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A Technique for Identifying Treatment Opportunities from Western Oregon and Washington Forest Survey Plots

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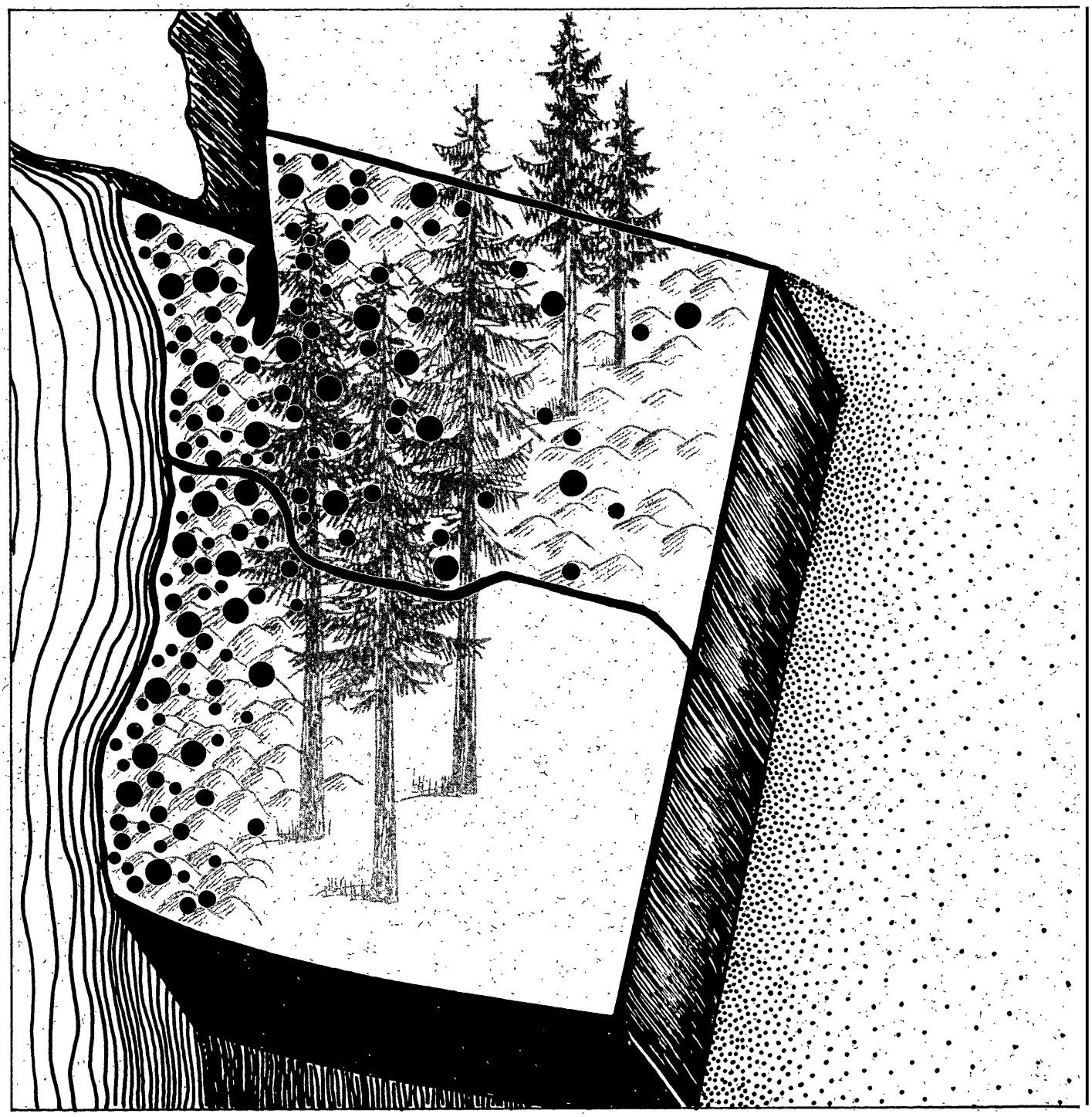

Abstract

Identification of opportunities for silvicultural treatment from inventory data is an important objective of Renewable Resources Evaluation in the Pacific Northwest. This paper describes the field plot design and data analysis procedure used by what used to be known as Forest Survey to determine the treatment opportunity associated with each inventory plot in western Oregon and Washington. Information thus obtained should be of considerable interest to planners, legislators, and public administrators.

KEYWORDS: Survey methods/planning, forest surveys, silvicultural treatments.

CONTENTS

INTRODUCTION

Traditionally, forest inventories were undertaken to determine the available supply of merchantable timber. When old-growth timber was abundant and future timber needs could be met from stored stocks, such inventories met the needs of both managers and planners. As old-growth stocks dwindled, however, interest in immature stands and cutovers--the likely source of future supplies— increasedmarkedly. Thus, there was a need to broaden timber inventory design to include collection of the data needed to assess the condition of cutovers and identify opportunities to improve yields through silvicultural practice.

In order to meet these information needs, new inventory designs were developed. The most common approach (Stage and Alley 1972) (USDA Forest Service, Pacific Northwest Region undated) (Harding 1973) is to prepare a 100-percent stand map and then to sample a representative proportion of the stands, collecting inventory data from a series of sample points. Unsampled stands are usually classified by photo interpretation. The cost of such inventories is high, but the manager of the forest property obtains the needed in-place information about the characteristics and treatment needs of specific forest stands.

Regional and national planners also need to know the condition of cutover lands and the extent of existing opportunities for silvicultural treatment, but they do not need to know the exact location of each treatable stand. Thus, less costly Forest Survey inventories,1/ based entirely on sample data, are potentially capable of providing the information needed for planning.

The first major Forest Service effort to assess the condition of young-growth forests and cutovers was the "Timber Resources Review" (USDA Forest Service 1958). Much of this assessment was based on special surveys taken to fill in the gaps in Renewable Resources Evaluation data. This experience triggered a substantial effort to design Forest Surveys that were more useful for assessing forest condition and identifying opportunities for silvicultural treatment. One product of this effort was a 10-point, variable-radius plot cluster designed to sample about an acre.2/ In the Pacific Northwest this 10-point plot was installed on a 3.4-mile (5 470-meter) grid that sampled all conditions of forest land with equal intensity.

1/Regularly scheduled Forest Surveys are conducted nationwide, by Renewable Resources Evaluation Research, a project of the USDA Forest Service. The Pacific Northwest Forest and Range Experiment Station conducts the survey in Alaska, California, Hawaii, Oregon, and Washington.

2/A. A. Hasel, Plot design of the Forest Survey. Unpublished manuscript on file at Pacific Northwest Forest and Range Experiment Station, Portland, Oreg.

Several analysts found the new inventory data useful to identify treatment opportunities (Fight and Gedney 1973, Gansner, et al. 1973). In the Pacific Northwest, Fight and Gedney identified treatment opportunities by sorting inventory plots into ownership, age class, stocking class, and broad forest types. Thus, poorly stocked stands were planting opportunities, hardwood stands on conifer site were conversion opportunities, well-stocked stands aged 10 to 30 were precommercial thinning opportunities, etc.

Although the approach produced much useful information, Fight and Gedney were frequently frustrated by the inadequacies of the data, particularly in relation to stocking and age. Even a superficial look at the inventory plots showed that some fell in uneven-aged forests while others sampled clumpy stands where dense thickets were interspersed with open spaces. In addition, the plots often straddled type lines, thus reflecting two or more forest conditions. The average stocking and age levels for such mixed plots were meaningless from a silvicultural point of view. In addition, the small 1-acre (.4-hectare) plots sometimes sampled microconditions too small for feasible treatment. These frustrations led me and my colleagues to: (1) revise the inventory plot design, and (2) develop a new analytical procedure to identify treatment opportunities from individual plot data for the Portland, Oregon Renewable Resources Evaluation Unit.

METHODS

Developing the Techniques

The techniques were developed in conjunction with a regularly scheduled Forest Survey of non-Federal forest lands in western Oregon. The procedures described are currently being used to evaluate treatment opportunities in western Washington and represent the culmination of several years of development. The study was done in five discrete steps: First a procedure to quantify the relative density of each stand component was developed. That stand density measure--expressed as a percent of "normal" density--has already been described (MacLean 1979). Then we selected and defined the silvicultural treatments to be identified. Third, a field design to collect the necessary data was developed. Fourth, an analytical procedure for screening the plot data was developed. Finally, we screened inventory plots and revised procedures to correct for logic errors and to accommodate unforeseen circumstances.

Objectives

Our objective in inventorying treatment opportunities is to identify physical opportunities to increase timber production through silvicultural manipulation of tree stocking. Although our primary interest is in physical opportunities, we also hope to obtain at least some of the inputs needed for subsequent economic analysis. The new procedures are subject to certain constraints:

(1) Information needs must be met from data collected as part of the regular Renewable Resources Evaluation inventories.
(2) Treatment opportunity classification should be based on office evaluation of data rather than subjective field judgment in order to: (a) permit data collection by summer field assistants, (b) obtain consistent classification results, and (c) permit later reevaluation with different treatment criteria.
(3) The analytical procedures used to identify treatment opportunities should be as easy and straightforward as possible and should be applicable over a wide geographic area.
(4) Reasonable results should be expected for stands of mixed ages, mixed species, and variable spacing.

These constraints make it impossible to consider all the subtleties a trained silviculturalist might observe before prescribing for an individual stand. Our intent, however, is not to provide managers with guidance in treating individual stands but to give planners estimates of acreages available for various types of treatment. We hope to develop estimates that are as accurate as is possible within our usual budgetary and manpower limitations.

The Treatments

In western Oregon and Washington, most managers practice some form of even-aged management. Our procedures are predicated on a long-range objective of even-aged management for conifer wood production, even for stands that are presently of mixed species or uneven age. Thus, for treatment identification purposes, all stands are sorted into two species groups--conifer and saleable hardwoods (with or without a conifer component), and conifer stands are further sorted into three stage-of-development categories--mature, intermediate, and regeneration. An additional category--"no manageable stand present"--is used to describe areas where trees are few or lacking or where the stocking of potentially saleable trees is not sufficient to fully utilize the site.

The treatments identified are those which can be expected to increase timber production through manipulation of growing stock. Two other common treatments--fertilization and genetic improvement--are omitted: but potential fertilization opportunities should be identifiable by combining treatment opportunity class with site index and cost information. Genetic improvement, of course, is possible wherever a planting opportunity exists.

Mature Conifer Stands

Mature stands have a density at least 20 percent of normal (MacLean 1979), on at least EO percent of the area, and exceed the age when mean annual increment of cubic foot volume culminates. Since the exact age of culmination of each stand is not known, we rely on the following broad assumptions for western Oregon and Washington:

Zone	Age of culmination	Source
Conifers growing in Pacific silver fir zone	120 years	(Curtis, Herman, and DeMars 1974)
All west-side conifers except those growing in Pacific silver fir zone	60 years	(Barnes 1962, McArdle et al. 1961)

Mature stands may be candidates for one of the following treatments:

1. Shelterwood removal cut.

This is the final stage of a shelterwood cut, when the regeneration is well established and the remaining overstory can be removed. Overstory density should be less than 50 percent of normal and understory density should be at least 35 percent. Natural stands with a composition that resembles this description will be treated in the same manner.

2. Clearcut.

This is the prescription for stands which fail to qualify for a shelterwood removal cut because of excessive overstory or inadequate understory, unless environmental or land use restrictions make clearcutting undesirable. Stands identical as clearcutting opportunities are also suitable for a shelterwood seed cut.

3. Shelterwood seed cut.

This is the proper description for mature, dense (at least 50 percent of normal density) stands on sites where clearcutting is inappropriate.

4. Shelterwood with harvest delayed until after underplanting.

Some mature stands lack an adequate understory but have too little overstory (less than 50 percent of normal density) to permit a shelterwood seed cut. If such a stand occurs on a site that is unsuitable for clearcutting, then it must be regenerated before the overstory can be removed. Usually site preparation is necessary, and sometimes cull trees must be removed.

Intermediate Conifer Stands

Intermediate conifer stands are below the age of culmination of mean annual increment, have a quadratic mean diameter of at least 20 cm (7.9 in) and have at least 25 percent of normal density on at least 60 percent of the area. Although, normally, such stands are not harvested until maturity, they may be candidates for one of the following treatments:

1. Commercial thinning.

An intermediate harvest in which excess growing stock is removed for sale. Stands that exceed the recommended "maximum" percent of normal density--approximately 75 percent--(Reukema and Bruce 1977) on at least 60 percent of the area are potential candidates for this treatment.

2. Improvement cutting.

The removal of unsaleable material in order to free crop trees from competition. Improvement cutting differs from a commercial thinning in that the material removed is not marketable. Stands are candidates for this treatment if unmarketable tree competition exceeds 20 percent of normal density over at least 60 percent of the area.

3. Sanitation salvage cutting.

The removal of salvable dead trees and trees expected to die within 10 years (high risk trees). When the merchantable volume in salvable dead and high risk conifer trees over 20 cm (7.9 in) in d.b.h. exceeds 70 m3 per ha (1,000 ft3 per acre), the stand is a candidate for sanitation salvage cutting.

Conifer Regeneration Stands

These immature stands of growing stock conifers have a quadratic mean diameter of less than 20 cm (7.9 in) and a density that is expected to reach 25 percent of normal on at least 60 percent of the area by the time the quadratic mean diameter of the stand is 20 cm. Such stands may be candidates for one of the following treatments:

1. Precommercial thinning.

Regeneration stands qualify for precommercial thinning, (1) if the average height of the codominant and dominant trees is between 3 and 9 m (9.8 and 29.5 ft) and (2) if, on at least 60 percent of the area, the stand density is expected to exceed 75 percent of normal by the time the quadratic mean diameter of the stand reaches 20 cm (7.9 in). At 20 cm, normal density varies from 970 to 1,340 trees per ha (393 to 542 trees per acre) depending upon species. The standard for smaller trees is slightly higher to account for anticipated mortality.

2. Precommercial thinning of clumps.

Candidates for the precommercial thinning of clumps qualify when at least 30 but less than 60 percent of the area exceeds the density standard.

3. Cleanina or release.

A cleaning is called for when a regeneration stand is partly stocked with brush or hardwoods. If this competition is overtopping the conifers, the treatment is called a release. The usual treatment is with herbicidal sprays. Stands are candidates for cleaning or release when field records indicate substantial competition from brush or hardwoods on at least 60 percent of the area.

4. Prepare site and plant holes.

Sometimes regeneration stands contain nonstocked holes. If these holes make up one-third or more of the area and if competition from trees over 1.5 m (4.9 ft) is absent, the nonstocked patches are suitable for spot planting, after site preparation. This treatment is only suitable for regeneration stands.

5. Improvement cutting.

Candidates for improvement cutting are regeneration stands overtopped by hardwood and cull conifer trees that exceed 20 cm (7.9 in) in d.b.h. when the density of such trees exceeds 20 percent on at least 60 percent of the area. These stands resemble overstory removal opportunities except that the overstory is composed of nonsaleable material.

High-value Hardwood Stands and High-value Hardwood-conifer Mixed Stands

These stands fail to qualify as manageable conifer stands but have at least 25 percent of normal density of red alder (Alnus rubra Bong.), black cottonwood (Populus trichocarpa Torr. & Gray), and conifers on at least 60 percent of the area. Although these stands are treated as opportunities to convert to conifer production, they are identified separately in order to permit identification of alternative opportunities to manage for hardwood production. The opportunities currently identified are the same as those listed under "Manageable stand absent."

Manageable Stand Absent

Areas that fail to qualify as mature, intermediate, or regeneration stands are assumed not to have a manageable stand. Such stands are candidates for regeneration treatments. Those treatments are:

1. Harvest cutting (clearcutting).

Stands which average at least 70 m3 per ha (1,000 ft3 per acre) in conifer and high-value hardwood trees over 20 cm in d.b.h. are candidates for clearcutting.

2. Stand conversion.

Candidates for stand conversion are areas where a manageable stand is absent and the volume per acre is less than 70 m3 per ha but where the density of trees over 20 cm in d.b.h. is at least 20 percent on 60 percent of the area. This treatment calls for removing the existing trees and planting the area with desirable growing stock.

3. Site preparation and planting.

Candidates for removal of competing vegetation and for planting are areas where a manageable stand is absent and the density of trees over 20 cm in d.b.h. is inadequate for stand conversion.

Plot Design

The data for treatment opportunity analysis are collected during the course of regularly scheduled Renewable Resources Evaluation timber inventories. In the Pacific Northwest, field plots are located on a 5 470-m (3.4-mi) grid. Each grid point is located on an aerial photo, and forest stands are delineated in the immediate vicinity. The minimum area for this delineation is 3 ha (7.4 acres). The grid point is then located in the field, and a 5-point cluster is established within the type-island associated with the grid point. If possible, the points are layed out in the pattern illustrated in figure 1. Where necessary, points are moved in a predetermined pattern to insure that the area sampled falls entirely within the type-island, thus avoiding plots that straddle condition-class boundaries. If the average diameter of the conifer trees on the plot is less than 12 cm (4.7 in), an additional five points may be established midway between the initial five plots.

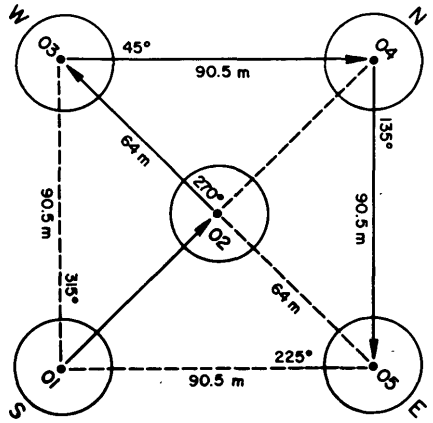

Figure 1.--Inventory plot layout.

At each sample point, three plots are established as follows:

Trees tallied	Plot size
(1) All trees up to 17.5 cm (6.9 in) in diameter	0.004-ha (.01-acre) fixed radius plot.
(2) Trees between 17.5 cm and 89.9 cm (35.4 in) in diameter	Metric basal area factor 7 (English BAF 30.5) variable radius plot
(3) Trees over 89.9 cm in diameter	0.09-ha (0.22-acre) fixed-radius plot

Species, d.b.h., crown class, crown ratio, total height, age, defect, and damage class is recorded for each tally tree. In addition, trees in the main canopy are separated from understory trees. Sometimes a few large trees--the remnants of past logging or fire--are scattered through regeneration stands. Such trees are separately identified as residual overstory.

Information is collected on competing vegetation, including a record of the degree to which growing stock trees are shaded by competing brush or hardwoods. The site index, topographic class, and stand history of each sampled stand is also recorded as well as information on erosion, land-use conflicts, and environmental factors affecting treatment./

Tree Classification

The first step in classification of the field plot data is to assign tree class designations to each tally tree. The major tree categories--main stand (overstory), future stand (understory), residual overstory, conifer and hardwood--are assigned in the field. Additionally, objective criteria are used to classify each tree as follows:

1. Mature tree.

A conifer, black cottonwood, or red alder that has passed the age when mean annual increment is assumed to culminate and is expected to live longer than 10 years.

2. High risk tree.

A merchantable conifer, red alder, or cottonwood likely to die within 10 years because of disease, injury, or poor vigor, as indicated by damage codes recorded on the plot card.

3/Field procedures are described in detail in a treatment opportunity field manual on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

3. Immature growing stock tree.

A presently or potentially merchantable conifer, red alder, or cottonwood tree that is less than the presumed age for culmination of mean annual increment.

4. Low-value hardwood.

A hardwood other than red alder or cottonwood. Such trees are not now considered suitable for potential timber crop trees because of poor prospects for a present or future market.

5. Cull tree.

A tree that is unmerchantable because of rot or poor form.

6. Salvable dead tree.

A dead tree that is still at least 25-percent sound and merchantable.

Plot Classification

Initial screening.--Before inventory plots are classified for treatment opportunity, certain plots may be identified as representing areas unsuitable for management because treatment is not feasible or is unlikely to succeed. Such plots usually occur on hot, dry sites where productivity is low and regeneration hazard is high. Identification of these areas is based on guidelines obtained from forest managers and ecologists familiar with the region. Hardwood stands growing on hardwood sites--usually river bottoms--are also identified as unsuitable for treatment because of the poor market for most hardwood species. Poorly stocked recent clearcuts--cut within 5 years--and stands partially cut within 3 years are placed in a special category. Since the regeneration of clearcuts is now a legal obligation, we assume they are awaiting scheduled treatment. The success of regeneration after recent partial cutting will be evaluated at the time of the next inventory.

Identifying the management category.--After initial screening, each plot is placed in one of the seven management categories. First, the plot is examined to see whether at least three of the five points qualify as mature conifer. If not, the plot is reexamined to see if three points qualify as intermediate conifer. This process is repeated until a management category is found that fits the plot tally on at least three points. The order of categories tested is (1) mature conifer, (2) intermediate conifer, (3) conifer regeneration, (4) high-value hardwood, (5) high-value hardwood-conifer mixed. Stands which do not fit any of these categories are classed as "manageable stand absent." The process is illustrated in figure 2.

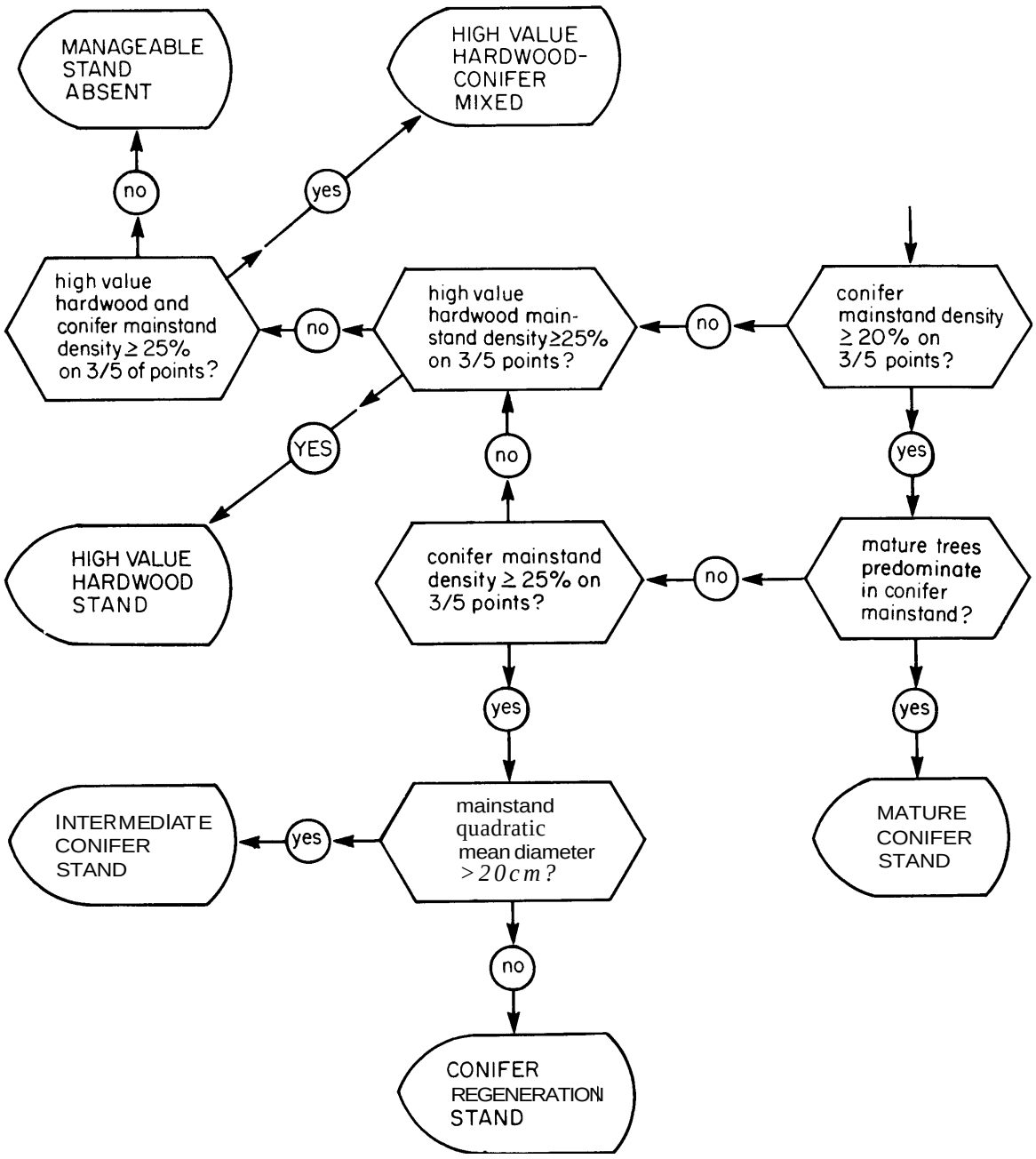

Figure 2.--Treatment opportunity logic: Identifying the management category.

The primary tool for this plot classification is a computer printout showing the stand density at each sample point by (1) softwoods and hardwoods, (2) stand position (mainstand, future stand, and residual overstory), and (3) tree class. An example of this printout is shown in table 1. Based on these density data, the management category is first determined; and then within that category, the actual treatment--occasionally treatments--are identified,

Treatment opportunities in mature stands.--The age at which a manager harvests timber varies widely with organization objectives, multiple-use policies, and a variety of economic considerations. Stands classed as mature in our analysis may add substantial growth if held for later harvest. On the other hand, somewhat younger harvest ages will not greatly reduce the long-term total yield. In any event, stands classed as mature in this analysis have passed the point where large increases in productivity are possible through manipulation of existing growing stock.

Mature stands are identified as opportunities to clearcut-and regenerate except in stands (1) qualifying for a shelterwood removal cut, or (2) in areas where clearcutting is unacceptable because of regeneration .hazard or other environmental restraints. Areas not suitable for clearcutting because of regeneration hazard are identified by local criteria obtained from managers and ecologists familiar with the area. Such areas are candidates for a shelterwood seed cut, a shelterwood removal cut, or for underplanting, depending on the characteristics of the stand. The logic used to identify these opportunities for treatment is illustrated in figure 3.

Treatment opportunities in intermediate stands.--Intermediate stands, although not ready for final harvest, have passed the age where large yield increases are possible through silvicultural manipulation of growing.stock. The denser stands, however, may be candidates for commercial thinning to reduce capital investment and to increase the size of the trees to be removed in the final harvest. In addition, the growth of some stands may be increased by removing culls, hardwoods, and high-risk trees. The logic used to identify these treatments is illustrated in figure 4.

Treatment opportunities in regeneration stands.--Regeneration stands are at the stage of development where silvicultural treatment can often have considerable impact on future yield (Reukema and Bruce 1977). Timely precommercial thinning can redistribute growth to those trees most likely to survive until harvest and increase height growth as well, and the planting of nonstocked openings can return such areas to timber production. Additionally, the control of hardwood and brush competition can substantially increase future yields.

The logic used to identify opportunities for silvicultural treatment in regeneration stands is illustrated in figure 5.

Table 1--Example of display of stand density by point and by stand component

S O U T H W E S T W A S H I N G T O N

STATE 53 PLOT SEQUENCE 68 NUMBER OF POINTS 5 QUADRATIC MEAN DIAMETER, MAINSTAND (CON= 28.22 HWD= 0.00)
COUNTY 15 PLOT NUMBER 12 STOCKING POINTS 0 QUADRATIC MEAN DIAMETER, FUTURE STAND (CON= 5.24 HWD= 7.61)
PROPORTION OF STOCKABLE AREA 1.08
SALVABLE DEAD STOCKING 0.00

PERCENT OF NORMAL DENSITY FOR PLOT 12

		1/	SOUND CULL	ROTTEN CULL	-GROWING STOCK- LO-VALUE HARDWOOD	----SOFTWOOD/RED ALDER/COTTONWOOD---- HIGH RISK IMMATURE	MATURE	TOTAL	TOTAL POINT STOCKING
POINT 1 (CC=99)	M/S	SFTWCS	0.0	0.0	0.0	0.0	23.1	0.0	23.1	
	M/S	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	F/S	SFTWDS	0.0	0.0	0.0	0.0	105.4	00	105.4	
	F/S	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	SFTWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	00	
	TOTAL		0.0	0.0	0.0	0.0	128.5	0.0	128.5	128.5
POINT 2 (CC=99)	M/S	SFTWCS	0.0	0.0	000	0.0	44.3	0.0	44.3	
	M/S	HRDWDS	0.0	0.0	0.0	00	0.0	0.0	0.0	
	F/S	SFTWCS	0.0	0.0	0.0	00	35.0	0.0	35.0	
	F/S	HRDWDS	0.0	0.0	000	0.0	0.0	00	0.0	
	F/O	SFTWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	HRDWDS	0.0	00	0.0	0.0	0.0	0.0	0.0	
	TOTAL		0.0	00	0.0	0.0	79.3	0.0	79.3	79.3
POINT 3 (CC=99)	M/S	SFTWCS	0.0	0.0	0.0	00	0.0	0.0	0.0	
	M/S	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	F/S	SFTWDS	0.0	0.0	000	128.0	153.2	0.0	281.2	
	F/S	HRDWDS	0.0	0.0	000	0.0	0.0	0.0	0.0	
	R/O	SFTWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	HRDWDS	0.0	00	0.0	0.0	0.0	0.0	0.0	
	TOTAL		0.0	00	000	128.0	153.2	00	281.2	281.2
POINT 4 (CC=99)	M/S	SFTWCS	0.0	0.0	0.0	0.0	12.6	0.0	12.6	
	M/S	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	00	
	F/S	SFTWDS	0.0	0.0	0.0	0.0	108.8	0.0	108.8	
	F/S	HRDWDS	0.0	0.0	0.0	0.0	44.5	0.0	44.5	
	R/O	SFTWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	HRDWDS	0.0	0.0	0.0	0.0	0.0	00	0.0	
	TOTAL		0.0	00	0.0	0.0	166.0	0.0	166.0	166.0
POINT 5 (CC=99)	M/S	SFTWCS	0.0	0.0	0.0	0.0	12.6	0.0	12.6	
	M/S	HRDWDS	41.0	00	0.0	0.0	0.0	0.0	0.0	
	F/S	SFTWDS	0.0	0.0	0.0	0.0	231.5	0.0	237.5	
	F/S	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	SFTWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	R/O	HRDWDS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	TOTAL		47.8	0.0	0.0	0.0	250.1	0.0	250.1	297.8

1/ MS = Mainstand,
FS = Future stand,
RO = Residual overstory.

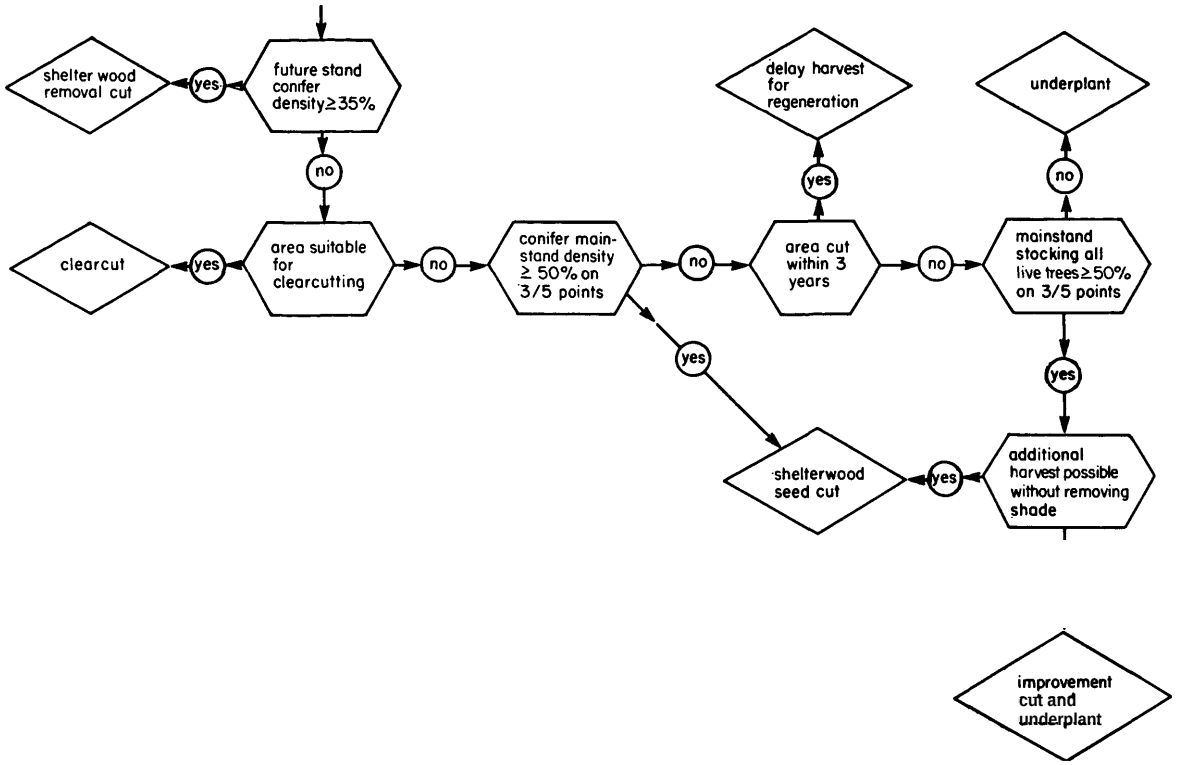

Figure 3.—Treatment opportunity logic fo mature stands.

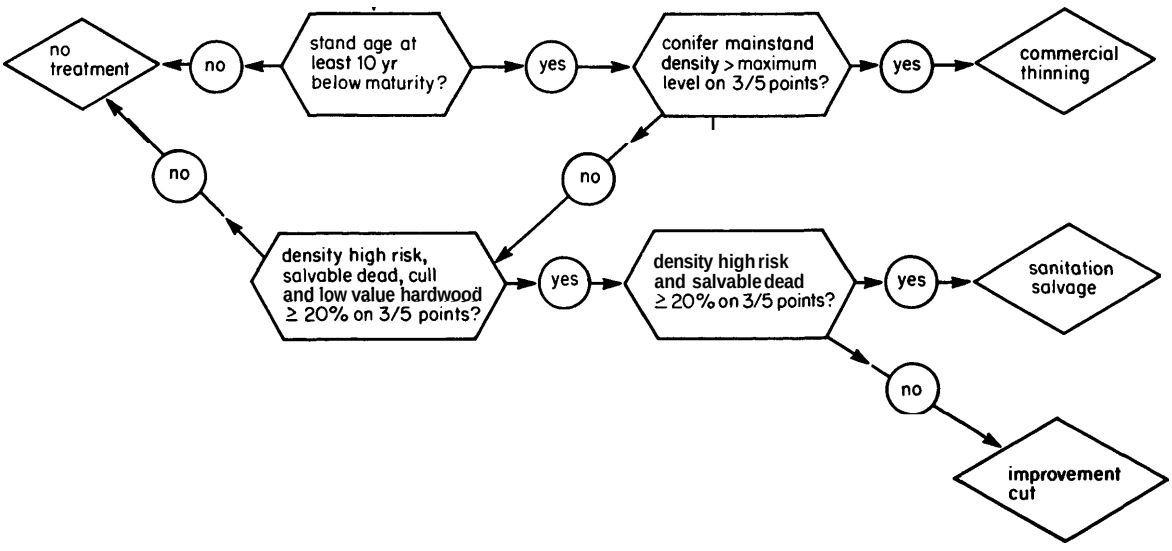

Figure 4.--Treatment opportunity logic for intermediate stands.

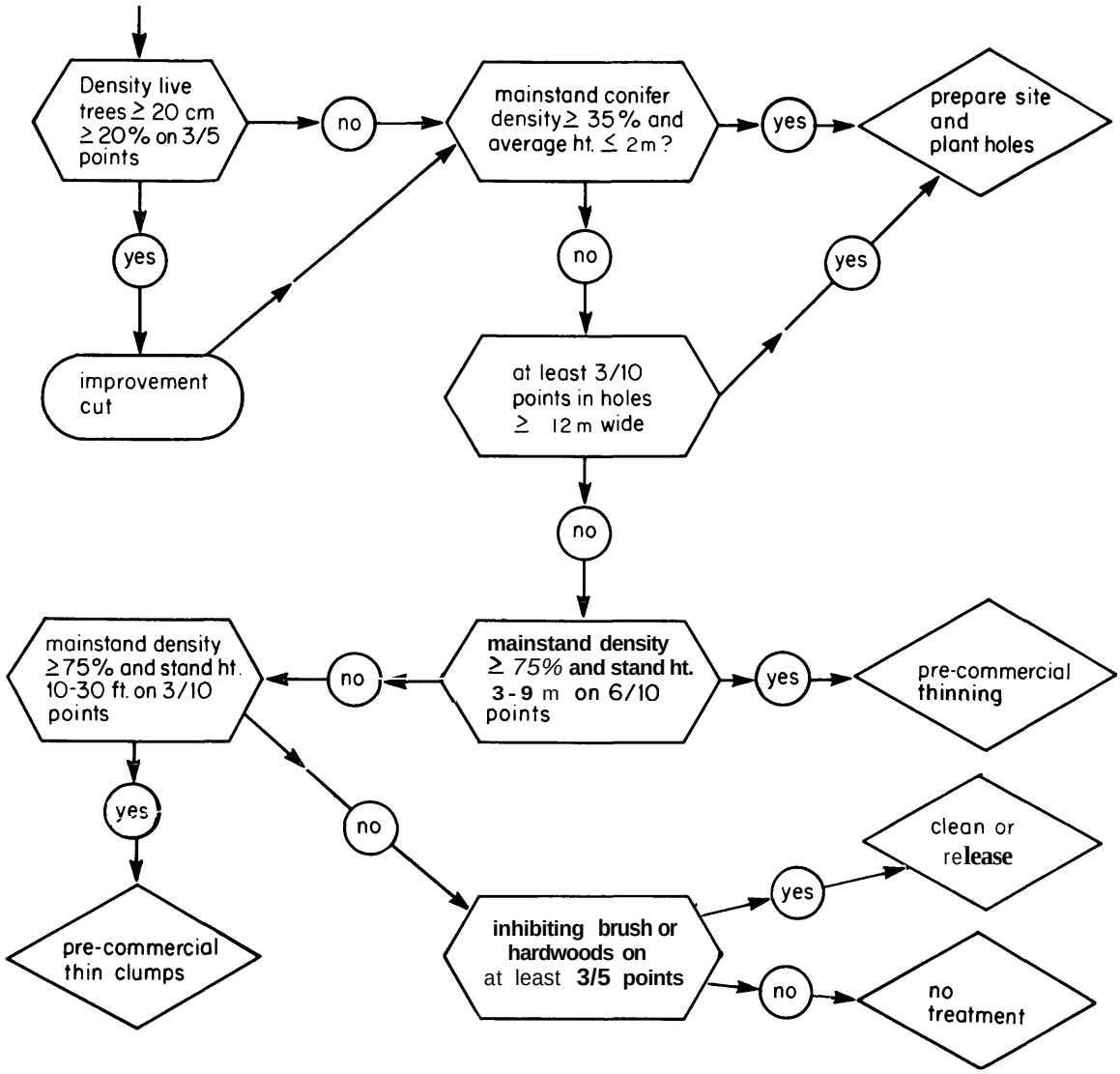

Figure 5.--Treatment opportunity logic for regeneration stands.

Treatment opportunities in hardwood stands and areas where no manageable stand exists.--The greatest opportunity to increase timber production through silvicultural treatment is to regenerate areas now growing weeds, brush, and low-value hardwoods. Further increases may be realized by replacing stands of red alder and poorly stocked conifer with new conifer regeneration stands. In our analysis, all such stands are regarded as opportunities for replacement. The logic for identifying such opportunities is illustrated in figure 6. Red alder stands are, however, identified separately. If the demand for that species improves, we may want to consider growing alder as an alternative to replacement.

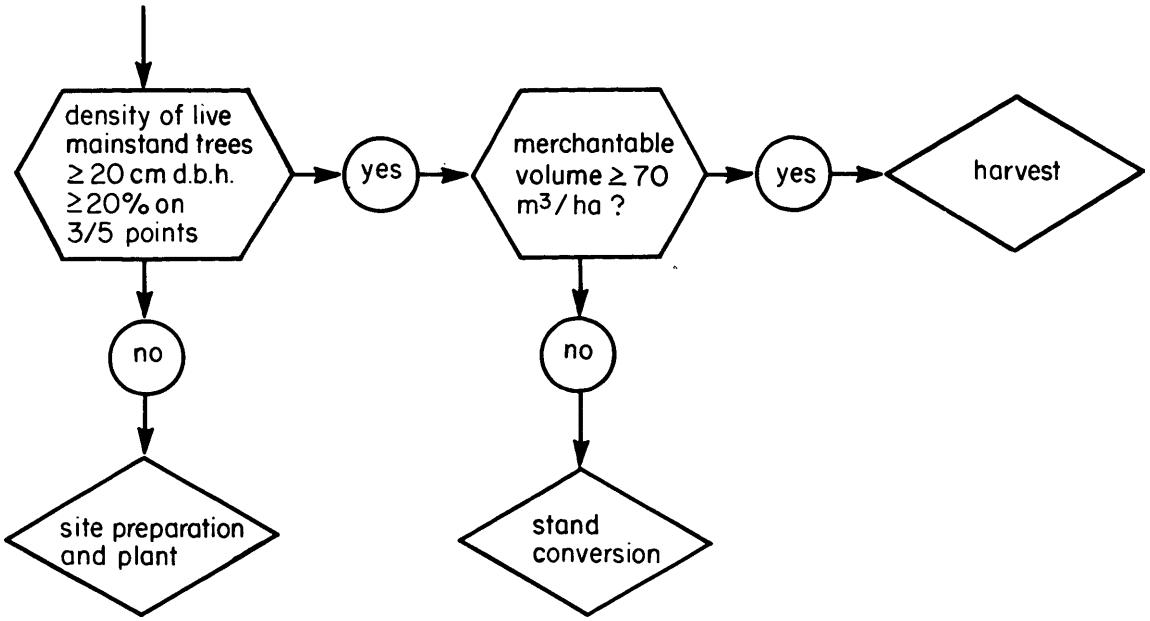

Figure 6.--Treatment opportunity logic for areas where no manageable stand exists.

FURTHER REFINEMENTS

We have now analyzed treatment opportunity data from western Oregon and will soon begin an analysis of western Washington data. We are making the same analysis in eastern Oregon but with slightly altered criteria to reflect the different conditions that exist on the east side of the Cascade Range. In our initial work, we have hand-screened the data to make sure that each plot has been assigned a reasonable treatment. While this process has uncovered a few defects, the results have been generally good. Our experience in analyzing western Washington data will undoubtedly permit further refinement.

While the procedures now work well, some subjective verification of results will probably always be necessary, particularly in heavily disturbed stands. A system complex enough to anticipate all conditions that may be encountered in the woods is probably neither possible nor desirable.

Thus far, treatment opportunity classification has proved a very useful tool for assessing forest condition. Preliminary analyses have also convinced us that it will provide an excellent means of stratifying our inventory in order to project future timber supply under various assumptions.

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Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.

2. Developing and evaluating alternative methods and levels of resource management.

3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

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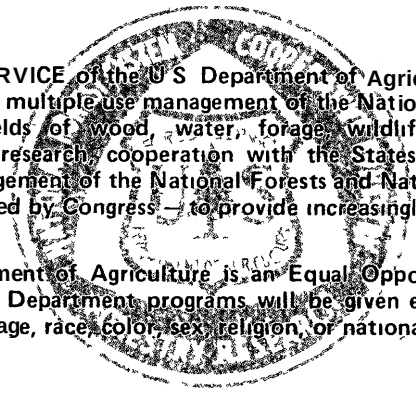

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