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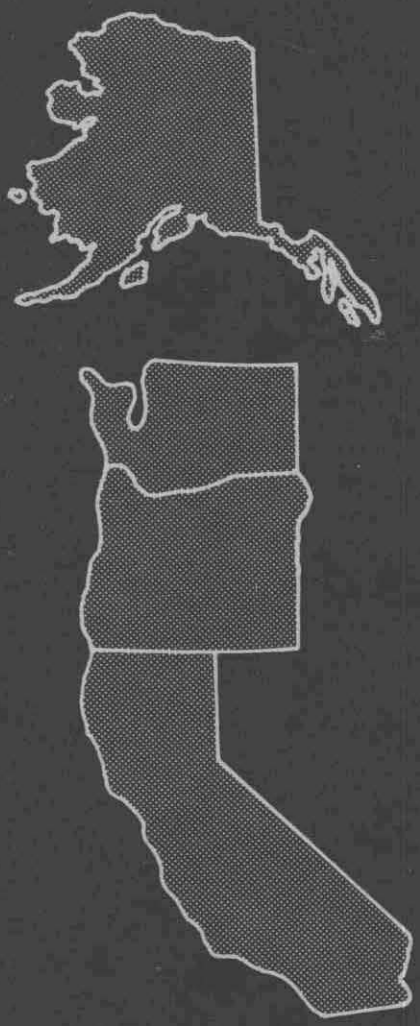
Two Projections of Timber Supply in the Pacific Coast States



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TWO PROJECTIONS OF TIMBER SUPPLY IN THE PACIFIC COAST STATES

Reference Abstract

Gedney, Donald R., Daniel D. Oswald, and Roger D. Fight

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Two projections of softwood timber supply for 1970-2020 for California, western Oregon, eastern Oregon, western Washington, eastern Washington, and coastal Alaska are presented. One projection shows how much timber will likely be available in the future if forest management continues at recent levels. The second projection shows the impact of one program of intensified management on future timber supplies for these States except coastal Alaska.

KEYWORDS: Resources (forest), timber management planning, supply/demand (forest products).

Research Summary
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Softwood timber supply is projected from 1970 to 2020 by individual State or an area of the State and by owner group. The first projection shows how much timber will likely be available if forest management continues at recent levels. This projection is most meaningful over the next two or three decades, and the general pattern emerging is of relatively stable harvest levels from public lands and sharply declining yields from private lands. The second projection predicts the effect on timber supply to the year 2030 from a program of intensified management—some immediate increase in harvest on public lands because of their large inventory of old-growth timber but only a minor response on private lands until 2000. This management program assumes a required rate of return and identifies qualifying management opportunities; other projections based on different assumptions would forecast different timber supply situations.

If recent management levels continue, softwood timber supply will decrease from the 1970 level of 24.9 billion board feet, International ¼-inch scale, to 20.8 billion by 2000—83 percent of the 1970 level—and continue at that level to 2020. The projected decrease for fiber is less, from 3.8 billion cubic feet in 1970 to 3.4 billion 2000—88 percent of 1970 supply.

These overall trends are not shared equally by each State. In coastal Alaska, a substantial increase is projected; in eastern Oregon and eastern Washington, there is an immediate decrease in supply, then a continuing recovery; in California, western Oregon, and western Washington, the trend is downward. In each of these areas except coastal Alaska, individual projections of supply are made for National Forests, other public, forest industry, and other private owners. For coastal Alaska, the projection is for National Forests only.

Increased intensity in forest management would increase supply over a six-decade period by 201 billion board feet, with most of the increase occurring after 2000.

The projection of supply under recent levels of management assumes that such practices as planting, fertilizing, and other cultural activities will continue in the future. For public owners, the agencies announced allowable cut was used. For private owners, past trends were projected, tempering each projection by the available inventory, the long-term capacity of the forest to renew itself, and the total timber supply and demand situation in each area.

The projection of timber supply with intensified management presents results with only those practices included that would return at least a 5-percent rate of return on the marginal costs of treatments: site preparation, development of genetically superior stock, planting, release, precommercial thinning, fertilization, stand conversion, and commercial thinning. Only a one-decade program was considered because the purpose of the analysis was to determine the impact of a short-term program and provide input for budget planning purposes; in these terms, a decade is a realistic time period.

The management intensification program would require an investment of $469 million on 6.7 million acres and would increase total harvest by 201 billion board feet over a six-decade period. However, only nominal increases would become available this century; 86 percent of the increase would occur between 2000 and 2030.

Assumptions, techniques, costs, and yields behind the projections of supply are given. Appendix tables show area, supply, inventory volume, growth, and removals for the projection period.

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Introduction

Periodically, the United States Forest Service reviews the Nation's timber supply situation to help implement or guide public and private policy, especially those land use or management decisions that affect or are affected by timber supply.

The latest national timber supply study, "The Outlook for Timber in the United States" (USDA Forest Service 1973), presents a broad overview of the timber supply situation from 1970 to 2020. Projections of supply are for major geographic regions such as the Pacific coast region which includes California, Oregon, and Washington, and coastal Alaska. This broad regional outlook, although meeting national needs, does not provide the information needed by those concerned with local timber supply situations.

For the Pacific coast region, we made projections of timber supply for individual States or, in some cases, for subareas such as western Oregon and eastern Oregon. In this report we give the local projections of timber supply in the Pacific Coast States that were made in support of the national study. Two projections of future supply on the Pacific coast are provided. The first answers the question: "How much timber is likely to be available in the future, if forest management continues at recent levels?" This projection is particularly important in the next two to three decades because most management effort will have limited effect on the timber supply in the immediate future.

However, management is not static. Trends in forest investment and legislation, such as new Forest Practices Acts, point to increased management effort. The second projection, therefore, predicts the effect of one program of intensified forest management on future timber supplies. The one presented here assumes a required return on investment that restricts some management opportunities. Projections based on different assumptions would forecast different supply situations.

The States of Washington and Oregon are also conducting studies on this subject. In Oregon, a study by the School of Forestry at Oregon State University is designed to predict the most likely future timber supply situation in many localized parts of the State. In Washington, the State's Department of Natural Resources is determining biologic opportunities for modifying supply through intensification of forest management. Both of these studies are scheduled for completion in mid-1975. This evidence of growing interest in timber supply forecasts is encouraging. A heightened awareness of problems and a wider array of solutions provided by additional studies will provide citizens of the Northwest with more choices than are possible in this study.

This report is structured in six major sections. In the first section, the historical development of softwood production by broad national regions is examined. This not only puts the Pacific Coast States into national perspective but examines what happened to other regions after initial harvesting of their old-growth timber resources—a situation presently confronting the Pacific Coast States. In the second section, the assumptions, techniques, and methodology behind the projection of supply under continuation of recent levels of management are examined so that the projection can be more fully understood. In the third section, projections of supply are presented under the assumption of a continuation of recent levels of management. In the next two sections the assumptions, methodology, and the costs and yields resulting from an intensification of forest management are shown. In the appendix, tables of commercial forest area, site classes, product output, inventory volume, and growth and removals are shown for the projection period.

Because future hardwood supplies are not critical and are generally produced elsewhere than in the Pacific Coast States, the discussion in this report deals only with softwood supply. However, projections of hardwood supply are presented in the appendix.

The projections cover the following areas and owner groups:

California	National Forests, other public, forest industry, other private
Western Washington	National Forests, other public, forest industry, other private
Western Oregon	National Forests, other public, forest industry, other private
Eastern Oregon	National Forests, other public, forest industry, other private
Eastern Washington	National Forests, other public, forest industry, other private
Alaska	National Forests only

Regional Patterns of Timber Development

The rate of liquidations of old-growth timber resources has historically been based on the demand for wood products. In the long run, however, production from a region's timberlands must be brought into balance with the forest's biological capacity to renew itself. This is often below the liquidation rate of the old-growth resource. How these changes have occurred can be found in patterns of timber production for regions which have already made the transition from old-growth to young-growth forests (figs. 1 and 2). With the Pacific coast among the last major timber regions in the country still operating on old-growth timber, these patterns point out possible changes yet to occur.

Most of the Nation's softwood timber first came from the northern region of the United States.[1] But by 1925, production had decreased to less than 8 percent of the total. After the old growth in the North was depleted, the South emerged as the major softwood lumber-producing region in the country until the latter part of the 1920's.

As lumber production continued to decline in the North, production increased

[1] Many books, (e.g., Brown (1923) and Horn (1943)) are available on the history and development of the forest industry.

Sections of the Contiguous United States

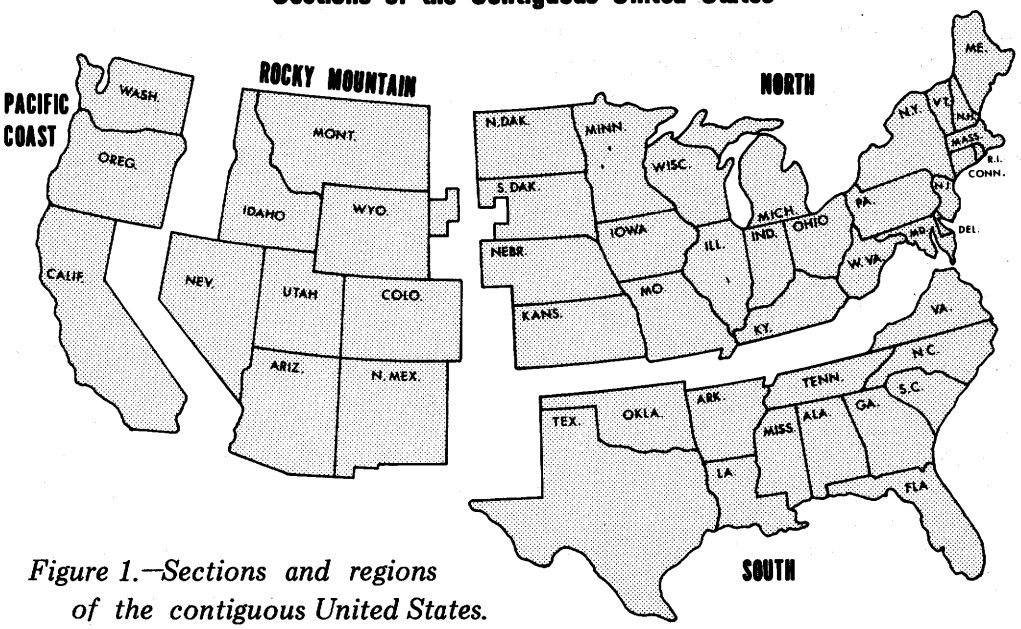

Figure 1.—Sections and regions of the contiguous United States.

rapidly on the Pacific coast where large reserves of old-growth timber were still available. Softwood production continued to climb on the Pacific coast, peaking in the 1960's after over a hundred years of continuous and almost constantly increasing production.

In every wood-producing region in this country, production from privately owned old-growth timber has been determined primarily by market demand constrained only by the limitations of the standing inventory. The "sustainable" harvest level of young-growth replacement forests was not used as a constraint on the rate of old-growth liquidation on private lands nor on public lands until recent years. Consequently, timber production declined substantially in the North and the South when the old growth was depleted.

On the Pacific coast, the private old-growth reserves, which constitute the last of such privately held reserves in the United States, are becoming scarce, a trend of declining supply marking the adjustment from old growth to young growth (Wall 1972, Oswald 1970). However, coincidental with the decrease in private supply, harvesting of old growth on public lands increased, offsetting for the time being most of the decline in the private sector. The next two to three decades of timber supply depend on private decisions on how quickly to harvest its remaining old growth and on how soon growth from maturing young-growth stands will enter the market. However, with only limited private old-growth resources available and most of the remaining old growth in public ownership, the level of supply will mainly depend on public timber harvesting policies. Eventually, supply will be determined by the level of management of both public and private lands and by how completely the capacity of the region for producing wood is realized.

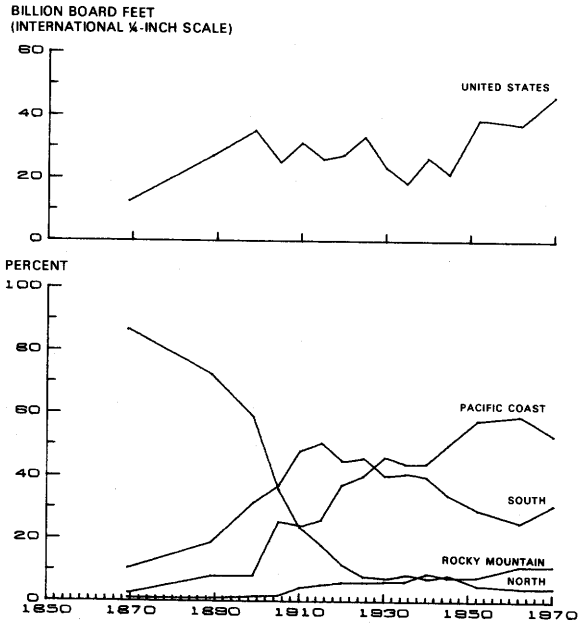

Figure 2.—Regional softwood sawtimber production in the United States, 1869-1970. Source: Production from 1869 to 1945 based on softwood lumber production as compiled by Steer (1948). After 1945, softwood sawtimber cut for all products was included, based on table 36, p. 51, of "The Outlook for Timber in the United States" (USDA Forest Service 1973).

Projection of Timber Supply Under Recent Levels of Management

The projections presented here show a level of supply that might reasonably take place under the assumption that recent levels of management will continue during the projection period. Such cultural practices as planting, thinning, fertilization, as well as protection activities, are assumed to continue at recent levels. Recent trends of timber supply will continue, changing with availability of the inventory.

These projections are especially meaningful in the next two to three decades. Most of the timber that will be cut during that period is already harvestable or almost harvest size. Measures such as planting, stand conversion, or precommercial thinning will have limited effect on immediate levels of supply, because they are most applicable to very young stands and do not result in immediate increases in material of usable size.

However, under certain circumstances, immediate increases in timber supply can be realized from these types of management practices. Increases can result if the forest manager has available reserves of merchantable timber. Having these reserves permits the forest manager to harvest the anticipated increased growth on unmerchantable size trees from the reserve of merchantable timber. Because this so-called allowable cut effect requires a substantial reserve of merchantable timber, this practice is largely limited to public owners. Therefore, on public lands, although the planned allowable cut includes benefits from future planned levels of management activities, modification of plans would have an immediate impact on present cutting levels (Schweitzer et al. 1972, Fight and Schweitzer 1974).

Other measures that directly increase supply, such as commercial thinning, are of limited importance because there are relatively few acres of timber of the right age and stocking to warrant thinning (Fight and Gedney 1973).

Owner Objectives

We projected supply separately for each owner group (National Forest, other public, forest industry, other private) and each area. For public owners, we extended over time each agency's presently calculated allowable cut.

Projections for private owners were more difficult because no one set of uniform objectives can be attributed to many individual owners. Some owners practice a very high level of forest management, and others make little conscious effort at management. However, for the projection we had to aggregate the owners into owner groups. For each owner group, we considered recent trends and current supply levels and projected these trends over time—tempering each projection by the available inventory, the long-term capacity of the resource to provide timber, and the total supply and demand situation in each area.

Our general approach was to extend and modify recent trends in supply. We first considered whether recent trends could be maintained without substantially reducing the growth capacity of the forest. If not, we modified trends so as to approach sustainable levels in the long run. The projection shows gradual rather than abrupt changes because individual owners will adjust supply levels at different times rather than all at one time. Sustainable levels of supply were continued or modified upward if resource capacity, owner objectives, and demand for raw material indicated potential for future higher levels.

Utilization Assumptions

Not all the tree volume that is harvested is used; some remains in the woods as logging residue. For this projection, we assumed that utilization of trees harvested would remain at recent levels. Logging residue averaged 6 percent of the board-foot volume in sawtimber size trees and 12 percent of the cubic-foot volume in growing-stock-size trees. Sawtimber trees are at least 11.0 inches in diameter at breast height (d.b.h.), contain at least one 12-foot log, and have a top diameter of not less than 7.0-inch outside bark. Growing-stock-size trees are at least 5.0-inch d.b.h., with a top diameter of not less than 4.0-inch outside bark.

In the projections, we increased the board-foot supply because trees smaller than 11.0 inches in diameter are increasingly being used. Board-foot supply from smaller trees was included on the following basis: the board-foot equivalent of 50 percent of the cubic-foot volume cut in trees 5- to 10.9-inch d.b.h. for 1970-80, 75 percent for 1980-90, and 88 percent thereafter.

The projections of supply not only include wood from live sound trees but also wood from dead and down trees and cull material which amounts to approximately 9 percent of the total supply over the projection period.

The Projection Model

The computer program used for the projections was developed by the Forest Service for projecting inventories to a common date and for projecting timber supplies under

varying assumptions (Larson and Goforth 1970, 1974). It was used for projections of timber supply made for the outlook study under the assumption of 1970 level of management (USDA Forest Service 1973). This program projects a stand table over time on the basis of radial growth, mortality, and ingrowth rates of trees. For the Pacific coast, these rates were based on field measurements at the time of the inventories which ranged from 1962 to 1969. Growth and mortality rates are not held constant in the program but are continually modified relative to the changing density of the forest. Increased stand density decreases growth and increases mortality within limits, and decreased stand density has the opposite effect.

The output by numbers of trees is converted to volume (cubic, International ¼-inch scale, and Scribner scale for the Pacific Coast States) by volume tables.

Area Assumptions

We assumed there would be no changes in commercial forest area[2] caused by sales or exchanges of land from one owner group to another during the projection period. Although these types of shifts were recognized for the period 1952-70, we assumed for the projection that the bulk of these changes had already occurred.[3] The projection of commercial forest land does continue the trend of losses to other uses such as roads, powerlines, rights-of-way, reservoirs, and urban development (Bolsinger 1973). The rate of loss, based on both historical trends and anticipated changes affecting the commercial forest land base, varies by area and owner.

Changes in the public sector, resulting from reclassification of commercial forest land into land reserved from timber harvesting—such as wilderness areas—were not extended. The one exception was in Alaska where one withdrawal was projected between 1970 and 1980. These types of changes, usually substantial, generally occur infrequently and were not anticipated.

Projection of Supply[4]

Softwood sawtimber supply is projected to decrease from the 1970 level of 24.9 billion board feet to 20.8 billion board feet by 2000, or 83 percent of 1970 supply, and to continue at that level thereafter to 2020 (table 1).

An increasing part of the timber supply over time will be from trees of less than 11.0-inch d.b.h. Harvest of these small trees will yield the equivalent of an additional 1.2 billion board feet by 2020—almost 6 percent of the total supply.

The projected decrease for fiber is substantially less—from the 1970 level of 3.8 billion cubic feet to 3.4 billion in 2000, 88 percent of the 1970 level of supply. By 2020, supply will increase to 3.5 billion cubic feet, 92 percent of the 1970 level.

These overall trends in timber supply are not shared equally by each State. In coastal Alaska, a substantial increase is projected, and in eastern Washington the general trend is upward. In eastern Oregon, there is an immediate drop from the 1970 level of supply but then a continuing recovery. In California, western Washington, and western Oregon the downward trend is steeper and of longer duration.

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[2] Commercial forest area is defined as forest land producing or capable of producing crops of industrial wood and not withdrawn from timber utilization. It must also have the capability of producing at least 20 cubic feet per acre per year.

[3] In Alaska this assumption may be unrealistic because of the Alaska Statehood Act and the Alaska Native Claims Settlement Act which can have a significant effect on the ownership of commercial forest land.

[4] Timber supply is the net utilizable roundwood volume removed from the forest and includes wood from live sound, dead, and cull trees.

Table 1.--*Supply of softwood sawtimber and softwood roundwood by State and area, 1970,*[1] *with projections*[2] *to 2020*

State and area	1970	1980	1990	2000	2010	2020
	Million board feet, International 1/4-inch scale					
Pacific coast sawtimber:						
California	5,408	5,035	4,628	4,444	4,444	4,407
Western Washington	7,365	6,719	5,853	5,417	5,218	5,104
Western Oregon	8,035	7,342	6,682	6,647	6,833	6,971
Eastern Oregon	2,120	1,843	1,855	1,863	1,879	1,899
Eastern Washington	1,230	1,198	1,252	1,290	1,318	1,344
Coastal Alaska	754	1,136	1,134	1,134	1,134	1,134
Total	24,912	23,273	21,404	20,795	20,826	20,859
	Million cubic feet					
Pacific coast roundwood:						
California	829	781	727	705	727	739
Western Washington	1,144	1,077	954	890	878	871
Western Oregon	1,166	1,113	1,014	1,050	1,112	1,164
Eastern Oregon	345	295	309	316	328	335
Eastern Washington	203	195	206	213	220	225
Coastal Alaska	119	175	175	176	177	179
Total	3,806	3,636	3,385	3,350	3,442	3,513

[1] Estimates are for trend level and consequently may differ from actual figures for the specified years.

[2] Projections were made under the assumption that forest management would continue at recent levels.

CALIFORNIA

California's timber economy has developed largely in response to local needs. Unlike other areas in the West which depend on nationwide demand, most of California's supply has been geared to its large and rapidly growing population. This, plus growth in national markets for California's wood products, has placed increasing demand on the forest resources of the State. However, since the mid-1950's, the trend in California softwood supply has been downward, indicating limitations in the capability of the resource to maintain supply at high levels. Softwood supply in California in 1970 was about 5.4 billion board feet,[5] a decrease of about 16 percent from the 1952 level of 6.5 billion board feet. Future output is projected to continue to decline and is estimated at 4.4 billion board feet in 2020, a decrease of 19 percent from the 1970 level (fig. 3). In terms

[5] Trended values are shown rather than actual point in time data.

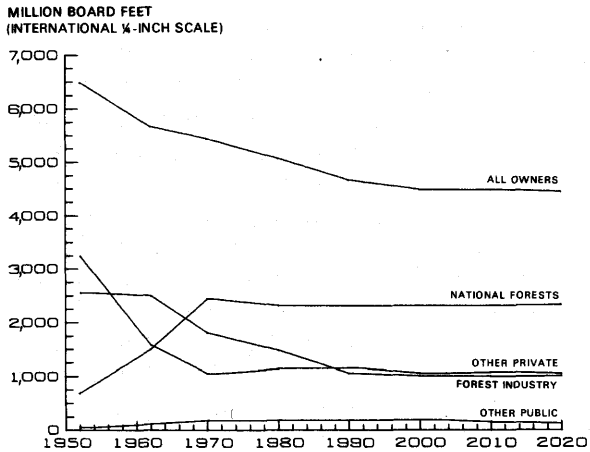

Figure 3.—Softwood sawtimber supply in California, 1952, 1962, and 1970, with projections to 2020.

of fiber, the decrease is much less, from 0.8 billion cubic feet to 0.7 billion—a decrease of 11 percent.

National Forests.—National Forests are the largest single owner in California. The 8.3 million acres of commercial forest land in National Forests is 50 percent of the total commercial forest land base, and the 162 billion board feet of softwood sawtimber is 59 percent of the total softwood sawtimber inventory in the State. National Forest lands are of generally poorer site quality[6] than those in other ownerships (appendix table 12).

Total softwood sawtimber supply from National Forests increased sharply over the last two decades. In 1952, supply was 0.7 billion board feet, about 10 percent of the State's total harvest; by 1970 it was 2.4 billion, about 45 percent of total supply in the State. Under a regulation policy of even flow, the softwood sawtimber supply has been projected at 2.3 billion board feet per year, about 50 percent of total. This includes 200 million board feet of dead and cull material and small sawtimber.

[6] Site quality expresses the relative ability of land to grow wood and is in terms of cubic-foot annual growth at culmination of mean annual growth in fully stocked natural stands.

Other public.—"Other public," consisting mainly of Bureau of Land Management (BLM) and Bureau of Indian Affairs (BIA) in the U.S. Department of the Interior, and State ownerships, represents a relatively small proportion of the total area, volume, and output in California. In 1970 the 476,000 acres of commercial forest land in these ownerships was less than 3 percent of the State's total commercial forest land; the 6.8 billion board feet of inventory volume was only 2.4 percent of the total volume; and the 172 million board feet of softwood sawtimber harvested was 3.2 percent of total supply. The land is of relatively low site quality.

Supply from these other public lands increased rapidly over the last two decades, from 26 million board feet in 1952 to 172 million in 1970. Supply is projected at the announced allowable cut level of 162 million board feet until after the turn of the century when a decrease is projected.

Total current allowable harvests for these public owners has been accepted as the projected supply through year 2000. However, this level of harvest beyond that time would result in depletion of the growing-stock base and would have a negative effect on growth. The projected supply beyond year 2000 was therefore adjusted downward. This in effect recognizes a shift to sustainable levels of harvest after removal of remaining old-growth timber, primarily on BIA and BLM lands.

Forest industry.—Forest industry land in California totals 2.7 million acres, about 16 percent of the total commercial forest area and about a third of the total commercial forest area in private ownership. The 43.4 billion board feet of softwood sawtimber inventory is 10 percent of the total sawtimber inventory in the State. Forest industry has the best site lands in the State.

Cutting on industrially owned lands has been in progress for about 100 years and has been heavy in recent decades. In 1952 the 2.5-billion-board-foot timber harvest was 39 percent of the total softwood sawtimber supply in the State. By 1970 supply dropped

to 1.8 billion board feet, about 33 percent of the total. The decline indicates that recent supply levels cannot be sustained indefinitely.

The projection of supply from industrially owned land has been made under the assumption that the present decline will continue until 1990 and then remain level. Higher levels would deplete the inventory to a point where present growth could not be maintained. Accordingly, the projected supply has been gradually reduced to about 1 billion board feet in 1990, with minor changes thereafter. This is about 58 percent of the 1970 level.

Instead of the gradual decrease assumed here, industry could maintain present supply in response to market demand or to protect industrial capacity. However, an extension of the present level of cutting would result in a depleted inventory and a precipitous decline in supply in the next two or three decades.

Other private.—The "other private" ownership is the largest owner group in the State with the exception of National Forests. In 1970 the 5.3 million acres in this group consisted of an estimated 1.5 million acres in farm ownership and 3.8 million acres in miscellaneous private ownership. The miscellaneous private owners consist of diverse groups and individuals ranging from a very substantial ownership to acreages held by recreationists, estates, and many others with a wide range of ownership objectives.

The forest land in this ownership group has lower site quality than industrially owned land but is of better site quality than public lands.

A long history of heavy cutting has reduced the old-growth softwood sawtimber inventory on some of these lands; in 1970, although the area was 32 percent of the total land base, it contained only 59.9 billion board feet or 22 percent of the total sawtimber volume.

Other private lands have produced much of California's early timber. After World War II, the demand for lumber rose sharply, and much of this demand was met by small mills cutting timber from other private lands. In 1952 timber cut from these ownerships totaled 3.2 billion board feet, almost 50 percent of the total output in the State. By 1970 the acreage in this ownership had dropped by almost 10 percent as these highly accessible lands were lost to urban development, recreation, and agricultural development, or were purchased by forest industry. The high level of supply and land loss reduced the inventory substantially, and in 1970, the inventory was only one-third of what it had been 18 years earlier. By 1970 the annual supply had dropped to 1.0 billion board feet, 19 percent of the State's total.

In projecting timber supplies from the other private ownerships, we assumed that the inventory would not be further depleted; we continued the approximate balance between growth and supply, a balance approached in 1970.

Uncertainty exists about the projected levels of supply from the other private ownership group. Any sustained increase is unlikely because of reduced inventories. In addition, the owners of many of these lands have objectives other than timber management which may limit availability of timber for harvesting. Although these lands could benefit substantially from intensified management, the level of future supply will be determined by owners' willingness to make the long-term investments needed to restore production.

THE DOUGLAS-FIR REGION OF OREGON AND WASHINGTON

Although timber supplies from western Oregon and western Washington (the Douglas-fir region) will be discussed separately, supply from these areas is closely interrelated and interdependent. Both areas supply national demand, and both areas with relatively small populations consume little of their total output. Many of the principal industrial owners have extensive holdings and mills in both States. Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), and true firs (*Abies* spp.) are the dominant softwood species in both States. Together, the two States have generally maintained increasing supply over time with in-

creases from one State offsetting declines in the other.

The Douglas-fir region is the most highly productive forest region in the country, and it supplies tremendous quantities of wood for both national and international markets. In 1970 the region produced about one-fourth of the Nation's entire roundwood supply and about 32 percent of the total sawtimber supply.

Timber harvesting first centered in western Washington because of easy accessibility to water transportation, mainly along the coast and in the Puget Sound area. Subsequently, production centers shifted southward, first into southwestern Washington and then into Oregon.

Until the early 1940's supply in western Washington exceeded western Oregon; but thereafter supply in western Oregon was greater, with a peak reached in about 1952 of 68 percent of the total volume harvested in the Douglas-fir region. Since then, the differences have diminished, and by 1970, supply in western Washington had increased to 48 percent of total supply in the Douglas-fir region.

Western Washington

Timber harvesting in western Washington increased rapidly in recent years (fig. 4). In

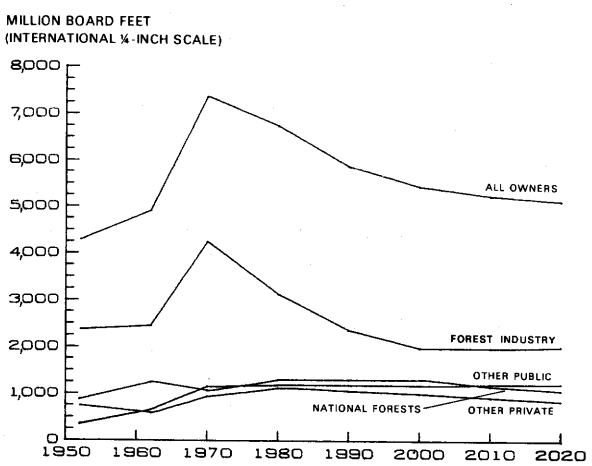

Figure 4.—Softwood sawtimber supply in western Washington, 1952, 1962, and 1970, with projections to 2020.

1970 supply was 7.4 billion board feet, an increase of 2.5 billion board feet over the 1962 level of 4.9 billion. This was in contrast to the increase of 625 million board feet between 1952 and 1962.

Most of this increase was attributable to an intensified demand for export logs. In 1970, western Washington harvested 7.4 billion board feet, of which about 2 billion was exported (Holt 1974); the high prices paid for logs stimulated production from the price-responsive sectors of the timber economy. From 1962 to 1970, the other public sector harvest increased 77 percent, or about 500 million board feet; forest industry increased 73 percent or 1.8 billion board feet; and other private output increased 66 percent, about 373 million board feet. Only National Forests did not participate in this increase; supply actually dropped.

National Forests.—National Forests in western Washington, with 2.3 million acres or 23 percent of the total commercial forest area, represent the second largest owner category in the State. These lands contain 95.3 billion board feet of softwood sawtimber, 41 percent of the total inventory with much of the volume in old-growth timber. Commercial forest land in National Forests has the poorest site quality of any ownership category in western Washington.

Supply from National Forests increased from 0.9 billion board feet in 1952 to 1.2 billion in 1962, then decreased to 1.0 billion in 1970. In 1962 National Forests produced 25 percent of total softwood supply, but the sharp rise by all the other owners in 1970 reduced its proportion to 14 percent of the total. Supply is projected to remain level until after the turn of the century and then to decrease somewhat, mainly because of decreased harvesting in the Shelton Sustained Yield Unit.

Other public.—Other public lands in western Washington consist mainly of land in State ownership with lesser amounts in BIA, county, and municipal ownerships. They represent combined holdings of 1.8 million acres, 18 percent of the total commercial

forest land area. The other public ownership includes some of the more productive land in the State. The 43.1 billion board feet in this ownership is 18 percent of total softwood sawtimber volume in western Washington.

Softwood supply from other public lands increased sharply between 1952 and 1970, from 338 million board feet to 1,150 million, an increase of 240 percent. This rapid increase is due to many administrative and management decisions reflecting different methods of calculation of allowable cut as well as intensified forest management. The projected allowable cut is assumed to remain at this level.

Other public lands will assume a more important role in supplying softwood timber to meet future needs. In 1970 its harvest of 1.2 billion board feet was 16 percent of the total supply from all commercial forest land; by 2020, the projected 1.2 billion board feet from the other public sector will be 24 percent of the total supply in western Washington.

The forests on the other public lands produce a higher level of growth than any other owner group in western Washington (appendix table 11). A principal factor in this high level of growth is the low proportion of lands in a nonproductive condition (Fight and Gedney 1973). Only 18 percent of the coniferous forest land base either is in hardwood stands or is less than 10 percent stocked. In addition, 75 percent of the total commercial forest land area is in rapidly growing young age classes, with only a relatively small area in slower growing old-growth stands. Removal and growth are currently in balance, and the level of softwood cut is projected to remain in balance with net growth to 2020.

Forest industry.—Wood from industrially owned forest land in western Washington provided 58 percent of the total harvest from all ownerships in 1970; this came from 3.6 million acres—about 36 percent of the total area in commercial forest land. The 1970 softwood sawtimber inventory was 74.8 billion board feet, about 32 percent of the total softwood sawtimber volume in all ownerships. Industrially owned forest land has highest site quality in the State.

Sawtimber supply, which was 2.4 billion board feet in 1952 and 1962, rose sharply to 4.2 billion board feet in 1970. The industrial owners of western Washington are still producing primarily from inventories of old-growth timber, and this gives them considerable flexibility to respond to market demand. However, they are rapidly approaching the time of transition from old-growth timber to supply based on the capacity and condition of young timber resources.

Recognizing that individual owners will run out of old growth at different times because of different situations, we projected a gradual decline in harvesting over a 30-year period. A 54-percent decline in supply—to 2 billion board feet—is projected by 2000. For total fiber, the projected decrease in roundwood output is 49 percent.

The transition could, of course, be different. Increasing production from some owners could offset—or more than offset—declining production from others, resulting in maintenance of or an increase in output from all owners. But this could be maintained for only a few years, and an abrupt decline would eventually follow. Continued strong markets for wood products reflected in high prices could result in this type of profile.

Although forest industry has greatly intensified forest management effort in recent years, there are still areas that are not being fully utilized for timber production. Of the commercial forest area in industrial ownership that is capable of growing softwoods, 16 percent is in hardwood stands; another 7 percent is in stands less than 10 percent stocked with either softwoods or hardwoods. Although at present 53 percent of forest industry lands are in young-growth stands under 100 years of age, 21 percent are only 10-39 percent stocked.

Other private.—The other private ownership in western Washington totals 2.3 million acres—about 23 percent of the total commercial forest land. Eighty-one percent, 1.8 million acres, is in miscellaneous private own-

ership and the rest is in farms. The miscellaneous private ownership is widely diverse, including companies primarily geared to timber production as well as many small individual owners with a wide range of ownership objectives. Much of this ownership is at lower elevations and occurs on less fertile sites than most other ownerships. Despite the substantial area in this ownership, these lands contain only 9 percent of the total softwood sawtimber inventory.

Production from these lands is relatively low. In 1970, 936 million board feet were harvested, about 13 percent of the total supply from all owners. Other private harvest is projected to increase to 1.1 billion by 1980 and thereafter gradually decrease to about 824 million board feet in 2020. Much of the projected reduction in supply is the result of expected loss of commercial forest land to other uses—mainly urban development and roads, with the area base declining 30 percent by 2020.

Many of these lands suited to growing softwoods are stocked with hardwoods, and many are carrying less than adequate softwood stocking. Of the area capable of growing conifers, 40 percent is occupied by hardwood stands or is less than 10 percent stocked, and 40 percent of the young conifer stands under 100 years of age is only 10-39 percent stocked. However, some of the less attractive features from the viewpoint of timber production, such as presence of hardwoods or poor stocking, may be attractive to owners. Because some owners have objectives other than timber production, not all these lands can be considered as available for commercial timber production and much of the area will not be available for intensified forest management.

Western Oregon

Timber harvesting in western Oregon lagged behind western Washington until the early 1940's. By 1952, softwood sawtimber supply in western Oregon was 9.3 billion board feet, 68 percent of total supply in the Douglas-fir region. This level was critical to the maintenance of the output from the Douglas-fir region as harvesting activities in western Washington decreased to relatively low levels. Within western Oregon, supply of timber was the result of the interaction between public and private ownerships. In 1952, private supply was 76 percent of total output. By 1970, private output had decreased to 54 percent of the total.

Supply in western Oregon trended downward to 1970 mostly in the private sector (fig. 5). The harvest from private ownership decreased 2.6 billion board feet, more than offsetting increases of 1.4 billion board feet from public ownerships. Total softwood sawtimber supply in western Oregon is projected to decrease 17 percent from 8.0 billion in 1970 to a low of 6.6 billion board feet by 2000. However, in terms of fiber, the decrease is only 10 percent from 1.2 billion cubic feet to 1.1 billion.

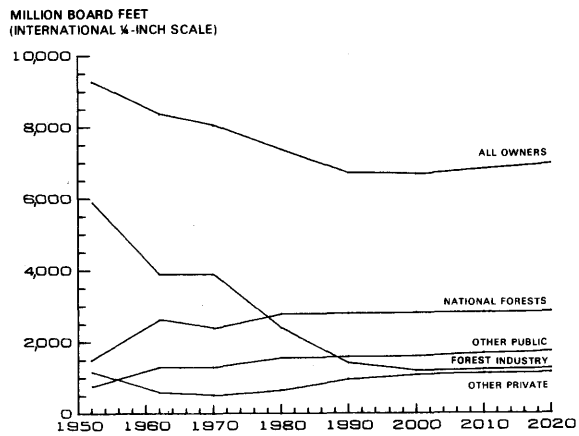

Figure 5.—Softwood sawtimber supply in western Oregon, 1952, 1962, and 1970, with projections to 2020.

National Forests.—National Forests are the largest owner group in western Oregon. Their 4.8 million acres of commercial forest land is 33 percent of the total; they also contain 172.3 billion board feet, slightly more than half the total softwood sawtimber volume. National Forest lands have the lowest site quality of any owner in western Oregon.

Timber harvesting on National Forests rose sharply between 1952 and 1962, increasing from 1.5 billion board feet to 2.6 billion, or 74 percent. At the same time, its importance in western Oregon rose from 16 percent of the total supply in 1952 to 31 percent in 1962. In 1970, timber harvest from National Forests dropped to 2.4 billion board feet, although it maintained the same relative importance as in 1962.

Timber supply in the future is projected at 2.8 billion board feet which is the present allowable cut level plus approximately 350 million board feet of additional volume in dead, cull, and small trees. With the total cut expected to decrease in western Oregon, the level of cut projected for National Forests will become an increasingly important part of the total harvest; and by 2000, the National Forest timber harvest will be 42 percent of the total from all owners.

Other public.—The other public ownership in western Oregon is mainly in land managed by the Bureau of Land Management. Of the total 2.9 million acres in this ownership 70 percent is BLM, with most of the remaining area State owned. This is the smallest owner group with an area of only 20 percent of the total and a softwood sawtimber inventory of 67.1 billion board feet, 20 percent of the total inventory in western Oregon. The lands in this ownership are of high site quality.

The harvest of softwood sawtimber increased from 749 million to 1,300 million board feet between 1952 and 1962, an increase of 74 percent. Log production in 1970 stayed at about the 1962 level but is projected to increase to 1.7 billion board feet in 2020. The other public ownership has become increasingly important as private cut declines. In 1952 other public owners accounted for only 8 percent of the total timber harvest; by 1970, the proportion had increased to 16 percent and is projected to increase to 25 percent by 2020.

The increasing cut from other public ownerships in western Oregon is due to many factors, principally the high intensity of forest management practices incorporated into the allowable cut calculation. However, unlike some situations where recognition of a high level of management precludes further increases in the allowable cut, the projected removal-growth ratio shows an excess of growth over removals. One major factor is that large areas, such as the former Tillamook Burn which is in State ownership, contribute substantial cubic-foot growth on material not yet at harvestable size. In the future this volume may increase supply levels substantially.

Forest industry.—Industrially owned forest land in western Oregon is 52 percent of total private ownership and 25 percent of total commercial forest land. Unlike many other ownerships whose land base has gradually diminished over time to other land uses or to other ownerships, industrial ownership has been increasing through acquisition of forest land from other private owners. In 1952 the area in this ownership was 3.1 million acres; by 1970 it totaled 3.6 million acres, a 16-percent increase. Industrially owned lands contain the largest proportion of high site land in western Oregon.

The rapid development of the timber industry in western Oregon has been sustained largely by raw material from forest lands owned by industry. In 1952, although industry lands were only 21 percent of the total commercial land, these lands supplied 5.9 billion board feet or 64 percent of the total timber harvest in western Oregon. In 1970 the harvest decreased to 3.9 billion board feet, but this was still 48 percent of the supply from all owners. As a result of the continuing high levels of supply, softwood sawtimber inventory from this ownership declined 42 percent between 1952 and 1970. A continuation of the declining trend starting in the early 1950's is projected for the future with the harvest on industry-owned lands down to about 1.2 billion board feet in 2000, about 30 percent of the 1970 timber harvest. After 2000, supply is projected to turn upward.

Much of the past timber cutting, especially in the dry sites in southwestern Oregon or on the coast where competition with brush hinders stand establishment, has resulted in

stands not now in a highly productive condition. Approximately 12 percent of the area capable of supporting coniferous growth has reverted to hardwood stands, and an additional 21 percent is less than 10 percent stocked. On young coniferous stands, one-third is poorly stocked having 10-39-percent stocking.

Other private.—Although other private ownerships in western Oregon had 22 percent of the total commercial forest land area, they supplied only 6 percent of the total timber harvest in 1970. They have a low inventory volume containing only 8 percent of the softwood sawtimber inventory in western Oregon. The commercial forest lands in other private ownerships have a higher site capacity than National Forests but not as good as either industry-owned or other public lands.

Timber supply from these private lands has steadily decreased from 1.1 billion board feet in 1952 to 482 million in 1970. More than half—55 percent—of the lands in these ownerships that once supported coniferous forests are now occupied by hardwood stands or are nonstocked. Of the young-growth forests, about 50 percent are poorly stocked (10-39 percent).

Removals in 1970 were less than growth. Much of the softwood sawtimber in this ownership is costly to harvest because trees are scattered in stands with low volumes per acre. Some owners of this timber have objectives other than timber production. The projection continued the trend of removals being less than growth. But we do anticipate that, with buildup of inventories, more timber will become economical in the future and timber harvest will be closer to balancing growth.

PONDEROSA PINE REGION OF OREGON AND WASHINGTON

The areas of Oregon and Washington east of the Cascade Range of mountains (ponderosa pine region) have developed largely independently of each other and the Douglas-fir region in growth of forest industries. Except in recent years, most of the timber operating companies within each area were independent of mills in the other State. Each operated within its own supply area; mobility of industrial development was not nearly as evident here as in the Douglas-fir region. The wider swings in production both within and between States that characterized development west of the mountains did not occur in the ponderosa pine region because of the larger proportion of public ownership of timber.

The ponderosa pine region lying in the rain shadow of the Cascade Range has more arid growing conditions and produces much less timber for national consumption than does the Douglas-fir region. In 1970 the region produced about 7 percent of the national supply of softwood sawtimber. The population is limited because of the relatively harsh environment, so most of the timber is for national markets, mainly in the Midwest.

Each State area in the ponderosa pine region has developed somewhat differently from the other. The earlier development of the timber industries in eastern Oregon resulted from more accessible ponderosa pine. In time the industry expanded to areas of more difficult accessibility and to acceptance of other species. Although development in eastern Washington lagged substantially behind eastern Oregon, continued growth marked the development of both areas.

Future production by owner group in the ponderosa pine region, once the residual stands of old growth are gone, will largely reflect intensity of management practiced. Unlike the Douglas-fir region where a wide range of site classes exists, most lands in the ponderosa pine region have only limited differences in site. In both States, more than half the area in any ownership is classed as capable of yielding from 50 to 85 cubic feet per acre per year.

Eastern Oregon

The softwood sawtimber harvest in eastern Oregon rose steadily between 1952 and 1970, paced by increasing output from National Forests (fig. 6). In 1952 it was almost 1.4 billion board feet; and by 1970 it reached 2.1 billion board feet, an increase of

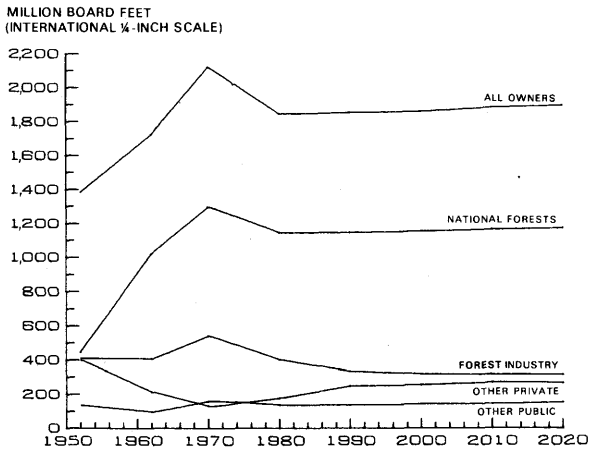

Figure 6.—Softwood sawtimber supply in eastern Oregon, 1952, 1962, and 1970, with projections to 2020.

54 percent. Projection of timber harvest for 1980-2020 is about 1.9 billion board feet—a little less than in 1970.

Much of the increase in supply has been made possible by increased use of species other than ponderosa pine (*Pinus ponderosa* Laws.). In 1925 ponderosa pine accounted for 96 percent of eastern Oregon's total timber harvest; in 1968 the proportion was 72 percent. With increasing demand for most species and easier access to timber, the supply of timber available to industry has increased.

About 70 percent of the commercial forest area in eastern Oregon is in public ownership; and more important in the short-term outlook, 83 percent of the softwood sawtimber volume is in public ownership. The timber supply in the immediate future will largely depend on the policies and objectives of the public agencies managing the timber resources.

Land ownership patterns in eastern Oregon changed rapidly between 1952 and 1962 as the result of the dissolution of the Klamath Indian Reservation. Former reservation land became part of the National Forest System; it also increased the other private and industry sectors.

National Forests.—The 7.2 million acres of commercial forest land in National Forests represent 65 percent of total commercial forest land in eastern Oregon. This very substantial ownership indicates that over the long haul, the level of eastern Oregon's timber production will inexorably be linked with National Forest timber harvest policies. In the immediate future, the importance of National Forests to the supply outlook for eastern Oregon is substantial because National Forests have about three-fourths of the total merchantable sawtimber volume.

National Forests have been increasing in both area and timber harvested. The inclusion of part of the former Klamath Indian Reservation into the National Forest System resulted in formation of a new National Forest. Between 1952 and 1970 the commercial forest land area on National Forests increased 453,000 acres, about 7 percent more than the National Forest commercial forest land in 1952; supply increased from 446 million board feet to 1.3 billion—a threefold increase. During this time, private timber harvesting dropped so the National Forest share of the total supply increased from 32 percent in 1952 to 61 percent in 1970. Supply from National Forests is projected to 2020 at about 1.2 billion board feet or 62 percent of the total harvest from all owners during the entire period.

Other public.—The other public ownerships consist mainly of land in reservations managed by the BIA[7] or public domain lands under administration of the BLM. The 316,000 acres managed by the BIA and the 200,000 acres under BLM management, together with the 78,000 acres in other miscellaneous public ownership (mainly State), represent about 5 percent of the total commercial forest land area. They contain 7 billion board feet of sawtimber.

Despite a decrease of almost 750,000 acres from termination of the Klamath Indian Reservation, the timber harvest in this owner group increased from 129 million in 1952 to 159 million board feet in 1970. During the

[7] Although Indian lands are included in public ownership due to the nature of their trusteeship and administration, they are privately owned by various tribes and some individuals.

entire projection period from 1970 to 2020, we assumed supply would remain at the allowable cut level of 130-150 million board feet. This is approximately 8 percent of the total harvest from all owners.

Forest industry.—Forest industry owns 1.6 million acres of commercial forest land or about 14 percent of the total commercial forest land base, but as of 1970, this land contained only 9 percent of the total sawtimber volume in eastern Oregon. In part, this lower than average volume can be explained by heavier cutting on private land than on other ownerships. In 1952 the 409 million board feet supplied from industrially owned commercial forest land made up 30 percent of the total timber harvest; by 1970 harvest had increased to 540 million board feet. Supply is projected to decrease to 309 million board feet in 2010.

Other private.—Other private commercial forest totals 1.7 million acres, about 100,000 acres more than the industrial ownership and about 15 percent of the total commercial forest area. About 72 percent of other private land is owned by farmers, and the remainder is in miscellaneous private ownership.

Easy access resulted in early heavy cutting on the other private lands. In 1952 the timber harvest from these lands was about 29 percent of the total supply of sawtimber in eastern Oregon. However, even with the additional acreage from the former Klamath Indian Reservation, the harvest from this ownership dropped from 397 million board feet in 1952 to 124 million in 1970.

This owner group has long provided substantial timber harvests from their lands, reducing inventories and availability of timber of merchantable size. Although harvests have decreased, growth has increased. In 1970, cubic-foot growth was three times the volume of wood removed for products. Inventory increases resulting from this buildup are assumed in the projection, making possible increased supply in the future. By 2000, timber harvest is projected at 254 million board feet, twice what it was in 1970.

Eastern Washington

Timber harvests in eastern Washington have been gradually increasing; between 1952 and 1970, supply increased by one-third to 1.2 billion board feet, with increases in public production of 481 million board feet offsetting decreases in private production of 170 million. Total harvest is projected to increase slightly in the future by about 114 million board feet, with the largest part coming from the other private ownership sector (fig. 7).

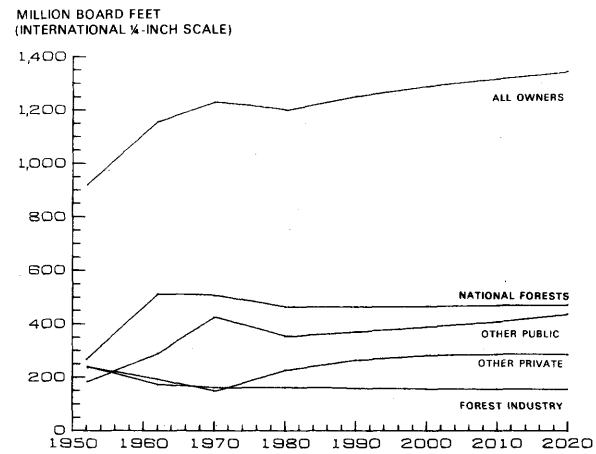

Figure 7.—Softwood sawtimber supply in eastern Washington, 1952-2020.

Public ownership in eastern Washington represents 64 percent of the total commercial forest land area. With 79 percent of the total sawtimber volume in public ownership, the direction and growth of the forest industry largely depend on programs and policies of these owners.

Private ownership in eastern Washington is dominated by land in other private ownership. Industrial ownership of forest land is relatively minor—only 25 percent of private ownership. Forest industry in eastern Washington depends on public lands and other private land for a continuing supply of timber (Bergvall and Ormrod 1974).

National Forests.—The 3.1 million acres of commercial forest land in National Forests

in eastern Washington is 37 percent of the total commercial forest land base. This land contains 51 percent of the present sawtimber inventory. Timber harvesting on National Forests has increased rapidly in recent years. In 1952 it totaled 267 million board feet, about 29 percent of total harvest. This increased by 1962 to 511 million board feet and essentially leveled in 1970 at 504 million—about 41 percent of the total supply from all owners. Supply from the National Forests is projected at about 460-470 million board feet.

Other public.—Commercial forest land in other public ownership totals 2.3 million acres, with most of it in the 1.4 million acres in Indian reservations and 0.7 million acres in State ownership; the balance is largely in other Federal ownership. Currently, the 27 percent of total commercial forest land in this owner group contains 28 percent of the total sawtimber inventory volume.

Timber harvest from these lands has steadily increased. In 1952 it was 180 million board feet or about 20 percent of the total in eastern Washington; by 1970 it was 424 million board feet or one-third of total output. However, the projected cut drops to the allowable cut level of 351 million board feet in 1980 with projected increases to 436 million board feet by 2020.

Forest industry.—Forest industry's 750,000 acres is only 9 percent of the total commercial forest land base in eastern Washington—a smaller proportion than in California, Oregon, or western Washington. The area contains 5.4 billion board feet or 7 percent of the total sawtimber inventory. The small area and volume in industrial ownership make the forest industries of eastern Washington dependent on other owners for their timber.

This dependency has increased in recent years. In 1952, industry-owned lands supplied 236 million board feet, about 26 percent of total wood harvested. By 1970 supply on industry-owned lands decreased to 157 million board feet or about 13 percent of the total harvest.

Other private.—The commercial forest area in other private ownership totals 2.3 million acres or about 27 percent of the total commercial forest land area in eastern Washington. Most of the forest land (63 percent) is owned by farmers.

Because much of this area is at lower elevations, access is easy, and there is a high proportion of ponderosa pine. These desirable features favored early logging, and by 1970, the other private ownership had only 13 percent of the total sawtimber inventory volume. This reduced timber inventory has resulted in a sharply decreased timber harvest. In 1952, these lands supplied 236 million board feet—about 26 percent of the total harvest from all owners. By 1970 the timber supply dropped to 145 million board feet and was only 12 percent of total harvest. However, since 1962, growth of both sawtimber and growing-stock trees has been either equal or in excess of removals, resulting in a buildup of inventory.

Public timber has supplanted private timber as a source of supply in this area. During 1962 to 1970, output from public lands increased rapidly. Public timber may be more desirable for many reasons; one reason is easier contractual arrangements with public agencies than with individual private owners. In addition, larger tree size, heavier volumes per acre, and concentrations of timber are more easily obtained from the old-growth stands in public ownership than from private lands stocked with young growth.

However, this is assumed to be a temporary situation, and supply is projected to increase as the inventory builds and becomes more attractive to industry. By 2000, output is projected at 283 million board feet—an increase of 95 percent over the 1970 level.

COASTAL ALASKA

The commercial forest land in coastal Alaska totals 5.6 million acres, of which 5.1 million acres is in National Forests. Most of the remaining commercial forest land is in State ownership, with a relatively small area under management of the Bureau of Land

Management, and only 30,000 acres in private ownerships. In 1970, of total removals, 91 percent came from National Forest lands.

Alaska's timber economy is just developing, so predicting the future (fig. 8) is difficult. Since most of the public ownership is in National Forests, the projection of potential supply is the announced allowable cut of the National Forests.

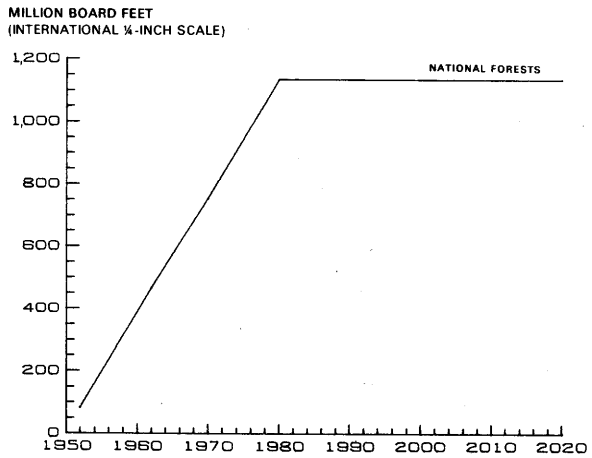

Figure 8.—Softwood sawtimber supply from National Forests in coastal Alaska, 1952, 1962, and 1970, with projections to 2020.

The 1970 harvest in coastal Alaska was 754 million board feet; the projected level is 1.1 billion board feet, about 50 percent more than in 1970.[8] This projected level does not include any timber from land currently classed as marginal commercial forest land or land presently classed as noncommercial. Both of these contain timber although logging would be uneconomical at 1970 prices. The projection reflects a decreasing commercial forest area in coastal Alaska up to about 1980 because of withdrawals for recreational purposes.

Future demand for timber from coastal Alaska depends on many factors, but principal among them is the relation of Alaska's timber resources to foreign demands and the allocation of timberland to commercial timber production. A large proportion of timber produced in Alaska is used by Japanese markets. The direction and level of exports depend on the Japanese economy as well as both State and Federal foreign trade policies.

SUMMARY

In this section we have presented estimates of future timber supplies on the Pacific coast, answering the question: "How much timber is likely to be available in the future if forest management continues at recent levels?"

The projection shows that supply of board-foot volume will decrease from the 1970 level of 24.9 billion board feet, International ¼-inch scale, to 20.8 billion by the year 2000—a decrease of 17 percent. In terms of fiber the decrease is less, from 3.8 billion cubic feet to 3.4 billion—a decrease of 12 percent. The prospect of declining timber supplies over the next two or three decades is not desirable from either the national or regional perspective. Nationally, it will mean reduced supplies of wood products from the Nation's most important sawtimber-producing region during a period of increasing demands. Regionally, it will have an adverse impact on employment and income.

These projections, especially in terms of the longer outlook, are of most value in providing a base from which to evaluate the impacts and effectiveness of programs of intensified forest management. The next section of this report presents one program of intensified management of timber resources on the Pacific coast which could change the timber supply outlook for the region.

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[8] Regional Forester Yates of Region 10, USDA Forest Service, in review of this paper, stated that if the full potential of Alaska's National Forests could be cut, it could reach 1.654 billion board feet, International ¼-inch scale, by 2020.

Projection of Timber Supply With Intensified Management

There are many programs of intensified forest management that could improve future softwood timber supplies on the Pacific coast. Any program that would improve the condition of existing stands or bring nonproducing acres into production would eventually increase timber supplies to some degree. This section presents the assumptions and methodology for *one* program for intensification of forest management for Oregon, Washington, and California.[9]

This projection was shown in the outlook report (USDA Forest Service 1973, p. 123) as a case study of intensified management for Washington, Oregon, and California and, as in this report, excluded Alaska.[10] It included all owners except National Forests, but for this report National Forests are included.

Intensification of timber management can result in short-term increases in yields, if opportunities for harvest of merchantable material are available. Short-term increases can come from commercial thinnings or from increased rates of harvest in old-growth reserves in response to anticipated increases in future supplies resulting from investments, i.e., allowable cut effect. Increases in output that will be realizable only in the distant future can result from cultural operations in existing stands as well as from planting of currently unproductive acres. We are interested in both the quickly realizable and the long delayed increases in timber output in response to intensified management. As in the previous projection, only opportunities for increasing softwood timber supplies are considered. The program of intensified management presented here—as would be true with other programs—requires the expenditure of funds in programs that will result in eventually realizable increases in wood output. The program, then, is an investment program and is developed with the use of economic criteria.

ASSUMPTIONS AND METHODOLOGY

In conducting the analyses required to develop the management program, we considered the effects of a *one-decade* program of intensified management. Only those acres that were candidates for treatment during the first decade were considered. However, any acre so selected had the opportunity for continuing treatments during the entire projection period. This one-decade program was selected so that this analysis would be useful for short-term program and budgeting planning purposes; in these terms, a decade is a realistic time period.

The practices considered in the selection of acres for treatment varied by owner; in general, they included only practices considered feasible for each ownership class. Thus, the practices for National Forests are somewhat different from those for other ownerships. The practices considered were also limited to forest types for which yield data—with and without intensified management—were available.

In arriving at the amount of treatable acres, we subjected yields with and without treatment to an economic analysis to determine which combination of practices would yield dollar returns exceeding the cost of required capital investment including the interest on invested capital.

The objective of the analysis was to determine increased yields possible from programs that would be in addition to those currently underway. We assumed that the present ongoing programs would continue and that the benefits from the previous projection of supply under the assumption of continued

[9] Comparable data for Alaska were not available so Alaska was not included in the analysis. Since Alaska's allowable cut is projected to increase beyond current levels of demand, the need for this type of analysis is less than in areas where supply is already limited.

[10] The results of this projection will differ from the outlook study because some treatments were excluded from that study.

recent levels of management had already been claimed. Thus, the intensification effort represented here is in excess of that anticipated from ongoing programs. For National Forests, other public owners, and forest industry, records were used to indicate the present extend and type of management treatments. For other private owners, State programs of forest management assistance provided evidence of management treatments. In addition, for the other private owners a judgmental reduction was applied to the total acreage available for treatment. We assumed that some acreage would not be managed for timber production.

Identification of Treatable Acres

On National Forests, treatment opportunities were identified in three major forest types: Douglas-fir, fir-spruce, and ponderosa pine. The treatments considered on these types were site preparation, planting, release, and precommercial thinning. Estimates of the acres that were physically suitable for these treatments were from "project work inventories." Project work inventories are estimates of treatable acres that are prepared by field personnel based on their knowledge of local areas.

On lands other than National Forests, the estimates of treatable acres are based on a stratification of the Forest Survey inventory plots (Fight and Gedney 1973; USDA Forest Service 1973, table 48, p. 308). The treatment opportunities were evaluated for all conifer stands in western Oregon, western Washington, and for Douglas-fir stands in the north coastal area of California. Treatments were planting, converting hardwood stands to Douglas-fir, precommercial thinning, commercial thinning, fertilizing, and developing genetically superior stock for planting. In eastern Oregon, eastern Washington, and interior California only ponderosa pine and lodgepole pine were considered; treatments were precommercial and commercial thinning.

The various treatments for west-side conifer stands were included in several management regimes. Planting was evaluated as an alternative to natural regeneration or seeding on recently clearcut acres. Planting was also considered in conjunction with site preparation to convert hardwood stands occupying conifer sites. Precommercial thinning was considered on 15- and 25-year-old stands with more than 450 trees per acre. Commercial thinning was considered on 35- to 75-year-old stands with basal area stocking in growing-stock conifers in excess of 70 percent of normal. All stands currently given precommercial thinning would also be commercially thinned. Fertilization was considered for all stands qualifying for commercial thinning plus those that would be thinnable in 10 years. Fertilization was also considered as a future addition to stands currently being precommercially thinned. A program of genetic improvement was evaluated for all west-side conifer sites.

Estimates of thinnable acres of ponderosa pine and lodgepole pine were based on a stratification into stand size classes. Expert opinion was relied on to determine the thinnable acres from those classes.

Cost Assumptions

Costs of intensified management on lands other than National Forest were derived from a number of public and private sources. The assumed direct per-acre costs for 1970 were:[11]

a. Planting west-side conifers following harvest—$35
b. Site preparation and planting of nonstocked areas—$125
c. Site preparation for conversion of hardwood stands less than 45 years of age—$40
d. Precommercial thinning—$50
e. Commercial thinning—net return assumed
f. Fertilization—$22

Costs for a program of genetic improvement are for a 100,000-acre unit. The initial cost for setting up the program in the first

[11] Indirect costs were not available for other than National Forest owners. Indirect costs are highly variable and depend considerably on accounting practice.

decade is $64,000 per unit. Costs for the next four decades are $32,000 per decade. The first seedlings showing partial genetic improvement become available in the second decade and are used in the planting program for that unit thereafter. Because of the progression of regeneration cutting, the entire unit would not be planted with genetically improved stock until the second decade beyond the end of the rotation.

Costs for National Forests are based on actual costs in each region. The costs presented here and used in this analysis are the direct costs of doing the job on the ground plus local overhead costs.[12] Assumed direct plus local overhead costs per acre for 1970 are:

Practice	California National Forests	Oregon and Washington National Forests
	(Dollars)	
Site preparation and plant:		
Douglas-fir	63	64
Fir-spruce	71	74
Ponderosa pine	63	69
Release:		
Douglas-fir	14	12
Fir-spruce	17	16
Ponderosa pine	13	12
Precommercial thinning:		
Douglas-fir	31	36
Fir-spruce	35	42
Ponderosa pine	27	31

Price Assumptions

Prices for these analyses were based on 1970 National Forest timber sales. These sales are predominantly of old-growth timber and are based on Scribner log scale. The prices were adjusted to reflect sales of young growth based on International ¼-inch log scale. Thinnings were priced at 75 percent of final harvest prices. This resulted in initial prices of $23, $17, and $4 for Douglas-fir, ponderosa pine, and lodgepole pine final harvests, respectively.

As determinants of economically attractive treatments, the prices anticipated in 30 to 80 years when the increased harvests will occur are much more important than the prices assumed for the immediate future. Future prices were computed by adding regular price increases to 1970 prices. The trend in real prices[13] was projected by increasing a composite wood product price by a 1½-percent annual compound rate and attributing three-fourths of that increase to stumpage. Because stumpage prices are much less than product prices, this resulted in stumpage price increases at annual compound rates of 3½ to 5 percent over the first five decades. The anticipated final harvest prices for young growth in 2020, ignoring general inflation, are $98, $92, and $53, respectively, for Douglas-fir, ponderosa pine, and lodgepole pine.

Although these prices appear conservative when compared with trends since 1970, they were not particularly constraining in determining the potential increases in harvest that could result from more intensive management. Most practices were limited by availability of treatable acres, not the requirement that investments should earn a minimum 5-percent rate of return.

Yield Assumptions

Yield data for managed and unmanaged stands of west-side conifers were developed by Timber Management Research scientists at the Pacific Northwest Forest and Range Experiment Station. Reductions were then made to reflect expected average insect and disease impacts and unused portions of the commercial forest land base such as rock outcrops, streambeds, and natural openings.

The "full acre" yield estimates developed by Timber Management Research showed that, with stocking control, yields somewhat above Staebler (1955) gross yields, which are also "full acre" yields, could be expected. With reductions to get average yields over large areas, our estimates for full stocking control are somewhat less than Staebler gross yields on sites III and better, but somewhat

[12] Including the indirect costs of National Forest general overhead, the costs would be about double; therefore, the amount requested from Congress to implement these management practices would be about twice the amounts shown.

[13] "Real prices" are actual price levels divided by an "all commodity" price index which eliminates the price changes reflecting general inflation. The real price shows how the price of wood products has changed compared with prices of other commodities.

higher than Staebler gross yields on site IV. With full-stocking-level control and fertilization, average yields over broad areas are still less than Staebler gross yields on site II but are substantially above Staebler gross yields on sites III and IV.

Managed yields for other types were based on estimates by research silviculturists of the Pacific Northwest Forest and Range Experiment Station.

Economic Analysis

The yields, prices, and costs developed for each area, owner, and forest type were used in developing estimates of areas that would yield at least a 5-percent rate of return on the marginal costs of treatments. Tax effects on private lands were ignored, so this is a 5-percent rate of return before taxes. Although a 5-percent rate of return seems quite low by recent standards, we must recognize that we are ignoring general inflation of prices by using real prices in our price projections; it is therefore appropriate to use an interest rate that ignores inflation. The 5-percent rate resulted in most practices passing the economic screen.

The rate of return from treatments was calculated independently for each stand. Increases in yields were the changes in yields between the with-treatment and without-treatment regimes and were claimed for the years that the regimes differed. Thus, the economic evaluation did not consider any allowable cut effect.

All increments of management intensity were required to yield at least a 5-percent rate of return. Where more than one increment was considered, such as both precommercial thinning and fertilization, each increment was evaluated separately and each had to yield a minimum 5-percent return on the marginal costs of that practice.

Projection Technique

Our purpose for this projection is to identify the increases in growth and harvest that could result from the increased treatments. Increases in growth were the difference in mean annual growth between the with-treatment and the without-treatment regimes. This average over the remainder of the rotation was multiplied by the number of acres involved to estimate the growth increases for treatments. On public lands, because of the general applicability of even-flow constraints, we assumed that the allowable cut effect would result in harvest increases by the same amount and during the same period that growth increased. Eventual reductions in harvest result on other public lands because some management regimes reach rotation age before the end of the projection period and therefore quit contributing increased growth from the original investment. New opportunities in future decades and scheduling of the harvest increases would largely eliminate this irregular pattern. On private lands, where even flow is not generally a management objective, harvests were increased according to the differences in thinnings and harvests that resulted from subtracting the without-treatment regime from the with-treatment regime on a decade by decade basis. These differences were multiplied by the number of acres treated to arrive at the change in harvest resulting from the treatments. Very irregular patterns result from this procedure. These irregularities would be substantially smoothed after the first decade by considering new treatment opportunities and by scheduling the harvest to conform to management objectives.

Costs and Yields of One Program for Intensification of Timber Management

Given the previous assumptions on prices, direct costs, yields, and generally prescribed practices for various owners, many acres met the investment criteria specified for this management program in Oregon, Washington, and California.

The stand establishment practices that met the criteria included (a) planting of all

nonstocked sites (3.7 million acres); (b) use of genetically superior stock, except on low sites with long rotations; and (c) conversion of mature hardwood stands on medium sites and all hardwood stands on high sites to softwood stands (1.4 million acres).

In addition, several cultural practices applicable to existing stands met the specified criteria. These included (a) precommercial thinning followed by commercial thinning on all sites in the ponderosa pine type, and on all but the lowest site in other types (811,000 acres); (b) commercial thinning of all acres needing thinning in each area (401,000 acres); (c) fertilization of stands on high and medium sites that will be thinned and given final harvest in the next 20 years (219,000 acres—these acres are also included in b above); and (d) release of young conifer stands by herbicide application on all sites on National Forest lands (367,000 acres).

The management program outlined here involves stand establishment on 5.1 million acres and cultural treatment of existing stands on 1.6 million acres. These acres are in excess of those likely to receive treatment with recent levels of management. In total, some 6.7 million acres would receive intensified management under this alternative, at an initial cost of $468.9 million in the first decade.

Table 2 shows the distribution of these additional treatable acres by location and owner. Some significant characteristics of the distribution of these acres warrant brief discussion. Relatively few treatable acres were identified in eastern Oregon and eastern Washington. In these areas, general lack of a hardwood competition problem and widespread uneven-age management with natural regeneration in the extensive ponderosa pine forests are major reasons why the area qualifying for regeneration, release, or conversion is small. However, there are 458,000 acres, mostly in dense young stands that qualify for precommercial thinning followed by commercial thinning. The thinning opportunities occur on all ownerships.

Most of the planting opportunities in the next decade are on private lands. Of this 3.2 million acres, 2.0 million acres is from the backlog of unregenerated acres. The remainder is from the opportunities created by the harvest activities in the first decade.

Opportunities for release of conifer stands, usually through herbicide application to hardwoods that are inhibiting conifer growth, are identified only on the National Forests, primarily in western Oregon and northern California. Many acres in other ownerships probably could benefit by this treatment, but resource data needed to identify them were not available.

Almost half the acreage of hardwood conversion opportunities is in the other private owner category. The acres susceptible to this treatment, all of which are in western Oregon, western Washington, and northern California, represent areas dominated by hardwood stocking. Hardwood conversion was not identified separately from regeneration (planting) on National Forest lands.

Analysis of the increases in timber harvest that will result from the program of intensified management outlined here indicates that the $468.9 million investment in the first decade will yield 201 billion board feet of additional harvest over a six-decade period. Though the sum of the yields over the six decades is very substantial, the true impact of the program can best be understood by study of the timing of these yields (table 3, fig. 9).

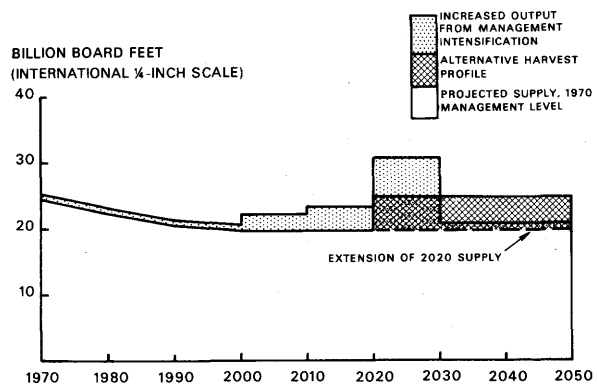

Figure 9.—Projected softwood sawtimber supply from Oregon, Washington, California, with and without intensified forest management.

Table 2.--*Area of treatment above 1970 level by management practice and owner in Oregon, Washington, and California*

(Thousand acres)

Area and owner	Planting	Thinning[1]	Hardwood conversion	Release	All practices
Western Oregon:					
National Forest	[2]83	123	--	140	346
Other public	--	100	161	--	261
Forest industry	1,107	--	190	--	1,297
Other private	791	37	329	--	1,157
Total	1,981	260	680	140	3,061
Western Washington:					
National Forest	[2]11	44	--	17	72
Other public	82	74	118	--	274
Forest industry	635	--	146	--	781
Other private	218	25	218	--	461
Total	946	143	482	17	1,588
Eastern Oregon:					
National Forest	37	104	--	14	155
Other public	--	11	--	--	11
Forest industry	--	72	--	--	72
Other private	--	55	--	--	55
Total	37	242	--	14	293
Eastern Washington:					
National Forest	20	56	--	5	81
Other public	--	32	--	--	32
Forest industry	--	39	--	--	39
Other private	--	89	--	--	89
Total	20	216	--	5	241
California:					
National Forest	[2]263	220	--	191	674
Other public	7	16	16	--	39
Forest industry	296	34	75	--	405
Other private	176	81	130	--	387
Total	742	351	221	191	1,505
All areas:					
National Forest	414	547	--	367	1,328
Other public	89	233	295	--	617
Forest industry	2,038	145	411	--	2,594
Other private	1,185	287	677	--	2,149
Total	3,726	1,212	1,383	367	6,688

[1]Includes commercial thinning and combinations of precommercial thinning, commercial thinning, and fertilization.

[2]Includes hardwood conversion.

In the first three decades, increased harvests from this program range from 930 to 975 million board feet annually, an increase of about 4.5 percent over the base-level projection of output in Oregon, Washington, and California presented in the first part of this paper.

Table 3.—Costs and responses to intensified management in Oregon, Washington, and California[1]

Area and owner	Area treated	Cost	Change in annual harvest by decade						
			First	Second	Third	Fourth	Fifth	Sixth	Seventh
	Thousand acres	*Million dollars*	*Million board feet (International 1/4-inch scale)*						
Western Oregon:									
National Forest	346	11.4	118.0	118.0	118.0	118.0	118.0	118.0	118.0
Other public	261	14.4	159.3	159.3	154.0	151.4	147.8	138.4	136.6
Forest industry	1,297	119.2	--	--	--	482.8	844.7	3,084.9	11.3
Other private	1,157	121.7	17.2	4.7	15.7	370.5	719.7	2,865.9	12.5
Total	3,061	266.7	294.5	282.0	287.7	1,122.7	1,830.2	6,207.2	278.4
Western Washington:									
National Forest	72	2.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6
Other public	274	13.3	190.6	190.6	190.6	187.0	172.2	161.8	161.8
Forest industry	781	55.2	--	--	--	348.9	522.0	1,673.8	22.7
Other private	461	37.5	20.9	-9.5	-8.0	195.0	288.7	1,120.0	9.9
Total	1,588	108.6	234.1	203.7	205.2	753.5	1,005.5	2,978.2	217.0
Douglas-fir region:									
National Forest	418	14.0	140.6	140.6	140.6	140.6	140.6	140.6	140.6
Other public	535	27.7	349.9	349.9	344.6	338.4	320.0	300.2	298.4
Forest industry	2,078	174.4	--	--	--	831.7	1,366.7	4,758.7	34.0
Other private	1,618	159.2	38.1	-4.8	7.7	565.5	1,008.4	3,985.9	22.4
Total	4,649	375.3	528.6	485.7	492.9	1,876.2	2,835.7	9,185.4	495.4
Eastern Oregon:									
National Forest	155	6.2	45.7	45.7	45.7	45.7	45.7	45.7	45.7
Other public	11	0.2	2.2	2.2	2.2	2.2	1.2	1.2	1.2
Forest industry	72	2.4	7.0	11.0	5.6	10.8	-5.0	8.2	7.4
Other private	55	1.2	8.7	13.9	7.0	9.9	-11.2	5.1	5.0
Total	293	10.0	63.6	72.8	60.5	68.6	30.7	60.2	59.3
Eastern Washington:									
National Forest	81	3.3	26.6	26.6	26.6	26.6	26.6	26.6	26.6
Other public	32	0.6	6.8	6.8	6.8	6.8	3.5	3.5	3.5
Forest industry	39	1.5	2.6	4.1	2.1	6.8	2.4	7.2	7.2
Other private	89	3.6	5.3	8.4	4.3	16.1	5.8	18.6	20.2
Total	241	9.0	41.3	45.9	39.8	56.3	38.3	55.9	57.5
Ponderosa pine region:									
National Forest	236	9.5	72.3	72.3	72.3	72.3	72.3	72.3	72.3
Other public	43	0.8	9.0	9.0	9.0	9.0	4.7	4.7	4.7
Forest industry	111	3.9	9.6	15.1	7.7	17.6	-2.6	15.4	14.6
Other private	144	4.8	14.0	22.3	11.3	26.0	-5.4	23.7	25.2
Total	534	19.0	104.9	118.7	100.3	124.9	69.0	116.1	116.8
California:									
National Forest	674	25.5	294.8	294.8	294.8	294.8	294.8	294.8	294.8
Other public	39	2.8	22.8	22.8	22.7	22.5	22.2	22.2	22.2
Forest industry	405	21.0	7.3	11.4	5.8	184.4	245.2	687.5	5.9
Other private	387	25.3	16.3	25.7	13.1	127.0	180.5	703.3	7.2
Total	1,505	74.6	341.2	354.7	336.4	628.7	742.7	1,707.8	330.1
All areas:									
National Forest	1,328	49.0	507.7	507.7	507.7	507.7	507.7	507.7	507.7
Other public	617	31.3	381.7	381.7	376.3	369.9	346.9	327.1	325.3
Forest industry	2,594	199.3	16.9	26.5	13.5	1,033.7	1,609.3	5,461.6	54.5
Other private	2,149	189.3	68.4	43.2	32.1	718.5	1,183.5	4,712.9	54.8
Total	6,688	468.9	974.7	959.1	929.6	2,629.8	3,647.4	11,009.3	942.3

[1]Includes intensified management opportunities returning 5 percent or more. Investments are made only in first decade; this results in reduced response in the seventh decade.

The increased harvests in the first three decades come almost entirely from public lands. On these lands, which have reserves of old-growth timber, expected gains in growth in the future as the result of intensified management are reflected in immediate increases in the allowable harvest rate in the old-growth reserves. Consequently, all practices initiated can result in immediate increases in harvest, even though the fiber resulting from the practice might not be available for several decades. On private lands, large reserves of old growth are no longer available. Thus, yields cannot be realized substantially in advance of their availability for harvest. The only practice that provides immediate yields on private lands is commercial thinning, which accounts for virtually all of the increases in harvests on private lands in the first three decades.

In the fourth and fifth decades, the increases in harvest from intensified management total 2.6 and 3.6 billion board feet annually over the base projections for those decades, an increase of 13 to 18 percent. About 72 percent of the increased harvest from 2000 to 2020 would come from private lands, primarily from commercial thinnings on stands regenerated or precommercially thinned during the first decade of the planning period. The increase in public harvest during the 2000-2020 period would remain at about the same level as for the first three decades of the planning period.

The large payoff for the program of intensified management becomes available in the sixth decade, during which the annual harvest could increase approximately 11.0 billion board feet (or 56 percent) over an extension of the 2020 base projection level. Of this increased harvest, 92 percent would come from private lands. The large amount of volume available for harvest in the sixth decade is due to availability (for final harvest) of stands created by investments on private lands in the first decade.

The intensified management program outlined here could increase total sawtimber output by 201 billion board feet, or 16 percent, over the next six decades.

The economic analysis underlying the intensified management program outlined in this section was based on the assumption that rotation age for privately owned timber is 50 years, and that stands created in the first decade will be harvested in the sixth decade. The harvest profile from this analysis shows very high increased yields in the sixth decade, followed by a much lower level in the seventh decade.

For illustrative purposes we have also shown an alternative final harvest profile extending through the eighth decade, which could result if rotation ages were extended and final harvest spread over three decades. This alternative is not necessarily consistent with the economic guidelines used in developing the intensified management program presented in this section.

If the sixth decade final harvests were spread over three decades, the annual increase in yields could average 5 billion board feet over the three decade period (fig. 9). This type of final harvest profile would provide for more stable output, which could likely be added to and extended further into the future with added investment in intensified management beyond the first decade.

SUMMARY

This section has presented one of many possible programs of intensified management of the timberlands of Oregon, Washington, and California. Given the management intensification program outlined here, $469 million invested on 6.7 million acres in the first decade would increase total harvests by 201 billion board feet over the next six decades. However, only nominal increases—from increased allowable cuts on public lands—would become available during this century; 86 percent of the increases would occur in the fourth through sixth decades. On private lands, yields from intensified management would largely be realized as the treated stands matured. Yields from this program will do little to mitigate the supply declines projected for the next two or three decades; they will have a substantial beneficial impact on timber supplies during the period 2000-2030.

The general pattern that emerges from these projections is one of relatively stable harvest levels from public lands and sharply declining harvest from private lands. The program of intensive management that we considered would result in immediate long-term increases in harvest on public lands. Although long-term increases are projected on private lands, only a minor part of these will occur within the first 30 years of the projection.

The two factors that could have a significant effect on this pattern are the scheduling of harvest on public lands and the assumed potential growth. On public lands, an accelerated liquidation of the old-growth inventory would substantially increase harvest levels in the immediate future. Increased potential growth could result from assumptions of significantly greater response to treatments, from treatments of stands and types not currently considered, and from other treatments not now included. This would extend the range of treatments beyond those currently considered feasible.

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Appendix

TABLES 4-12

Table 4.—Supply in California by owner class and species group, 1952, 1962, and 1970,[1] with projections to 2020[2]

(In millions)

Owner class and species group	Unit	1952	1962	1970	Projections				
					1980	1990	2000	2010	2020
National Forests:									
Softwoods	Board feet	681	1,502	2,439	2,301	2,303	2,309	2,319	2,338
Hardwoods	Board feet	3	8	19	25	25	25	25	25
Softwoods	Cubic feet	88	216	346	325	328	334	344	360
Hardwoods	Cubic feet	2	3	5	6	6	7	7	7
Other public:									
Softwoods	Board feet	26	108	172	162	162	162	111	79
Hardwoods	Board feet	1	2	4	5	4	4	4	4
Softwoods	Cubic feet	3	16	26	25	26	27	20	14
Hardwoods	Cubic feet	--	1	1	2	1	1	1	1
Forest industry:									
Softwoods	Board feet	2,540	2,473	1,777	1,444	1,023	960	956	985
Hardwoods	Board feet	2	4	11	13	14	14	16	18
Softwoods	Cubic feet	393	385	294	246	179	174	177	188
Hardwoods	Cubic feet	2	3	3	3	3	4	4	4
Other private:									
Softwoods	Board feet	3,228	1,555	1,020	1,128	1,140	1,013	1,058	1,005
Hardwoods	Board feet	3	8	18	20	25	24	31	29
Softwoods	Cubic feet	468	230	163	185	194	170	186	177
Hardwoods	Cubic feet	2	4	7	5	6	6	8	8
All owners:									
Softwoods	Board feet	6,475	5,638	5,408	5,035	4,628	4,444	4,444	4,407
Hardwoods	Board feet	9	22	52	63	68	67	76	76
Softwoods	Cubic feet	952	847	829	781	727	705	727	739
Hardwoods	Cubic feet	6	11	16	16	16	18	20	20

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 5.—Supply in western Oregon by owner class and species group, 1952, 1962, and 1970,[1] with projections to 2020[2]

(In millions)

Owner class and species group	Unit	1952	1962	1970	Projections				
					1980	1990	2000	2010	2020
National Forests:									
Softwoods	Board feet	1,501	2,615	2,372	2,774	2,787	2,803	2,818	2,840
Hardwoods	Board feet	--	4	19	31	31	31	31	31
Softwoods	Cubic feet	234	401	345	411	414	418	424	432
Hardwoods	Cubic feet	--	1	4	4	4	4	4	4
Other public:									
Softwoods	Board feet	749	1,300	1,294	1,554	1,574	1,599	1,673	1,730
Hardwoods	Board feet	22	4	5	6	7	8	9	10
Softwoods	Cubic feet	109	192	179	222	227	237	257	277
Hardwoods	Cubic feet	5	1	1	1	1	1	1	2
Forest industry:									
Softwoods	Board feet	5,890	3,870	3,887	2,368	1,379	1,171	1,227	1,260
Hardwoods	Board feet	66	46	54	56	65	75	81	81
Softwoods	Cubic feet	874	583	572	368	210	207	233	252
Hardwoods	Cubic feet	16	11	12	8	11	14	16	18
Other private:									
Softwoods	Board feet	1,126	558	482	646	942	1,074	1,115	1,141
Hardwoods	Board feet	13	6	3	9	17	19	20	20
Softwoods	Cubic feet	182	97	70	112	163	188	198	203
Hardwoods	Cubic feet	4	2	1	2	3	3	3	3
All owners:									
Softwoods	Board feet	9,266	8,343	8,035	7,342	6,682	6,647	6,833	6,971
Hardwoods	Board feet	101	60	81	102	120	133	141	142
Softwoods	Cubic feet	1,399	1,273	1,166	1,113	1,014	1,050	1,112	1,164
Hardwoods	Cubic feet	25	15	18	15	19	22	24	27

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 6.—Supply in western Washington by owner class and species group, 1952, 1962, and 1970,[1] with projections to 2020[2]

(In millions)

Owner class and species group	Unit	1952	1962	1970	Projections				
					1980	1990	2000	2010	2020
National Forests:									
Softwoods	Board feet	870	1,245	1,042	1,302	1,305	1,308	1,138	1,051
Hardwoods	Board feet	--	--	--	4	4	4	4	4
Softwoods	Cubic feet	126	185	145	185	186	187	164	151
Hardwoods	Cubic feet	--	--	1	1	1	1	1	1
Other public:									
Softwoods	Board feet	338	650	1,150	1,193	1,172	1,166	1,215	1,218
Hardwoods	Board feet	--	4	30	20	20	20	20	20
Softwoods	Cubic feet	49	98	164	184	188	188	202	207
Hardwoods	Cubic feet	--	2	8	5	5	5	5	5
Forest industry:									
Softwoods	Board feet	2,366	2,446	4,237	3,109	2,342	1,964	1,962	2,011
Hardwoods	Board feet	4	34	88	114	144	166	181	182
Softwoods	Cubic feet	370	393	661	499	389	336	346	362
Hardwoods	Cubic feet	2	11	25	28	37	43	46	46
Other private:									
Softwoods	Board feet	705	563	936	1,115	1,034	979	903	824
Hardwoods	Board feet	4	77	61	72	72	72	72	73
Softwoods	Cubic feet	134	110	174	209	191	179	166	151
Hardwoods	Cubic feet	2	22	15	15	15	15	15	15
All owners:									
Softwoods	Board feet	4,279	4,904	7,365	6,719	5,853	5,417	5,218	5,104
Hardwoods	Board feet	8	115	179	210	240	262	277	279
Softwoods	Cubic feet	679	786	1,144	1,077	954	890	878	871
Hardwoods	Cubic feet	4	35	49	49	58	64	67	67

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 7.—Supply in eastern Oregon by owner class and species group, 1952, 1962, and 1970,[1] with projections to 2020[2]

(In millions)

Owner class and species group	Unit	1952	1962	1970	Projections				
					1980	1990	2000	2010	2020
National Forests:									
Softwoods	Board feet	446	1,021	1,297	1,139	1,147	1,156	1,165	1,175
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	68	161	208	172	176	179	184	188
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
Other public:									
Softwoods	Board feet	129	92	159	132	135	141	145	152
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	20	15	26	22	24	25	28	30
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
Forest industry:									
Softwoods	Board feet	409	403	540	395	326	312	309	312
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	62	65	90	65	58	58	59	59
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
Other private:									
Softwoods	Board feet	397	208	124	177	247	254	260	260
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	60	34	21	36	51	54	57	58
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
All owners:									
Softwoods	Board feet	1,381	1,724	2,120	1,843	1,855	1,863	1,879	1,899
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	210	275	345	295	309	316	328	335
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 8.—Supply in eastern Washington by owner class and species group, 1952, 1962, and 1970,[1] with projections to 2020[2]

(In millions)

Owner class and species group	Unit	1952	1962	1970	Projections				
					1980	1990	2000	2010	2020
National Forests:									
Softwoods	Board feet	267	511	504	460	463	466	470	472
Hardwoods	Board feet	1	1	3	3	3	3	3	3
Softwoods	Cubic feet	32	71	78	69	70	71	72	73
Hardwoods	Cubic feet	--	--	1	1	1	1	1	1
Other public:									
Softwoods	Board feet	180	288	424	351	370	389	408	436
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	28	46	71	57	61	65	69	74
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
Forest industry:									
Softwoods	Board feet	236	169	157	160	155	152	154	153
Hardwoods	Board feet	--	--	--	--	--	--	--	--
Softwoods	Cubic feet	38	28	27	28	28	27	28	28
Hardwoods	Cubic feet	--	--	--	--	--	--	--	--
Other private:									
Softwoods	Board feet	236	188	145	227	264	283	286	283
Hardwoods	Board feet	1	1	4	--	--	--	--	--
Softwoods	Cubic feet	40	34	27	41	47	50	51	50
Hardwoods	Cubic feet	--	--	1	--	--	--	--	--
All owners:									
Softwoods	Board feet	919	1,156	1,230	1,198	1,252	1,290	1,318	1,344
Hardwoods	Board feet	2	2	7	3	3	3	3	3
Softwoods	Cubic feet	138	179	203	195	206	213	220	225
Hardwoods	Cubic feet	--	--	2	--	1	1	1	1

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 9.--*Softwood supply from all owners in coastal Alaska, 1952, 1962, and 1970,*[1] *with projections for National Forests to 2020*[2]

(In millions)

Year	All owners		National Forests	
	Board feet	Cubic feet	Board feet	Cubic feet
1952	82	13	--	--
1962	467	74	--	--
1970	754	119	--	--
1980	--	--	1,136	175
1990	--	--	1,134	175
2000	--	--	1,134	176
2010	--	--	1,134	177
2020	--	--	1,134	179

[1]Estimates are for trend levels and consequently may differ from actual figures for the specified year.

[2]Projections were made under the assumption that forest management would continue at recent levels.

Table 10.--*Commercial forest area by region and owner, 1952-2020*

(Thousand acres)

Region and owner	1952	1962	1970	Projections				
				1980	1990	2000	2010	2020
Western Oregon:								
National Forests	4,576	4,857	4,830	4,810	4,791	4,772	4,752	4,733
Other public	3,154	2,963	2,922	2,825	2,755	2,700	2,658	2,644
Forest industry	3,128	3,548	3,624	3,516	3,439	3,378	3,331	3,316
Other private	3,743	3,379	3,259	3,168	3,103	3,050	3,011	2,998
Western Washington:								
National Forests	2,398	2,398	2,321	2,312	2,302	2,293	2,284	2,275
Other public	1,952	1,852	1,802	1,714	1,630	1,598	1,573	1,562
Forest industry	3,748	3,686	3,598	3,485	3,404	3,339	3,290	3,274
Other private	2,531	2,416	2,270	2,036	1,868	1,734	1,634	1,600
Eastern Oregon:								
National Forests	6,720	7,208	7,173	7,160	7,148	7,135	7,123	7,110
Other public	1,345	595	594	589	585	582	580	579
Forest industry	1,533	1,585	1,582	1,565	1,554	1,544	1,537	1,534
Other private	1,489	1,699	1,689	1,677	1,669	1,662	1,657	1,655
Eastern Washington:								
National Forests	3,197	3,196	3,103	3,098	3,093	3,088	3,083	3,078
Other public	2,340	2,304	2,292	2,284	2,278	2,274	2,270	2,268
Forest industry	637	652	750	749	748	747	746	746
Other private	2,386	2,356	2,265	2,221	2,190	2,165	2,147	2,140
California:								
National Forests	8,372	8,393	8,344	8,336	8,329	8,322	8,314	8,307
Other public	703	531	476	471	467	465	462	462
Forest industry	2,167	2,457	2,665	2,618	2,590	2,563	2,555	2,547
Other private	5,885	5,662	5,343	5,232	5,107	5,107	5,053	5,053
Coastal Alaska:								
National Forests[1]	5,713	5,713	5,639	5,313	5,313	5,313	5,313	5,313

[1]Includes other owners.

Table 11.—Average inventory volume, grow

(Cubic f

Region and owner	1970			1980			1990		
	Inventory	Growth	Removals	Inventory	Growth	Removals	Inventory	Growth	Removals
Western Oregon:									
National Forests	6,335	30	73	5,819	34	87	5,318	37	88
Other public	4,241	76	62	4,290	85	79	4,503	96	83
Forest industry	3,232	50	163	2,571	56	108	2,553	65	65
Other private	2,489	72	22	2,980	76	36	3,371	82	54
Western Washington:									
National Forests	6,864	28	65	6,420	31	76	6,003	34	77
Other public	5,132	125	100	5,494	130	115	5,904	133	124
Forest industry	4,257	105	200	3,674	107	159	3,480	112	131
Other private	3,007	122	89	3,362	122	128	3,622	116	127
Eastern Oregon:									
National Forests	2,466	33	22	2,590	35	23	2,730	37	23
Other public	2,680	13	45	2,477	17	39	2,291	22	41
Forest industry	1,427	34	58	1,349	38	43	1,376	42	38
Other private	1,621	38	12	1,846	39	21	1,975	38	31
Eastern Washington:									
National Forests	2,664	32	26	2,772	34	23	2,889	35	23
Other public	2,153	27	32	2,178	27	26	2,182	27	28
Forest industry	1,851	46	37	1,932	47	38	2,031	47	38
Other private	1,414	45	13	1,739	49	19	2,058	51	22
California:									
National Forests	3,621	31	45	3,530	34	42	3,472	38	43
Other public	3,120	42	61	3,002	46	60	2,902	50	62
Forest industry	3,476	53	118	3,048	63	101	2,938	67	75
Other private	2,488	40	34	2,573	42	39	2,659	44	42
Coastal Alaska:									
National Forests	6,166	5	28	5,819	8	43	5,471	11	44

[1]Includes live sound trees 5.0-inch d.b.h. and larger. Removals represent total drain on the forest including timber products, logging residue, and volume lost through conversion of commercial forest land to other uses. Projections were made under the assumption that forest management would continue at recent levels.

d removals by region and owner, 1970-2020[1]

acre)

2000			2010			2020		
ventory	Growth	Removals	Inventory	Growth	Removals	Inventory	Growth	Removals
,835	40	89	4,365	43	91	3,904	46	93
,729	105	89	4,947	113	98	5,114	120	106
,677	74	66	2,776	79	76	2,802	80	82
,656	83	63	3,858	81	67	3,990	80	69
,608	37	78	5,331	40	69	5,072	43	70
,149	135	126	6,284	137	138	6,320	138	141
,493	119	120	3,548	125	126	3,555	129	131
,775	112	127	3,913	110	124	4,002	109	109
,884	39	24	3,049	41	24	3,221	42	25
,114	25	44	1,940	28	48	1,754	31	53
,463	46	38	1,552	46	38	1,622	45	39
,044	38	33	2,098	38	34	2,137	38	35
,013	36	24	3,142	37	24	3,274	37	24
,167	27	29	2,131	27	31	2,065	26	34
,134	48	38	2,235	48	38	2,330	47	38
,364	51	24	2,651	50	25	2,906	47	24
,438	40	43	3,416	42	45	3,395	44	47
,799	53	65	2,872	53	49	3,051	53	37
,913	68	73	2,874	69	75	2,820	70	80
,740	44	37	2,813	45	41	2,882	46	39
,176	17	44	4,935	25	44	4,810	38	44

Table 12.—Area of commercial forest land by ownership, site class,[1] and State, January 1, 1970

(Thousand acres)

State and owner	Site class					
	Total	165+ cu. ft.	120-165 cu. ft.	85-120 cu. ft.	50-85 cu. ft.	Less than 50 cu. ft.
Western Oregon:						
National Forest	4,830	656	1,363	1,172	1,413	226
Other public	2,922	597	1,294	515	466	50
Forest industry	3,624	1,285	1,140	648	415	136
Other private	3,259	796	1,013	629	626	195
Total	14,635	3,334	4,810	2,964	2,920	607
Western Washington:						
National Forest	2,321	390	596	517	721	97
Other public	1,802	639	636	301	187	39
Forest industry	3,598	1,450	1,198	545	386	19
Other private	2,270	426	886	496	457	5
Total	9,991	2,905	3,316	1,859	1,751	160
Eastern Oregon:						
National Forest	7,173	57	211	1,672	4,105	1,128
Other public	594	30	81	76	334	73
Forest industry	1,582	47	77	305	902	251
Other private	1,689	--	64	202	963	460
Total	11,038	134	433	2,255	6,304	1,912
Eastern Washington:						
National Forest	3,103	112	296	686	1,513	496
Other public	2,292	58	122	431	1,416	265
Forest industry	750	27	52	166	465	40
Other private	2,265	52	132	427	1,398	256
Total	8,410	249	602	1,710	4,792	1,057
California:						
National Forest	8,344	459	889	2,214	3,821	961
Other public	476	31	75	91	243	36
Forest industry	2,665	680	706	681	572	26
Other private	5,343	619	1,553	1,189	1,340	642
Total	16,828	1,789	3,223	4,175	5,976	1,665
Coastal Alaska:						
National Forest	5,144	131	1,535	2,440	945	93
Other public	465	12	65	155	210	23
Other private	30	1	8	14	6	1
Total	5,639	144	1,608	2,609	1,161	117

[1]A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth.

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Gedney, Donald R., Daniel D. Oswald, and Roger D. Fight

1975. Two projections of timber supply in the Pacific Coast States. USDA For. Serv. Resour. Bull. PNW-60, 40 p., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Two projections of softwood timber supply for 1970-2020 for California, western Oregon, eastern Oregon, western Washington, eastern Washington, and coastal Alaska are presented. One projection shows how much timber will likely be available in the future if forest management continues at recent levels. The second projection shows the impact of one program of intensified management on future timber supplies for these States except coastal Alaska.

KEYWORDS: Resources (forest), timber management planning, supply/demand (forest products).

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The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.