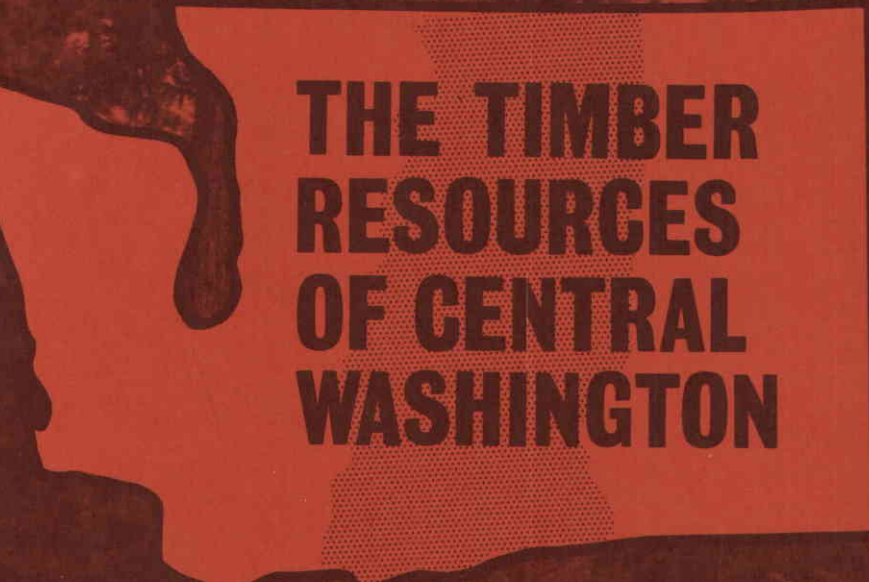




THE TIMBER RESOURCES OF CENTRAL WASHINGTON



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PREFACE

This report summarizes the findings of the latest inventory of the forests in Chelan, Douglas, Kittitas, Klickitat, Okanogan, and Yakima Counties, Washington. Although part of the central Washington inventory unit, Benton and Grant Counties have no forest land and were not inventoried. Fieldwork on lands outside the National Forests was done in 1967. Fieldwork on the Wenatchee National Forest was done in 1964 and 1965. The portion of the Snoqualmie National Forest in the central Washington area (Naches-Tieton Working Circle) was inventoried in 1964. The inventory of the Okanogan National Forest was done in 1965 and 1966. The fieldwork for the portion of the Gifford Pinchot National Forest in the central Washington area was done in 1969. Previous inventories were completed as follows:

<i>County</i>	<i>First inventory</i>	<i>Second inventory</i>
Chelan	1934-35	1959-60
Douglas	1934-35	1959-60
Kittitas	1934-35	1953
Klickitat	1935	1954
Okanogan	1935	1958-59
Yakima	1933-34	1957

These inventories were conducted by the Forest Survey, a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and subsequent amendments. The purposes of the Forest Survey are (1) to obtain comprehensive information on timber resources, including the extent and condition of forest lands, the amount and kind of timber growing on these lands, the rate of forest growth and depletion, the amount of timber cut, and probable future trends in timber requirements, and (2) to analyze and make available survey information needed to formulate forest policies and programs. Resurveys are made periodically to update basic information.

The Forest Survey is conducted throughout the continental United States, Alaska, and Hawaii by the USDA Forest Service Experiment Stations. The Pacific Northwest Forest and Range Experiment Station at Portland, Oregon, is responsible for the States of Alaska, California, Hawaii, Oregon, and Washington.

ABSTRACT

The findings of the latest inventory of the timber resources of central Washington indicate there are 50.9 billion board feet of sawtimber on 4,370,000 acres of commercial forest land. Land owned or administered by public agencies accounts for 73 percent of the area and 84 percent of the sawtimber volume; farmer and miscellaneous private ownerships account for 17 percent of the area but only 9 percent of the volume; and the forest industry sector is smallest, with only 10 percent of the area and 7 percent of the volume.

About 280,000 acres are classified as non-stocked. Much of this occurs in the lower fringe of the forest zone and may not be able to support additional stocking.

Douglas-fir is the most abundant species, occurring on 37 percent of the commercial forest land and accounting for 38 percent of

the sawtimber volume. Ponderosa pine is found on 27 percent of the area and accounts for 24 percent of the volume. True firs cover only 10 percent of the area but account for 17 percent of the volume.

Poletimber stands cover 809,000 acres, with about 220,000 acres classified as overstocked. These stands present a problem of reduced future yields unless they are thinned. Harvest exceeds growth by almost 200 million board feet, primarily because of a large volume of old-growth timber and the low overall site productivity of the area.

Recreational use of the forests of central Washington has been increasing rapidly. Associated with this increased demand has been pressure to reserve land area exclusively for recreation use. Presently there are almost 800,000 acres in reserved status.

Keywords: Forest surveys, forest appraisal, Washington (central).

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INTRODUCTION

This report is concerned with the timber resources of central Washington, comprised of eight counties along the eastern slope of the Cascade Range of Washington — Benton, Chelan, Douglas, Grant, Kittitas, Klickitat, Okanogan, and Yakima. This area has just over 33 percent of the total land area of the State of Washington but only 11 percent of the State's population. With only 16 people per square mile, central Washington is the least populous area in Washington. This is a reflection of the lack of a major port or metropolitan area, coupled with a vast acreage of back country without roads along the Cascades and extensive grassland and farmland in the eastern portion of the unit. Yakima and Wenatchee rank fourth and twelfth, respectively, in population among all cities in Washington.

This part of Washington is one of striking contrasts, varying from dry, rolling hills and steep-walled coulees, with grass and sagebrush as the natural vegetation, to the forested slopes and glacier-covered peaks of the Cascade Range. In the forest zone (fig. 1), the annual precipitation reaches 65 inches along the Cascades, much of it as snow. To the east in the nonforest zone, rainfall as low as 6 inches is not uncommon. These two factors, moisture and topography, dictate generally the character of the forests in the area. Along the eastern fringe of the forest zone, the timber stands are scattered and occur mainly as narrow bands of trees in canyon bottoms. These meandering strips of timber merge into sparse ponderosa pine and Oregon white oak forests, which in turn give way to denser

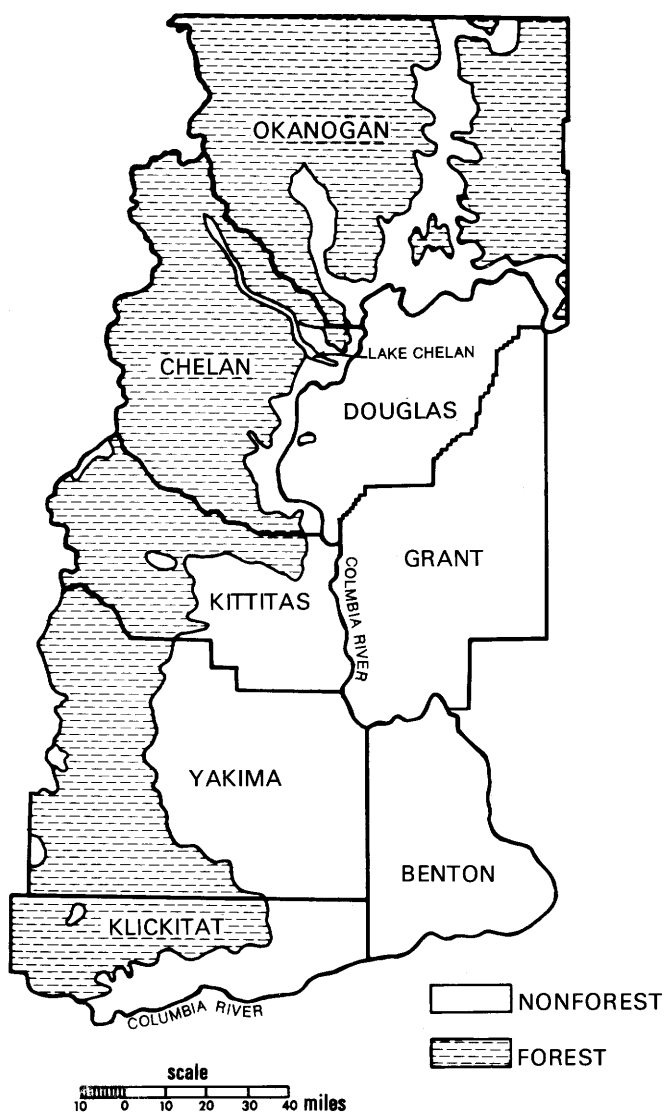


Figure 1.—Forest areas of central Washington.

stands of mixed species in the higher moisture and elevation zones. As a result, a large portion of the timber volume is found along a 30-mile-wide band following the crest of the Cascades,¹ except in eastern Okanogan County where a substantial volume occurs in the Okanogan Highlands.

The forest resource data in this report and

the discussions of forest area, volume, growth, and cut relate to the supply of wood available to meet regional and national needs. The information is presented for the use of legislators, service organizations, local and regional planners, investors, forest industry managers, and others interested in the timber situation.

¹ *There is no forest land in either Benton or Grant Counties. In addition, the small portion of forest land in western Douglas County has been included with the Chelan County statistics. The combined figures are reported as Chelan-Douglas in the tables.*

BACKGROUND

The first American settlement in this part of Washington was in 1811 at Fort Okanogan, located at the confluence of the Okanogan and Columbia Rivers. Between 1811 and 1858, fur traders traveled in the central Washington area, but settlement was restricted by continuing Indian troubles.

Following the Indian wars of 1850-57, eastern Washington was declared open for settlement in 1858. The first immigrants were miners attracted to discovery of gold at Fort Colville, Conconully, Similkameen River, and the Swauk District in Kittitas County. Extravagant claims were made, but results fell short of expectations as ground was quickly worked out or the ore proved to be of low grade.

As the excitement of gold fever faded, the people turned to more stable livelihoods, primarily agriculture—growing such crops as fruit and wheat.

Establishment of towns, hampered by Indian problems, preceded statehood by only a few years. Yakima was incorporated in 1883, but the entire town was moved 4 miles north in 1884 to be closer to the Northern Pacific Railway station. The original location was later named Union Gap. The town of Okanogan was established in 1886, followed by Wenatchee in 1888.

The forests of central Washington provided the fuel and building materials needed by the early settlers. The primary products were poles, posts, mine timbers, and hand-hewn boards. The first recorded lumber production was in 1860, from a whipsaw operation on Mill Creek in Klickitat County. The lumber industry remained insignificant through the late 1800's, existing as small operations and responding to local building needs. It was not

until the rapid development of the agricultural industry that the forest industry gained a footing as a major industry of central Washington.

The central Washington area had its beginning as a major fruit producer in 1870 when John Beck planted the first apple orchard in the Yakima Valley (Washington State Historical Society 1941). The institution of the first irrigation system near Yakima in 1872 launched the agricultural industry.

As agricultural shipments grew, a need developed for materials for storage and transportation containers. Wooden boxes from the locally abundant ponderosa pine proved to be ideally suited for this purpose, and the apple producers of the Pacific Northwest were the first to use them. In response to this demand, many sawmills began producing box shooks for the rapidly expanding agricultural industry. This market, coupled with local and regional building, marked the beginning of the forest industry in central Washington. In 1930, agriculture and forestry accounted for almost 40 percent of the total employment in central Washington; the forest industry contribution was only 2 percent.

The economy changed considerably in the next few decades. By 1969, the proportion employed in the agricultural and forest industries had declined from 40 to 27 percent, although the forest industry itself had grown to 9 percent.

By 1963, Washington led all States in the production of apples, producing almost 32 million bushels (25 percent of the total U.S. production). In addition, Washington produced over 28 percent of the Nation's pears (U.S. Bureau of the Census 1965). Most of this was from central Washington, indicating

the importance of agriculture in the local economy.

Although fruit and vegetables now are shipped mostly in paperboard containers, wooden boxes are still used for bulk movement within processing and storage facilities. Many sawmills which started as box shook producers in the late 1800's have expanded into other products and have a major influence on the local economy.

In 1969, the forest industry of central Washington employed 4,380 people with a payroll of \$32 million, about 11 percent of the total payroll (Washington (State) Employment Security Department 1969). Although making up only 9 percent of the total employment, the forest industry accounted for 35 percent of the manufacturing, or export-

based, employment. This latter statistic more clearly reveals the importance of the forest industry to the area's economy.

Common to a maturing economy, much of the recent growth has been in the service-oriented sectors, with the cities of Yakima and Wenatchee, in Yakima and Chelan Counties, emerging as the service centers for the central Washington area. In 1969, the forest industry in these two counties accounted for only 5 percent of total employment. On the other hand, in Klickitat and Okanogan Counties, the forest industry accounted for 50 and 23 percent, respectively, of the total employment.

These figures do not include the hundreds of people employed by various agencies which manage and protect the vast holdings of public forest land.

FOREST LAND

Only 41 percent of the total land area is forest land; only 30 percent is commercial forest land

About 6 million acres, 41 percent of the total land area of central Washington, is classified as forest land. About 4.4 million acres, or 30 percent of the total land area, is commercial forest land. This relatively low proportion, compared with 78 percent in western Washington, reflects the vast acreages of nonforest, unproductive, and reserved forest land in central Washington.

The current inventory shows 8.7 million

acres of nonforest land, 59 percent of the total land area. This land is characterized by rolling hills, grassland, orchards and other farmland, rocky outcrops, and glaciers, as well as man-made features such as roads and urban areas.

Noncommercial forest land, which includes both unproductive forest land and productive forest land reserved by law or administrative order, occurs throughout the forest zone, occupying about 11 percent of the total land area. Noncommercial rocky forest land and subalpine forests of the upper slopes of the Cascades account for over two-thirds of the unproductive forest land (see figs. 2 and 3).



Figure 2. — Noncommercial rocky areas such as this may contain trees of commercial size, but the low density of the trees, the terrain, and difficulty of regeneration preclude harvest operations.



Figure 3. — This subalpine forest, although not growing trees of commercial size or quality, ranks high in esthetic appeal and also provides summer range for livestock.

These lands have massive recreational potential; it is their rugged beauty that is bringing national prominence to this region.

The reserved lands are wholly under public jurisdiction. About 90 percent of the reserved forest land is within National Forest boundaries, and 10 percent is on other public lands.

Commercial forest area is decreasing

Since the previous inventory, the area of commercial forest land in central Washington has decreased about 20,000 acres. Unlike the western portion of the State where urbanization is the major contributing factor to the decline in the commercial forest land base, reclassification is the prime cause of the change in central Washington. The impact of urbanization has been light because most of the towns are located in the nonforest areas. This loss of 20,000 acres reflects the net impact of land use changes between the three major land classes. Some of the shifts are a result of new definitions of land use or different interpretation of existing ones. Other changes are the result of enactment of public statutes.

Not reflected in this loss is the more subtle change associated with the early stages of land development for recreational purposes. In this area and throughout the West, forest land is being subdivided into lots on much of which subsequent development has not occurred and may not occur for some time. Breaking down of large tracts of forest land into small parcels effectively removes the land from the timber producing base. It is this trend that may have the greatest impact on the commercial forest land base in the future.

Seventy-three percent of commercial forest land is under public management

About 73 percent, 3.2 million acres, of the commercial forest land in central Washington

is under public management. National Forests and Indian lands account for the largest proportions, 43 percent and 18 percent, respectively. Figure 4 shows land under public management for central Washington. Although much of the public land is in large blocks, there are areas, such as in western Kittitas County, where public and private lands are intermingled. The ownership pattern of this particular area is the result of the railroad grants of the 1800's. Such scattered blocks create problems in management of forest lands because of conflicting objectives for recreational values and road systems.

Private ownership accounts for 27 percent of commercial forest land

Less than 10 percent of the commercial forest land is owned by the forest industry. This is in distinct contrast with western Washington where forest industry accounts for 35 percent of the total commercial forest land. Because of this relatively small share of the commercial forest land, the forest industry in central Washington receives 87 percent of its total log consumption from other owners (Bergvall and Gedney 1970). About 67 percent of the logs consumed are from lands under public management.

The remaining 17 percent of the commercial forest land is held by farmer and miscellaneous private owners. It is this group that is the largest in terms of numbers of owners, with tracts ranging from less than 1 acre to tens of thousands of acres.

Over 280,000 acres are nonstocked

The survey indicates that 282,000 acres of the commercial forest land are currently nonstocked. This amounts to 6.5 percent of the total commercial forest land area, compared with only 4 percent in western Washington. Over two-thirds of the nonstocked area occurs in ponderosa pine type which is the dominant forest type in the lower elevation fringes of

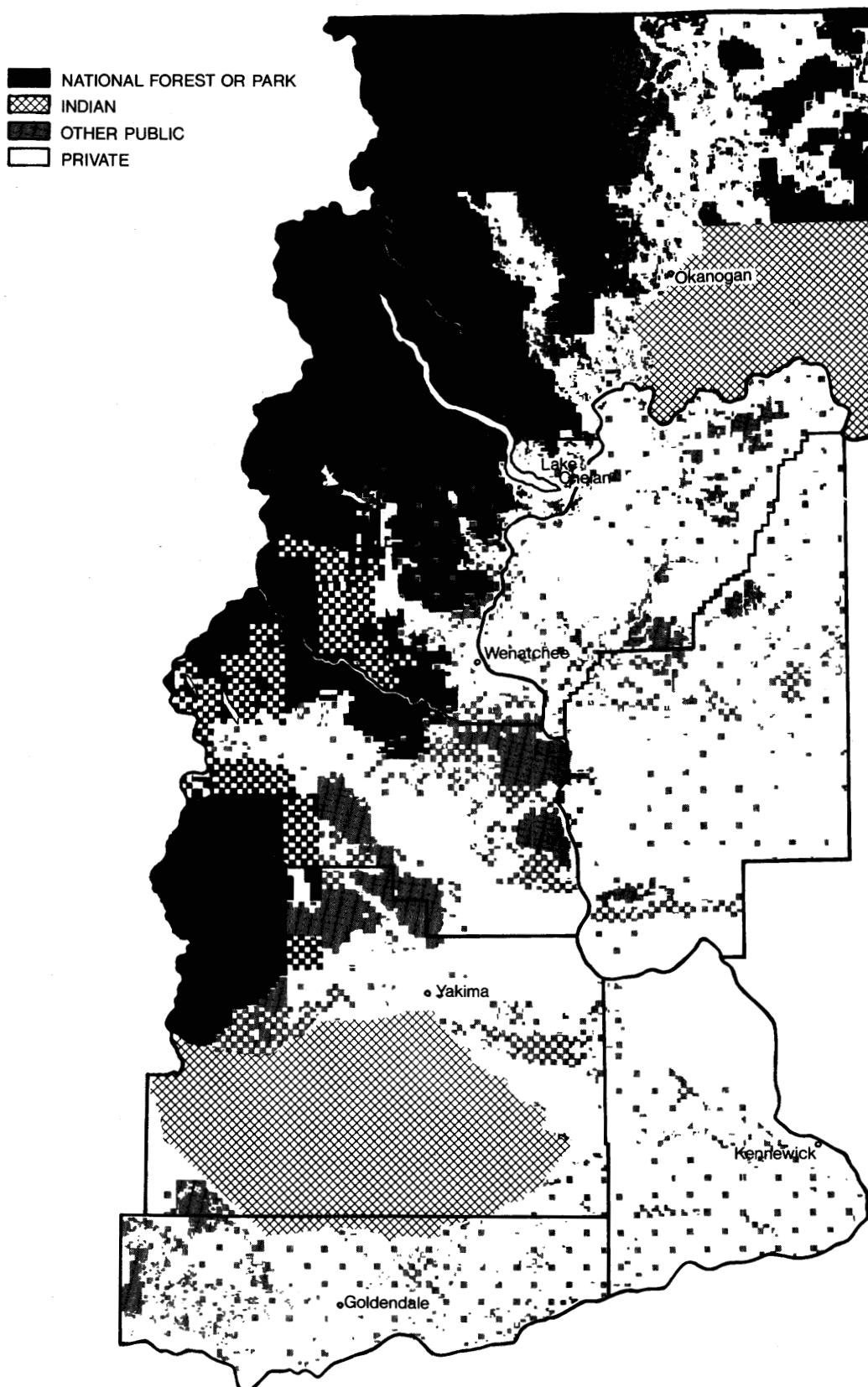


Figure 4. — Ownership map of central Washington.

the forest zone (fig. 5). Okanogan County has almost 50 percent of the nonstocked area.



Figure 5. — This sparsely stocked ponderosa pine stand is located in the outer fringe of the forest zone. There are some indications that areas such as this may actually be stocked to the full capability of the site.

Almost 60 percent of the total nonstocked acreage is found on farm and miscellaneous private land. In addition to being the predominant ownership in the lower elevations of the forest zone, some of these lands were heavily cut over and many have not been adequately restocked.

Since completion of this inventory, special studies have been conducted in arid sites in eastern Oregon and California² to determine whether sparsely stocked stands can carry additional stocking. The findings indicate that many of these “nonstocked” and “poorly

² Colin MacLean and Charles Bolsinger. *Estimating productivity on sites with a low stocking capacity. (In preparation for publication, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.)*

stocked” areas are actually stocked to their full potential or nearly so. Thus, it is probable that some of the similar areas in central Washington do not have the potential for increased yield through additional stocking.

Douglas-fir and ponderosa pine types occupy almost 64 percent of the commercial forest land

Douglas-fir type is the most extensive forest type in central Washington, covering 1,592,000 acres, over 36 percent of the commercial forest land; ponderosa pine is second, occupying over 27 percent of the commercial forest land. True firs and lodgepole pine account for 10 and 7 percent, respectively. These proportions have changed considerably since the previous inventory. Data from that inventory showed ponderosa pine most extensive, with 47 percent, followed by Douglas-fir, with 28 percent. Although changes in land use classifications have occurred, a major factor is the change in stand composition after harvesting. Many of the pine stands have been selectively cut, leaving the understory species virtually untouched. As a result, in many of these stands, species other than ponderosa pine now make up a majority of the stocking.

The forests of central Washington are nonhomogeneous in nature

One noticeable feature of the forests of central Washington is their nonhomogeneous nature, relative to species, age, and size class. This is attributable in part to the selection method of harvesting timber used in this area and the natural tendency of some of the species to regenerate in small clumps. In addition, the stand composition reflects the transition from moist west-side conditions of the Cascades to the drier east side along the Columbia River.

A study was made of stand composition from Forest Survey inventory data. A pure stand is defined as having 80 percent or more of the stocking in one species. Based on this standard, only 40 percent of all the commercial

forests could be classified as pure. Only 36 percent of the Douglas-fir stands were pure; the highest percentage — 59 — occurred in the ponderosa pine stands. This higher proportion is partially due to the occurrence of ponderosa pine in the lower moisture zones, where few other species exist. Douglas-fir, on the other hand, is a transition species, mixing with ponderosa pine where the moisture level permits and extending to the subalpine zone in the higher elevations.

Forest Survey standards define an uneven-aged stand as having less than half of the growing stock stocked in two adjacent 10-year age groups. In the central Washington area, about 43 percent of all stands were classified as uneven-aged. Although 57 percent of the commercial forest area has stands classified as even-aged, much of this area has

two or more distinct age and size classes represented (i.e., they are not one-age stands such as found in western Washington). Examples of this are common to the ponderosa pine type where old-growth trees may predominate, but a substantial understory of sapling or poletimber trees exists.

A primary benefit of the mixed-composition stands in central Washington is the ease of managing the stands for both timber production and recreational usage. Records indicate that about 95 percent of the log harvest comes from partial cutting systems. This periodic reentry into stands allows removal of part of the volume without interfering with the esthetic appearance of the area. Even in high-intensity recreation areas, dead or high-risk trees can be removed without disturbing the recreational value of the stand (fig. 6).



Figure 6. — Protection of esthetic values is easier in stands such as this where selection methods of harvesting can be used.

Overstocking of poletimber stands poses a problem

Many of the poletimber stands in central Washington are overstocked and present a problem of reduced future yields unless some thinning is done. With the poor market for small logs that exists in this area, the little thinning that takes place is generally pre-commercial. The U.S. Forest Service and other agencies maintain thinning programs, but the budget limits these programs (fig. 7).

Analysis of inventory data for areas outside the National Forests indicates that about 60,000 acres of poletimber stands are overstocked. In addition to these stands, about 15 percent of the area that is classified as understocked has clumps of trees that are actually overstocked. This condition is quite common in the ponderosa pine region where uneven-aged stands result in dense patches of reproduction.

On the four National Forests, an even greater proportion of the poletimber stands are overstocked. Based on available statistics, it is estimated that the proportion of acres more than 70 percent stocked on National Forest lands is about 2½ times greater than on all other ownerships. Based on the assumption that this relationship exists for all stocking classes, it is estimated that there are 160,000 acres of overstocked poletimber stands.

Thus, in central Washington, there is a total of 220,000 acres of overstocked poletimber stands, about 28 percent of the total acreage of poletimber stands. Without stocking control, many of these stands will remain stagnated for long periods of time, thereby reducing potential yields. The very little thinning currently being done on either private or public lands reflects the poor gains from thinning and the limited market for small logs.



Figure 7. — A dense poletimber stand in Okanogan County. This stand will have reduced yields due to overstocking unless thinned.

TIMBER VOLUME

Live sawtimber volume totals almost 51 billion board feet

The total sawtimber volume of trees 11.0 inches in diameter and larger for all owners is 50.9 billion board feet, International ¼-inch rule. Hardwoods account for only 122 million board feet, less than one-quarter of 1 percent of the total. In terms of growing-stock volume, softwoods account for 99.5 percent of the 10,974 million cubic-foot total.

Public lands account for 84 percent of the sawtimber volume

The current inventory indicates that just over 84 percent of the sawtimber volume is under public management. The National Forests have the largest share with 28.5 billion board feet, almost 56 percent of the total. In addition, 92 percent of the over-rotation-age sawtimber is located on publicly managed lands. The primary reason for this large share of the sawtimber volume on public lands is the historical pattern of logging in central Washington. Most of the early log harvest came from private lands in the lower portion of the forest zone. Timber harvesting on public lands did not occur in any significant amount until most of the lower elevation stands had been heavily cut over. Also, there was very little timber harvesting on the Yakima Indian Reservation until after World War II.

Volume per acre varies widely by county and ownership

As figure 8 shows, the sawtimber volume per acre varies considerably by ownership from county to county. Okanogan County, with a large acreage of rocky and dry-site

land, is lowest among the counties in volume per acre. Yet it ranks second to Yakima County in total sawtimber volume, reflecting the large acreage of commercial forest land, 37 percent of the central Washington total. The high volume per acre on National Forest land in Klickitat County is not significant as it represents only a 9,000-acre block of old-growth timber adjacent to Skamania County. No logging had occurred in this part of the Gifford Pinchot National Forest before 1952, and very little cutting has been done since then.

The relatively high volumes in private land in Chelan-Douglas and Kittitas Counties are not characteristic of the other counties. As a result of the railroad grants of the 1800's,

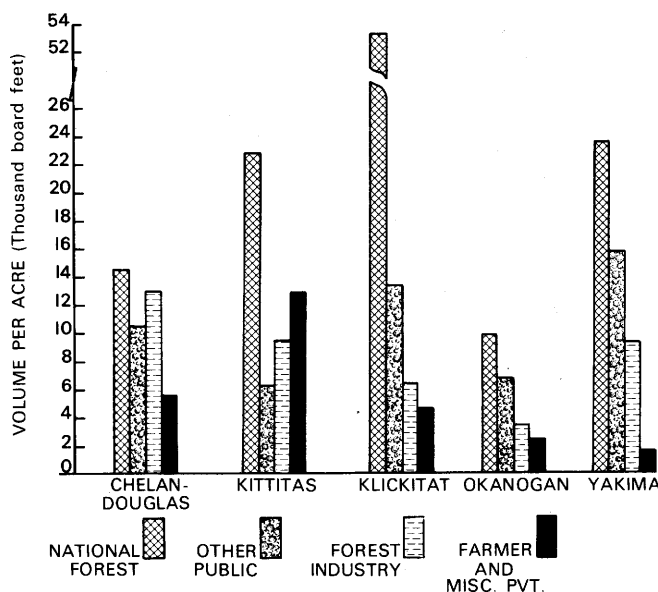


Figure 8. — Volume per acre by county and ownership, central Washington.

private land is intermingled with alternate sections of National Forest land (see fig. 4) and has had only limited access and cutting. This, coupled with its being in the higher volume transition zone, has resulted in per-acre volumes that are higher than other areas of central Washington.

The high volume per acre in the "other public" owner group in Yakima and Klickitat Counties is due to the remaining stands of old-growth timber on the Yakima Indian Reservation.

The "farmer and miscellaneous private" owner group has the lowest average volume per acre in the central Washington area. These lands were heavily cut over during the early years of logging in the area, leaving two-thirds of the forest land currently stocked with less than 5,000 board feet per acre.

Douglas-fir has greatest volume, ponderosa pine second

Douglas-fir is the leading species in terms of sawtimber volume with 19.3 billion board feet, International ¼-inch rule. Ponderosa pine is second with almost 12 billion board feet, followed by the true firs with 8.4 billion board feet. The distribution of volume has changed considerably since the first inventory, at which time ponderosa pine accounted for the largest share of the sawtimber volume, almost 40 percent of the total.

Sawtimber volume of ponderosa pine has decreased 22 percent since the previous inventory

The previous inventory for central Washington, completed during the 1953-60 period, indicates that ponderosa pine accounted for 15.4 billion board feet, International ¼-inch rule, or 27 percent of the total sawtimber volume. The current inventory shows about 12 billion board feet, a 22-percent decrease. During this same period, the sawtimber volume of all other species decreased only 5.5 percent.

A large part of this change is explained by the historical trend in log harvest. Since the

beginning of the forest industry in central Washington, ponderosa pine has contributed heavily to the log harvest. In 1925, ponderosa pine accounted for 72 percent of the log harvest. Even though the annual harvest of ponderosa pine has increased slightly since 1925, it now accounts for only 35 percent of the total log harvest. Although producing over one-third of the logs harvested, ponderosa pine is only 24 percent of the total inventory volume. Thus, it is being cut at a more rapid rate than the other species, due to the continued high value of pine products.

Salvable dead volume totals 1.6 billion board feet

The total volume of salvable dead trees is 1.6 billion board feet (International ¼-inch rule). This is 4 percent less than the estimated 5-year mortality for the 1963-67 period. Thus, no appreciable buildup of dead material occurs in this area. The 5-year mortality for all pines is 21 percent greater than their salvable dead volume, reflecting their rapid deterioration.

Douglas-fir accounts for 31 percent of the total salvable dead volume, all pines 24 percent, and the true firs 19 percent. Of the Douglas-fir volume, almost 61 percent is in trees which have a net volume of 500 or more board feet. About 50 percent of the pine volume and 32 percent of the true fir volume are in this category. For all species, less than 2 percent of the total salvable dead volume is in trees with a net volume of 2,500 or more board feet.

Although the total volume of salvable dead material is rather large, the lack of concentrated volumes makes harvesting of much of it economically unfeasible. Only 20 percent is in concentrations of 5,000 or more board feet per acre, and 54 percent is in volumes of less than 2,500 board feet per acre. This is substantially different from western Washington where almost 65 percent occurs in concentrations of 5,000 or more board feet per acre.

GROWTH, CUT, AND MORTALITY

Net annual growth is about 578 million board feet

Net annual growth of sawtimber in central Washington is 578 million board feet (International ¼-inch rule), about 1 percent of the inventory volume. This net annual growth amounts to about 132 board feet per acre, approximately 63 percent of per-acre gross growth. Net annual growth of all growing-stock trees is 121 million cubic feet.

Growth rate is lowest in the National Forests, highest on private lands

As table 1 indicates, the growth rate on National Forest land is less than half that on private lands. This disparity is due to the widely different forest conditions of the two ownership groups. The National Forests contain 65 percent of the old-growth timber,

compared with only 9 percent on private lands. In most cases, the net growth rate in older stands is much less than in younger stands. These younger stands are growing about the same number of board feet but on a smaller base. As the old-growth timber on National Forest lands is harvested, the growth rates of these two owner groups will come closer together.

With harvesting concentrated in the old-growth timber, it is to be expected that cut will exceed growth. Unlike managing a second-growth stand on a sustained yield basis, the cut-growth relationship in old-growth timber is not very meaningful.

Western larch has a negative net growth

The net annual growth for western larch is a negative 24.8 million board feet (International ¼-inch rule), of which 21.2 million board feet occurs in Yakima County. An

Table 1. — Per-acre volume¹ and net annual growth, by ownership class, January 1, 1968

Ownership class	Inventory volume per acre	Net growth per acre	Net growth as a percent of inventory volume
	 Board feet		Percent
National Forests	15,268	131	0.9
Other public	10,908	128	1.2
Forest industry	8,085	150	1.9
Farmer and miscellaneous private	6,011	133	2.2
All owners	11,650	132	1.1

¹ International ¼-inch rule.

analysis of all western larch trees tallied in the inventory in Yakima County showed a very high occurrence of dwarf mistletoe; 53 percent of all live sawtimber trees were infected. The analysis also indicated that 72 percent of the sawtimber mortality was caused by disease. For trees greater than 20-inch d.b.h., this proportion was 88 percent. This evidence points to dwarf mistletoe as the probable cause of death. Thus, the negative net growth of western larch was caused by very slow growth of live trees, possibly caused by dwarf mistletoe infestation, and a high rate of mortality, resulting in a large volume loss.

**Total cut exceeds
total growth by 39 percent**

The average annual log harvest in central Washington for the 1965-69 period was 690 million board feet (Scribner scale), which exceeded the net annual growth of 496 million board feet by 39 percent. This relationship is due largely to the low growth rate associated with old-growth timber. This is pointed out in table 2 which shows publicly managed lands, with most of the old-growth timber, having a much larger gap between growth and cut. As mentioned previously, this will continue as long as a majority of the sawtimber volume is in old-growth stands.

**Harvest of ponderosa pine
exceeds net growth by 211
million board feet**

The average annual log harvest of ponderosa pine for 1965-69 was about 340 million

board feet (Scribner scale), which exceeds the net annual growth by approximately 211 million board feet. This gap can be accounted for primarily by the great demand for old-growth pine timber and the slow growth of the old-growth pine stands.

The volume of ponderosa pine harvested has increased slightly since 1965. Should this level of harvest continue, the inventory of pine timber will continue to decrease. In the long run, there will be increased utilization of other species.

Two possibilities for increasing the available supply of pine sawtimber would be thinning the dense patches of reproduction and planting cutover areas that are not adequately stocked. In the farmer and miscellaneous private ownership group, about 22 percent of the commercial forest land is nonstocked. Much of this is located in the lower portion of the forest zone where the stocking cannot be increased appreciably. However, restocking of those areas that are poorly stocked after early cutting operations might yield a sizable gain in sawtimber volume for the future.

**Growth of true firs exceeds
cut by 70 million board feet**

The true firs are the only species group for which growth exceeds cut. The annual log harvest of true firs is about 67 million board feet (Scribner scale). The net annual growth is 137 million board feet, 70 million board feet greater than cut. This excess of growth over cut can be attributed mainly to the relatively high growth rate of this species

Table 2. — Growth-cut relationships by ownership class for central Washington, 1965-69

Ownership class	Net annual growth	Average annual log harvest	Log harvest as a percent of growth
	Thousand board feet, Scribner rule		Percent
Public	361,800	533,841	148
Private	133,800	156,484	117
Total	495,600	690,325	139

group (1.65 percent of the inventory volume), the more limited market for true firs, and the historical lack of access to many of the true fir stands. Although the harvest of true firs is still limited, it has been increasing rather dramatically. In 1925, only 1 percent of the log harvest was from true firs (Moravets 1949); in 1970, this proportion had reached 17 percent, with the largest part of the increase coming since 1955. This change can be attributed mainly to increased recognition of the value of true firs both for their pulping quality and in the construction industry where their primary use is as framing material.

Much of the true fir type is found in the higher elevations of the Cascade Range in areas of prime recreational and scenic value, where timber management practices are restricted or prohibited. Withdrawal of more of these high altitude areas for recreational use will remove a large share of the true fir type from future timber harvest. If present trends continue, the outlook is for decreasing acreage of available true fir timber, although the annual harvest will not be affected for some time.

Annual mortality is almost 343 million board feet

Average annual mortality in the forests of central Washington is 342.7 million board feet, International ¼-inch rule, about 0.7 percent of the sawtimber inventory. The highest rate occurs in western larch where annual mortality is about 1.5 percent of the sawtimber inventory. Annual mortality in ponderosa pine and Douglas-fir average about 0.6 percent of their respective sawtimber inventories.

Insects and diseases are leading causes of death

Inventory statistics show that insects and diseases were identified as the causal factor for 38 percent of total mortality. An additional 27 percent is attributed to other causes such as wind, animals, and fire. The cause of death for the remaining 35 percent may be partly attributable to insects and diseases but is classified as unknown because of the difficulty in identifying specific causes.

Although no data are available on the volume loss due to specific insects and diseases for this particular area, Childs and Shea (1967) estimated that 57 percent of total volume loss to diseases and insects was attributable to dwarf mistletoe. This parasite is found throughout the central Washington area, attacking pines, Douglas-fir, and western larch. Trees of all ages are attacked, and many of them eventually are killed. Childs and Shea report that the growth loss due to dwarf mistletoe is almost 4 percent greater than the mortality loss.

As shown in figure 9, dwarf mistletoe occurs on Douglas-fir and on western larch as witches' brooms and is readily detectable. In the pines, this disease is found on the branches or stem, occurring in plant form or causing local swelling on the main bole of the tree. Control of dwarf mistletoe is difficult and costly, but removal of infected trees during harvesting can reduce spread. The lack of a good small-log market in this area hampers the control of dwarf mistletoe.

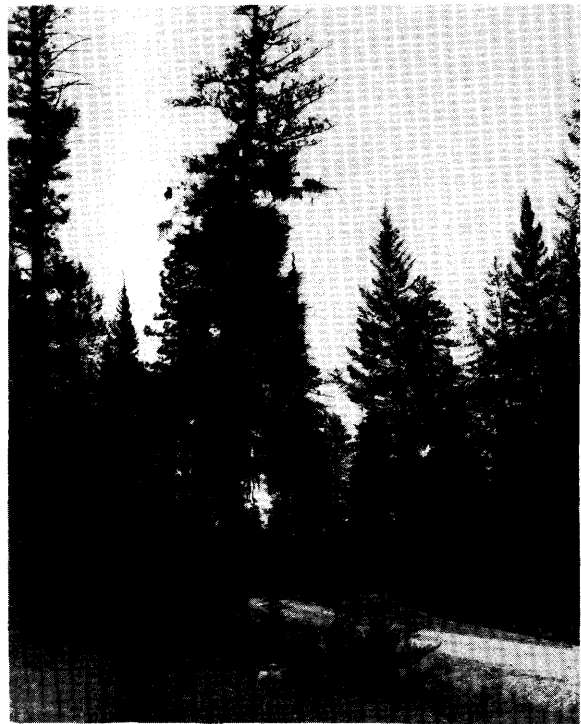


Figure 9. — Heavy mistletoe infestation, such as on the Douglas-fir in the center, is the cause of reduced growth and in severe cases, death.

THE FOREST INDUSTRY

The forest industry consists mainly of sawmills, with little diversification

Beginning with its dependence upon the demand for box shooks, the forest industry in central Washington has been primarily oriented to sawn products. This is due in part to the type of products made from ponderosa pine and the true firs. However, the inability to compete in markets for other products such as plywood and pulp has also restricted the industry. Factors contributing to this situation are: (1) the competitive edge of the western Washington industry in relation to availability and quality of transportation systems, (2) the wide geographic distribution of the timber in central Washington, causing processing plants to incur high transportation costs for their raw materials, and (3) lower quality and lack of concentrated volumes of species suited for plywood production.

Until 1958, only sawmills operated in central Washington. Since then, two plywood plants and two container board (pressed pulp) plants have begun operation in the southern half of the area. The installation of these facilities may be a signal of increased demand and decreasing supply or both in western Washington. More recently, a few firms have installed small-log processing equipment, and several chipping saw units have been set up close to woods operations.

Periodically, interest in a pulpmill on the Columbia River near Wenatchee flares up. To date, no firm plans have been made, with concentrated wood supply and financial considerations appearing to be major problems. Although no pulpmills exist in central Washington, approximately 90 percent of the coarse residues developed by sawmills are shipped

to pulp and paper operations in other areas (Bergvall and Holtcamp 1971).

Eight sawmills process 60 percent of the total log consumption

In 1968, about 370 million board feet (Scribner), 60 percent of the total log consumption for central Washington, was processed by eight large sawmills (80,000 or more board feet per 8-hour shift). Similar figures for 1970 indicate the proportion of logs consumed by these mills has increased to 71 percent. This increase reflects the character of the industry, with many of the smaller sawmills shutting down operation during periods of depressed prices.

In 1968, these larger mills operated an average of almost two 8-hour shifts per day. This is indicated by a 1968 study (Bergvall and Gedney 1970) which shows mills in this class operated at 197 percent of their annual capacity, based on one 8-hour shift per day. Although the large mills processed a larger proportion of the total log consumption in 1970 than 1968, their consumption dropped to 155 percent of annual 8-hour shift capacity.

The number of sawmills has decreased sharply since 1947

As table 3 shows, the number of sawmills operating in central Washington has decreased 82 percent since 1947. This decline, characteristic of the Pacific Northwest as a whole, has been due to the smaller and less efficient mills going out of business and to consolidation of operations by larger companies.

The decrease in sawmills between 1968 and 1970 attests to the contracted business conditions and depressed lumber markets. Al-

Table 3. — Number of sawmills in central Washington by county, for selected years

Year	Total	Chelan	Grant	Kittitas	Klickitat	Okanogan	Yakima
1925	70	10	5	8	21	22	4
1947	118	12	20	14	37	27	8
1963	31	4	1	4	7	10	5
1968	29	4	1	3	6	12	3
1970	21	3	1	2	6	6	3

though many mills were not operating in 1970, a change in economic conditions comparable with those of the middle 1960's would revive some of them. The "in-business today, out-tomorrow" tendency is characteristic of the small sawmill segment of the industry in the Pacific Northwest.

Log harvest by county has shifted since 1925

Much of the early log harvest in central Washington came from private lands. It is for this reason that Chelan, Kittitas, and Klickitat Counties, with a combined total of 70 percent of the private land in central Washington, contributed over 82 percent of the 1925 log harvest. Klickitat County reached a peak log production in 1953 when 146 million board feet was harvested. Since then, the annual harvest has declined to about 75 million board feet. Interestingly, Klickitat County was the only county in central Washington to show no increase in log production in response to the lumber price increases of the late 1960's. Kittitas County has shown a general upward trend in log harvest since 1950, reflecting the greater access to the private lands in the western portion of the county.

Yakima County has experienced the most dramatic change in log production. In 1925, Yakima County accounted for only 1 percent of the central Washington log harvest. Even in 1936, logging was virtually nonexistent in the county, and sawmills were heavily dependent on timber from adjoining counties.

Since the public sawtimber was mainly in the nonroaded higher elevations, log production was primarily from private lands. As sawtimber volume on private lands decreased, roads were built, unlocking the virgin stands on public lands and increasing their contribution to the county log production. By 1969, log production had reached 250 million board feet, about 37 percent of the total. This increase in cut occurred mainly on National Forest and Indian lands, which accounted for over 90 percent of the 1925-69 increase in log production for the county. With over 97 percent of the current sawtimber volume on publicly managed lands, most of the future cut will come from these lands.

Okanogan County has contributed heavily to the central Washington log harvest, with a general upward trend through 1968. As was the case in Yakima County, this trend reflects a large old-growth timber resource and increased accessibility. With 94 percent of the sawtimber volume on publicly managed lands, the trend in log production will be controlled by public policies. For the National Forests, particularly, the greatest factor may be the land use decisions associated with the recreation potential of much of the land along the Cascade Range.

In 1969, Okanogan and Yakima Counties accounted for almost 62 percent of the central Washington log harvest. With almost 60 percent of the remaining old-growth volume, these counties should continue to lead central Washington in log production.

The log harvest in Chelan-Douglas Counties has increased steadily since 1950—from 50 million board feet annually to about 90 million board feet in 1969.

Small-log utilization has been historically low

In an area such as central Washington with extensive acreage of overstocked poletimber stands, potential yields will not be realized without thinning programs. However, commercial thinning programs are hampered by a lack of a small-log market in the area. This is reflected by the fact that in 1968 only 5 percent of the logs consumed in sawmills were from trees less than 100 years old (Bergvall and Gedney 1970).

The primary factors that have contributed to the poor utilization of small logs in central Washington are: (1) overall supply of old-growth timber has been adequate for past and current demands, (2) small logs produce poorer quality material, thus hampering their use for products such as millwork, (3) the industry is geared to cut large logs and cannot handle small logs efficiently, and (4) high transportation costs for long hauling distances greatly reduce the returns to conversion of small logs. These factors, in addition to the little diversification and competition in the industry, have severely hampered the opportunities for intensive forest management in this area.

This condition will change over time as the old-growth timber is cut and the sawmills gear their operations to handle small logs. Additionally, increasing competition for timber in western Washington probably will result in increased demand for east-side supplies which may provide an outlet for some of the smaller logs.

Since the 1968 mill study, a few mills have installed small-log processing equipment to handle the increasing number of smaller logs they are receiving. An expansion of this trend toward increased utilization of small logs would promote the intensive management

practices needed for many areas in central Washington.

The outlook for the industry is for increasing dependency on public timber and a smaller commercial forest land base

With the exception of periods of depressed prices, such as during 1969-70, the trend in log consumption has generally been upward. This trend has been buoyed by increased harvest of overmature stands on publicly managed lands. With 84 percent of the sawtimber volume, these lands should contribute an increasingly larger share of the log harvest.

Important to the forest industry is the supply of ponderosa pine sawtimber. Although log production in central Washington amounts to only 10 percent of the State's total, 73 percent of the ponderosa pine consumed in Washington came from this area (State of Washington 1961-68). The demand for pine products remains strong and will continue to exert pressure on the supply. However, the imbalance of cut to growth for ponderosa pine and the decreasing supply of high quality trees will soon result in a reduction of both quantity and quality.

The major question at this time is the impact of changing recreational and environmental values on the timber inventory. This part of Washington is recognized as having a particularly high potential for recreation, and pressures to remove areas from cutting are increasing. As the public agencies, particularly the National Forests, modify land use decisions to meet increasing recreational needs, the commercial forest land base and available timber volume will decrease. The result will be diminished allowable cuts and reduced volume of logs harvested from the area. Although the land use decisions are presently fluctuating, it appears that recreational usage will have an increasing impact on the forest resource and forest industry of central Washington, either through setting aside of forest land or through modification of management practices.

RECREATION — A GROWING IMPACT

Beyond supplying the raw material base for the forest industry, the forests of central Washington provide many additional benefits. Three of the most important uses are (1) water for urban and agricultural needs, (2) wildlife habitat and range for livestock, and (3) outlets for recreational pursuits. It is this last use that has become increasingly important in the land use decisions of the forest owners in central Washington.

From Mount Adams north, the Cascade Range displays rugged beauty; the northern part of this mountain range has been referred to as the "American Alps" (fig. 10). In addi-

tion to spectacular scenery, this area offers opportunity for almost every form of recreation.

Beginning in 1935, the natural beauty of this area was formally recognized by the establishment of the 801,000-acre North Cascades Primitive Area (part of which was on the west side of the Cascades). In 1960, the 458,000-acre Glacier Peak Wilderness was established. In 1968, culminating long and controversial debate, Congress created the North Cascades National Park, Ross Lake and Lake Chelan National Recreation Areas, and the Pasayten Wilderness Area, and added



Figure 10. — This part of the Cascade Range contains what has been described as the most beautiful and spectacular mountain scenery in the continental United States. Glacier Peak is in the background.

10,000 acres to the Glacier Peak Wilderness Area. In all, some 1,644,000 acres have been set aside in some degree of reserved status. Of this total, about 767,000 acres are in the central Washington unit. The impact on commercial forest land in central Washington was minor. Most of this area had been previously classified as reserved, as part of the Primitive Area set aside in 1935. Of the 767,000 acres, about 141,000 acres were transferred to the National Park Administration, with the remainder staying under U.S. Forest Service jurisdiction.

In addition, special management units have been proposed on National Forest land along the perimeter of the Park and Wilderness areas (see fig. 11). These areas cover about 428,000 acres in the central Washington area. The areas are proposed as scenic or roadless units according to their pristine condition, recreational amenities, and freedom from roads. Land within these special management units is rugged, with about 59 percent of the total area classified as unproductive from a timber management standpoint. Land capable

of producing commercial timber comprises about 21 percent of the area, occurring mainly in the lower river drainages and along the perimeters. An additional 20 percent is classified as nonforest, exemplified by talus slopes, alpine meadows, and rocky peaks. Very little timber cutting is prescribed in these units. The North Cascades Land Use Plan, now being prepared by the U.S. Forest Service, indicates that approximately 800 million board feet of timber lies within these scenic and roadless units in central Washington. The plan currently calls for annual salvage of 1.9 million board feet of dead and high-risk trees in the scenic units only.

With almost 3.7 million acres in the central Washington area, most of which lie along the Cascades, the National Forests manage a vast area of prime recreational potential (fig. 12). All types of recreational use of the National Forests have been increasing rapidly, but recent Forest Service statistics show more than 40 percent of visitation is oriented to camping and backpacking.

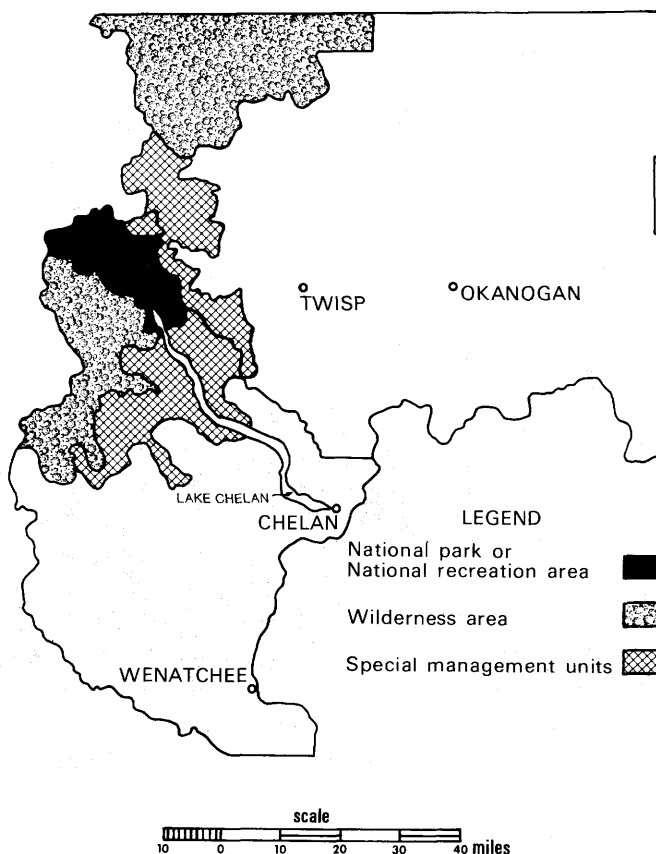
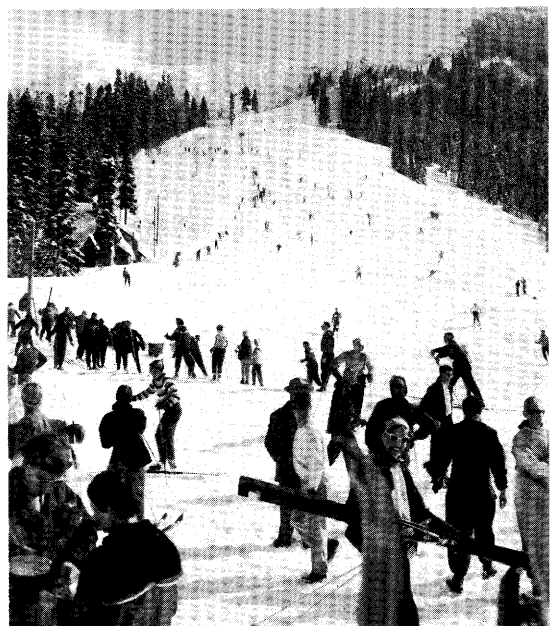
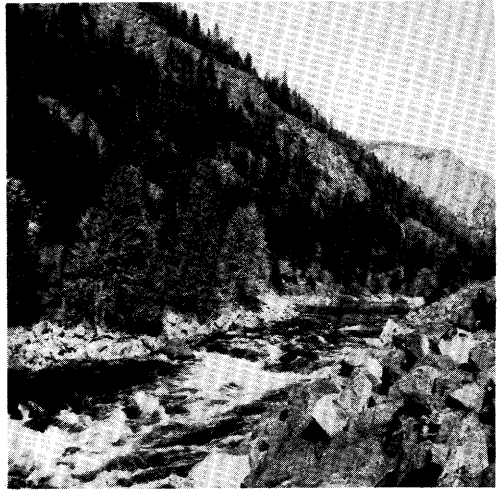
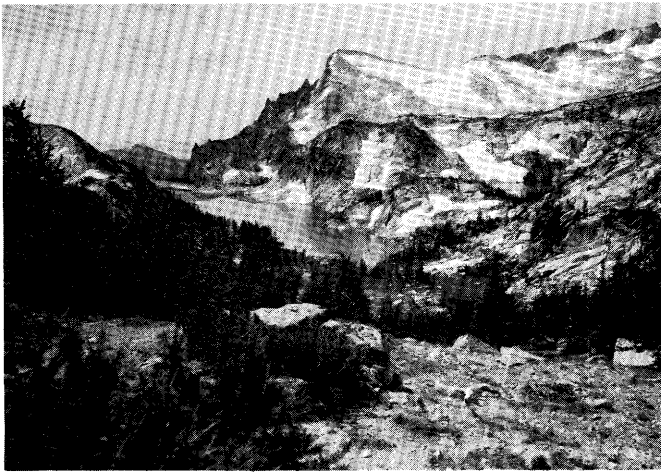
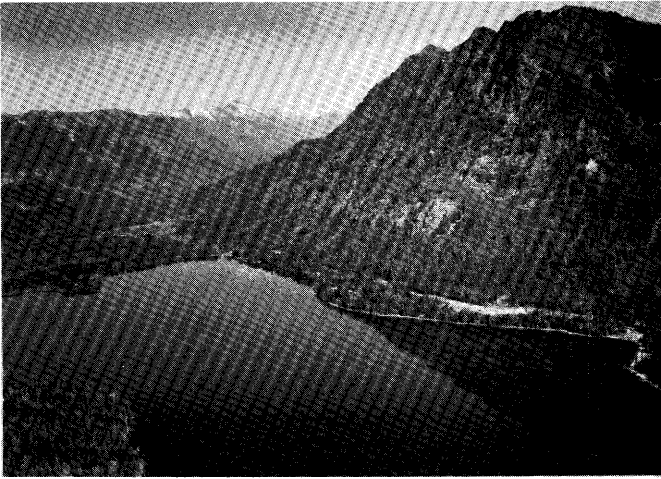


Figure 11. — North Cascades recreation complex — central Washington portion.



*Figure 12. — Recreational opportunities
abound in the forests of central Washington.*

From 1950 to 1964, the number of visitor days of recreation usage on the National Forests of central Washington nearly doubled. From 1966 to 1969, the number of visitor days increased from 4 million to 6.2 million, or 55 percent. The creation of the North Cascades National Park and National Recreation areas, with the recently opened North Cascades highway, will increase the recreation potential tremendously. The Park Service predicted a visitation rate of 1 million annually for the new park in 1972 (National Park Service 1971). The Bonneville Power Administration predicts a fourfold increase over the 1960 level in forest-related recreational participation by the year 2000 (Katz 1967).

With the rapidly increasing population of the Puget Sound area demanding more facilities for recreation, it seems natural that the forest lands of central Washington will be expected to supply a large share.

Recognizing the need to protect the natural beauty of the North Cascades, the Forest Service has initiated a protective management system of scenic areas in addition to the wilderness system and special management units. Zones, known as Visual Resource Zones (VRZ), are set up to protect the natural landscape and esthetic appearance of forest land along or adjacent to travel routes, rivers, recreation sites, and scenic areas. This category presently covers approximately 623,000 acres of commercial forest land in central

Washington. The sawtimber volume on these areas is approximately 8.5 billion board feet, about one-third of the total volume under National Forest management. Logging takes place on most of these areas, but special care is taken to maintain the natural scenic beauty. In the areas adjacent to recreation sites or major travel routes, the harvest is modified by extending the allowable cut over longer rotation periods, by using special technology, or by not cutting. In the background areas, timber management practices are designed to blend with the natural settings.

As table 4 shows, about 50 percent of the total National Forest area is classified as commercial forest land, with about one-third of this in Visual Resource Zones. Some of this land will have reduced yields due to modifications of harvesting and other management practices.

Land development for recreational purposes is increasing rapidly in the central Washington area, as is the case in most of the Northwest. Land is being purchased in large blocks, then subdivided for resale. In Klickitat County, for example, about 21,500 acres were purchased in 1969 for development (Olsen 1970). Most of this land has been subdivided into vacation home sites of 1 to 5 acres, effectively removing them from timber production.

Table 4. — Land classification¹ on National Forests of central Washington

National Forest	Total area	Commercial forest land			Noncommercial and nonforest land	Land in reserved status
		Standard ²	Special ³	Total		
----- <i>Thousand acres</i> -----						
Okanogan	1,498	450	316	766	334	398
Wenatchee	1,609	544	235	779	423	407
Snoqualmie	521	227	57	284	101	136
Gifford Pinchot	67	23	15	38	5	24
All Forests	3,695	1,244	623	1,867	863	965

¹ Based on management plans for each Forest.

² Areas where timber management is the primary consideration.

³ Areas such as Visual Resource Zones, where management for values other than timber dictates modification of timber management practices.

Some areas have been plagued with water, sewage, and pollution problems, which indicates the need for better planning or zoning. Areas of high-intensity development, such as Snoqualmie Pass, show the impact of concentrated development in relatively small areas. In such areas, intermingled public land may prove valuable as a buffer against overdevelopment and damage to the environment. Many private forest landowners are facing pressure to sell land, as escalating recreational land values tend to make timber management a second-best alternative.

Land development is creating problems for the Forest Service, particularly in western Kittitas and western Chelan Counties. Here, National Forest land alternates with blocks of private land as a result of the old railroad grants (fig. 4). Much of this area has prime recreational and scenic values, as well as the potential for higher than average volumes and yields for timber management. In these areas, the Forest Service has problems in coordinating land management to meet multiple goals of recreational usage and timber production, since timber management or recreational development on the private lands may not fit into the environmental plans of the Forest Service. Some land trades have occurred in areas adjacent to high-intensity recreation sites to allow the Forest Service to manage effectively the recreational potential.

Recreational pressure on the forests of central Washington is certain to increase rapidly. Recreation is becoming a big business and many communities are intensifying their pursuit of the recreational dollar. Leavenworth, in Chelan County, has completely remodeled the city center to resemble a Bavarian town (fig. 13). The town of Chelan is actively seeking a new ski development. The communities in the Methow River Valley are preparing for the increased tourism stemming from the completion of the North Cascades highway. Thus, it appears that many communities are striving to establish a larger recreational sector of their local economies. Along with this trend is pressure on the Forest Service to increase development of recreational facilities complementary to the towns' programs.

The North Cascades Land Use Plan is indicative of the Forest Service's policy of expansion of multiple opportunity recreation areas. With the acceptance of this plan almost certainly will come the demand to expand other areas with extensive scenic and recreational values such as Alpine Lakes or Cougar Lake. At the present time areas south and west of Wenatchee are being analyzed for inclusion in the Wilderness program.

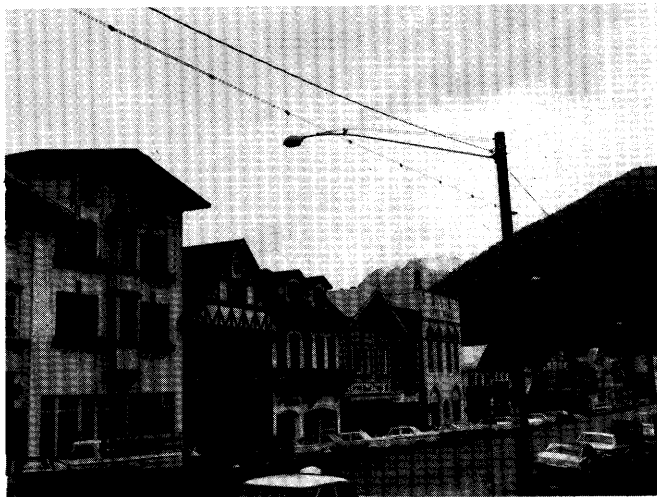


Figure 13. — This Bavarian facade in Leavenworth in Chelan County is an example of how towns are attempting to attract tourist trade.

The increasing interest in forest-oriented recreation will carry with it a reduction in the amount of timber available for forest industries. On public lands, upcoming decisions concerning Wilderness Areas, such as the Alpine Lakes area, will have a very real effect on the allowable cut level. Similarly, on private lands, recreational development will reduce the timber-producing land base. Factors related to decisions bearing on the use of the forest resources of central Washington are important to the local economies of both timber and recreation, as well as the ability of the area to provide wood for the Nation while satisfying other human needs. Critical evaluation of benefits and costs involved in meeting local, regional, and national objectives requires a high level of planning and care in establishing priorities in land use.

Table 5.—Area by land class and county, central Washington, January 1, 1968

(In thousand acres)

Land class	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima	Grant	Benton
Forest land:								
Commercial	4,370	750	657	502	1,620	841	—	—
Productive reserved	402	106	14	1	203	78	—	—
Unproductive	1,231	462	100	52	447	170	—	—
Total	6,003	1,318	771	555	2,270	1,089	—	—
Nonforest land ¹	8,696	1,731	714	666	1,123	1,644	1,716	1,102
Total area ²	14,699	3,049	1,485	1,221	3,393	2,733	1,716	1,102

¹ Includes swampland, industrial and urban areas, other nonforest land, and 17,163 acres, classed as water by Forest Survey standards, but defined by the Bureau of the Census as land.

² Source: U.S. Bureau of the Census, *Land and Water Area of the United States, 1960*, revised 1965.

Table 6.—Area of commercial forest land, by ownership class and county, central Washington,
January 1, 1968

(In thousand acres)

Ownership class ¹	All counties	Chelan- Douglas	Kittitas	Klickitat	Okanogan	Yakima
Public:						
National Forest	1,867	552	267	9	766	273
Other Federal:						
Bureau of Land Management	19	5	—	2	12	—
Bureau of Indian Affairs	779	1	—	44	319	415
Miscellaneous Federal	27	11	9	2	4	1
Total other Federal	825	17	9	48	335	416
State	492	31	77	75	218	91
County and municipal	2	—	—	2	—	—
Total public	3,186	600	353	134	1,319	780
Private:						
Forest industry	433	65	108	193	28	39
Farmer-owned	311	10	6	69	216	10
Miscellaneous private	440	75	190	106	57	12
Total private	1,184	150	304	368	301	61
All ownerships	4,370	750	657	502	1,620	841

¹ Estimates of commercial forest land in specific ownerships are derived by sampling methods. Consequently, they may not agree with the official estimates of the individual agencies.

Table 7.—Area of commercial forest land, by stand-size and ownership classes, central Washington, January 1, 1968

(In thousand acres)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:					
Old-growth ¹	1,312	856	342	53	61
Young-growth ²	1,584	485	548	273	278
Total sawtimber	2,896	1,341	890	326	339
Poletimber stands	809	403	211	50	145
Sapling and seedling stands	383	99	154	30	100
Nonstocked areas	282	24	64	27	167
Total, all classes	4,370	1,867	1,319	433	751

¹ Stands 140 years and older.

² Stands less than 140 years old.

Table 8.—Area of commercial forest land, by stand volume and ownership class, central Washington, January 1, 1968

(In thousand acres)

Stand volumes (board feet per acre ¹)	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Less than 1,500	679	234	131	57	257
1,500 to 4,999	1,028	303	358	118	249
5,000 to 9,999	969	377	356	136	100
10,000 to 19,999	803	388	249	89	77
20,000 to 29,999	421	239	110	29	43
30,000 to 39,999	271	151	95	—	25
40,000 to 49,999	89	81	4	4	—
50,000 or more	110	94	16	—	—
Total	4,370	1,867	1,319	433	751

¹ Net volume, International 1/4-inch scale.

Table 9.—Area of commercial forest land, by site and ownership classes, central Washington, January 1, 1968

(In thousand acres)

Site class ¹ (cubic feet per acre)	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
225 or more	1	1	—	—	—
165 to 224	118	32	47	27	12
120 to 164	251	75	82	36	58
85 to 119	855	349	266	98	142
50 to 84	2,477	1,064	750	248	415
20 to 49	668	346	174	24	124
All classes	4,370	1,867	1,319	433	751

¹ A classification in terms of capacity for cubic-foot annual growth per acre at culmination of mean annual growth in fully stocked stands.

Table 10.—Area of commercial forest land, by forest type and ownership class, central Washington, January 1, 1968

(In thousand acres)

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Douglas-fir	1,592	829	406	95	262
Pacific silver fir	98	59	17	4	18
Subalpine fir	87	45	39	3	—
Grand fir	263	99	81	55	28
Noble fir	2	2	—	—	—
Western larch	147	81	60	6	—
Ponderosa pine	1,195	361	505	202	127
Lodgepole pine	321	198	91	14	18
Western white pine	13	13	—	—	—
Whitebark pine	4	4	—	—	—
Engelmann spruce	101	62	25	4	10
Western redcedar	11	11	—	—	—
Alaska-cedar	1	1	—	—	—
Western hemlock	47	36	—	—	11
Mountain hemlock	43	30	7	—	6
Commercial hardwoods ¹	67	12	7	—	48
Noncommercial hardwoods	96	—	17	22	57
Nonstocked	282	24	64	28	166
Total	4,370	1,867	1,319	433	751

¹ Includes red alder, bigleaf maple, quaking aspen, and black cottonwood forest types.

Table 11.—Area of noncommercial forest land, by ownership class and forest type, central Washington, January 1, 1968

(In thousand acres)

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
<i>RESERVED</i>					
Productive: ¹					
Douglas-fir	50	50	(2)	—	—
Subalpine fir	23	23	—	—	—
Grand fir	12	12	—	—	—
Western larch	6	6	—	—	—
Ponderosa pine	12	11	1	—	—
Lodgepole pine	90	90	—	—	—
Spruce	179	179	—	—	—
Other conifers	30	30	—	—	—
Hardwoods	(2)	(2)	(2)	—	—
Total	402	401	1	—	—
Unproductive:					
Low site ³	251	221	30	—	—
Noncommercial rocky	136	97	39	—	—
Other	—	—	—	—	—
Total	387	318	69	—	—
Total reserved	789	719	70	—	—
<i>UNRESERVED-UNPRODUCTIVE</i>					
Low site: ³					
Douglas-fir	2	—	—	—	2
Subalpine fir	4	—	—	4	—
Grand fir	—	—	—	—	—
Western larch	—	—	—	—	—
Ponderosa pine	19	—	19	—	—
Lodgepole pine	—	—	—	—	—
Spruce	6	—	6	—	—
Other conifers	1	—	1	—	—
Hardwoods	—	—	—	—	—
Unclassified	319	319	—	—	—
Total	351	319	26	4	2
Noncommercial rocky: ⁴					
Douglas-fir	70	—	31	17	22
Subalpine fir	17	—	—	12	5
Grand fir	—	—	—	—	—
Western larch	7	—	7	—	—
Ponderosa pine	45	—	37	4	4
Lodgepole pine	—	—	—	—	—
Spruce	—	—	—	—	—
Other Conifers	4	—	1	3	—
Hardwoods	—	—	—	—	—
Unclassified	214	214	—	—	—
Total	357	214	76	36	31
Noncommercial hardwoods	74	2	25	3	44
Critical watershed ⁵	10	10	—	—	—
Adverse location ⁵ •	52	52	—	—	—
Total unreserved	844	597	127	43	77

¹ Includes forest land capable of growing 20 cubic feet or more per acre per year in the North Cascades National Park; Lake Chelan National Recreation Area; Glacier Peak, Pasayten, and Alpine Lakes Wilderness Areas; several natural areas; and several State and county parks.

² Less than 500 acres.

³ Areas stocked with commercial tree species but incapable of growing 20 cubic feet per acre because of soil and climatic factors; primarily found in the mountains at the upper limits of tree growth (timberline).

⁴ Includes areas that are capable of growing merchantable trees but are too steep and rocky for timber management.

⁵ Includes unstable areas that cannot be logged without seriously affecting the watershed and small isolated patches of commercial forest land on steep mountainsides.

Table 12.—Average number of growing-stock trees per acre on commercial forest land by diameter and ownership classes, central Washington, January 1, 1968

Diameter class (inches at at breast height)	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
5.0-6.9	46.1	55.5	45.3	27.8	34.9
7.0-8.9	29.8	35.5	28.1	26.0	20.5
9.0-10.9	17.3	20.9	15.6	14.9	12.6
11.0-12.9	10.7	12.0	10.7	8.7	8.8
13.0-14.9	7.2	8.5	6.5	7.2	5.4
15.0-16.9	5.1	6.1	4.7	4.1	4.1
17.0-18.9	3.6	4.5	3.1	3.3	2.3
19.0-20.9	2.5	3.3	2.2	1.6	1.6
21.0-28.9	5.0	6.7	4.5	3.6	2.3
29.0-38.9	1.6	2.2	1.7	.9	.6
39.0 and larger	.4	.4	.4	.2	.1
Total	129.3	155.6	122.8	98.3	93.2

Table 13. — Number of growing-stock trees on commercial forest land by species and diameter class, central Washington, January 1, 1968

Species	(Thousand trees)											
	Diameter class (inches at breast height)											
	All classes	5.0- 6.9	7.0- 8.9	9.0- 10.9	11.0- 12.9	13.0- 14.9	15.0- 16.9	17.0- 18.9	19.0- 20.9	21.0- 28.9	29.0- 38.9	39.0 and larger
Softwoods:												
Douglas-fir	165,718	51,654	35,991	22,274	14,592	11,088	7,881	5,742	3,952	8,730	3,004	810
Pacific silver fir	20,758	7,100	3,814	2,182	2,011	1,400	1,192	970	596	1,201	256	36
Subalpine fir	36,744	14,348	9,097	5,186	3,317	2,167	1,141	693	344	403	48	—
Grand fir	56,968	23,993	12,517	6,933	4,647	3,067	2,106	1,172	806	1,226	440	61
Noble fir	416	134	76	12	19	72	9	15	20	33	22	4
Western larch	25,069	6,324	5,076	3,948	2,320	1,957	1,411	923	814	1,726	448	122
Ponderosa pine	99,790	30,827	22,426	13,855	8,770	5,678	4,350	3,426	2,509	5,483	2,098	368
Lodgepole pine	98,224	47,613	27,548	12,518	5,651	2,395	1,274	599	363	248	18	—
Western white pine	5,975	1,816	1,093	984	603	479	337	200	167	221	69	6
Whitebark pine	2,751	1,230	502	426	222	198	77	43	9	40	4	—
Engelmann spruce	22,406	6,947	4,859	3,686	2,253	1,430	1,040	708	473	781	212	17
Western redcedar	2,160	668	459	195	131	103	112	92	71	180	105	44
Alaska-cedar	1,242	325	210	229	93	52	51	70	38	133	39	2
Western hemlock	7,847	2,167	1,381	1,096	659	632	443	305	281	663	175	45
Mountain hemlock	8,689	1,836	1,502	948	946	776	861	502	360	748	178	32
Total softwoods	554,757	196,982	126,551	74,472	46,234	31,494	22,285	15,460	10,803	21,813	7,116	1,547
Hardwoods ¹	10,269	4,494	3,536	1,064	719	184	71	86	38	37	40	—
All species	565,026	201,476	130,087	75,536	46,953	31,678	22,356	15,546	10,841	21,850	7,156	1,547

¹ Primarily black cottonwood, quaking aspen, Oregon white oak; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 14. — Area of commercial forest land and volume of growing stock and sawtimber by stand-age and ownership classes, central Washington, January 1, 1968

Stand age (years)	All ownerships			National Forest			Other public			Forest industry			Farmer and miscellaneous private		
	Thousand acres	Growing stock	Sawtimber	Thousand acres	Growing stock	Sawtimber	Thousand acres	Growing stock	Sawtimber	Thousand acres	Growing stock	Sawtimber	Thousand acres	Growing stock	Sawtimber
		Million cubic feet	Million board feet ¹		Million cubic feet	Million board feet ¹		Million cubic feet	Million board feet ¹		Million cubic feet	Million board feet ¹		Million cubic feet	Million board feet ¹
Nonstocked: ²	282	50	245	24	(³)	4	63	16	72	28	5	19	167	29	150
0- 9	79	31	162	15	6	49	21	10	48	15	6	26	28	9	39
10- 19	70	35	156	30	9	36	24	21	107	—	—	—	16	5	13
20- 29	53	19	40	20	8	28	—	—	—	—	—	—	33	11	12
30- 39	152	113	227	48	26	53	43	44	106	29	17	53	32	26	15
40- 49	209	236	738	70	75	184	58	74	282	34	31	77	47	56	195
50- 59	209	353	971	73	106	283	75	140	367	19	27	64	42	80	257
60- 69	282	565	1,635	116	234	638	83	204	548	37	59	195	46	68	254
70- 79	191	440	1,406	99	244	728	37	76	266	18	24	102	37	96	310
80- 89	86	214	691	86	214	691	—	—	—	—	—	—	—	—	—
90- 99	80	203	611	58	170	535	13	27	48	—	—	—	9	6	28
100-109	106	319	1,364	86	280	1,156	4	3	14	—	—	—	16	36	194
110-119	83	276	1,223	66	208	868	10	23	104	—	—	—	7	45	251
120-129	67	196	924	60	187	866	—	—	—	7	9	58	—	—	—
130-159	207	675	3,311	191	641	3,140	16	34	171	—	—	—	—	—	—
160-199	176	663	3,606	172	631	3,423	—	—	—	4	32	183	—	—	—
Over 200	365	1,870	11,084	314	1,599	9,590	26	175	974	11	49	292	14	47	228
Uneven, under rotation age ²	1,092	2,422	10,536	143	374	1,907	546	1,230	5,269	193	426	1,798	210	392	1,562
Uneven, over rotation age ²	581	2,294	11,979	196	830	4,327	300	1,143	6,012	38	122	634	47	199	1,006
Total, all classes	4,370	10,974	50,909	1,867	5,842	28,506	1,319	3,220	14,388	433	807	3,501	751	1,105	4,514

¹ International 1/4-inch rule.

² See "Definition of Terms."

³ Less than 500,000 cubic feet.

Table 15.—Volume of all growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, central Washington, January 1, 1968

Ownership class	Average volume per acre	Total volume		
		All species	Softwoods	Hardwoods
	<i>Cubic feet</i>	<i>----- Million cubic feet -----</i>		
All growing stock:				
National Forest	3,129	5,842	5,827	15
Other public	2,441	3,220	3,213	7
Forest industry	1,864	807	805	2
Farmer and miscellaneous private	1,471	1,105	1,075	30
All ownerships	2,511	10,974	10,920	54
	<i>Board feet</i>	<i>----- Million board feet -----</i>		
Sawtimber (International ¼-inch rule):				
National Forest	15,268	28,506	28,451	55
Other public	10,908	14,388	14,365	23
Forest industry	8,085	3,501	3,496	5
Farmer and miscellaneous private	6,011	4,514	4,475	39
All ownerships	11,650	50,909	50,787	122
Sawtimber (Scribner rule):				
National Forest	13,569	25,333	25,279	54
Other public	9,572	12,626	12,603	23
Forest industry	6,975	3,020	3,015	5
Farmer and miscellaneous private	5,124	3,848	3,811	37
All ownerships	10,258	44,827	44,708	119

Table 16.—Volume of all growing stock and sawtimber on commercial forest land by county and ownership class, central Washington, January 1, 1968

County	Total	National Forest	Other public	Forest industry	Farmer miscellaneous private
----- Million cubic feet -----					
Growing stock:					
Chelan-Douglas	2,124	1,713	118	179	114
Kittitas	2,102	1,168	142	234	558
Klickitat	883	74	332	278	199
Okanogan	2,826	1,680	906	22	218
Yakima	3,039	1,207	1,722	94	16
Total	10,974	5,842	3,220	807	1,105
----- Million board feet -----					
Sawtimber (International ¼-inch rule):					
Chelan-Douglas	9,783	7,975	502	839	467
Kittitas	10,128	6,080	519	1,022	2,507
Klickitat	4,124	474	1,652	1,187	811
Okanogan	11,991	7,502	3,705	92	692
Yakima	14,883	6,475	8,010	361	37
Total	50,909	28,506	14,388	3,501	4,514
Sawtimber (Scribner rule):					
Chelan-Douglas	8,838	7,293	421	729	395
Kittitas	8,992	5,503	445	887	2,157
Klickitat	3,518	375	1,457	1,011	675
Okanogan	10,402	6,539	3,194	81	588
Yakima	13,077	5,623	7,109	312	33
Total	44,827	25,333	12,626	3,020	3,848

Table 17. — Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, central Washington, January 1, 1968

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	8,124	8,108	16
Upper-stem portion	472	463	9
Total	8,596	8,571	25
Poletimber trees	2,378	2,349	29
All growing-stock trees	10,974	10,920	54
Sound cull trees	103	38	65
Rotten cull trees	76	71	5
Salvable dead sawtimber trees	295	295	(1)
Total, all timber	11,448	11,324	124

¹ Less than 500,000 cubic feet.

Table 18. — Volume of growing stock and sawtimber on commercial forest land, by stand-size class and by softwoods and hardwoods, central Washington, January 1, 1968

Stand-size class	Average volume per acre	Total volume		
		All species	Softwoods	Hardwoods
	<i>Cubic feet</i>	<i>----- Million cubic feet -----</i>		
All growing stock:				
Sawtimber stands	3,259	9,437	9,410	27
Poletimber stands	1,543	1,248	1,224	24
Sapling and seedling stands	624	239	236	3
Nonstocked areas	177	50	50	—
Total	2,511	10,974	10,920	54
	<i>Board feet</i>	<i>----- Million board feet -----</i>		
Sawtimber (International 1/4-inch rule):				
Sawtimber stands	16,443	47,620	47,527	93
Poletimber stands	2,697	2,182	2,162	20
Sapling and seedling stands	2,256	864	855	9
Nonstocked areas	862	243	243	—
Total	11,650	50,909	50,787	122
Sawtimber (Scribner rule):				
Sawtimber stands	14,505	42,008	41,917	91
Poletimber stands	2,295	1,857	1,837	20
Sapling and seedling stands	1,963	752	744	8
Nonstocked areas	745	210	210	—
Total	10,258	44,827	44,708	119

Table 19. —Volume of all growing stock on commercial forest land, by species and county, central Washington, January 1, 1968

(In million cubic feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	3,864	744	845	426	1,226	623
Pacific silver fir	564	128	179	8	—	249
Subalpine fir	522	208	72	2	139	101
Grand fir	916	142	216	102	14	442
Noble fir	19	—	10	5	1	3
Western larch	659	31	121	1	304	202
Ponderosa pine	2,319	403	223	278	601	814
Lodgepole pine	799	202	98	51	240	208
Western white pine	136	51	39	1	—	45
Whitebark pine	27	8	—	—	9	10
Engelmann spruce	493	87	52	—	261	93
Western redcedar	66	27	24	8	1	6
Alaska-cedar	38	5	1	—	—	32
Western hemlock	239	45	142	—	—	52
Mountain hemlock	259	39	77	—	—	143
All softwoods	10,920	2,120	2,099	882	2,796	3,023
Hardwoods ¹	54	4	3	1	30	16
All species	10,974	2,124	2,102	883	2,826	3,039

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 20.—Volume of sawtimber on commercial forest land, by species and county, central Washington, January 1, 1968 (International ¼-inch rule)

(In million board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	19,281	3,580	4,503	2,134	5,555	3,509
Pacific silver fir	2,911	625	953	49	—	1,284
Subalpine fir	1,555	654	178	5	358	360
Grand fir	3,824	572	772	449	24	2,007
Noble fir	114	1	59	36	2	16
Western larch	3,302	161	604	3	1,499	1,035
Ponderosa pine	11,971	2,393	1,101	1,209	3,185	4,083
Lodgepole pine	1,468	388	171	179	192	538
Western white pine	707	296	174	3	—	234
Whitebark pine	79	22	—	1	14	42
Engelmann spruce	2,241	420	234	—	1,093	494
Western redcedar	350	135	126	52	4	33
Alaska-cedar	202	30	6	—	3	163
Western hemlock	1,390	275	845	—	—	270
Mountain hemlock	1,392	225	391	—	1	775
Total softwoods	50,787	9,777	10,117	4,120	11,930	14,843
Hardwoods ¹	122	6	11	4	61	40
All species	50,909	9,783	10,128	4,124	11,991	14,883

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 21.—Volume of sawtimber on commercial forest land, by species and county, central Washington, January 1, 1968 (Scribner rule)

(In million board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	17,224	3,277	4,118	1,824	4,755	3,250
Pacific silver fir	2,510	561	838	38	—	1,073
Subalpine fir	1,290	543	147	4	303	293
Grand fir	3,260	498	667	377	20	1,698
Noble fir	97	—	55	30	1	11
Western larch	2,885	139	529	3	1,313	901
Ponderosa pine	10,831	2,245	1,000	1,039	2,838	3,709
Lodgepole pine	1,196	319	142	150	155	430
Western white pine	608	258	147	2	—	201
Whitebark pine	67	17	—	1	12	37
Engelmann spruce	1,930	365	200	—	939	426
Western redcedar	314	122	114	47	3	28
Alaska-cedar	174	27	4	—	3	140
Western hemlock	1,024	206	623	—	—	195
Mountain hemlock	1,298	255	397	—	—	646
Total softwoods	44,708	8,832	8,981	3,515	10,342	13,038
Hardwoods ¹	119	6	11	3	60	39
All species	44,827	8,838	8,992	3,518	10,402	13,077

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 22.—Volume of growing stock on commercial forest land by species and ownership class, central Washington, January 1, 1968

(In million cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	3,864	2,218	861	292	493
Pacific silver fir	564	413	98	14	39
Subalpine fir	522	362	136	12	12
Grand fir	916	377	322	108	109
Noble fir	19	18	—	—	1
Western larch	659	288	315	13	43
Ponderosa pine	2,319	779	1,008	297	235
Lodgepole pine	799	508	238	22	31
Western white pine	136	104	10	12	10
Whitebark pine	27	17	7	3	—
Engelmann spruce	493	307	129	28	29
Western redcedar	66	45	10	3	8
Alaska-cedar	38	20	13	—	5
Western hemlock	239	201	7	1	30
Mountain hemlock	259	170	59	—	30
Total softwoods	10,920	5,827	3,213	805	1,075
Hardwoods ¹	54	15	7	2	30
All species	10,974	5,842	3,220	807	1,105

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 23.—Net volume of sawtimber on commercial forest land by species and ownership class, central Washington, January 1, 1968 (International ¼-inch rule)

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	19,281	11,691	4,076	1,371	2,143
Pacific silver fir	2,911	2,180	444	81	206
Subalpine fir	1,555	998	457	51	49
Grand fir	3,824	1,505	1,426	448	445
Noble fir	114	108	—	—	6
Western larch	3,302	1,662	1,441	36	163
Ponderosa pine	11,971	4,882	4,840	1,280	969
Lodgepole pine	1,468	867	551	40	10
Western white pine	707	569	50	42	46
Whitebark pine	79	52	23	4	—
Engelmann spruce	2,241	1,431	594	133	83
Western redcedar	350	248	57	7	38
Alaska-cedar	202	103	70	—	29
Western hemlock	1,390	1,209	33	3	145
Mountain hemlock	1,392	946	303	—	143
Total softwoods	50,787	28,451	14,365	3,496	4,475
Hardwoods ¹	122	55	23	5	39
All species	50,909	28,506	14,388	3,501	4,514

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 24.—*Net volume of sawtimber on commercial forest land by species and ownership class, central Washington, January 1, 1968 (Scribner rule)*

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	17,224	10,626	3,601	1,183	1,814
Pacific silver fir	2,510	1,879	384	72	175
Subalpine fir	1,290	829	377	44	40
Grand fir	3,260	1,246	1,256	381	377
Noble fir	97	92	—	—	5
Western larch	2,885	1,468	1,248	29	140
Ponderosa pine	10,831	4,598	4,288	1,112	833
Lodgepole pine	1,196	694	461	32	9
Western white pine	608	491	45	34	38
Whitebark pine	67	44	20	3	—
Engelmann spruce	1,930	1,232	512	116	70
Western redcedar	314	222	52	6	34
Alaska-cedar	174	85	63	—	26
Western hemlock	1,024	863	30	3	128
Mountain hemlock	1,298	910	266	—	122
Total softwoods	44,708	25,279	12,603	3,015	3,811
Hardwoods ¹	119	54	23	5	37
All species	44,827	25,333	12,626	3,020	3,848

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 25. — Volume of growing stock on commercial forest land, by species and diameter class, central Washington, January 1, 1968

(In million cubic feet)

Species	Diameter class (inches at breast height)											
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:												
Douglas-fir	3,862	147	231	260	272	304	299	290	254	890	595	320
Pacific silver fir	564	24	28	30	43	46	57	60	48	151	61	16
Subalpine fir	523	60	71	72	75	69	50	42	27	47	10	—
Grand fir	916	74	85	86	95	93	91	68	59	143	96	26
Noble fir	19	1	—	—	—	2	1	1	2	4	6	2
Western larch	659	19	33	48	45	56	56	47	54	174	87	40
Ponderosa pine	2,320	83	126	144	148	142	156	164	160	591	452	154
Lodgepole pine	799	165	199	157	104	63	45	25	20	19	2	—
Western white pine	136	5	8	13	12	14	15	12	13	25	17	2
Whitebark pine	27	3	3	4	3	5	4	2	—	2	1	—
Engelmann spruce	493	26	37	50	51	47	47	43	36	101	48	7
Western redcedar	66	2	2	1	1	4	4	4	4	16	15	13
Alaska-cedar	38	1	2	2	2	2	1	4	2	14	7	1
Western hemlock	239	5	7	13	14	19	18	18	20	75	33	17
Mountain hemlock	259	4	7	11	16	20	32	27	24	74	34	10
Total softwoods	10,920	619	839	891	881	886	876	807	723	2,326	1,464	608
Hardwoods ¹	54	9	13	7	9	3	2	3	1	3	4	—
All species	10,974	628	852	898	890	889	878	810	724	2,329	1,468	608

¹ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 26. — Volume of sawtimber on commercial forest land, by species and diameter class, central Washington, January 1, 1968 (International 1/4-inch rule)

(In million board feet)

Species	Diameter class (inches at breast height)								
	All classes	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:									
Douglas-fir	19,281	1,159	1,452	1,563	1,624	1,512	5,700	4,084	2,187
Pacific silver fir	2,911	210	244	320	359	300	956	409	113
Subalpine fir	1,555	306	320	244	214	146	264	61	—
Grand fir	3,824	446	483	486	383	339	878	629	180
Noble fir	114	2	13	3	6	9	31	39	11
Western larch	3,302	190	286	314	299	337	1,105	527	244
Ponderosa pine	11,971	720	725	843	931	934	3,718	3,041	1,059
Lodgepole pine	1,468	497	346	254	145	115	98	13	—
Western white pine	707	68	79	88	74	83	171	126	18
Whitebark pine	79	15	23	13	8	3	15	2	—
Engelmann spruce	2,241	246	235	253	239	217	653	342	56
Western redcedar	350	7	11	21	22	22	91	98	78
Alaska-cedar	202	8	7	9	21	13	91	49	4
Western hemlock	1,390	71	105	108	111	127	505	238	125
Mountain hemlock	1,392	82	103	170	141	133	461	226	76
Total softwoods	50,787	4,027	4,432	4,689	4,577	4,290	14,737	9,884	4,151
Hardwoods¹									
	122	35	13	9	14	8	16	27	—
All species	50,909	4,062	4,445	4,698	4,591	4,298	14,753	9,011	4,151

¹Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 27. — Volume of sawtimber on commercial forest land, by species and diameter class, central Washington, January 1, 1968 (Scribner rule)

(In million board feet)

Species	Diameter class (inches at breast height)								
	All species	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-28.9	29.0-38.9	39.0 and larger
Softwoods:									
Douglas-fir	17,224	905	1,181	1,306	1,386	1,315	5,120	3,838	2,173
Pacific silver fir	2,510	164	193	259	295	254	838	384	123
Subalpine fir	1,290	230	251	204	184	127	237	57	—
Grand fir	3,260	333	383	400	317	290	782	596	159
Noble fir	97	1	7	2	5	7	26	39	10
Western larch	2,885	138	215	251	248	287	1,001	507	238
Ponderosa pine	10,831	504	567	707	824	845	3,513	2,888	983
Lodgepole pine	1,196	385	275	207	124	101	90	14	—
Western white pine	608	50	63	75	64	75	154	111	16
Whitebark pine	67	9	18	12	7	3	15	3	—
Engelmann spruce	1,930	182	196	217	209	193	582	303	48
Western redcedar	314	6	9	16	18	17	79	90	79
Alaska-cedar	174	5	4	9	18	12	79	44	3
Western hemlock	1,024	51	69	71	71	88	358	204	112
Mountain hemlock	1,298	66	92	152	130	124	442	224	68
Total softwoods	44,708	3,029	3,523	3,888	3,900	3,738	13,316	9,302	4,012
Hardwoods ¹	119	35	13	7	11	9	16	28	—
All species	44,827	3,064	3,536	3,895	3,911	3,747	13,332	9,330	4,012

¹Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 28.—*Net annual growth of growing stock on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹*

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	45,700	20,700	9,000	5,700	10,300
True firs	31,300	14,900	10,200	3,100	3,100
Western larch	-3,400 ²	-300 ²	-2,400 ²	100	-800 ²
Ponderosa pine	27,800	5,800	12,900	4,300	4,800
Lodgepole pine	8,600	5,900	2,000	-300 ²	1,000
Other pines	200	500	—	200	-500 ²
Engelmann spruce	5,900	3,200	2,400	-100 ²	400
Cedars	1,000	700	200	100	—
Hemlock	3,200	2,500	400	—	300
Total softwoods	120,300	53,900	34,700	13,100	18,600
Hardwoods ³	1,100	300	—	—	800
All species	121,400	54,200	34,700	13,100	19,400

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding gross annual growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 29.—Net annual growth of sawtimber on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹ (International ¼-inch rule)

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	226,900	100,800	36,100	27,600	62,400
True firs	137,400	58,700	49,800	13,700	15,200
Western larch	-24,800 ²	-4,000 ²	-18,400 ²	2,900	-5,300 ²
Ponderosa pine	151,600	35,600	68,100	22,600	25,300
Lodgepole pine	23,400	16,800	5,000	-400 ²	2,000
Other pines	3,200	2,700	2,800	700	-3,000 ²
Engelmann spruce	36,400	15,200	22,000	-2,500 ²	1,700
Cedars	5,300	4,000	800	200	300
Hemlock	15,500	12,600	1,500	—	1,400
Total softwoods	574,900	242,400	167,700	64,800	100,000
Hardwoods ³	2,600	1,900	500	—	200
All species	577,500	244,300	168,200	64,800	100,200

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding gross annual growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 30.—Net annual growth of sawtimber on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹ (Scribner rule)

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	196,400	94,100	29,400	23,200	49,700
True firs	118,000	50,200	42,700	12,100	13,000
Western larch	-21,000 ²	-3,000 ²	-14,900 ²	1,800	-4,900 ²
Ponderosa pine	129,100	32,900	58,100	17,900	20,200
Lodgepole pine	18,600	13,500	3,900	-400 ²	1,600
Other pines	3,000	2,700	2,200	700	-2,600 ²
Engelmann spruce	30,500	13,400	17,900	-2,300 ²	1,500
Cedars	5,100	3,800	700	300	300
Hemlock	13,400	10,600	1,400	—	1,400
Total softwoods	493,100	218,200	141,400	53,300	80,200
Hardwoods ³	2,500	1,800	400	—	300
All species	495,600	220,000	141,800	53,300	80,500

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding gross annual growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 31.—Net annual growth of all growing stock on commercial forest land, by species and county, central Washington, January 1, 1968¹

(In thousand cubic feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	45,700	10,300	9,300	6,200	15,900	4,000
True firs	31,300	5,300	6,300	3,100	2,200	14,400
Western larch	-3,400 ²	100	500	—	-900 ²	-3,100 ²
Ponderosa pine	27,800	4,200	1,800	4,800	8,800	8,200
Lodgepole pine	8,600	300	1,000	1,200	4,200	1,900
Other pines	200	200	-500 ²	—	100	400
Engelmann spruce	5,900	500	900	—	3,600	900
Cedars	1,000	400	300	100	—	200
Hemlock	3,200	1,000	1,100	-200 ²	—	1,300
Total softwoods	120,300	22,300	20,700	15,200	33,900	28,200
Hardwoods ³						
	1,100	-100 ²	100	100	400	600
All species	121,400	22,200	20,800	15,300	34,300	28,800

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding annual gross growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 32.—*Net annual growth of sawtimber on commercial forest land, by species and county, central Washington, January 1, 1968¹ (International ¼-inch rule)*

(In thousand board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	226,900	45,400	56,800	36,400	67,500	20,800
True firs	137,400	21,200	26,500	14,600	7,000	68,100
Western larch	-24,800 ²	-200 ²	1,300	—	-4,700 ²	-21,200 ²
Ponderosa pine	151,600	25,100	10,500	35,700	31,200	49,100
Lodgepole pine	23,400	1,900	2,000	1,400	7,400	10,700
Other pines	3,200	1,000	-3,100 ²	—	300	5,000
Engelmann spruce	36,400	300	3,100	—	32,000	1,000
Cedars	5,300	2,100	1,300	400	100	1,400
Hemlock	15,500	5,100	6,100	-1,000 ²	—	5,300
Total softwoods	574,900	101,900	104,500	87,500	140,800	140,200
Hardwoods ³	2,600	—	200	—	1,600	800
All species	577,500	101,900	104,700	87,500	142,400	141,000

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding gross annual growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 33.—*Net annual growth of sawtimber on commercial forest land, by species and county, central Washington, January 1, 1968¹ (Scribner rule)*

(In thousand board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	196,400	43,800	48,900	30,000	56,700	17,000
True firs	118,000	19,500	22,900	12,900	5,700	57,000
Western larch	-21,000 ²	100	1,300	—	-4,700 ²	-17,000 ²
Ponderosa pine	129,100	23,600	8,700	28,000	27,400	41,400
Lodgepole pine	18,600	1,700	1,700	1,200	6,000	8,000
Other pines	3,000	1,200	-2,700 ²	—	300	4,200
Engelmann spruce	30,500	300	2,700	—	26,400	1,100
Cedars	5,100	2,100	1,200	500	100	1,200
Hemlock	13,400	4,600	5,100	-900 ²	—	4,600
Total softwoods	493,100	96,900	89,800	71,700	117,900	116,800
Hardwoods ³	2,500	—	400	—	1,300	800
All species	495,600	96,900	90,200	71,700	119,200	117,600

¹ See "Inventory Procedures" for an explanation of growth estimates and the actual periods over which growth was measured.

² Negative growth is the result of annual mortality exceeding gross annual growth.

³ Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 34.—Average annual mortality of growing stock on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹

(In thousand cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	21,300	10,400	7,600	1,000	2,300
True firs	15,200	6,300	5,300	1,800	1,800
Western larch	9,800	2,700	5,800	100	1,200
Ponderosa pine	14,300	3,100	6,600	2,300	2,300
Lodgepole pine	7,500	3,500	3,300	700	—
Other pines	1,900	1,100	100	—	700
Engelmann spruce	3,100	1,500	600	700	300
Cedars	100	100	—	—	—
Hemlock	1,600	1,300	100	—	200
Total softwoods	74,800	30,000	29,400	6,600	8,800
Hardwoods ²	400	100	200	—	100
All species	75,200	30,100	29,600	6,600	8,900

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 35.—Average annual mortality of sawtimber on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹ (International ¼-inch rule)
(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	106,900	53,400	38,100	5,500	9,900
True firs	66,700	27,100	22,400	8,100	9,100
Western larch	49,800	14,400	28,900	400	6,100
Ponderosa pine	67,100	19,300	26,300	12,800	8,700
Lodgepole pine	18,100	5,500	10,100	2,500	—
Other pines	9,900	6,100	—	—	3,800
Engelmann spruce	13,500	7,800	2,400	3,300	—
Cedars	400	400	—	—	—
Hemlock	9,600	7,400	1,000	—	1,200
Total softwoods	342,000	141,400	129,200	32,600	38,800
Hardwoods ²	700	100	—	—	600
All species	342,700	141,500	129,200	32,600	39,400

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 36.—Average annual mortality of sawtimber on commercial forest land, by species and ownership class, central Washington, January 1, 1968¹ (Scribner rule)

(In thousand board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	94,300	46,500	34,000	5,000	8,800
True firs	57,100	23,500	19,200	6,700	7,700
Western larch	44,200	13,900	24,300	300	5,700
Ponderosa pine	61,000	18,500	23,200	11,200	8,100
Lodgepole pine	15,000	4,400	8,500	2,100	—
Other pines	8,500	5,200	—	—	3,300
Engelmann spruce	12,300	7,200	2,100	3,000	—
Cedar	400	400	—	—	—
Hemlock	8,000	6,200	900	—	900
Total softwoods	300,800	125,800	112,200	28,300	34,500
Hardwoods ²	700	100	—	—	600
All species	301,500	125,900	112,200	28,300	35,100

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 37.—Average annual mortality of growing stock on commercial forest land by species and county, central Washington, January 1, 1968¹

(In thousand cubic feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	21,300	3,200	2,700	3,000	8,000	4,400
True firs	15,200	4,900	3,100	1,600	1,200	4,400
Western larch	9,800	300	600	—	3,600	5,300
Ponderosa pine	14,300	1,200	2,200	2,900	3,000	5,000
Lodgepole pine	7,500	2,900	400	300	1,900	2,000
Other pines	1,900	700	1,100	—	—	100
Engelmann spruce	3,100	1,000	100	—	1,000	1,000
Cedars	100	—	—	—	—	100
Hemlock	1,600	100	800	100	—	600
Total softwoods	74,800	14,300	11,000	7,900	18,700	22,900
Hardwoods ²						
	400	100	—	—	300	—
All species	75,200	14,400	11,000	7,900	19,000	22,900

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 38.—Average annual mortality of sawtimber on commercial forest land by species and county, central Washington, January 1, 1968¹ (International ¼-inch rule)

(In thousand board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	106,900	15,100	13,300	16,600	37,200	24,700
True firs	66,700	21,800	14,500	7,000	4,000	19,400
Western larch	49,800	1,500	3,300	—	16,800	28,200
Ponderosa pine	67,100	6,300	11,700	11,900	17,700	19,500
Lodgepole pine	18,100	10,300	600	400	1,700	5,100
Other pines	9,900	3,900	5,700	—	200	100
Engelmann spruce	13,500	4,700	400	—	2,800	5,600
Cedars	400	—	100	—	—	300
Hemlock	9,600	100	5,300	1,000	—	3,200
Total softwoods	342,000	63,700	54,900	36,900	80,400	106,100
Hardwoods ²	700	—	—	100	600	—
All species	342,700	63,700	54,900	37,000	81,000	106,100

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 39.—Average annual mortality of sawtimber on commercial forest land by species and county, central Washington, January 1, 1968¹ (Scribner rule)

(In thousand board feet)

Species	All counties	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
Softwoods:						
Douglas-fir	94,300	13,900	12,200	14,600	31,100	22,500
True firs	57,100	18,600	12,900	5,800	3,600	16,200
Western larch	44,200	1,200	2,900	—	15,900	24,200
Ponderosa pine	61,000	6,000	10,800	10,700	15,700	17,800
Lodgepole pine	15,000	8,700	500	400	1,400	4,000
Other pines	8,500	3,300	5,000	—	100	100
Engelmann spruce	12,300	4,300	400	—	2,700	4,900
Cedars	400	—	100	—	—	300
Hemlock	8,000	100	4,500	900	—	2,500
Total softwoods	300,800	56,100	49,300	32,400	70,500	92,500
Hardwoods ²	700	—	—	100	600	—
All species	301,500	56,100	49,300	32,500	71,100	92,500

¹ See "Inventory Procedures" for details on the mortality estimates and periods over which mortality was estimated.

² Consists primarily of black cottonwood and quaking aspen; also includes small amounts of red alder, western paper birch, bigleaf maple, and white alder.

Table 40. — Average annual mortality of growing stock and sawtimber on commercial forest land, by cause of death and by softwoods and hardwoods, central Washington, January 1, 1968

Species	All causes	Fire	Insects	Disease	Weather	Miscellaneous	Unknown
----- Thousand cubic feet -----							
Growing stock:							
Softwoods	74,700	3,000	8,500	17,700	5,800	12,700	27,000
Hardwoods	500	100	100	—	—	100	200
Total	75,200	3,100	8,600	17,700	5,800	12,800	27,200
----- Thousand board feet, International 1/4-inch rule -----							
Sawtimber:							
Softwoods	342,000	14,200	41,200	87,500	28,500	50,000	120,600
Hardwoods	700	—	600	—	—	100	'8
Total	342,700	14,200	41,800	87,500	28,500	50,100	120,600
----- Thousand board feet, Scribner rule -----							
Sawtimber:							
Softwoods	300,800	12,800	36,800	76,000	24,700	43,400	107,100
Hardwoods	700	—	600	—	—	100	—
Total	301,500	12,800	37,400	76,000	24,700	43,500	107,100

Table 41.—Net volume of salvable dead sawtimber on commercial forest land, by volume-per-acre class and by county, central Washington, January 1, 1968

Volume-per-acre class	Total	Chelan-Douglas	Kittitas	Klickitat	Okanogan	Yakima
----- Thousand cubic feet -----						
1-199	72,500	9,400	16,800	7,800	18,700	19,800
200-499	112,900	21,900	22,600	12,100	16,400	39,900
500-999	60,900	9,500	7,500	—	11,700	32,200
1,000-1,999	46,500	21,900	20,000	—	800	3,800
2,000 or more	—	—	—	—	—	—
Total	292,800	62,700	66,900	19,900	47,600	95,700
----- Thousand board feet, International ¼-inch rule -----						
1-499	92,700	10,700	3,200	22,400	21,100	35,300
500-999	243,100	38,000	38,400	47,900	62,300	56,500
1,000-2,499	552,300	107,700	91,000	95,000	87,700	170,900
2,500-4,999	433,600	76,300	40,300	50,700	66,300	200,000
5,000-9,999	309,500	129,400	45,100	25,500	23,600	85,900
10,000 or more	14,000	—	—	—	—	14,000
Total	1,645,200	362,100	218,000	241,500	261,000	562,600

Table 42. — Net volume of salvable dead sawtimber on commercial forest land, by volume-per-tree class and species group, central Washington, January 1, 1968

Volume-per-tree class	Total	Douglas-fir	True firs	Pines	Other softwoods	Hardwoods
----- Thousand cubic feet -----						
1-49	101,700	22,900	24,900	25,000	28,400	500
50-99	76,500	21,200	22,200	18,600	14,500	—
100-499	112,000	42,400	12,500	26,800	30,300	—
500 or more	2,600	1,400	600	—	600	—
Total	292,800	87,900	60,200	70,400	73,800	500
----- Thousand board feet, International ¼-inch rule -----						
1-149	238,700	55,000	44,800	73,300	62,700	2,900
150-499	602,800	148,800	168,000	125,600	160,400	—
500-2,499	773,800	303,500	93,700	187,000	189,600	—
2,500 or more	29,900	8,700	4,300	8,200	8,700	—
Total	1,645,200	516,000	310,800	394,100	421,400	2,900

Table 43. — Timber harvest by ownership class, central Washington, 1952-68 (International 1/4-inch scale)

(In thousand board feet)

Year	All ownerships			Private ¹			State ¹			National Forest			Other public		
	Total	Live	Dead ²	Total	Live	Dead ²	Total	Live	Dead ²	Total	Live	Dead ²	Total	Live	Dead ²
1952	453,633	446,043	7,590	—	—	—	257,058	257,058	—	119,305	113,630	5,675	77,270	75,355	1,915
1953	537,414	(³)	(³)	—	—	—	255,200	250,098	5,102	176,657	(⁴)	(⁴)	105,557	105,557	—
1954	509,849	490,012	19,837	—	—	—	249,783	241,583	8,200	164,994	153,652	11,342	95,072	94,777	295
1955	510,921	491,128	19,793	248,343	246,617	1,726	35,739	35,629	110	131,462	113,531	17,931	95,377	95,351	26
1956	491,251	481,406	9,845	185,434	183,445	1,989	34,000	33,634	366	162,533	155,043	7,490	109,284	109,284	—
1957	507,714	498,785	8,929	218,435	217,039	1,396	30,892	30,838	54	170,487	163,048	7,439	87,900	87,860	40
1958	489,677	478,993	10,684	185,202	183,764	1,438	19,446	19,037	409	179,901	171,064	8,837	105,128	105,128	—
1959	562,543	547,375	15,168	181,429	179,797	1,632	20,839	20,813	26	253,043	240,294	12,749	107,232	106,471	761
1960	567,252	555,067	12,185	254,543	251,724	2,819	15,039	14,692	347	210,477	202,688	7,789	87,193	85,963	1,230
1961	533,171	513,163	20,008	213,433	211,605	1,828	16,396	14,731	1,665	200,954	194,743	6,211	102,388	92,084	10,304
1962	579,440	573,978	5,462	155,634	154,817	817	25,630	25,261	369	293,822	289,756	4,066	104,354	104,144	210
1963	607,730	599,727	8,003	178,898	177,831	1,067	32,553	32,486	67	273,064	267,393	5,671	123,215	122,017	1,198
1964	697,069	688,798	8,271	191,331	190,928	403	27,523	27,523	—	310,193	302,736	7,457	168,022	167,611	411
1965	727,122	720,694	6,428	168,808	168,808	—	53,923	53,616	307	325,280	319,181	6,099	179,111	179,089	22
1966	704,897	700,929	3,968	153,186	151,676	1,510	58,100	58,093	7	308,598	307,207	1,391	185,013	183,953	1,060
1967	741,243	730,547	10,696	165,312	165,232	80	54,672	54,365	307	314,473	305,729	8,744	206,786	205,221	1,565
1968	790,247	778,500	11,747	178,948	178,870	78	62,965	62,808	157	344,418	336,184	8,234	203,916	200,638	3,278

¹Data for State and private ownership for 1952-54 were not separated.²Includes snags and down material existing before initial logging. Salvage of this material does not constitute a drain on the volume of the forest inventory of live trees.³Incomplete data.⁴Data not available by live and dead.

RELIABILITY OF FOREST RESOURCE ESTIMATES

Forest land area and timber volume

The estimates of forest land area and timber volume in central Washington were derived by sampling and thus have sampling errors. Sampling errors have been computed for the estimates of commercial forest land area, noncommercial forest land area, net cubic-foot volume of growing stock, and net board-foot volume (International 1/4-inch rule) of sawtimber. These sampling errors are presented in table 44 as a percent of the estimated total at the 68-percent and 95-percent probability levels. They may be interpreted as meaning that the odds are two out of three for 68-percent probability, or 19 out of 20 for 95-percent probability, that the ranges shown include the true value (i.e., the results of a 100-percent inventory). For

example, we can expect, with 95-percent confidence, that the estimate of total commercial forest land area—4,370,000 acres ± 2.4 percent (104,880 acres)—includes the true value.

In addition to measurable sampling errors, there may be other nonsampling errors due to mistakes in judgment, measurement, and compilation. The magnitude of errors of this nature cannot be determined. However, such errors are kept to a minimum through training, supervision, field checking, and complete editing and machine verification in compiling the data.

The sampling error of any breakdown of these totals will be substantially greater than for the total. The smaller the breakdown, the larger the sampling error. An approximation of the increasing sampling error can be obtained from table 45, which shows the sampling error associated with smaller estimates.

Table 44. — Sampling errors of estimate of forest area and timber volume, central Washington, January 1, 1968

Item	Estimated total	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land	4,370,000 acres	± 1.2	± 2.4
Noncommercial forest land	844,000 acres	± 4.4	± 8.6
Volume:			
Growing stock	10,974 million cubic feet	± 1.9	± 3.7
Sawtimber (International 1/4-inch rule)	50,909 million board feet	± 2.4	± 4.7

Table 45. — Approximate sampling error by size of estimate, central Washington,
January 1, 1968

Commercial forest land		Growing stock		Sawtimber	
Area	Sampling error ¹	Volume	Sampling error ¹	Volume	Sampling error ¹
<i>Thousand acres</i>	<i>Percent</i>	<i>Million cubic feet</i>	<i>Percent</i>	<i>Million board feet²</i>	<i>Percent</i>
4,370	1.2	10,974	1.9		
1,573	2.0	9,904	2.0	50,909	2.4
699	3.0	4,402	3.0	32,582	3.0
393	4.0	2,476	4.0	18,327	4.0
252	5.0	1,585	5.0	11,729	5.0
63	10.0	396	10.0	2,932	10.0
28	15.0	176	15.0	1,303	15.0
16	20.0	99	20.0	733	20.0
10	25.0	63	25.0	469	25.0
7	30.0	44	30.0	326	30.0
		25	40.0	183	40.0
		16	50.0	117	50.0
		4	100.0	29	100.0

¹ By random sampling; 68-percent probability.

² International 1/4-inch rule.

INVENTORY PROCEDURES

The summary tables in this report include data from the inventories of the Gifford Pinchot, Okanogan, Snoqualmie, and Wenatchee National Forests, conducted by the Division of Timber Management, Region 6, U.S. Forest Service, and data from the inventory of lands outside the National Forests, conducted by the Forest Survey project, Pacific Northwest Forest and Range Experiment Station. National Forest lands were inventoried in 1964-66, except the Gifford Pinchot which was done in 1969. Land outside the National Forest was inventoried in 1967. No updating was done to bring data to a common date. The same general standards and definitions were used for both National Forests and lands outside the National Forests, except as explained in the following paragraphs.

National Forest lands

Field plots were distributed on a systematic grid at 1.7-mile intervals on National Forest lands.

On the Okanogan National Forest, field plots consisted of three $\frac{1}{5}$ -acre subplots located 6 chains apart, which were permanently established during 1957-59. The current data are based on the 1965-66 remeasurement of these plots.

All field plots on the Wenatchee National Forest consisted of three $\frac{1}{5}$ -acre subplots located 6 chains apart. Permanent $\frac{1}{5}$ -acre subplots were established in 1957-58 in the northern portion of the forest (the old Chelan and Entiat Working Circles) but not on the southern portion (Wenatchee and Ellensburg Working Circles). The current inventory data are based on the 1964-65 remeasurement of the $\frac{1}{5}$ -acre subplots established in the north-

ern portion in 1957-58, and on new $\frac{1}{5}$ -acre subplots established in the southern portion in 1964 and 1965.

The fieldwork on the portion of the Snoqualmie National Forest in central Washington (Naches-Tieton Working Circle) consisted of three $\frac{1}{5}$ -acre subplots spaced 6 chains apart. These plots were permanently established in 1964. The current inventory data are based on these new $\frac{1}{5}$ -acre subplots.

For that part of the Gifford Pinchot National Forest in central Washington, the field plots consisted of 10 sample points distributed systematically over an acre. The variable-radius plot sampling principle was used at each point to select the trees to be tallied. Where no trees were tallied, a ground cover class was recorded. Summations of the 10-point tally expressed the timber resources and conditions for that acre and were used to estimate forest area and volume.

Growth estimates for the National Forests were based on data from the remeasurement of trees on the $\frac{1}{5}$ -acre subplots and from increment borings.

Estimates of annual mortality were based on (1) the tally of dead trees previously recorded as live on the $\frac{1}{5}$ -acre subplots originally established during 1957-59, and (2) the tally of dead trees estimated to have died within the past 5 years from the date of the inventory on the newly established plots.

Lands outside National Forests

A double sampling design was used for lands outside the National Forests. In the first stage, aerial photo sample plots were distributed systematically across the area. Photo plots were classified into one of three

major land classes—commercial forest, non-commercial forest, and nonforest—and the commercial forest plots were further classified into stand volume classes. All photo plots were classified by kind of owner from public records. Approximately 11,000 photo plots were examined. The second stage consisted of a basic systematic grid of field plots 3.4 miles apart with supplemental plots added. A total of 804 field plots were established at photo plot locations. Plots consisted of 10 sample points distributed systematically over an acre. The plot procedures used were the same as previously described for the Gifford Pinchot National Forest.

In addition to the two-stage sample using 10-point variable radius plots, previously established $\frac{1}{5}$ -acre plots were remeasured in Okanogan and Wenatchee Counties. The remeasured data were used to develop multiple regression equations of diameter growth, which in turn were used to estimate diameter 1 year ago for all trees on the 10-point variable-radius inventory plots. Net volume was computed for both past and present diameters, and gross growth was obtained

by subtracting past from present net volume. Variables in the regression equations included d.b.h., average stand diameter, basal area per acre, tree age, crown ratio, site index, and combinations of these.

In Okanogan and Wenatchee Counties, annual mortality estimates are based on the tally of dead trees recorded as live on the originally established $\frac{1}{5}$ -acre subplots. For the other counties, where remeasurement was not possible, the procedures used were the same as previously described for the National Forests.

Timber harvest

The timber harvest figures used in this report have been obtained from various agencies using varying standards and methods of reporting. These timber cut figures are therefore not strictly comparable with Forest Survey's commercial forest land, volume, and growth data, but they are considered adequate for the analyses made.

DEFINITION OF TERMS

Land Area

Total Land Area

Includes dry land and land temporarily or partially covered by water, such as marshes, swamps, and river flood plains; streams, sloughs, and canals less than one-eighth mile wide; and lakes, reservoirs, and ponds less than 40 acres in area.

Forest Land Area

Land at least 16.7 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for non-forest use. Minimum area of forest land recognized is 1 acre.

Nonforest Land Area

Land that has never supported forests and lands formerly forested where use for timber management is precluded by development for other uses. Included are areas used for agricultural crops, improved pasture, residential areas, city parks, improved roads of any width and right-of-way clearings, powerline clearings of any width, and 1- to 40-acre areas of water classified by the Bureau of the Census as land. If intermingled in forest areas, unimproved roads and other nonforest strips must be more than 120 feet wide and clearings, etc., more than 1 acre in size, to qualify as nonforest land.

Forest Land Classes

Commercial Forest Land Area

Forest land which is producing or capable of producing industrial wood and not withdrawn from timber utilization.

Noncommercial Forest Land Area

Unproductive forest land incapable of yielding crops of industrial wood because of adverse site conditions, and productive public forest land withdrawn from commercial timber use through statute or administrative regulation.

Productive-reserved.—Public forest land withdrawn from timber utilization through statute, ordinance, or administrative order, but which otherwise qualified as commercial forest land. Also included are forest lands managed exclusively for Christmas tree production.

Unproductive.—Forest land incapable of yielding crops of industrial wood products because of adverse site conditions such as sterile soil, poor drainage, high elevation, steepness, and rockiness.

Forest Types

Forest types are determined on the basis of species plurality of all live trees that contribute to stocking, considering both size and spacing.

Tree Classes

Growing-stock Trees

Sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except cull trees.

Sawtimber trees (11.0-inch d.b.h. and larger).—Live trees of commercial species. Softwood trees must contain at least one 12-foot saw log with a top diameter not less than 6 inches inside bark; hardwood trees must contain at least one 8-foot saw log with

a top diameter not less than 8 inches inside bark. At least 25 percent of the board-foot volume in a tree must be free of defect for either softwoods or hardwoods.

Poletimber trees (5.0- to 10.9-inch d.b.h.).—Live trees of commercial species not less than 50 percent sound on a cubic-foot basis and with no disease, defects, or deformities which are likely to prevent their becoming growing-stock sawtimber trees.

Sapling and seedling trees (less than 5.0-inch d.b.h.).—Live trees of commercial species with no disease, defects, or deformities which are likely to prevent their becoming growing-stock poletimber trees.

Non-growing-stock Trees

Cull trees.—Trees of noncommercial species and trees of commercial species which are too defective or which are unlikely to become growing-stock trees due to deformity, disease, low vigor, etc.

Sound cull trees. Trees of noncommercial species or with excessive defect due to form, roughness, etc.

Rotten cull trees. Trees with excessive defect due primarily to rot.

Mortality trees.—Trees of commercial species which have died from natural causes within a specified period and which were not cull trees at the time of death.

Salvable dead trees.—Standing or down dead trees of commercial species 11.0 inches or more in diameter that contain 25 percent or more of sound volume and at least one merchantable 16-foot softwood log or one merchantable 8-foot hardwood log.

Stand-size Classes

Sawtimber Stand

Stand at least 16.7 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with sawtimber stocking equal to or greater than poletimber stocking.

Large sawtimber stand.—Stand in which the majority of the sawtimber stocking is in trees 21.0-inch d.b.h. and larger.

Small sawtimber stand.—Stand in which the majority of the sawtimber stocking is in trees from 11.0- to 20.9-inch d.b.h.

Poletimber Stand

Stand at least 16.7 percent stocked with growing-stock trees, with half or more of this stocking in sawtimber and poletimber trees, and with poletimber stocking exceeding sawtimber stocking.

Sapling and Seedling Stand

Stand at least 16.7 percent stocked with growing-stock trees, with more than half of this stocking in saplings and/or seedlings.

Nonstocked Area

An area of commercial forest land less than 16.7 percent stocked with growing-stock trees.

Stocking

Stocking is a means of expressing the extent to which growing space is effectively utilized by present or potential growing-stock trees of commercial species. "Percent of stocking," synonymous with "percentage of growing space occupied," is the ratio of actual stocking to full stocking for comparable sites and stands. Basal area is used as a basis for measuring stocking.

"Stocking percentages" express current area occupancy in relation to specified standards for full stocking based on number, size, and spacing of trees considered necessary to fully utilize the forest land.

Full utilization of the site is assumed to occur over a range of basal area. As an interim guide, 60 percent of the normal yield table values has been used to establish the lower limit of this range which represents full site occupancy. This is called 100-percent stocking. The upper limit to full stocking has been set at 132 percent. Sites with less than 100-percent stocking represent understocking with less than full site occupancy. Overstocking is characterized by sites that have over 132-percent stocking.

Age

Stand Age

Stand age is based upon growing-stock stocking. In order for a stand to be even-aged,

a majority of the growing-stock stocking must be in two adjacent age classes. Stands that do not meet this criterion are classified as uneven-aged.

Rotation Age

The period of years between establishment of a stand of timber and the time when it is considered ready for cutting. Rotation age in softwood stands is 120 years, except lodgepole pine which is 80 years; in hardwood stands, it is 50 years.

Old-growth Sawtimber Stand

Sawtimber stand in which 50 percent or more of the growing stock is in trees at least 140 years old.

Young-growth Sawtimber Stand

Sawtimber stand in which more than 50 percent of the growing stock is in trees less than 140 years old.

Timber Volume

Live Sawtimber Volume

Net volume in board feet of live sawtimber trees of commercial species. Net volume equals gross volume less deduction for rot, sweep, crook, and other defects that affect use for lumber.

Scribner rule.—The common board-foot log rule used in determining volume of sawtimber in Washington. Scribner volume in the central Washington area is measured in terms of 16-foot logs.

International 1/4-inch rule.—The standard board-foot log rule adopted nationally by the Forest Service for the presentation of Forest Survey volume statistics.

Saw-log portion.—That part of the bole of sawtimber trees between the stump and the saw-log top.

Upper-stem portion.—That part of the bole of sawtimber trees above the saw-log top to a minimum top diameter of 4 inches outside bark or to the point where the central stem breaks into limbs.

Growing-stock Volume

Net volume in cubic feet of live sawtimber trees and live poletimber trees from stump to

a minimum 4.0-inch top (of central stem) outside bark. Net volume equals gross volume less deduction for rot and missing bole sections.

All Timber Volume

Net volume in cubic feet of live and salvable dead sawtimber trees and poletimber trees of commercial species, and cull trees of all species from stump to a minimum 4.0-inch top outside bark.

Industrial Wood

All roundwood products, except fuelwood.

Net Annual Growth

The increase in net volume of a specified size class for a specific year. (Components of net annual growth include the increment in net volume of trees at the beginning of the specific year surviving to the year's end, plus net volume of trees reaching the size class during the year, minus the net volume of trees that died during the year, minus the net volume of trees that became culls during the year.)

Ownership Classes

National Forest Lands

Federal lands which have been designated by Executive order or statute as National Forest or purchase units, and other lands under the administration of the Forest Service, including experimental areas and Bankhead-Jones title III lands.

Other Public Lands

Federal lands other than National Forests, including lands administered by the Bureau of Land Management, Bureau of Indian Affairs, and miscellaneous Federal agencies; and lands owned by States, counties, and local public agencies, or lands leased by these governmental units for more than 50 years.

Forest Industry Lands

Lands owned by companies or individuals operating wood-using plants.

Farmer-owned Lands

Lands owned by operators of farms.

Miscellaneous Private Lands

Privately owned other than forest industry or farmer-owned lands.

TREE SPECIES

Principal tree species found on the commercial forest land in the central Washington area include:

Softwoods:

Alaska-cedar (*Chamaecyparis nootkatensis*)
Douglas-fir (*Pseudotsuga menziesii*)
Engelmann spruce (*Picea engelmannii*)
Grand fir (*Abies grandis*)
Lodgepole pine (*Pinus contorta*)
Mountain hemlock (*Tsuga mertensiana*)
Noble fir (*Abies procera*)
Pacific silver fir (*Abies amabilis*)
Pacific yew (*Taxus brevifolia*)¹
Ponderosa pine (*Pinus ponderosa*)
Subalpine fir (*Abies lasiocarpa*)
Western hemlock (*Tsuga heterophylla*)
Western juniper (*Juniperus occidentalis*)
Western larch (*Larix occidentalis*)
Western redcedar (*Thuja plicata*)
Western white pine (*Pinus monticola*)
Whitebark pine (*Pinus albicaulis*)²

Hardwoods:³

Bigleaf maple (*Acer macrophyllum*)
Black cottonwood (*Populus trichocarpa*)
Cherry (*Prunus* spp.)¹
Crab apple (*Malus* spp.)¹
Hawthorn (*Crataegus* spp.)¹
Oregon white oak (*Quercus garryana*)¹
Quaking aspen (*Populus tremuloides*)
Red alder (*Alnus rubra*)
Western paper birch (*Betula papyrifera* var. *commutata*)
Willow (*Salix* spp.)

¹ Noncommercial species.

² Found only in high mountains near timberline, generally on noncommercial forest land.

³ In the central Washington area, a number of "brush" species occasionally attain tree size. They were not tallied as trees on this survey. Included are:

Cascara buckthorn (*Rhamnus purshiana*)
Elderberry (*Sambucus* spp.)
Indian plum (*Osmaronia cerasiformus*)
Ocean spray (*Holodiscus discolor*)
Rhododendron (*Rhododendron* spp.)
Douglas maple (*Acer glabrum* var. *douglasii*)
Mountain mahogany (*Cercocarpus ledifolius*)
Serviceberry (*Amelanchier* spp.)
Sitka alder (*Alnus sinuata*)
Vine maple (*Acer circinatum*)

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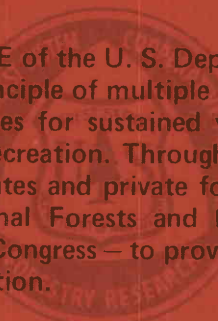
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The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation 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.

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