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A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture

Forestry Research West

In This Issue

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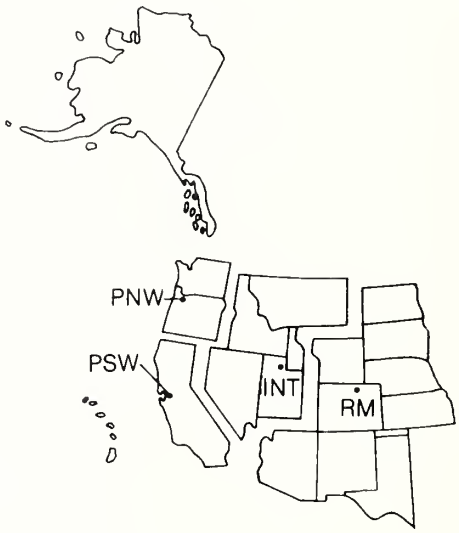


Growing successful seedlings

by Marcia Wood
Pacific Southwest Station

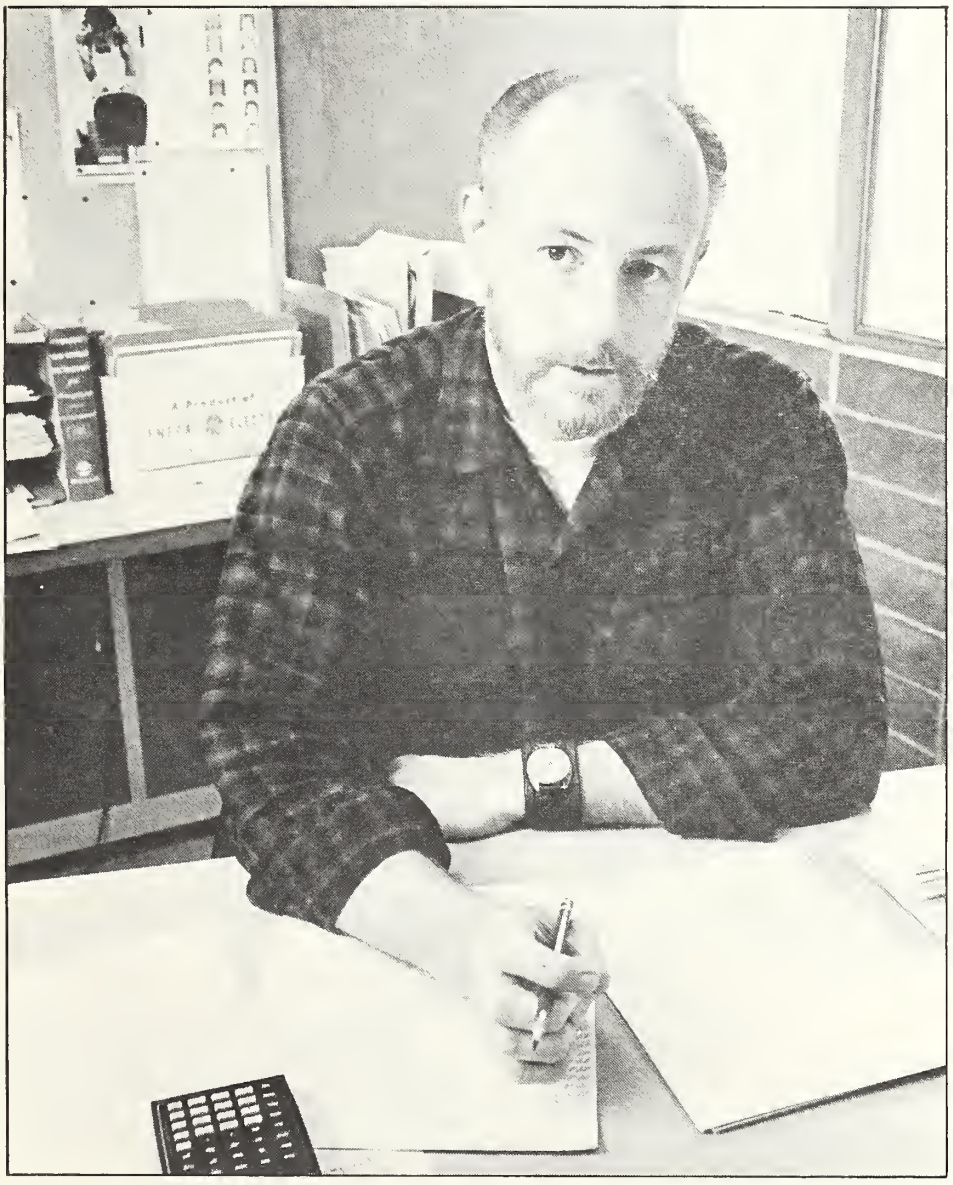
After one or two seasons in a forest nursery, tree seedlings are removed from the nursery bed, kept in cold storage for a while, then shipped to the field for planting. How well the seedlings will fare in their new location depends on many factors. Among the most critical are:

- the geographic and genetic origin of the seedling
- the interaction between seed origin, the nursery environment in which the seedling is raised, and the conditions at the site where the seedling is planted.

Over the past 10 years, Dr. James L. Jenkinson, plant physiologist at the Pacific Southwest Station, Berkeley, California, has studied the nursery and field growth of thousands of seedlings of major commercial tree species in California.

He has provided detailed information about the nursery regimes and planting site conditions these seedlings require. His findings have markedly changed cultural practices and lifting schedules at Forest Service nurseries in California. (These nurseries each raise 10 to 15 million seedlings a year, for planting on sites where forests have been burned or logged, or where brush has been cleared to convert the area to forest.)

His recommendations about when and how to plant nursery seedlings in the field have led to significant improvements in field survival of planting stock on many National Forests.



"Guidelines to optimum source windows have enabled the Humboldt Nursery to produce seedlings that will survive at rates of 90 to 99 percent the first year, provided the plantings are protected from vegetative competition and animal damage, says Plant Physiologist, James L. Jenkinson.

Currently, Jenkinson is conducting about a dozen different studies in southern Oregon and northern and central California. His purpose: to provide even better information about the way pines and firs from different seed sources interact with nursery environments and with the field sites where they are planted.

Here's a brief look at some of his current research.

White fir, red fir, compared

In a series of 10 plantations in the southern Cascade range and northern Sierra Nevada, Jenkinson is carefully monitoring the survival and growth of 20 to 30 sources of red fir and white fir. Now 5 to 8 years of age, these seedlings are progeny of parents that, in turn, are growing on commercially important true fir sites in California.

This long-term study is showing the differences in growth in the field of seedlings from different geographic sources and from different families within the same geographic location.

The experiment, involving more than 250 families, will show which sources and families do best at given planting sites. Further, the research will suggest new and more precise limits on how far true firs from each of the currently established "seed zones" can be moved from these seed collection areas and still grow successfully.

Seedlings for the experiment were raised in four consecutive nurseries at the Pacific Southwest Station's Institute of Forest Genetics in Placerville, California. Nursery growth, measured after two growing seasons in the nursery, showed a surprisingly strong influence of seed source over nursery environment.

"Even though there is marked variation in the nursery environment from year to year, the effect of seed source is so strong that sources consistently hold the same ranking—in terms of nursery height growth—from nursery to nursery," Jenkinson says. The interaction of seed source and nursery environment largely determines the survival of seedlings through their first summer on the planting site. On diverse planting sites, sources hold the same ranking—in terms of seedling survival—through the first year. Thereafter, survivals reflect the interaction of seed source with planting site environment.

Pines compared

In another experiment, Jenkinson is comparing the growth of ponderosa pines and Jeffrey pines from the species' low, middle and high elevation zones in the central Sierra Nevada. Seedlings used in this test were from sources—and were planted on sites—both east and west of the crest of the Sierra Nevada. The test includes 7 sources and 70 families.

Measurements of the young trees at 9 years of age show that west-side planting sites "enhance growth of both species, but ponderosa pine much more so than Jeffrey pine."

Both east and west of the crest, the slowest growing Jeffrey pines so far are those that originated nearest the location of the plantation. "We usually expect the 'local source' to grow best," Jenkinson said, "and in later years it may."

Soil fertility and pines

If ponderosa pine seedlings that originated from an infertile site were raised on a fertile site, how would they respond? What if the situation were reversed—how would seedlings that originated from a fertile site fare on an infertile site?

To find out, Jenkinson is analyzing young ponderosa pines from seed parents on a fertile soil and from a distinctly infertile serpentine soil—a type that is notoriously lacking in calcium, nitrogen, phosphorus, potassium, and probably other mineral nutrients.

Recent measurements of the young pines, now 11 years of age, show that the serpentine-origin seedlings, planted on the serpentine soil, "started pulling away from the non-serpentine origin seedlings after 3 years, putting on 1.5 percent more height growth per year than the other young trees. It's definitely a case of the home team doing better," Jenkinson says.

On the fertile site, the serpentine origin trees almost keep up with the non-serpentine origin seedlings. By the tenth year, they are trailing by 2 percent in total height.

"Adaptation is indicated on both soil types," Jenkinson says. "But, the adaptation is more striking on the infertile serpentine type than on the fertile soil. We thinned the plantations at 10 years, and did a biomass study, weighing the needles, bole, and limbs. The serpentine trees had 20 percent more wood and 25 percent greater weight of current-year needles on the serpentine site, than the non-serpentine trees. The serpentine trees were taking up greater amounts of the mineral elements from the soil than their non-serpentine origin counterparts.

To me, this suggests that we ought to start looking at any large differences in soil types within our seed collection zones. Right now, we collect ponderosa pine seed in the appropriate seed zone, but without attempting to match the soil type with that of the proposed planting site. We 'mix' soil types, and maybe we shouldn't. We're seeing adaptation to the serpentine soil type: there may be similarly important adaptations to other soils."

Drought tolerance

A small experiment involving ponderosa pine from one mesic and three droughty sites in central California has indicated that there is drought-adaptation (or tolerance) in ponderosa pine. Seedlings from 13 to 15 families per source, from sites where "summer drought" lasts from 4 to 8 months, were planted on a dry site at 500 ft elevation (8 months of no rain), in the western Sierra Nevada foothills. After 10 years, seedlings that were brought in from other localities (700, 800, and 4000 feet) were less successful than the local source seedlings, in both survival and growth.

"The lower mortality and better growth of the local source suggests that there is drought adaptation within ponderosa pine: some stands and families are more drought-tolerant than others. It's another factor that should be kept in mind when selecting planting stock for drier sites."

Douglas-fir at Humboldt Nursery

Seedlings have inherent patterns of growth, and nursery schedules have to be adapted to meet the physiological requirements of the small trees.

Many of the seedlings used in the research are grown at the Pacific Southwest Station's Institute of Forest Genetics in Placerville, California. The results are directly applicable to the Forest Service's nearby Placerville Nursery, where millions of seedlings are raised each year for planting on National Forests in California.

Perhaps nowhere is this more important than in defining when it is appropriate to lift seedlings from the nursery bed to put them in cold storage. Lifting too soon or too late can interfere with the seedling's ability to grow a strong root system when it is planted in the field.

In a combined effort with nurserymen and foresters from California and Oregon, Jenkinson has now determined the proper lifting dates for the entire geographic area (northern California and southern Oregon) served by the Pacific Southwest Region's Humboldt Nursery in McKinleyville, California. "We can now take any seed lot of Douglas-fir that's received in the Nursery, and pinpoint the calendar dates outside of which we must not lift, and inside of which we can be assured of seedling survival."

Some general patterns:
- different sources from the same local area have either the same or else highly similar lifting windows.
- The width of the window (number of calendar days—usually months) for safe lifting increases from southerly sources to northerly ones, from coastal sources to interior sources (west to east) and from low-elevation sources to high-elevation ones.

The Humboldt Nursery is probably the first nursery of its size to develop so comprehensive and reliable a guide to proper lifting schedules.

Experiments at the Institute of Forest Genetics showed that stratifying seed for 90 days and sowing before mid-March produced plantable 1-0 sugar pine with survival potential equal to 2-0 sugar pine.

1-0 seedlings

At both the Humboldt Nursery and the Institute of Forest Genetics research nursery, Jenkinson has experimented with 1-0 seedlings—plants that are kept in the nursery for only one growing season instead of the usual two seasons.

Work at the Humboldt Nursery showed that pre-treating (stratifying) the seeds for as much as 60 to 90 days, instead of the usual 30 to 40 days, and planting them in March instead of May, results in "a plantable 1-0 seedling that has the same survival potential as a 2-0 seedling."

"By sowing in May, we are losing what turns out to be a critical part of the growing season. By sowing in March—when germination and root growth are able to begin—we're adding an extra 6 to 10 weeks to the growing season."

Similar experiments with sugar pine at the Institute of Forest Genetics showed that 90-day stratification of the seed, followed by sowing before mid-March, 6 to 8 weeks before the usual May dates, produced "plantable 1-0 sugar pine with at least the survival potential of a 2-0 sugar pine."

The study, conducted in cooperation with Plant Pathologists Robert V. Bega of Pacific Southwest Station and Arthur McCain of the University of California, showed "the earlier we sow, the less susceptible sugar pine is to disease. This is important because of all the conifers we grow in California, sugar pine is probably the most susceptible to root and collar rots."

Free-growth

In most of his experimental plantations, Jenkinson keeps seedlings free from vegetative competition. The encouraging results he's seen in rapid tree growth have made him an outspoken proponent of early and thorough control of brush.

"Grasses and sedges should be suppressed immediately. Brush should be suppressed at 1 to 3 years after trees are planted, not at 10 years, as is the current practice on many California sites. The best approach is to keep the plantation grass- and brush-free as long as possible from the date of planting. Competing vegetation can be effectively spot-sprayed by crews using wands and small backpack sprayers, to kill the unwanted plants when they are small."

Potential growth

Keeping seedlings free of competing vegetation is especially critical for rapidly attaining full growth potential. "In Douglas-fir, ponderosa pine, and Jeffrey pine, seedlings can double their height in the first year on a field site, if the seedling is lifted at the right time, planted at the right time, and protected from animal damage and competing vegetation," Jenkinson says. "While it's not uncommon to see a planted seedling double its height in the first year, it is rare to see an entire plantation in a 'free-growth' condition. We're used to looking at sites where there are insect problems; deer and gophers that feed on the seedlings; and competing vegetation that takes up space, light, soil, water and nutrients. We've gotten accustomed to seeing fairly constant rates of leader growth in the planted seedlings. The fact is, if you put seedlings of Jeffrey pine, ponderosa pine, or Douglas-fir in a free-growth situation, the pattern of growth is better than just constant. Every year's leader length is substantially greater than the previous year's. In the field, you can go from a leader that is .10 meter long in the first year to 1.5 meters in the 10th year—a 15-fold increase in leader length!!"

Forestry Research West readers who would like more information about Jenkinson's research are invited to call him at (415) 486-3730 (FTS: 449-3730) or to write him at the Pacific Southwest Station, P.O. Box 245, Berkeley, CA 94701.

Forest habitat types of central Idaho

by Delpha Noble
Intermountain Station

Abies grandis/Spiraea betulifolia h.t. on a northwest exposure east of Cascade, Idaho (6,400 feet [1,950 m] elevation). A near-climax stand of Abies grandis dominates an undergrowth composed mainly of Spiraea betufolia and Thalictrum occidentale.

Central Idaho, with its high, massive mountains dissected by deep valleys; with its gentle basins and rolling uplands; with its areas underlaid by granitic, volcanic, and sedimentary rocks, has within its boundaries a broad variety of forest environments. Elevations vary from over 10,000 feet on numerous mountain peaks to as low as 2,000 feet above sea level. Climates vary from severe cold and wet in the high mountains to hot and dry in the lower elevation forests. All these factors produce forest vegetation that is a complex array of composition and structure. A common basis for communication, management decision, and research application can be a valuable tool for people who manage these lands.

Habitat type classifications offer that common basis by reducing environmental diversity to a reasonable number of units. This classification system defines a habitat type as all the land capable of producing similar plant communities at climax. Using the system, land managers should be able to predict plant succession for each habitat type; responses to management treatments should be similar on most lands within the same type.

The classifications help provide answers to questions such as:

(1) How will the land respond to various timber, range, and wildlife management activities?

(2) How will various sites respond to recreational use impacts?

(3) What are the productive capabilities of each vegetation type?

Pinus ponderosa/Agropyron spicatum h.t. on a steep southerly exposure in the Hitt Mountains west of Cambridge, Idaho (4,200 feet [1,280 m] elevation). Scattered Pinus ponderosa form an open stand which dominates a layer of Agropyron spicatum and Lomatium dissectum.

Perhaps the most important use of habitat types is a land stratification system—designating areas with approximately the same environments—that can be used as a tool for cataloging (1) research and administrative study results, (2) field observations, and (3) intuitive evaluations.

The study

Forest Habitat Types of Central Idaho, a new Intermountain Station report, describes an intensive reconnaissance study of 16.6 million acres, including five National Forests and adjacent forest land. About 800 stands—in a wide variety of environments—were sampled to develop the classification. Each habitat type described includes a general discussion of physical environmental features, geographical distribution, key vegetational features, descriptions of phases, and general implications for management.

The study leading to the classification system was conducted by Robert Steele, plant ecologist with the Intermountain Station's research work unit concerned with ecology and silviculture of Rocky Mountain Douglas-fir and ponderosa pine ecosystems. Steele and Robert D. Pfister, formerly a plant ecologist with the Station, Russell A. Ryker, former Project Leader of the unit, and Jay Kittams, forester on the Tongass National Forest, are coauthors of the report. The Intermountain Region provided major financial assistance.

To represent these central Idaho lands, Steele and the others have defined 64 habitat types which can be grouped into eight climax series. They also define 55 other phases of habitat types. The report contains a "key" for field identification and a general description of each type. The key covers natural forest vegetation within the lower valleys and foothills up through the subalpine types. For each of the 64 habitat types listed in the report, the authors discuss 1) vegetation; 2) soil; 3) productivity/management; and 4) other studies. Tables included in the report can be used for detailed comparisons.

An example

The following excerpts from the section of the report dealing with the ponderosa pine/western needlegrass (*Pinus ponderosa/Stipa occidentalis*) habitat type give an idea of the scope of information included in the publication.

Distribution.—Minor amounts of *PIPO/STOC* occur along the South Fork of the Payette and South and Middle Forks of the Boise River. This h.t. ranged from 3,500 to 4,800 feet and was found on very gentle river terraces in areas where the *PIPO/AGSP* h.t. was common on steeper slopes.

Vegetation.—Widely spaced *Pinus ponderosa* dominate a sparse layer of *Stipa occidentalis*. On some very similar sites, *Stipa thurberiana* was the undergrowth dominant. Small amounts (poorly represented) of *Purshia tridentata* are usually present but shrubs in general are very inconspicuous.

Soil.—The soils appear to be old alluvial deposits and are mainly sandy loams. Soil pH ranged from 5.3 to 6.2 and averaged 5.7. Exposed surface rock varies from 0.5 to 15 percent and bare soil ranges from 0 to 30 percent. Litter depths are less than 3.5 cm.

Productivity/Management.—Timber productivity is apparently very low to low and of poor quality. The trees regenerate sporadically and form open stands with limited stocking. Forage production is low, but the gentle terrain attracts livestock. Use by wildlife is generally light.

Other studies.—R. and J. Daubenmire (1968) describe a *Pinus ponderosa/Stipa comata* h.t. in eastern Washington that appears very similar to *PIPO/STOC*. In fact, two of their stands were dominated by *Stipa thurberiana* in the undergrowth and three *Stipa* spp. now treated as *S. occidentalis* by Hitchcock and Cronquist (1973) also appeared in their stands.

The classification framework

The classification is presented in the following order:

1. Key to the habitat types.—To identify the habitat type, one must first carefully read the provided instructions and definitions of terms used in the key. Identification proceeds from climax series to habitat type, and finally to the phase (where appropriate).

2. Series description.—Some h.t. characteristics are summarized at the series level, rather than repeating similarities in each habitat type description.

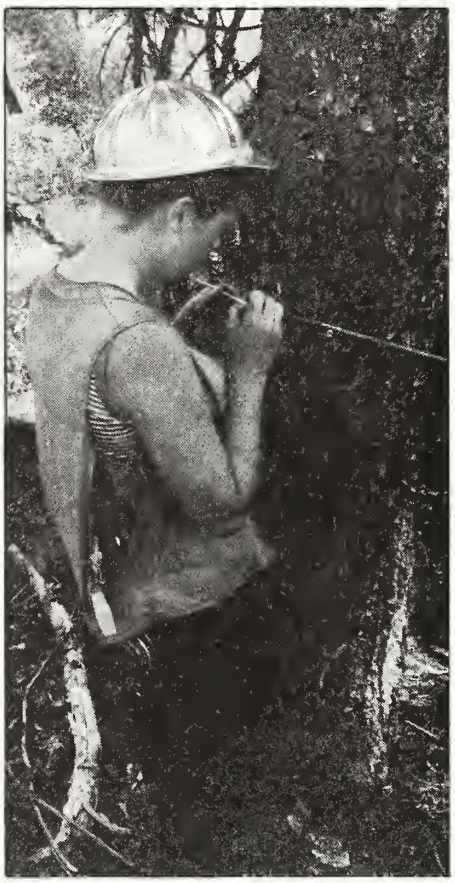
3. Habitat type description.—This information summarizes geographic range, vegetation, phases, and general management implications.

Arrangement of the h.t.'s within the keys tends to follow a pattern of moderate to severe environments. Species appearing first in the key tend to have the least ecologic amplitude and the greatest importance as indicators in any given series. Thus at the lower elevations, progression through the keys leads one to increasingly drier h.t.'s and at upper elevations it leads one to increasingly colder types. Occasionally this order deviates when habitat types from different geographic areas are merged into one key. Once familiar with the key, awareness of this sequence can help the user identify sites that are difficult to key out.

A useful tool

Natural classification of forest ecosystems by habitat type has proven useful in forest management and research; application has expanded rapidly over the last decade. This widespread use reflects recognition of the need to emphasize management of resources as ecosystems rather than individually.

The central Idaho classification is the result of 6 years of field sampling, writing preliminary drafts, and on-the-ground testing by foresters. Suggested revisions were analyzed and often incorporated. These inputs have substantially improved the classification, but because it was developed through a series of approximations, Steele says it should "always remain open to further refinement."



Technician counts growth increments to determine site productivity of the habitat type.

He cautions that habitat types are not a panacea for all decisionmaking or intepretations. They will complement information on soils, outdoor recreation, socioeconomic conditions, hydrology, and wildlife, and will aid development of more intensive land-management planning and practices.

Copies of *Forest Habitat Types of Central Idaho,* GTR-INT-114-FR31, are available from: U.S. Government Printing Office, Documents Warehouse, 8610 Cherry Lane, Laurel, Maryland 20810, at $15.00 per copy.

Cattle ranchers in eastern Oregon get a helping hand

by G. James Patterson
Eastern Oregon State College

A major Forest Service research and development project in Grant County, Oregon has helped some local ranchers stay in business, and provided examples for other ranchers on how to improve their operations, a team of anthropologist from Eastern Oregon State College (EOSC) has found.

The team was employed by the Oregon Range and Related Resources Evaluation Project, an intensive 10-year range management study sponsored by the Pacific Northwest Region of the Forest Service. The Pacific Northwest Station's Range and Wildlife Habitat laboratory in La Grande is responsible for scientific testing and validating range management strategies. The role of the EOSC team in the project was to accumulate a social history, and also to conduct studies of archaeological features and contemporary social change.

The project involved twenty ranchers in Grant County to determine whether a combination of a number of forest and range management practices on their ranches will have long term benefits to the area, and produce results that will be useful throughout much of the western United States for development of range management programs on federal, state, county, and private lands.

Patterson is Professor of Anthropology at Eastern Oregon State College in La Grande, Oregon. *The author acknowledges the assistance of Samuel T. Frear, Pacific Northwest Station, in the preparation of this article.*

Because some of the range improvement practices—such as water development, timber thinning and seeding, timber debris disposal, use of check dams, fertilization, vegetation control, rotation grazing, and erection of cattle guards—might alter or destroy remnants of the prehistoric past, Eastern Oregon State College was contracted to conduct archaeological and anthropological studies.

G. James Patterson, Professor of Anthropology at EOSC, along with two graduate assistants, Phyllis Lancefield-Steeves and Scottie Steeves, studied ranchers and ranching as part of an intensive range management project in this part of the state. In addition, the contract called for studying the region's history, and investigating the effects of the project on the local communities and participating and non-participating ranchers.

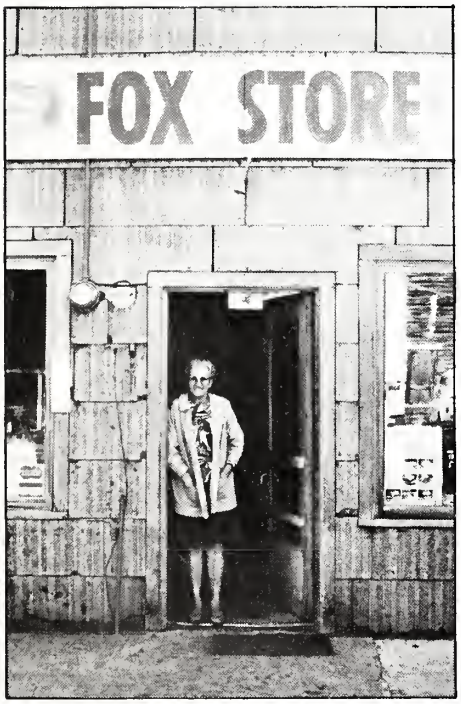
Grant County was selected for the Oregon Range and Related Resources Evaluation Project because it is typical of many areas of the West: it is a large county, about 4,500 square miles in size, with only 8,000 people living there. About 3,000 of these people live in the county's two principal towns, meaning there is about one person per square mile for the rest of the county.

Grant County, Oregon is 4,533 square miles in size. Ranching and logging are the principal industries.

The terrain is varied. The John Day River and its forks provide valleys where farming is profitable. The western part is dry rimrock country covered with juniper. There are several high mountain valleys, used mostly for cattle ranching. And there is a lot of high mountain country, where logging predominates.

Portland and Boise, the two nearest cities, are five and three hours away respectively. There is no interstate highway, railroad passenger line or scheduled air service closer than several hour's drive. The winters are severe and the summers are hot. It is a remote, isolated, and beautiful country.

But local unemployment is disturbingly high. In the spring of 1982, Grant County's number of jobless rate exceeded 23 percent, roughly double that for the State of Oregon—itself higher than the national rate. Much of this is due to the depressed timber market, and the decrease in the number of ranches making a profit.



People in the rural West live in small, cohesive communities based on shared values and face-to-face contact.

Effects of the project

The team found that the Evaluation Project has had a beneficial effect on social life and community stability in Grant County. Economic benefits are beginning to accrue for some participating ranchers.

In the study, team members talked to many of Grant County's inhabitants and got to know them well. The people live in small, cohesive communities based on shared values and face-to-face contact. Western cowboy and ranching-based lifestyles permeate the region, and heavily influence local values and attitudes. Self-sufficiency, independence, enjoyment of the outdoors, being one's own boss, helping neighbors in times of need, and hospitality to strangers are not only thought to be desirable, but are practiced by the people.

No desire to sell-out

Many ranchers, suffering from low incomes and rising taxes, could sell-out, invest the money elsewhere, and possibly do better in other ventures. But they choose not to, for this is their way of life. They ranch because they love it, as much as to make a profit. They often are jacks-of-all-trades, and can raise cattle, manage their books, fix equipment, rodeo, and sell with a broker's skill. Most of them would not trade this way of life for a more affluent urban existence.

The Evaluation Project, supported by the great majority of participating ranchers, is helping some ranchers stay in business, and is providing examples for non-participating ranchers on how to improve their operations. By encouraging ranch improvement, the program is playing a part in keeping some in business who might otherwise give up.

The team believes the best efforts of the Forest Service, are probably not enough to fully counter the negative effects of the recession in ranching and timber. A gradual breakdown in traditional ranching lifestyles and an increase in community instability is underway, mainly caused by national and global economic factors. But these changes would be considerably greater were it is not for the Project and other local activities of the Forest Service and other agencies.

Team members found the Project is helping to mitigate the trend toward a decline in traditional family ranching lifestyles and community stability, although it is helpless to stop such change altogether. The project's greatest contribution, therefore, is scientific as it helps timber and range managers understand how to improve ranch efficiency. Such knowledge can then beapplied to similar environments in other parts of the West.

In addition to this work, team members collected a wealth of historic data, from documentary sources to oral histories. One suprise was the paucity of local archaeological artifacts, despite the team's knowledge that prehistoric Indians frequently moved about the general area. Another was the generally constructive way in which local ranchers, in light of their distrust of "big government," have worked with the participating federal agencies, including the Forest Service. The team found considerable international interest in the anthropological work carried out in Grant County.

The Southwest—host to wintering bald eagles

by Rick Fletcher
Rocky Mountain Station

Every fall, bald eagles migrate south from Canada and the northern U.S. to winter in warmer climates. Many find refuge in the Mississippi Valley; others locate in Western Plains States. Some travel as far south as New Mexico and Arizona. Researchers with the Rocky Mountain Station are attempting to learn more about the distribution of this bird and its habitat needs in the Southwest.

Scientists with the Wildlife Habitat Research on Southwestern Forests and Rangelands project in Tempe, Arizona, have collected survey data that can help resource specialists in the Southwest become better informed about bald eagle habitat. These data have been analyzed and published in a new Rocky Mountain Station report titled *Bald Eagle Winter Habitat on Southwestern National Forests*.

National forests important habitat

Wintering bald eagles usually start arriving in the Southwest by November, with a population peak in January and February. Most have headed north by the first of April. Aerial surveys indicate that National Forest lands are important to the wintering bald eagle in this region, with nearly one-third of the surveyed population residing on National Forests.

Feeding habits

Typically, bald eagles in this part of the country require a large area such as a major river course or collection of lakes. Here, the birds perch, roost, and feed alone or in small groups. Eagles tend to congregate around water which supports populations of waterfowl—a major source of prey for bald eagles.

Teryl Grubb, research wildlife biologist at the Tempe lab, and co-author of the report, explains that the eagle's diet fluctuates with winter conditions. "As the severity of winter increases," says Grubb, "the waterfowl become more vulnerable because they accumulate on the small remaining areas of open water. This makes them easier prey. But, if these bodies of water freeze over, the waterfowl leave. At the same time, such harsh conditions usually lead to an increase in both the winter kill of big game and the vulnerability of small mammals such as cottontails and jackrabbits. Wintering bald eagles do feed on fish, but initial data indicate birds and mammals are more important prey." So, regardless of the weather, eagles have a rather reliable food supply.

Wintering bald eagles often forage for prey along the shores of lakes and rivers.

Behavior

Eagles wintering in Arizona and New Mexico are generally mobile and scattered. (On extremely cold days, however, they are relatively inactive.)

Birds residing near lakes and reservoirs show habitual patterns of activity in contrast to the more mobile, opportunistic patterns in eagles wintering along rivers. Charles Kennedy, a coauthor of the report, and forest biologist on the Coronado National Forest in southern Arizona, says, "Eagles associated with standing bodies of water are more predictable. These eagles favor specific perches, patterns of foraging, flight routes, etc. When disturbed, they tend to return to their original location after the disturbance has passed. In contrast, eagles wintering near rivers are not so predictable. Birds were observed perching in a variety of locations. When flushed, they often fly off along the river and may not return."

Roosts

Because of their limited number and consistent use, Grubb believes roosts are the most critical component of winter habitat needing management protection. Unfortunately, in the small, scattered eagle population of the Southwest, roosts are difficult to locate. Roosting flights often occur after dark or before dawn. "It is somewhat ironic that the most stable and perhaps most critical component of eagle winter habitat is the least known in the Southwest," says Grubb.

Most roosts observed in the Southwest were in ponderosa pine stands, several hundred yards to several miles from the water source associated with daytime activities. Roosts are usually in live trees in relatively dense stands, in protected draws or small drainages. Eagles prefer roost trees that are well foliated with large "windows" in the canopy.

The hours are often long and conditions harsh when studying wintering bald eagles.

Perches

Perch sites, which are used for a variety of "loafing" and foraging activities, seem to be chosen on the basis of availability, and the ability of the eagle to observe the surrounding area. They can range from tall snags to limbs in the pinyon-juniper ecosystem, or rock outcroppings.

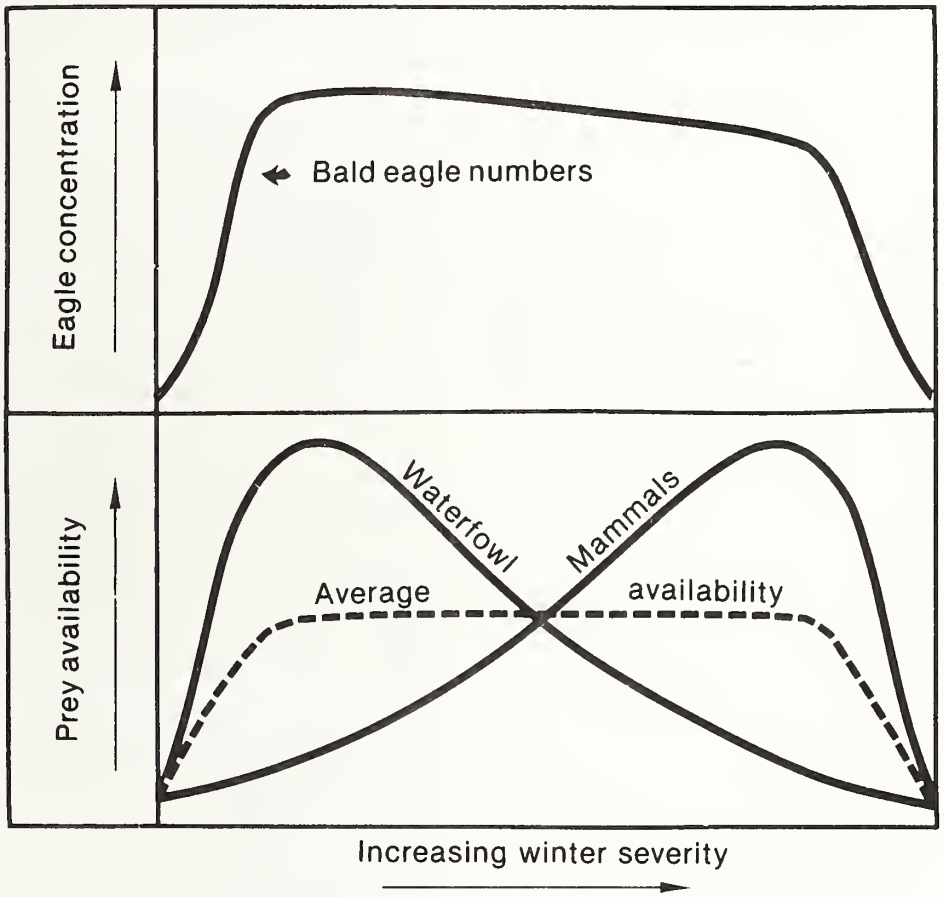
Surveys show that perches are probably the least critical component of eagle habitat. Kennedy says that although perching is the most typically observed activity, the lack of perch sites will rarely limit eagle populations.

Management needs

The winter bald eagle population in New Mexico and Arizona, while less concentrated in comparison to other well-known wintering areas, is never-the-less significant to the overall survival of the species.

From a management standpoint, the study showed the importance of roosts as the most critical winter habitat component needing protection to favor eagles. An intensive effort is required as a first step to locate existing roosts. Old growth trees, or small, protected stands in the vicinity of foraging and loafing areas are good candidates for roosting activity. Once identified, roosts should be managed in the same fashion as nest sites, with temporal and spatial restrictions on potentially disturbing activities such as logging, recreation, and development.

Next would be the importance of foraging areas—including a nearby water source, supporting a waterfowl population, and a population of



This chart shows the fluctuation of avian and mammalian prey leading to a relatively stable, average prey base as winter severity varies, and the resultant, postulated change in bald eagle concentration (or dispersal).

small mammals. Management practices beneficial to waterfowl should benefit wintering eagles as well. It may also be possible to supplement or modify the foraging activity of eagles by placing large mammal carcasses (such as road kills) at selected locations.

"Because of the mobile nature of wintering bald eagles, resource specialists need to know that the bird's winter habitats can be affected by one of many management practices," say Grubb and Kennedy. "Recognition of the wintering needs of the bald eagle in the Southwest can maintain and improve its habitat, and help assure that this noble bird will continue to use this region as winter quarters," they say.

This study, although extensive, was limited to one field season; therefore, much of the information presented is more qualitative than quantitative. Subsequent years of data can establish norms and trends in habitat utilization, population numbers and distribution.

If you would like a copy of this new report, write the Rocky Mountain Station and request *Bald Eagle Winter Habitat on Southwestern National Forests*, Research Paper RM-237, by Teryl G. Grubb and Charles E. Kennedy.

For further reading the following publications are available from the Rocky Mountain Station:

Grubb, Teryl G., 1980, *An Artificial Bald Eagle Nest Structure*, Research Note RM-383.

Grubb, Teryl G. and Duane M. Rubink, 1978, *First Bald Eagle Eggs Collected for Analysis in Arizona*, Research Note RM-352.

New Publications

Agricultural implications for Douglas-fir

Is the strategy which produced the "Green Revolution" in agricultural crops such as corn and wheat applicable to management of Douglas-fir timber?

In a report published by the Pacific Northwest Station, Geneticist Roy R. Silen examines the implications of agriculture strategies for Douglas-fir. The basis of these strategies is to increase the number of grain-bearing stalks per acre by (1) relieving (through agronomic techniques) the constraints of drought, competition, cold, infertility, and insect and disease problems; and (2) upgrading uniformity and harvestability of the crop.

Most agronomic methods to increase biomass yield are difficult to use in the Douglas-fir region, except for short-term crops such as Christmas trees and in forest nurseries. Silen identifies practical limits for nearly every potential agronomic technique available to relieve growth constraints. Because neither genetics nor spacing is site enhancing, their contribution to yield, as in agriculture, is considered to be indirect—primarily in improving the proportion of the crop harvested.

An added complication for Douglas-fir is a precise, probably template-like, adaption of the tree to landform—elevation, latitude, aspect, and slope. In nature, this assures high survival and reliability of the crop. Agricultural crops originally were as precisely adapted and reliable, with improved agronomy, however, the agricultural plants had to be shortened to avoid lodging and slimmed to permit close planting. Ecological instability of the new genetic population has required added pest control and continuous breeding effort.

The research report concludes that in much of the Douglas-fir region the genetics of the locally adapted forest need not be greatly changed because the upper limit of improved yield for intensive Douglas-fir management is modest. This upper limit depends primarily upon how much enhancement of the site can be indefinitely maintained above natural carrying capacities. A new, faster-growing population would appear necessary with any permanent site enhancement. Such a population would likely be less stable than natural populations and may become relatively unadapted if site enhancement efforts were discontinued.

Copies of *Nitrogen, Corn, and Forest Genetics,* General Technical Report PNW-137, are available from the Pacific Northwest Station.

Partial cutting hard on aspen

Quaking aspen stands in the Rocky Mountain States occupy about 4.1 million acres of commercial forest land. Because many of these stands are mature or overmature, efforts to harvest them are increasing. However, aspen have soft, living bark, and are easily wounded during partial cutting—predisposing them to various insects and diseases.

A new research paper out of the Rocky Mountain Station suggests that, although land managers must consider many factors in determining the best method of harvesting a stand, the pathological problems associated with partial cutting of aspen should be carefully considered.

A study showed that, 5 to 7 years after partial cutting, aspen mortality amounted to 20 percent; 41 percent of the living residual trees were infected with canker diseases; and 30 percent had been attacked by wood borers.

If you would like to learn more, request from the Rocky Mountain Station, *Effects of Partial Cutting on Disease, Mortality, and Regeneration of Rocky Mountain Aspen Stands,* Research Paper RM-240, by James W. Walters, Thomas E. Hinds, and David W. Johnson.

Mineral activities and wildlife

Energy and mineral resources are the basic raw materials of United States industry and highly important to the country's economy and national security. A substantial portion of the domestic mineral supply presently comes from lands managed by the Federal Government. These lands, however, also contain valuable nonmineral resources, including wildlife, timber, forage, water, wilderness, and beautiful scenery.

Because mining projects can effect land uses for long periods of time, individuals responsible for managing wildlife in these areas have special concerns. They need information about the nature and extent of mineral activities that are likely to occur and how those activities could influence wildlife. This enables them to develop mitigation measures that will protect and/or benefit wildlife in the long run.

A new publication issued by the Intermountain Station addresses this need. *Wildlife User Guide for Mining and Reclamation,* GTR-INT-216-FR-31, covers the major points of concern to the biologist involved in managing wildlife habitat when mining is planned or is occurring. Topics include: the biologist's role in minerals-area management; the legal framework; land-management planning; the phases of mining; guidelines for assessing and evaluating the impacts of mining on wildlife; mitigation measures; and opportunities for wildlife management.

The report is based on presentations and discussions during the Forest Service-sponsored Wildlife User Workshop held May 6-8, 1981, in Ogden, Utah. Wildlife biologists and minerals specialists of the Intermountain Region were major contributors to the workshop.

The Wildlife guide is one of a series of guidebooks initiated by the Surface Environment and Mining (SEAM) Program. Other guides include Vegetation, Soils, Hydrology, Engineering, and Sociology and Economics. Copies of the guides are available from the Intermountain Station.

Assessing revegetation of uranium mine spoils

Various national and state regulatory agencies consider wastes from uranium mining and mill operations radioactive and potentially hazardous. Studies show that they can contaminate the environment via wind and water erosion and by leaching into groundwater.

While reclamation efforts on uranium spoils are just beginning, a new report is now available that sheds light on this problem. The paper, titled *A Review of Uranium Spoil and Mill Tailings Revegetation in the Western United States,* General Technical Report RM-92, by Teruo Yamamoto, combines data from literature reviews, seminars, meetings, and field observations. It discusses (1) the magnitude of the uranium spoils and tailings problem, (2) the current knowledge of revegetation research on uranium spoils and tailings, (3) how to relate Forest Service SEAM (Surface Environment and Mining) research experience to uranium spoils research, and (4) safety aspects of the research.

Copies of the report may be obtained from the Rocky Mountain Station.

Which fuel model?

Mathematical models to calculate fire danger or fire behavior require descriptions of fuel properties (fuel models). But which fuel model should be used? During the past two decades the Forest Service has progressed from a fire danger rating system comprised of two fuel models in 1964 to 20 models available today.

A new report issued by the Intermountain Station can help fire behavior officers, fuel management specialists, and other field personnel answer the question. *Aids to Determining Fuel Models for Estimating Fire Behavior,* GTR-INT-122-FR-31, contains photographic examples and tabulations that will facilitate the selection of the proper model and allow comparison with fire danger rating fuel models.

In the report, Hal Anderson, author and physicist at the Station's Northern Forest Fire Laboratory, Missoula, presents 13 fire behavior fuel models in 4 fuel groups: grasslands, shrublands, timber, and slash. Each group comprises three or more fuel models; two or more color photographs illustrate field situations relevant to each fuel model. The 13 fire behavior fuel models are cross-referenced to the 20 fuel models of the National Fire Danger Rating System by means of a similarity chart.

Copies are available from the Intermountain Station.

Monetary valuation of forest products

A new report issued by the Rocky Mountain Station is helping resource managers and analysts understand methods used for deriving monetary value for market forest products.

The paper reviews what monetary values are, and how values for stumpage, livestock forage, and water can be derived for use in comparing land management alternatives. It also demonstrates the use of valuation methods, using central Arizona's stumpage, forage, and water market situations as an example. The report covers constant product price, changing product price, revenue and cost estimation, price change over time, and market characteristics.

If you would like details, request from the Rocky Mountain Station, *Monetary Valuation of Timber, Forage, and Water Yields from Public Forest Lands,* General Technical Report RM-95, by Thomas C. Brown.

Range management for deer

The rangelands of the West, normally managed for livestock, also are the habitat of mule deer. Their needs, however, may or may not be compatible with livestock.

The optimum habitat for mule deer, and information to help managers predict the consequences of range management alternatives on deer, is described in a new report from the Pacific Northwest Station. It is one of 14 publications in the series *Wildlife Habitats in Managed Rangelands —the Great Basin of Southeastern Oregon.*

While information in this series is specific to Oregon, it is generally applicable to the shrub-steppe areas of the western United States. The purpose of the series is to provide information so managers can make fully informed range-management decisions that take into account the welfare of wildlife.

Copies of *Mule Deer,* General Technical Report PNW-139, by Donavin A. Leckenby and others, are available from the Pacific Northwest Station, as are the following in the series:

Plant Communities and Their Importance to Wildlife, GTR PNW-120.

Native Trout, GTR PNW-84

Riparian Zones, GTR PNW-80

Edges, GTR PNW-85.

Geomorphic and Edaphic Habitats, GTR PNW-99

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Goats for brush control

Fuelbreaks—wide strips through brushlands on which woody fuels have been reduced or eliminated—are an important factor in fire control plans, particularly in chaparral lands. To be effective, the strips must contain no more than a low volume of low-growing vegetation to provide firefighter safety and a place for backfiring.

Clearing the strips by hand or mechanical treatment is expensive, and herbicides are frequently unacceptable from an environmental standpoint.

However, the use of goats to control regrowth of brush is a promising alternative. Several years of experimentation on the Cleveland National Forest in southern California are summarized in a recent publication by the PSW Station. The test showed that stocking rates of one goat for each 0.5 to 3 acres of brushland would control regrowth. If the goats remove all leaves and small twigs two or three times a year, small shrubs will be killed in 2 years and most larger shrubs will be killed in 3 to 4 years.

Using Goats to Control Brush Regrowth on Fuelbreaks, General Technical Report PSW-59, is available from the Pacific Southwest Station.

Anadromous fish habitat series

Two more publications in a series on anadromous fish habitat have been published by the Pacific Northwest Station. *Timber Harvest* and *Silvicultural Treatments* provide information that will help managers predict the effects of various activities on anadromous fish habitat in the West.

Timber Harvest by T.W. Chamberlin reviews the effects of timber harvesting on stream ecosystems, in terms of direct impacts; water balance; and elements of a stream habitat.

Silvicultural Treatments by Fred H. Everest and R. Dennis Harr examines the impacts of cutting prescriptions, broadcast burning, mechanical site preparation, planting, and other silvicultural practices.

Timber Harvest, General Technical Report PNW-136, and *Silvicultural Treatments* PNW-134, are available from the Pacific Northwest Station, as are those other reports in the series:

Habitat Requirements of Anadromous Salmonids, General Technical Report PNW-96, by D.W. Reiser and T.C. Bjornn.

Impacts of Natural Events, General Technical Report PNW-104, by Douglas N. Swanston.

Planning Forest Roads to Protect Salmonid Habitat, General Technical Report PNW-109, by Carlton S. Yee and Terry D. Roelofs

Effects of Livestock Grazing, General Technical Report PNW-124, by William S. Platts.

Effects of Mining, General Technical Report PNW-119, by Susan B. Martin and Williams S. Platts.

Processing Mills and Camps, General Technical Report PNW-113, by Donald C. Schmiege.

Preattack planning for fire management aided by remote sensing techniques

Current methods used to document preattack planning information for fire management involve tedious processes of interpreting low-altitude photography, followed by extensive ground checking.

The PSW Station has investigated the use of remote sensing techniques as a means of improving methods of documenting preattack plans. Remote sensing was used to develop a basic preattack plan that included fuel types, road systems, and water sources.

The investigation showed that remote sensing techniques provide basic preattack planning information that is moderately reliable and easily updated.

Results of the study are reported in *Remote Sensing Techniques Aid in Preattack Planning for Fire Management,* Research Paper PSW-162, which is available from the Pacific Southwest Station.

Soil and sediment in forest ecosystems

The movement of soil and sediment through forest ecosystems is a complex process. A workshop was held in Corvallis, Oregon in 1979 to bring together a variety of professional disciplines to improve communications among those working in the field and to encourage a commonality of approaches.

The results of this workshop have been published by the Pacific Northwest Station as a report consisting of 14 papers covering sediment budgets and routing studies which are important tools for both researchers and land managers. A sediment budget is the quantification of transportation and storage of soil and sediment. Sediment routing is the overall movement of soil and sediment through a series of landscape units.

The papers provide methods for judging the relative importance of sediment sources, and information about the many roles of biological factors in sediment transport and storage. The importance of recognizing changes of sediment storage within basins when interpreting sediment yield is emphasized.

Copies of *Sediment Budgets and Routing in Forested Drainage Basins,* General Technical Report PNW-141, by Frederick J. Swanson and others, are available from the Pacific Northwest Station.

Proceedings on mediterranean-type ecosystems

Mediterranean-type ecosystems—those characterized by a seasonal cycle of a hot, dry summer alternating with a cool period throughout the rest of the year—are found in North and South America, Europe, Africa, and Australia. In California, the regions of Mediterranean climate contain more than 70 percent of the State's population in about 40 percent of its land area.

Of all the world's ecosystems, the regions in the Mediterranean climate offer some of the greatest challenges to resource management because the metropolitan areas are generally heavily populated, and they often abut natural systems that are prone to fire and flood.

To provide a forum for exchange of information on resource management in these ecosystems, the PSW Station sponsored, in coopreration with San Diego State University, an International Symposium on the Dynamics and Management of Mediterranean-Type Ecosystems. Held in San Diego, California, June 22-26, 1981, the Symposium attracted almost 400 registrants from the United States and 15 other countries.

The results of the 4-day Symposium have been documented in a 637-page Proceedings that includes some 90 invited papers that cover perspective and management, vegetation, fauna, soils, hydrology, and fire.

The volume also includes 50 brief summaries of poster displays that present specific case studies.

Copies of the publication are available from the PSW Station, while the limited supply is available. Request General Technical Report PSW-58.

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A comparison of harvesting and logging residue practices

Called the "Wyoming study," the comprehensive series of studies began in 1971 and continued for a decade. The activities involved researchers of the Intermountain Station, land managers of the Bridger-Teton National Forest, and staff of Champion International Inc.

The cooperative effort was designed to compare harvesting and logging residue treatments on four 20-acre units on the Bridger-Teton. Located near the Union Pass area southwest of Dubois, Wyoming, the area contains extensive lodgepole pine timber stands. After the units were clearcut in 1971, residues were piled and burned, broadcast burned, chipped and spread back on the ground, or removed from the site. Two units were logged with conventional practices; residues were removed from the other two using a feller-buncher and rubber-tired grapple skidder in combination with a mobile chipper. On all four harvesting treatments, scientists compared regeneration by planted seedlings, direct seeding, and natural regeneration.

During the next 10 years (1971-1981) scientists measured the effects of the practices on soils, soil microbiology, nutrients, water, microclimate, tree survival and growth, vegetation development, wildlife habitat, and esthetics. They compared logging costs and returns and projected future stand conditions from an economic standpoint.

The results of the Wyoming study are now available in *Management Consequences of Alternative Harvesting and Residue Treatment Practices—Lodgepole Pine,* GTR-INT-132-FR-31. The report is written by Robert E. Benson, a research forester assigned to the Systems of Timber Utilization for Environmental Management Program (STEM) of the Intermountain Station.

In the report, individual scientists discuss the effects of the harvesting and residues practices on the different resources. Various tables and graphs can be used as references for the land manager seeking information on how different practices will affect wildlife habitat, water, or other resources. For example, one of the tables shows that when timber is produced it affects wildlife through harvest patterns, percent of area cutover, site preparation method used, and density of trees.

Author Benson says, "Our intent was to integrate and reference the findings of the study. The report is not a "cookbook" or substitute for the manager's on-the-ground knowledge and judgment, but we believe the information provides a useful tool."

Copies of the report are available from the Intermountain Station.

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