FIR Report

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"FIR REPORT" is a quarterly publication containing information of interest to individuals concerned with forest management in southwest Oregon. It is mailed free on request. Requests should be sent to: FIR REPORT, 1301 Maple Grove Drive, Medford, Oregon 97501.

FIR REPORT communicates recent technological advances and adaptive research pertinent to southwest Oregon, and alerts area natural resource specialists to upcoming educational events. Comments and suggestions concerning the content of "FIR REPORT" are welcome and should be sent to the Maple Grove address.

The Southwest Oregon Forestry Intensified Research Program (FIR) is an Oregon State University, School of Forestry program designed to assist region foresters and other specialists in solving complex biological and management problems unique to southwest Oregon. FIR specialists organize, coordinate, and conduct educational programs and adaptive research projects specifically tailored to meet regional needs.

Established in October, 1978, the FIR project is a cooperative effort between Oregon State University, the Bureau of Land Management, U.S. Forest Service, O & C Counties, and southwest Oregon timber industries. It represents a determined effort by the southwest Oregon forestry community and county governments to find practical solutions to important forest management problems.

For the FIR Staff,

Steven D. Tesch
Silviculture Specialist

Inside

OREGON STATE UNIVERSITY EXTENSION SERVICE

FORESTRY INTENSIFIED RESEARCH

SERVING SOUTHWEST OREGON THROUGH ADAPTIVE RESEARCH AND EDUCATION

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NOTES FROM THE EDITOR

Subscribers who did not renew their subscription have been removed from our mailing list. We will be happy to return names to the list if a request is made. In the meantime, be sure to share this issue with your friends--its full of new information.

We are particularly pleased with the number of Fundamental FIR articles we've received recently. As you will see, many results of fundamental research can be linked directly to land management practices.

Please note that three Adaptive FIR sponsored workshops will be held in southwest Oregon within the next 12 months. A prescribed fire workshop and a weed control workshop are both scheduled for fall 1982, in Grants Pass. A young stand management workshop is scheduled for June 1983, in Medford.

Steve Tesch

Current Research

Fundamental FIR

SHORT-TERM EFFECTS OF CHEMICAL AND MANUAL RELEASE TREATMENTS ON CONIFERS

Dr. Mike Newton, of the OSU School of Forestry, discussed "Chemical Management of Herbs and Sclerophyll Brush" at the Reforestation of Skeletal Soils Workshop held in Medford last November. The information he presented will appear in the published proceedings of that workshop, which should be available shortly. His paper provides a very thorough discussion of the functional nature of weed competition on harsh sites, as well as providing up-to-date information on vegetation treatments and their results.

Perhaps some of the most important results presented document the early results of implementing vegetation management programs with or without herbicides, including hand-release. Studies initiated by Newton seek to answer the often asked question about whether conifers respond positively to weed control and, specifically, if herbicides injure crop species more than they help them.

Two sets of data are summarized which have direct application to rocky, shallow soils on hot, dry sites. The first data set involves a major two-part study with research sites scattered throughout southwest Oregon. Initially, test plots were installed to compare the short-term effects of various vegetation control treatments on conifer growth. Two-year data from comparisons of hand-release, untreated, and six-combinations of herbicide treatment are presented as the ratio of height growth during the two years following treatment to growth during the two years before release. The pretreatment weed observations were adjusted to a common basis, using covariance analysis, so that the effects of the vegetation treatments on conifer growth are directly comparable. Many of the conifers were dominant to the brush at the time of treatment, so the study was most likely to reflect potential injury rather than release. A second phase of this study was recently initiated at three additional sites to determine the longer-term effects of the various treatments on conifer growth.

Results suggest that the control trees were accelerating in height growth during the four-year study period and were of good vigor (Table 1). In fact, an increase in growth was observed on the untreated trees in the short term. Triclopyr ester, applied on October 5, had no measureable deleterious effect on the trees reflecting an innate increase in growth; but, picloram injured Douglas-fir and significantly reduced height growth from the control level at $P = .05$. Hand-release also resulted in a significant reduction in the conifer height growth at $P = .05$, despite having removed the brush more completely than other treatments.

A second set of data comes from a study initiated in the Cascades by Terry Peterson as part of a master's thesis. Four methods of release were compared for five- and ten-year-old Douglas-fir in codominant status with snowbrush ceanothus. For ten-year-old trees, the methods were no treatment, release by basal spray of shrubs to a 4 m radius around the sample conifer, release by basal spray of shrubs and broadcast control of all herbs within a 4 m radius of the conifer, and hand-release within a 4 m radius of cutting all cover to within about 10 cm of the ground with a chain saw. Five-year-old trees were given all treatments, except hand-release, to a radius of 2 m. A substantial increase in tree response was observed as the degree of weed vegetation control increased (Table 2). But, ten-year-old hand-released conifers responded negatively to release. After three years, Newton observed that the differences between volume growth are still increasing rapidly.

Table 1. Release of Douglas-fir from evergreen brush: Ratio of height growth in two years after treatment to growth two years before treating, adjusted and unadjusted by crown class (from Newton et al. 1982).

Treatment	Ratios[1] Adjusted	Unadjusted
Control	1.48:1	1.22:1
Hand-Release 100%	0.60:1	0.80:1
2,4-D 3 lb/acre		
August 1	1.03:1	1.02:1
October 5	--	1.21:1
Triclopyr Ester 3 lb/acre		
August 1	1.14:1	1.04:1
October 5	1.48:1	1.22:1
Picloram + 2,4-D		
August 1	0.48:1	0.72:1
October 5	0.56:1	0.76:1

[1]Ratio of 1.060:1 means trees grew 1.060 times as much in two years post-treatment as in two years before.

Table 2. Three-year net growth of 5 and 10-year-old Douglas-fir after release from snowbrush ceanothus, near McKenzie Pass, Cascades.

	3-Year Response	5 Years	10 Years
Control	Net dia growth	1.22 cm	2.31 cm
	Net ht growth	96 cm	104 cm
	Changes in D^2H	1,194 cm^3	7,742 cm^3
Shrubs	Net dia growth	2.41 cm	2.77 cm
	Net ht growth	117 cm	114 cm
	Changes in D^2H	3,083 cm^3	9,948 cm^3
Shrubs and herbs controlled	Net dia growth	3.20 cm	3.33 cm
	Net ht growth	136 cm	122 cm
	Changes in D^2H	4,950 cm^3	12,115 cm^3
Hand-released	Net dia growth	5-yr	2.39 cm
	Net ht growth	trees	85 cm
	Changes in D^2H	not done	7,223 cm^3

ht = height; dia = diameter

Newton suggests that the tables support two hypotheses. The first is that exposure of conifer canopies without reduction or elimination of root competition causes stress which leads to reduced tree growth. Trees released by hand consistently failed to respond positively over the two and three-year sampling periods. The second hypothesis is that directed spraying with herbicides, as in the Cascade study, provides freedom to grow without conifer damage, but broadcast spraying may have caused enough chemical trauma in the conifers to offset the early tendency to accelerate in growth. Table 2 certainly suggests that a greater degree of chemical vegetation control produces additional increases in tree growth.

S. T.

BE AWARE OF TANOAK SEEDLINGS WHEN THINNING SECOND-GROWTH STANDS.

Recent work by the OSU Fundamental FIR vegetation management project has determined that tanoak reproduction by seed is quite common in young conifer stands. Tanoak seedling establishment and understory development appears to begin when conifer stands are 25 to 35 years of age, with establishment continuing as stands get older. Within a sample of seven 50- to 70-year old conifer stands, tanoak seedlings ranged in age from 1 to 45 years and up to 3 feet in height were found. Tanoak seedlings encountered in a sample of five old-growth conifer stands ranged in age from 1 to 60 years and up to 6 feet in height. This pattern of seedling occurrence represents a wide range of sites from the coast near Gold Beach to interior sites near Cave Junction and Grants Pass.

More than 2000 seedlings per acre were found in the 50- to 70-year-old Douglas-fir and mixed conifer stands, even though the nearest tanoak seed source was at least 3 to 5 chains away. Tanoak seedling growth and development in these stands was quite slow, with seedlings only about 3 feet tall after 35 to 45 years. However, these seedlings represent the beginning of a well-developed tanoak understory so common in older stands.

When planning thinning or other treatments in stands 40 to 100 years of age, foresters might consider the effects of the treatment on tanoak understory development. Treatments which open up the stands will undoubtedly enhance the growth rate of existing seedlings. But if the number of seed-producing tanoak trees (6" + dbh) is reduced during the operation, the rate of seedling establishment will probably decline.

Tanoak seedlings will survive clearcutting and burning. They will sprout after these treatments, although their potential for sprouting is well below that of larger tanoak trees. Two years after cutting, tanoak trees may produce 20 to 30 sprouts 3 to 6 ft in length; the smaller seedlings produce only 1 to 5 sprouts, 1 to 1.5 ft in length.

Your comments on tanoak establishment and occurrence in young and old conifer stands and its control are welcome.

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WATER STORAGE WITHIN ROCKS: A SIGNIFICANT FACTOR IN SKELETAL SOILS.

During the past two years, the Reforestation Microclimate Research Project at OSU has been measuring available soil water in selected southwest Oregon soils. Many of these soils are mapped as skeletal; this means that they contain at least 35 percent rock fragments per unit volume. The researchers have found that, in these rocky soils, one must account for the water contained in the rocks in order to estimate the water available for use by plants. The procedure suggested here to account for water content of rock fragments is a preliminary result of the study.

In many studies, the water content of rock fragments has been ignored or assumed to be zero when estimating soil water content. A review of available literature showed that porous, weathered rock fragments contain significant amounts of moisture. Table 1 shows gravimetric water content for several rock types at various water potentials. These data show that rock fragments hold a significant amount of water at saturation. The data for "field capacity" and "wilting point" show that the water can be extracted by plants and is therefore "available" water.

Table 1. Gravimetric water content of rock fragments (grams water/gram dry rock).

Soil name	Rock type	Sat.[d]	F.C.	W.P.	A.W.C.
[a]Cecil	Granitic	25.5	13.5	2.1	11.4
[a]Alamance	Slate	10.5	8.2	5.1	3.1
[a]Herndon	Slate	23.5	9.2	5.5	3.7
[a]Georgeville	Slate	27.0	15.3	7.7	7.6
[b]Cutshin	Sandstone	14.9	10.0	3.9	7.6
[b]Colyer	Shale	49.5	26.7	13.8	12.9
[c]Lapine	Pumice		100.5	9.1	91.4
[c]Lapine	Pumice		121.7	6.4	115.3

[a]Coile, 1953
[b]Hanson and Blevins, 1979
[c]Cochran, 1966
[d]Saturation, "field capacity", "wilting point", "available water capacity"

The data in Table 1 and additional data were used to calculate a general rock water release curve which could be used to estimate water content at various rock water potentials (Figure 1). The r^2 value for the curve is 0.73 so the equation should be used as a guideline only.

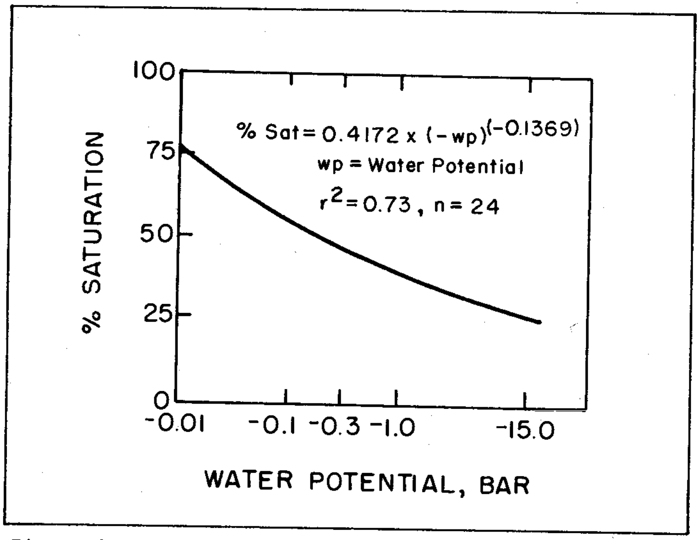

Figure 1. Water release curve for rock fragments.

This figure can be used to estimate rock fragment water content by choosing a rock water potential of interest (for instance, 0.1 or 0.3 bars) and finding the percent Saturation on the vertical axis. Then multiply this number by the measured or estimated saturated water content (or porosity) of the rock. This value can be measured fairly simply and should be done for detailed studies. Our measurements of the physical characteristics of 10 southwest Oregon soils are tabulated below to give an indication of some typical values (Table 2).

Table 2. Physical characteristics of 10 southwest Oregon soils.

	Average	Range
Saturated water content, g water/g rock x 100	13.0	7.0 - 23.0
Bulk density of a rock fragment, g cm^{-3}	1.96	1.55 - 2.41
Solid density of a rock fragment, g cm^{-3}	2.58	2.37 - 2.87
Porosity, percent	24.5	16.0 - 34.0

If the water release curve from Figure 1 and the average data from Table 2 are used, the water holding properties of rock fragments can be calculated (Table 3). These calculations show that rock fragment water content is appreciable over the water potential range of interest for plant growth. The importance of this water can be examined using Figure 2.

Table 3. Calculated properties of rock fragments.

Water Potential, bar	Rock Water Content % Saturation	Grav.[a]	Volume[b]
-0.1	0.57	7.4	14.5
-0.3	0.48	6.2	12.2
-15.0	0.29	3.8	7.4

[a]g water/g dry rock x 100
[b]cm^3 water/cm^3 rock x 100. To obtain this value, multiply the gravimetric water content by bulk density.

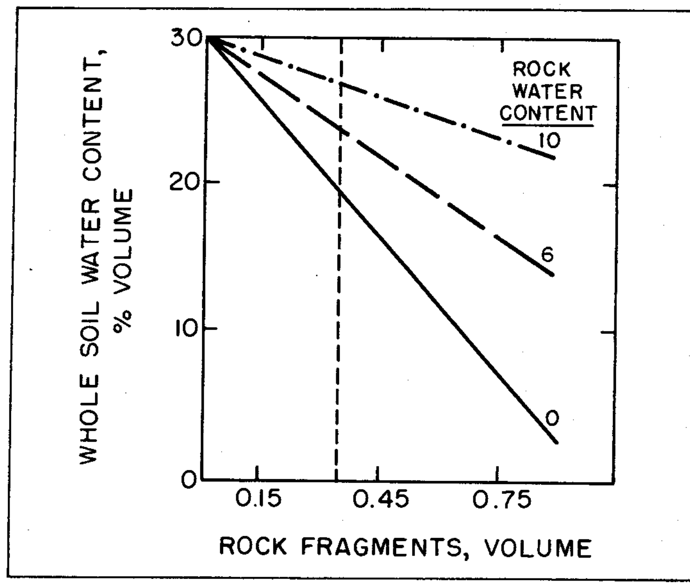

Figure 2. Effect of rock fragment percentage and rock fragment water content on whole soil water content.

This figure shows the diluting effect rocks have on total soil water content. The three lines are for representative rock water contents (0, 6 percent, and 10 percent). In the example, a rock-free soil has a water content of 30 percent. If, for example, a skeletal soil with 35 percent rock fragments (the dashed line) has a rock water content of 6 percent (the 0.3 bar value from Table 3), the whole soil water content will be 24 percent. If it is assumed that the rock water content is 0, the whole soil water content would be 20 percent. The 4 percent difference in water content would result in a 17 percent error.

In order to properly assess the water content of a whole soil, water in both the fine soil and rock fragments must be accounted for. In rocky soils, it is important to measure rock fragment percentage and make a measurement or estimate of porosity of rock fragments. Whole soil bulk density must also be measured if results are to be expressed in useful management units such as volume of water or inches per foot.

Stuart Childs, OSU, Soil Science
Alan Flint, OSU, Soil Science

THE FIR GROWTH AND YIELD PROJECT: WHAT IS IT AND WHAT'S IT UP TO?

Following recent FIR REPORT articles discussing tree growth in southwest Oregon, the FIR Growth and Yield folks have been answering lots of questions about their project. The questions indicate a need for the forestry public to become better informed on the type of information being collected, the form the growth models will take, and the utility of the results to forest managers.

Over the years, growth and yield information has been presented in three forms, including tables, equations, and models or simulators. In the past, results were presented mainly in tabular form and classified as either "normal" or "empirical". The normal yield tables were based on fully stocked, undisturbed natural stands. Normal yield information is of limited value because normal stands bear little resemblance to managed stands.

Empirical growth and yield tables have been prepared which are based upon average stand conditions under existing management practices. However, as management objectives change over time, the usefulness of the existing empirical information is reduced.

With the development of computers, foresters started using more complicated mathematical functions to describe growth and yield. A growth model links several mathematical functions, each of which predicts the behavior of components of the system, into a framework which imitates a complete naturally-behaving system.

In the FIR Growth and Yield Project two types of growth models will be adapted to southwest Oregon: an individual tree model and a stand diameter-class model. These two types of models are in use already in the West; however, local information is necessary to ensure that they behave properly in this area. Both models will contain a gross growth component; a mortality component for non-catastrophic losses; a means of introducing managerial decisions; and a display technique for portraying the results of the simulations.

These two stand growth models will require the same basic data to run, but they differ in the way they characterize the stand. Both models use a sample of trees from a stand in order to model the stand's development. The stand diameter-class model will group all the trees of the sample into one-inch diameter classes and then predict how the number of trees in each diameter class will change over time. The individual tree model calculates diameter growth, height growth, and mortality for each sample tree and then sums these into stand values for each growth period of interest. The trade-off to be compared will be between the increased accuracy of the individual tree model versus the increased number of calculations involved (cost in computer time) for the individual tree growth model.

Both growth models allow the handling of mixed species stands and practically any stand structure or management regime. These growth models use solar radiation, soil water holding capacity, precipitation, and elevation to characterize the site's productivity. By not using site index, the need for the modeled stand to meet the "free growing, fully stocked, single species" assumptions of site index curves has been eliminated.

The individual tree growth model will also include a sample stand self-calibration routine. This involves taking past radial growth information from the stand being modeled and using it to adjust the growth prediction up or down. This will allow adjustments for microsite, genetic, etc. differences not built into the basic model framework.

The sampling procedure keys on six major species, Douglas-fir, white fir, grand fir, incense cedar, sugar pine, and ponderosa pine. Ages of sampled stands range between 5 and 125 years, enabling application of results to second-growth plantations as well as naturally developing stands. As long as there are sufficient key conifers to constitute a stand, any structure or age mix is allowed. Sampling includes measurements of hardwood trees on the site, so the effects of competing vegetation on conifer growth may also be predicted within this model framework.

The sampling system used collects basic tree data in an inventory format. The sample plot consists of a cluster of 4 or more 20 BAF prism points plus two clustered circular fixed area plots at each point.

The resulting growth models will be useful to local forest managers in a variety of ways. Growth and yield information is necessary for ownership-wide modeling of general growth trends, modeling of optimal scheduling of stand treatments, and modeling regional assessments of future timber supplies.

If you have any further questions regarding the FIR Growth and Yield Project, please contact us.

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BOTH SLOPE AND ASPECT INFLUENCE TIMING OF MAXIMUM POTENTIAL SOLAR HEATING

Reforestation problems on steep, rocky sites in southwest Oregon, especially on south exposures, have emphasized the significance of the additional heat gained during fair weather periods by virtue of site orientation toward the sun. Part of this increased heat load, not widely recognized, is a result of the combined effects of slope and aspect in controlling the time of year when maximum solar heating can occur.

The relationships involved are demonstrated in Figure 1, which shows the dates when maximum solar heating potential is greatest for different aspects and slopes. From it we see that steeply sloped sites with due south aspect experience greater solar heating in the spring than on the longest day of the year, June 21, given clear sky conditions. Using the graph, we also find a radiation maximum for a SSW facing 70 percent slope on about April 12. Such steep slopes also exhibit a second maximum, displaced by the same number of days as the springward shift, into the fall, as noted by the dates on the right hand y-axis of the figure. However, the graph indicates that, for all practical purposes, slopes flatter than about 36 percent will have a singular maximum in solar heating potential near the summer solstice. This is apparent as both the left and right y-axes approach June 21 as they intercept the x-axis. Also, for east and west aspects, all slopes are predicted to receive maximum solar energy, regardless of their steepness on June 21.

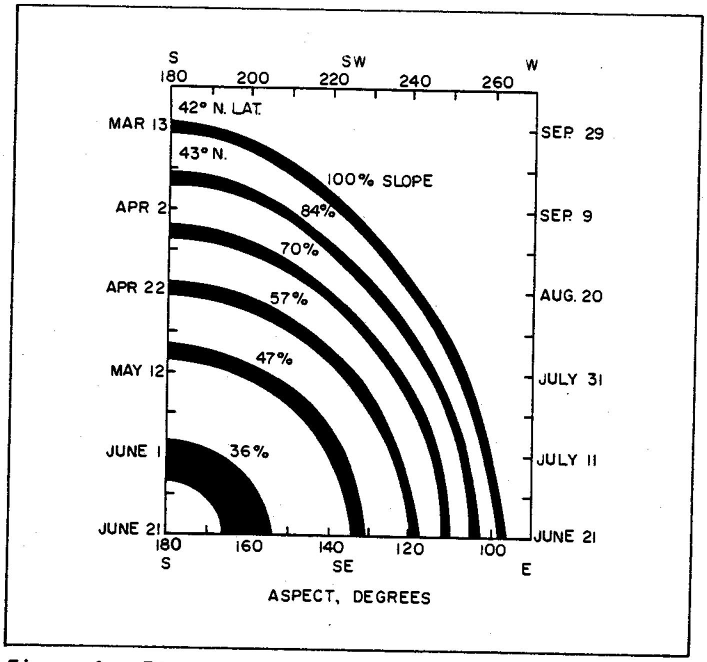

Figure 1. Effect of slope and aspect on date of maximum solar heating potential. Width of line covers latitude range of southwest Oregon up to Roseburg.

The interpretation of these relationships should be useful in a variety of ways in the study of vegetative responses to the physical (radiant) environment. In particular, this information may permit some improvement in explaining the variability in dates of bud-burst, since most sites exhibit considerable micro-topographic variability when examined closely.

This information certainly reinforces the winter planting of steep, south-facing slopes, (where access is possible) because at later dates the seedling may encounter an early "radiation summer" prior to becoming well-enough established to withstand stress. This figure certainly doesn't advocate waiting for the early spring radiation peak to pass before planting. Other site resources become limiting as the temperatures warm and soils dry out.

Recognition of the late summer maximum also pertains to site modification strategies, such as mulches and shadecards, since a solar maximum late in the year may pose a greater threat to seedling welfare than the early maximum. This is because reductions in soil moisture and heat capacity have occurred by that time.

The relationships used in developing the figure are not limited to the slopes chosen and have been programmed for HP 41C calculator execution. Interested readers should send a self-addressed stamped envelope and a blank HP magnetic card to the following address if they wish to receive the program. H. R. Holbo, Forest Research Laboratory, Oregon State University, Corvallis, Oregon 97331.

H. R. Holbo, OSU, Forest Engineering

BRUSHFIELD CONVERSION ON STEEP SLOPES

Approximately 193,000 acres (± 30 percent) of brushfields are found on slopes in excess of 35 percent in southwest Oregon. An earlier FIR REPORT article (3(4):4) reported on the initial phases of a brushfield conversion techniques study being conducted by Hank Froehlich and Daryl Steffan, Department of Forest Engineering, School of Forestry, Oregon State University. They have been exploring options for reclaiming brushfields when chemical, prescribed fire, or hand conversion methods are infeasible and steep slopes preclude the use of ground-based vehicles. The following results were presented in Daryl's Master of Forestry paper, Mechanical Brush Control on Steep Slopes in Southwest Oregon.

Sampled brushfields ranged in height up to 20 feet with stem diameters ranging from 0.25 to 4.0 inches at one foot above ground. Larger stem material was encountered occasionally, sometimes as conifers. The most common brush species found were manzanita, ceanothus, and chinkapin.

A review of pertinent literature enabled Daryl to determine that successful brushfield conversion treatments should provide physical access for planting crews, be usable on steep slopes, minimize soil impacts, treat the resulting slash, be compatible with the existing timber harvest road spacing, have an acceptable operating cost, and provide a suitable microsite for seedling survival and growth. New devices, or modifications of existing devices, should have low development costs and high development feasibility. Thirteen brush treatment techniques were evaluated according to these criteria using a combination of field trial data and theoretical design information. Two modifications of existing tools were selected as the best devices for treating brush on steep slopes: a modified Fallon's Tool and a modified Pepiot's Rake.

The Fallon's Tool is composed of two concrete-filled steel cylinders, beveled on one side on both ends and welded together side by side with the bevels outward. Overall dimensions are 60 inches by 60 inches. The tool, which weighs approximately 5,000 pounds, is yarded along the ground by a highlead yarder with a crawler tractor used as a mobile tailhold. The tool has successfully treated salmonberry, chokecherry, vine maple, ceanothus, and alder up to four inches dbh and is also suitable for treating small diameter logging residue. As designed, the tool can successfully treat brush and expose mineral soil on approximately five acres/day at a cost of $450/acre. Suggested modifications include adding root-grubbing teeth and a vertical slash rake and rigging the tool in a running skyline configuration.

The Pepiot's Rake is a 2,500 pound tractor brush rake modified for cable operation. The rake has been used to treat logging slash, canyon live oak, vine maple, and dogwood. Stumps and residual trees were observed to decrease production significantly. In one test operation, the brush root system was disturbed and mineral soil was exposed on 0.8 acres per day at a cost of $1,050/acre. The developer felt that increasing the rake's weight and strength and using a yarder with power matched to the conditions would increase production and reduce operating costs.

D. L.

NEEDLE TEMPERATURES OF OUTPLANTED DOUGLAS-FIR SEEDLINGS

One of the goals of the Reforestation Microclimate Project is to assess the thermal energy budget of outplanted Douglas-fir seedlings. The energy budget provides a framework for evaluating the effectiveness of techniques used by silviculturists to change the microclimate in an attempt to enhance seedling survival and growth. The needle-air temperature difference is a measure of the degree to which a needle is in thermal equilibrium with its surroundings. This difference varies with changes in energy inputs from the sun and from the soil surface, and with changes in how this energy is dissipated by the plant (Figure 1).

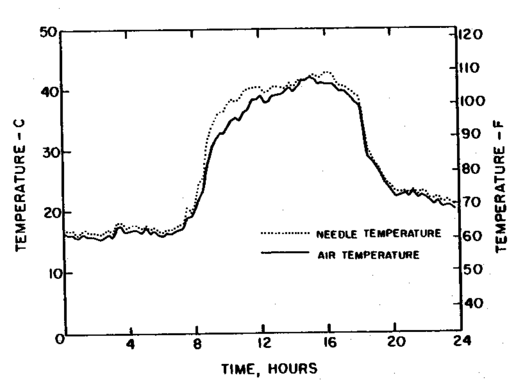

Figure 1. Needle (......) and air (——) temperature for seedlings at Oregon Caves site on August 7, 1981.

Studies performed elsewhere have reported conifer needle temperatures ranging up to 15°C above air temperature. Should this be the situation in regions like southwestern Oregon, where summertime air temperature can exceed 40°C, the needle temperatures could exceed the limits for survival. In a previous FIR REPORT (4(1):5-6), we reported that soil temperatures during the 1981 heat wave event, when surface temperatures often exceeded 65°C, were high enough to be lethal to root tissue. Figure 1 is representative of our needle and air temperature data for the same period for seedlings during the first growing season after planting. It reveals needle-air temperature differences of no more than 4°C (7°F), far below 15°C. This demonstrates that the needles are effectively coupled to the air, which provides a mechanism for dissipating the heat load of the environment, and prevents higher needle temperatures from occurring.

While this finding alleviates some concerns about heat damage to the shoots, the data are being analyzed more completely to evaluate the effects of these elevated needle temperatures on transpiration and moisture stress.

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H. Richard Holbo, OSU, Forest Engineering
Stuart W. Childs, OSU, Soil Science
Edward L. Miller, OSU, Forest Engineering

REFORESTATION SYSTEMS STUDY IS UNDERWAY

In a large-scale cooperative venture between Fundamental and Adaptive FIR and the BLM, a study of reforestation systems has been started for Douglas-fir in the Siskiyou Mountains. The general objective is to identify the best combination of regeneration methods for sites considered difficult to reforest. All of the study sites are planned to be on lands withdrawn from the BLM allowable cut base or lands of very similar nature.

The plan calls for creating four side-by-side clearcut vs. shelterwood comparisons in each of three consecutive years. The first set, on the Galice Resource Area, is being harvested as this is written. Half of each type of harvest cut will be burned for site preparation, and half will be left as is normal after a clean-logging operation. Four planting blocks will be installed in each of the site preparation units. The planting blocks will contain shaded and unshaded seedlings of four different stock types--2-0's grown at 25-30 per square foot in the nursery, 2-0's grown at 15 per square foot, plugs, and plug-1's.

Performance of the planting stock is the response of greatest interest, and it will be followed closely for at least 10 years. In addition, the response to treatment and subsequent development of all of the vegetation will be monitored regularly. A pre-harvest survey of vegetation was made on the first set of study sites this past March.

Not only will the study provide much needed reforestation data for development of management guidelines, but the sites will become excellent demonstration areas for prompt technology transfer to managers. Furthermore, the sites are available for other scientists to superimpose additional studies--especially of an observational nature. Anyone wanting more information about the study should contact Pete Owston, USDA Forest Service, 3200 Jefferson Way, Corvallis, Oregon 97331 or Steve Hobbs at the Medford FIR Office.

Pete Owston
PNW Station, Corvallis

COST AND EFFECTIVENESS OF SKIDDING TREE TOPS USING DESIGNATED SKID TRAILS - CONTINUED

The logging production portion of an Adaptive FIR study on the effects of unmerchantable tree top skidding on logging production, residual stand damage, and site fuel loading (FIR REPORT 3(3):2) has been completed. The timber sale purchaser was granted a contract extension before all of the merchantable volume was removed from the study area; therefore, the effects of top removal on residual stand damage and fuel loading cannot be evaluated at this time. Enough timber was removed, however, to evaluate the effects of top removal on logging production.

Designated skid trails were located by the Forest Service before the timber sale was final. Because the terrain was nearly flat, parallel skid trails with an average spacing of 140 feet were used. The designated skid trails were used to separate the treatment (required removal of unmerchantable tree tops remaining attached to the top merchantable log after falling) and the control (unmerchantable tops may be bucked off and left in the woods). At the logger's discretion, attached tops from the control area could be removed. Tops removed from the harvest unit were piled at a single central landing.

A 10 percent cruise, by area, conducted before logging began indicated no significant differences in estimated total stand volume, volume to be removed, or average tree diameter between the treatment and the control area (P = .05). Therefore, differences in skidding productivity cannot be attributed to differences in stand characteristics.

Skidding cycle time, number of tops skidded, merchantable volume skidded, and delays were recorded for each turn of logs. Because delays were recorded by categories, an effective hour which includes top disposal-related delays but excludes all other delays could be established.

Skid trails were constructed prior to falling the timber adjacent to the trail. Typically, larger trees were felled and skidded before the smaller trees were felled. Directional falling towards the skid trails was accomplished with a minimum amount of breakage and without the use of jacks. A single Caterpillar Tractor Model 518 rubber-tired skidder equipped with a blade, winch, and integral arch was used to skid logs. Five chokers with sliders were attached to the winch line.

On the landing either the logging foreman or the loader operator acted as a landing sawyer, removing limb stubs and attached tops from the logs. Because the limb stubs and attached tops were removed immediately after the skidder departed the landing for another turn, the skidder was not delayed as a result of these activities. The removed tops were allowed to lay in the landing until the skidder approached with the subsequent turn. As the skidder again approached the landing, the skidder operator would lower the blade slightly, and push the previous turn's tops towards the burn pile without significantly reducing speed. After unchokering the turn, the skidder would continue to push the tops into the burn site following the normal turning exit route from the landing. No observable delay was recorded when tops were pushed into the burn pile in this manner. Top-related delays were recorded whenever the skidding operation was interrupted to condense the burn pile or because the previous turn's tops could not be easily pushed toward the burn pile.

As shown in Table 1, no significant differences in skidding production were measured between the treatment and the control units. Mean time required per turn of logs, amount of wood skidded per turn, and amount of wood skidded per effective hour (including only top-related delays) were statistically equal (P = .05).

Table 1. Logging production summary, including only top disposal-related delays.

Production component	Treatment (n=57)	Control (n=68)
Time/turn (dec. hours)	0.187 (.058)	0.170 (.056)
MBF/turn (net vol.)	0.759 (.205)	0.679 (.253)
MBF/hour (net vol.)	4.059 (1.669)	3.994 (1.986)

( ) standard deviation

The only observable difference between the treatment and the control was that an average of 2.05 tree tops per turn were skidded from the treatment units as compared with an average of 0.98 tops per turn from the control units.

The skidder operator left the designated skid trails frequently. During an observation peroid of 54 turns, the skidder left the designated skid trails 63 percent of the time. The average estimated distance driven off the trail was 21 feet with one observation of 75 feet (Figure 1).

The impact of leaving the trails on the top-skidding versus top-leaving production comparison is probably minimal. The operator left the designated skid trail 67 percent of the time while skidding the top-skidding units and 58 percent of the time while operating in top-leaving units.

The turns during which the operator lift the designated skid trail probably don't truly represent "logger's choice" or unplanned skidding. However, a comparison of time required per turn when the logger stayed on the trail versus when he left the trail should provide some measure of the effort required to pull winch line out to the logs from the trail or to position the skidder beside the logs to be skidded for turns in which the skidder left the trail. In this case, however, the average time required per turn of logs was identical (0.179 hours) for "in trail" and "off trail" turns.

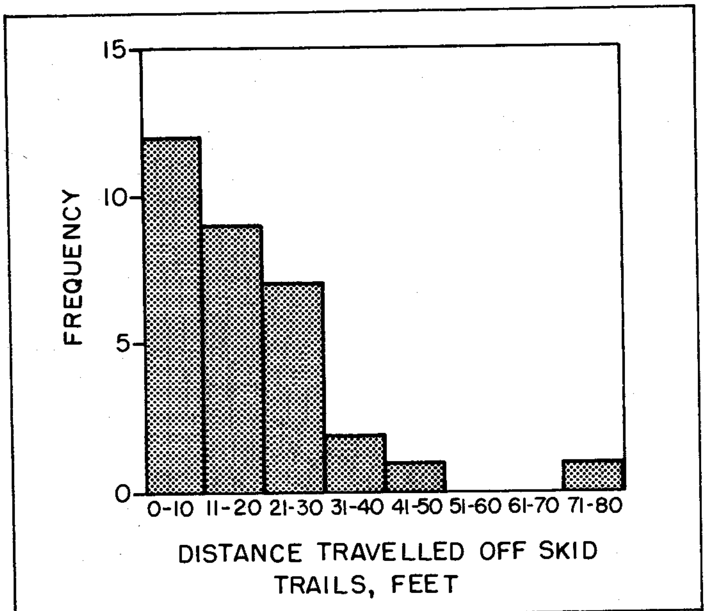


Figure 1. Distribution of distances traveled off designated skid trails to choker logs.

We feel two conclusions may be drawn from this study conducted in a commercial thinning-salvage timber sale where some departure from the designated skid trails was observed.

1. Logging productivity was not reduced as a result of skidding attached unmerchantable tree tops to the landing.

2. Pulling winch line out to logs from a designated skid trail resulted in the same skidding time per turn as driving directly to logs for chokering.

The effect of tree top removal on residual stand damage and fuel loading will be reported after logging is completed.

D. L. and S. T.

PROTECTING SEEDLINGS FROM RAVEL

Ravel protection for seedlings planted on steep slopes is being evaluated in a new Adaptive FIR study. Before the study began, several seedling protection devices were tested in a gravel pit to determine which were most effective at deflecting ravel away from an imaginary seedling. Most devices caught material rather than deflect it to one side.

Four whole-plot treatments included a control of unprotected seedlings, both 1 x 2 x 18 inch and 1 x 4 x 18 inch stakes driven into the soil directly upslope of seedlings, and shingle wedges located above the seedling and pointed upslope. Benching, using an 8-inch level bench excavated into the hillside behind the planted seedling, will be evaluated also. The experimental design will be a 4 x 4 Latin square with benching as a split plot treatment. Because benching may potentially change the seedling's microenvironment, it cannot be evaluated as equivalent to the other treatments.

The study site is a steep, previously unstocked clearcut, covered with varying depths of surface gravel, in the Glendale Resource Area of the Medford District BLM (T.31S., R.8W., Sec. 19). After site preparation with herbicides, 2-0 bareroot Douglas-fir seedlings were planted on the site in mid-March.

Survival will be recorded during the summer, fall, and spring of the next two years and again after five years. Mortality specifically attributed to ravel will be identified. Seedling growth will be measured at the end of the second and fifth summers. Ravel collection boxes have been installed near the plots to measure the amount of material moving on the slope. Contents will be removed and weighed quarterly.

D. M.

BRUSH RECOVERY TWO YEARS AFTER HAND SLASHING

In 1980, Adaptive FIR and the Medford District of the BLM initiated a cooperative study to evaluate site and vegetation response to various levels of brush removal with chainsaws. The experimental design and the results of soil moisture and plant moisture stress measurements have been reported in two previous issues of the FIR REPORT (2(2):2, 3(3):2-3). Data on brush resprout development in the total brush removal treatment have been compiled recently and show some surprising results.

Canyon live oak (Quercus chrysolepis) and greenleaf manzanita (Arctostaphylos patula) are the dominant brush species with silk tassel (Garrya fremontii) and Pacific madrone (Arbutus menziesii) occurring as minor associates. After two years, canyon live oak had produced the greatest number of resprouts despite the fact that prior to treatment there were more greenleaf manzanita stems per acre (Table 1).

Table 1. Number of stems per acre by brush species.

Species	Density (No. stems per acre) Pretreatment	1st year	2nd year
Canyon live oak	19,500	223,800	236,300
Greenleaf manzanita	35,500	124,850	112,700
Pacific madrone	900	3,150	4,050
Silk tassel	600	1,600	2,450
Total	56,500	353,400	355,500

During the second year following treatment, there was a small decline in the number of greenleaf manzanita resprouts. I was unable to identify any obvious disease or insect problems and am assuming that the reduction is density dependent. Resprouts of all other species have continued to increase in number over the two-year period.

Although the number of greenleaf manzanita resprouts declined during the second year, resprout basal area actually exceeded the pretreatment level (Table 2). This suggests that prior to slashing, the greenleaf manzanita was severely suppressed. Silk tassel responded in a similar manner. Canyon live oak basal area production was particularly impressive with

Table 2. Basal area per acre by brush species.

Species	Basal area (ft² per acre) Pretreatment	1st year	2nd year
Canyon live oak	98.76	10.52	26.92
Greenleaf manzanita	7.47	6.10	8.22
Pacific madrone	2.51	0.63	2.14
Silk tassel	0.10	0.23	0.31
Total	108.84	17.48	37.59

more than 27 percent of its original basal area regained in just two years in the form of resprout stems.

Changes in foliar coverage showed trends comparable with basal area except for silk tassel, which was periodically browsed by deer (Table 3). After two years canyon live oak had recovered 31 percent of its original coverage while greenleaf manzanita regained 61 percent.

Table 3. Foliar coverage (percent) by brush species.

Species	Coverage (percent)[1] Pretreatment	1st year	2nd year
Canyon live oak	68.38	15.25	21.13
Greenleaf manzanita	21.25	10.75	12.88
Pacific madrone	4.00	0.75	1.88
Silk tassel	7.50	0.25	0.25

[1]Based on individual species coverage because of multiple canopy strata rather than percentage of total cover.

If basal area is considered a measure of dominance, prolific resprouting has recovered 34 percent of the original basal area in just two years when it took approximately 35 years to attain the pretreatment level. This represents a substantial recovery rate and emphasizes the fact that the mechanical treatment of sclerophylls, where the roots and root crown are left intact, may increase brush problems in the long-run. Any site preparation or release benefit to be gained from slashing would probably be of very short duration in environments similar to the one in this study.

S. H.

HARDWOOD UNDERPLANTING STUDY - AN UPDATE

This project is designed to address the feasibility of converting hardwood stands composed of tanoak, chinkapin, and madrone to conifers by herbicide injection followed by underplanting. Hardwoods in three replications, located in the Galice Resource Area, were injected with Garlon 3A during the first week of September 1981. The treatment and control areas were planted this spring to 2-0 bareroot and 1-0 10-cubic-inch container Douglas-fir seedlings. Predawn plant moisture stress will be measured through the summer.

Eight months after injection, leaves in the tree tops have generally turned brown. Leaves lower in the canopy are, however, still green. Of the hardwood species, tanoak leaves do not appear as affected as madrone nor is there as much necrosis around the injection points as with madrone.

O. H.

Continuing Education

NORTHWEST FOREST SOILS COUNCIL

July 19-22, 1982. Northwest Forest Soils Council will hold their summer meeting and field trip in southwest Oregon. An evening meeting on the 19th, followed by two days of field trips in the Western Siskiyou Mountains and Western and High Cascades is planned. An optional third day trip to northern California is possible. Preregistration is required. Fee is $5. CONTACT: Dave McNabb, FIR.

ECOSYSTEM CONCEPTS FOR FOREST MANAGEMENT

July 19-23, 1982. Oregon State University. H. J. Andrews Experimental Forest, Blue River. Program will emphasize stream ecology. Other topics will include management of old-growth forests and nutrient cycling in forest ecosystems. Field oriented. Enrollment is limited to 40. CONTACT: Conference Assistant, School of Forestry, Oregon State University, Corvallis, OR 97331, (503) 754-2004.

CALIFORNIA FOREST SOILS COUNCIL

July 30-31, 1982. California Forest Soils Council, Ft. Bragg and Ukiah, California. Two-day trip to observe soil forming and erosional processes in the northern Coast Range. Preregistration required. Transportation fee is $10. CONTACT: Gary Nakamura, (916) 365-7631.

WESTERN FOREST GENETICS ASSOCIATION

August 3-5, 1982. Oregon State University, Corvallis. 1982 annual meeting. Program offers variety of field trip opportunities and technical sessions. Technical session titles include: Advances in Genetics, Advances in Forest Genetics and Tree Breeding, and Genetic Architecture of Western Tree Species. CONTACT: Conference Assistant, School of Forestry, Oregon State University, Corvallis, OR 97331, (503) 754-2004.

IUFRO SYMPOSIUM ON FOREST SITE AND CONTINUOUS PRODUCTIVITY

August 22-26, 1982. University of Washington, Seattle, Washington. Cosponsored by Forest Service PNW and PSW Experiment Stations, Northwest Forest Soils Council, University of Washington, and Weyerhaeuser

Company. This international program will cover all aspects of forest site, including factors which determine site, maintenance of site quality, role of fertilizers, effect of operations and management on site, and research needs. CONTACT: Dr. Stanley P. Gessel, College of Forest Resources, AR-10, University of Washington, Seattle, WA 98195, (206) 545-1931.

PRESCRIBED FIRE WORKSHOP

September 8-9, 1982. Adaptive FIR, Josephine County Fairgrounds, Grants Pass, Oregon. This two-day workshop will address factors affecting the use of prescribed fire in southwest Oregon, including its effect on hazard reduction, reforestation, vegetation, smoke management, and soils. Enrollment is limited. Fee is $25. CONTACT: Elaine Morse, Adaptive FIR.

HOW TO PLAN A STATISTICALLY SOUND EXPERIMENT

October 13-15, 1982. Oregon State University, Corvallis. Designed for foresters faced with planning field experiments. Emphasis will be placed on application of statistical methodology to practical problems. Topics include review of basic statistics, experimental design, analysis of data, and interpretation of results. CONTACT: Conference Assistant, School of Forestry, Oregon State University, Corvallis, OR 97331, (503) 754-2004.

BAREROOT NURSERY TECHNOLOGY

October 26-28, 1982. Oregon State University, Corvallis. Program will address forest tree nursery development, seedling growth as related to soil-water-plant management, harvesting and planting the bareroot seedling, operational planning, computerized record keeping systems, quality control and research needs. CONTACT: Conference Assistant, School of Forestry, Oregon State University, Corvallis, OR 97331, (503) 754-2004.

SOUTHWEST OREGON FOREST WEED ECOLOGY

November 9, 1982. Adaptive FIR, Best Western Riverside Conference Center, Grants Pass, Oregon. This one-day workshop will cover the operational environment, the competitive ecology of grass and woody shrubs, the prediction and assessment of weed competition, and control measures. This workshop is designed to provide a fundamental understanding of southwest Oregon forest weeds. Fee is $10. Limited enrollment. CONTACT: Elaine Morse, Adaptive FIR.

YOUNG STAND MANAGEMENT IN SOUTHWEST OREGON

June 14-16, 1983. Adaptive FIR, Holiday Inn, Medford, Oregon. Program is in the preliminary planning stages. Topics will address management practices which affect young stand growth, as well as how young stand management decisions may affect future management alternatives. CONTACT: Steve Tesch, Adaptive FIR.

Of Interest

A DARN NICE OVERSTORY REMOVAL

Ivend Holen, silviculturist for the South Jacksonville Resource Area, Medford District BLM, recently shared with me a BLM summary of seedling survival results following an overstory removal near Medford. The results are particularly significant because the planted seedlings had only been in the ground one season and were still small (10-15 inches tall). The unit provided an important test of the hypothesis that very small seedlings survive poorly during yarding as they are not well-rooted and could easily be displaced from the soil.

The unit was located on a 60 percent southwest-facing slope. Partial cutting was completed in 1980 using skyline yarding; the area was then broadcast burned and planted in April 1981. Grass invaded the site during the summer and contributed to heavy seedling mortality by fall. Grass and weed control was prescribed for March 1982, and an overstory removal was scheduled to accommodate aerial spraying.

The sale area contained 65-70 square feet of basal area per acre of merchantable trees with stems averaging 20 inches dbh. An average of 32 trees per acre were removed, with an average volume of 8.4 Mbf per acre.

Timber was felled parallel to the contours. After falling no seedling mortality was observed, but numerous seedlings were bent over and pinned beneath fallen logs. Eleven yarding corridors were predesignated and flagged jointly by the BLM and the logger, with the goal of providing good deflection. A GT-3 running skyline yarder with 75 feet of lateral yarding capability was used to yard the area. One-end suspension was required, with two or three logs constituting a typical turn. After yarding, BLM surveys reported no direct mortality, but the fate of 14 out of 378 trees per acre was uncertain.

In comparison with some past results of overstory removal, the 96 percent seedling survival observed here is nothing short of fantastic! There are some good reasons for the success, however. Overstory removal recommendations resulting from the Adaptive FIR overstory removal study (FIR REPORT 4(1):2-4) suggested directional falling, minimizing lateral slope yarding, and minimizing converging corridors.

In this case, directional falling was used to keep logs from sliding downhill. Contour-felled logs stayed in place. The predesignated yarding corridors minimized steep lateral slope yarding. Most corridors ran directly across the contours at right angles, creating a very flat lateral slope which resulted in skyline corridors less than 4 feet wide. The ground was definitely disturbed within the corridors, but surviving seedlings were observed immediately adjacent to the disturbed area. Surviving seedlings on opposite sides of a corridor could easily be within 10 feet of one another, certainly well within the range of a reasonable managed stand spacing. The number of converging corridors at any one yarder setting was also minimized, preventing areas of concentrated impacts directly below landings.

As for seedling size, it is encouraging to see that the small, not well established seedlings survived well. Small seedlings are definitely flexible; in this sale, many had logs roll over them without damage. I think the key here is that the logging methods used minimized gouging of the soil. One-end suspension of logs and minimum lateral slope yarding reduced the area of the unit impacted by gouging. This enabled small seedlings to avoid being dislodged from the soil or severed at the ground surface.

I'm sure Ivend and his colleagues in the Jacksonville Resource Area would be happy to provide more details if you're interested. This is certainly a noteworthy success story!

S. T.

ASSESSING REGENERATION COSTS

Early plantation costs and performance are often evaluated solely in terms of percent seedling survival. Costs of establishment would, of course, be better compared against the value of timber that would come from the site. However, if the long-term productivity of a site is unknown, establishment costs can also be measured against the survival and early growth of the plantation.

A recent publication, (Ball, W. J. 1980. Plantation performance in perspective. Forest Management Note No. 4. Northern Forest Research Center, Edmonton, Alberta) describes a seemingly simple and effective means of evaluating early plantation success. This note describes an evaluation method, with an accompanying calculator program, which divides the summed present net worths of costs derived from the initial regeneration survey, site preparation, planting stock, planting, and survival appraisal by a performance index called aggregate height. Aggregate height is simply the product of percent survival multiplied by average plantation height. Because the first five years are regarded as critical in plantation establishment, Ball uses height and survival to compute aggregate height.

This method has a deficiency which may, however, limit its applicability. Aggregate height may not provide a good basis for comparing sites that require different stocking levels. For example, a site that is planted to fewer trees may have the greater cost per unit of aggregate height, when in reality its initial reforestation costs may be lower if seedling survival meets stocking goals.

Nor does the concept of cost per unit aggregate height consider future costs of deviation from ideal stocking levels, costs which may come from fill-in planting, or extra precommercial thinning as does a technique developed by the British Columbia Ministry of Forests (B.C. Research). Sites may have similar survival rates and average seedling heights, but different stocking goals. Sites that are closest to their optimal levels should incur the lesser costs.

For outplanting sites that have very similar stocking and management goals, prorating establishment costs against aggregate height does, however, appear to be a potentially useful means of comparing cost effectiveness of stand establishment cost components (survey, site preparation, planting, weed control, etc.) that may bear on plantation success. Because the cost variables tend to be confounded with each other, the cost information should, however, be weighed carefully.

O. H.

LINE TENSIONS IN SERIES MULTIPLE STUMP ANCHORS

As the old-growth forests are harvested, increased emphasis is being placed on the use of small stumps in multiple stump anchors for cable logging. One method of rigging a multiple stump anchor is to wrap the tensioned line once around a notched stump and then pass the line to a second stump in line with the direction of pull. The line is secured to the second stump. This method of rigging is called a series multiple stump anchor. A rule-of-thumb states that the loaded line will transmit one-third of the loaded tension to the second stump in the series; the first stump will absorb two-thirds of the line tension. Gail Kimbell recently explored line tensions in series multiple stump anchors in her Master of Forestry paper in Forest Engineering at Oregon State University. Her paper, Tension Relationships for Steel Cable on Notched Stumps, contains some important results.

Gail assumed that the cable wrapped around the first stump in a series multiple stump anchor behaves like a V-belt in a pulley. Therefore, the following equation relating the line tension before the first stump to the line tension between the stumps pertains:

$$\frac{T_1}{T_2} = e^{\frac{(\mu\ \alpha)}{(\sin\ \beta/2)}}$$

where: T_1 = tension in the loaded side of the cable, pounds

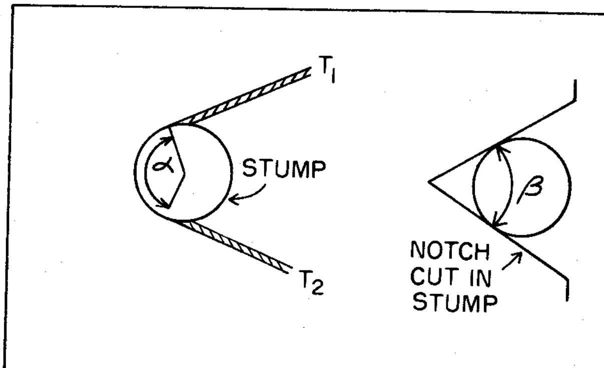
T_2 = tension in the cable between the stump and the cable

μ = coefficient of friction between the stump and the cable

α = angle of cable contact around the stump, radians

β = notch angle, degrees

The following diagrams clarify the nomenclature.



Gail measured T_1 and T_2 for 116 samples at two sites under the following conditions.

β degrees	α radians	inside notch stump diameter, inches
65	2π	22.2
73	2.0833π	37.5
70	2π	18.1
74	2π	15.7

As is the case with all research results, extrapolating the results beyond the range of variables used to derive the results is risky. Gail used two cable diameters, 7/16 and 3/4-inches. The cables were in good condition with no observed cracks or frays.

When using the V-belt equation to obtain estimates of line tension, variables α and β can be measured or assumed. The coefficient of friction, μ, has to be determined. Using multiple regression techniques, Gail obtained the following equation to estimate μ. All coefficients were significantly different from zero at the P = .01 level.

$$\mu = 0.00440 + 0.006768\ (DIAM) + 0.321073\ (CABL) - 0.007993\ (TENS) - 0.010465\ (DICA) + 0.000213\ (DITE)$$

$R^2 = .62 \qquad n = 116$

where: DIAM = inside notch stump diameter, inches
CABL = diameter of cable, inches
TENS = tension in loaded cable, T_1, pounds
DICA = (DIAM) x (CABL)
DITE = (DIAM) x (TENS)

Gail used only green Douglas-fir stumps for her first stump. One other researcher believes the coefficient of friction would increase approximately 20 percent if the stumps used had been dead and dry. The mean coefficient of friction value was 0.1768. Assuming one full wrap on the first stump and a notch angle of 60 degrees, the V-belt equation yields a ratio of loaded line tension to tie-back tension of approximately 9:1, much higher than the 3:1 rule-of-thumb ratio. This means the first stump must withstand almost all of the loaded line tension in a series multiple stump anchor configuration.

One method of dissipating the loaded line tension equally among more than one stump is through the use of an equalizer block. The loaded line ends in an equalizer block. A line is passed through the equalizer block and tied to two stumps. If the angle in the line between the stumps and the equalizer block is quite small, the two stumps will each share approximately half of the loaded line tension. Additional equalizer blocks may be used to further dissipate the loaded line tension.

D. L.

INJECTING FUMIGANTS INTO TREES AND STUMPS TO CONTROL ROOT ROTS

Oregon State University and Forest Service scientists have been successful in injecting fumigants into pressure-treated Douglas-fir transmission poles to prevent internal decay. Bob Graham, Mal Corden, and Walt Thies have controlled decay using Chloropicrin, Vapam, and Vorlex for eleven years.

A valuable spin-off of this research for southwest Oregon foresters may be the potential to use fumigants to control root rots in the forest. The current alternative of pulling infected stumps is operationally difficult and environmentally questionable.

These scientists have found fumigants applied to stumps of ponderosa pine and Douglas-fir trees reduced the inoculum potential of root-infecting fungi. Fumigants have also been applied internally to the heartwood of living Douglas-fir and alder trees with little adverse reaction after two years. Further studies are being conducted to develop simplified application techniques and to determine minimum effective dosages of fumigants that will reduce the impact of laminated rot (*Phellinus weirii*). If successful, operational techniques will be developed.

S. T.

VEXAR® TUBES DAMAGED BY SNOW

The unusually heavy snows over a wide range of elevations this past winter have crushed or flattened seedlings in many plantations where the seedlings were protected from browsing with Vexar® tubes. The prospect for quick recovery has probably been seriously reduced if immediate action to straighten or right these tubes was not initiated soon after the snow melted. Managers were advised of the need for tube maintenance earlier by letter. I now want to share my observations on the types of damage involved, its causes, and the probable fate of the damaged seedlings.

Snow damage to Vexar® tubes took two forms. The base of the tubes can be crushed producing an accordian shaped seedling inside, or the tube may be partially or completely bent over. In some cases, a combination of the two was observed. Tubes tended to be crushed on gentle slopes, or on steep slopes, near brush, cull logs, or stumps. Tubes were most likely to be flattened on steep slopes.

Crushing apparently results when snow rapidly accumulates around the top of the tube. As the snow settles, the more rigid top of the tube is driven downward, folding and collapsing the bottom around the seedling. On steep slopes, tubes are toppled as the snowpack creeps downslope or, if the tubes are near brush or other obstructions, they may first be crushed before the snowpack can begin to creep over adjacent obstacles. No site subject to heavy snow accumulation is immune to seedling damage where tubes are used.

Crushing of seedlings is probably the least serious form of damage. Mortality will be minimum and the subsequent stem deformation will become less apparent with age. Tubes with bent tops will affect leader growth and possibly result in a lateral becoming the new leader. Flattened tubes should cause the most mortality, particularly on southerly aspects where the foliage will be trapped near the hot, soil surface. If a flattened seedling survives, apical dominance should produce a new, vertical leader but the stem will be L-shaped.

Complete removal of tubes is not recommended, particularly flattened tubes, unless the tube is badly crushed. Tubes can be righted if done soon after snowmelt and, if supported, used to hold the seedling up. Fundamental FIR scientists do not believe that flattened Douglas-fir seedlings will straighten naturally if the tubes are removed. Tubes bent above the leader should be cut off below the bend to prevent further damage to the leader.

When planning to use rigid tubes for browse protection in the future, managers must plan to maintain the tubes, particularly after winters with heavy snowfall. Using larger stakes or pins may help, but I have seen 1 by 2 in. stakes flattened or broken as a result of snow creep. Annual maintenance is the only way to ensure that the protective devices do not become a cause of plantation failure.

D. M.

MULTISPAN PAYLOAD ANALYSIS TRICKS

All multispan computer programs involve an iterative juggling of unstretched line length and input loads to obtain a desired carriage clearance and skyline headspar tension. The process is iterative, tedious, and frustrating. The following two figures, which use terrain data from the Ft. Collins/HP-9830 multispan analysis handout, prepared by the FIR Harvesting Specialist, show two important relationships in multispan payload analysis.

Figure 1 shows that small increases in skyline length result in dramatic increases in net payload. The increased line length will also reduce headspar tension for a constant input load and will reduce carriage clearance. Unfortunately, no simple relationship ties line length with carriage clearance.

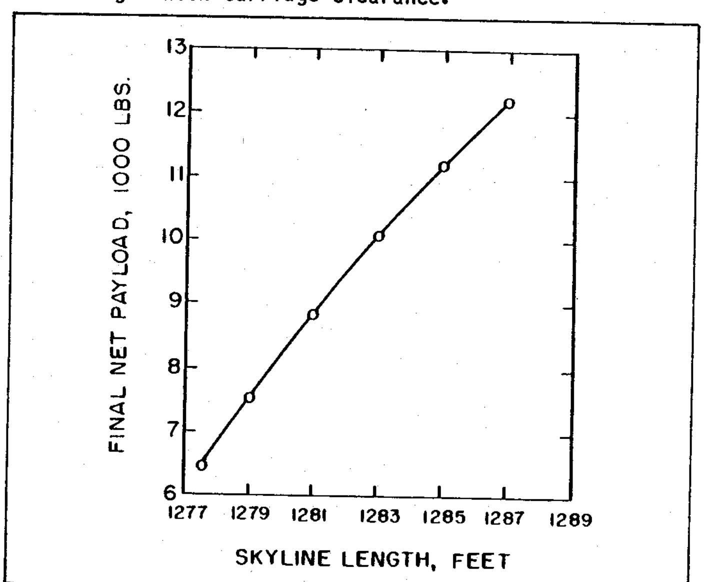


Figure 1. Final net payloads as a function of skyline length, headspar tension equals the safe working load.

Figure 2 shows that as the input load is increased, the maximum headspar tension increases. Carriage clearance will decrease as a result of increased skyline stretch. Figure 2 shows that the relationship between input load and maximum headspar tension is nearly linear, particularly over a narrow range of data.

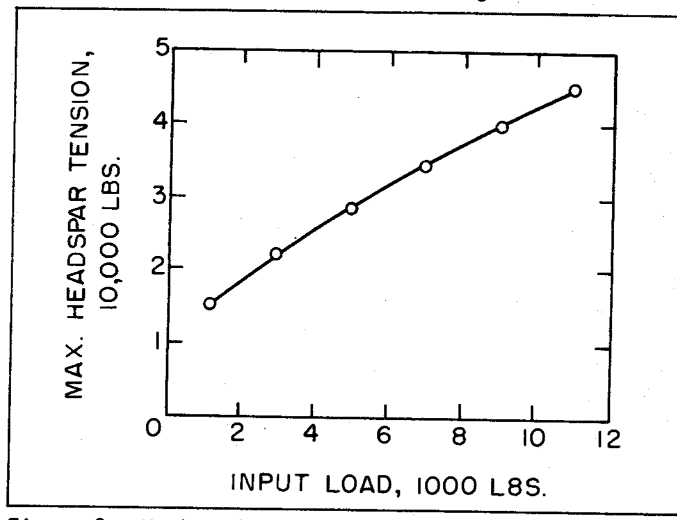


Figure 2. Maximum headspar tensions as a function of input loads, line length = 1277.5 ft.

For two sets of input load and maximum headspar tension data, a third input load may be linearly interpolated or extrapolated which will produce a maximum headspar tension very close to the safe working load of the skyline. The "linear" curve fitting programs for many handheld calculators will conveniently perform the interpolation or extrapolation.

D. L.

Recent Publications

For copies of the publications cited, mail your requests to the appropriate address as indicated by the number following each summary. Requests should be sent to:

(1) Publications
Pacific Northwest Forest and Range Experiment Station
809 NE 6th Avenue
Portland, OR 97232

(2) Publications
Forest Research Laboratory
Oregon State University
Corvallis, OR 97331

REGENERATION OUTLOOK ON BLM LANDS IN THE SOUTHERN OREGON CASCADES, by W. I. Stein. USDA Forest Service Research Paper PNW-284. 70 p. A recently published comprehensive evaluation of regeneration on BLM lands cutover during 1956-1970 in the southern Cascades shows that most partial cuts were moderately or well-stocked with natural regeneration. Clearcuts in the Butte Falls area were well-stocked, but many in the Dead Indian area were not. In partial cuts, regeneration established before logging made up about half the total stocking and dominated nearly half the stocked subplots. Many second-year seedlings were found in partial cuts, few in clearcuts; yet their potential for changing stocking levels was minor.

Naturally established true firs, Douglas-fir, and incense cedar were the dominant species in partial cuts. Artificially established ponderosa pine was dominant in clearcuts. In general, a mix of species was found per four-milacre subplot.

Stocking correlated significantly with an array of environmental variables. The associations differed for partial cuts and clearcuts, Butte Falls and Dead Indian areas, forest types, and for classes and species of regeneration. In both partial cuts and clearcuts, stocking generally increased as amount of woody perennials increased, and elevation increased. Regression equations describe present stocking patterns and others predict future stocking based on variables that can be observed or specified before harvest.

The author concluded that the Dead Indian area has more severe ecological conditions than the Butte Falls area and claimed reforestation there requires commensurately greater caution and attention. However, he stated clearcutting should not be ruled out completely in the southern Cascades. Used judiciously in conjunction with the best available planting technology, clearcutting should be appropriate in much of the Butte Falls area and for reestablishment of ponderosa pine and other frost-hardy species in the Dead Indian area. Prudent use of clearcutting requires better identification of locations or situations where chances for frost damage during the growing season are low. Where, how much, and how long to retain overstory are the foremost questions to answer for use of shelterwoods.

①

MACHINES AND TECHNIQUES FOR SKYLINE YARDING OF SMALLWOOD, by L. D. Kellogg. 1981. Research Bulletin 36. Forest Research Laboratory, School of Forestry, Oregon State University, Corvallis, OR. 15 p. This paper discusses skyline machines and techniques currently available for yarding smallwood. Three categories of machines are discussed: used yarders (with low initial cost) adaptable to smallwood; new and versatile U.S.-made yarders (with high initial cost); and foreign-built yarders (with low initial cost) specifically developed for smallwood. The author stresses the importance of factors such as prebunching and correct crew size in cost-effective use of alternatives.

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FIVE STEPS TO SUCCESSFUL REGENERATION PLANNING, by B. D. Cleary and B. R. Kelpsas. 1981. Special Publication 1. Forest Research Laboratory, School of Forestry, Oregon State University, Corvallis, OR. 31 p. This paper presents a method by which reforestation planning information is organized step by step and then used as the basis for alternative selection. Site information, harvest system constraints, seedling environment information, and site preparation are considered in developing a site-specific regeneration prescription.

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HERBICIDE AND CONIFER OPTIONS FOR REFORESTING UPPER SLOPES IN THE CASCADE RANGE, by E. J. Dimock II. 1981. USDA Forest Service Research Paper PNW-292. 14 p. Nine herbicides were compared for aiding establishment of western white pine, Englemann spruce, red fir, and noble fir on upper-slope forest sites dominated by sedge and beargrass. After three years greatest gains in conifer survival were associated with glyphosate sprays. Over three replications survival of white pine ranged from 30 to 80 percent with glyphosate treatment as compared with a range of 4 to 40 percent for untreated plots. Differences with treatment were similar for the other species. According to the author, similar survival increases were also consistently achieved with atrazine + dalapon mixtures. Preplanting sprays of glyphosate and atrazine + dalapon proved generally, but not always, superior to post planting sprays.

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YIELD TABLES FOR MANAGED STANDS OF COAST DOUGLAS-FIR, by R. O. Curtis, G. W. Clendenen, D. L. Reukema, and D. J. DeMars. 1982. USDA Forest Service General Technical Report PNW-135. 182 p. Yield tables generated by the stand simulation program DFSIM (Douglas-Fir SIMulator) are presented for a number of possible management regimes. These include a "normal" yield table, tables for stands planted or precommercially thinned to 300 and 400 trees per acre; tables for commercially thinned stands with and without prior commercial thinning; and tables showing the effect of nitrogen fertilization. While guides are presented for the number of trees to be planted or left after precommerical thinning, one must remember most recommendations cannot be applied directly to southwest Oregon stands. It is interesting, however, to study the tables and observe how various management regimes affect stand and individual tree characteristics over time.

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