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Opportunities for Silvicultural Treatment in Western Oregon

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Metric Equivalents

1,000 acres = 404.69 hectares
1,000 cubic feet = 28.3 cubic meters
1 cubic foot per acre = 0.0700 cubic meter per hectare
1 square foot basal area per acre = 0.2296 square meter per hectare
1 foot = 30.48 centimeters
1 inch = 2.540 centimeters

Opportunities for Silvicultural Treatment in Western Oregon

Reference Abstract

MacLean, Colin D.

1980. Opportunities for silvicultural treatment in western Oregon. USDA For. Serv. Resour. Bull. PNW-90, 35 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

A recent Forest Survey inventory of western Oregon has been analyzed to determine the extent of physical opportunities to increase wood production through silvicultural treatment. Results are presented by owner group and by geographic unit.

Keywords: Silvicultural treatments, intensive management, timber resources, Oregon (western).

Research Summary

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Almost 6 million acres of private forest holdings and over 7 million acres of public forest lands in western Oregon are potentially capable of growing continuous crops of conifer timber. Production of conifers on many of these acres could be increased through silvicultural treatment. The objective of this analysis was to determine how many acres of timberland in western Oregon are physically suited for silvicultural manipulation of growing stock and competing vegetation to increase timber production.

The analysis identified almost 1.4 million acres of young conifer stands on private lands that would be more productive if silviculturally treated by thinning, cleaning, improvement cutting, or reinforcement planting. Another 1.5 million acres lack adequate conifer stocking for management; 40 percent of this land is nonstocked, and the remainder is stocked with either hardwoods, scattered residual conifers, or a mixture of the two. Almost 2 million acres of private forest land--about one-third of the western Oregon total--support productive young conifer stands that offer no substantial opportunities for treatment and another 900,000 acres of timberland that support harvestable conifer stands over 70 years old.

Unlike private forests, public forests are still predominantly mature and offer relatively few opportunities for investment in silvicultural treatments that will increase future yields. Over 4 million acres of public timberland support harvestable conifer stands that exceed 70 years of age, and an additional 1.3 million acres support young conifer stands not currently in need of silvicultural treatment. There are almost 1 million acres of young conifer stands available for treatment and another 250,000 acres of functionally nonstocked cutover land. In addition, fires and other natural catastrophes have created 700,000 acres of hardwood and brush types that could be converted to conifer production if other resource considerations permit.

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Introduction

Now that much of western Oregon's privately owned, old-growth timber has been logged, harvesting activity is shifting to young stands growing in old clearcuts. Future supplies of conifer timber will come increasingly from lands that now support young conifer stands, hardwood trees, and, in some cases, brush and weeds. Current management practices on these lands will have a substantial impact on future supplies of timber.

In recent years, there has been widespread interest in programs to encourage silvicultural activity that will increase future yields of conifer timber. Thus, planners and legislators need information on the area available for treatment and kinds of treatment possible. A recent inventory of western Oregon timberlands was designed to provide this kind of information. The findings of that inventory are reported here. They are intended to provide information on (1) the condition of forest lands in western Oregon and (2) the physical opportunities to increase timber production on those lands through silvicultural treatment. Not all treatment opportunities identified in this report are likely to be undertaken. Some will conflict with objectives of the landowner and others may not be cost effective. However, neither landowner objectives nor cost effectiveness were analyzed for this report.

The Survey

A Renewable Resources Evaluation^{1/} inventory of private, State, and municipal forest lands in western Oregon was recently completed. Statistical reports of the findings have already been published (Bassett 1979, Jacobs 1978, Mei 1979). As part of that inventory, additional data were collected to permit plot-by-plot analysis of the opportunities to increase timber production through silvicultural treatment. The findings of that analysis are reported here. The field design and data analysis procedures are those described by MacLean (1979).

The Renewable Resources Evaluation inventory was based on a 3.4-mile grid of field plots covering all private, State, county, and municipal timberlands^{2/} in western Oregon. At each of these 958 grid locations and at 127 locations in southwestern Oregon, special plots were laid out for the express purpose of identifying opportunities for silvicultural treatment--particularly treatments dependent on the manipulation of tree stocking: planting, thinning, weeding, and harvesting. Although Federal lands administered by the USDA Forest Service and the U.S. Department of the Interior Bureau of Land Management (BLM) were not included in the inventory, treatment opportunities on those lands were identified by analysis of data from over 5,000 inventory plots furnished by the two agencies.

^{1/}Renewable Resources Evaluation inventories (formerly called the Forest Survey) are conducted in the Pacific Coast states by the Pacific Northwest Forest and Range Experiment Station as part of a nationwide project of the USDA Forest Service.

^{2/}Timberland is forest land capable of producing 20 ft³ per acre per year of industrial wood and not withdrawn from timber production. Timberland was formerly called commercial forest land.

The Treatments

Renewable Resources Evaluation plots consist of 10 sample points distributed over approximately 10 acres. At each point, trees over 35-inches in d.b.h. were sampled on a 55.6-foot-radius plot, trees 7 to 35 inches were sampled with a 30-factor prism, and trees under 7 inches were sampled on an 11.1-ft-radius plot. Plots on BLM lands and National Forests consisted of 10 points distributed over approximately 1 acre. At each point, trees over 5 inches in d.b.h. were sampled with an 80-factor prism and trees under 5 inches were sampled with either a 300th-acre or a 580th-acre fixed-radius point. Extensive data on nontree competition (shrubs, grasses, ferns, and other plants) were collected at each plot location; but this type of data was usually not available for the BLM and National Forest plots.

In western Oregon, most forest managers practice some form of even-aged management. The Resources Evaluation analysis assumes 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 merchantable stands are sorted into two species groups--conifer and salable hardwoods (with or without a conifer component), and conifer stands are further sorted into three maturity classes--mature, intermediate, and regeneration. An additional category--"no manageable stand present"--describes areas where trees are lacking or where the stocking of potentially salable trees is not sufficient to fully utilize the site.

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

The treatments identified in this analysis are described and defined in this report. The definitions were written after consultation with silviculturists and forest managers in the Pacific Northwest; they represent the silvicultural conventional wisdom of today, adapted to fit the variable stocking commonly found on inventory plots. The analytical procedure used to identify the treatment opportunities are described in a previous paper (MacLean 1980).

Mature Conifer Stands

Mature stands have a density of at least 20 percent of normal (MacLean 1979) on at least 60 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 use the normal yield table age--70 years (McArdle et al. 1961):

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 the same.

2. Clearcut.--This is the prescription for stands that fail to qualify for a shelterwood removal cut because of excessive overstory or inadequate understory, unless environmental or land use restrictions make clearcutting undesirable.

3. Shelterwood seed cut.--This is the proper prescription 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 8 inches, 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 "maximum" percent of normal density (Reukema and Bruce 1977) on at least 60 percent of the area are potential candidates for this treatment.

2. Improvement cutting.--The removal of unsalable material to free crop trees from competition. Improvement cutting differs from commercial thinning in that the material removed is not marketable. Stands are candidates for this treatment if the density of competition from unmarketable trees exceeds 20 percent of normal 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 8 inches in d.b.h. exceeds 1,000 cubic feet 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 8 inches and a density 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 8 inches. Such stands may be candidates for one of the following treatments:

1. Precommercial thinning.--Regeneration stands qualify for precommercial thinning:

(a) if the average height of the dominant and codominant trees is between 10 and 30 ft and (b) 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 8 inches. At 8 inches, normal density varies from 390 to 540 trees per acre, depending on species. The standard for smaller trees is slightly higher to account for anticipated mortality.

2. Precommercial thinning of clumps.--

Stands qualify for the precommercial thinning of clumps if their density exceeds the density standard on at least 30 percent but less than 60 percent of the area and the stand otherwise qualifies for precommercial thinning.

3. Cleaning 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 has been 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. Preparing site and planting 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 5 feet is absent, the nonstocked patches are suitable for spot planting, after site preparation.

5. Improvement cutting.--Regeneration stands qualify for improvement cutting when they are overtopped by hardwood and cull conifer trees that exceed 8 inches in d.b.h., and when the density of that overstory exceeds 20 percent on at least 60 percent of the area. These stands resemble stands that are candidates for overstory removal except that the overstory is composed of nonsalable 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 to identify alternative opportunities to manage for hardwood production. The opportunities currently identified are the same as those listed under "Manageable Stand Absent."

Results

Manageable Stand Absent

Areas that fail to qualify as mature, intermediate, or regeneration stands are assumed to not have a manageable stand and are candidates for the following regeneration treatments:

1. Harvest cutting (clearcutting).--Stands that average at least 1,000 cubic feet per acre in conifer and high-value hardwood trees over 8 inches in d.b.h. are candidates for clearcutting.

2. Stand conversion.--Stand conversion is the removal of all existing trees and their replacement with desirable growing stock. Stands qualify for stand conversion (a) if no manageable stand is present, (b) if the volume per acre is less than 1,000 cubic feet, and (c) if at least 60 percent of the area is stocked to a density of at least 20 percent with trees that exceed 8 inches in d.b.h.

3. Site preparation and planting.--Site preparation and planting is the removal of competing vegetation and the planting of desirable conifer growing stock. Areas qualify for this treatment if they lack a manageable stand and if the density of trees over 8 inches in d.b.h. is insufficient for stand conversion.

Since the area covered by this study encompasses a wide range of climatic, topographic, and geologic conditions and has a varied fire and cutting history, the findings are presented separately for three geographic strata--northwestern, west-central, and southwestern Oregon. In addition, five owner-groups--forest industry, other private, National Forest, Bureau of Land Management, and other public--are identified.

The acres of timberland in western Oregon that are suitable for silvicultural treatment are itemized in this report. The reader should be aware, however, that these are opportunities only in the physical sense. Some treatments suggested may be too costly to be justified under today's market conditions. The economic feasibility of the treatments identified by this study cannot be determined without further screening.

Reliability of the data.--Silvicultural prescription is, of necessity, a subjective process. The procedures (MacLean 1980) are an attempt to objectify the process, but judgment still plays an important part. The readers may reject the basic assumptions listed earlier or they may accept them and still disagree with some of the prescriptions. If, however, they accept the plot prescriptions as correct, the acreages presented here are still subject to sampling errors that vary inversely with the size of the estimate. The approximate size of those sampling errors can be estimated from table 1 (see appendix).

The treatment opportunities identified in this study are as of the date of inventory. Renewable Resources Evaluation inventories were conducted in southwest Oregon in 1973-74, in west-central Oregon in 1975, and in northwest Oregon in 1976. National Forest and BLM inventories were either taken or updated between 1973 and 1976.

NORTHWEST OREGON (Clackamas, Clatsop, Columbia, Hood River, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties)

Northwest Oregon has a cool, moist climate that is excellent for growing timber. Although well-stocked, immature stands of conifers predominate overall, mature conifer stands are extensive on Federal lands. Thus, silvicultural opportunities differ substantially between owner groups.

Forest industry lands.--Most of the lands owned by forest industry were logged during the period 1900-60, and now support thrifty young conifer stands (fig. 1). About 8 percent (fig. 2) of the area is occupied by stands that are mature by the definition used in this study, and another 6 percent could be harvested if rotation age were 50 years. About half the remaining area is well stocked with intermediate conifer stands (over 8 inches in average diameter). Because rapid growth permits relatively short rotations, many of these stands will be harvested within 20 years.



Figure 1.--In northwest Oregon, most forest industry-owned lands support thrifty young stands of conifers.

Although some opportunities for commercial thinning exist, most intermediate stands are moderately well stocked and will do well without further treatment. Productivity within the intermediate stands is high; over 80 percent of the area is devoted to conifer production. The occasional clumps of hardwood seldom are extensive enough to warrant improvement cutting.

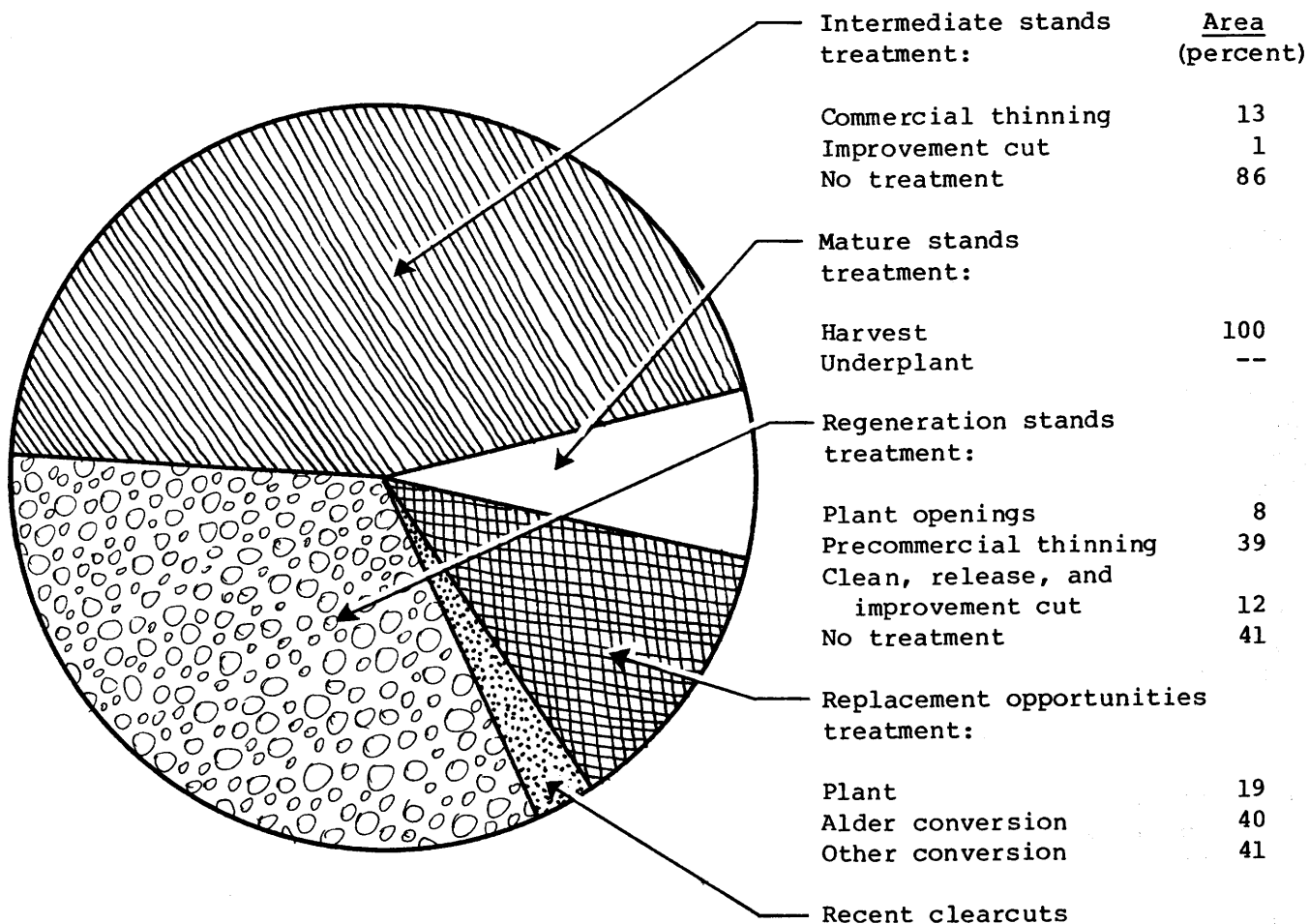


Figure 2.--Treatment opportunities on forest industry land in northwest Oregon.



Figure 3.--Red alder sometimes replaces conifers after clearcutting.

Most of the opportunities for silvicultural treatment are in the regeneration-sized stands and on areas where conifer stocking is either lacking or so poor that replacement is indicated. Generally, high-site lands where trees grow rapidly seem more likely to need precommercial thinning. On the other hand, regeneration failures are more common on the lower sites where clearcutting has occasionally converted conifer forest to hardwood type or brushland (fig. 3). The opportunities for silvicultural treatment on forest industry-owned lands in northwest Oregon are:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	60 $\pm$ 23	90
Improvement cut	6 $\pm$ 6	70
No treatment needed	409 $\pm$ 45	74
Total and average	475 $\pm$ 45	76
MATURE STANDS		
Harvest: Clearcut	75 $\pm$ 27	84
Shelterwood: Removal cut	6 $\pm$ 6	100
Total and average	81 $\pm$ 28	85
REGENERATION STANDS		
Plant openings	28 $\pm$ 14	49
Precommercial thinning	45 $\pm$ 17	97
Improvement cut	16 $\pm$ 11	90
Precommercial thinning of clumps	93 $\pm$ 23	93
Clean and release	29 $\pm$ 13	66
No treatment needed	146 $\pm$ 27	84
Total and average	357 $\pm$ 34	84
REPLACEMENT OPPORTUNITIES		
Site preparation and plant	20 $\pm$ 16	27
Alder conversion	43 $\pm$ 16	17
Other conversion	44 $\pm$ 19	35
Total and average	107 $\pm$ 27	26

Conifer occupancy is the percent of the area occupied by growing stock conifer trees. When conifer occupancy is less than 100 percent, the remaining area is bare ground or is growing hardwoods, brush, cull conifers, or other vegetation.

*Confidence intervals at the 0.68-probability level.

In addition to the acres available for treatment, there were 23,000 acres of recent clearcuts (cut within 5 years).

Lands owned by forest industry in north-west Oregon are generally well managed, and inventory crews found considerable evidence of recent silvicultural activity. Although study data were inadequate to determine the exact level of current activity, many treatable acres identified in this study are undoubtedly scheduled for treatment.

Other private lands.--Like forest industry lands, about 8 percent of the other private lands support mature timber (fig. 4) and another 10 percent could be harvested under a 50-year rotation. In other respects, however, the ownerships are dissimilar. Unlike forest industry lands, other private lands are frequently understocked. Overall, only 44 percent of the area available for conifer production is occupied by conifer trees, with the remaining area shared by hardwoods, brush, herbs, and grasses. While some of the hardwoods and brush patches are scattered within manageable conifer stands, almost half of the nonindustrial private acres lack the minimum conifer growing stock needed for reasonable management (fig. 5).

Although only 8 percent of the other private land is nonstocked, another 40 percent has been high graded repeatedly and now supports a scattered mixture of sawtimber-size conifers, red alder, other hardwoods, and brush. Merchantable volumes in these stands are less than 5,000 board feet per acre. These stands are currently producing only a fraction of their potential. Extensive site preparation will be needed before they can be replaced by new conifer stands.

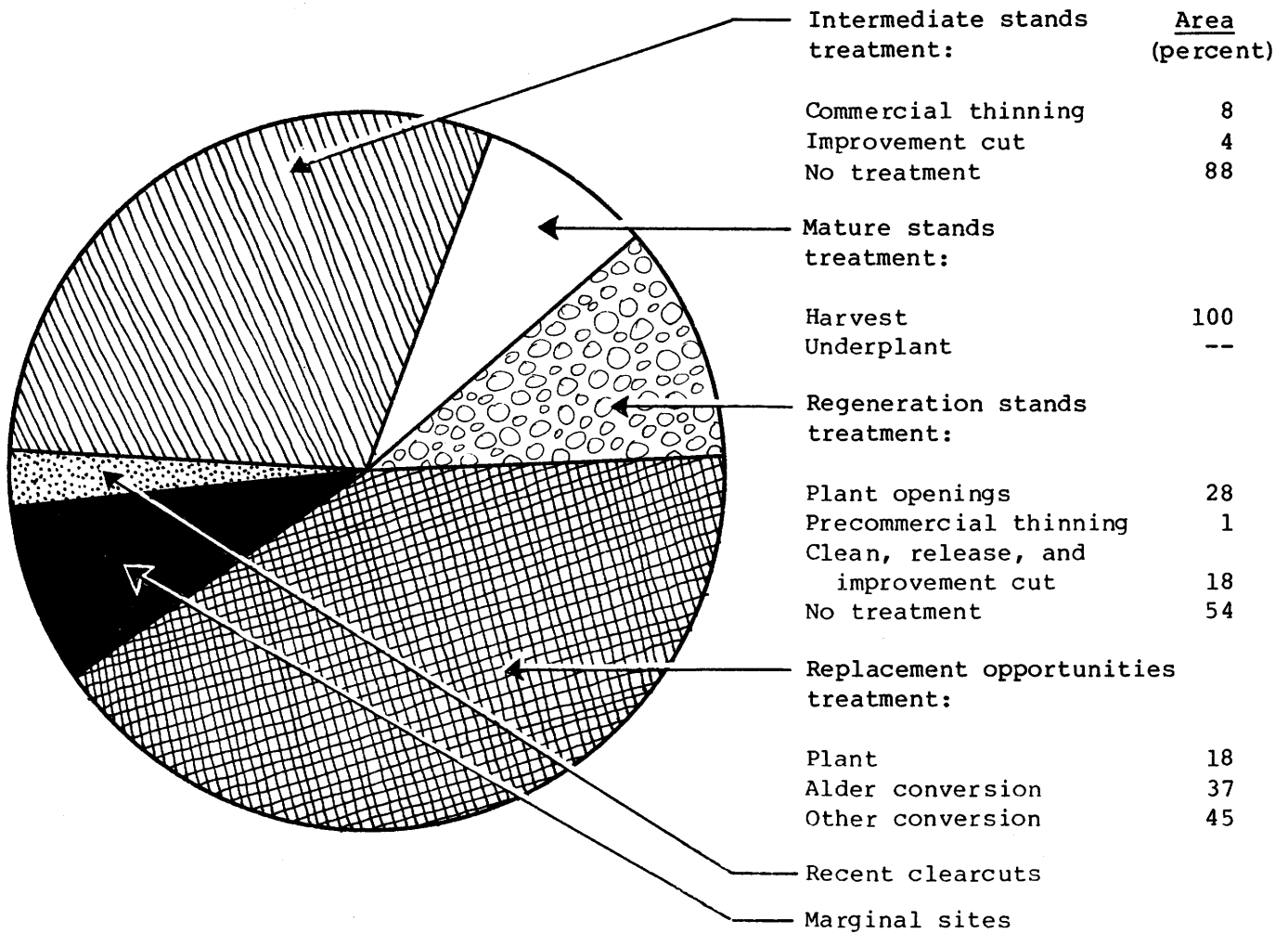


Figure 4.--Treatment opportunities on other private lands in northwest Oregon.



Figure 5.--Almost half the nonindustrial private land in northwest Oregon lacks the minimum conifer growing stock needed for reasonable management.

The opportunities for silvicultural treatment are:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy</u> (Percent)
INTERMEDIATE STANDS		
Commercial thinning	19 + 11	95
Improvement cut	9 + 9	41
No treatment needed	201 + 33	68
Total and average	229 + 34	69
MATURE STANDS		
Harvest: Clearcut	57 + 18	46
Total and average	57 + 18	46
REGENERATION STANDS		
Plant openings	22 + 13	50
Precommercial thinning	1 + 1	100
Improvement cut	7 + 7	54
Clean and release	7 + 7	62
No treatment needed	43 + 17	68
Total and average	80 + 23	62
REPLACEMENT OPPORTUNITIES		
Site preparation and plant	57 + 20	17
Alder conversion	118 + 27	12
Other conversion	141 + 30	29
Total and average	316 + 40	20

*Confidence intervals at the 0.68-probability level.

An additional 62,000 acres are wet bottom-lands unsuitable for growing conifers; 23,000 acres are recent cutovers, assumed to be scheduled for planting.

State, county, and municipal lands.--After the devastating Tillamook fires in the 1930's and 1940's, the State of Oregon acquired title to large tracts of burned-over forest land. After burned timber was salvaged, a massive regeneration effort was undertaken. Although study results do not specifically identify the Tillamook burn, the State owns all but 50,000 acres of the non-Federal public lands in north-west Oregon, and much of that land is in the Tillamook burn (now known as the Tillamook Forest). It is evident from the study results (fig. 6) that the regeneration effort has mainly been successful; over three-quarters of the State, county, and municipal lands are growing manageable stands of conifer.

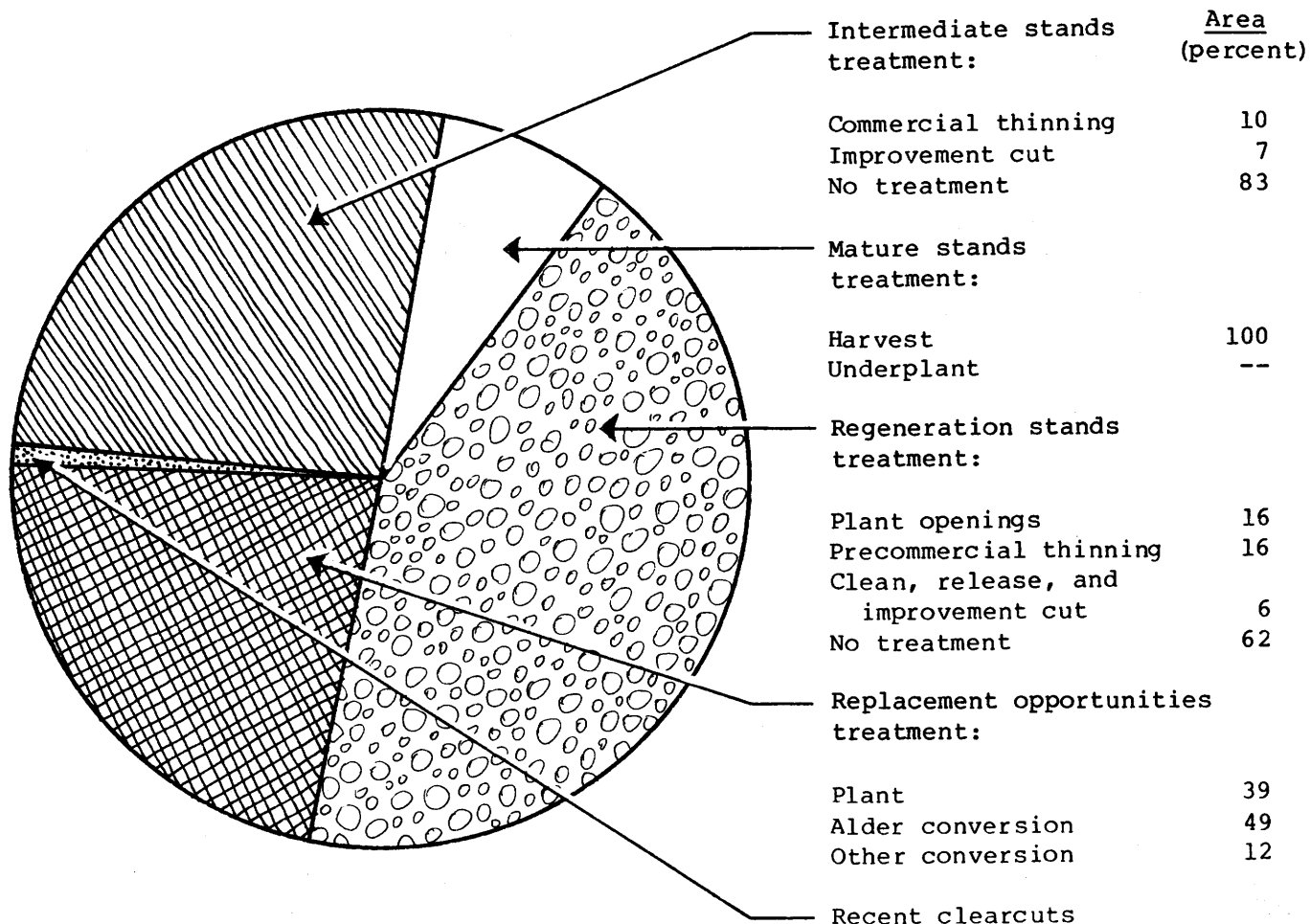


Figure 6.--Treatment opportunities on State, county, and municipal lands in northwest Oregon.

The opportunities for treatment on State, county, and municipal lands are:

<u>Treatment*</u>	<u>Thousand acres**</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	16 ± 12	93
Improvement cut	11 ± 11	38
No treatment needed	127 ± 31	77
Total and average	154 ± 34	76

MATURE STANDS		
Harvest: Clearcut	42 ± 15	92
Total and average	42 ± 15	92

REGENERATION STANDS		
Plant openings	38 ± 17	48
Precommercial thinning	20 ± 12	87
Improvement cut	15 ± 11	60
Precommercial thinning of clumps	20 ± 12	92
Clean and release	--	--
No treatment needed	149 ± 30	82
Total and average	242 ± 32	77

REPLACEMENT OPPORTUNITIES		
Site preparation and plant	51 ± 19	20
Alder conversion	63 ± 21	10
Other conversion	16 ± 12	39
Total and average	130 ± 25	17

*Neither economic feasibility nor practical operational considerations, such as poor access and adverse topography, have been considered in assigning these treatments. The Oregon State Department of Forestry has completed an intensive rehabilitation program on

the Tillamook forest. They believe that most of the opportunities identified here are infeasible because of cost, operational difficulty, or environmental restraints.

**Confidence intervals at the 0.68-probability level.

Only one field plot (representing 7,000 acres) was in a recent clearcut.

Federal timberlands.--Although only about one-third of the timberland in northwest Oregon is owned by the Federal Government, that land includes 80 percent of the mature timber in the area (fig. 7). National Forest land, in particular, is characterized by older stands: 63 percent of the area is in mature timber, and another 20 percent is occupied by intermediate

stands. As a result, silvicultural treatment opportunities other than harvest cut are limited, primarily to commercial thinning.

About 200,000 acres of Federal land have been clearcut and two-thirds of these have been successfully regenerated. The remaining one-third are evenly divided between recent cutovers scheduled for planting and regeneration failures.

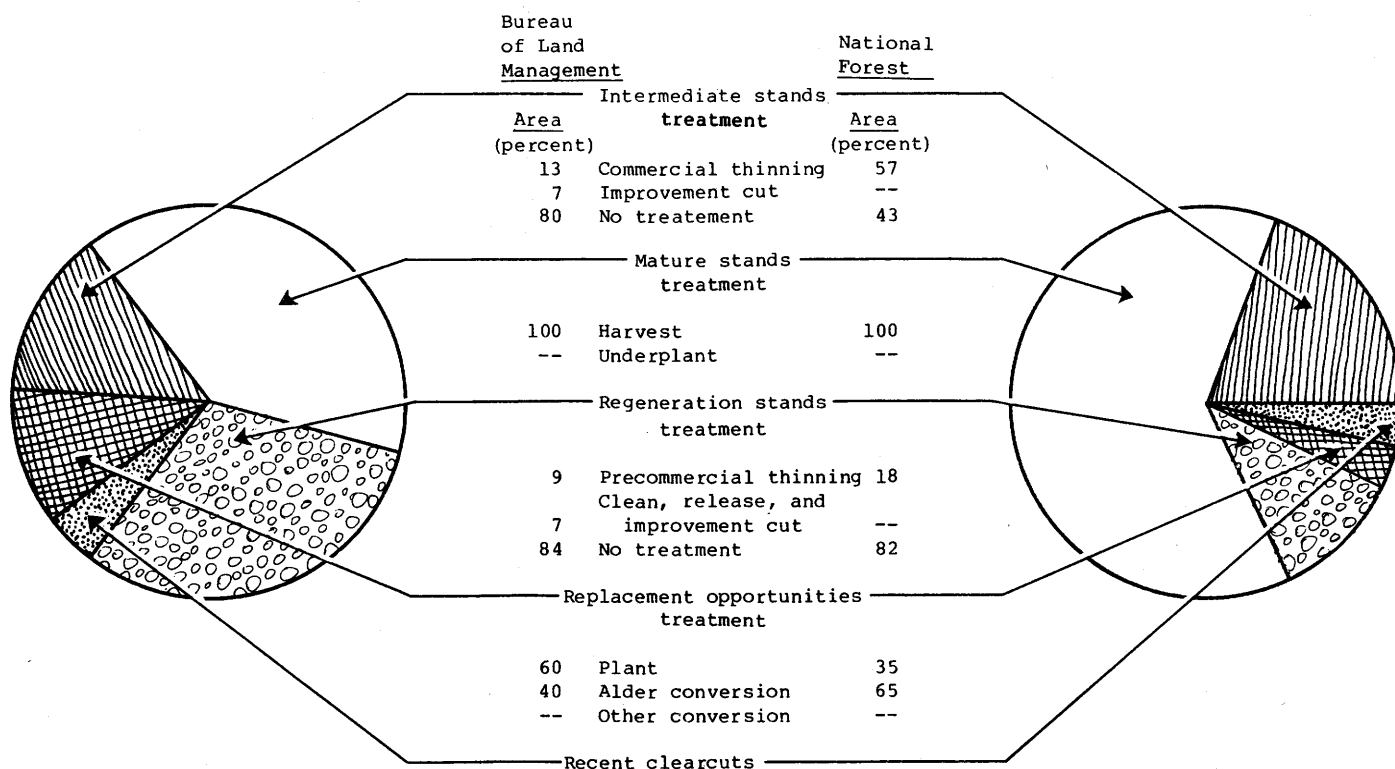


Figure 7.--Treatment opportunities on Federal land in northwest Oregon.

Treatment opportunities on Federal lands are:

	National Forest	Bureau of Land Management
	(Thousand acres*)	

INTERMEDIATE STANDS

Commercial thinning	104 ± 14	4 ± 1
Improvement cut	--	2 ± 1
No treatment needed	78 ± 11	24 ± 3
Total	182 ± 16	30 ± 3

MATURE STANDS

Harvest: Clearcut	552 ± 25	91 ± 5
Shelterwood: Removal cut	37 ± 17	--
Total	589 ± 25	91 ± 5

REGENERATION STANDS

Precommercial thinning	18 ± 6	6 ± 1
Improvement cut	--	1 ± 1
Clean and release	--	4 ± 1
No treatment needed	3/ 82 ± 11	3/ 59 ± 4
Total	100 ± 14	70 ± 5

REPLACEMENT OPPORTUNITIES

Site preparation and plant	12 ± 5	15 ± 3
Alder conversion	22 ± 6	10 ± 2
Other conversion	--	--
Total	34 ± 8	25 ± 3

Data on conifer occupancy are unavailable for federally owned lands.

3/ Two treatments--"Plant openings" and "Precommercial thinning of clumps"--could not be identified because of the small size of the plot.

*Confidence intervals at the 0.68-Probability level.

WEST-CENTRAL OREGON (Benton, Lane, Lincoln, and Linn Counties)

The climate of west-central Oregon is slightly hotter and drier than that of northwest Oregon, and the immature stands in the area are younger than those farther north--reflecting a more recent logging history. The area is potentially as productive as northwest Oregon and is less subject to hardwood incursion on conifer sites. The hotter climate, however, increases the risk of regeneration failure, particularly in the southern Willamette Valley.

Forest industry lands.--Lands owned by forest industry in west-central Oregon are predominantly conifer regeneration (figs. 8 and 9). Only one-third of the ownership supports stands larger than 8 inches in average diameter and 60 percent of that is less than 50 years old. About 70 percent of the remaining area has been regenerated successfully, and one-third of these regeneration stands would benefit from precommercial thinning.

There are still substantial opportunities to increase timber production through planting and stand conversion activities. Almost 200,000 acres of good timber-growing land is currently either unproductive or growing alder--a species that is both less productive and less marketable. The cost of putting these acres into production may be quite high, but the return is potentially more than 26 million cubic feet per year.

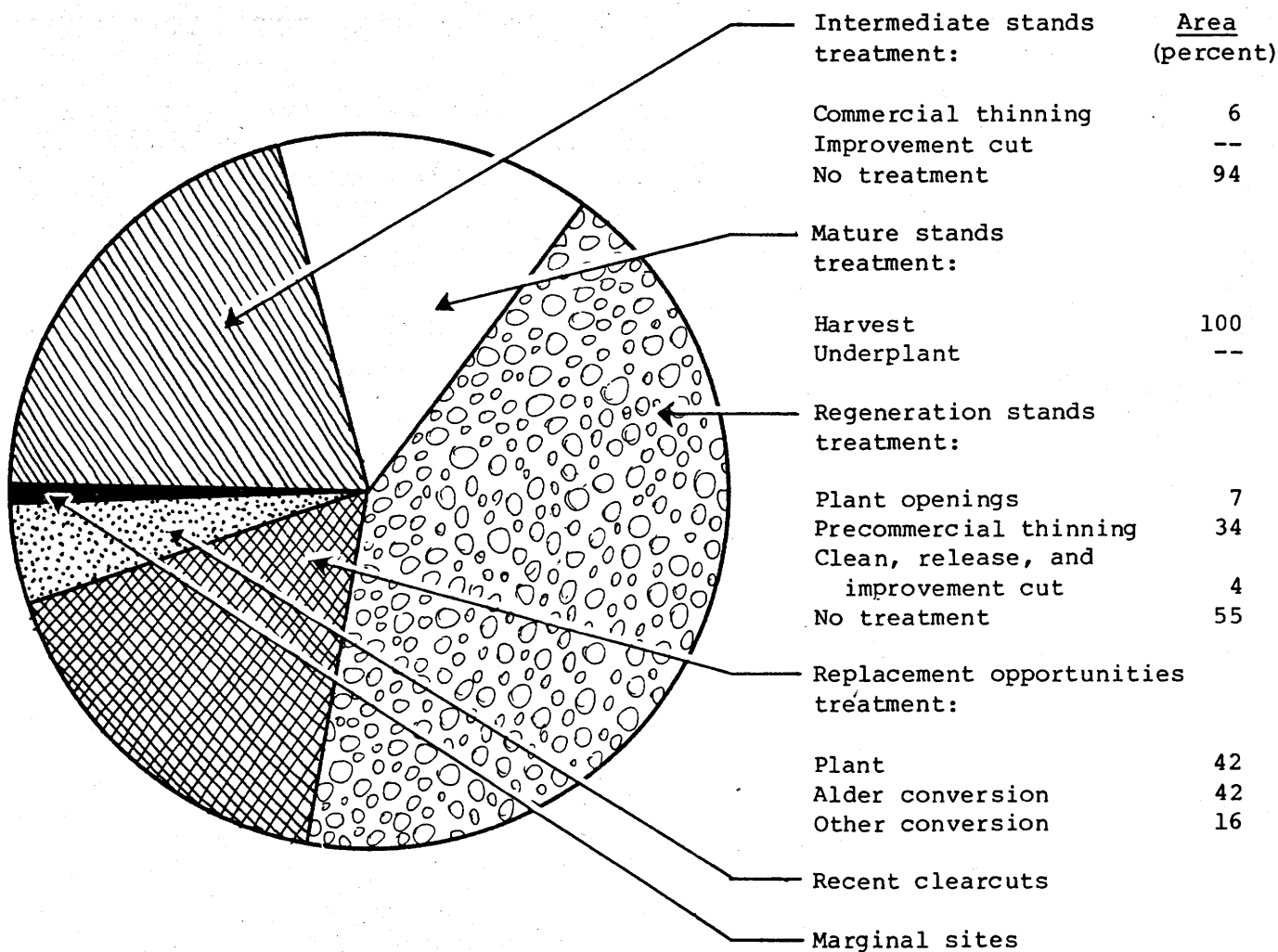


Figure 8.--Treatment opportunities on forest industry lands in west-central Oregon.

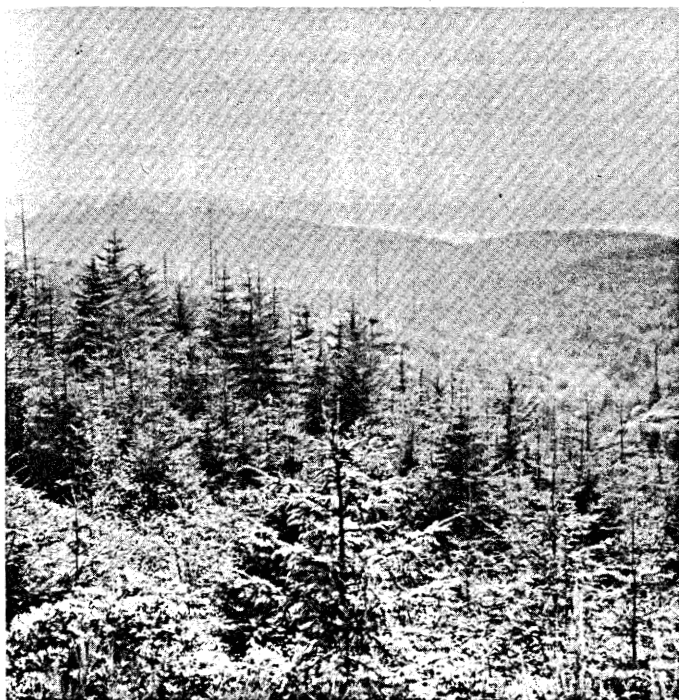


Figure 9.--Forest industry lands in west-central Oregon are predominantly stocked with conifer regeneration.

A detailed list of the opportunities for silvicultural treatment on lands owned by forest industry in west-central Oregon follows:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
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INTERMEDIATE STANDS

Commercial thinning	12 $\pm$ 12	100
Improvement cut	--	--
No treatment needed	205 $\pm$ 36	75
Total and average	217 $\pm$ 37	76

MATURE STANDS

Harvest: Clearcut	150 $\pm$ 25	81
Shelterwood: Removal cut	6 $\pm$ 6	97
Total and average	156 $\pm$ 26	82

REGENERATION STANDS

Plant openings	31 $\pm$ 16	51
Precommercial thinning	81 $\pm$ 25	79
Improvement cut	14 $\pm$ 10	64
Precommercial thinning of clumps	82 $\pm$ 28	86
Clean and release	7 $\pm$ 7	80
No treatment needed	258 $\pm$ 43	80
Total and average	473 $\pm$ 47	78

REPLACEMENT OPPORTUNITIES

Site preparation and plant	79 $\pm$ 23	17
Alder conversion	79 $\pm$ 20	14
Other conversion	30 $\pm$ 12	37
Total and average	188 $\pm$ 39	19

An additional 55,000 acres of recent clear-cuts are probably scheduled for planting. There are an estimated 6,000 acres of hardwood site that are unsuitable for growing conifers.

Other private lands.--Only 8 percent of the other private lands in west-central Oregon support mature timber stands. Intermediate stands account for 30 percent of the area; about one-quarter of these are over 50 years in age.

*Confidence intervals at the 0.68-probability level.

Conifer regeneration is somewhat more extensive on the other private lands of west central Oregon than on similar lands to the north (fig. 10). The reason, however, is not better management but an environment where hardwood encroachment on conifer sites is less common. Still, most of the opportunity for silvicultural activity lies in the planting of non-stocked areas and unproductive stands that theoretically could be growing 33 million cubic feet of wood per year. A list of the opportunities for silvicultural treatment on the other private lands of west-central Oregon follows:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	12 ± 12	100
Improvement cut	5 ± 5	50
No treatment needed	191 ± 36	77
Total and average	208 ± 34	78

MATURE STANDS		
Harvest: Clearcut	58 ± 20	67
Total and average	58 ± 20	67

REGENERATION STANDS		
Plant openings	19 ± 14	53
Precommercial thinning	18 ± 13	90
Improvement cut	10 ± 7	70
Precommercial thinning of clumps	9 ± 9	71
Clean and release	--	--
No treatment needed	91 ± 28	75
Total and average	147 ± 35	73

REPLACEMENT OPPORTUNITIES		
Site preparation and plant	106 ± 31	18
Alder conversion	58 ± 18	7
Other conversion	88 ± 25	33
Total and average	252 ± 39	21

*Confidence intervals at the 0.68-probability level.

An additional 37,000 acres of commercial forest land were classed as marginal. Typically, these marginal acres are: (1) hardwood bottomlands incapable of growing conifers; (2) hot, dry sites--frequently with shallow soil, where productivity is low, regeneration difficult, and management infeasible; or (3) serpentine soil types, where soil toxicity prevents establishment of productive stands.

State, county, and municipal lands.--These government agencies own only about 100,000 acres of timberland in west-central Oregon--about evenly divided between mature and intermediate stands. Opportunities for silvicultural treatment are too small to be accurately assessed from the relatively extensive sample taken for this study. The estimated acreages of treatment opportunities are listed below. From these statistics, the reader can infer that some opportunities for thinning and stand conversion exist; but little reliance should be placed on the exact acreage shown.

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	9 ± 9	93
No treatment needed	39 ± 18	81
Total and average	48 ± 20	83

MATURE STANDS		
Harvest: Clearcut	45 ± 21	76
Total and average	45 ± 21	76

REGENERATION STANDS		
Alder conversion	8 ± 8	27
Other conversion	8 ± 8	35
Total and average	16 ± 10	31

*Confidence intervals at the 0.68-probability level.

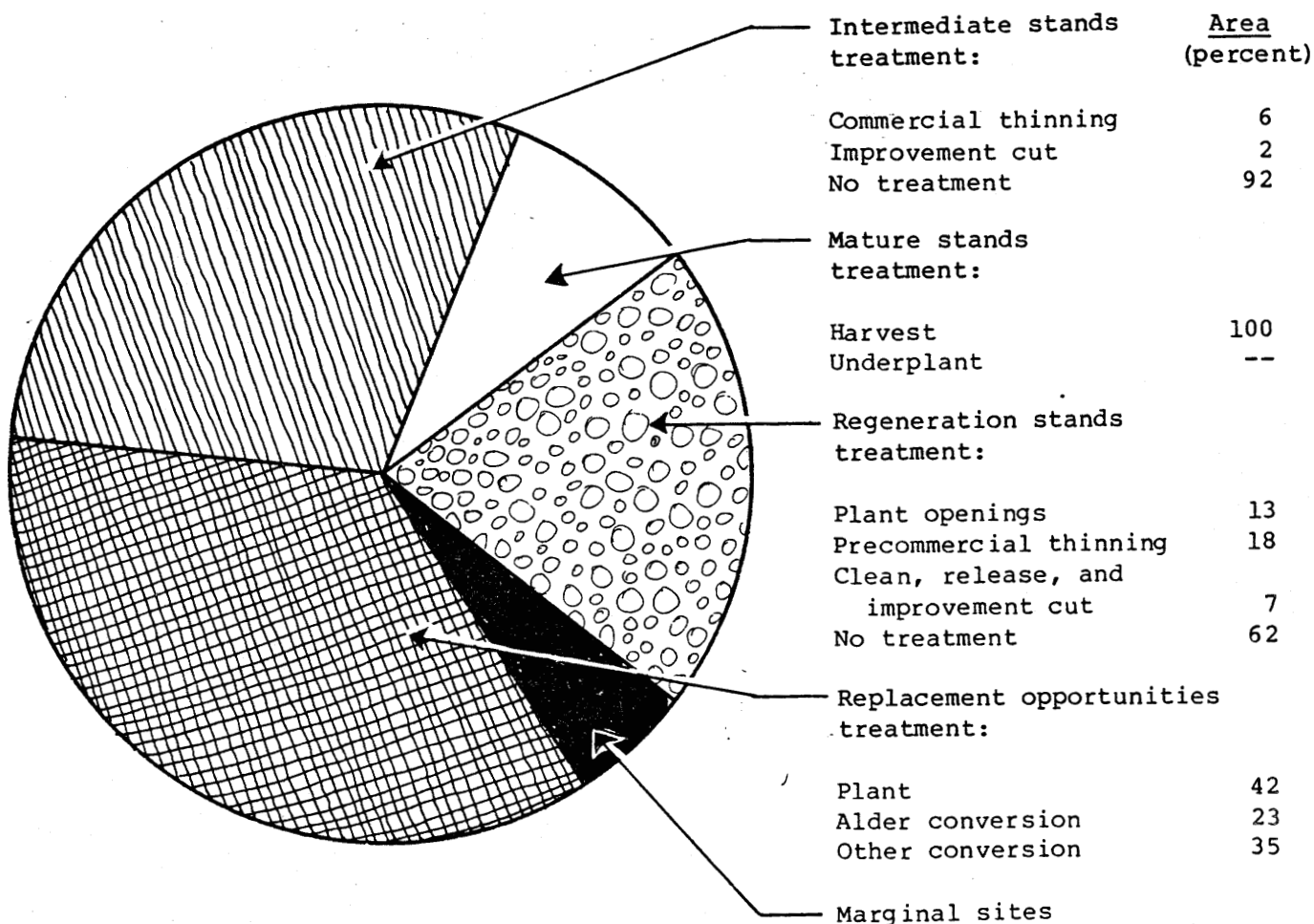


Figure 10.--Treatment opportunities on other private lands in west-central Oregon.

Federal timberlands.--National Forests contain 40 percent of the timberland in west-central Oregon, and the BLM administers another 10 percent (fig. 11). Two-thirds of the National Forest land and over 40 percent of the BLM land is occupied by mature forests (fig. 12) which offer little opportunity for silvicultural activity except scheduled harvest. Substantial opportunities for commercial thinning, however, were found on the 192,000 acres of intermediate forest land that is federally owned. These intermediate stands, unlike those on private land, originated almost entirely from fire and are quite densely stocked.

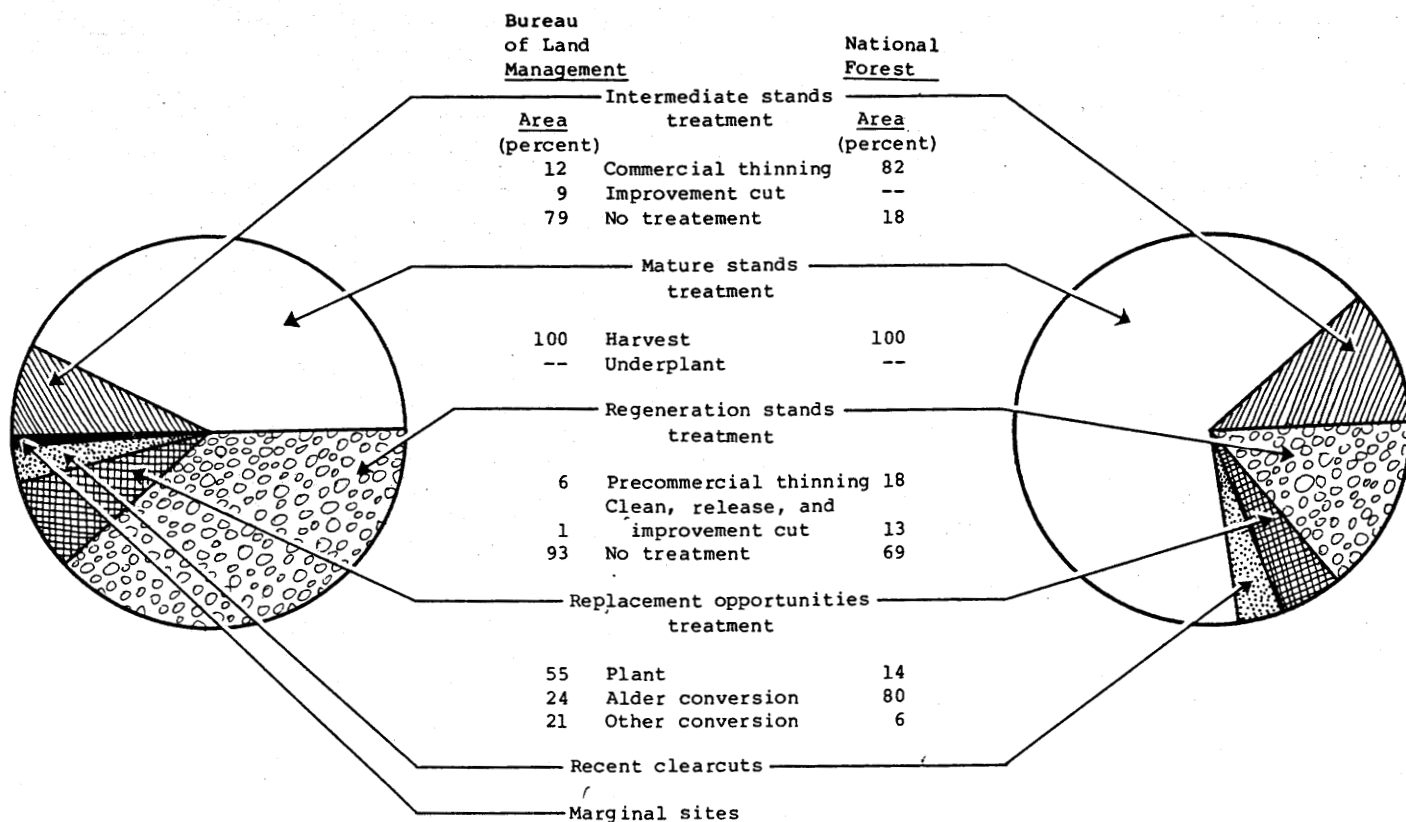


Figure 11.--Opportunities for treatment on Federal land in west-central Oregon.

Over 400,000 acres of the Federal forest land in west-central Oregon have been clearcut. If recent clearcuts are excluded, over 90 percent of the area is now growing conifers. An additional 75,000 acres, mostly on National Forest land, are conifer sites that are now growing intermediate and mature red alder. Although the alder stands on private lands usually originated after clearcutting, those on Federal land are nearly all of natural origin. Conversion would substantially increase timber production, but conflict with nontimber use could restrict this activity.



Figure 12.--Mature forests predominate on Federal land.

Treatment opportunities on Federal forest land in west-central Oregon are as follows:

Bureau
National of Land
Forest Management
(Thousand acres*)

INTERMEDIATE STANDS

Commercial thinning	134 ± 15	4 ± 2
Improvement cut	--	3 ± 2
No treatment needed	30 ± 7	27 ± 4
Total	164 ± 16	34 ± 5

MATURE STANDS

Harvest: Clearcut	1,069 ± 25	
Shelterwood: Seed cut	6 ± 3	
Regenerate: underplant shelterwood	2 ± 2	186 ± 9
Total	1,077 ± 25	186 ± 9

REGENERATION STANDS

Precommercial thinning	44 ± 9	10 ± 3
Improvement cut	23 ± 6	1 ± 1
Clean and release	9 ± 4	2 ± 2
No treatment needed	^{4/} 171 ± 16	^{4/} 155 ± 8
Total	247 ± 19	168 ± 5

REPLACEMENT OPPORTUNITIES

Site preparation and plant	12 ± 5	18 ± 3
Alder conversion	66 ± 10	8 ± 2
Other conversion	5 ± 3	7 ± 2
Total	83 ± 12	33 ± 5

^{4/}Two treatments--"Plant openings" and "Precommercial thinning of clumps"--could not be identified because of the small size of the plot.

*Confidence intervals at the 0.68-probability level.

An additional 76,000 acres that were recently clearcut are scheduled for planting.

SOUTHWEST OREGON (Coos, Curry, Douglas, Josephine, and Jackson Counties)

Southwest Oregon provides a transition between the cool, moist Douglas-fir forest of the Northwest and the more arid mixed-conifer forests of California. The forests of this region are generally less even-aged than those farther north and are more often of mixed species. In the Siskiyou Mountains, evergreen hardwoods form an important part of most stands and often provide shade for conifer seedlings. Douglas-fir seedlings, which thrive on bare clearcuts in northwest Oregon, cannot always survive without shade on the hotter and drier sites of southwest Oregon (fig. 13).



Figure 13.--Douglas-fir seedlings, which thrives on bare clearcuts in northwest Oregon, cannot always survive without shade on the hotter and drier of the southwest Oregon sites.

Logging began later in southwest Oregon than in other parts of the State, and clearcuts are of more recent origin. Thus, intermediate stands make up less than 8 percent of the total forest. Most stands are either mature or regeneration-size, and a substantial area of unregenerated clearcuts remains. Many owners have now switched to shelterwood cutting, in the hope of avoiding future regeneration failures.

Forty-five percent of western Oregon's commercial forest land lies in southwest Oregon. Potentially, the area could supply more than one-third of western Oregon's timber, but environmental problems will make that goal difficult to achieve.

Forest-industry-owned lands.--One-third of the lands owned by forest industry in southwest Oregon support mature or intermediate conifer stands. Almost 80 percent of these stands are over 70 years old, and another 8 percent are more than 50 years old. A high proportion of these lands in southwest Oregon, however, would benefit from silvicultural treatment. Many acres have been cutover for 20 years or more and are now completely occupied by hardwoods and brush. About one-quarter of the industry-owned lands will produce little conifer timber unless they are planted or converted to conifer type (fig. 14). Some of these lands were repeatedly burned by previous owners in the vain hope of encouraging grass for fodder (fig. 15). Rehabilitation may be costly and difficult, but the potential return could be as much as 55 million cubic feet per year. There is, of course, no guarantee that all treatments will succeed.

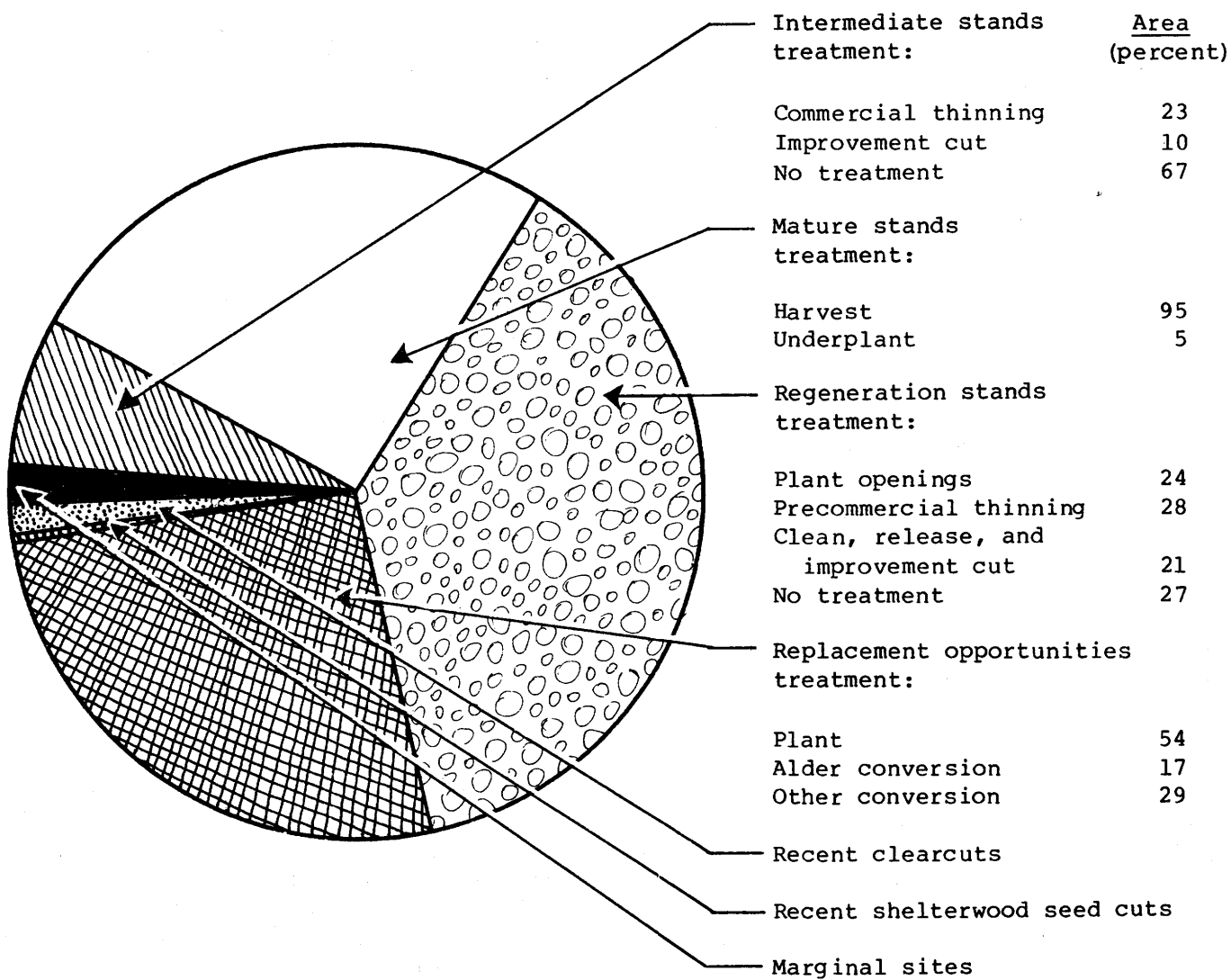


Figure 14.--Treatment opportunities on forest-industry-owned land in southwest Oregon.



Figure 15.--Some lands have been subjected to repeated fires to encourage grass for fodder.

Two-thirds of the regenerated stands have too many conifer trees, too many competing shrubs and hardwood trees, or large holes devoid of conifer reproduction. Treatment of these acres could substantially increase timber production. About 25 percent of the area was, at the time of inventory, still occupied by mature timber--mostly old growth. Care in the harvesting of this timber may reduce the cost of future treatments.

A detailed list of the opportunities for silvicultural treatment on forest-industry-owned lands follows:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	27 $\pm$ 12	81
Improvement cut	12 $\pm$ 9	46
No treatment needed	80 $\pm$ 19	69
Total and average	119 $\pm$ 25	69
MATURE STANDS		
Harvest: Clearcut	241 $\pm$ 30	78
Shelterwood:		
Removal cut	36 $\pm$ 15	80
Seed cut	111 $\pm$ 26	79
Regenerate:		
Underplant shelterwood	19 $\pm$ 10	72
Total and average	407 $\pm$ 40	78
REGENERATION STANDS		
Plant openings	152 $\pm$ 24	53
Precommercial thinning	153 $\pm$ 24	82
Improvement cut	44 $\pm$ 17	58
Precommercial thinning of clumps	25 $\pm$ 13	82
Clean and release	88 $\pm$ 20	67
No treatment needed	176 $\pm$ 30	82
Total and average	638 $\pm$ 38	71
REPLACEMENT OPPORTUNITIES		
Site preparation and plant	228 $\pm$ 29	27
Alder conversion	73 $\pm$ 20	16
Other conversion	128 $\pm$ 23	34
Total and average	429 $\pm$ 38	26

*Confidence intervals at the 0.68-probability level.

There are 20,000 acres of recent clearcut. Another 26,000 acres were considered marginal because the poor site and hot dry climate or serpentine soils made management for timber production difficult or impossible.

Other private lands.--Other private lands in southwest Oregon typically have a moderate to low potential productivity and a deficiency of growing stock. Two-thirds of the area has been clearcut, and most of the remaining land has been partially cut (fig. 16). Although some land has restocked, half the clearcut area still lacks a manageable conifer stand (fig. 17).

Over 150,000 acres of other private land in southwest Oregon are "tough sites" that are difficult to regenerate and have a low productive potential. About two-thirds of this area has been logged and now supports only brush and grass. The hot, dry climate makes successful regeneration of these areas unlikely. The low productive potential--about 50 cubic feet per acre per year after successful regeneration--will probably discourage anyone from trying. I have classed these acres as marginal and excluded them from the list of opportunities for silvicultural treatment.

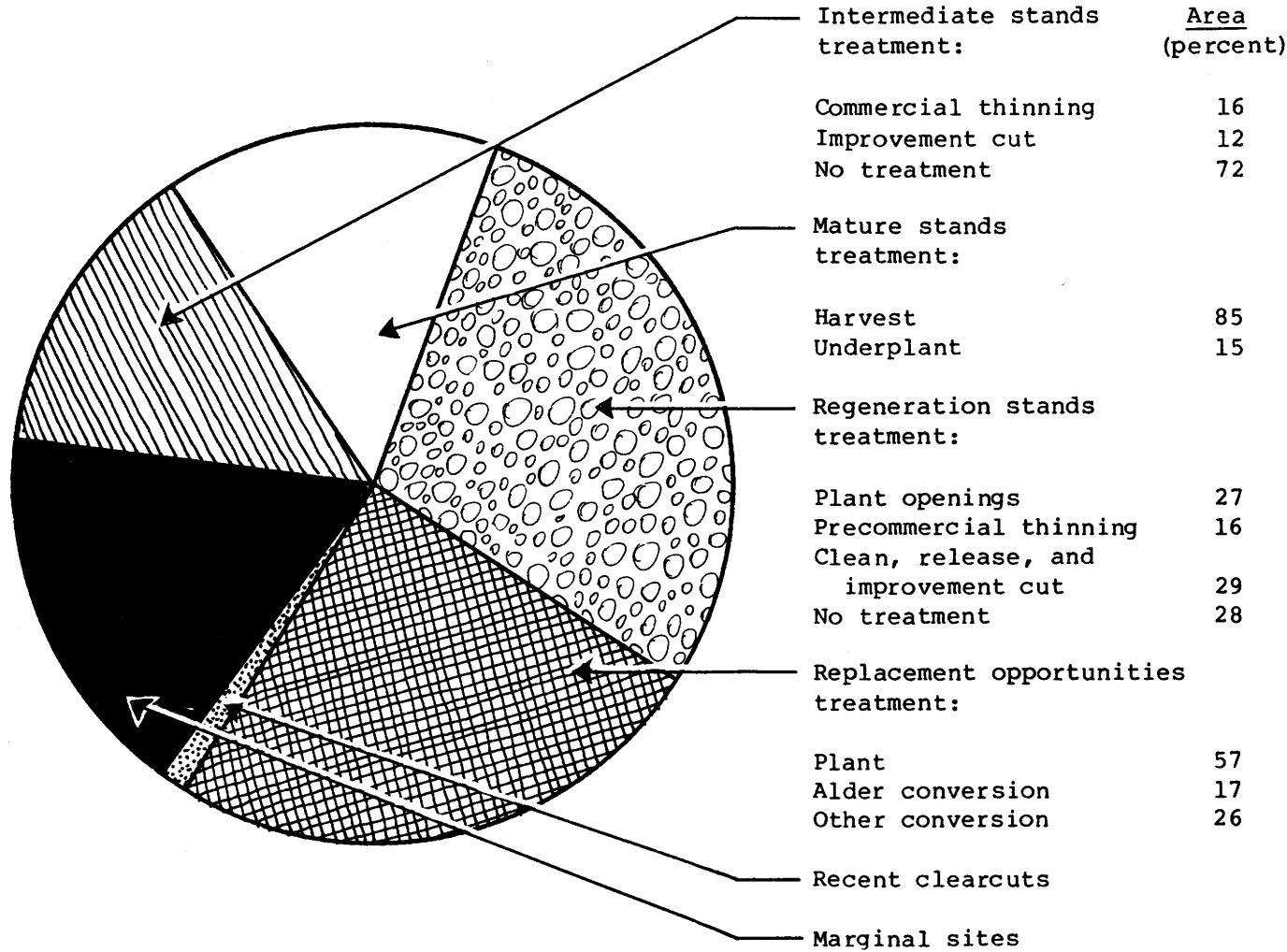


Figure 16.--Treatment opportunities on other private land in southwest Oregon.

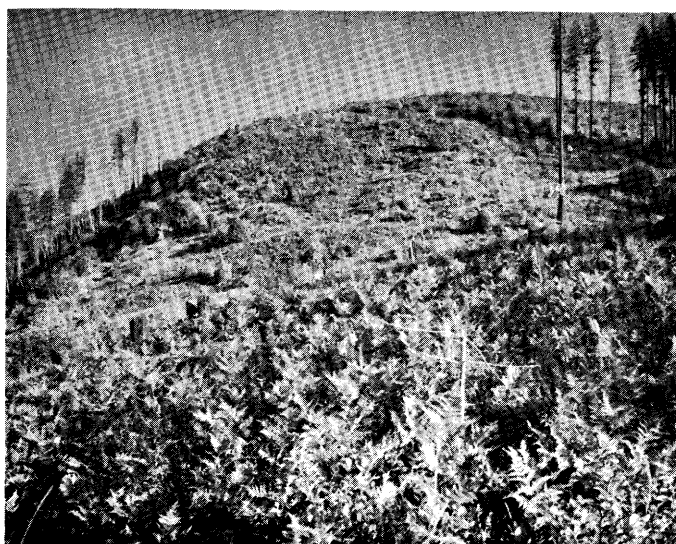


Figure 17.--Half the clearcut area on other private lands in southwest Oregon lacks a manageable conifer stand.

After the tough sites are excluded, there remain 243,000 acres with a potential productivity of 25 million cubic feet per year that need planting or stand conversion. Another 74,000 acres of conifer reproduction intermixed with patches of brush are producing at half their capability. Finally, there are 21,000 acres of low-density residual mature stands growing on sites that are unsuited to clearcutting and should be underplanted before further harvest. In all these cases, treatment will be difficult and with substantial risk of failure.

A complete list of opportunities for silvicultural treatment on other private lands follows:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
INTERMEDIATE STANDS		
Commercial thinning	9 ± 6	90
Improvement cut	25 ± 11	57
No treatment needed	88 ± 20	73
Total and average	122 ± 23	71
MATURE STANDS		
Harvest: Clearcut	68 ± 18	63
Shelterwood:		
Removal cut	18 ± 9	63
Seed cut	39 ± 13	66
Regenerate:		
Underplant shelterwood	21 ± 9	59
Total and average	146 ± 24	63
REGENERATION STANDS		
Plant openings	74 ± 18	49
Precommercial thinning	43 ± 18	88
Improvement cut	50 ± 16	54
Precommercial thinning of clumps	--	--
Clean and release	31 ± 13	61
No treatment needed	76 ± 18	77
Total and average	274 ± 32	65
REPLACEMENT OPPORTUNITIES		
Site preparation and plant	144 ± 26	23
Alder conversion	42 ± 15	18
Other conversion	63 ± 15	24
Total and average	249 ± 31	23

*Confidence intervals at the 0.68-probability level.

In addition, there are 160,000 acres of marginal lands and 7,000 acres of recent clearcut.

State, county, and municipal lands.--These lands are quite diverse and the treatment opportunities reflect this diversity. Although most acres would benefit from some form of silvicultural treatment, the treatment needs vary greatly (fig. 18). About 10 percent of the area needs planting, and an additional 10 percent could produce substantially more conifer volume if nonstocked holes were planted. In addition, 15,000 acres of natural alder stands could be converted to conifer production, provided treatment does not conflict with other uses.

Opportunities for silvicultural treatment on State, county, and municipal lands in southwest Oregon are:

<u>Treatment</u>	<u>Thousand acres*</u>	<u>Conifer occupancy (Percent)</u>
------------------	------------------------	------------------------------------

INTERMEDIATE STANDS

Commercial thinning	9 + 8	98
Improvement cut	--	--
No treatment needed	21 + 8	72
Total and average	30 + 12	80

MATURE STANDS

Harvest: Clearcut	40 + 16	76
Shelterwood: Removal cut	4 + 4	74
Regenerate:		
Underplant shelterwood	4 + 4	29
Total and average	48 + 18	63

REGENERATION STANDS

Plant openings	17 + 8	57
Precommercial thinning	15 + 8	80
Improvement cut	11 + 9	47
Precommercial thinning of clumps	--	--
Clean and release	9 + 6	49
No treatment needed	6 + 6	100
Total and average	58 + 16	64

REPLACEMENT OPPORTUNITIES

Site preparation and plant	18 + 8	9
Alder conversion	15 + 10	22
Other conversion	--	--
Total and average	33 + 14	15

In addition to the above, there were 8,000 acres of hardwood site.

*Confidence intervals at the 0.68-probability level.

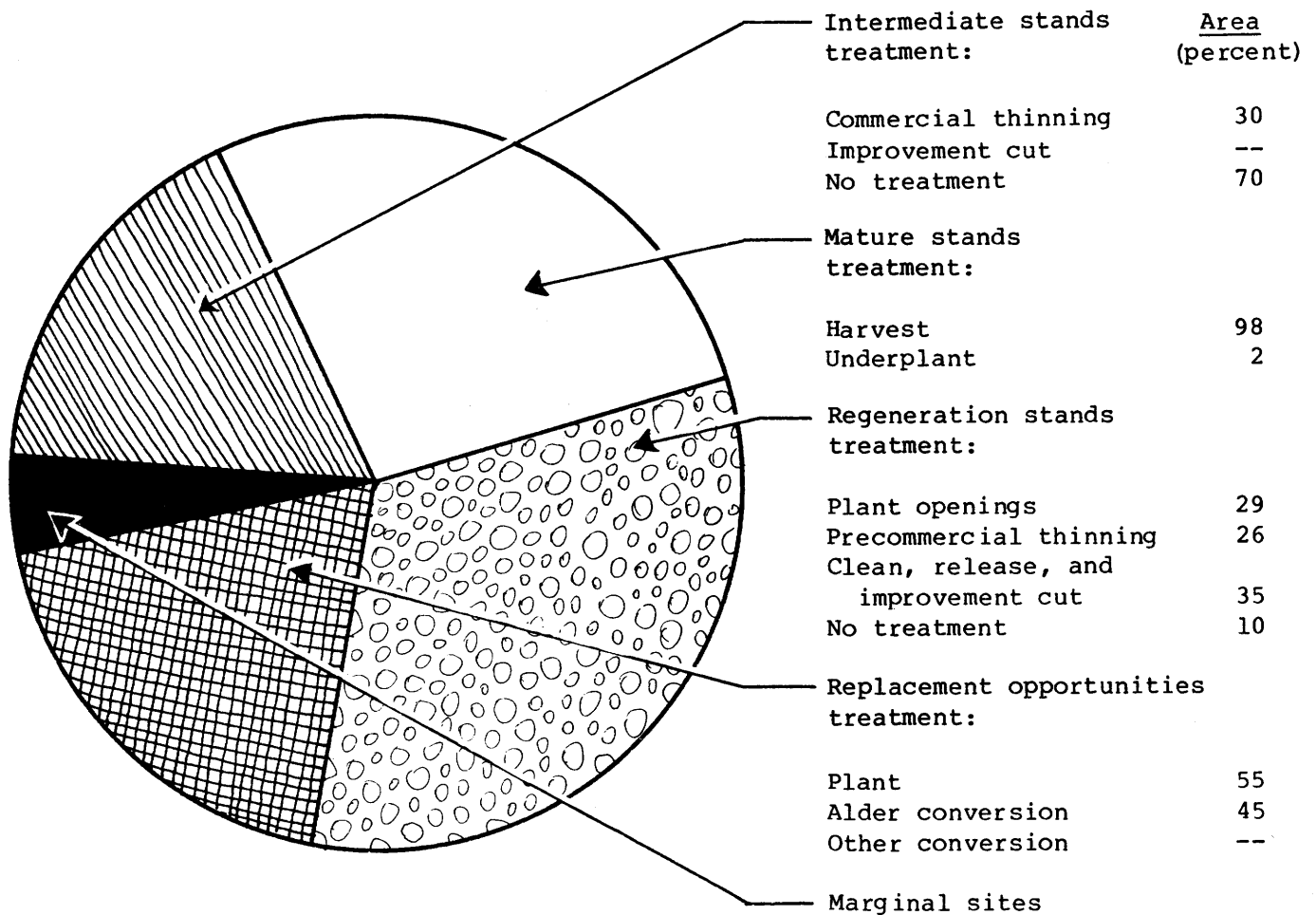


Figure 18.--Treatment opportunities on "other public" lands in southwest Oregon.

Federally-owned land.--Although about two-thirds of the federally owned timberland in southern Oregon supports mature timber (fig. 19), only slightly over one-half of it is suitable for clear-cutting. The other half lies in the southern interior portion of the region where clearcutting often leads to regeneration failure.^{5/} Over 157,000 acres of BLM land is marginal for timber

production because of low productive potential and extreme regeneration hazard. The BLM has excluded these acres from consideration as opportunities for silvicultural treatment because of low yield and high risk of treatment failure. I have assumed that the remaining 40 percent of the mature timber is suitable for shelterwood management--recognizing that the risk of regeneration failure is greater here than in other parts of western Oregon.

^{5/}Waring, R. H., K. N. Johnson, and W. H. Emmingham. 1974. Tough site management: A discussion of timber management on public land in southwestern Oregon. Unpublished manuscript on file at Oregon State University, Corvallis.

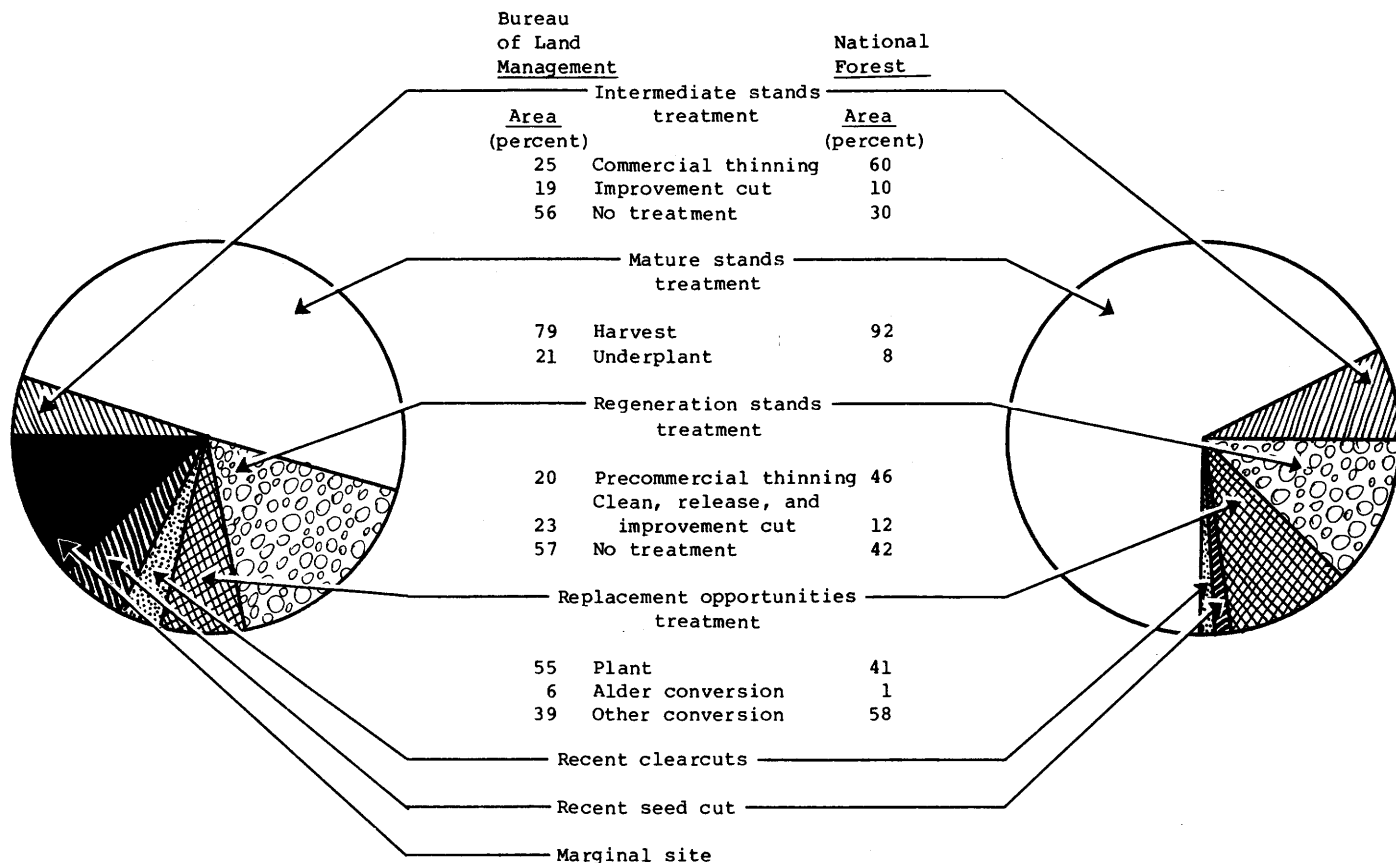


Figure 19.--Treatment opportunities on federally owned land in southwest Oregon.

Only two-thirds of the mature timber suitable for shelterwood management is available for immediate harvest. The remaining 350,000 acres are too lightly stocked with conifers to permit further cutting until adequate regeneration has been obtained. About 100,000 acres of this area has been recently logged and is omitted from the list of treatment opportunities. The remaining 250,000 acres should be underplanted before further harvest is attempted.

Intermediate stands are almost absent on Federal lands in southwest Oregon, but logging and fires have created almost 500,000 acres of regeneration-size stands and an additional 350,000 acres of stand conversion opportunities. An estimated 500,000 acres of Federal land has been clearcut; 80 percent of that area has restocked with conifer, the remainder growing either brush or hardwoods. An additional 127,000 acres of regeneration and 60,000 acres of planting opportunities probably are of fire origin. Finally, there are 112,000 acres of intermediate-size hardwood stands growing on sites that could support conifer. Conversion of these stands would increase timber production, but the impact of such conversion on other resource values is beyond the scope of this study.

Conclusions

Opportunities for silvicultural treatment on federally owned land areas are:

	National	Bureau
	Forest	of Land
	Management	
	(Thousand	acres*)

INTERMEDIATE STANDS

Commercial thinning	92 + 13	16 + 4
Improvement cutting	15 + 5	12 + 3
No treatment needed	46 ± 9	36 ± 6
Total	153 + 15	64 + 8

MATURE STANDS

Harvest: clearcut	840 + 30	372 + 18
Shelterwood:		
overstory removal cut	145 + 15	28 + 6
seed cut	283 + 21	121 + 11
Regenerate:		
underplant shelterwood	108 ± 14	139 ± 12
Total	1,376 + 28	660 + 20

REGENERATION STANDS

Precommercial thinning	116 + 14	48 + 7
Improvement cutting	31 + 8	11 + 4
Clean and release	--	46 + 7
No treatment needed	^{6/} 105 ± 13	^{6/} 140 ± 12
Total	252 + 20	245 + 15

REPLACEMENT OPPORTUNITIES

Site preparation and plant	80 + 12	48 + 7
Alder conversion	2 + 1	5 + 2
Other conversion	112 ± 14	35 ± 6
Total	194 + 19	88 + 10

In the short run, timber supply in western Oregon will come from the 8 million acres of timberland that now support stands of mature and intermediate-size conifers. Although these stands present some opportunities for commercial thinning and improvement cutting, such practices can have only minor impact on yield. Thus, most of the opportunities to increase timber yields are found in the regeneration-size stands and in the nonstocked areas. The impacts of such treatments on timber supply are potentially large, but the direct effects will not be felt for at least three decades.

There are 13.5 million acres (table 6) of timberlands in western Oregon, and only 8 million of them support merchantable stands of conifers. The remaining 5.5 million acres will not contribute to timber supply for at least 30 years, but they will become increasingly important thereafter. The size of the timber yield from these young stands and nonstocked areas will depend on the silvicultural investment made during the next few years. The fate of 2.2 million acres of timber that do not now support a manageable conifer stand will be particularly important. These acres are not totally unproductive, since about 800,000 of them are growing hardwood stands and the other 1.4 million support scattered conifers and hardwoods. Still, the potential timber production from present growing stock is but a fraction of the 250 million cubic feet per year of timber that could be grown if the area were fully stocked with conifers.

^{6/}Two treatments--"plant openings" and "precommercial thinning of clumps"--could not be identified because of the small size of the plot.

*Confidence intervals at the 0.68-probability level.

I am not suggesting that all these acres can or should be treated. The bulk of the nonstocked area is in southwest Oregon where rehabilitation will be both difficult and expensive. Furthermore, the conversion of hardwood stands may not be environmentally desirable or even possible in all cases. Even so, the large areas of brushland, "junk conifer," and hardwoods in western Oregon represent a substantial opportunity to increase future timber supply (fig. 20) through investment in site preparation, stand conversion, and planting.



Figure 20.--Large areas of brushland and hardwoods represent a substantial opportunity to increase future timber supplies.

In the long run, timber supply will depend on regeneration success on the 300,000 acres of recent cutover and on the new cutover lands that are created each year. Present backlogs of unregenerated land attest to the inadequacy of past efforts. Declining timber supply, rising prices, and a new Oregon Forest Practices Act all have encouraged both public and private owners to increase their investment in regeneration. Better planting stock, new technology, and experience gained from past mistakes should all contribute to higher survival. The next Resources Evaluation inventory of western Oregon, scheduled for the mid-1980's, should provide a measure of the success of these efforts.

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Appendix

Table 1--Approximate confidence intervals for estimates of various sizes in tables 3-6^{1/}

Area	Private and other public lands	National Forest	Bureau of Land Management
	----- Thousand acres (+) -----		
1,000	60	24	17
800	55	25	18
600	49	25	18
400	42	23	16
200	31	17	12
100	23	13	9
50	17	9	6
25	12	7	5
15	10	5	4
10	8	4	3

^{1/}Confidence intervals at the 0.68-probability level.

Table 2--Condition of clearcut lands in western Oregon, by owner group^{1/}
(Thousand acres)

Management condition	Forest industry	Other private	Other public	National Forest	Bureau of Land Management	Total
Manageable intermediate stand	533	314	100	7	21	975
Manageable regeneration stand	1,407	384	105	425	436	2,757
Manageable stand absent	720	707	74	73	105	1,679
Marginal land (manageable stand absent)	0	79	0	0	1	80
Recent clearcuts	105	24	7	113	69	318
Total	2,734	1,539	286	618	632	5,809

^{1/}Estimates are subject to sampling error. See table 1.

Table 3--Area of treatment opportunities on high sites^{1/} in western Oregon, by owner group^{2/}

(Thousand acres)

Type of stand and treatment	Forest industry	Other private	Other public	National Forest	Bureau of Land Management	Total
Mature:						
Harvest--clearcut	204	43	37	359	127	770
Shelterwood (cut)	10	0	4	24	9	47
Regenerate--shelterwood (underplant)	0	0	0	4	12	16
Total	214	43	41	387	148	833
Intermediate:						
Commercial thinning	48	0	0	43	5	96
Improvement cut	0	0	11	0	0	11
No treatment	168	95	44	11	6	324
Total	216	95	55	54	11	431
Regeneration:						
Plant openings	21	5	14	<u>3/</u>	<u>3/</u>	40
Precommercial thinning	27	6	0	<u>36</u>	<u>4</u>	73
Improvement cut	0	0	0	5	0	5
Precommercial thinning of clumps	71	0	0	<u>3/</u>	<u>3/</u>	71
Clean and release	22	5	0	0	5	32
No treatment	75	20	20	63	33	211
Total	216	36	34	104	42	432
Replacement opportunities:						
Site preparation and plant	18	32	6	3	11	70
Alder conversion	54	28	31	16	3	132
Other conversion	37	44	11	1	3	96
Total	109	104	48	20	17	298

^{1/}Sites capable of producing more than 165 cubic feet per acre per year.

^{2/}Estimates are subject to sampling error. See table 1.

^{3/}Treatment opportunities not identifiable because of the small size of the plot.

Table 4--Area of treatment opportunities on medium sites^{1/} in western Oregon, by owner group^{2/}

(Thousand acres)

Type of stand and treatment	Forest industry	Other private	Other public	National Forest	Bureau of Land Management	Total
Mature:						
Harvest--clearcut	175	87	81	785	349	1,477
Shelterwood (cut)	41	5	0	107	49	202
Regenerate--shelterwood (underplant)	6	0	0	27	36	69
Total	222	92	81	919	434	1,748
Intermediate:						
Commercial thinning	45	47	34	138	11	275
Improvement cut	6	19	0	0	8	33
No treatment	464	268	121	28	56	937
Total	515	334	155	166	75	1,245
Regeneration:						
Plant opening	124	35	30	<u>3/</u>	<u>3/</u>	189
Precommercial thinning	161	23	26	26	20	256
Improvement cut	26	17	7	13	3	66
Precommercial thinning of clumps	76	0	20	<u>3/</u>	<u>3/</u>	96
Clean and release	88	12	4	0	14	118
No treatment	317	98	105	95	230	845
Total	792	185	192	134	267	1,570
Replacement opportunities:						
Site preparation and plant	176	154	47	24	35	436
Alder conversion	113	171	56	21	12	373
Other conversion	102	144	5	12	19	282
Total	391	469	108	57	66	1,091

^{1/}Sites capable of producing between 120 and 165 cubic feet per acre per year.

^{2/}Estimates are subject to sampling error. See table 1.

^{3/}Treatment opportunities not identifiable because of the small size of the plot.

Table 5--Area of treatment opportunities on low sites^{1/} in western Oregon, by owner group^{2/}

(Thousand acres)

Type of stand and treatment	Forest industry	Other private	Other public	National Forest	Bureau of Land Management	Total
Mature:						
Harvest--clearcut	86	53	8	1,315	173	1,635
Shelterwood (cut)	108	52	0	341	91	592
Regenerate--shelterwood (underplant)	13	21	4	79	91	208
Total	207	126	12	1,735	355	2,435
Intermediate:						
Commercial thinning	5	4	0	149	9	167
Improvement cut	13	10	0	15	8	46
No treatment	61	117	22	115	25	340
Total	79	131	22	279	42	553
Regeneration:						
Plant openings	66	75	11	<u>3/</u>	<u>3/</u>	152
Precommercial thinning	91	33	9	116	39	288
Improvement cut	48	50	19	36	9	162
Precommercial thinning of clumps	53	9	0	<u>3/</u>	<u>3/</u>	62
Clean and release	14	21	5	9	34	83
No treatment	188	92	30	200	92	602
Total	460	280	74	361	174	1,349
Replacement opportunities:						
Site preparation and plant	133	120	15	77	35	380
Alder conversion	28	19	0	53	7	107
Other conversion	63	104	8	104	21	300
Total	224	243	23	234	63	787

^{1/}Sites capable of producing between 20 and 120 cubic feet per acre per year.

^{2/}Estimates are subject to sampling error. See table 1.

^{3/}Treatment opportunities not identifiable because of the small size of the plot.

Table 6--Area of treatment opportunities in western Oregon^{1/}
(Thousand acres)

Type of stand and treatment	Forest industry	Other private	Other public	National forest	Bureau of Land Management	Total
Mature:						
Harvest--clearcut	465	183	126	2,459	649	3,882
Shelterwood (cut)						
Regenerate--shelterwood	159	57	4	472	149	841
(underplant)	19	21	4	110	139	293
Total	643	261	134	3,041	937	5,016
Intermediate:						
Commercial thinning	98	51	34	330	25	538
Improvement cut	19	29	11	15	16	90
No treatment	693	480	187	154	87	1,601
Total	810	560	232	499	128	2,229
Regeneration:						
Plant opening	211	115	55	<u>2/</u>	<u>2/</u>	381
Precommercial thinning	279	62	35	<u>3/</u> 178	63	617
Improvement cut	74	67	26	54	12	233
Precommercial thinning of clumps	200	9	20	<u>2/</u>	<u>2/</u>	229
Clean and release	124	38	9	9	53	233
No treatment	580	210	155	358	355	1,658
Total	1,468	501	300	599	483	3,351
Replacement opportunities						
Site preparation and plant	327	306	68	<u>4/</u> 104	81	886
Alder conversion	195	218	87	90	23	613
Other conversion	202	292	24	117	42	677
Total	724	816	179	311	146	2,176

^{1/}Estimates are subject to sampling error. See table 1.

^{2/}Treatment opportunities not identifiable because of small plot size.

^{3/}Includes 55,837 acres of precommercial thinning opportunities reported in the 1977 Needs Report of the Pacific Northwest Regional Office of the Forest Service as having a high probability of being treated by 1984.

^{4/}Includes 79,240 acres of planting opportunities reported in the 1977 Needs Report of the Pacific Northwest Regional Office of the Forest Service as having a high probability of being treated by 1984. The balance--25,000 acres--have apparently been planted since the inventory on which this report is based.

