

FIR Report



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"FIR REPORT" is a quarterly newsletter 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 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 Medford address.

The Southwest Oregon Forestry Intensified Research Program (FIR) is a joint effort between the School of Forestry at Oregon State University and the Pacific Northwest Forest and Range Experiment Station of the U.S.D.A. Forest Service. It is 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 research projects specifically tailored to meet regional needs.

Established in October, 1978, the FIR Program is supported by Oregon State University, the Bureau of Land Management, U.S.D.A. 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

U
Ole T. Helgersen
Silviculture Specialist

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FORESTRY INTENSIFIED RESEARCH

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Current Research

Fundamental FIR

WIND PATTERNS IN A CLEARCUT AND AN ADJACENT SHELTERWOOD STAND

Foresters have long argued the effects that clearcut and shelterwood harvesting have on the climate near the ground. In addition to providing a radiation barrier for shade or frost protection, shelterwood harvesting has been felt to also have an effect on patterns of air flow. Because air movement has a strong effect on the temperature and water relations of conifer seedlings, this study was designed to look for differences in air flow patterns between shelterwood and clearcut areas to help develop greater insight into causes of seedling mortality.

The study was conducted in a south-facing clearcut (7 ha) and a shelterwood stand (12 ha) which adjoined on contour. The paired sites were inclined at slopes of 27 to 36 percent, and were located midway between the ridgetop and canyon bottom. Windspeed was measured at 1.5 m above the ground in the center of each site, and its average recorded every 30 minutes.

The shelterwood held Douglas-fir and grand fir which averaged 48 m in height, with a basal area of 24 m²/ha (105 ft²/ac)--about one-third of the original stand density. The shelterwood had only scattered

thistles in the understory and was bounded on its other side by another clearcut unit. The clearcut study unit contained sparsely scattered five to ten year old seedlings, a result of previously unsuccessful reforestation efforts.

The windspeed data revealed that the clearcut and shelterwood stands differed in wind velocity and frequency of change as indicated by autocorrelation analysis. Nighttime air flows, probably caused by downslope air drainage, were common in the clearcut but did not appear in the shelterwood data. Instead, air flow in the shelterwood appeared to change over longer time periods, i.e., at a lower frequency. Surprisingly, daytime maximum windspeeds were always greater in the shelterwood, perhaps because the standing trees confined the incoming airflow into a smaller space.

The magnitude of variation in windspeed was also greater in the shelterwood stand to the extent that computed intensities of turbulence were consistently twice as large as in the clearcut. This implies that convective heat and moisture exchanges could be about four times greater in the shelterwood.

Dick Holbo
Forest Engineering, OSU

VARIATION IN SUNLIGHT UNDER SHELTERWOOD CANOPIES

Foresters and ecologists have often noted that while solar radiation reaching the forest floor is roughly related to stand basal area, the pattern of sunflecks and shadows, which determine a seedling's microclimate, can often be quite variable. Most models of solar radiation beneath a canopy follow Beer's law which can be good at predicting average conditions. Such a relationship between stand basal area and the mean daily transmission of solar radiation through three shelterwood canopies in southwest Oregon is shown in Figure 1. Unfortunately, this relationship does not describe the ecologically important variability in light intensity.

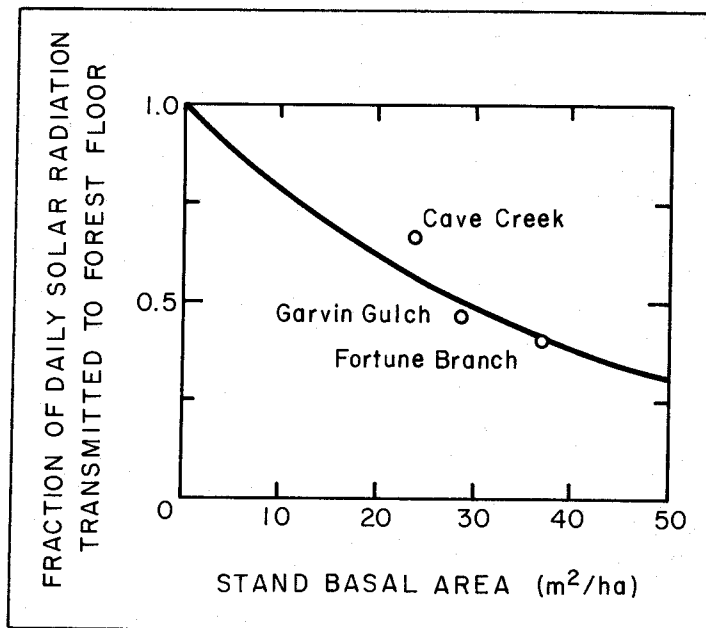


Figure 1. Transmitted solar radiation versus stand basal area for three shelterwood canopies.

The general problem of expressing this variability is seen in Figure 2. For these three canopies of different basal areas, we see that the range of sunlight at a point under each canopy is the same, varying from full sun to nearly full shade. Canopy density appears, however, to affect the duration and rapidity of change from full sun to full shade. How can this variability be described?

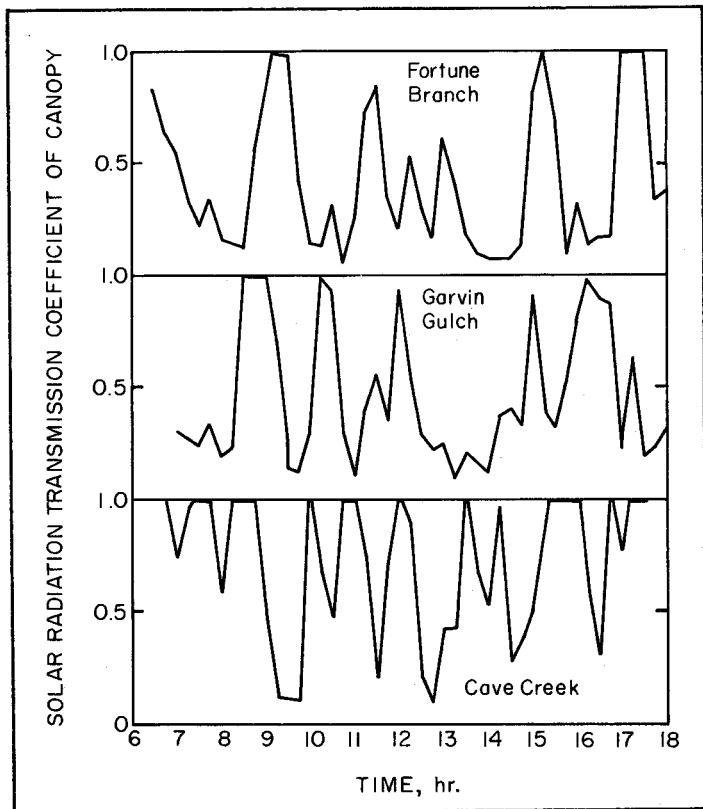


Figure 2. Daytime fluctuations of solar radiation under three shelterwood canopies.

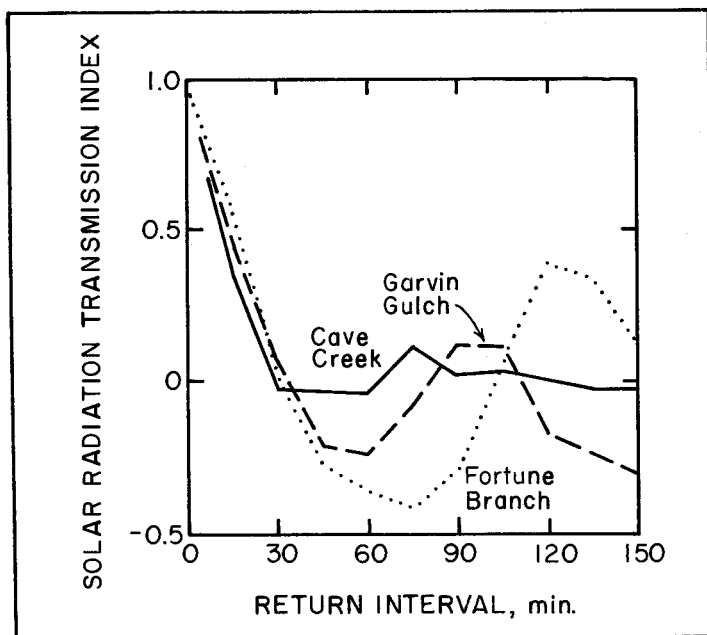


Figure 3. Return interval or periodicity of fluctuations of solar radiation beneath three shelterwood canopies.

One approach is to use a mathematical technique known as autocorrelation analysis. This method describes the variation in a variable over time by correlating pairs of values of the variable at increasingly greater time separations. This technique can describe the length of time or return interval for which a given level of the variable, in this case, relative light intensity, occurs.

The effect of these three different shelterwood canopies on the periodicity and duration of sunflecks is illustrated in Figure 3. The vertical axis in this figure is a normalized index based on the duration of light transmission. The zero level represents the average transmission coefficient from the plots in Figure 2. Note that the shelterwood stand with the greatest basal area (Fortune Branch) produces the lowest minima, indicating that relative to its mean, it has the longest lasting periods of shade. Thus, a seedling microsite under this shelterwood, in addition to receiving less solar energy on the average (Figure 1), would be exposed to shade for longer periods of time each day. The index in Figure 3 would be useful in seeing whether two stands with the same average levels of canopy cover and solar radiation have different periodicities of light and shadow. This may help explain why survival and seedling growth may differ between two otherwise similar shelterwood stands. Although the data in this study were collected electronically, it may also be possible to acquire suitable data photographically or by other means.

Dick Holbo
Forest Engineering, OSU

HORMONE RESEARCH AND DOUGLAS-FIR CONE PRODUCTION

Irregular production of cones in Douglas-fir often complicates the forester's job of reforesting cutover lands with seedlings from the proper seed source. Plant hormones have long been implicated in the physiological control mechanism which determines when cones are initiated. The gibberellins, a class of hormones associated with flowering in other plants, have been under investigation for several years, but the cytokinins, which are usually associated with cell division processes, have been largely ignored. With the development of new techniques which utilize immune reactions in laboratory animals to measure very small quantities of plant hormones, cytokinin levels can now be measured in shoots of Douglas-fir.

Recent measurements indicate that differences exist in the cytokinin contents of male, female, and vegetative shoots. These results suggest the cytokinins may play a role in inducing cones. Furthermore, cytokinin contents appear to differ between undifferentiated shoots which subsequently produce cones and those which produce only vegetative shoots. The precise identification of specific cytokinins is the subject of a current experiment. Preliminary results indicate that zeatin riboside (one of the cytokinins) is common in vegetative shoots but exists only in small quantities in shoots which later produce cones.

This research could lead to methods for increasing cone production or for predicting years when cone set will be low.

Joe Zaerr
Forest Science, OSU

2,4-D HERBICIDE DAMAGE DETECTED FROM GROUND BASED SPECTRAL MEASUREMENTS

Remote sensing is an effective and economical method for monitoring growth patterns of vegetation, diseases, plant mortality and insect infestation. This technique could also be very useful in monitoring herbicide effectiveness in forest vegetation management, particularly in remote areas. Few studies, however, have looked at changes in the spectral response of plants treated with herbicide. Such knowledge is necessary if remote sensing techniques are to be applied to forest vegetation management.

This study was initiated to assess the potential of ground-based spectral measurements, in the visible and near-infrared, to detect biological damage caused by the aerial application of 2,4-dichlorophenoxy acetic acid (2,4-D) herbicide for forest vegetation management. Three dominant southwestern Oregon brush species were studied in the field during the summer of 1981, four months after 2,4-D treatment. The plants' basic spectral characteristics, damage gradients, contrasts in reflectance data, and associations with seasonal plant moisture stress and individual canopy cover were investigated.

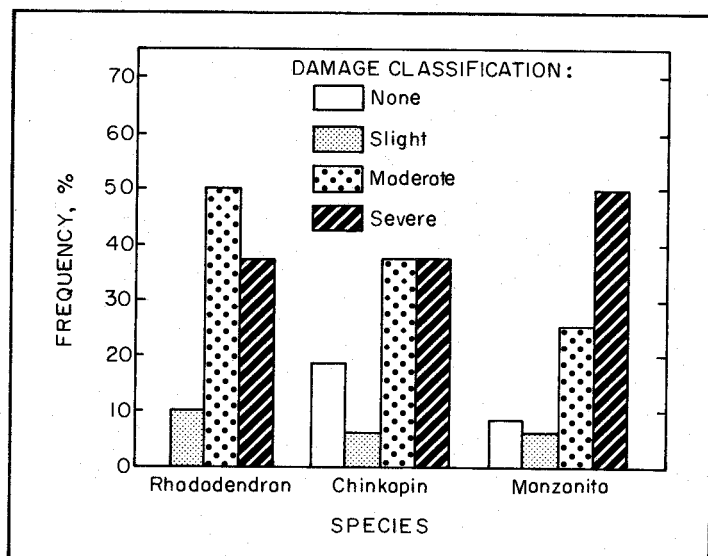
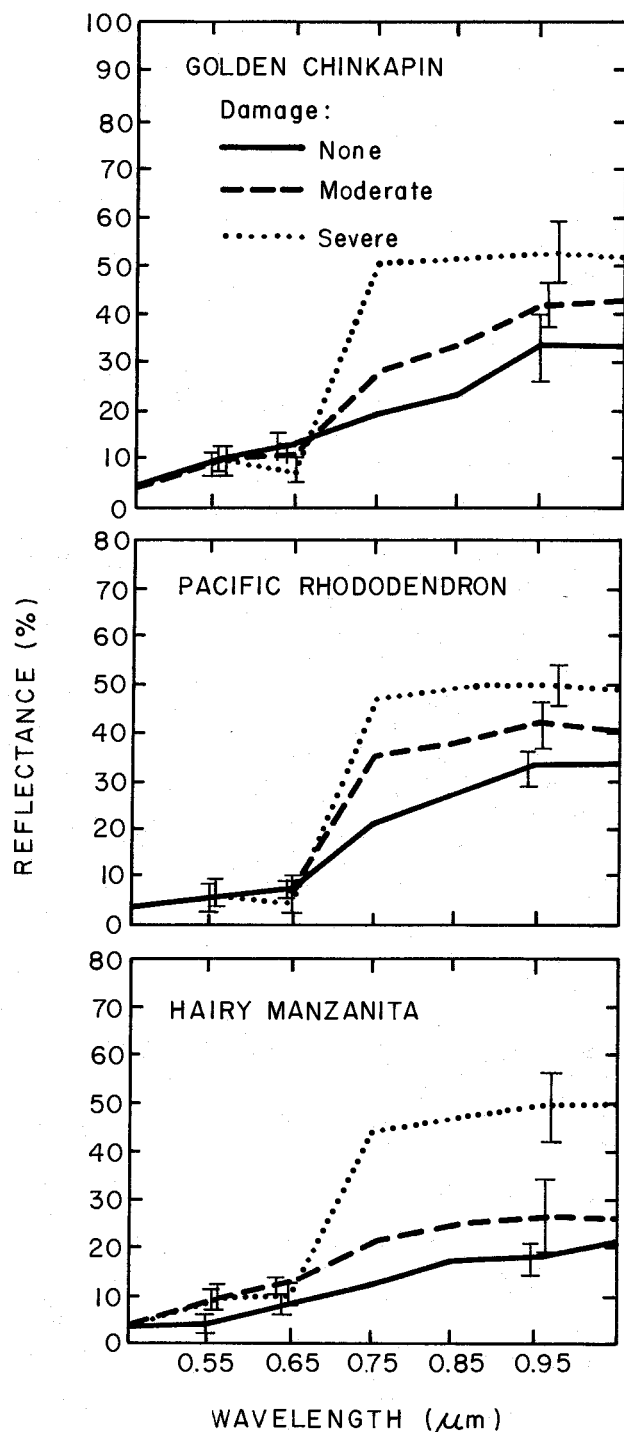


Figure 1. Observed brush damage by species four months after the aerial application of 2,4-D herbicide. Damage classification is based on the following criteria: (1) healthy plants with no evidence of herbicide damage; (2) slightly damaged plants showing some sign of deformed, or chlorotic and/or necrotic tissue, but less than 25 percent of the foliage so damaged; (3) moderately damaged plants exhibiting 25 to 75 percent foliage discoloration and some stem damage; (4) severely damaged plants with 75 to 100 percent foliage and stem kill.

Figure 2. Spectral reflectance curves, \pm standard deviation, contrasting golden chinkapin, Pacific rhododendron, and hairy manzanita by damage level four months after treatment with 2,4-D herbicide.

The study site was an approximately 10-year-old clearcut located in the Cow Creek reforestation unit (T32S, R10W, Sec. 2, Willamette Meridian) on the Siskiyou National Forest in southwestern Oregon. Portions of the area had been aerially sprayed with 2,4-D at 3.4 kg acid equivalent per hectare in May 1981. The treatment plots were situated on an east aspect with a 40 percent slope. Spectral reflectance of the foliage differed among species in the treated and untreated (control plots), with the largest contrast found in the near-infrared portion of the spectrum. Plants in the



unsprayed control area displayed typical reflectance curves associated with healthy vegetation, i.e., absorption in the blue and red wavebands and high reflectance in the near-infrared. Those in the sprayed plot displayed a slight change in the visible region, notably an increase in red reflectance. More obvious was a relatively large decrease in near-infrared reflectance, suggestive of changes in leaf cellular arrangement, cell wall/air interfaces, and leaf orientation.

Ocular estimates of damage based on ground observations revealed variation within and between species in the sprayed plot. Hairy manzanita displayed the most severe damage. Pacific rhododendron and golden chinkapin were moderately to severely damaged in most cases. Some individuals of all three species showed little effect (Figure 1).

Spectral measurements were grouped for individual plants of each species by damage level. Mean reflectance values were used from the control plot for contrasting healthy versus moderately to severely damaged plants across a portion of the spectrum. The curves illustrate reflectance by wavelengths for three levels of foliar damage -- none, moderate, or severe (Figure 2).

The use of spectral responses has the potential to provide better estimates of brush damage than ocular estimation. This is because foliar damage from herbicide that is not visible to the eye is detected easily with infrared sensors.

The current use of infrared detection technology extends from aircraft to satellites which can be fitted with photographic or electronic sensors. For applied forestry use, however, my personal experience suggests strongly that images taken from light aircraft with handheld cameras and commercially available infrared film will provide more accurate estimates of herbicide effectiveness than currently used ground based surveys, and at a far lower cost.

Richard W. McCreight
Forest Science, OSU

WATER AVAILABILITY IN SKELETAL SOILS

Water is often the primary factor which limits reforestation success in southern Oregon. Reforestation management should benefit if better estimates of available water could be obtained. Skeletal soils constitute nearly two-thirds of the soil on land withdrawn because of reforestation problems. Measuring available soil water on these soils has also proven to be particularly difficult in the past. For these reasons, I decided to assess soil water availability in relation to physical factors on a variety of skeletal soils in southwest Oregon for my Master's thesis.

To measure water availability, it was first necessary to accurately estimate bulk density of soils taken from irregularly shaped holes over a range of slopes. Thus a sampler was designed to sample bulk density and rock fragment content under these conditions. Next, physical properties and available water were measured for soils at 40 locations in southwest Oregon.

The soils were derived from nine parent materials including granite, basalt, andesite, ash, serpentine and metasediments. Samples were taken from the top 25 cm, an area considered to be the root zone for newly planted seedlings.

The variability of these soils was great enough so that the physical soil characteristics were unique for each site and could not be transferred from soil to soil. Although the soils averaged 25 percent rock fragment (>2mm diameter) by volume, the bulk density of the fine soil portion averaged 0.94, quite suitable for root growth. On the whole soil basis, organic matter averaged six percent, but excluding rock fragments, it averaged 12 percent. This high concentration not only improves the nutrient status of the soil but also helps to maintain low bulk densities.

The presence of rock fragments in these soils has been felt to considerably reduce soil water availability. This effect is offset, however, by the discovery that the rock fragments are porous enough to provide over 15 percent of the total available water. Available water capacity was defined as the difference between field capacity and the seasonal low. This was estimated from studies of soil wetting at all 40 locations.

At 19 sites, field capacity was measured on naturally wetted soils in March. At the remaining locations, the soil was thoroughly saturated *in situ* during the summer and sampled two days later. The water content at field capacity for the soils measured in March averaged 27 percent and was 24 percent for the soils tested during the summer. Water potentials at field capacity measured in March averaged -7 kPa (-.07 bars), with some soils having values as low as -2 kPa (-.02 bars). The rock fragments appear to have a positive effect in that the rock fragments and layering appear to lower water potentials and elevate water contents at field capacity.

Regression equations were also developed to predict total available water from soil characteristics. These models, when used in conjunction with other field information, can provide a reasonable estimate if direct measurement is not possible. These equations require, however, very specific information for each soil. Estimates of physical properties can be used but decrease the reliability of the answers. For these reasons, direct measurement of a soil's water characteristics is preferable.

In addition to soil characteristics, water supply to a seedling depends on such factors as precipitation inputs, rates of evapotranspiration, competing vegetation and root growth. More accurate knowledge of soil water availability should, however, help greatly in leading to more site specific reforestation practices. Managers will be better able to decide when such techniques as artificial shade, shelterwood harvesting or more intense site control techniques may be necessary.

Copies of the Master's Thesis "Soil Physical Properties and Available Water Capacity of Southwest Oregon Forest Soils" are available from the Department of Soil Science, OSU, Corvallis, OR 97331.

Alan Flint
Soil Science, OSU

Adaptive FIR

ALTERNATIVE METHODS OF BRUSH CONTROL STUDY

A new study designed to explore alternative methods of brush control has been initiated by members of the Adaptive FIR staff in cooperation with the Medford District of the Bureau of Land Management. The study will compare several handslashing treatments with one or more herbicide prescriptions and untreated controls. The sequence of slashing treatments may be scheduled to coincide with different stages of phenological development or levels of plant moisture stress. Emphasis will be placed on units where post-planting maintenance is required to control resprouting sclerophyll brush. Study sites will have been clearcut and broadcast burned prior to planting. Treatments will probably be installed on units where brush resprouts are from one to three years old. Seedling survival and growth, and resprout growth will be measured over a period of several years. Estimates of treatment costs will also be made.

Over the next three months the study plan will be developed and study sites located. As the study progresses, periodic summaries will appear in the FIR REPORT.

S. H.

REGENERATION POTENTIAL OF WITHDRAWN LANDS

As reported in past issues of the FIR REPORT (4(1):4; 4(4):4), this study is designed to better define the potential for artificial reforestation of lands withdrawn from the allowable cut land base in cooperation with the Medford District, BLM. The basic steps of the study are to classify withdrawn lands by their site characteristics, select and prepare sample sites that represent the range of withdrawn lands, plant Douglas-fir seedlings to serve as bioindicators of site quality, and then to look for relationships between Douglas-fir survival and growth, and site characteristics.

MEANS FOR SITE VARIABLES FOR LOW INTENSITY AND LIMITED USE LANDS

Class	No. Sites	Average Slope (%)	Average Elev. (Feet)	Primary Aspect (Deg.)	Summer Precip. (In.)	Average Available Soil H ₂ O (In.)	Summer Sunshine (Gram Cal.)
Limited Mgmt.	1563	49.3	2544	96 & 264	5.5	3.9	131390
Low Intensity Mgmt.	906	47.2	2825	98 & 262	5.0	3.9	132770

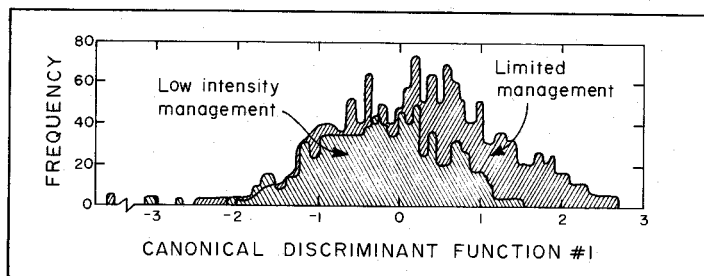


Figure 1. Comparison of two categories of withdrawn lands by selected site characteristics.

The withdrawn lands were originally split into two administrative categories. As a first step in classification, it was necessary to see if these lands truly differed. A technique called discriminant analysis was used to see if these two classes could be separated in terms of slope, aspect, elevation, precipitation, solar radiation and soil characteristics. The results indicated that the two administrative categories shared very similar characteristics (Figure 1). The horizontal axis is a composite variable based on the site variables.

Average aspect shows two values because a cosine function was used for the statistical analyses. Cosine functions are, however, difficult to visualize. A frequency plot (Figure 2) shows more clearly how the withdrawn lands lie with respect to aspect. Although most sites face southerly, many withdrawn lands have northerly aspects.

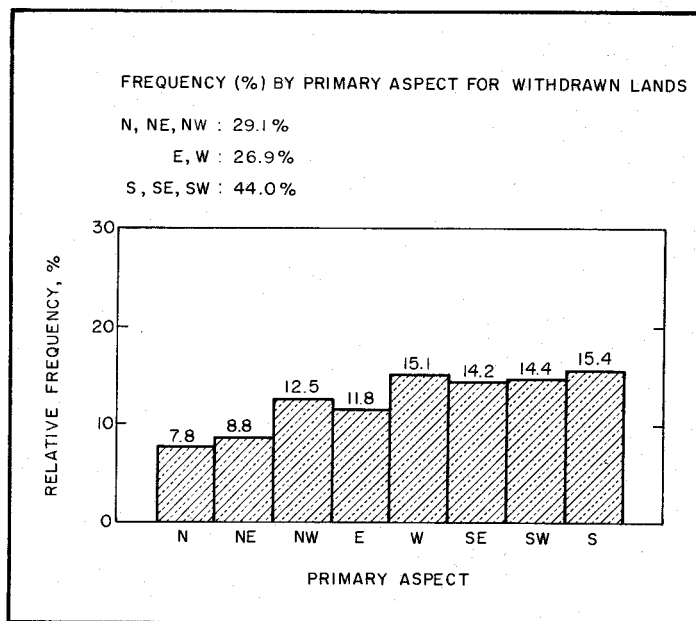


Figure 2. Frequency of withdrawn lands by primary aspect.

The next classification step was to identify major sources of environmental variation in the body of withdrawn lands. This was necessary to provide a strong foundation for selection of test sites by helping to ensure that the site characteristics with the greatest ranges would be covered in the sampling process. For example, if the withdrawn lands varied more in aspect than in elevation, then a sampling method based primarily on aspect could be expected to do a better job of covering the greatest range of site conditions.

A statistical technique called principal components analysis was used to see which site variables contributed the most to the overall variation found across the withdrawn lands. This technique revealed that variables associated with water supply and solar radiation accounted for 74 percent; elevation, 10 percent and slope 8 percent of the total variation. Also revealed was a strong correlation between aspect and solar radiation for this set of data.

These results were fortuitous. Solar radiation (as aspect) and water, aside from their statistical importance, have been associated with seedling survival in the study by Dieter Schöne reported in this issue.

The maximum amount of water available to a seedling is constrained by what the soil can hold at the onset of the growing season, plus additional precipitation during the growing season. Transpiration rates and heat loads in a seedling's environment are associated with solar radiation during the growing season. Thus these variables provided a realistic basis for subsequent sampling.

Plotting numbers of withdrawn sites by their summertime solar radiation and water characteristics revealed that most sites have high radiation loads (SW, SE, S aspects) and are low in water (Figure 3). The distribution of radiation loads mirrors that of aspect in Figure 2. The distribution across total available water, however, ranges from dry sites with shallow rocky soils to sites with deep, good soils and high levels of precipitation.

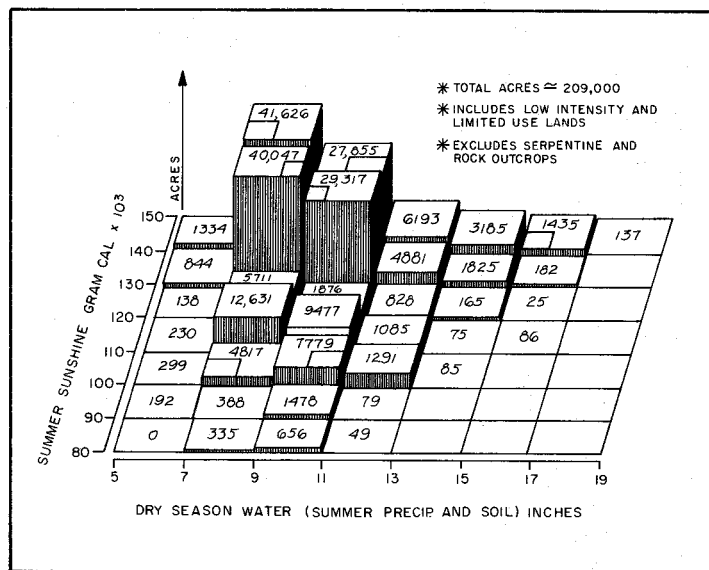


Figure 3. Acreage of withdrawn lands by summer sunshine and water availability (May 1 - September 30).

Sampling the withdrawn lands on this radiation by water grid must meet several conditions. Most sites should be represented, sampling should be more intense where more sites occur, selected sites should be planted over several growing seasons, and estimates of experimental error are necessary. The sampling scheme that has been selected is to plant a minimum of six sites at each of the six shaded regions on the radiation by water grid. The test sites will be planted over several years to reduce the influence of uncommonly good or bad planting years. On suitable sites, ponderosa pine will also be planted.

This study is designed to provide an overall view from which to approach the reforestation problems of withdrawn lands. As such it will help to place other ongoing reforestation research in perspective and will help to define other areas where information is lacking. Survival results from this and other FIR studies indicate that good initial seedling survival can be achieved on certain types of withdrawn land. As more study sites are prepared and planted, stronger estimates of expected survival will become established across the full range of withdrawn lands.

O. H.

Continuing Education

SEEDLING PHYSIOLOGY AND REFORESTATION SUCCESS

A one-day technical session will be held on Tuesday, October 18, during the SAF National Convention in Portland, Oregon. This Physiology Working Group Session includes overview and specific research reports on the relations between seedling physiology and reforestation success. The program will be split to cover stock quality and the response of planting stock to site conditions. More detailed discussions will be presented on tissue culture and vegetative propagation, seed, bareroot and container seedlings, matching species and stocktype to site, weed control and nutrition management. The proceedings of this session will be published. For more information contact: Mary L. Duryea, Department of Forest Science, OSU, Corvallis, OR 97331. Telephone (503) 753-9166.

UPCOMING ADAPTIVE FIR WORKSHOPS

Six workshops are being planned for fiscal year 1984. Workshop topics in approximate order of presentation are "Reforestation Research Advances in Southwest Oregon" (February 1984); "Minimizing Timber Harvesting Impacts" (Spring 1984); "Timber Harvesting Systems - Cable"; "Timber Harvesting Systems - Tractor"; "Forest Weed Control for Southwest Oregon"; and "Selecting Stands for Fertilization" (Fall 1984). More detailed information will be forthcoming in workshop flyers. For advance information contact: Elaine Morse, Adaptive FIR.

Of Interest

SECOND PRINTING

A second printing of the Proceedings of the Reforestation of Skeletal Soils Workshop has recently been completed and copies are once again available for purchase at \$7.50 a copy. The proceedings contain 19 papers which address various aspects of the reforestation of skeletal soils with particular emphasis on southwest Oregon. Topics range from "The nature of skeletal soils in steep terrain" to "Site preparation strategies for skeletal soils" and "Mycorrhizal inoculation." Checks or purchase orders should be made payable to: OSU SCHOOL OF FORESTRY, for \$7.50 per copy (US dollars) and sent to:

Workshop Proceedings
 FIR
 1301 Maple Grove Drive
 Medford, OR 97501

PROBABILITY, SITE QUALITY, AND SEEDLING SURVIVAL

Foresters, particularly in southwest Oregon, have long recognized that reforestation is an uncertain process. Recent research completed by Dieter Schöne for his Ph.D. in Forest Management at OSU has yielded insight into the uncertainties of the reforestation process in southwest Oregon. Dieter used a technique called Bayesian analysis to study the effects that site characteristics have on the probability of reforestation success with regard to optimum planting densities and the return on investment of gathering additional site information. He conducted the study at two ecologically and politically different areas; the Tillamook region in northwest Oregon and the south Umpqua area in southwest Oregon.

The results of this study are intriguing. Despite different ecologic conditions and management goals, the reductions in reforestation costs that could be achieved and the amount of money that could be spent per acre to acquire site information to increase reforestation success are very similar for the two areas. The reasons, however, differ.

For southwest Oregon, the central implication is that regeneration foresters must be keenly aware of specific site characteristics because of the region's greater ecologic diversity. But, which site characteristics appear to be important predictors of reforestation success?

For the southwest Oregon data base, soil water availability, dry season precipitation, aspect and competing vegetation were among the more important site characteristics that were related to seedling survival. Associated with this, the cumulative distribution of first year survival is related to site productivity. More productive sites have greater probabilities for high rates of survival, although sites with low productivity can also show very good survival.

Other significant findings include a strong ($r = .89$) regression equation that estimates total trees per acre from "effective" trees per acre measured from stocking surveys; and the development of a relation between soil water availability and soil texture which is presented as a series of isolines on the textural triangle.

This research is an important benchmark in reforestation operations. In addition to further identifying and clarifying relations between site characteristics and reforestation success, this study shows how to use knowledge of site characteristics most effectively in establishing optimum levels of stocking on a site specific basis. For more information contact: Dr. Dieter Schöne, Am Unkersberg 1, 555 Ardel, West Germany, or Dr. John Beuter, Department of Forest Management, Oregon State University, Corvallis, OR 97331.

O. H.

ADDITIONAL THOUGHTS ON MULTIPLE STUMP CABLE ANCHORS

An article in the Summer, 1982 issue of the FIR REPORT discussed some recent research results regarding multiple stump anchors for cable logging systems. This research, conducted by Gail Kimbell for her Master's degree at OSU's Forest Engineering Department, is valuable work in that it increases our knowledge about

the mechanics of multiple stumps rigged in a series for cable system anchors. Results showed that, for the stumps used during the project, only 10 percent of the loaded line tension was being transferred to the second stump instead of the 30 percent that had been assumed previously. Recent discussions with other logging engineers has led to some additional thoughts on this type of anchoring system which should be considered by harvesting project planners and loggers.

If the primary stump in a multiple stump series is strong enough to withstand an applied force, there will be no perceptible forward motion of that stump. As a result, only a small part of the load will be transferred to the second stump. This is the situation that was observed and described in the Kimbell project and in the previous FIR REPORT article. However, if the first stump of a series does move, a different pattern of force distribution is likely.

The series multiple stump anchor system is rigged under the assumption that single stumps are too small and/or weak to withstand the anticipated line tensions. With multiple stump anchors, when the front stump begins to move, the tension in the line between the first and second stumps will increase. Since the line between stumps is already under some tension from rigging, very little movement of the front stump is necessary to transfer a significant part of the load to the second and perhaps subsequent stumps. The load will then be more evenly distributed between stumps. The second stump can thus help to stabilize the front stump and keep it from working loose during the yarding operation. Unfortunately, current knowledge is inadequate to predict how much force is transferred to subsequent stumps when the first one moves.

As was mentioned in the previous FIR article on this topic, an alternate system to distribute loads between two stumps is to use an equalizing block on the end of the tensioned line. This can be a good option when adequate planning time is available because this anchoring system requires additional analysis, equipment and set-up time.

For large yarding equipment and the associated large line sizes, a block large enough to safely transmit cable loads may weigh several hundred pounds. Also, if this type multiple stump anchor is rigged improperly, it can actually apply more force to the individual stumps than if the line were attached directly to either of the stumps. Consider the diagram in Figure 1.

The static equilibrium formula for this system is:

$$\Sigma F_x = 0 = T_g - 2T_e \cos \theta \quad (1)$$

Therefore,

$$T_e = \frac{T_g}{2 \cos \theta} \quad (2)$$

As the angle θ approaches 60° , the cosine function approaches 0.5 and the divisor in equation (2) becomes 1.0 making T_e , the tension in the equalizing line, the same as the tension in the primary line be it guyline or skyline. If the angle θ is greater than 60° , the tension in the equalizing line is greater than the tension in the primary line, as is shown for various values of angle θ and ϕ in Table 1.

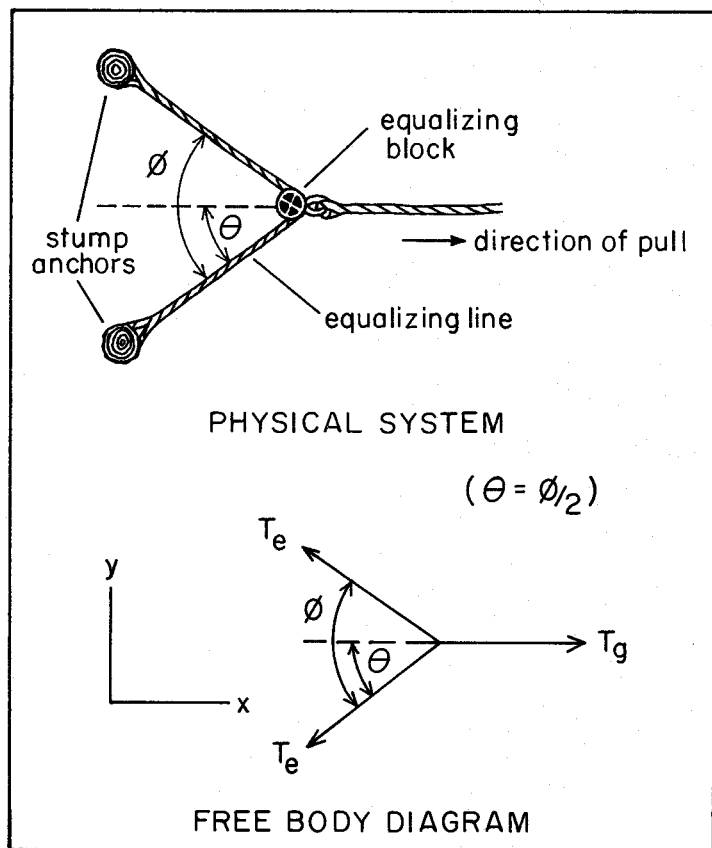


Figure 1. Equalizer block anchoring system.

Table 1. Tensions in equalizing line for various values of the central angle of a two stump anchor.

ϕ	θ	$\cos\theta$	T_e
20°	10°	0.9848	$0.5 \times T_g$
114°	57°	0.5446	$0.92 \times T_g$
116°	58°	0.5299	$0.94 \times T_g$
118°	59°	0.5150	$0.97 \times T_g$
120°	60°	0.5000	$1.00 \times T_g$
122°	61°	0.4848	$1.03 \times T_g$
124°	62°	0.4695	$1.07 \times T_g$
126°	63°	0.4540	$1.10 \times T_g$

To gain any advantage from using this type anchoring system, the central angle must be quite small. The force in the primary line is split approximately equally only for central angle (ϕ) values below 20°. Depending on the distance that the two stumps are apart, this could make for an extremely long equalizing line.

Multiple stump anchors are useful alternatives when single stumps appear too small to oppose the forces generated in cables during logging operations. The

series multiple stump anchor configuration is a quick and easy, self-tensioning, tie-back system, but with yet indeterminate transfer of force should the first stump move. Until the front stump moves, the ratio of primary loaded line tension to tie-back line tension is quite high. Series multiple stump anchors can be used effectively but the stumps should be inspected regularly and often during logging to insure the safety of the operation.

The equalizer block multiple stump anchor costs more to rig, but has distributions of tension that are relatively simple to predict. Regular inspection of the stumps also applies to this anchoring method. Both systems have advantages and disadvantages, and both are viable anchoring alternatives that should continue to be a part of the logger's bag of tricks when the strength of a single stump is in doubt. A good understanding of the strength and weaknesses of each method is needed before choosing the one that best fits any particular situation.

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PRECOMMERCIAL THINNING OF CLUMPY ADVANCE REGENERATION: DOES IT PAY?

There has been considerable discussion recently on the topic of managing natural regeneration present in stands prior to final harvest. This regeneration may be of preharvest or postharvest origin resulting from the opening up of a stand by partial cutting. In either case, a decision to manage that regeneration for the next rotation means additional harvesting costs to protect reproduction during overstory removal. Even if trees survive logging, no local data documents the growth potential of those trees after overstory removal, although evidence from other studies in the West suggests good growth rates are possible.

The distribution of advance regeneration is frequently clumpy, with the density of trees within groups often substantially greater than optimum for good diameter growth. The economic feasibility of precommercially thinning the clumps to a more reasonable within-clump density is often questioned.

A master's thesis addressing this topic has been completed by Hugh Speechley at U.C. Berkeley, under the direction of John Helms. His thesis, entitled "Projections of growth and economic returns after precommercially thinning young growth California white fir" addresses the issue for stands from the McCloud area in northern California. Selective harvesting of old-growth mixed-conifer stands in the northern Sierra Nevada has resulted in many areas of uneven-aged young-growth stands, which vary in stocking from dense groups to open, unstocked areas.

The objectives of the study were to develop a method of stand description based on types of groups and the proportion of the stand made up of each group. Average diameter and volume growth models were developed for each group type based on easily measured and manipulated variables. A wide range of precommercial thinning prescriptions was applied to each group type using the models to predict the age and volume per acre when a specific average group diameter is reached, corresponding to an expected merchantable limit. Results from each group type are then combined to generate for the whole stand, the age and volume per

acre when the specific average stand diameter is reached. Then, by applying suitable economic variables, including stumpage prices, thinning costs and alternative rates of return, the economic viability of various thinning strategies can be evaluated.

Field work was conducted on a 20-acre stand of young-growth white fir, average site index 85 feet at 50 years, from which an overstory of ponderosa pine had been removed 12 years previously. Six groups were identified based on the diameter of trees in the group. Small type groups had most trees in or below the 6-inch diameter class, with a maximum diameter of 10 inches. Medium groups had most crop trees in the 6- and 8-inch diameter class with a maximum diameter of 12 inches. Large type groups had most of the trees in the 12-inch and greater diameter class. Open type groups were those in each size category in which the current density was too low to be considered for thinning. Dense type groups were those whose basal area exceeded 200 square feet per acre and would be considered for thinning.

Prescriptions were defined in terms of a target number of residual trees per acre for each group type. Using a generated diameter distribution for each type, prescriptions were simulated by first harvesting the overstory down to a specified minimum merchantable diameter limit. Then the group was precommercially thinned, removing all trees from below to a maximum diameter limit.

Precommercial thinning costs were estimated for prescriptions aimed at leaving 100, 200, and 500 residual trees per acre in each group type (about \$50/acre). A price for white fir stumpage of \$102 per MBF was used, a 2 percent escalation rate in the real price of stumpage up to year 2030 was assumed and a real alternative rate of return of 7 percent was used.

Inputs into the simulation were then as follows:

- a) the proportion of the stand made up of each group type;
- b) the prescribed residual trees per acre;
- c) the diameter limit for overstory removal;
- d) the diameter limit for precommercial thinning;
- e) the required final diameter for the projection;
- f) the economic variables.

The economic value of greatest interest was the net contribution of precommercial thinning to the stand's present worth.

Fourteen prescriptions were simulated with various combinations of diameter limits for precommercial thinning and overstory removal, and target residual trees per acre. If the stand was grown to a final diameter of 16 inches, the prescription yielding the highest contribution to present net worth, + \$368 per acre, was that which set the target within groups stocking to 200 trees per acre, the precommercial thinning limit to 7 inches and the overstory removal limit to 15 inches. If the stand was grown to an average diameter of 20 inches, the prescription giving the highest net contribution to present worth, of + \$478 per acre, was that which retained 200 trees per acre,

set the precommercial thinning limit to 9 inches and the overstory removal limit to 11 inches. These were the highest values associated with the prescriptions tested; they are not necessarily optimal solutions. Holding the stand to a final average diameter of 20 inches always gave a higher contribution to present net worth than an equivalent prescription for growing stands to 16 inches.

In these simulations, the assumption was made that area was 68 percent stocked by groups. When stocking of groups was increased to 80 percent, with more groups of the dense type, the prescription yielding the greatest value for the study area increased in present net worth from \$478 to \$912 per acre.

Sensitivity to precommercial thinning costs and the base price of stumpage was relatively low. A 20 percent change in thinning cost changed the contribution to present net worth by only + \$9 per acre. Twenty percent changes in the stumpage price caused changes which depended on rotation length. If the stand was grown to 16 inches, the change was only + \$18 per acre, but for a rotation grown to an average diameter of 20 inches, the change was in the order of + \$100 per acre.

The model must be viewed cautiously. It is based on a limited sample and statistically only a moderately good fit to the data. However, if one looks at the differences between costs and contributions to present net worth, break even costs for precommercial thinning are \$412 and \$522 per acre for final average diameters of 16 and 20 inches, respectively. Based on the current thinning costs and uncertainties in this model, it still appears that precommercial thinning of clumps of white fir to 200 trees per acre after overstory removal can be justified economically.

S. T.

PRECIPITATION INTENSITY IN THE WESTERN SISKIYOU MOUNTAINS

The recently completed average annual precipitation map for southwest Oregon indicates that precipitation in the Western Siskiyou Mountains has been underestimated by as much as 30 percent in some locations. Do errors also exist in maps depicting precipitation intensity-frequency relationships?

These relationships are valuable for designing forest roads and choosing among forest practices which may expose mineral soil to erosion. Only recently have data been collected at higher elevations to allow a preliminary evaluation of this question. Data must be collected for many years before the results are conclusive, but existing data suggest that precipitation intensity is higher in the Western Siskiyou Mountains than existing isopluvial maps indicate.

The largest 24 hour precipitation event occurring for each month over 20 years (1962-81) was calculated for weather stations near Kerby and Brookings. The 20 largest storms, regardless of the year of occurrence, were selected to construct a partial duration series (PDS) of precipitation intensity and return period. The site specific PDS for Kerby and Brookings give lower precipitation intensity values for a specific return period than do the isopluvial maps for Oregon in the most recent NOAA Atlas (Figure 1).

While the NOAA Atlas overestimates precipitation at these and other low elevation, coastal and interior valley sites, the maximum precipitation intensity projected for the western Siskiyou Mountains appears to be underestimated at higher elevations. This interpretation is based on determining the return periods (calculated from the Kerby and Brookings data) for two recent winter storms measured at four low elevation sites around the western Siskiyou Mountains. These return periods were compared with those predicted from the NOAA Atlas for precipitation from the same two storms measured at two recently installed mountain stations. One site is on the west edge of the Kalmiopsis Wilderness (T28S, R11W, S30; 3,033 ft.) and the other is located in Hunter Creek (T37S, R13W, S9; 2,400 ft.), approximately 15 miles to the northwest. Data from the two sites were provided by Bruce Sims and Russell Gripp of the Siskiyou National Forest.

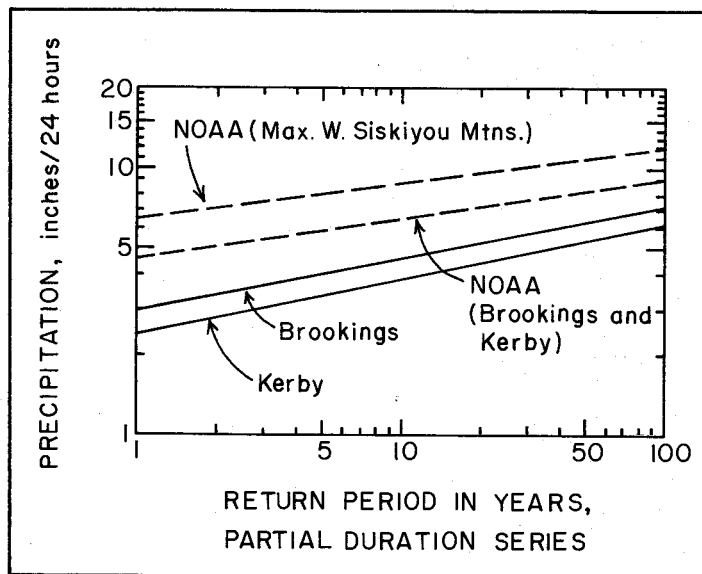


Figure 1. Precipitation intensity versus return period.

Both high elevation sites received between 14.0 and 14.6 inches of precipitation in 24 hours on December 5-6, 1981, and 9.5 and 9.6 inches in 24 hours on February 17-18, 1983. The NOAA Atlas predicts a minimum return period of 30 years for a 10 inch storm, and a return period of over 100 years for a 14 inch in 24 hours storm. Yet for the same storms, Brookings, Gold Beach, Cave Junction and Illahe received five inches or less of precipitation in 24 hours, reflecting return periods of between 2 and 15 years. The strong differences between predicted and actual return periods at the low elevation and mountain stations are the basis for judging the NOAA isopluvial maps as underestimating the precipitation intensity at the higher elevations of the western Siskiyou Mountains.

Users of precipitation data should note that the NOAA isopluvial maps conservatively estimate return periods for maximum 24 hour precipitation events at low elevations in southwest Oregon, i.e., for a given storm intensity the return period is longer than the map shows, or conversely, for a specific return period, the precipitation intensity is less than the maps indicate. As elevation increases, however, the relationship between actual and NOAA data rapidly reverses. A given intensity of precipitation will occur more often than the

NOAA data indicates. Based on these limited data, for sites along the coastal side of the western Siskiyou Mountains and above 2,500 ft. elevation, 24 hour precipitation intensities for a given return period should be doubled to better estimate precipitation intensity. Adjustments for sites further east probably need not be as large.

D. M.

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HERBICIDE HANDBOOK OF THE WEED SCIENCE SOCIETY OF AMERICA, FIFTH EDITION, by WSSA Herbicide Handbook Committee. 1983. This fifth edition of the Herbicide Handbook describes herbicides, desiccants, plant growth regulators, names of various adjuvants, protectants, abbreviations, definitions and conversion factors used in weed science. Information on all compounds has been reviewed and revised. All herbicides are listed alphabetically by their common names or by code designations for unnamed compounds. Indices for common and trade names, and chemical names are also included. As with past editions, information on each herbicide covers chemical properties, herbicidal use, use precautions, physiological and biochemical behavior, behavior in or on soils, toxicologic properties, and sources of further information. The book is not a summary of current federally registered herbicide uses, but is written for those wanting additional information on herbicide properties that are not typically included on product labels.

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THE EFFECT OF BRUSH COMPETITION AND PLASTIC MULCH ON MOISTURE STRESS ON PLANTED DOUGLAS-FIR, by J. R. Tonn and R. T. Graham. 1982. USDA Forest Service, Res. Note 320, Intermountain Forest and Range Experiment Station, Ogden, UT. 4 p. The effects of black plastic mulch and brush competition on seedling plant moisture stress,

soil temperature and survival of planted 2-0 Douglas-fir seedlings in northern Idaho were investigated. Seedlings were planted in 12-year-old brush 2 to 8 feet tall, in 3 by 3 foot cleared blocks, and similarly sized natural openings. No significant differences for mean plant moisture stress, soil temperature or survival were observed between treatments at the end of the first summer. Survival ranged between 83 and 90 percent. Mean plant moisture stress was significantly greater 30 days after planting (May) than any other date during the summer. Precipitation averaged 1.85 inches per month from May through October. July and August received at least 1.5 inches of precipitation each month. Thus treatment effects were not fully tested with regard to soil moisture drawdown. Also, the small treatment areas relative to the size of the brush could have been ineffective at creating treatment differences because roots from adjoining brush may have occupied the opened areas.

③

ENERGY EXCHANGE OF TRANSPLANTED DOUGLAS-FIR SEEDLINGS ON TWO CUTOVER SITES IN SOUTHWEST OREGON, by J. A. Vanderwall. 1983. 16th Conference on Agriculture and Forest Meteorology, Ft. Collins, Colorado, p. 214-215. An energy balance was prepared for 2-0 bareroot, Douglas-fir seedlings planted in clearcut and shelterwood harvested units approximately two miles north of the Oregon Caves National Monument. A portion of seedlings in each unit was also shaded by shadecards. In the clearcut, shadecards decreased the solar radiation a seedling received by 22 percent. The combination of shelterwood and shadecards reduced solar radiation by 47 percent, and the shelterwood alone reduced incoming solar radiation by 29 percent compared to the open clearcut. Water use per unit leaf area by seedlings in the clearcut was high early in the season but decreased markedly by July and August. Under the

partial cut, initial water use was about one-third of the rate in the clearcut, increased about 50 percent, and returned to near starting levels.

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ACCEPTANCE BY BLACK-TAILED DEER OF FOLIAGE TREATED WITH HERBICIDES, by Dan L. Campbell, James Evans, Gerald D. Lindsey, and William E. Dusenberry. Res. Pap. PNW-290. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Olympia, WA: U.S. Department of the Interior, Fish and Wildlife Service, Forest-Animal Damage Control Research Project. 1981. 31 p. To test their acceptance of foliage treated with herbicides, captive black-tailed deer were exposed to Douglas-fir seedlings and salal treated with standard formulations of 2,4,5-T, 2,4-D, atrazine, dalapon, fosamine, and glyphosate herbicides. Carriers were diesel oil and water. Tests were made from November 1977 through February 1978. Deer readily browsed 2,4,5-T treatments and most formulations of 2,4-D in oil compared with oil alone, but rejected some phytotoxic glyphosate treatments. Consumption of herbicide-treated foliage did not cause noticeable health problems in test animals.

④

RESEARCH ON FOREST AND RANGE SOILS IN OREGON AND WASHINGTON: A BIBLIOGRAPHY WITH ABSTRACTS FROM 1975 THROUGH 1979, by G. O. Klock and R. F. Tarrant. 1981. USDA Forest Service, Gen. Tech. Rep. PNW-30. Pacific Northwest Forest and Range Experiment Station, Portland, OR. 23 p. An annotated bibliography of 218 papers and theses on forest and range soils in Oregon and Washington supplementing three earlier bibliographies published by the Pacific Northwest Forest and Range Experiment Station.

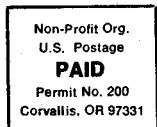
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