FIR Report

FALL 1985

VOL. 7 NO. 3

The Southwest Oregon Forestry Intensified Research Program (FIR) is a cooperative effort between the College of Forestry at Oregon State University and the Pacific Northwest Forest and Range Experiment Station of the USDA Forest Service. It is designed to assist foresters and other resource management specialists in solving complex biological and management problems endemic to southwest Oregon. FIR specialists organize, coordinate, and conduct educational programs and research projects specifically tailored to meet the needs of this area.

Established in October 1978, the FIR Program is supported jointly by Oregon State University, the Bureau of Land Management, USDA Forest Service, O&C Counties, and the southwest Oregon forest products industry. It represents a determined effort by the southwest Oregon forestry community and county governments to find practical solutions to important forest management problems.

The "FIR REPORT" is one of the principal methods of reporting recent technological advances and research results pertinent to southwest Oregon, and alerts area natural resource managers to upcoming continuing education opportunities. Comments and suggestions concerning the content of "FIR REPORT" are welcome and encouraged. The report is prepared quarterly and is mailed free on request by contacting us at this address: FIR REPORT, 1301 Maple Grove Drive, Medford, OR 97501.

For the FIR Staff,

David H. McNabb
Extension Watershed Specialist

Inside

OREGON STATE UNIVERSITY EXTENSION SERVICE

FORESTRY INTENSIFIED RESEARCH

SERVING SOUTHWEST OREGON THROUGH RESEARCH AND EDUCATION

Adaptive FIR

1301 MAPLE GROVE DRIVE
MEDFORD, OR 97501

(503) 776-7116

FIR Specialists

OLE HELGERSON, Silviculture
STEVE HOBBS, Reforestation
JOHN MANN, Harvesting
DAVE McNABB, Watershed
STEVE TESCH, Silviculture

For specifics on the overall FIR program, contact Jack Walstad, FIR Program Leader, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, OR 97331, (503)757-4617; or Steve Hobbs, Adaptive FIR Project Leader at the Medford address.

Because of space limitations, results appear as extended abstracts. Readers who are interested in learning more about an individual study are encouraged to contact the principal investigator or wait for formal publication of more complete results.

Current Research

MODELING AND TESTING TWO-STUMP ANCHORS FOR CABLE LOGGING SYSTEMS

Stump anchor failure in cable logging can be catastrophic. Pulling a stump out of the ground could happen in harvesting small timber or when setting up a yarder in areas with shallow or poorly drained soil where root systems are of limited depth.

If a single stump is not expected to provide sufficient pull-out resistance, one option is to use a multiple-stump anchor. What is the behavior of the various multiple stump anchor rigging configurations under applied load? To answer this question, a Masters Degree study was recently conducted at Oregon State University by Rick Toupin. As a part of this research, a model was developed to describe the behavior of four types of two-stump anchors in young growth Douglas-fir. The study also compared field load test data and results of the model calculations with published guidelines on load transfer in multiple stump anchors.

The four rigging configurations modeled are (Figure 1): 1. Series Multiple - the skyline, used to link two stumps together, is wrapped around a notch in the first stump and passed to the second stump where it is wrapped in a notch and secured. 2. Tieback - the skyline is wrapped around the first stump and secured. A separate, smaller line is used to tie this stump to a second one. It is wrapped around the two stumps several times and tightened by twisting the wraps with a stick. 3. Elevated Tieback - similar to the tieback, except that the tieback line is attached higher than the skyline on the first stump. 4. Equalizer Block - an equalizer line is tied-off to one stump, passed through a block and secured to a second stump. The skyline is attached to the block.

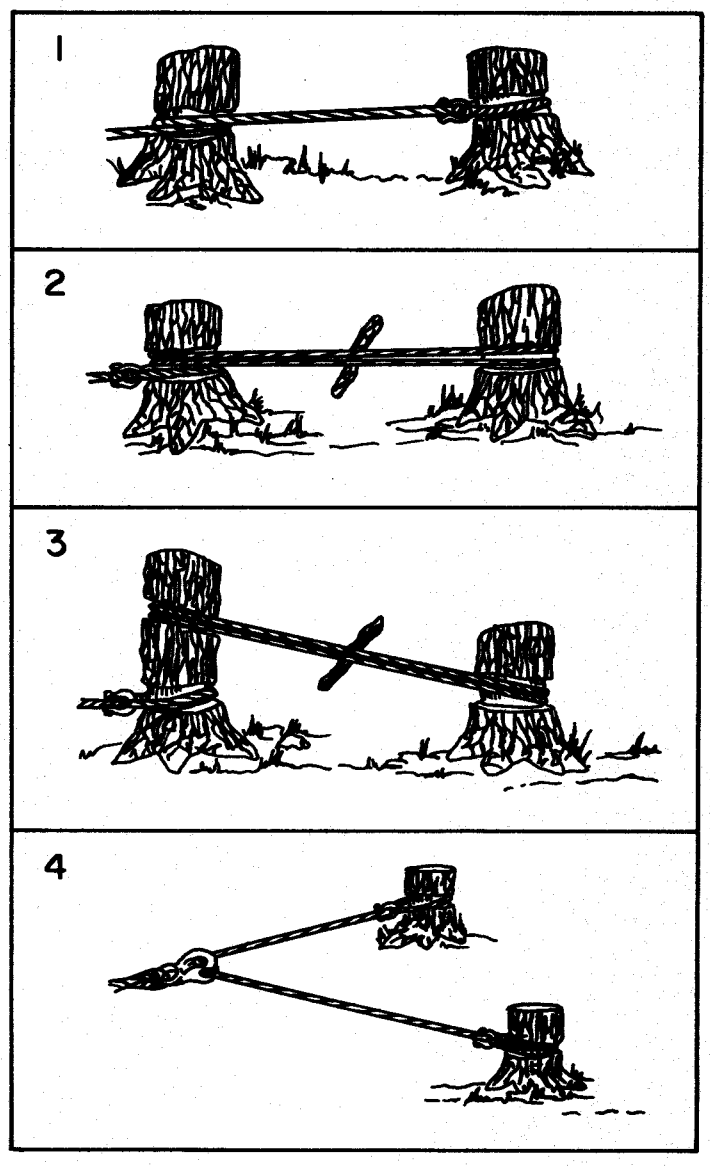

FIGURE 1.--The four types of two-stump anchors investigated in Toupin's study: 1) Series multiple, 2) Tieback, 3) Elevated Tieback, and 4) Equalizer block.

To select the best multiple stump anchoring method for a particular yarding situation it is necessary to know how the various rigging configurations respond to applied loads. Toupin's model produces load-deformation curves for each of the four rigging methods. In

the model, the computed deformation, or stump movement, and the direction of applied load are parallel to the ground surface. The intent of the model was to determine how the load-deformation behavior of individual stumps could be combined to describe the behavior of a two stump system. This assumes the linkage between the stumps is rigid.

A comparison of the four rigging methods was made by using results from Toupin's model for varying stump capacities and sizes. The tieback configuration results also included the effect of varying tieback line pretension. Figure 2 shows the load-deformation curves for a weak first stump, and a strong second stump. The equalizer block curve is significantly lower than the other anchor types which means that this rigging configuration has a lower maximum capacity. It was also noted that the equalizer block anchor will reach its maximum at a lower amount of stump movement than the other types. Results with a strong first stump and a weak second stump would be nearly the same as those shown in figure 2 for the series multiple, tieback, and equalizer block methods. The elevated tieback would have nearly the same maximum load, but would experience about 20% more deformation at a given load if the weak stump is the second stump.

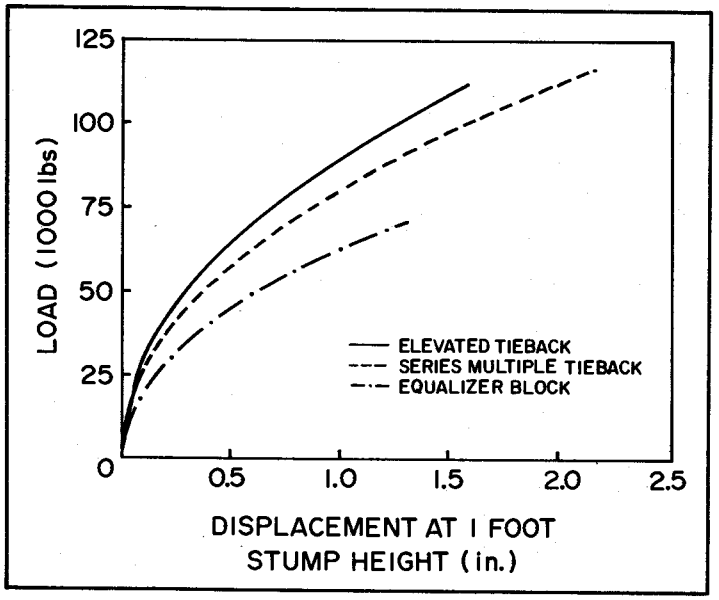

FIGURE 2.--Load deformation (stump displacement) functions as determined by Toupin's model for four types of multiple stump anchors using a 12-inch diameter first stump and 18-inch diameter second stump. Functions end at the load where anchor failure occurs.

Based on other model computations explained in Toupin's report, the series multiple, tieback, and equalizer block anchors have identical load-deformation curves if both stumps have the same maximum capacity. The load-deformation curve for the elevated tieback method was consistently above the other anchor types up to its maximum capacity, but its maximum was slightly lower than the tieback and the series multiple systems. Additionally, tieback pretension does not greatly affect the model results.

Which system is best? The model computations indicate that the series multiple and both tieback systems are similar in behavior. However, the equalizer block system appears to have a much lower load-deformation curve and maximum capacity under some situations, making it less desirable than the others. In general, the maximum capacity of the series multiple or tieback rigging methods approaches the sum of the capacities of the individual stumps. The maximum capacity of the equalizer method appears to be about twice the capacity of the weaker of the two stumps, depending on the angle between the two sides of the equalizer line.

Since the load-deformation characteristics for the series multiple and the two tieback systems are similar, the preferable system is the one that is easiest to rig. The series multiple anchor requires less hardware to rig because the skyline is used as the link between the two stumps. The equalizer block appears to be the least preferred method because it is more likely to fail at a lower load than the other anchor types.

A few words of caution are necessary. The research described in this article considered only pull-out failure. Stumps may fail in other ways, such as being sheared by the wire rope. Also, the model was constructed with the assumption that the linkage between the two stumps was rigid, meaning that the distance between them remains constant during load application. In a real logging situation this distance may change. Additional research is needed to determine the influence of linkage behavior on anchor capacity, however it is believed that the equalizer block anchor would still be less resistant to pull-out forces than the other anchoring methods.

This study was conducted on Douglas-fir in relatively dry soil. It is expected that the results for different soil moisture conditions would vary from those presented by Toupin, but the modeling technique should still apply. The model needs to be expanded to include other species and different timber growing sites.

John W. Mann, OSU
Marvin R. Pyles, OSU

Adaptive FIR

UNDERCUTTING AFFECTS SEEDLING MORPHOLOGY BUT NOT FIELD PERFORMANCE

In 1980, a study was initiated to see if various undercutting treatments conducted in the USDA Forest Service, J. Herbert Stone Nursery would modify Douglas-fir and ponderosa pine seedling morphology and improve field performance (survival and growth) on droughty south aspects. Bareroot seedlings starting their second growing season in the nursery, were subjected to five different undercutting treatments that varied by depth, time of undercutting, and the number of undercuts (see FIR Report 2(2):2-3). These were compared to an untreated control.

When the seedlings were lifted in January 1981, a systematic, random sample of seedlings was taken from each treatment to measure morphological characteristics. Undercut seedlings were significantly shorter, had lower shoot:root ratios, and had less tap root biomass than untreated controls. These differences were more pronounced in ponderosa pine than in Douglas-fir. This differential effect occurred because severing the

prominent tap root of ponderosa pine probably had more of an impact on seedling physiology than it had on Douglas-fir seedlings which have a more diversified root system. In general, the primary difference in morphology for both species was between untreated controls and undercut seedlings regardless of the type of undercutting treatment (see FIR Report 3(2):3-4).

To evaluate the effectiveness of undercutting on field performance, seedlings from each undercutting treatment were planted on two droughty south aspects in 1981. The Douglas-fir test site (1067m elevation; 30% slope) had been clearcut and broadcast burned the previous year. The average annual precipitation is 1650 mm and the soil is a loamy-skeletal Xerochrept with a coarse fragment content of 40 to 50%. Four replications of 40 seedlings of each treatment were hoe-planted in February.

The ponderosa pine test site was considerably different. This site had been dominated by a manzanita brushfield which was root-raked, piled, burned, and the soil ripped in 1980 (see FIR Report 3(3):4-5). Located at an elevation of 610 m (30% slope) with an average annual precipitation of approximately 750 mm, the site has a fine-loamy Haploxeralf soil with a coarse fragment content <35%. Seedlings were shovel-planted in early April. On each test site 40 seedlings per treatment were planted in each of four blocks for a total of 160 seedlings per treatment across all blocks for each site.

Four years after planting, the undercutting treatments produced no significant differences in survival or growth for either species, despite significant differences in morphology at the time of planting. Douglas-fir seedling survival was poor, ranging from 39 to 54%, although height growth over the 4-year period was good (74 to 88 cm). Seedling mortality was due primarily to heat lesions, the result of sustained, unusually high soil surface temperatures during August 1981 (see FIR Report 4(1):5-6). Ponderosa pine survival, on the other hand, remained high (95 to 98%) with 4-year height growth (78 to 86 cm) similar to that of Douglas-fir. The reason ponderosa pine seedlings were able to maintain high survival during the August 1981 heat wave is unknown. To speculate whether or not this can be attributed to an inherent genetic ability of ponderosa pine to withstand high soil surface temperatures or the possibility that soil surface temperature never actually reached a lethal level, would be conjecture since soil surface temperatures were never measured, and both species were not planted on each site.

The results of this study clearly show that the morphological changes induced by undercutting did not affect field performance for either Douglas-fir or ponderosa pine within the conditions of this study. These results may not be applicable to other nurseries, however. In this study, nursery seedbed conditions at the time of undercutting may have adversely affected the magnitude of morphological change due to undercutting, particularly in the root systems. At the time of the study, low available soil phosphorus, high soil bulk density, and possibly soil particle cementing with increasing soil moisture depletion, may have prevented additional root development following undercutting. For this reason, undercutting should not be discarded as a bareroot cultural practice to modify seedling morphology. Had the soil environment in the nursery been more suitable for root development, field performance results might have been different.

S.H.

RAVEL BEFORE, DURING, AND AFTER HARVESTING

Ravel, the downslope movement of soil, rock and woody debris, may contribute to reforestation failure by burying seedlings. This is most likely to occur on steep slopes in excess of 60 percent with accumulations of coarse fragments on or near the soil surface and loose logging debris. Previous observations on ravel in both the Oregon Coast Range and Cascades indicate that ravel increases substantially as slopes approach 80 percent. The problem is most serious following disturbance by harvesting and broadcast burning.

Protecting newly planted seedlings from ravel on steep slopes could increase survival; however, preliminary tests of ravel deflectors on an old clearcut have been inconclusive (FIR Report 5(3):2). Few seedlings were buried on this site because the ravel was relatively stable. One hypothesis for the stability of the ravel was that the site had not been recently disturbed which allowed brush to cover most of the site.

Although ravel is assumed to be a serious reforestation problem on some sites, actual measurement of seedling burial and movement of ravel has been limited to a few sites. The effects of harvesting on ravel or the amount of ravel in natural stand have not been determined. Therefore, I expanded the study on protecting seedlings from ravel to include determining the effects that harvesting and site preparation have on the natural movement of ravel. This should provide additional information for interpreting the causes of accelerated raveling and determining the need for protecting seedlings on harvested sites.

The site selected for this part of the study is in the Galice portion of the Grants Pass Resource Area, Medford District of the Bureau of Land Management. The site is a northerly exposure with a mean slope of 77 percent. The elevation averages 1150 m. An 110 year-old even-age stand of Douglas-fir covered the site before clearcut harvesting. The understory had about a 10 percent cover of low forbs and shrubs. The site is typically covered with a winter snowpack which lasts for several months; the trees were pistol butted as a result of snow creep on the steep slopes.

Twenty-five sheet metal boxes, 1.5 m in length, were buried along the contour of the slope at random locations over the general timber sale area in September 1983. Nineteen of the boxes were in the clearcut area and six were installed in the adjacent uncut stand to serve as a control. Ravel was seldom allowed to accumulate in the boxes for more than four months but actual dates for cleaning boxes were dependent on access to the site and when felling and yarding occurred. The ravel collected was oven dried at 105°C, and separated into organic debris, soil and fine gravels <3.76 mm in diameter, and gravel and cobbles >3.76 mm. Movement is reported on a daily, mass per length of box (g/m-day) basis rather than as a mass per area because of the difficulty of defining the source area for ravel above an individual box.

Harvesting started after March 23, 1984 and was completed by May 24, 1984. Harvesting was delayed during the first month because of late spring snows; about half the unit was felled the first month and only a small portion yarded. The site was logged with a running skyline. One-end log suspension was achieved over about two-thirds of the area and full suspension over the remainder. Boxes were emptied prior to the start of harvesting, between the felling and yarding

operations when boxes were accessible, and immediately after harvesting. Two boxes were destroyed by harvesting and data for another two were deleted because the boxes were partially dislodged.

Ravel prior to harvesting was relatively low, averaging about 9 g-m/day (Table 1). Less than 2 percent of the ravel during this period was in the soil and fine gravel size fraction; another 10 percent was organic debris. The rate was lower than anticipated and may be below normal. Snow creep, which appears to be an important factor moving ravel on steep, upper elevation sites, was a minor factor during that particular winter. The site was accessible several times in January and February 1985 because of the unusually dry January (see FIR Report 7(2):5-7).

TABLE 1.--Ravel movement before, during and after harvesting on a steep site in the western Siskiyou Mountains.

Material	Preharvest 9/30/83 – 3/22/84	Harvest[1] 3/23/84 – 5/24/84	Post Harvest 5/25/84 – 10/16/84
	-g/m-day-		
Organic debris	0.88	50.62	2.35
Soil, fine gravel, <4.76 mm	0.14	9.89	0.21
Gravel, cobbles, >4.76 mm	7.81	312.00	8.25
Total	8.83	372.81	10.51

[1]Ravel averaged over 63 days, but most movement probably occurred over a 2-4 day period when harvesting directly above a box.

Harvesting greatly increased the daily average rate of movement of ravel. As might be expected, the proportion of organic debris in the ravel nearly doubled but the soil and fine gravel size fraction remained unchanged. Approximately 89 percent of the ravel moving during the harvest occurred during the yarding phase. The rate of movement may also be underestimated because at least two boxes were completely filled and ravel slid over the top of the boxes. The average daily rate is also somewhat misleading because portions of the site were not impacted during the first month or were felled and yarded early and had little further impact. As a result, most of the ravel probably moved during a 2 to 4 day period when trees were being felled and logs yarded from directly over a sample point.

Initial post harvesting ravel was slightly higher than preharvesting movement. The greatest increase was again in the organic debris fraction which maintained the two-fold increase over the preharvest proportion. Of particular interest, ravel declined during the first winter after harvesting to a value less than half of the preharvest rate. This is not an anomaly of the data set, because ravel in the control was similar for the two winters. Evidently, the untreated slash was sufficiently interconnected and held on the slope by stumps such that little movement other than its compaction occurred during the first winter. Future measurements will determine whether this temporary reduction in ravel will persist as the slash decomposes.

The original silvicultural prescription for the site included broadcast burning during the fall of 1984, but dry fall conditions and a northerly exposure prevented the site from being burned during the fall and winter of 1984-85. Rather than delay planting another year, a decision was made to plant the site without broadcast burning and test the effectiveness of ravel deflection devices. The site was planted with 2-0 bareroot Douglas-fir in the spring of 1985. One treatment protected seedlings from ravel with a 2 by 9 cm wood stake, another treatment protected seedlings with a shingle wedge, and a third left seedlings unprotected. The burial of these seedlings is being monitored on a bimonthly basis and will be reported in future issues of the FIR Report.

DM

RELEASE STUDY: DOUGLAS-FIR DATA SET COMPLETED

Forest managers in southwest Oregon are frequently faced with decisions regarding management or disposition of advance regeneration. This natural regeneration is usually scattered and somewhat clumpy. Prescriptions in the past have often called for removal of these trees through burning or mechanical site preparation on the assumption that an even-aged, well-distributed stand could then be established through planting. But planting is expensive and may be risky on harsh sites. Currently, thousands of acres in southwest Oregon are at least partially stocked with naturals and/or trees planted prior to overstory removal.

The objective of the Adaptive FIR project entitled "Growth Potential of Released Understory Conifers" is to study the growth performance of advance Douglas-fir and white fir regeneration on a variety of sites in southwest Oregon. Specifically, this study will determine how well and how quickly understory seedlings and saplings respond to overstory removal with increased height growth. The effects of varying overstory density, understory competition and site characteristics on release are being examined.

Study sites are being selected which offer at least a 10-year period of release following overstory removal. For the most part, we are utilizing old clearcuts that contained advance regeneration and were not subsequently burned. Site classes 3, 4 and 5 are being examined, with plots located on a variety of slopes and aspects. Past height growth is determined by sectioning sample trees at 0.5 ft. intervals and counting annual rings. A measure is also made of preharvest overstory density and current stand competition. As of October 10, 1985, 360 Douglas-fir and 86 white fir have been analyzed, with completion of the data set of 360 trees of each species anticipated by fall 1986.

Field observations to date clearly indicate that both Douglas-fir and white fir reproduction will respond to removal of the overstory with increased height growth, even after being suppressed for 50 years (Table 1). We have observed a period of several years following harvest during which the trees adjust to increased growing space by developing a large crown. Height growth does increase during this time, but it eventually reaches a much greater level. The sample trees

listed below demonstrate this phenomenon. Observations indicate that Douglas-fir on poor sites will reach a relatively rapid growth rate after a short period of adjustment (probably 2 to 3 years).

TABLE 1.--Examples of change in height growth of Douglas-fir (DF) and white fir (WF) following release.

Species/ Site Class	Age at Release	Post-release Period	Annual Height Growth[1] Pre-release	Post-release	Most Recent
	- - years - -		- - - - - ft - - - - -		
DF/3	16	31	0.10	0.40	2.20
WF/3	23	21	0.35	0.50	1.80
DF/4	46	22	0.18	1.50	3.10
WF/4	28	20	0.25	0.50	2.84
DF/5	29	23	0.17	0.40	2.22
WF/5	25	23	0.22	0.38	1.80
DF/4	8	22	0.20	0.70	2.84
DF/4	14	11	0.11	0.16	0.80
DF/5	9	23	0.10	0.25	1.42
DF/5	5	23	0.40	0.70	1.25

[1] Mean value based on five year periodic measurements.

Analysis of the Douglas-fir data set will begin this winter and be directed at determining the length of the adjustment period and the degree of release. This information will help forest managers evaluate silvicultural alternatives regarding the management of advance regeneration versus starting over with a new stand.

Chip Weber, Adaptive FIR
Steve Tesch

SITE NITROGEN REDUCED BY BROADCAST BURNING

Adaptive FIR research on using broadcast burning for site preparation is a multifaceted project designed to address several of the issues associated with broadcast burning in southwest Oregon. The primary objectives of this study are to determine the effects that broadcast burning has on vegetative competition, seedling survival and growth, the fuel load, and the soil resource. The objectives were identified from meetings with cooperators (FIR Report 3(2):7-8). The first study site selected for burning was a slashed brushfield, Spring-White, east of Selma in the Grants Pass Resource Area, Medford District of the Bureau of Land Management (FIR Report 5(4):3-4). The effects of broadcast burning on soil wettability and infiltration at this site were reported in FIR Report 5(4):4, and the effects of broadcast burning and planting crew on seedling survival was reported in the last issue (FIR Report 7(2):2). This time, I am reporting on the effects of broadcast burning on fuel, litter, and duff consumption and the loss of site nitrogen.

The site was part of the reforestation backlog in the mixed evergreen forest type that had two previous harvest entries and was covered by sclerophyll brush. Tanoak and madrone were the dominant species. During the summer of 1981, hardwood saplings less than 6 inches in diameter were slashed; larger trees were girdled to reduce the fuel load. Thus, the fuel load consisted of old logging slash and slashed, smaller hardwoods. The unit was broadcast burned in June 1982 following a prolonged drying period that reduced the fuel moisture content below the prescription. Rain in early June rewet the fuels and the site was burned when they again dried into prescription. As a result, the large fuels and duff were probably drier than is typical of a "spring burn." The prescription we requested was for a moderate to a high- moderate intensity burn. The prescription was generally achieved (Lynn Levitt, BLM, personal communication).

The total fuel load was 54.6 tons per acre; the duff layer was a third of this load. Compared to other low elevation sites in the mixed evergreen forest type, the duff load was relatively high. This probably reflects the presence of old logging slash which had not been treated during two previous harvest entries. Bark, limbs, and accumulations of organic debris were common in the forest floor.

Broadcast burning consumed 78 percent of the woody fuel, litter, and duff on the site. It consumed all litter and rotten wood over 3 inches in diameter and nearly all woody fuels less than an inch in diameter. Nitrogen content of the aboveground biomass was reduced by 204 lb/acre. Approximately 70 percent of this reduction occurred in the litter and duff layers. Although nitrogen was reduced in the aboveground components, not all the nitrogen was lost from the ecosystem.

Soil nitrogen did not change in the 0 to 5 cm soil layer but increased significantly in the 5 to 15 cm soil layer following the burn. An insignificant change, 0.002 percent, in soil nitrogen occurred in the 15 to 30 cm soil layer. Burning was not expected to have a significant effect on soil nitrogen at this depth because of the moderate intensity of the burn; however, the small change tends to validate the increase in the 5 to 15 cm soil layer. If soil nitrogen had changed substantially at the lowest depth, it would have been difficult to assume that any changes in soil nitrogen between 0 and 15 cm was an effect of broadcast burning. As a result of broadcast burning, soil nitrogen increased by 52 lb/acre.

An increase in soil nitrogen following burning is not unusual. Compounds volatilized during the burning can move into the soil layer as a result of steep temperature gradients and diffusion. In this case, the assimilation was primarily in the 5 to 15 cm depth. This increase was measured as total nitrogen. Burning had no effect on mineralizeable nitrogen at this depth which would have included changes in the availability of ammonium and nitrate nitrogen. Thus, the increase in soil nitrogen is probably in stable organic materials which would not be easily leached from the soil.

Adding the gain in soil nitrogen to the loss from the aboveground components, the net loss in site nitrogen was about 150 lb/acre. This represents approximately 13 percent of the nitrogen contained in the aboveground litter, duff, and woody fuel components and the top 30 cm of soil. This should be considered a significant loss of nitrogen from sites in the mixed evergreen forest type. However, considering the amount of fuels consumed, particularly the duff portion, the loss is generally higher than would normally be expected on these sites.

The data collected from this site illustrate that nitrogen losses from broadcast burning are primarily

determined by the amount of duff consumed. Adopting fuel management prescriptions which limit duff consumption can significantly reduce the loss of site nitrogen and any adverse impacts the loss of nitrogen may have on long-term site productivity.

DM

Fundamental FIR

MEASURING BASELINE CONCENTRATIONS OF HERBICIDES IN AIR IN SOUTHWEST OREGON

The concentrations of the herbicides triclopyr, picloram, and 2,4-D in the regional air masses of southwest Oregon are being assayed in a Fundamental FIR study recently installed in the field. The objectives of the study are to quantify the concentration of these herbicides in the air at various times of the year. Measurements will be taken for three years. The data will be used to estimate the exposure of humans and other animals. The sampling sites are not near specific spray sites because the objective is to determine baseline levels for the air mass rather than site-specific losses. Specific losses will be measured in a subsequent FIR study pending resumption of spraying on Federal lands.

Air sampling stations are located in six of the larger, coastal and interior valleys of the Siskiyou Mountains. The sites are at Rand, Applegate Valley, Illinois Valley, Chetco River, Agness, and Powers. They were selected for their proximity to agricultural, commercial forest, and inhabited areas.

The study required development of methods to filter herbicide residues from air, and then efficiently recover the residues from the filter for chemical analysis. About 252 m^3 of air are filtered over a weekly sampling period. The acid and ester residues of 2,4-D, triclopyr, and picloram are removed from a specially prepared amberlite XAD-4 filter, through which a measured volume of air is pulled by a vacuum pump. After extraction and evaporation, the herbicides present in the sample are determined by high pressure, liquid chromatography.

The overall analytical detection limit is about 20 nanograms per cubic meter of air for each residue; this represents an inhalation exposure for a resting person of 4 nanograms per week. For 2,4-D, this concentration in breathing air is three orders of magnitude below the tolerance for chronic occupational exposure. The ability to detect these low concentrations of herbicides in air will improve our understanding of the dynamics and extent of 2,4-D, picloram, and triclopyr in ambient air after aerial spray applications.

Ken Bentson
Logan Norris
OSU Forest Science

RAPID METHODS FOR EVALUATING NURSERY STOCK QUALITY

An effective method for evaluating seedling vigor would allow nurserymen to check stock quality and take corrective measures in a timely manner as well as enable foresters to avoid planting seedlings which have a poor chance of survival before they are planted. Several techniques have been used for this purpose but they have seldom been compared, and new methods are being proposed and tried without a thorough evaluation. Therefore, the objective of this Fundamental FIR study is to evaluate new ideas for assessing seedling vigor and to develop promising methods for vigor evaluation.

Various treatments designed to decrease vigor were applied to a lot of two-year-old, bare-root Douglas-fir seedlings. After one and two months of storage, their vigor was evaluated by: 1. measuring their root regenerating potential (RRP); 2. applying the OSU vigor test; 3. measuring their osmotic potential, and 4. measuring the starch concentration in their shoots and roots. Results from these tests were compared with survival of seedlings planted in the field.

The OSU vigor test was well correlated with the field survival but RRP was correlated well with field survival only after several months of storage. Osmotic concentration of xylem sap at the time of planting showed promise in predicting low-vigor seedlings such as those subjected to frost, but it did not correlate well with severe damage after long-term storage or moderate damage after short-term storage.

Starch levels were not evaluated because a satisfactory method for measuring starch was not available. A method using enzymes has now been adapted to conifer tissue and will be applied to the samples in the fall.

This experiment will be repeated with slight modifications during the coming year. Emphasis will be placed on osmotic concentration as a technique for detecting moderate damage, and starch concentration as an indicator of moderate or mild damage. Both of these techniques could be completed within a few days of sample collection and hence, could prove useful as operational techniques for detecting low-vigor seedlings.

Joe Zaerr
OSU Forest Science

IMPROVING DROUGHT TOLERANCE OF CONIFER SEEDLINGS WITH MYCORRHIZAE: PROGRESS REPORT

One of the key Fundamental FIR studies on mycorrhizae involves selecting mycorrhizal fungi that will improve the drought tolerance of conifer seedlings planted in southwest Oregon. Earlier studies developed a rapid, sensitive technique for quantifying conifer response to stress and the effects of mycorrhizae using plant physiological measurements. This assay should not only prove useful for selecting ectomycorrhizal fungi which specifically improve seedling drought tolerance but it should also aid in determining the optimal form of inoculum and timing of the application.

To date, a total of 16 fungal isolates have been obtained from droughty sites and 3 from non-droughty sites in western Oregon. Inoculum of each is being grown to inoculate Douglas-fir seedlings, along with 14 other stock, fungal isolates. Once mycorrhizae have formed on seedlings, each will be evaluated for its capacity to alleviate physiological stress from drought.

The ultimate success of the assay depends on how well seedlings grown in small pots in a controlled environment duplicate the natural environment of field planted seedlings. Varying the volume of soil

available for an individual seedling by using different sizes of pots is a simple method of evaluating the applicability of the assay technique to soil conditions in the field.

To test the effect of soil volume on the assay technique, seedlings pre-inoculated or not with Rhizopogon vinicolor (RV) were transplanted into small, medium, or large (gallon) containers to evaluate their relative response to drought-cycle treatments. Dramatic differences in plant growth occurred, but data are still being collected on photosynthetic and transpiration rates. Needles were smaller and plants were shorter in small containers. RV followed and colonized root tips in small containers but did so to a lesser extent in the large containers. Plants subjected to repeated drought cycles were definitely more adaptable to drought than well-watered plants that occasionally dried, regardless of the presence of RV, suggesting that physiological conditioning had occurred. Water uptake was continuous in well-watered plants, but was not so in drought-cycled plants.

The large container best simulated the soil volume of the out-planting situation, but the morphological appearance of the trees grown in the small container was more like out-planted trees. Further analysis of the data will show whether the mycorrhizal influence is the same regardless of container size and validate the use of a small container system in the evaluation of ectomycorrhizae for drought stress alleviation.

R.G. Linderman
USDA-ARS, Horticultural Crops Laboratory, Corvallis

REASONS FOR PERIODICITY AND QUALITY VARIATIONS OF SEED CROPS

Cone crop production of conifers, particularly Douglas-fir, is extremely erratic in southwest Oregon. Intervals between good crops are as long as 8 to 10 years. Late frosts and insects reduce the frequency of harvestable cones, but physiological factors may also affect the periodicity and quality of the crop. Because forest regeneration and genetics projects are both dependent upon flower, cone, and seed production by desirable trees, determining the physiological factors basic to flower initiation and development in conifers is crucial to the long-term success of these programs.

The level of plant growth regulators in vegetative buds is a physiologic factor affecting cone production. One group of regulators, cytokinins, is essential for the maintenance of cell division and is of particular interest. Using techniques recently developed, in part, at the OSU Department of Forest Science, an unusual cytokinin was identified in buds from Douglas-fir. Levels of this compound, measured in spring vegetative buds from a series of trees, correlated strongly with the number of seed cones produced the next year.

How this particular cytokinin works is unclear. It may be an indicator of physiological conditions favorable for seed cone production, or it may actively induce seed cone formation. Additional research will be needed to determine the role of this regulator and how it may be effectively utilized.

Joe Zaerr
OSU Forest Science

FIR GROWTH AND YIELD PROJECT: UPDATE

Substantial progress has been made on the development of the growth simulator for southwest Oregon (ORGANON). A good deal of the model framework has been pieced together and many of the important driving equations have been developed. Some very useful information is provided by equations that have been completed, and efforts are being made to publish that information as soon as possible. The major equations are listed below with notations about publication status.

1. Diameter and squared diameter inside bark equations for the six major conifer species (Douglas-fir, white fir, grand fir, ponderosa pine, sugar pine and incense cedar). (OSU Forest Research Lab. FRL Res. Note 77).

2. Gross total stem cubic foot volume equations for the six major conifer species. (In press, available soon as FRL Research note.)

3. Merchantable cubic foot volume equations for six major conifer species. (Draft publication in editorial process.)

4. Scribner board foot volume (32' logs) to six-inch top equations for the six major conifer species. (Draft publication in editorial process.)

5. Taper equations for the six major conifer species. (Draft publication in editorial process.)

6. Site index and dominant height growth equations for Douglas-fir and ponderosa pine. (Manuscript in preparation.)

7. Equations to predict Douglas-fir site index from ponderosa pine and vice versa. (Manuscript in preparation.)

Substantial effort has gone into the development of productivity variables based on soil and site data. At this time, it appears these kinds of variables contribute little to the prediction of height growth, which is the main driver of the growth model. Given these problems, site index appears to be the best available measure of site quality, despite the inherent problems with its use in southwest Oregon. As noted in the list, new equations have been developed for Douglas-fir and ponderosa pine. One of these species should occur on most sites where this model will be used.

For further information regarding the status of this growth model, contact Dr. David Hann, OSU College of Forestry (754-4673 or 754-4951).

S.T.

THE WESTERN HEMLOCK SERIES OF THE SISKIYOU REGION

This is the seventh in a collection of brief reports describing forest and woodland vegetation in southwestern Oregon. Previous reports include a summary of all Series (FIR Report 4(4):6), the Jeffrey Pine Series (FIR Report 5(4):6), the Mountain Hemlock and Red Fir Series (FIR Report 6(1):4), the Tanoak Series (FIR Report 6(3):6 and 6(4):7) and the Oregon White Oak Series (FIR Report 7(1):5). Objectives and details of data collection procedures have been presented in these earlier issues of FIR Report.

Vegetation described in this collection of reports is based on 1642 plots sampled from the Siskiyou Region, arbitrarily defined as being south of Cow Creek and west of Interstate 5. There are 68 plots in the Western Hemlock Series, 45 on USFS lands and 23 on BLM lands.

The Species

Distribution. Western hemlock grows along the Pacific Coast from the Kenai Peninsula in Alaska south into northern California. It also grows in the Cascades of Washington and Oregon and occurs as a major forest component of the Inland Empire region of northern Idaho and Montana and southeastern British Columbia. Coastal populations of western hemlock show a marked constriction of range south of Port Orford. North of this boundary, western hemlock occurs eastward well into the coastal mountains. South of this boundary the species is largely restricted to the western slopes of the coastal mountains, except for a few isolated patches. This boundary is coincident with major changes in bedrock geology and climate. Upper elevational limits of at least the western Oregon and Washington populations seem to be determined by the presence of a permanent mid-winter snowpack. It is not a significant species in the FIR study area.

Western hemlock populations in the Siskiyou Mountains range between 40 and 1250 m (130 to 4100 ft), but are largely confined to northerly aspects. Slope steepness varies from flat to over 95%. Western hemlock occurs on all major bedrock types, but least often on ultrabasics and granitics. Soils average 109 cm (43 in) deep, about 15 cm (6 in) deeper than the average Siskiyou data soil depth.

Ecology. Western hemlock is the predicted climax dominant throughout much of it's range. It requires relatively high moisture levels and cool but not frosty temperatures. Inland populations, in the study area, occur on deep, well watered soils at higher than average elevations.

The Series

Distribution. The Series is generally restricted to the western slopes of the coastal mountains south of the Rogue River, except for isolated stands, but is distributed more widely to the north. Coordination with other classification efforts in California, Oregon and Washington will be a necessary part of finalizing these preliminary associations. In the coastal environment, the Series occurs on most combinations of slope and aspect. Interior stands are restricted to cool habitats with low evaporative demand or sites with deep, high water-holding capacity soils.

Composition. Douglas-fir occurs on 94% of the plots and is, typically, the stand dominant. Western hemlock is usually found as a minor component of the overstory, but is the major reproducing species. High proportions of tanoak (66%) and Port-Orford-cedar (35%) in the series indicate the high similarity and overlap between portions of the Western Hemlock, Tanoak, and Port-Orford-cedar Series.

Understory species are generally similar to western hemlock forest stands in the Cascades of Washington and Oregon. Dwarf Oregongrape, swordfern, salal and Pacific rhododendron are common. Important species unique to the region include tanoak, Sadler oak and California laurel, and distinguish the Series in southwestern Oregon from similar western hemlock forests elsewhere.

Nine associations are defined for the Western Hemlock Series (Table 1). The first six associations listed occur mostly to the west of the Coast Range crest, two associations straddle the crest and the last listed is found mainly to the east of the crest.

TABLE 1.--Selected environmental and productivity measures for each association in the Western Hemlock Series.

Association	Elevation	Aspect	Slope	Soil Depth	Basal Area
	m	deg.	%	cm	m^2/ha
California Laurel/ Swordfern	250	17	48	119	55
California Laurel/ Pacific Rhododendron	410	83	42	117	71
Swordfern	489	329	51	127	83
Salal	719	334	50	78	59
Port-Orford-Cedar/ Pacific Rhododendron	779	359	45	114	78
Port-Orford-Cedar/ Sierra-Laurel	1187	325	17	---	54
Sadler Oak	1073	109	35	66	62
Dwarf Oregongrape	995	25	38	---	64
White Fir	1073	45	45	127	64

Association Descriptions

The first two associations have the strongest coastal affinities, and are characterized by California laurel in the tree reproduction layers. The WESTERN HEMLOCK-CALIFORNIA LAUREL/SWORDFERN Association occurs below 500 m (1600 ft) on marine sediments, gneiss or volcanic rocks and indicates relatively moist habitats. Abundant California laurel and tanoak form a sub-canopy under western hemlock and Douglas-fir. Western red cedar is common and expected to do well in this type. The understory consists of a patchy shrub layer of either evergreen huckleberry or vine maple and a nearly complete cover of swordfern.

The WESTERN HEMLOCK-CALIFORNIA LAUREL/PACIFIC RHODODENDRON Association indicates relatively dry coastal habitats below 600 m (2000 ft). Most stands were sampled near Brookings on metavolcanic soils. Douglas-fir is often the sole overstory species. Western hemlock and tanoak codominate the reproduction layers along with small amounts of California laurel. Dense, often impenetrable, thickets of Pacific rhododendron and evergreen huckleberry dominate the species-poor understory.

The WESTERN HEMLOCK/SWORDFERN Association occurs along the coast south to Brookings and, north of the Rogue, inland nearly to the Wild Rogue Wilderness. Most plots are well below 914 m (3000 ft) on cool,

moist, north slopes. Soils are the deepest in the Series and are mostly derived from volcanic rocks of the Dothan Formation. Douglas-fir dominates the overstory, with western hemlock forming a dense secondary canopy. Stands near Brookings may also have some redwood. Small amounts of evergreen huckleberry can be found in the understory, which is overwise characterized by dense swordfern.

Relatively dry habitats in the Series are identified by the WESTERN HEMLOCK/SALAL Association. These stands occur between 400 and 1100 m (1300 to 3600 ft) on most aspects. Soils are the shallowest of the coastal western hemlock associations. Douglas-fir and western hemlock again dominate the overstory. Tanoak is usually present in small amounts. The understory is characterized by abundant salal and, oftentimes, Pacific rhododendron.

Three associations are codominated by Port-Orford-cedar in addition to Douglas-fir and western hemlock. The WESTERN HEMLOCK-PORT-ORFORD-CEDAR/PACIFIC RHODODENDRON Association occurs mainly to the west of the coastal crest below 1100 m (3600 ft) on upper slope and ridgetop positions. Soils are deep and moist. Pacific rhododendron and salal dominate the understory. Other common species include red huckleberry and dwarf Oregongrape.

The WESTERN HEMLOCK-PORT-ORFORD-CEDAR/SIERRA-LAUREL Association straddles the coastal crest near Mt. Peavine and Chrome Ridge. It typically occurs on moist toeslope positions between 1000 and 1500 m (3300 to 4300 ft). Port-Orford-cedar and western hemlock codominate the tree layers. Some stands also have abundant Douglas-fir. Pacific rhododendron thickets completely dominate the understory. Sierra-laurel is common and salal, although usually present, is not abundant.

The uncommon WESTERN HEMLOCK/SADDLER OAK Association represents an unusual combination of lower montane and upper montane species. Shallow soils and low moss cover indicate a cool but dry habitat. Western hemlock, Douglas-fir and Port-Orford-cedar codominate the overstory. Thickets of Pacific rhododendron, salal and Sadler oak characterize the understory. Other typical species include beargrass, dwarf Oregongrape and twinflower.

The WESTERN HEMLOCK/DWARF OREGON GRAPE Association occurs mainly to the east of the coastal crest and north of the Rogue River. These stands occur at mid-elevation between 800 and 1200 m (2600 to 3400 ft) on cool, moist soils. This type often forms a buffer strip between the relatively drier mid-slope associations and a riparian zone following a first or second order stream. Soils are generally derived from Dothan Formation sediments. Large, old Douglas-fir dominates mature stands, with abundant western hemlock and western red cedar occurring as codominants. Small numbers of western yew and tanoak are found on most plots. The understory is the richest of all associations in the Series, but no one species exhibits strong dominance or high cover. Dwarf Oregongrape, twinflower, red huckleberry and vanillaleaf are characteristic components. Vine maple and Pacific rhododendron can also occur.

The WESTERN HEMLOCK-WHITE FIR Association is another unusual, relatively rare type. It occurs on ridgetops near 1100 m (3600 ft) with deep but stony soils. Dothan Formation volcanic rocks comprise the regolith. Douglas-fir and western hemlock dominant the overstory. White fir is an important but not dominate component of both the overstory and reproduction layers. Pacific rhododendron and dwarf Oregongrape characterize the species-rich understory.

Management Implications

The Western Hemlock Series is one of the most productive in southwest Oregon. The generally deep, well-watered soils ensure good growth increment and high stocking. The relatively mild climate characteristic of the Series allows a good selection of valued species for regeneration. Douglas-fir and western hemlock grow extremely well on all types. Western red cedar, Port-Orford-cedar, redwood and white fir will do well on associations where they commonly occur.

The major management problem with the series is the presence on many sites of potentially strong competitors. These include Pacific rhododendron, salal, Sadler oak, evergreen huckleberry and tanoak. Vegetation management schemes appropriate to site and species may have to be used to insure rapid re-establishment of the tree layer. Not only are these species strong competitors, but when present with high cover, they also form a physical barrier to planting. In such cases site preparation will often be necessary.

If you have any questions or comments please contact us either at the Siskiyou National Forest, Grants Pass, OR 97526, at the Department of Forest Science, Oregon State University, Corvallis, OR 97331, or at the Forestry Sciences Lab, 3200 Jefferson Way, Corvallis, OR 97331.

Brad Smith OSU
Tom Atzet Siskiyou NF
David Wheeler Siskiyou NF
Jerry Franklin PNW

Continuing Education

NOTE FROM THE EDITOR

Regular readers of the FIR Report will recognize that only one FIR sponsored workshop is scheduled in the coming months. This is not an omission on our part but reflects a change of emphasis in our formal, Adaptive FIR educational program for the coming fiscal year. During 1985-86 we are developing state-of-the-art papers on several topics, including reforestation of skeletal soils, use of artificial shade to enhance seedling survival, optimizing soil physical properties in intensively managed forests, and clearcut and shelterwood regeneration systems in southwest Oregon. These papers are in the early stages of preparation. When published, they will be listed in RECENT PUBLICATIONS.

STREAMSIDE MANAGEMENT: FORESTRY AND FISHERY INTERACTIONS

February 12-14, 1986. University of Washington, Seattle. The program will present and discuss current knowledge in the area of forestry/fishery interactions. Topics will include channel morphology, sediment, large organic debris, temperature, and productivity. A series of case

studies will also be presented. CONTACT: Diana M. Perl (206), Manager of Continuing Education, 543-0867.

10TH B.C. SOIL SCIENCE WORKSHOP

February 20-21, 1986. University of British Columbia, Vancouver, British Columbia. Theme of workshop is "Degradation of Forested Land - Forest Soils at Risk." Topics include: effects of harvesting, road building, and site preparation; soil disturbance/ productivity relationships; predicting soil disturbance, rehabilitation, economics of soil degradation and rehabilitation, and research needs. Sponsors of the meeting are B.C. Ministry of Forests (Research Branch), B.C. Land Resource Science Lead Committee, and Soil Conservation Society of America (B.C. Chapter). CONTACT: Gerry Still (604) 354-6279 or Dan Lousier (604) 387-3338.

VEGETATION MANAGEMENT WORKSHOP

March 5-7, 1986. Oregon State University, Corvallis, Oregon. First day is for those unfamiliar with concepts of vegetation management in forests. Second and third day will discuss the effectiveness of treatment programs from the biological and economical perspectives. Registration is possible for either or both portions of the program. Attendance is limited to 150. CONTACT: Conference Assistant (503) 754-2004.

SILVICULTURE INSTITUTE

April 20, 1986. Oregon State University, Corvallis, Oregon. Application deadline for individuals planning to attend 1986-87 program. Attendance is limited to 30. CONTACT: Dave DeYoe (503) 754-2244.

FIRST NATIONAL CONFERENCE ON SOCIAL SCIENCE IN FOREST AND PARKS

May 12-16, 1986. Oregon State University, Corvallis, Oregon. Designed for managers and others having responsibility for recreation management or incorporating social science data into the planning and decision-making process. Contemporary issues in recreation management, such as resource development, tourism, and human resource management issues for the decade of the 90's, provide the foundation for the workshop participants to look and plan for the future. Attendance is limited to 200. CONTACT: Conference Assistant (503) 754-2004.

NORTHWEST FOREST SOILS COUNCIL IS GOING TO ALASKA

Early July, 1986. Fairbanks, Alaska. Three days in the field with visits to the Bonanza Creek Experimental Forest, landforms of unglaciated Alaska and other stops around Fairbanks. Additional half day of seminars by invited participants. Field trip is hosted by University of Alaska and the USDA Forest Service, Institute of Northern Forestry. Ed Packee (University of Alaska) is making the arrangements. LOCAL CONTACT: Dick Miller (206) 753-9470.

REFORESTATION OPERATIONS IN SOUTHWEST OREGON

Late summer 1986. Adaptive FIR, Medford, Oregon. Specific topic has not been decided. Additional information will be provided in forthcoming issues of the FIR Report and the Program announcement.

Of Interest

BUDCAPS AND SHADECARDS--NEGATIVE EFFECTS ON SEEDLING SURVIVAL?

In the summer of 1983, a 28 acre brushfield located in the Butte Falls Resource Area, Medford District of the Bureau of Land Management was manually slashed and prepared for planting in 1984. The unit faces south at about a 60 percent slope, has skeletal soils, and is at an average elevation of 3800 feet. The unit was regarded as a high use area for deer.

Because the site was regarded as difficult to reforest, BLM foresters Ivend Holen and Terry Tuttle wanted to closely monitor seedling survival. In addition, they wanted to further assess the effectiveness of shading and budcapping as aids to seedling survival. A study was designed by Terry to address these questions.

The unit was planted with 2-0 bareroot Douglas-fir seedlings on an average spacing of 7 by 7 feet in the spring of 1984. Randomly selected seedlings scattered throughout the unit either received Remay budcaps and shadecards, shadecards, or were left untreated.

Terry made the following observations. Survival after one growing season was: Remay budcaps + shadecards, 39 percent (26/67); shadecards, 40 percent (16/40); and untreated controls 52 percent (46/88). A chi-square test of independence indicated that the treatments did not differ at the five percent level.

The failure of the shadecard and shadecard + budcap treatments to increase survival is disappointing considering their cost. Some on-site observations may help explain these results.

Damaged tissue, presumably from heat, was observed on the portions of seedlings covered by the Remay sleeves regardless of the presence of shadecards. Similar observations of heat damage were previously reported by Dave DeYoe (FIR Report 5(1):4). Furthermore, budcaps were not effective in preventing or even substantially reducing deer browsing. Seedlings were often clipped one-half of the way into the caps. Approximately the same proportions of protected and unprotected trees were browsed -- 10 of the 26 surviving, budcapped seedlings compared to 32 of the 62 seedlings without budcaps (controls plus shadecarded seedlings). A chi-square test indicated that frequency of browsing was not related to whether the seedlings were protected by Remay sleeves. In addition, some seedlings located in deer trails appear to have been killed by trampling.

An increase in ravel may be a problem on this site. The increase appears to be partially caused by deer but also by the crew that slashed the unit. In particular, the shadecards tend to catch raveling material, often partially burying the seedling. This may have offset any positive effects of shading on seedling survival.

This study supports the conclusion of Dave DeYoe that spun polyester sleeves should not be used for deer browse protection on seedlings planted on hot, south-facing slopes because of potential heat damage. In addition, it appears that the sleeves were ineffective in reducing deer browsing on this site. The failure of shadecards to increase survival is not unique, but their contributing to seedling burial demonstrates that protecting seedlings from one potential cause of mortality may contribute to mortality from another cause. It also reinforces the need for site-specific interpretation of all the environmental factors and consequences of treatments that can affect seedling survival.

OH

DOES NITROGEN LOSS FROM BROADCAST BURNS AFFECT FOREST PRODUCTIVITY?

A net loss of site nitrogen is an expected consequence of infrequent broadcast burning in Western forests. The magnitude of the loss depends on the amount of fuels present, the proportion of the fuel load that is consumed, and the change in soil nitrogen. An example of these components and an estimate of an 150 lb/-acre loss of nitrogen from a mixed evergreen forest site is reported in this issue of the FIR Report (see page 6-7).

In a region where forest stands generally respond to nitrogen fertilizers, the logical conclusion is to assume that a loss of nitrogen will reduce productivity. Quantifying this impact on productivity, however, is a complex problem to which there is no ready solution. Current nutrient models, like FORCYTE, which relates changes in nitrogen to stand growth, provide estimates of site productivity loss from broadcast burning, but have not been validated in temperate forest ecosystems. Another part of the problem is determining the specific impact that burning has on soil productivity versus the more general impact that it may have on site productivity (FIR Report 7(1):9-10). Other factors include how we define productivity, the specific forest type and the historical role of fire in that ecosystem, the effectiveness of burning for site preparation, the magnitude and frequency of nitrogen loss, and the possibility for the accelerated loss of nitrogen from sites which are not burned.

Although research of broadcast burning is extensive, the studies have generally been fragmented and weak in a thorough investigation of the effects of fire on productivity. The current establishment of long-term ecological studies at sites like the H.J. Andrews Ecological Reserve on the Willamette National Forest, the sites that Adaptive FIR is establishing, and the study that the western Districts of the BLM are starting (FIR Report 7(1):3) should quantify many of the impacts of broadcast burning. In the meantime, only reasoned judgement is available to estimate these impacts. I offer the following discussion of how the several factors are related using various tree growth scenarios typical of forest sites in southwest Oregon as examples. The main objective, however, is to raise the issue that before a loss of nitrogen can be directly related to a loss in productivity, a number of factors must be considered.

The stage of stand growth may have a significant effect on our ability to measure stand response to broadcast burning. If the loss of nitrogen from burning has an effect on productivity, it will most likely occur when the annual demand for nitrogen by the stand is greatest. This will generally occur about crown closure. This would suggest that some measure of periodic annual increment would be the best estimator of productivity losses associated with burning; however, this measurement would be sensitive to differences in relative stand density and competing vegetation that could easily mask differences in growth caused by a loss of nitrogen. If burning affects initial stand establishment or the cover of noncommercial species, making comparisons between burned and unburned stands would be difficult; these factors have consistently limited our ability to predict the response of stands to fertilization.

Several other aspects of forest management can affect site productivity besides broadcast burning. The most immediate impact would be the result of successful reforestation of harvested sites rather than relying on the slow, often variable stocking that is achieved with natural reforestation (Figure 1). This would be a particularly valid scenario for southwest Oregon where the natural establishment of a forest stand may take several decades or more. Development of a young stand model could help quantify the magnitude of some of these changes in yield trajectory which could make quantifying management impacts on soil productivity easier (FIR Report 6(4):6-7).

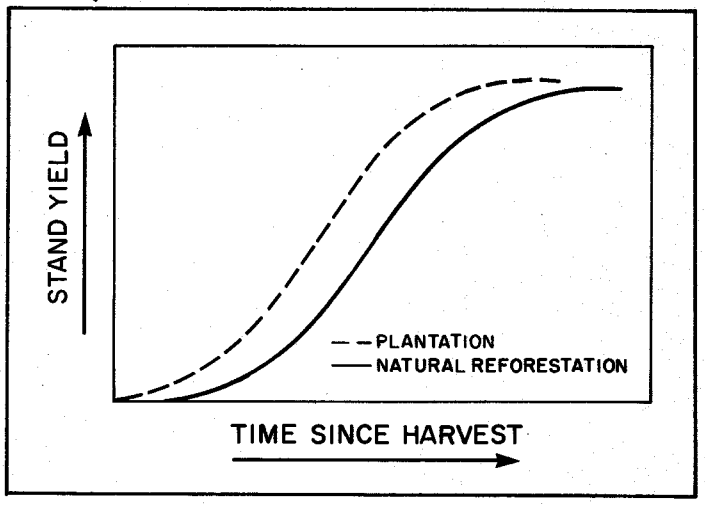

FIGURE 1.--Average stand yield over time of successfully reforested plantations compared with growth of natural stands which may initially be poorly stocked.

A major factor that often escapes consideration is the historical role of fire in specific forest ecosystems. For example, the FORCYTE model, developed at the University of British Columbia, uses the current nitrogen stored in the various components of a harvested site and the site productivity of the previous stand as the starting reference point to determine the effect of reducing site nitrogen on productivity. If the site is a mesic, old-growth forest like those to the North, a considerable increase in site nitrogen may have occurred as a result of nonsymbiotic dinitrogen fixation by early successional species such as alder and snowbrush, and fixation by epiphytic species and in decaying logs. But, most of these forests originated from infrequent, catastrophic wildfires which consumed large

amounts of organic residues and volatilized proportionally large amounts of site nitrogen. Thus, early successional forests in these ecosystems developed on sites with a lower level of site nitrogen than presently exists. Comparing the site nitrogen in an old-growth forest with the height over age curve of the young stand following a wildfire tends to inflate the importance of site nitrogen to the productivity of a specific site.

Sites with frequent fire histories are less likely to lose large quantities of nitrogen in a specific fire, but repeated wildfires may consume substantial amounts of nitrogen over several centuries. This situation is typical of many sites in the mixed evergreen forest type of southwest Oregon. Some of the poorest sites appear to be the knobcone pine stands on exposed upper slopes and ridges in the western Siskiyou Mountains where wildfires have been most frequent and intense. Soils on these sites are generally relatively deep but they have little organic matter and the surface is nearly always bare.

An equally important factor in the loss of site nitrogen from sites in southwest Oregon is the prospect of replacing the lost nitrogen by natural means. Nonsymbiotic nitrogen fixing plants are rare, and the Mediterranean climate and fire history are not conducive to the development of the traditional old-growth forest with epiphytic dinitrogen fixation and old logs on the forest floor. Thus, frequent wildfires have further contributed to a reduced level of site nitrogen as the norm for many sites in southwest Oregon because replacement by biological processes is slow.

Interpreting the impact of broadcast burning on forest sites must consider both the frequency and magnitude of the nitrogen loss from broadcast burning and that lost in wildfires. Forest sites with infrequent wildfires may be degraded by intense broadcast burns that repeatedly consume both the logging slash and the duff layers. This impact is potentially more damaging as rotations become shorter. In contrast, wildfire in southwest Oregon has already had a substantial impact on site nitrogen levels of most sites. In these situations, reducing fire intensity or not burning may potentially increase the long-term productivity of the site (Figure 2).

Although nitrogen volatilized during broadcast burning is an obvious loss from the site, the ability of forest stands to respond to increased site nitrogen in the form of unburned logging residues and duff is uncertain. How site nitrogen changes over time in unburned residues has seldom been investigated. If nitrogen in unburned slash and duff cannot be retained, then burning becomes a less serious impact on productivity. In terms of stand growth, questions also remain regarding how much of the site nitrogen in unburned slash and duff actually becomes available to trees and will it result in an increase in stand growth.

An important use of broadcast burning is for site preparation. If burning increases seedling survival or temporarily controls competing vegetation, the subsequent growth of the stand may be affected by differences in relative density or differences in competition (FIR Report 7(1):9-10). The ultimate impact of broadcast burning in this situation will depend on the differences that burning has on stand establishment and early growth versus the effect that a reduction in site nitrogen may have on long-term soil productivity (Figure 3).

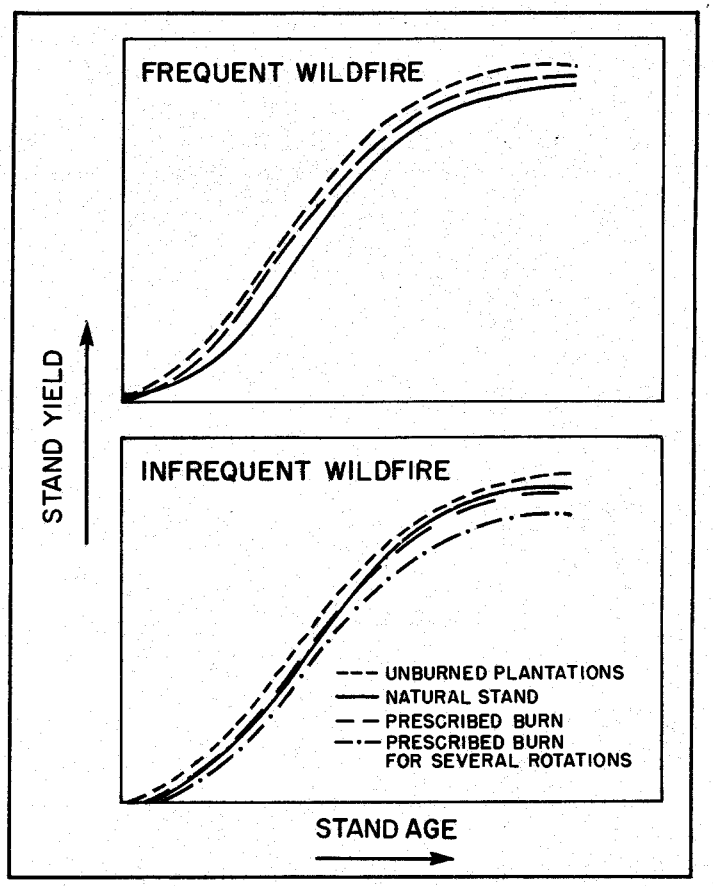

FIGURE 2.--Interpreting the impacts of broadcast burns must consider the historical frequency and intensity of wildfires relative to the frequency and intensity of broadcast burns.

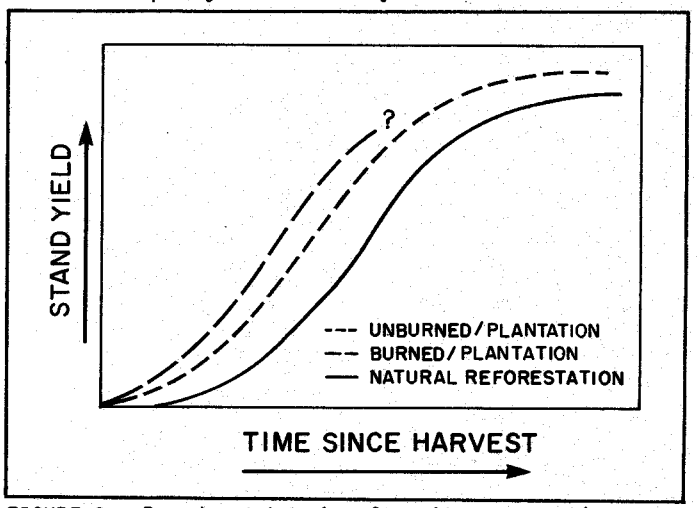

FIGURE 3.--Broadcast burning for site preparation may increase seedling survival and accelerate young stand growth more than any detrimental impacts of a loss in site nitrogen.

In conclusion, before assuming that broadcast burning reduces the productivity of forest stands, particularly those in southwest Oregon, consideration must be given to the frequency and magnitude of site nitrogen lost from broadcast burning compared to the loss from wildfires. Quantifying the effect of a loss of site nitrogen on productivity is confounded by the effects of intensive site preparation and reforestation

practices on young stand growth. If site preparation is not an important benefit of broadcast burning, avoiding burning certain sites in southwest Oregon could potentially improve site nitrogen over historically low levels, thereby increasing soil productivity.

The complexity of the problem makes detecting any short-term changes in stand growth as a result of burning improbable; only long-term, carefully measured plots with a complete record of stocking, competing vegetation, and stand growth will provide the needed information to determine if any changes occur in soil productivity. These interpretations regarding the role of fire in managed forest ecosystems, however, do not justify the use of intense broadcast burning on any site. The careful use of broadcast burns or not burning offers the potential to increase the productivity of some sites. Low intensity burns also reduce particulate emissions and help achieve smoke management objectives. They also leave more of the duff layer intact which can protect the soil from erosion. In other words, the judicious use of broadcast burning is always good forest management.

D.M.

Recent Publications

For copies of these publications, mail your request to the indicated address:

Forestry Business Office
College of Forestry
Oregon State University
Corvallis, OR 97331 (1)

Publications
Pacific Northwest Forest and
Range Experiment Station
P.O. Box 3890
Portland, OR 97208 (2)

Publications
Rocky Mountain Forest and
Range Experiment Station
3825 East Mulberry
Ft. Collins, CO 80526 (3)

Publications
Intermountain Forest and
Range Experiment Station
507 25th St.
Ogden,UT 84401 (4)

SHELTERWOOD MANAGEMENT SYSTEM by J.W. Mann and S.D. Tesch (eds.). 1985. Forest Research Laboratory, Oregon State University, Corvallis. (Proceedings available at $6.00 (US) or $7.00 (CAN) from the Forestry Business Office) Contains 16 papers presented at an Adaptive FIR workshop on May 13-14, 1985, in Grants Pass, Oregon. Papers include the effects of shelterwood harvesting on soil, microclimate, and plant competition in southwest Oregon; the economics of shelterwood versus clearcut harvesting; and numerous operation considerations from planning and administration through logging techniques and regeneration recovery. (1)

IMPLEMENTING FOREST PEST MANAGMENT PRACTICES IN THE USA: PROBLEMS AND SOLUTIONS by L. A. Norris. 1985. For. Chronicle 61:243-246. Implementation of effective pest management strategies in intensive forestry is impeded by educational, technical, administrative, and legal problems. Some of the immediate problems can be solved through improved forestry education and research. Solution of the educational and technical programs, together with relief in the administrative and legal areas, will improve the integration of pest management into intensive forest management programs. (1)

HERBICIDE TOLERANCE IN RELATION TO GROWTH AND STRESS IN CONIFERS by S.P. King and R. Radosevich. 1985. Weed Sci. 33:472-478. Herbicide injury to five coniferous species was determined for the butoxyethanol ester of 2,4-D, the isopropylamine salt of glyphosate, and the triethylamine salt of triclopyr, throughout the growing season of 1981. The relationship of herbicide tolerance to growth rate, water stress, and photosynthesis was determined for Jeffrey pine, sugar pine, red fir, white fir and Douglas-fir. Although most of the species showed a high correlation of injury to leader or needle growth rate and xylem pressure potential, the seasonal trend in the degree of injury and the relationship of herbicide tolerance to various physiological factors were unique for each species. Criteria for determining herbicide application periods depended on species and herbicide. (1)

THE ROLE OF THE GENUS CEANOTHUS IN WESTERN FOREST ECOSYSTEMS by S.G. Conard, A.E. Jaramillo, K. Cromack, Jr., and R. Sharon. 1985. USDA Forest Service, Gen. Tech. Rep. PNW-182. Pacific Northwest Forest and Range Experiment Station, Portland, OR. This report was developed from discussions on the role of Ceanothus in western forests that took place at a workshop held November 22-24, 1982, at Oregon State University, Corvallis, Oregon. The workshop provided a forum for discussing research relevant to Ceanothus management. Major topics were autecology and synecology; interactions between Ceanothus species and the soil system; the physiological ecology of Ceanothus and associated conifers; and the effects of Ceanothus on forest productivity and growth. (2)

THE INFLUENCE OF RESIDUE REMOVAL AND PRESCRIBED FIRE ON DISTRIBUTIONS OF FOREST NUTRIENTS by S.N. Little and G.O. Klock. 1985. USDA Forest Service, Res. Pap. PNW-338. Pacific Northwest Forest and Range Experiment Station, Portland, OR. Nutrients lost from increased removal of residue were small compared with nutrients removed in merchantable timber. Differences in amount of nutrient capital removed during harvest between the two levels of residue removal (all woody material larger than 15 x 180 cm and material larger than 10 x 120 cm) amounted to 1 percent of the total site nitrogen and 4 percent of the total site sulfur. The site with less residue removed by harvest lost 7 percent more nitrogen by the combination of harvest and

prescribed burn. It appears that nutrient losses due to fire may be mitigated by increased residue removal.

2

CALCULATING MOISTURE CONTENT OF 1000-HOUR TIMELAG FUELS IN WESTERN WASHINGTON AND WESTERN OREGON by R.D. Ottmar and D.V. Sandberg. 1985. USDA Forest Service, Res. Pap. PNW-336. Pacific Northwest Forest and Range Experiment Station, Portland, OR. A predictive model is presented to calculate moisture content of 1000-hour timelag fuels in Douglas-fir and western hemlock from daily measurements of precipitation duration, maximum and minimum relative humidities, and maximum and minimum temperatures. Comparison of measured and calculated fuel moisture contents showed good agreement. Current fire-weather stations provide adequate weather data for satisfactory operation of the 1000-hour fuel moisture model.

2

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA: PART 10. INFLUENCES OF RECREATION by R.N. Clark, D.R. Gibbons, and G.B. Pauley. 1985. USDA Forest Service, Gen. Tech. Rep. PNW-178. Pacific Northwest Forest and Range Experiment Station, Portland, OR. A major concern of fishery managers is the possible adverse effect of recreational uses on fish habitat. Conversely, the management of fish habitats may have either positive or negative effects on recreation. This report describes interrelations between recreation and fisheries. Recreational issues affecting either the supply of habitat for anadromous fish production and use, or the demand for the fisheries are also discussed.

2

INFLUENCE OF FOREST AND RANGELAND MANAGEMENT ON ANADROMOUS FISH HABITAT IN WESTERN NORTH AMERICA: PART 14. ECONOMIC CONSIDERATIONS by D.D. Huppert, R.D. Fight, and F.H. Everest. 1985. USDA Forest Service, Gen. Tech. Rep. PNW-181. Pacific Northwest Forest and Range Experiment Station, Portland, OR. Although many effects of forest and rangeland management on anadromous fisheries are difficult to measure, economic methods for the evaluation of costs and benefits can be helpful. Such methods can be used to address questions of equity as well as efficiency. Evaluations of equity can show who bears the costs and who captures the benefits of management actions, but they cannot judge the goodness of any particular allocation of cost and benefits.

2

HOW TO IDENTIFY BROOMS IN DOUGLAS-FIR CAUSED BY DWARF MISTLETOE by R.O. Tinnin and D.M. Knutson. 1985. USDA Forest Service, Res. Note PNW-426. Pacific Northwest Forest and Range Experiment Station, Portland, OR. The brooming caused in Douglas-fir by dwarf mistletoe is both obvious and distinctive and is the key to detection of the parasite. This paper describes how to identify dwarf mistletoe brooms, illustrates the various types of brooms caused by dwarf mistletoe, and discusses some other types of brooms in Douglas-fir.

2

PROCEEDINGS OF A WORKSHOP ON SLOPE STABLILITY: PROBLEMS AND SOLUTIONS IN FOREST MANAGEMENT by D. Swanston, editor. 1985. USDA Forest Service, Gen. Tech. Rep. PNW-180. Pacific Northwest Forest and Range Experiment Station, Portland, OR. This workshop provided mid- and upper-level forest managers and technical specialists with an overview of slope stability problems on forest lands, current state of knowledge, and practical techniques available for problem solving.

2

PROCESSING DATA FROM SOIL ASSESSMENT SURVEYS WITH THE COMPUTER PROGRAM SOILS by J.W. Hazard, J. Snellgrove, and J.M. Geist. 1985. USDA Forest Service, Gen. Tech. Rep. PNW-179. Pacific Northwest Forest and Range Experiment Station, Portland, OR. Program SOILS processes data from soil assessment surveys following a design adopted by the Pacific Northwest Region of the Forest Service. It accepts measurements from the line transects and associated soil subsamples and generates estimates of the percentages of the sample area falling in each soil condition class. Summary or preliminary estimates may be inserted into the program for computing sample sizes to help in planning future surveys.

2

SOIL BULK DENSITY RECOVERY ON COMPACTED SKID TRAILS IN CENTRAL IDAHO by H.A. Froehlich, D.W.R. Miles, and R.W. Robbins. 1985. Soil Sci. Soc. Am. J. 49:1015-1017. In west-central Idaho, the bulk densities of soil in major skid trails were compared with those of adjacent undisturbed soil in order to determine rates of recovery. The percent increase in bulk density of soil on a skid trail over that on an adjacent undisturbed area was greater in the volcanic than the granitic soil, but recovery rates (slope of the regression line) for the two soils were not significantly different. Linear regression models showed a significant ($p < 0.05$) recovery trend for all depths except the 15.2-cm depth on the volcanic site. Except for the surface 5.1 cm of the granitic soil, none of the bulk densities in skid trails had returned to the undisturbed values in the 23 years since logging.

1

SHADECARD AND SHELTERWOOD MODIFICATION OF THE SOIL TEMPERATURE ENVIRONMENT by S.W. Childs, H.R. Holbo, and E.L. Miller. 1985. Soil Sci. Soc. Am. J. 49:1018-1023. Three clearcut sites and three shelterwood sites were instrumented to measure soil temperature at five depths in the vicinity of shaded and unshaded Douglas-fir seedlings. Shelterwoods decrease soil temperatures approximately 6°C when compared with clearcuts. This result holds at both 2- and 32-cm depths. Shelterwoods also decrease the depth of diurnal heating and decrease maximum hourly heat loss and gain. Shadecards generally have little effect on the soil temperature regime of skeletal soils but are effective in reducing daily heat flux. Shelterwoods ameliorate seasonal soil temperature conditions significantly. Over a season, shadecards exert little control, and their influence on stress is limited.

1

ECON: A SYSTEM FOR ECONOMIC ANALYSIS WITH A PROGRAMMABLE CALCULATOR by N.E. Elwood and J.C. Kincaid. 1985. Forest Research Laboratory, Special Publication 12. Oregon State University, Corvallis. Instructions are

given for using program ECON to analyze financial performance of forestry or nonforestry projects. Although it is written for the Hewlett-Packard 41-C or 41-CV calculator, the program listing can be translated to other languages. ECON calculates net present worth and net future worth, soil expectation value, benefit-cost ratio, and rate of return.

1

HEIGHT GROWTH AND SITE INDEX CURVES FOR DOUGLAS-FIR ON DRY SITES IN THE WILLAMETTE NATIONAL FOREST by J.E. Means and M.E. Helm. 1985. USDA Forest Service, Res. Pap. PNW-341. Pacific Northwest Forest and Range Experiment Station, Portland, OR. Equations and curves are presented for estimating height and site index of Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco) on hot, dry sites in the Willamette National Forest in western Oregon. The equations are based on the dissected stems of 27 trees. The curves differ from those previously published for Douglas-fir. Instructions are presented for their use.

2

THE FRASER EXPERIMENTAL FOREST, COLORADO-RESEARCH PROGRAM AND PUBLISHED RESEARCH 1937-1985 by R.R. Alexander, C.A. Troendle, M.R. Kaufmann, W.D. Shepperd, G.L. Crouch and R.K. Watkins. 1985. USDA Forest Service, Gen. Tech. Rep. RM-118. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO. This report provides an overview of the research done on the Fraser Experimental Forest. It replaces CTR's RM-40 and RM-40A by Robert A. Alexander and Ross K. Watkins, published in 1977 and 1978. Included are descriptions of physical features and resources, highlights of past and current research, and the publications derived from that research.

3

BELOW-COST TIMBER SALES: ANALYSIS OF A FOREST POLICY ISSUE by E.G. Schuster, and J.G. Jones. 1985. USDA Forest Service Gen Tech. Rep. INT-183. Intermountain Forest and Range Experiment Station, Odgen, UT.

Explores the question should the Forest Service sell timber for less than the costs associated with the sale? Issue is analyzed within the existing context of comprehensive land management planning. Several approaches to managing two study areas in Montana were developed. Below-cost sales were found compatible with overall management efficiency.

4

OPTIMIZING THE SEQUENCE OF DIAMETER DISTRIBUTIONS AND SELECTION HARVESTS FOR UNEVEN-AGE STAND MANAGEMENT by R.G. Haight, J.D. Brodie, and D.M. Adams. 1985. For. Sci. 31:451-462. The optimal sequence of diameter distributions from initial condition to a dynamic steady state (without a fixed end point) is determined using a steepest-ascent method. The model is applied to an existing hardwood model but shows promise of application to any diameter class model and for study of the even- versus uneven-age decision.

1

EVALUATING SEEDLING QUALITY: PRINCIPLES, PROCEDURES, AND PREDICTIVE ABILITIES OF MAJOR TESTS by M.L. Duryea, editor. 1985. Forest Research Laboratory, Oregon State University, Corvallis. (Proceedings available at $9.00 plus $1.50 postage from Forestry Business Office) This volume brings together state-of-the-art information on the principles, procedures, and predictive abilities of such major tests of seedling quality as nutrition, morphology, and root-growth potential and lays the groundwork for future operational testing and research.

1

FIR

1301 MAPLE GROVE DRIVE
MEDFORD, OR 97501

(503) 776-7116

Non-Profit Org.
U.S. Postage
PAID
Permit No. 200
Corvallis, OR 97331

Oregon State System of Higher Education

KINCH, Mike
Agri. Forestry Dept
Kerr Library
Corvallis, OR 97331

To correct your name or address, please return the mailing label with changes indicated.