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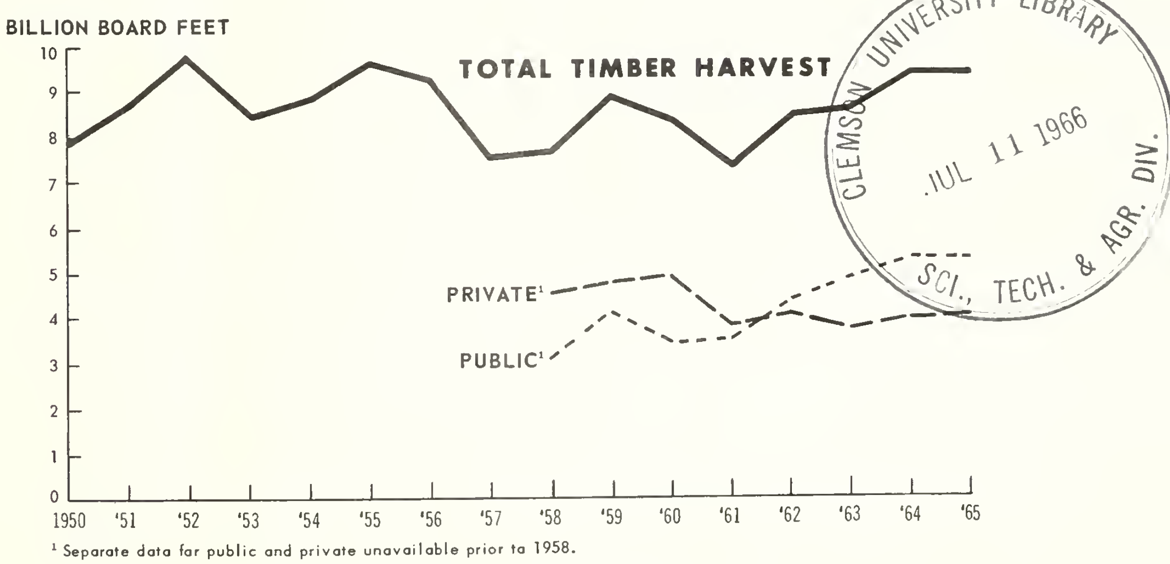
1965 OREGON TIMBER HARVEST

by Brian R. Wall

Oregon maintained its high level of timber harvest in 1965 with an output of 9.4 billion board feet. This was the first time since 1926 that production remained unchanged in 2 consecutive years. The harvest from private lands remained stable at 4 billion feet, or 43 percent of the total. Forest industry's cut declined 2 percent (83 million board feet) from 1964, whereas other private landowners increased their cut by 17 percent (103 million feet). Forest industry's share of private production was 83 percent in 1965 compared with 85 percent in 1964.

The total public timber harvest was marked by offsetting increases and decreases. National Forests had the greatest gain with a 350-million-board-foot (10-percent) increase over 1964. State, county, and municipal harvest, which also reflected high demand for public timber, increased 18 million board feet (7 percent). The 398-million-board-foot (24-percent) decrease of the Bureau of Land Management reflected an adjustment to normal cut levels following completion of logging in 1962 blowdown material. The Indian harvest declined 17 million board feet (18 percent) in 1965 due to readjustment to allowable cut levels and to seasonal factors.



OREGON TIMBER HARVEST, 1950-65.

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Timber Harvest by Ownership in the State of Oregon, 1965[1]

(In thousands of board feet, Scribner log rule)

State and county	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[2]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	26,096	31,396	57,492	53,347	5,600	--	--	9,628	--	126,067
Clackamas	97,406	17,797	115,203	18,289	259,600	--	--	500	--	393,592
Clatsop	271,670	18,067	289,737	--	--	--	--	31,433	140	321,310
Columbia	71,794	28,604	100,398	75	--	--	--	2,015	125	102,613
Coos	341,100	45,066	386,166	156,588	62,600	--	--	60,935	1,432	667,721
Curry	201,311	14,482	215,793	37,354	96,600	--	--	1,853	1,250	352,850
Douglas	627,472	81,850	709,322	380,778	528,300	--	--	31,614	--	1,650,014
Hood River	12,311	2,545	14,856	--	40,500	--	--	45	1,750	57,151
Jackson	147,967	18,944	166,911	129,122	145,200	--	--	2,250	--	443,483
Josephine	6,526	6,622	13,148	74,762	57,300	--	--	909	1,090	147,209
Lane	396,017	61,761	457,778	191,446	857,200	--	1,757	20,793	492	1,529,466
Lincoln	256,366	33,375	289,741	10,271	130,500	--	--	8,644	1,400	440,556
Linn	295,371	104,688	400,059	64,464	236,100	--	1,269	3,445	--	705,337
Marion	4,350	5,765	10,115	12,989	97,600	--	--	6,450	--	127,154
Multnomah	4,400	4,099	8,499	17	35,500	--	--	--	--	44,016
Polk	46,397	5,075	51,472	45,056	3,600	--	--	14,263	--	114,391
Tillamook	104,148	18,798	122,946	26,057	42,700	--	--	43,249	800	235,752
Washington	10,045	12,402	22,447	5,859	--	--	--	1,937	--	30,243
Yamhill	8,577	10,649	19,226	21,521	600	--	--	--	--	41,347
Total	2,929,324	521,985	3,451,309	1,227,995	2,599,500	--	3,026	239,963	8,479	7,530,272
Eastern Oregon:										
Baker	--	1,151	1,151	68	107,800	--	--	--	--	109,019
Crook	5,650	870	6,520	1,728	60,100	--	--	--	--	68,348
Deschutes	22,786	74	22,860	127	108,300	--	--	23	--	131,310
Gilliam	--	--	--	--	--	--	--	--	--	--
Grant	20,302	8,366	28,668	1,214	223,100	--	--	--	--	252,982
Harney	--	--	--	501	77,500	--	--	--	--	78,001
Jefferson	--	--	--	--	50,600	49,815	--	--	--	100,415
Klamath	180,675	41,428	222,103	7,749	185,200	--	--	2,892	--	417,944
Lake	51,345	8,092	59,437	--	113,100	--	--	32	--	172,569
Malheur	--	--	--	--	1,200	--	--	--	--	1,200
Morrow	5,703	10,262	15,965	--	11,300	--	--	--	--	27,265
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	34,721	26,323	61,044	--	31,300	262	--	850	--	93,456
Union	24,840	29,855	54,695	--	68,800	--	--	--	--	123,495
Wallowa	35,094	32,323	67,417	--	61,900	--	--	--	--	129,317
Wasco	16,700	3,945	20,645	184	53,700	23,792	--	8,200	--	106,521
Wheeler	12,788	8,945	21,733	--	27,900	--	--	1,860	--	51,493
Total	410,604	171,634	582,238	11,571	1,181,800	73,869	--	13,857	--	1,863,335
Total Oregon	3,339,928	693,619	4,033,547	1,239,566	3,781,300	73,869	3,026	253,820	8,479	9,393,607

1/ Includes volume removed as logs, poles and piling, but not volume removed for woodcutting operations.

2/ Compiled by State Forester.

3/ Compiled by U.S. Bureau of Land Management.

4/ Compiled by U.S. Forest Service, Region 6.

5/ Compiled by U.S. Bureau of Indian Affairs.

Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oreg.

FOREST INDUSTRIES OF EASTERN WASHINGTON

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COVER PHOTO: Mills in the 0- to 39,000-board-foot size class, Walla Walla, Wash.

Contents

Introduction

A sawmill, built in 1872, marked the beginning of the forest industry in eastern Washington — almost half a century after the emergence of the lumber industry in western Washington. Since then, this industry has increased in importance to eastern Washington's economy, now furnishing about one-fifth of the total manufacturing employment and wages paid — in some counties and many communities, it is the major source of employment and wages. In 1962, various forest products firms paid about $43 million in wages to more than 8,000 employees (Washington Employment Security Department 1963).

The forest industries are not only important to the whole economy of eastern Washington, but the health of these industries determines how intensively the forest resource can and will be managed. In order to inform those interested in the forest resource as well as those interested in the general economy of eastern Washington, the present primary forest industries are examined in this paper; these include lumber, pulp, plywood, and a number of relatively smaller forest industries. The basis for this examination is a survey, made during the summers of 1963 and 1964. Each wood manufacturing plant was personally contacted, and information was obtained on log consumption, source of logs, equipment, production, degree of manufacturing, and use of mill residues.

The single most important forest industry in eastern Washington is lumber. To obtain additional background, a study was made of the numbers and stability of sawmills between 1945 and 1963.[1] Other historical data were obtained from two publications: "Washington, A Guide to the Evergreen State" (Writers' Program 1941) and "The Lumber Industry in Washington" (Melton 1938).

[1] *Data based on information taken from directories of the forest products industry, published by Miller Freeman Publications, 1946 through 1964.*

Lumber Industry of Eastern Washington

Production Increase Is Relatively Greater Than in Rest of Western Pine Region

The earliest recorded lumber production in the State of Washington was in 1826, when whipsawed boards were produced in western Washington near Fort Vancouver. In 1872, eastern Washington produced its first lumber from a waterpowered mill at Spokane Falls. However, most of the 1 billion board feet of lumber produced in the State in 1889 was still sawn in mills located west of the Cascade Range. By 1905, Washington led the Nation in lumber production, and in 1926 its output reached a peak of 7.5 billion board feet. Never since has Washington led. By 1932, lumber production had dropped to a low of 2.3 billion board feet, rising to 5.2 billion board feet in 1941 (Moravets 1949) and leveling off after World War II to an annual production ranging between 3 and 4 billion board feet.

The trend of lumber production in eastern Washington was much the same as that for the whole State until the end of World War II. Then, in 1946, east-side production began to increase sharply. During the period 1946-63, eastern Washington's softwood lumber production increased 83 percent — from 546 million to slightly over 1 billion board feet (table 1, page 21). This relative increase exceeded a similar change of 66 percent for the western pine region and 8 percent for the entire United States. During this same period, eastern Washington's share of the Nation's softwood lumber production increased from 2.1 percent in 1946 to 3.6 percent in 1963. For comparison, the 1904-63 lumber production trends for eastern Washington, Washington, and the United States are shown in figure 1. Here, the sharply increasing production in eastern Washington since 1946, relative to both Washington and the United States, is evident.

Employment Stable in the Lumber Industry

Although lumber production has been increasing in eastern Washington, employment in sawmills and planing mills has remained stable. In fact, this is the only area in the Pacific Northwest which has had stable employment in the lumber industry with the gains in productivity per employee paralleled by increasing total production. In 1950, there were approximately 4,800 covered employees[2] in the sawmills and planing mills in eastern Washington, and in 1963 there were still about the same number (Washington Employment Security Department 1951, 1963). However, lumber production per employee, which amounted to 139,900 board feet in 1950, had risen to 210,000 board feet per employee in 1963. The average annual increase in productivity for employees in sawmills and planing mills was 3.2 percent for this period.

Number of Sawmills Declining

Because of the significant economic changes since World War II, the period from 1945 to 1963 was chosen to study changes that have occurred in numbers of mills (figure 2; table 2, page 22). For this purpose, the mills were classified on the basis of their 8-hour headsaw capacity into four size classes as follows: 0 to 39,000 board feet, 40,000 to 79,000 board feet, 80,000 to 119,000 board feet, and 120,-000 board feet or more.

The majority of eastern Washington sawmills have been small, with a maximum 8-hour headsaw capacity of 39,000 board feet or less. Between 1946 and 1952, with the exception of the sharp decrease in numbers of mills at the start of the Korean conflict in 1950, the number of small mills did not change substantially.

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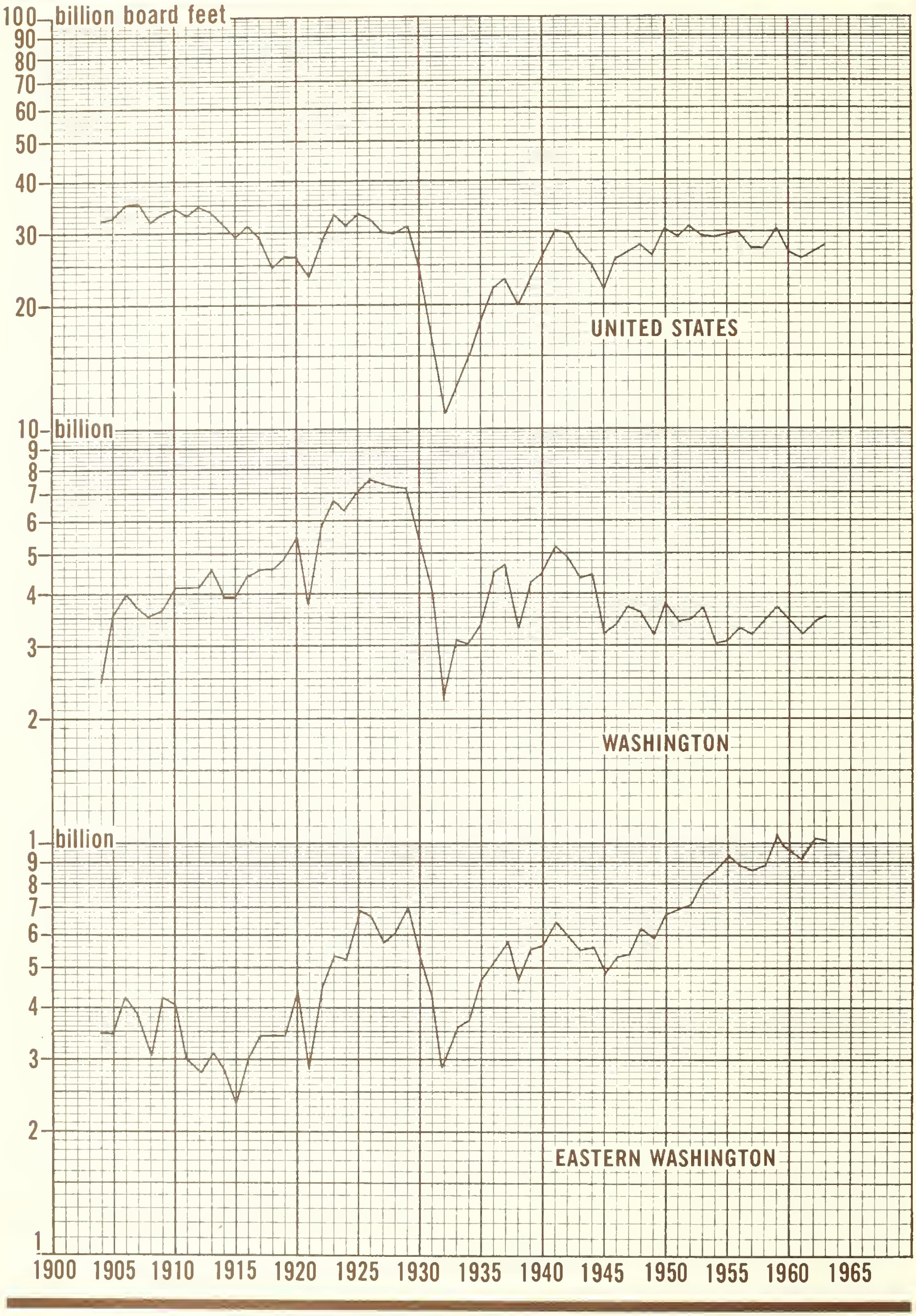
[2]*The covered employment data are based on statistics which include only workers directly employed by wood-using industries and those recorded by the Washington Employment Security Department.*

Figure 1 / **Production of softwood lumber, 1904-63.**



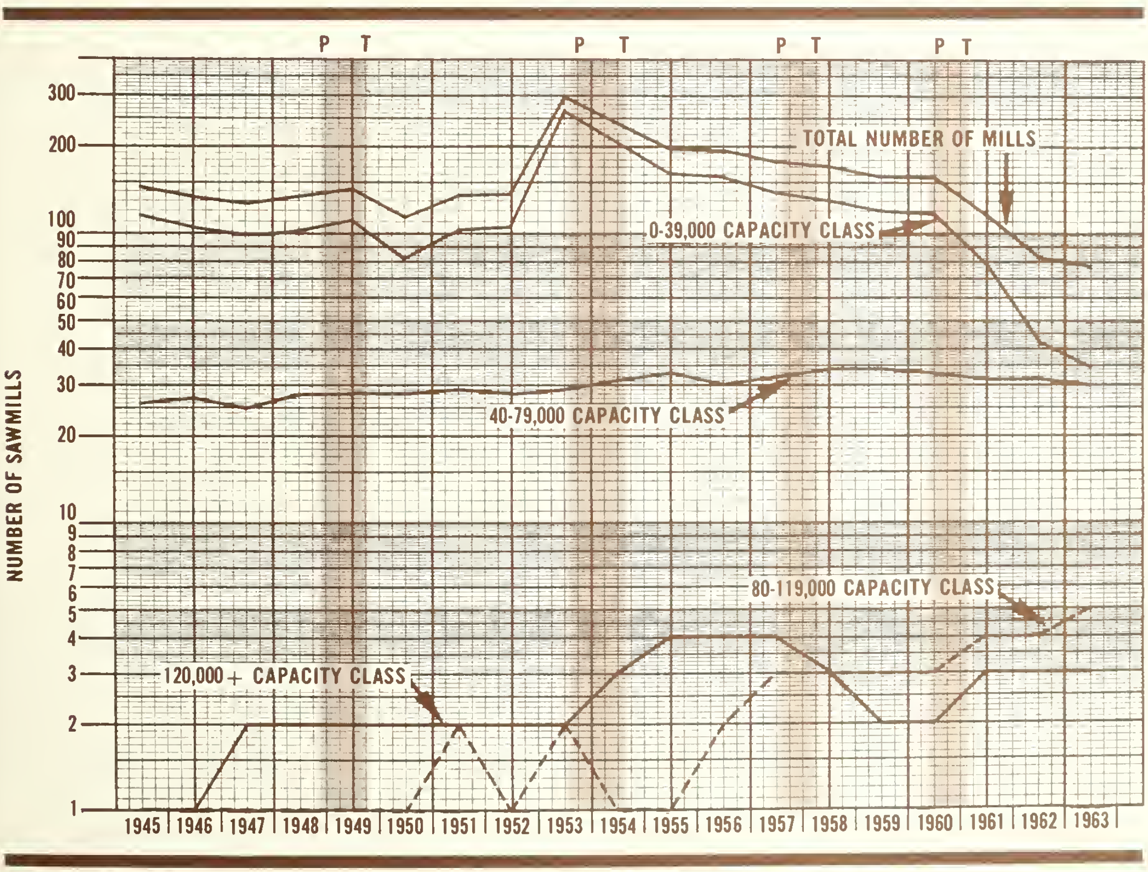
The number of small mills peaked in 1953 at the height of the general business cycle but since then has declined.

The trend of decreasing numbers of small mills is counter to increasing lumber production. During the 1953-63 period lumber production in eastern Washington increased 22 percent while the number of small mills declined 85 percent. This decrease is also common to the rest of the Pacific Northwest. In eastern Oregon, the number of small mills peaked earlier, in 1948 or 1949, but since then the number has steadily decreased (Gedney 1963). In the Douglas-fir subregion, total daily capacity in this small-mill class peaked in 1951 and then declined 42 percent to its 1960 level (Fedkiw 1964).

Except for those in the smallest size class, the number of mills in each class gradually increased throughout the study period. In 1945, there were 26 mills in the next largest size class, 40,000 to 79,000 board feet per 8-hour shift. By 1963, the number rose to 30. The relative stability of established mills in this class and the fact that these produce more lumber than any other class indicate that economies of scale have tended to favor these mills. This class of mill also dominates the eastern Oregon sawmill economy but has been of decreasing importance in the Douglas-fir subregion.

The next larger size class of mill (80,000 to 119,000 board feet) increased from one mill in 1945 to five mills in 1963. The largest class (120,000+ board feet) had three mills in 1963 where one existed in 1945. The number of mills in these two classes fluctuated from two in 1945 to a high of eight mills in 1963. The general upward trend in numbers

Figure 2 / **Number of sawmills in eastern Washington, 1945-63.**



Shaded areas represent contractions in the general business cycle.
(U.S. Bureau of Census 1965)
P—Peak in business activity in the U.S.
T—Trough in business activity in the U.S.

Not too different from many small mills in the 0-to 39,000-board-foot-capacity class was this sawmill, producing rough, green lumber at Naches, Wash., in Yakima County. All of the lumber produced here was shipped to nearby Yakima for further processing — planing and drying. The small size of mill and lack of specialized high-volume equipment, such as barkers and chippers, made more profitable utilization of residues difficult. Here, most of the residues were used either for fuel or for agricultural purposes. The smokestack in the power plant to the right of the sawmill indicates that fuelwood was used to generate power to operate the mill. The several gray-appearing, speckled, square areas to the rear are piles of slabs to be sold for residential fuel. A storage hopper to the immediate left of the building held sawdust for agricultural use; a truck is waiting to be loaded and one is just loading.

The picture was taken in 1964; now, in 1966, the mill has ceased operation, indicating that the trend of the decreasing number of smaller mills, as described in the text, is continuing. The logs which formerly would have been consumed by this mill are now being processed by a larger, integrated mill complex in Yakima.

The importance of agriculture to the economy can be seen by the extensive orchards along the top of the photograph. Under intensive agriculture, many high-value crops are produced here — including world-famous apples. Further to the east under dryland farming conditions, as illustrated in the background of the cover photo, many thousand acres of the rolling Palouse country produce thousands of bushels of wheat for both domestic use and export. Agriculture and the forest industries are often closely related in the eastern Washington economy.

of mills in these two classes is evident. Within each class, some minor fluctuation is present.

The net result of the changes in the various mill-size classes is a decrease in the number of mills and an increase in the average mill size. There were 144 mills in eastern Washington in 1945, and this number remained fairly stable through 1952. In 1953, the number of mills increased 114 percent, to a total of 296 mills. Since 1953, the number of mills has declined to the 1963 total of 77 mills (table 2).

One-third of Today's Mills Operating Since 1945

In spite of the decline in number of small sawmills in eastern Washington, there is an unexpectedly long tenure in the surviving mills of all classes. Of the 77 mills operating in 1963, 27 (35 percent) were operating in 1945, including 5 which had changed names and management (table 3). Of the 39 mills included in the smallest mill-size class in 1963, 10 (26 percent) were active in 1945. In the next largest class, 11 (37 percent) of the mills producing in 1963 were operating during the entire 18-year study period. In the third largest class, four out of five mills have competed successfully since World War II, and two of the three mills in the largest size class have been operating since 1945. Included in these estimates of surviving mills is the movement of mills from lower capacity classes into higher classes.

In eastern Washington, 21 mills expanded operations sufficiently between 1945 and 1963 to be reclassified into a higher capacity class; 17 of these, or 81 percent, were still operating in 1963. The number of mills expanding into higher mill capacities since 1945 are shown by their original capacity class in the following tabulation:

Original capacity class	Number of mills expanding	Number of mills still in operation, 1963
(M bd. ft. per 8-hour shift,		
0 - 39	14	11
40 - 79	4	3
80 - 119	2	2
120 - 199	1	1

The Lumber Industry, 1963

Saw-Log Consumption

Sawmills processed 92 percent of the 971,-760,000 board feet (International 1/4-inch rule) of logs consumed by eastern Washington forest industries. The 30 mills in the 40,000- to 79,000-board-foot-capacity class consumed the largest volume of logs — 413,-606,000 board feet. Ranked second were the five mills in the 80,000- to 119,000-board-foot-capacity class with a total log consumption of 200,288,000 board feet. The three largest mills were a close third, with a consumption of 191,530,000 board feet. The 39 smallest mills consumed only 87,384,000 board feet, less than 10 percent of the total (table 9, page 26).

Lumber Production

The 77 sawmills in eastern Washington in 1963 ranged in size from a two-man operation capable of producing only 4,000 board feet in an 8-hour shift to mills employing more than 500 persons and capable of producing over 200,000 board feet in a single shift. The 30 mills in the 40,000- to 79,000-board-foot-capacity class produced the most lumber — 493 million board feet. The five mills in the 80,000- to 119,000-board-foot-capacity bracket ranked second with 215 million feet of lumber produced.

The three largest mills, each sawing 120,000 board feet or more per 8-hour shift, accounted for 194 million feet of lumber, whereas the 39 smallest mills (0- to 39,000-board-foot capacity) produced the least amount of lumber — 99 million board feet (table 4, page 24).

All of the mills together produced a total of 1 billion board feet of lumber from roundwood (table 4, page 24). Of this volume, 84 million board feet were purchased rough green from smaller mills for remanufacturing by larger mills (table 5, page 24). The study showed that the degree of manufacturing varied with mill size. The largest mills produced 87 percent of their output in the form of surfaced-dry lumber; the proportions of surfaced-dry dropped to 58 percent for the next two classes of mills (40,000-79,000 and 80,000-119,000 board feet). The smallest mills (0-39,000 board feet) produced only 16 percent of their output dried and surfaced.

Utilization of Sawmill Capacity

In 1963-64, there were 77 sawmills in operation in eastern Washington. Their total 8-hour capacity was 3,199,000 board feet in 1963 (table 4, page 24). Increased lumber demand and production resulted in relatively full utilization of existing sawmill capacity in 1963. This was most noticeable in the larger mills, such as those in the 80,000- to 119,000-board-foot size class, which worked an average of 472 8-hour shifts. On the basis of a 230-day work year, these mills operated an average of two shifts per day. Mills on either side of this size class did not maintain this high level of plant utilization. For example, the largest mills, which produced over 120,000 board feet in 8 hours, averaged 422 shifts in 1963, and the mills producing 40,000 to 79,000 board feet averaged 305 shifts. Thus, the larger mills tended to double shift during at least part of the year. The number of shifts worked by the smallest mills (0-39,000 board feet) averaged only 148 shifts in 1963. These mills usually worked fewer days during the year with the number of shifts approximating the number of days.

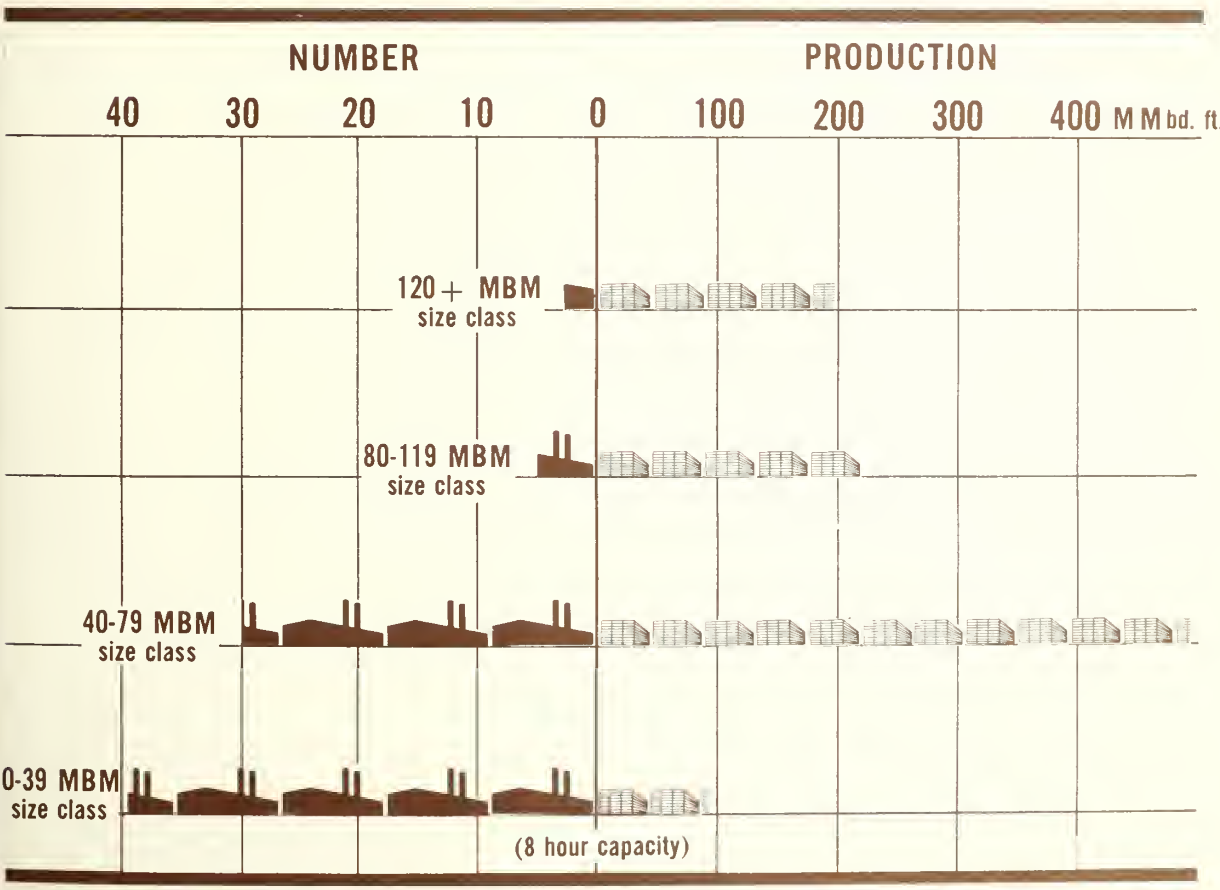
Sawmill Equipment

The larger the sawmill, the greater was its investment in manufacturing equipment. Each mill in the largest size class had a planer, dry kiln, barker, and chipper. In the 80,000- to 119,000-board-foot-capacity class, four out of the five mills had a planer, dry kiln, and chipper. All of the mills in this class had barkers, and one had a hog (table 6, page 25).

The 30 mills in the 40,000- to 79,000-board-foot class were not as well equipped on the average; 80 percent (24) of the mills had planers, 60 percent (18) had dry kilns, 40 percent (12) had barkers, and 37 percent (11) had chippers. There was one mill with a hog in this class.

None of the 39 smallest mills had a barker or a chipper. One mill had a hog, 62 percent (24) of the mills had a planer, and only 13 percent (5) had a dry kiln.

Figure 3 / **Eastern Washington timber production by sawmill size class, 1963.**



The mill shown here is an example of mills' locating near a raw material supply. The locale is the small community of Trout Lake in Klickitat County, only a few miles from the boundary of the Gifford Pinchot National Forest and the forested Yakima Indian Reservation. This mill, owned by the S.D.S. Lumber Co., is not on any rail line or main highway, but its proximity to timber is sufficiently attractive to offset the 35-mile haul south to the Columbia River and rail, major highway, and water transportation. The mill shown is a good example of the steadily increasing number of larger mills. In 1963, this mill was rated at 60,000 board feet per shift; and now, according to the 1966 Directory of the Forest Products Industry, it has expanded to a capacity of 80,000 board feet. Although this study was not designed to obtain information on mergers, it is interesting to note that this mill was independently owned in 1963 and, in 1966, is part of a larger company. The advantages of size, compared with the smaller mills, can be plainly seen in this photograph: a barker is located at the end of the log deck; chips are being loaded on a chip van seen slightly to the left of the burner; other visible equipment are the planer to the right of the main sawmill building and dry kilns located behind the planer.

In an analysis of planned investment in equipment other than a headrig, it was learned that only a small amount was scheduled for 1964 and 1965. A total addition of one planer and one barker was planned in the smallest size class. In the 40,000- to 79,000-board-foot-capacity class, the purchase of three barkers and three chippers was planned. No additions were contemplated by the larger mills.

Location of Sawmills

The pattern of sawmills generally follows the pattern of distribution of forest land. Starting at the Columbia River, mills usually occur at population centers at lower elevations along the east slope of the Cascade Range north to Okanogan County. Across the forested, northern tier of counties, sawmills are scattered eastward to the Idaho border (table 7, page 25). The few mills located in the southeast corner of the State, in Walla Walla, Asotin, and Columbia Counties, are associated with the forested Blue Mountains.

Most of the mills are in the northeast part of the State, with Stevens County having the greatest number of mills. Mills in Ferry, Stevens, and Spokane Counties are mostly in the smallest size class. The largest mills (120,000+ board feet per 8-hour shift) were in Klickitat, Okanogan, and Yakima Counties. These three counties also supported many medium-sized mills.

Planing Mills

Independent planing mills buy rough green lumber from sawmills which do not have their own planing facilities. The planing mills tend to be near small mills and to have access to distribution routes. In 1963, seven planing mills were located in eastern Washington; four of these operated within the City of Spokane. The towns of Kettle Falls, Danville, and Clarkston claimed the three remaining mills. The planing mills of eastern Washington ranged in size from 45,000- to 110,000-board-foot capacity in an 8-hour shift. Four had dry kilns, and a fifth had definite plans to install a kiln within 2 years. In 1963, approximately 53.4 million board feet were processed, with 11.2 million board feet surfaced-green and 42.2 million board feet both surfaced and dried.

Other Forest Industries

Pulp and Paper Industry Developed Early

In 1885, a pulpwood mill moved from Oregon City, Oreg., to Camas, Wash., and became the first pulpmill in Washington, a groundwood mill. This groundwood process remained the mainstay of the pulp and paper industry in Washington through the early part of the 1920's. By the late 1920's, chemical pulping dominated the industry. However, the pulp and paper industry first came to eastern Washington in 1911 when a groundwood mill began operation at Millwood, near Spokane. Five years later, in 1916, sulfite production was added to the plant. In 1966, a modern refiner groundwood system replaced the stone grinders at Millwood, and the mill started consuming chips instead of roundwood. It was not until the beginning of the 1960's that eastern Washington could claim its second pulp and paper plant — this time, a sulfate process mill at Wallula, Wash.

The sulfite and groundwood mill had a rated 24-hour capacity of 137 tons of pulp in 1963, of which 42 tons were sulfite and 95 tons were groundwood. The mill had a daily rated capacity of 115 tons of paper. The second mill, at Wallula in Walla Walla County, used only lumber and wood products residue, unlike the plant at Millwood which depended on roundwood for its wood supply. This mill had a capacity of 375 tons of unbleached sulfate pulp in 24 hours. The pulp from this operation was used to produce linerboard (Lockwood Trade Journal Co., Inc. 1964).

A plant producing molded-pulp fruit trays, not included in the 1963 survey, is not in the data shown in this report. The plant, located in Wenatchee, was classified as a groundwood pulpmill with a capacity of 50 tons per 24 hours, according to the 1965 Lockwood's Directory.

Plywood — A New Industry

Douglas-fir plywood was first shown as a potential product at the 1905 Lewis and Clark Exposition in Portland, Oreg. Although the first plywood in the region was produced at St. Johns, Oreg., the industry first located in western Washington, principally at Tacoma. Most early plywood plants were associated with door manufacturers. Eastern Washington waited nearly half a century before the first plywood plant was constructed at Bingen in 1958. In 1963, a second plant began operations in Yakima.

The plant at Yakima had a 1963 capacity of 84 million square feet (3/8-inch basis) and production for that year was estimated at 81 million square feet (Anonymous 1964). In 1964, the Bingen plant was rated at an annual capacity of 60 million square feet (3/8-inch basis) and produced about that amount (Anonymous 1965). Based on these levels of

The pulpmill of Boise Cascade Corp., at Wallula in Walla Walla County, is indicative of the increasing diversification of eastern Washington's forest industries and typifies the growing opportunity for fuller use of the annual timber harvest. The chips and sawdust piled high in the foreground of the picture will be processed by this mill. This is a more profitable use for residue formerly burned by outlying sawmills and plywood plants. To the left of the residue pile are chip cars being unloaded, and a chip van is just about to pass between the separated cars of the freight train in the left center of the photograph. The sagebrush in the background might make the location look improbable, but the pulpmill is central to the small and scattered forest industries in the Inland Empire. This mill draws residues from its own corporate mills as well as independent mills located in eastern Washington, Idaho, and eastern Oregon. Not seen here, but just beyond the right edge of the photograph, lies the Columbia River, backed up to form the pool behind McNary Dam.

production, an estimated 65 million board feet (International 1/4-inch rule) of logs was consumed by the two plants. Over half of this volume came from eastern Washington.

Miscellaneous Forest Industries

Four pole and piling yards operated in eastern Washington in 1963. All had barkers, and three had thermal nonpressure treating plants. The piling yard without a treatment plant sent its production to other plants within the area for treatment. In 1963, these plants produced 2,886,000 lineal feet of poles and more than 30,000 posts. One remaining forest industry operated in eastern Washington, an excelsior plant in Yakima County.

The Bingen Plywood Co., right center, is located in Klickitat County, Wash., in the town for which it was named. The plywood industry is still relatively small in eastern Washington. This mill and one other comprised the entire industry in 1964. However, now, in 1966, at least two other mills, one a green veneer mill and the other a plywood mill, are scheduled for early operation. Next to the plywood mill, and sharing some of the attractive features of this area as an industrial site, is the S.D.S. Lumber Co. with its 100,000-board-foot-capacity sawmill. Excellent transportation facilities, including highway, rail, and water, are available to this industrial complex. One of these facilities can be seen in the left center of the picture, where a barge is loading residue; less plainly seen, to the rear of the sawmill, are freight cars being loaded with chips. In the foreground, behind a dike which also serves as a roadway, is an extensive log holding and sorting area. In the millponds, center, are peeled logs and peeler blocks. The towns of Bingen and adjacent White Salmon, like many other communities in eastern Washington, find their economy depends to a very considerable extent on forest industry payrolls.

Characterizing the relatively easy movement of logs out of eastern Washington is the log raft, right center, moving down the Columbia River from eastern Washington to a mill at Cascade Locks in Hood River County, Oreg. Eastern Washington was an exporter of 128 million board feet of logs in 1963. The Columbia River provides easy, economical transportation of these logs, not only to Oregon but also to mills downstream in western Washington.

Log Imports and Exports

The greatest volume of logs imported into eastern Washington in 1963 came from Skamania County. These logs went to mills located in Klickitat County (table 8, page 26). This import of 63 million board feet (International 1/4-inch rule) was due to both the attractive timber market in Klickitat County and the easy access between the two counties. County boundaries between eastern and western Washington generally follow the crest of the Cascades. However, a significant portion of Skamania County, considered a western county, lies east of the Cascade crest.

Spokane County ranked second with 25 million board feet imported from Idaho and Montana. The pulpmill at Millwood, which demands specific species, consumed most of this volume. About 2 million board feet of logs flowed south to Okanogan County from Canada, making this county the third largest log importer.

Although eastern Washington imported logs for use in local mills, it was a net exporter of logs in 1963. Over 1 billion board feet (International 1/4-inch rule) of logs were produced in eastern Washington;[3] 882 million feet of these were consumed by eastern Washington's industries and 128 million board feet were exported (table 9, page 26). Since 90 million feet of logs were imported, it was estimated that eastern Washington had a net export of about 38 million board feet in 1963.

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[3]*Based on Berger (1964).*

Wood Residues

Residues Developed in Manufacturing

Forest product residues in eastern Washington were divided into two categories, coarse and fine. Coarse residues included slabs, edgings, trimmings, veneer clippings, roundup, log trim, and spur end. Sawdust and shavings were classified as fine residues. Residue volumes in eastern Washington were estimated by using factors developed by Corder and Gedney (1956).

In 1963, Yakima County produced more residue than any other county — 172,930 tons. Okanogan County ranked second in residue production with 129,630 tons, and Klickitat County followed closely with 118,330 tons. All of the counties in eastern Washington produced 857,660 tons of residue. Table 10 (page 27) shows the breakdown of this total in detail by county; the general breakdown is as follows: 50 percent coarse residue, 31 percent sawdust, and 19 percent shavings.

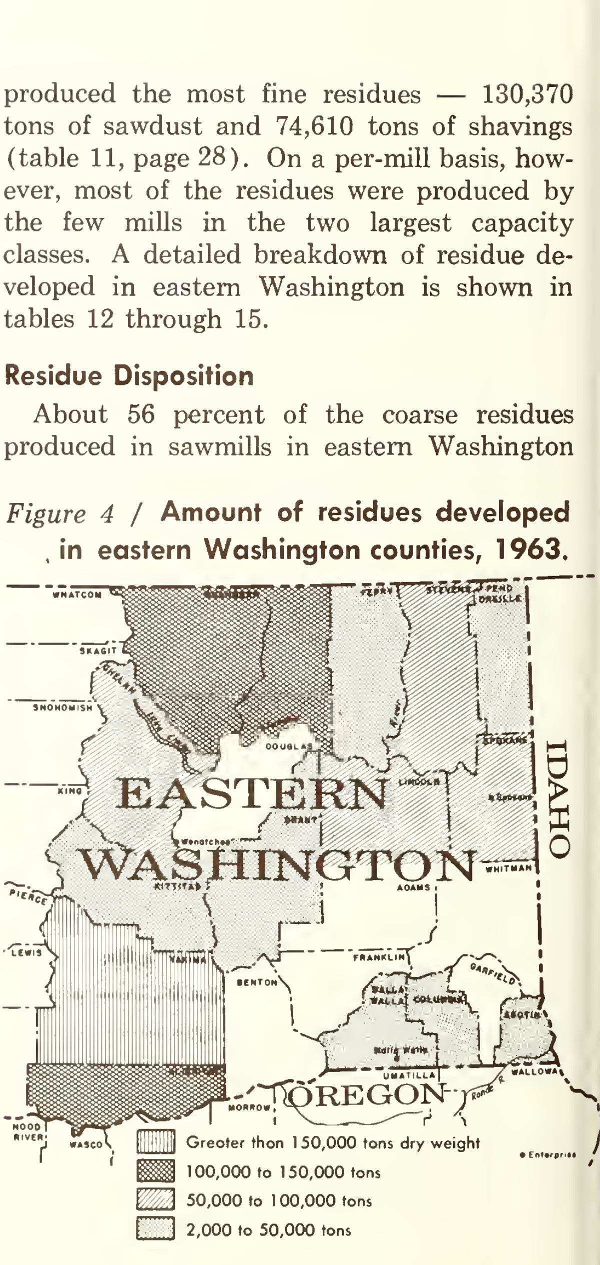
Residue from Douglas-fir and larch made up 60 percent of the total output of coarse residue and shavings. Pine accounted for 26 percent of the coarse residues and 28 percent of the shavings, with other species making up only 13 percent of the coarse residues and 14 percent of the shavings (table 10).

Plywood plants produced 27,440 tons of coarse residue. The group of sawmills with a daily capacity of 40,000 to 79,000 board feet per 8-hour shift produced 192,800 tons of coarse residue, more than any other sawmill group. This same group of sawmills also produced the most fine residues — 130,370 tons of sawdust and 74,610 tons of shavings (table 11, page 28). On a per-mill basis, however, most of the residues were produced by the few mills in the two largest capacity classes. A detailed breakdown of residue developed in eastern Washington is shown in tables 12 through 15.

Residue Disposition

About 56 percent of the coarse residues produced in sawmills in eastern Washington

Figure 4 / **Amount of residues developed in eastern Washington counties, 1963.**



were chipped and shipped to pulpmills. Of the remaining volume, 21 percent was burned as fuel, and 23 percent was not put to any use. All of the mills above the smallest size class converted a substantial proportion of their coarse residue to chips. Only in the three smallest capacity classes was it found that coarse residue went unused (table 16, page 32).

Of the sawdust developed in eastern Washington, 62 percent was used for fuel; 10 percent was used for agriculture and miscellaneous uses; and 28 percent was unused. In general, the smaller the mill, the larger was the proportion of residue not used. In the smallest size class, 65 percent of the sawdust produced remained unused. In the next two classes, this percentage of unused sawdust dropped to 38 percent and 5 percent, respectively. Most of the sawdust developed by the mills in the largest size classes was burned as fuel to operate dry kilns.

About 52 percent of the shavings developed in eastern Washington was used as fuel, 23 percent was used for agriculture, and the remainder was burned as waste.

About 75 percent of all the residues developed in eastern Washington were used (table 16, page 32). It was estimated that 95,160 dry tons of coarse residue (23 percent), 74,560 tons of sawdust (28 percent), and 41,710 tons of shavings (25 percent) went unused.

The substantial volume of residues unused or going to low-value uses not only offers promise for industrial growth but also offers a means to strengthen existing forest industries through greater returns from their operations.

Figure 5 / **Amount of residue developed in eastern Washington's wood industries, 1963.**

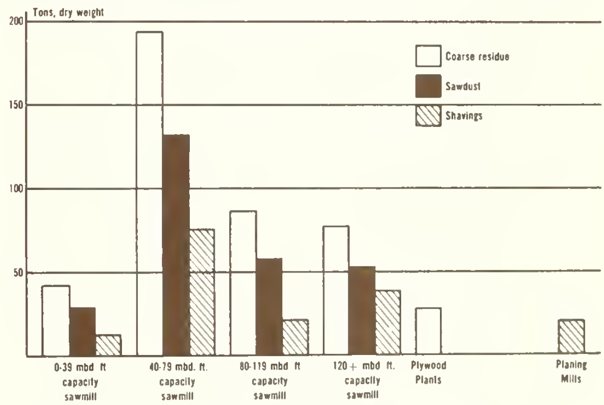
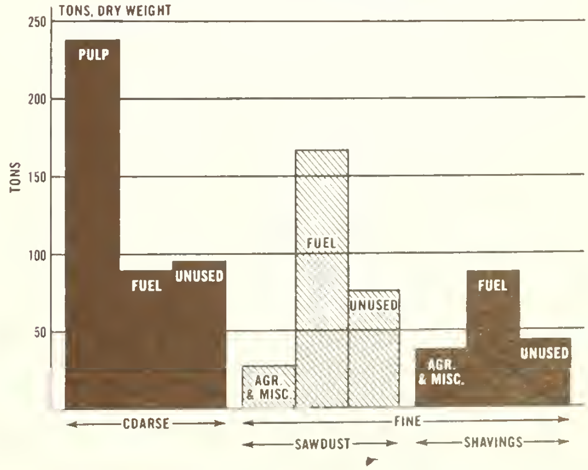


Figure 6 / **Disposition of wood residue in eastern Washington, 1963.**



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Appendix

Table 1 / **Softwood lumber production in eastern Washington, in the western pine region, and in the United States, 1946-63**

Year	Eastern Washington[1] Production	Eastern Washington[1] Percent of western pine region	Eastern Washington[1] Percent of U.S.	Western pine region[1] Production	Western pine region[1] Percent of U.S.	United States production[2]
	Million bd. ft.			Million bd. ft.		Million bd. ft.
1963	1,001[3]	9.9	3.6	10,092	36.3	27,821
1962	1,006	10.6	3.8	9,463	35.3	26,819
1961	907	10.0	3.5	9,054	34.7	26,066
1960	988	10.8	3.7	9,168	34.4	26,672
1959	1,031	10.4	3.4	9,924	32.5	30,509
1958	873	10.3	3.2	8,508	31.1	27,379
1957	851	10.6	3.1	8,050	29.7	27,100
1956	875	9.7	2.9	9,030	30.2	29,890
1955	929	10.5	3.1	8,818	29.6	29,815
1954	862	10.8	2.9	7,983	27.3	29,282
1953	823	10.7	2.8	7,721	26.1	29,562
1952	708	9.8	2.3	7,259	24.0	30,234
1951	683	9.4	2.3	7,288	24.7	29,493
1950	668	8.8	2.2	7,612	24.8	30,633
1949	597	9.1	2.3	6,546	24.7	26,472
1948	621	8.8	2.2	7,096	25.1	28,299
1947	574	8.8	2.1	6,517	23.3	27,937
1946	546	9.0	2.1	6,069	23.5	25,856

[1]*Data from:*

Western Pine Association. Production by States and species 1951 to 1961. Circ. No. 750. 1963.

Western Wood Products Association. Production by States and species 1952 to 1963. 1964.

[2]*Data from:*

U. S. Bureau of the Census. Current industrial reports, lumber production and mill stocks. Series M24T. 1958-63.

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[3]*Estimate by Forest Survey.*

Table 2 / **Number of sawmills in eastern Washington, by mill-size class, 1945-63**

Year	Mill-size class[1]				All classes
	0-39	40-79	80-119	120+	
1963	39	30	5	3	77
1962	44	31	4	3	82
1961	78	31	4	3	116
1960	118	33	3	2	156
1959	120	34	3	2	159
1958	130	34	3	3	170
1957	139	32	3	4	178
1956	156	30	2	4	192
1955	160	33	1	4	198
1954	205	31	1	3	240
1953	263	29	2	2	296
1952	107	28	1	2	138
1951	102	29	2	2	135
1950	82	28	1	2	113
1949	110	28	1	2	141
1948	102	28	1	2	133
1947	99	25	1	2	127
1946	104	27	1	1	133
1945	116	26	1	1	144

[1] *Thousand-board-foot capacity per 8-hour shift.*

Table 3 / **Date of origin of sawmills operating in eastern Washington in 1963, by mill-size class, 1945-63**

Year	Mill-size class[1]				All classes
	0-39	40-79	80-119	120+	
1963	1	0	1	0	2
1962	0	1	0	0	1
1961	1	1	0	0	2
1960	1	3	0	0	4
1959	0	1	0	0	1
1958	2	1	0	0	3
1957	1	1	0	0	2
1956	3	1	0	0	4
1955	6	2	0	0	8
1954	0	1	0	0	1
1953	5	2	0	0	7
1952	1	1	0	0	2
1951	3	1	0	0	4
1950	0	0	0	0	0
1949	2	1	0	0	3
1948	1	0	0	1	2
1947	1	1	0	0	2
1946	1	1	0	0	2
Mills operating in:					
1945	10	11	4	2	27
1963	39	30	5	3	77

[1]*Thousand-board-foot capacity per 8-hour shift.*

Table 4 / **Log consumption, lumber production, and average number of shifts in eastern Washington; by sawmill-size class, 1963**

Size class[1]	Headsaw capacity, 8 hours	Average number of 8-hour shifts	Total log consumption	Actual lumber production	Percent of total lumber production
	M bd. ft.		M bd. ft.[2]	M bd. ft.	
0-39	669	148	87,384	99,234	10
40-79	1,615	305	413,606	493,133	49
80-119	455	472	200,288	214,787	21
120+	460	422	191,530	194,062	20
Total	3,199	1,347	892,808	1,001,216	100

[1]*Thousand-board-foot capacity per 8-hour shift.*
[2]*International 1/4-inch rule.*

Table 5 / **Lumber production in eastern Washington, by mill-size class and degree of manufacture, 1963**

(In thousand board feet)

Lumber	Mill-size class[1]				All classes
	0-39	40-79	80-119	120+	
Rough green	28,663	75,278	—	—	103,941
Surfaced-green	55,161	132,978	6,540	34,500	229,179
Rough dry	8,845	2,150	83,187	—	94,182
Surfaced-dry	17,090	291,227	125,160	224,700	658,177
Total production	109,759	501,633	214,887	259,200	1,085,479[2]
Portion of production purchased from other mills for further manufacturing	10,525	8,500	100	65,138	84,263

[1]*Thousand-board-foot capacity per 8-hour shift.*
[2]*Includes 84,263,000 board feet of lumber purchased for additional manufacturing. Total lumber production from logs in eastern Washington was 1,001,216,000 board feet.*

Table 6 / **Number of sawmills in eastern Washington having additional manufacturing equipment, by mill-size class, 1963**

Mill-size class[1]	Total number of mills	Planer	Dry kiln	Barker	Chipper	Hog
0-39	39	24	5	0	0	1
40-79	30	24	18	12	11	1
80-119	5	4	4	5	4	1
120+	3	3	3	3	3	0

[1]*Thousand-board-foot capacity per 8-hour shift.*

Table 7 / **Number and location of sawmills in eastern Washington by mill-size class, 1963**

Sawmill location	Mill-size class[1]				All classes
	0-39	40-79	80-119	120+	
County:					
Asotin	1	0	0	0	1
Chelan	0	4	0	0	4
Columbia	0	1	0	0	1
Ferry	9	1	0	0	10
Grant	0	1	0	0	1
Kittitas	2	2	0	0	4
Klickitat	1	4	1	1	7
Lincoln	1	0	1	0	2
Okanogan	5	3	1	1	10
Pend Oreille	2	2	0	0	4
Spokane	5	2	1	0	8
Stevens	12	4	1	0	17
Walla Walla	1	2	0	0	3
Yakima	0	4	0	1	5
Total	39	30	5	3	77

[1]*Thousand-board-foot capacity per 8-hour shift.*

Table 8 / **Import of logs into eastern Washington, by source and destination, 1963**

(In thousand board feet, International 1/4-inch rule)

Source	County destination			Total
	Okanogan	Spokane	Klickitat	
Canada	1,830	—	—	1,830
Idaho and Montana	—	24,931	—	24,931
Skamania County	—	—	62,916	62,916
Total	1,830	24,931	62,916	89,677

Table 9 / **Forest industry log consumption in eastern Washington, by source, 1963**

(In thousand board feet, International 1/4-inch rule)

Log consumption	Total	Sawmills[1]				Other industry
		0-39	40-79	80-119	120+	
Total	971,760	87,384	413,606	200,288	191,530	78,952
From eastern Washington lands	882,083	86,806	394,057	200,288	163,282	37,650
Imported to eastern Washington mills	89,677	578	19,549	0	28,248	41,302

[1]*Mill-size class by thousand-board-foot capacity per 8-hour shift.*

Table 10 / **Amount of plant residue developed in eastern Washington, by class of residue, species, and counties, 1963**

(In tons, dry weight)

County	Coarse residue				Sawdust, all species	Shavings				Total
	Douglas-fir—larch	Pine	Other	Total		Douglas-fir—larch	Pine	Other	Total	
Asotin	620	2,170	340	3,130	2,450	340	990	960	2,290	7,870
Chelan	19,610	11,700	3,120	34,430	24,340	7,700	4,200	1,460	13,360	72,130
Columbia	—	1,000	300	1,300	1,030	—	—	—	—	2,330
Ferry	12,010	560	1,030	13,600	8,780	4,710	780	570	6,060	28,440
Grant	790	1,640	—	2,430	1,890	300	590	—	890	5,210
Kittitas	15,540	90	5,310	20,940	13,360	5,160	—	1,690	6,850	41,150
Klickitat	29,930	18,780	12,820	61,530	36,340	8,370	6,730	5,360	20,460	118,330
Lincoln	17,440	14,040	—	31,480	22,950	90	520	—	610	55,040
Okanogan	45,610	14,990	510	61,110	42,020	18,620	7,670	210	26,500	129,630
Pend Oreille	5,890	1,340	860	8,090	4,960	1,080	150	830	2,060	15,110
Spokane	16,030	12,550	2,170	30,750	21,670	17,210	8,380	1,190	26,780	79,200
Stevens	34,570	8,760	3,450	46,780	26,920	22,040	1,400	1,570	25,010	98,710
Walla Walla	6,640	60	8,280	14,980	9,620	3.110	20	3,850	6,980	31,580
Yakima	54,560	21,160	16,760	92,480	52,520	6,890	15,260	5,780	27,930	172,930
Total	259,240	108,840	54,950	423,030	268,850	95,620	46,690	23,470	165,780	857,660

Table 11 / **Amount of mill residue developed in eastern Washington, by industry and class of residue, 1963**

(In tons, dry weight)

Industry class	Coarse residue	Sawdust	Shavings
Sawmills (M bd. ft. per 8-hour shift):			
0-39	42,190	27,580	13,350
40-79	192,800	130,370	74,610
80-119	84,580	58,350	20,570
120+	76,020	52,550	37,580
Planing mills	—	—	19,670
Plywood plants	27,440	—	—
Total	423,030	268,850	165,780

Table 12 / **Amount of coarse residue developed in eastern Washington, by county, by sawmill-size class, and by plywood plants, 1963**

(In tons, dry weight)

County	Sawmill[1]				Plywood plants	Total
	0-39	40-79	80-119	120+		
Asotin	3,130	—	—	—	—	3,130
Chelan	—	34,430	—	—	—	34,430
Columbia	—	1,300	—	—	—	1,300
Ferry	6,760	6,840	—	—	—	13,600
Grant	—	2,430	—	—	—	2,430
Kittitas	980	19,960	—	—	—	20,940
Klickitat	270	17,230	17,220	16,250	10,560	61,530
Lincoln	1,570	—	29,910	—	—	31,480
Okanogan	6,720	14,950	17,360	22,080	—	61,110
Pend Oreille	4,390	3,700	—	—	—	8,090
Spokane	4,050	17,040	9,660	—	—	30,750
Stevens	13,520	22,830	10,430	—	—	46,780
Walla Walla	800	14,180	—	—	—	14,980
Yakima	—	37,910	—	37,690	16,880	92,480
Total	42,190	192,800	84,580	76,020	27,440	423,030

[1]*Mill-size class by thousand-board-foot capacity per 8-hour shift.*

Table 13 / **Amount of coarse residue by species developed in eastern Washington by county, by sawmill-size class, and by plywood plants, 1963**

(In tons, dry weight)

County	Pine					Douglas-fir—larch					Other species				
	Sawmills[1]				Plywood plants	Sawmills[1]				Plywood plants	Sawmills[1]				Plywood plants
	0-39	40-79	80-119	120+		0-39	40-79	80-119	120+		0-39	40-79	80-119	120+	
Asotin	2,170	—	—	—	0	620	—	—	—	—	340	—	—	—	—
Chelan	—	11,700	—	—	0	—	19,610	—	—	—	—	3,120	—	—	—
Columbia	—	1,000	—	—	0	—	—	—	—	—	—	300	—	—	—
Ferry	60	500	—	—	0	6,260	5,750	—	—	—	440	590	—	—	—
Grant	—	1,640	—	—	0	—	790	—	—	—	—	—	—	—	—
Kittitas	90	—	—	—	0	450	15,090	—	—	—	440	4,870	—	—	—
Klickitat	40	890	17,220	630	0	230	11,220	—	8,980	9,500	—	5,120	—	6,640	1,060
Lincoln	1,460	—	12,580	—	0	110	—	17,330	—	—	—	—	—	—	—
Okanogan	590	—	5,510	8,890	0	6,060	14,950	11,850	12,750	—	70	—	—	440	—
Pend Oreille	930	410	—	—	0	3,230	2,660	—	—	—	230	630	—	—	—
Spokane	1,590	7,830	3,130	—	0	1,950	8,470	5,610	—	—	510	740	920	—	—
Stevens	640	1,860	6,260	—	0	11,890	19,990	2,690	—	—	990	980	1,480	—	—
Walla Walla	60	—	—	—	0	600	6,040	—	—	—	140	8,140	—	—	—
Yakima	—	10,670	—	10,490	0	—	18,020	—	23,660	12,880	—	9,220	—	3,540	4,000
Total	7,630	36,500	44,700	20,010	0	31,400	122,590	37,480	45,390	22,380	3,160	33,710	2,400	10,620	5,060

[1] *Mill-size class by thousand-board-foot capacity per 8-hour shift.*

Table 14 / **Amount of sawdust and shavings developed in eastern Washington, by county, by sawmill-size class, and by planing mills, 1963**

(In tons, dry weight)

County	Sawdust (sawmills[1])				Shavings				
					Sawmills[1]				Planing mills
	0-39	40-79	80-119	120+	0-39	40-79	80-119	120+	
Asotin	2,450	—	—	—	—	—	—	—	2,290
Chelan	—	24,340	—	—	—	13,360	—	—	—
Columbia	—	1,030	—	—	—	—	—	—	—
Ferry	4,320	4,460	—	—	1,930	3,440	—	—	690
Grant	—	1,890	—	—	—	890	—	—	—
Kittitas	650	12,710	—	—	260	6,590	—	—	—
Klickitat	180	11,160	14,520	10,480	70	6,650	6,220	7,520	—
Lincoln	1,300	—	21,650	—	610	—	—	—	—
Okanogan	4,400	9,520	12,200	15,900	2,080	6,170	6,610	11,640	—
Pend Oreille	2,520	2,440	—	—	500	1,560	—	—	—
Spokane	2,430	12,440	6,800	—	930	6,080	4,180	—	15,590
Stevens	8,740	15,000	3,180	—	6,610	13,740	3,560	—	1,100
Walla Walla	590	9,030	—	—	360	6,620	—	—	—
Yakima	—	26,350	—	26,170	—	9,510	—	18,420	—
Total	27,580	130,370	58,350	52,550	13,350	74,610	20,570	37,580	19,670

[1]*Mill-size class by thousand-board-foot capacity per 8-hour shift.*

Table 15 / **Amount of shavings by species developed in eastern Washington, by county, by sawmill-size class and by planing mills, 1963**

(In tons, dry weight)

County	Pine					Douglas-fir—larch					Other species				
	Sawmills[1]				Planing mills	Sawmills[1]				Planing mills	Sawmills[1]				Planing mills
	0-39	40-79	80-119	120+		0-39	40-79	80-119	120+		0-39	40-79	80-119	120+	
Asotin	—	—	—	—	990	—	—	—	—	340	—	—	—	—	960
Chelan	—	4,200	—	—	—	—	7,700	—	—	—	—	1,460	—	—	—
Columbia	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ferry	480	200	—	—	100	1,250	2,940	—	—	520	200	300	—	—	70
Grant	—	590	—	—	—	—	300	—	—	—	—	—	—	—	—
Kittitas	—	—	—	—	—	120	5,040	—	—	—	140	1,550	—	—	—
Klickitat	70	220	6,220	220	—	—	4,170	—	4,200	—	—	2,260	—	3,100	—
Lincoln	520	—	—	—	—	90	—	—	—	—	—	—	—	—	—
Okanogan	210	—	1,990	5,470	—	1,870	6,170	4,620	5,960	—	—	—	—	210	—
Pend Oreille	30	120	—	—	—	420	660	—	—	—	50	780	—	—	—
Spokane	100	2,540	1,130	—	4,610	680	3,400	2,620	—	10,510	150	140	430	—	470
Stevens	180	820	230	—	170	6,230	12,350	2,640	—	820	200	570	690	—	110
Walla Walla	20	—	—	—	—	280	2,830	—	—	—	60	3,790	—	—	—
Yakima	—	3,850	—	11,410	—	—	3,040	—	3,850	—	—	2,620	—	3,160	—
Total	1,610	12,540	9,570	17,100	5,870	10,940	48,600	9,880	14,010	12,190	800	13,470	1,120	6,470	1,610

[1]*Mill-size class by thousand-board-foot capacity per 8-hour shift.*

Table 16 / **Production and disposition of residue in eastern Washington by sawmills, plywood plants, and planing mills, 1963**

Residue and disposition	Sawmills[1] 0-39	Sawmills[1] 40-79	Sawmills[1] 80-119	Sawmills[1] 120+	Plywood plants	Planing mills	Total	
	- - - - - - Tons, dry weight - - - - - -							Percent
Coarse residue:								
Pulp	—	83,190	59,200	68,600	27,440	—	238,430	56
Fuel	6,300	71,870	3,850	7,420	—	—	89,440	21
Unused	35,890	37,740	21,530	—	—	—	95,160	23
Total	42,190	192,800	84,580	76,020	27,440	—	423,030	100
Fine residue:								
Sawdust:								
Agriculture and misc.	3,570	13,620	3,740	6,290	—	—	27,220	10
Fuel	6,060	67,350	51,590	42,070	—	—	167,070	62
Unused	17,950	49,400	3,020	4,190	—	—	74,560	28
Total	27,580	130,370	58,350	52,550	—	—	268,850	100
Shavings:								
Agriculture and misc.	1,670	28,420	3,190	—	—	4,280	37,560	23
Fuel	1,060	29,730	14,710	30,060	—	10,950	86,510	52
Unused	10,620	16,460	2,670	7,520	—	4,440	41,710	25
Total	13,350	74,610	20,570	37,580	—	19,670	165,780	100

[1] *Mill-size class by thousand-board-foot capacity per 8-hour shift.*

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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DEPARTMENT OF AGRICULTURE

U.S. Forest Service
Resource Bulletin PNW-18

December 1966

1965 WASHINGTON TIMBER HARVEST

by Brian R. Wall

Washington's timber harvest increased for the fourth consecutive year in 1965 to 6.5 billion board feet. This 4-percent increase was not as great as the 15 percent experienced in 1964. The total timber harvest reached the highest level since 1929, with most of the increased production occurring in western Washington.

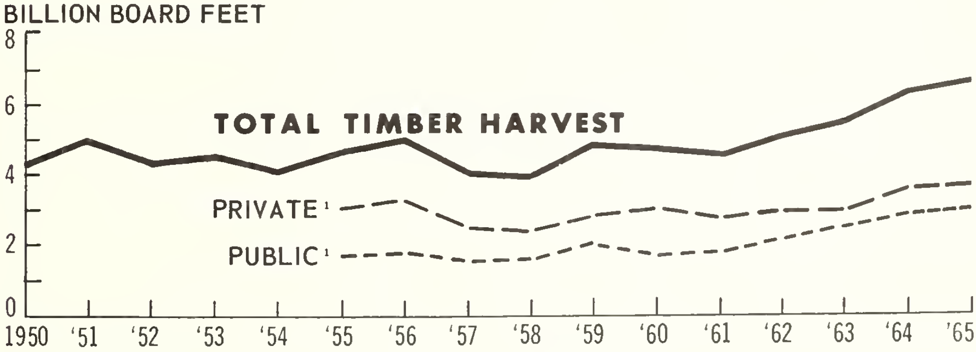
The timber harvest from public lands increased 193 million board feet or 7 percent during 1965. The State contributed most of the public increase with an increment of 149 million board feet.

In 1965, the private timber harvest increased only 87 million board feet (2 percent) compared with the 569 million board foot increase in 1964. Production from the private lands dropped from 56 percent of the total timber harvest in 1964 to 55 percent in 1965.

The salvage of dead timber declined from 1.2 billion board feet in 1964 to 979 million board feet in 1965. Most of this volume can be attributed to the Columbus Day Storm (1962). The effect of this blowdown over and above the usual dead harvest is shown in the following:

Year	1960	1961	1962	1963	1964	1965
Percent dead	5	3	3	20	19	15

Logging in the concentrated blowdown was generally completed in 1965. However, salvage logging of the scattered blowdown continued in 1966 and is planned for 1967 in parts of southwestern Washington.



[1]Separate data for public and private not available prior to 1955.

WASHINGTON TIMBER HARVEST 1950-65

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Table 1.--Timber harvest by ownership in State of Washington, 1965[1]

(In thousands of board feet, Scribner log rule)

State and county	Private		State		Bur. Land Management		National Forests		Indian lands		Other public[3]		Other Federal[4] agencies		Total production		
	Live	Dead[2]	Live	Dead[2]	Live	Dead	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live & Dead
Western Washington:																	
Clallam	153,402	729	85,367	55	--	--	56,500	13,300	8,343	67	2,900	--	4,317	--	310,829	14,151	324,980
Clark	26,099	900	8,238	2,032	--	--	--	--	--	--	52	--	--	--	34,389	2,932	37,321
Cowlitz	202,564	293,828	87,671	88,629	--	--	30,000	15,800	--	--	22	3	--	--	320,257	398,260	718,517
Grays Harbor	258,894	48,273	5,535	183	--	--	117,900	22,600	166,192	3,861	6,638	1,647	150	--	555,309	76,564	631,873
Island	9,873	--	--	--	--	--	--	--	--	--	--	--	90	--	9,963	--	9,963
Jefferson	121,577	653	146,407	335	--	--	44,000	5,300	5,940	--	--	--	916	--	318,840	6,288	325,128
King	246,081	571	12,608	42	--	--	41,600	10,000	--	--	22,091	1,081	3,890	--	326,270	11,694	337,964
Kitsap	16,446	--	2,082	--	--	--	--	--	60	--	894	--	350	--	19,832	--	19,832
Lewis	419,297	201,937	32,740	3,807	--	8	154,100	13,300	--	--	601	--	10	--	606,748	219,052	825,800
Mason	63,342	171	7,115	--	--	--	90,000	20,200	--	--	1,084	--	950	--	162,491	20,371	182,862
Pacific	365,606	115,385	13,873	1,464	--	--	--	--	--	--	90	--	4,651	--	384,220	116,849	501,069
Pierce	174,530	27,737	22,423	1,013	--	--	38,200	4,500	--	--	681	--	2,305	1,200	238,139	34,450	272,589
San Juan	4,505	--	--	--	--	--	--	--	--	--	--	175	--	--	4,505	175	4,680
Skagit	97,635	3,113	13,104	1,310	64	--	87,100	2,400	1,513	--	67	--	--	--	199,483	6,823	206,306
Skamania	64,916	940	4,468	270	--	--	287,200	23,300	--	31	--	--	--	--	356,584	24,541	381,125
Snohomish	192,426	4,972	14,037	14,184	--	--	111,800	5,200	--	--	1,320	--	60	--	319,643	24,356	343,999
Thurston	67,746	970	5,383	29	--	--	--	--	--	--	--	--	265	--	73,394	999	74,393
Wahkiakum	89,686	255	15,510	179	--	--	--	--	--	--	110	--	45	--	105,351	434	105,785
Whatcom	55,491	3,544	23,060	2,760	--	--	85,100	7,600	--	--	441	--	--	--	164,092	13,904	177,996
Total	2,630,116	703,978	499,621	116,292	64	8	1,143,500	143,500	182,048	3,959	36,991	2,906	17,999	1,200	4,510,339	971,843	5,482,182
Total live and dead	3,334,094		615,913		72		1,287,000		186,007		39,897		19,199				5,482,182
Eastern Washington:																	
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	356	--	--	--	--	--	5,100	100	--	--	--	--	--	--	5,456	100	5,556
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	18,568	--	--	--	--	--	75,800	1,700	--	--	9	--	--	--	94,377	1,700	96,077
Columbia	7,855	20	--	--	--	--	1,500	300	--	--	--	--	--	--	9,355	320	9,675
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	11,200	--	1,713	--	--	--	53,729	--	96,632	--	--	--	2,204	--	165,478	--	165,478
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garfield	138	--	--	--	--	--	10,800	200	--	--	--	--	--	--	10,938	200	11,138
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	49,207	--	13,819	--	--	--	77,900	3,100	--	--	696	--	1,204	--	142,826	3,100	145,926
Klickitat	46,473	--	8,516	180	--	--	1,900	300	21,760	--	--	--	130	--	78,779	480	79,259
Lincoln	206	--	--	--	--	--	--	--	--	--	--	--	--	--	206	--	206
Okanogan	2,019	--	18,986	18	116	--	99,100	300	28,986	--	60	--	--	--	149,267	318	149,585
Pend Oreille	19,826	--	2,087	--	103	--	35,507	178	1,260	--	--	--	--	--	58,783	178	58,961
Spokane	11,847	--	845	--	--	--	--	--	--	--	--	--	--	--	12,692	--	12,692
Stevens	43,241	--	11,740	--	424	--	21,676	--	10,662	--	--	--	1,707	--	89,450	--	89,450
Walla Walla	4,375	--	2,507	--	--	--	--	--	--	--	--	--	--	--	6,882	--	6,882
Whitman	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yakima	41,498	--	8,788	89	--	--	43,600	300	114,412	21	--	--	--	--	208,298	410	208,708
Total	256,809	20	69,001	287	643	--	426,612	6,478	273,712	21	765	--	5,245	--	1,032,787	6,806	1,039,593
Total live and dead	256,829		69,288		643		433,090		273,733		765		5,245				1,039,593
Total Washington	2,886,925	703,998	568,622	116,579	707	8	1,570,112	149,978	455,760	3,980	37,756	2,906	23,244	1,200	5,543,126	978,649	6,521,775
Total Washington live and dead	3,590,923		685,201		715		1,720,090		459,740		40,662		24,444				6,521,775

1/ Includes volume in logs, poles, piling, cordwood, shingle bolts, etc., as compiled by Washington State Department of Natural Resources.
2/ Includes snags and down material existing prior to initial logging. Salvage of this material does not constitute drain on the volume of the forest inventory of live trees
3/ Includes timber harvested from lands administered by cities, counties, public utility districts, and State agencies other than the Department of Natural Resources.
4/ Includes lands logged under jurisdiction of Bonneville Power Administration, National Parks, U.S. Army--Fort Lewis, U.S. Fish & Wildlife Service, and U.S. Navy.

ALASKA'S FOREST RESOURCE

by O. Keith Hutchison, Principal Economist

ST SERVICE RESOURCE BULLETIN PNW 19
. DEPARTMENT OF AGRICULTURE

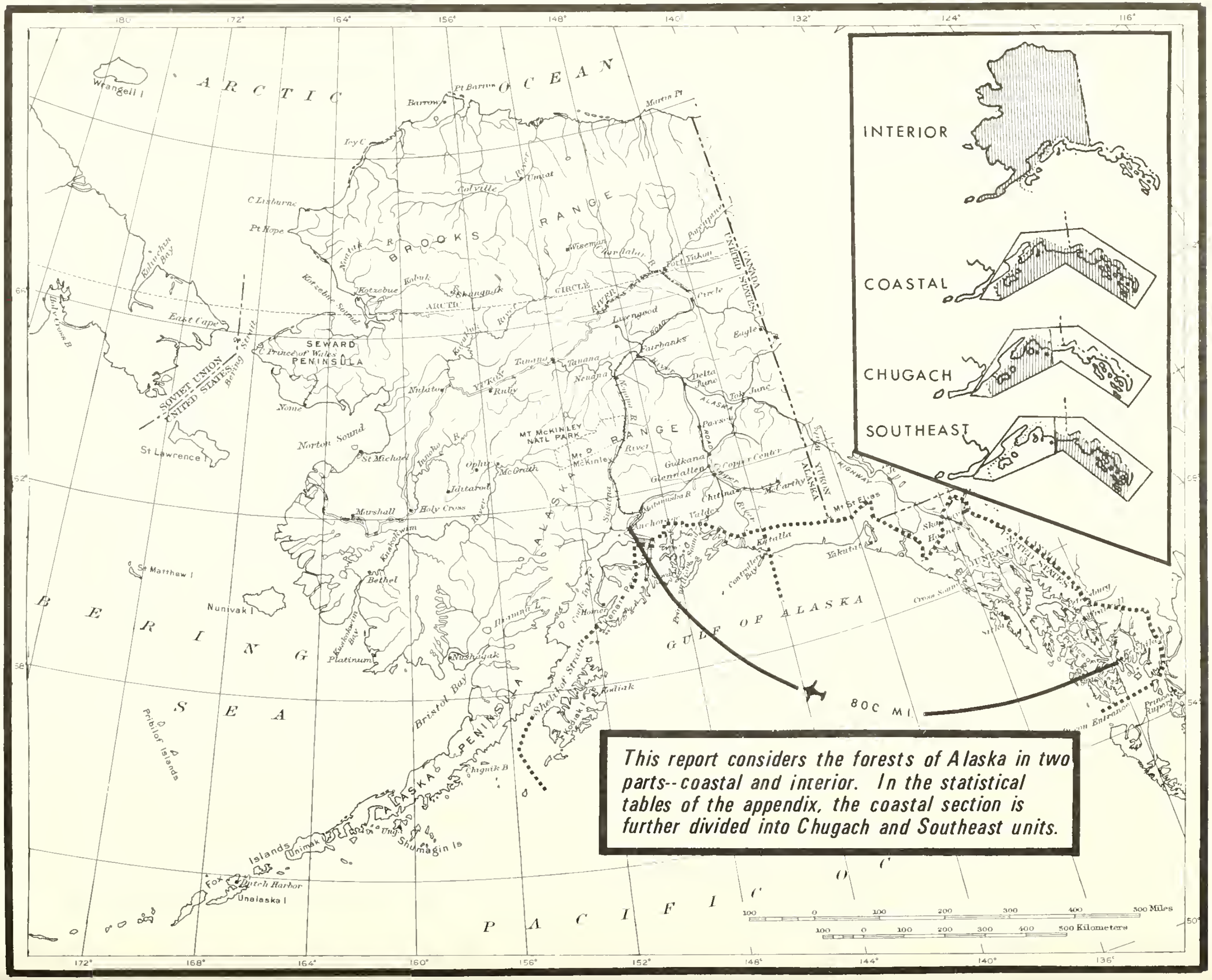
INSTITUTE OF NORTHERN FORESTRY, JUNEAU, ALASKA
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION

ACKNOWLEDGMENTS

The Institute of Northern Forestry of the Forest Service, U.S. Department of Agriculture, at Juneau, Alaska, is responsible for Forest Survey work in Alaska. The initial forest inventory being reported here represents the work of many people, and was a joint effort of the Institute and Region 10 of the Forest Service.

We thank the Ketchikan Pulp Co. for its contribution to the inventory of one working circle. We are also grateful to the Bureau of Land Management, U.S. Department of the Interior, and to the State Forester of Alaska and his staff for assistance on special studies which have contributed materially to this report.

We thank the people who provided willing, efficient, and courteous service to our field crews. Special thanks go to the aircraft pilots who took us where we needed to go and returned us safely.


INTERIOR
COASTAL
CHUGACH
SOUTHEAST
ARCTIC OCEAN
BERING SEA
GULF OF ALASKA
PACIFIC OCEAN
BROOKS RANGE
ALASKA RANGE
ALASKA PENINSULA
SEWARD PENINSULA
MT McKINLEY NATL PARK
YUKON
ALASKA
CANADA
UNITED STATES
SOVIET UNION
Wrangell I
St Lawrence I
St Matthew I
Nunivak I
Pribilof Islands
Shumagin Is
Fox Islands
Unalaska I
800 MI
This report considers the forests of Alaska in two parts--coastal and interior. In the statistical tables of the appendix, the coastal section is further divided into Chugach and Southeast units.
500 Miles
500 Kilometers

PREFACE

This report presents the results of the first forest inventory of Alaska, made as part of the nationwide Forest Survey authorized by the McSweeney-McNary Act of 1928. Forest inventory work began in Alaska in 1954 after the 83d Congress amended the 1928 Act to include Territories.

Because of recognized regional economic and forest differences, the inventory was planned in two parts — coastal and interior.

The coastal inventory. — The survey of coastal Alaskan forests was based on a study of aerial photographs, followed by field measurements to check the accuracy of the photo interpretation and to obtain supplemental tree measurements. The sampling technique was designed to determine the commercial forest area within ± 3 percent per million acres and the timber volume within ± 5 percent of the total net board-foot volume in each forest management unit. The 1:40,000 vertical photos and 1:20,000 twin oblique photographs taken in 1948 by the U.S. Navy were used for the southeast part of the region (fig. 1). For the Chugach portion, 1:15,840 vertical photography was used. This photography was contracted for by the U.S. Forest Service and completed between 1957 and 1960.

Systematically selected plots were interpreted on the photos and sample prints sent to the field for examination. Three 1/5-acre plots were measured at each field location. A summary of the number of plots studied is included with the accuracy statement in the appendix.

The interior inventory.—Suitable aerial photography was not available for interior Alaska. Because of the large area to be covered, the inventory plan called for photography at a scale of 1:5,000 along flight lines spaced 30 miles apart. About 11,000 lineal miles were photographed from 1958 through 1960 with cameras using infrared film with a minus blue filter.

A 1/2-acre plot was marked near the center of each photo, and classified by land type. All forest plots were studied carefully with a stereoscope to determine the kind, size, and density of the timber. Area estimates by land and forest type were determined from the percentage distribution of aerial photo plots and adjusted by air check and ground subsamples. Timber volume estimates were made from aerial photo stand volume tables. Growth, species, diameter distribution, quality, and mortality data were obtained from measurements of field plots.

Timber utilization. — Estimates of products output for 1961 are from a 100-percent canvass of the wood-using industries in Alaska. Where significant changes in production are known to have taken place, the output estimates have been adjusted to the dates indicated.

CONTENTS

'HE CHANGING SCENES

Alaska's romantic past includes the ıgnetic lure of gold; the mad stampede strike it rich; success and heartbreak; :n and animals battling snow, ice, spring eakup, insects, and loneliness; dog teams work and on desperate missions; river :amers battling the Yukon; bush pilots rforming miraculous flights; and hordes salmon taken by traps and seine boats. aces like Skagway, Dawson, Nome, Juau, and Fairbanks were boom towns. ›rtunes were made, gambled, and lost ernight.

The stampede is over, but the lure of :alth remains in forms other than that the yellow metal of the late 1890's. ·derly development is taking place in aska as it did in other Western States th frontier histories. No longer is aska merely a remote land of ice, snow, ld, and dog teams. Modern commercial rlines, air taxis, the Alaska Highway, d now a marine highway system serving Alaska ports, make Alaska accessible almost everyone. However, Alaska is ll an enchanting land to the residents d tourists who marvel at its great gla:rs, icefields, high peaks, colorful val-ys, tumbling streams, variety of wildlife, d extensive forests.

Alaska has many resources with which build its future. After the gold rush ys, salmon packing emerged as the lead; industry. It still is, but recently, ıber industries have shown the most ›id growth (Rogers and Cooley 1962)[1] d may soon challenge for the lead.

The forests of Alaska are destined to play an increasing and permanent role in the State's economy. These forests were important in Alaska's early history, but the official records will not show this except in a piecemeal fashion (Lutz 1963). Early Russian exploiters built ships along the coast. Many pilings were used to build fishtraps and for cannery foundations. Thousands of cords of wood were cut along the Yukon River and its main tributaries to fuel the river steamers. Most building construction was of logs, and an unknown quantity of wood was burned to thaw the gold-bearing gravel. Many railroad cross-ties were cut by competing companies in their frantic but futile effort to put a railroad over Thompson Pass from Valdez. In later years, local stands of timber were used to build the Alaska Railroad from Whittier and Seward to Fairbanks. The gold rush era might have failed without the forests. Certainly, hardships would have been greater. The coming importance of the forests is evident from the recently completed forest inventory.

Many terms have been used to describe the great size of Alaska. One writer said that "Alaska has limitless land." Certainly, that is the impression one gets in flying over the State. The total land area credited to Alaska is 365.5 million acres — 16 percent of the total area in the United States. There are another 10 million acres in lakes and streams. In size, Alaska ranks first among the 50 States, being 54 times as large as the smallest State and more than twice as large as Texas.

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ames and dates in parentheses refer to Literature Cited, p. 49.

Alaska has 16 percent of the forest land in the United States, or 119 million acres. This is as much forest land as is found in the States of Montana, Washington, Oregon, and California combined. But the average quality of forest land in Alaska is below that of the other States mentioned. Only 28.2 million acres is considered commercial; that is, capable of producing a minimum of 20 cubic feet of industrial wood per acre annually. Oregon alone has nearly as many acres of commercial forest land.

For forest inventory purposes, the State was treated as two regions — coastal and interior. This division was logical because of topographic, forest, and ecoonomic differences.

COASTAL ALASKA

Coastal Alaska includes a gross land area of 32,926,000 acres. Inland bodies of water up to 40 acres in size account for 371,000 acres of this total. Alabama, Arkansas, and North Carolina each have roughly the same land area, but where these States are mostly one continuous land mass, coastal Alaska is made up of many hundreds of islands and a narrow mainland broken by many fiords and inlets. The islands vary in size from those less than an acre to islands such as Kodiak with a gross area of 2,296,320 acres, Prince of Wales Island with a gross area of 1,618,553 acres, Chichagof with 1,249,724, Admiralty with 1,026,931, and Baranof with 973,530 acres. The widest part of the region is about 150 miles from the Gulf of Alaska to the Canadian border, whereas from Ketchikan to Anchorage via Yakutat is about 800 air miles.

The coastal forests are an extension of the rain belt forests so important in Oregon, Washington, and California. An important difference is that Douglas-fir is not found in Alaska. These forests extend along the Alaskan coast westward to Kodiak Island. Near Ketchikan are stands composed primarily of western hemlo[ck] and Sitka spruce (fig. 2), with interming[l]... small blocks and scattered trees of weste[rn] redcedar and Alaska-cedar. A few har[d]woods, mostly red alder and cottonwo[od] occur along streams and on slide area[s]. Mountain hemlock, alpine fir, and Paci[fic] silver fir are found; lodgepole pine, gro[w]ing mostly as a scrub tree, is found [on] poorer sites, on and adjacent to muske[gs].

Western redcedar is not found nor[th] of Frederick Sound. Alaska-cedar also b[e]comes less important northward and wes[t]ward, but does occur in cedar swamps [as] far westward as Port Wells on Prin[ce] William Sound. Cottonwood appears [in] the Stikine, Taku, and other mainla[nd] valleys, and commercially important v[ol]umes are found in the Haines area a[nd] on most alluvial bottom lands to the wes[t]ward (fig. 3). Sitka spruce remains [an] important component of the stands throug[h]out the coastal region and is the on[ly] conifer found on Afognak and Kodi[ak] Islands.

These observations on species comp[o]sition and distribution may be partia[lly] related to changes in longitude and l[at]itude. Other stand composition and tr[ee] distribution observations concern inter[re]lated factors of elevation, soil, slo[pe], drainage, and exposure. The topograp[hy] of this region is steep and rugged. Slo[pes] commonly begin near tidewater and r[ise] to elevations of 2,000 to 3,000 feet with[in] 2 or 3 miles. High points along [the] boundary with Canada range from ab[out] 6,000 to 18,000 feet.

The best stands of timber genera[lly] are found near tidewater with sta[nd] heights, volume per acre, and quality [di]minishing progressively up the slope. Ti[m]berline usually is reached at elevations [of] 2,000 to 2,500 feet. Muskegs and p[oor] drainage are common to the region. Co[m]mercial hemlock and spruce decline [in] height, quality, and numbers in proxim[ity] to muskegs. Tree growth is sparse wit[h]in the muskeg and consists mostly of lodge-pole pine in scrub form.

Figure 2.--A Forest Survey crew working in a mature stand of western hemlock and Sitka spruce. Trees in this stand average 30 inches d.b.h. and the stand volume is 117,000 board feet per acre.

ONFOREST AREAS

The 19.7 million acres of nonforest area ould be considered briefly to show im- ortant interrelationships with the forest ea for multiple uses: wildlife habitat, creation, watershed, and production of mber and minerals. It would be impos- ble to manage effectively either the forest nonforest area without considering de- ands upon the other. Almost any wild- e management text will describe the need birds and animals for habitat inter- ersion and edge effects. This region of laska is especially blessed with such hab- it as a natural condition.

The forest land manager also must un- rstand influences that may occur between s actions and the climate and topography. Heavy snow and rainfall on the upper slopes saturate the soil and, even when soil is held by dense tree growth, slippages often occur. The rugged topography of coastal Alaska results in pronounced var- iations of mean annual precipitation with- in relatively short distances — ranging, for example, from 152 inches at Ketchikan to 83 inches at Wrangell, 90 at Juneau, 134 at Yakutat, and 69 at Seward (Watson 1959). The quality of water and fluctu- ation of runoff at the lower levels greatly influence the productivity of salmon-spawn- ing streams. In planning activities on either the forest or nonforest area, the land managers consider the effects such activities will have upon the whole area.

Figure 3.--Black cottonwood, along the Klehini River about 35 miles northwest of Haines, attains 36-inch diameters and 120-foot heights.

FOREST AREAS

The forested area of coastal Alaska is estimated to be 13,247,000 acres. This area includes all land now at least 10 percent stocked with trees.[2]

The area defined as commercial forest land has a minimum of 8,000 board feet[3] of sawtimber per acre, or is capable of producing this amount, and a minimum area of 10 acres. The commercial forest area is 5,749,000 acres (fig. 4). To establish this estimate, the region was divided and sampled in units. Area estimates for these units are given in table 2 (Appendix).

FOREST MANAGEMENT

Ninety-two percent of coastal Alaska, the most productive timberland in the State, is in the National Forests. Because townsites, homesteads, and mining claims account for so little area, they have only very local influence on overall forest management problems and objectives. The State has an important management unit north and west of Haines, and other lands are being selected by the State at Cape Yakataga on the southern part of the Kenai Peninsula and in the vicinity of existing towns. Glacier Bay National Monument contains about 179,000 acres of commercial forest land. This land is withheld from timber harvesting activities in order to thoroughly preserve the area's outstanding scenic values.

Although the Forest Service is charged with the land management responsibility for most of this region, other agencies and special interest groups are kept informed of almost every activity and often invited to cooperate in the venture. For example, the Alaska Department of Fish and Game and the U. S. Fish and Wildlife Service are kept advised of timber management decisions and recreation plans which may affect wildlife habitat, salmon-spawning streams, and wildlife harvest. Some of the many shelters and cabins (fig. 5), erected for the use of the public, are located and built cooperatively with the Territorial Sportsman's Association.

The size of forest ownerships can be an important consideration in locating new timber products plants. Where wood users must deal with many owners to obtain a wood supply, managed use resulting in a sustained supply is difficult to arrange. This problem diminishes where individual ownerships are large enough to sustain one or more industries. Then the owner or manager can compute, as does the Forest Service in coastal Alaska, an annual allowable cut in order to assure operators of a managed supply. This does not eliminate competition since the timber is advertised and sold to the highest bidder.

For inventory purposes the coastal forests were divided into units as shown in figures 6 and 7. For management purposes, the Forest Service combines its holdings in these units into working circles and determines an annual allowable cut for each. An actual cut equal to the allowable cut has not been achieved on any of the working circles. Timber management plans, prepared for each of the National Forest working circles, are reviewed and revised at 10-year intervals. The area of commercial forest land in each working circle is adequate to sustain several important wood-using plants.

[2] For more exact definitions of Forest Survey terms used in this report see page 54.

[3] Throughout this report, unless otherwise stated, the values in board feet will be based on the International 1/4-inch rule.

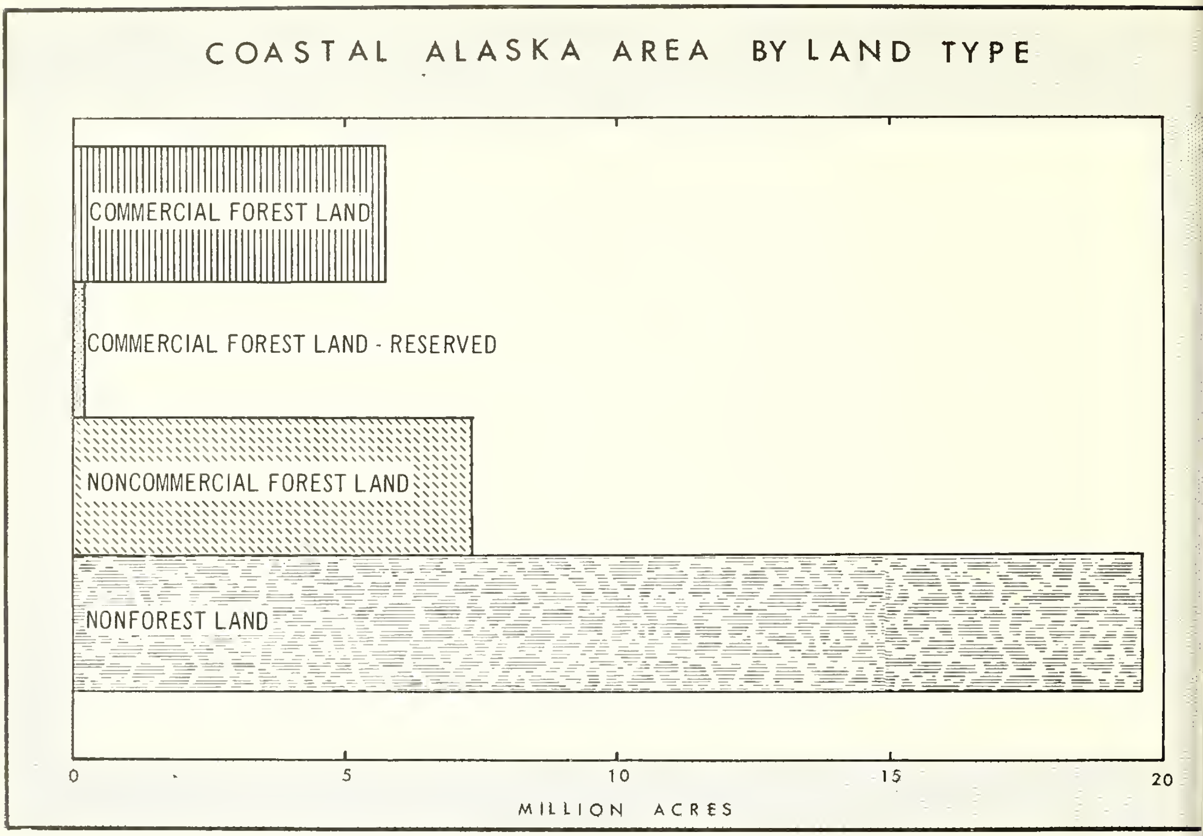

Figure 4.--The coastal land area is 40 percent forested, but only 43 percent of the forest land is of commercial value for timber production.

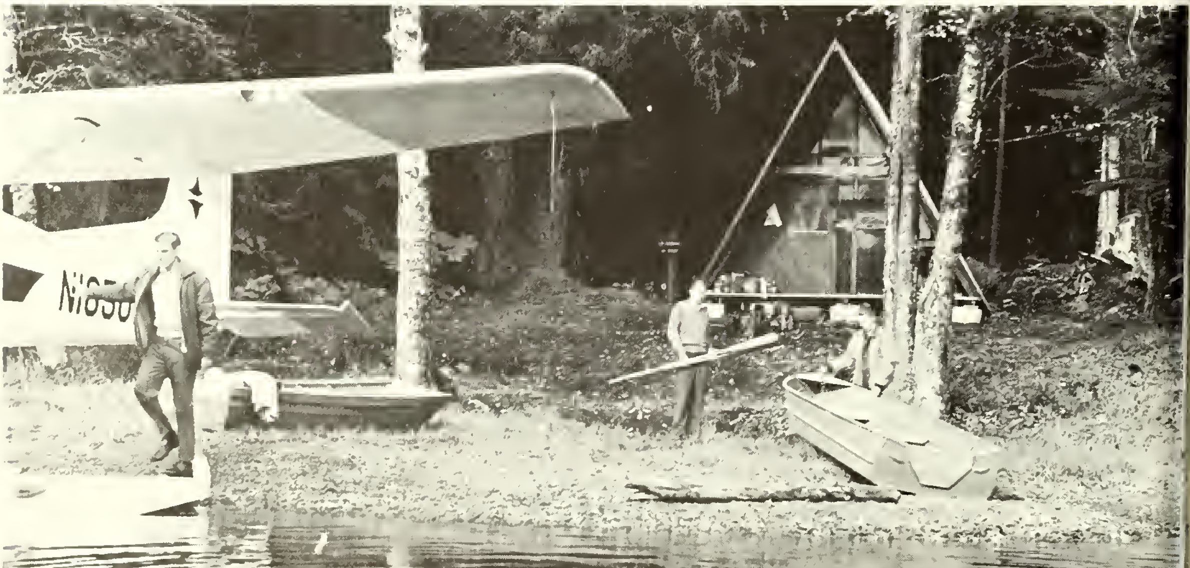

Figure 5.--This cabin, and many others similar to it, has been placed at a scenic, recreation spot for the public to use.

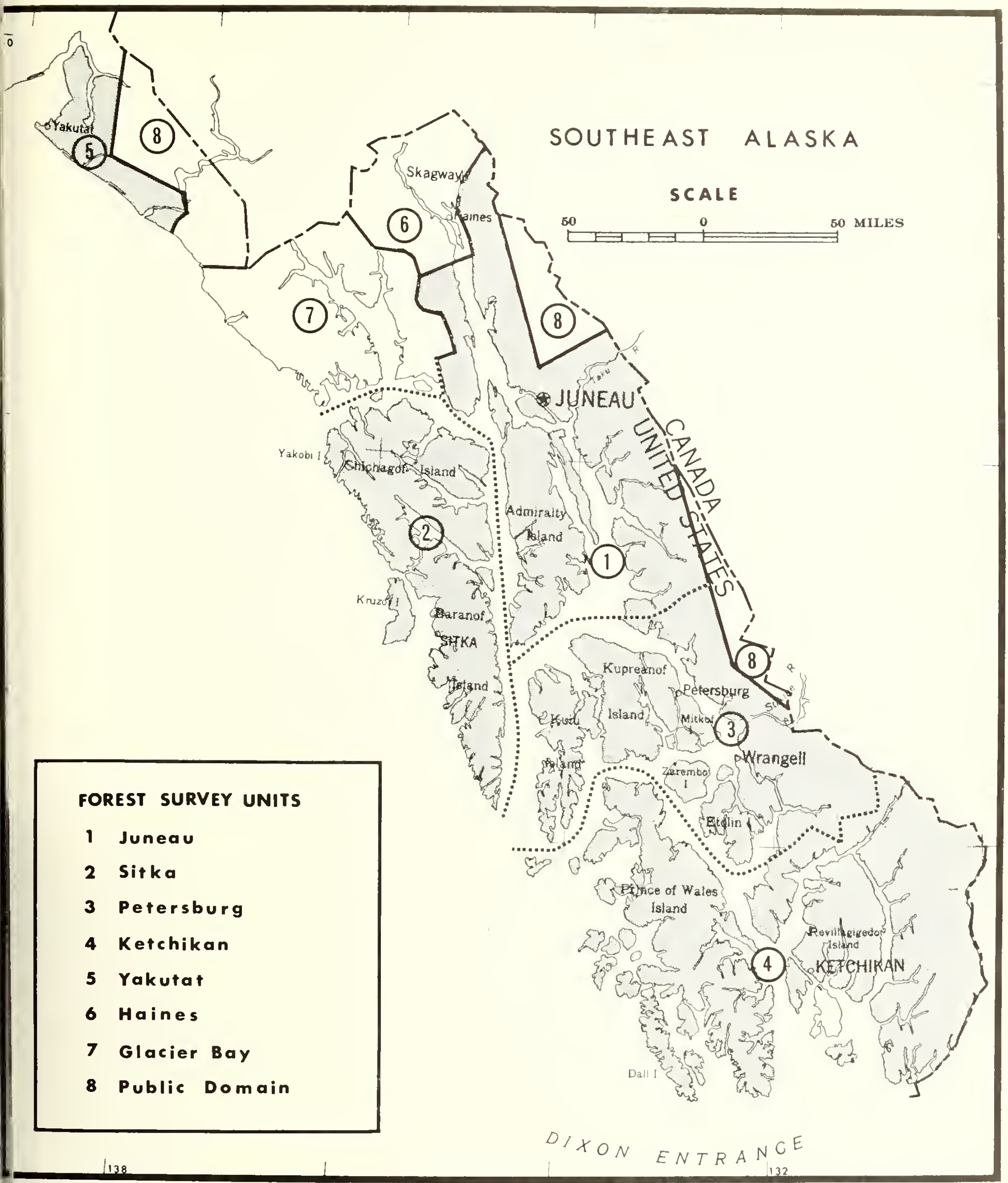

Figure 6.--The shaded areas are management units of the Tongass National Forests.

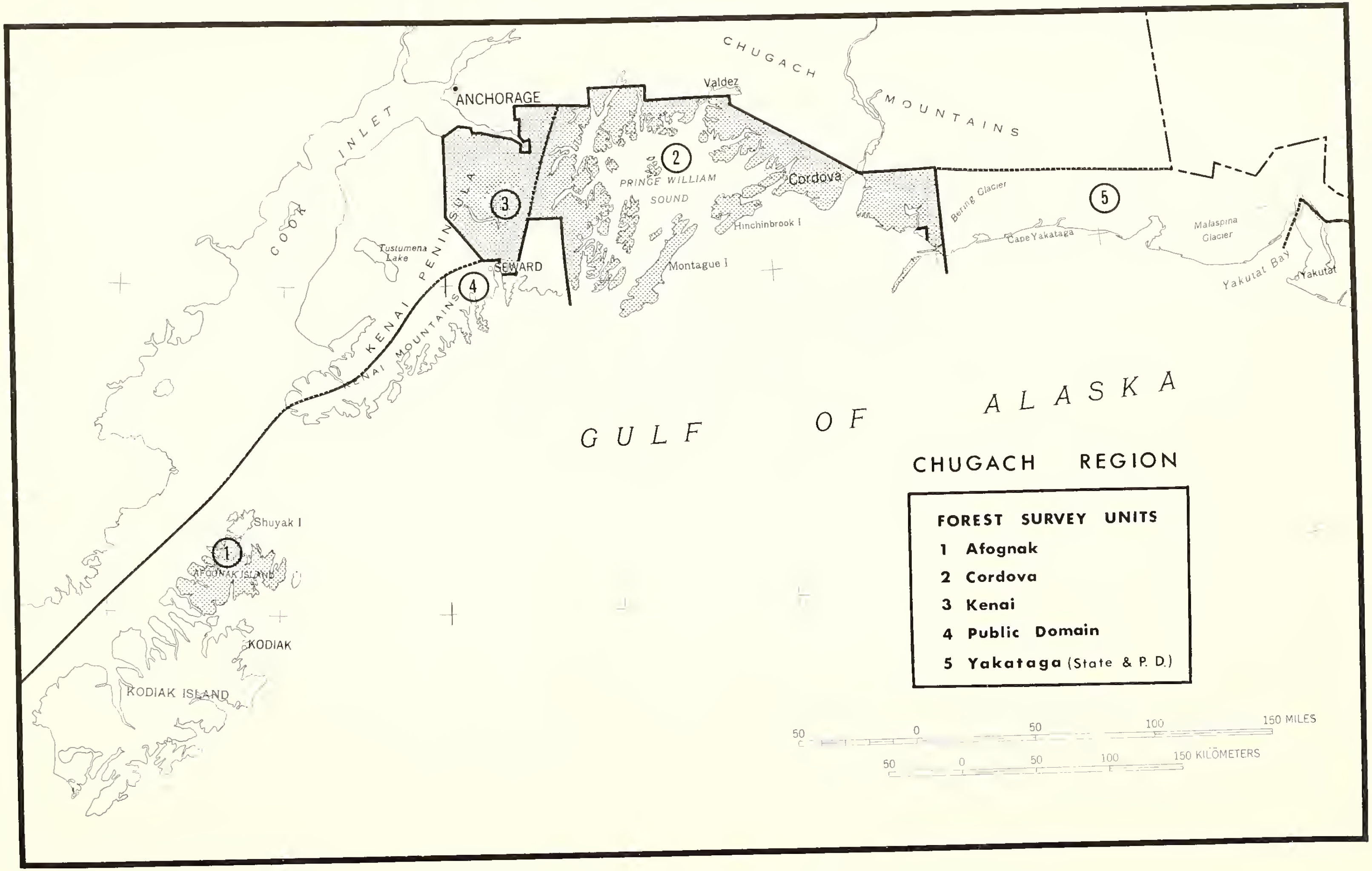

Figure 7.--Most of the shaded areas are management units of the Chugach National Forest.

·OREST AREA BY STAND TYPES

Western hemlock and Sitka spruce for- ;st types together account for 96 percent f the coastal forest area (fig. 8). These ,vo species are by far the most important ı the State by volume, value, and use. 'hey account for at least 99 percent of ıe present log production.

Western hemlock is dominant on about 7 million acres. On 1 million acres, Sitka ›ruce comprises 50 percent or more of ıe stand volume. On 1.5 million acres, ɘmlock and spruce are mixed, with spruce aking up 30 to 49 percent of the stand.

Some cedar is found in the southeastern ırt of the region, and hardwoods are ›und along some drainages. The area in ·dar is about equally divided between estern redcedar and Alaska-cedar.

Commercial stands of black cottonwood 'e found in several localized areas. The ·ikine, Taku, Haines, Yakutat, and Sew- ·d areas are the more important.

On the Kenai unit, a transition from astal to interior forest types occurs. ere, the western hemlock-Sitka spruce pe is displaced by white spruce and ›untain hemlock in mixture with aspen d paper birch.

)REST AREA BY STAND-SIZE .ASSES

Forest land was separated into com- ercial and noncommercial classes (fig. 9). ›mmercial forest land was defined as ıving a minimum volume of 8,000 board et per acre or the capacity to produce is volume. In a further classification commercial forest land, five conditions stand size were recognized: (1) old- 'owth sawtimber, (2) young-growth saw- nber, (3) poletimber, (4) seedling and ·pling, and (5) nonstocked. The first ur are related to conditions of stand 'e or maturity, whereas the fifth is the esent lack of land utilization by com- ɘrcial tree species.

These classes are important to the forest manager as well as to those interested in timber harvesting. The old-growth sawtimber stands, for example, are recognized as having reached or passed physiological maturity. They are no longer growing vigorously. Young-growth sawtimber, poletimber, and seedling-sapling stands, on the other hand, are characterized as vigorous, healthy stands contributing a maximum amount of wood annually through net growth. The old-growth stands are those the forest manager must harvest first in order to increase the overall productivity of the forest. These old-growth stands are also wanted by timber buyers and operators because they usually contain the best quality logs.

Eighty-four percent of coastal Alaska's commercial forest area is classed as old-growth sawtimber (fig. 10). Thus, we have 4.8 million acres of forest land which may be considered beyond the optimum age for harvesting. Currently, about 12,000 acres are being cut annually. Because of the unbalanced conditions of the total forest, the annual volume harvested can exceed the amount being grown for many years before sufficient young stands will be obtained to bring growth and cut into balance.

For the most part, younger stand sizes occur as scattered, small patches near tidewater. Many of these small tracts were logged earlier because they were easily accessible and possessed high volumes of quality timber. Young stands are also commonly found on areas of windthrow, glacial retreat, land uplift, and stream channel changes. Many landslides occur on the steep slopes, and these usually restock with forest growth. If these areas have not restocked satisfactorily, they are included in the nonstocked stand-size classification.

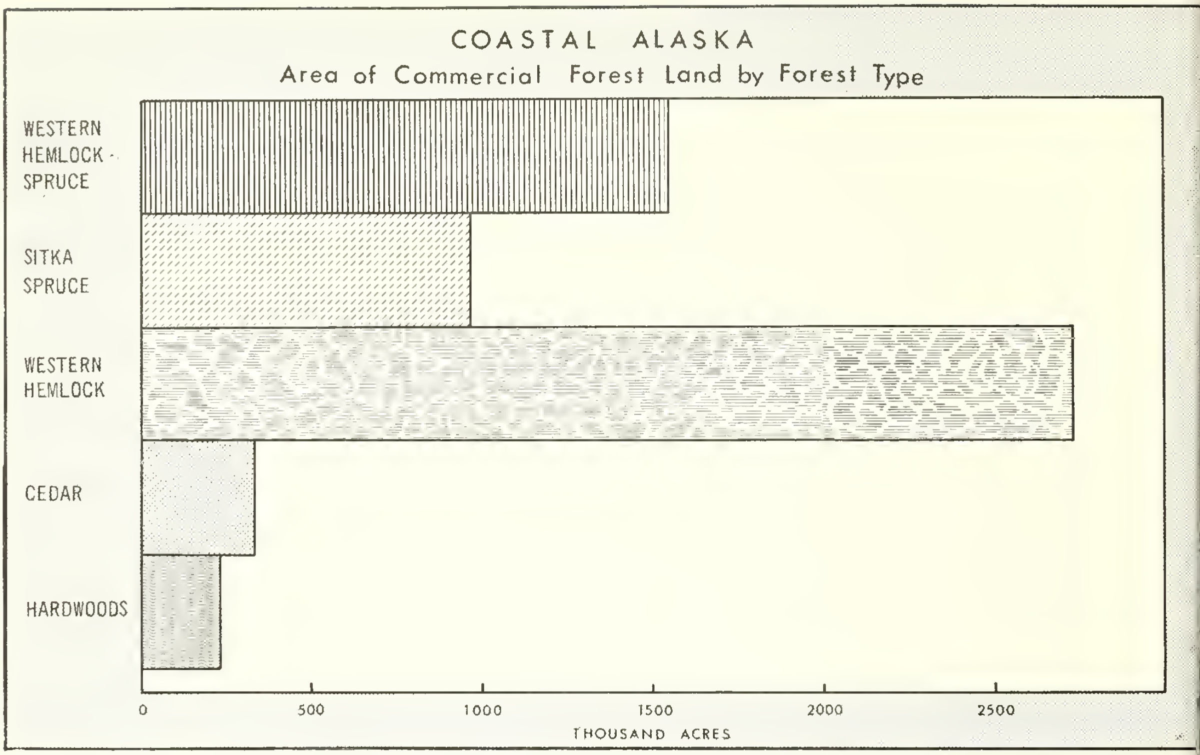

Figure 8.--The forest types of this region are not distinct--the species are intermingled and blended.

Figure 9.--Muskeg areas like this were not included in the commercial forest area.

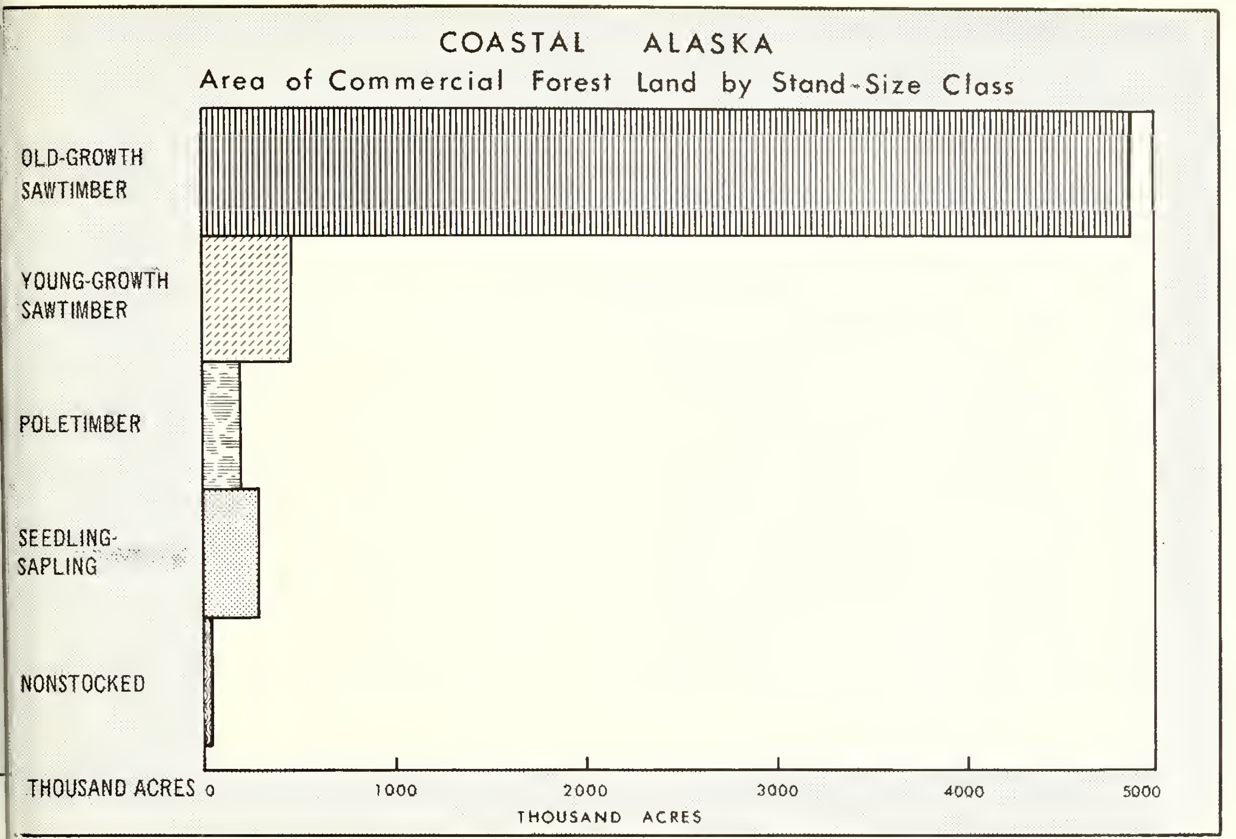

Figure 10.--As the stands become well managed, the old-growth sawtimber area will be replaced by thrifty young-growth sawtimber, poletimber, and seedling-sapling stands.

SAWTIMBER VOLUME

Coastal commercial forests contain a total net volume of 184.7 billion board feet of sawtimber. The importance of this figure depends upon the distribution of volume. Areas supporting high volumes per acre are usually much more operable, economically, than those supporting low volumes per acre.

The coastal commercial forests, with 86 percent of the sawtimber volume in Alaska, average more than 30,000 board feet per acre. The range per acre is from 8,000 to more than 100,000 board feet. These stands are attractive for industrial development, but some competing regions offer as much or more in quantity, quality, and preferred species. The forests of western Oregon and Washington have half the total sawtimber on the Pacific coast, and the preferred industrial species, Douglas-fir, comprises most of the volume. However, the average volume per acre of sawtimber stands in coastal Alaska compares favorably with similar stands in Oregon and Washington. Coastal Alaska has 88 percent of this Nation's total supply of Sitka spruce.

Soils and drainage are so complex and variable in coastal Alaska that the better stands are not always found on the benches and valley bottoms where they might ordinarily be expected. Muskegs, with the inherent characteristic of poor drainage, often occur on locations that otherwise would produce good timber. Most of the good stands of timber are, however, within 2 or 3 miles of tidewater.

The southernmost unit inventoried is the Ketchikan (figs. 7 and 8) with nearly twice as much sawtimber as any other unit. The Ketchikan unit has a greater total land area and a higher proportion of commercial forest land. The character of the commercial forests changes northward and westward from the Ketchikan unit. Volumes per acre tend to decline, trees are generally of poorer quality, and the stands become more variable and less extensive.

Western hemlock and Sitka spruce t
gether account for 94 percent of the boar
foot volume — 106 and 68 billion boa
feet, respectively (fig. 11). Alaska-ced
and western redcedar account for abo
4 billion board feet each. Most of the 1
billion board feet of hardwood is bla
cottonwood. The remaining 1.2 billi
board feet consists of other softwood
mostly mountain hemlock, white spruc
and lodgepole pine. Although western he
lock comprises most of the volume, t
largest and best quality trees available a
Sitka spruce. Sitka spruce is rather even
distributed throughout the four southea
ern units, accounting for about 30 perce
of the volume. The proportion increas
to 80 percent in the Yakutat unit and
100 percent on Afognak Island.

Most of the volume is in the 21- to
inch class (fig. 12). More than one-thi
of the volume is in trees greater than
inches d.b.h. (diameter breast height).
general, the spruce is larger than the he
lock. More than 50 percent of the spr
volume is in trees greater than 30 inc
d.b.h. These trees produce high-qual
spruce logs. Such trees are more comm
on the four southeastern units. The un
from Yakutat westward have smaller tre
On Afognak Island, the average diame
of all trees is 11.8 inches, and 51 percent
the volume is in the 11- to 20-inch-diame
group.

LOG QUALITY AND TREE DIAMETE

The stands of coastal Alaska are of
described as mature or overmature, of
clining quality, and suitable primarily
the manufacture of pulp. Much of t
is true, but intermixed in these pred
inantly pulpwood stands there is prese
a good supply of the finest quality Si
spruce and western hemlock to be fo
anywhere. To attain full utilization
coastal stands, more attention must
given to determining the supply and va
of the high-quality logs and to divert
them to their highest use.

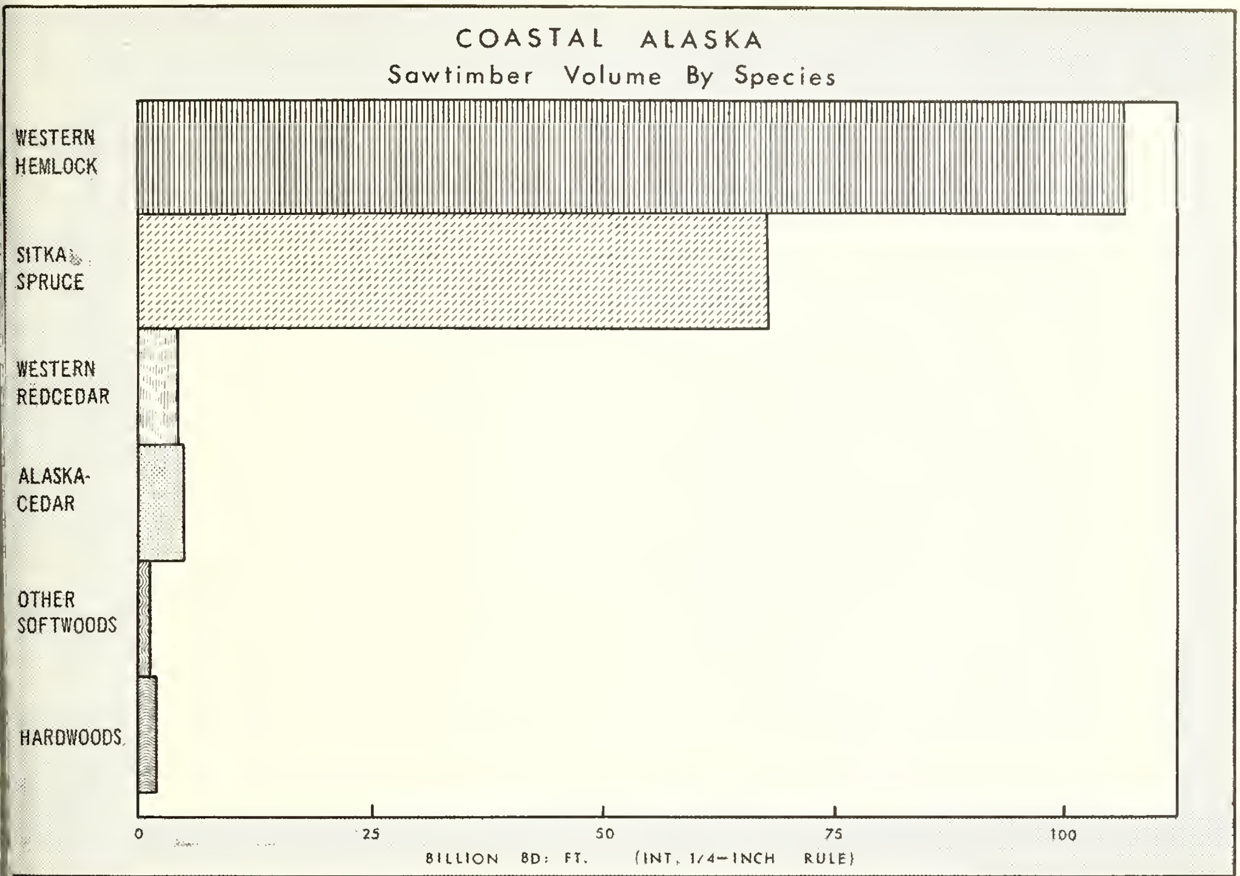

Figure 11.-- Future second-growth stands are expected to have a higher percentage of Sitka spruce volume than is shown here in old-growth stands.

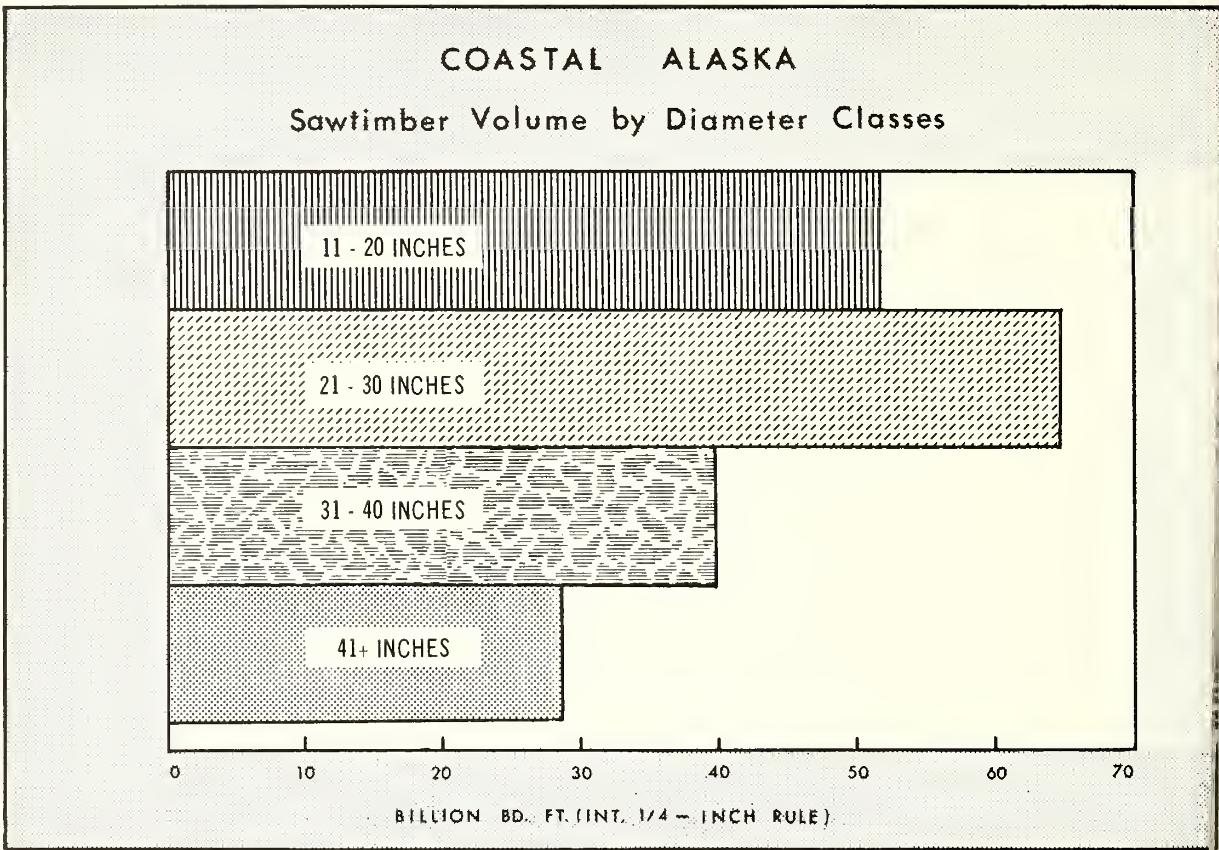

Figure 12.--The highest quality volume--that in trees 30 inches d.b.h. and larger--is in old-growth trees. The second-growth stands are likely to be scheduled for cutting long before they accumulate much volume in trees 30 inches d.b.h. and larger.

For many years, southeast Alaska has produced logs and cants for manufacture of high-quality specialty products. Beginning in World War I (U.S. Forest Service 1954), and especially during World War II, this region supplied much of the high-quality spruce used in the manufacture of aircraft. In this region, 9.3 billion board feet of the spruce are in Select and No. 1 grade logs. Another 5.5 billion board feet of western hemlock are in Peeler and No. 1 grade logs. These logs are desirable for the manufacture of veneer, plywood, and high-quality lumber products. The high-quality volume in the stands amounts to about 5 percent of the total hemlock and 4 percent of the spruce sawtimber volume. Much of this volume now is used in the production of dissolving pulp worth $175-$235 a ton. Whether the yield of pulp is greater from these high-quality logs than from lower quality logs is not known. It is known, however, that the supply of timber suitable for veneer, plywood, and other highly valued products is diminishing in all regions.

Log quality is, of course, closely related to tree diameter. Among the larger trees, more high-quality logs can be expected. Select grade Sitka spruce logs must be at least 30 inches in diameter, measured inside the bark at the small end. Peeler and No. 1 grade hemlock logs must measure at least 24 inches.

In southeast Alaska, more than 50 percent of the Sitka spruce sawtimber volume is in trees 31 inches or larger, d.b.h. Twenty-five percent of the volume in these trees is in either Select or No. 1 grade logs. Thirty-nine percent of the hemlock sawtimber volume is in the 21- to 30-inch-diameter class and another 30 percent is in trees 31 inches or larger.

If stand quality were evenly distributed throughout the region, logging operators could expect to obtain about 2,500 board feet per acre in grade 1 or better logs. Since the stands are not uniform in quality, anyone interested in high-quality logs will profit by searching for the better stands. Many of the better stands are being bypassed at present because the cost of reaching them is too great. Many good stands of timber occur as small, isolated pockets behind muskegs, on steep slopes, in side drainages, and in other hard-to-reach places. These stands are likely to remain unharvested until more favorable logging methods and economic conditions permit their harvest.

The coastal stands of Yakutat, Prince William Sound, Kenai Peninsula, and Afognak Island are significantly poorer in quality than those of the southeast coastal stands. Inventory shows a scattering of western hemlock Peeler logs, but no Select grade Sitka spruce. Less than 5 percent of the sawtimber volume of these species was in the two top grades of logs. The poorer quality of trees in this region is largely attributable to limbs, associated with the poorer stocking of the stands. The trees are not as tall as those found in the southeast and limbs tend to persist even on the first log. Thus, the degrade in lumber that can be produced from these stands will be largely from knots.

In southeast Alaska, there appears to be an opportunity to develop a much more integrated wood-using industry than now exists. Some of the high-quality logs, particularly Sitka spruce, are now sorted from the pulpwood rafts and sold to sawmills, but very few are processed. Most are cut into cants for export to Japan. Per capita use of plywood and veneer is expected to increase from 64 square feet in 1962 to 97 square feet in 2000. About 75 percent of this demand is expected to be for softwood plywood and veneer (U.S. Forest Service 1965a). Some other softwood plywood and veneer producing areas are facing raw material supply problems (Cowlin and Forster 1965). Alaska has 88 percent of the Sitka spruce and 40 percent of the western hemlock sawtimber in the Pacific Northwest region (U.S. Forest Service 1965a). With so much of the total raw material, Alaska can supply many industries using these species.

GROWTH ESTIMATES

Young-growth stands. — The study of forest growth in the initial inventory was confined to even-aged, young-growth sawtimber and poletimber stands. These stands account for only 578,000 acres, or 10 percent of the commercial forest area. On seventy-eight 1/5-acre plots studied, mean annual increment ranged from 30 to 966 board feet per acre. Lowest board-foot growth was on stands classified as poletimber, whereas the sawtimber stands produced most. The location producing 966 board feet annually was a well-stocked, 130-year-old stand of hemlock averaging 78,000 board feet of sawtimber per acre. The current annual increment of all coastal young-growth stands totals 379 million board feet or 64 million cubic feet.

Old-growth stands. — It was assumed that old-growth sawtimber stands (stands in which more than 50 percent of the volume is in trees at least 150 years old) are neither gaining nor losing volume. Since completion of the inventory, remeasurement of the Juneau and Sitka units has, however, revealed net growth in these units. It is not yet certain whether similar growth will be found in other units, or for how long this net increment may continue before offsetting losses predominate.

Stand conversion. — The present old-growth stands are by volume about 57 percent western hemlock and 36 percent Sitka spruce. Studies (Taylor 1934) show that second-growth stands at 75 to 100 years of age will be about 50 percent spruce. This may be a desirable change in stand composition since Sitka spruce brings, in present markets at least, the highest stumpage price.

Studies of second-growth stands (Taylor 1934) indicate that areas now being harvested should produce more than twice as much volume in the next rotation. Eventually, the commercial forests of coastal Alaska should sustain about twice the industry being planned for the present old-growth stands.

For economic and silvicultural reasons, forest managers in southeast Alaska prefer clearcutting as a timber harvesting practice (fig. 13). Adequate restocking ordinarily results from seed disseminated from surrounding timber. But if natural seeding should fail, it has been demonstrated that aerial seeding may be used to restock large areas at relatively low cost (Harris 1965). Some alluvial bottom lands may restock slowly and require special handling. These special situations warrant more study.

TIMBER LOSSES AND RISKS

The risk most commonly thought of i fire, but coastal forests are well protecte from fire by the climate. Rainfall is heav and well distributed throughout the sea sons so that only a few relatively smal fires have occurred. In the present old growth stands of coastal Alaska, fire i not a serious risk.

Field crews have a difficult time as signing the primary cause of tree deat Trees killed by fire and windthrow are ger erally obvious, but many trees show com binations of causal agents such as diseas insects, a fire scar, and wind damag Seventeen percent of the dead trees in th inventory sample were windthrown. A other 17 percent were believed to ha been killed by insects. Fire accounted f 11 percent of tree mortality, and practical all of this damage was on the Kenai un (fig. 8) of the Chugach region. Diseas killed 7 percent of the trees, and unknow or combined causes accounted for the r maining 48 percent.

Age seems to be the key factor of ris At one time, these coastal stands pro ably were even aged. As disease, insec wind, ice, etc., took their toll, holes open in the stands for new growth to ent and the stands became uneven aged. T stands are still predominantly old and a erage much more than 150 years. T

Figure 13.--Logging in Maybeso Valley on Prince of Wales Island was nearly completed when this picture was taken in 1959.

change from even-aged to uneven-aged stands is continuing. The annual volume loss from mortality averages 88 board feet on each commercial forest acre of coastal Alaska and totals 503 million board feet. This loss roughly equals the amount being harvested each year.

The above estimates of loss may be conservative. Biased estimates of mortality can result from inability to determine how long trees have been dead. Remeasurement studies showed that annual mortality in old-growth stands on the Juneau unit averaged about 108 board feet per acre annually.

An aerial view of coastal Alaska stands shows many dead tops. Some, but not all, dead tops indicate dead trees. Defoliating insects, the black-headed budworm, *Acleris variana* (Fern.), and the hemlock sawfly, *Neodiprion tsugae* Midd., are endemic throughout the region. High populations of the black-headed budworm attacked millions of acres of western hemlock and Sitka spruce from 1948 to 1955. Many trees died from these attacks; others were damaged, resulting in dead tops; and growth was lost or retarded on all defoliated trees. Scattered insect damage continues and is indicated in the measure of mortality, but there is no measure of the loss resulting from retarded growth.

As stands mature and age, many forms of damage develop in the trees. Decayed wood results from diseases which weaken and eventually kill the trees or hasten the losses attributed to wind and insects. A fifth of the gross volume of merchantable trees in coastal Alaska is unusable because of defects, mostly decayed wood. Defects vary considerably by species. Defective western hemlock amounted to 22 percent of the gross merchantable volume, 51 percent for Alaska-cedar, 9 percent for Sitka spruce, and 53 percent for western redcedar.

Coastal Alaska has 760 million cubic feet (net volume) of sound wood in rotten cull trees. The gross volume of these defective trees is about seven times greater than their net volume of sound wood. Most culls in coastal stands are the result o decay. The volume of wood in sound cul trees amounts to 114 million cubic feet only one-sixth of the volume in rotten cul trees. Generally, sound cull trees ar usable for pulpwood but not for lumbe products, whereas rotten cull trees ar normally unusable for any product.

Two common types of wood-decayin fungi are prevalent: brown rot and whit rot. Brown rot destroys the cellulose fiber and white rot destroys the lignin conten In the incipient stage of decay, the woo is discolored and softened by both form of decay, though it might still be use for pulp production. Even in an advance stage of decay, wood attacked by whit rot might be used for pulp manufactur although the yield would be reduced. Woo in the typical stage of brown rot is n usable.

ALLOWABLE CUT

Allowable cut is defined as "The volum of wood which can be cut under manag ment for a given period of time" (Socie of American Foresters 1958). In practic allowable annual cut is usually the plann total cut for a 10-year period divided 10. Each forest manager computes allo able cut based on his own concept of t factors included in the term "manag ment," such as amount of money invest in management, timber merchantabilit accessibility, utilization standards, marke and operating conditions. Anyone cou easily compute an entirely different allo able cut for the same forest by using d ferent definitions for these factors.

A precise allowable cut for all of coas Alaska cannot be computed from the F est Survey, for this would require kno edge of management objectives for areas and ownerships. However, 92 p cent of the commercial forest land coastal Alaska is in two National Fores and the allowable cut computed for th Forests determines, for practical purpos the potential commercial development this region.

The National Forests of Alaska contain about 5,292,000 acres of commercial forest land available for timber harvesting. The allowable annual cut is currently placed at 864 million board feet (Scribner scale). However, only 3.3 million acres (62 percent of the commercial forest land) were classified in the inventory as accessible. Allowable cut was computed for this land. As cheaper and more efficient logging methods are developed, as markets improve, as demand for stumpage increases, and as timber becomes scarcer, more and more of the 2 million acres of presently inaccessible commercial forest land will become economically operable and be brought into the allowable cut computation. The magnitude of this potential is apparent in the present estimate that inaccessible commercial forest land of southeast Alaska could support an annual cut of 415 million board feet.

The basic criteria used to determine accessibility were as follows: (1) a market must exist, (2) the minimum net volume available to a yarding tree must be at least 500,000 board feet, and (3) a minimum of 16,000 board feet per acre must be available in the area that can be yarded to a protected beach or truck road. Additional guides and controlling factors used are given in the appendix. Accessibility was provisionally determined from aerial photographs, then checked by sample field observations.

Improved markets for Alaskan timber may increase the allowable cut in future years. Since there is no active market for western redcedar and Alaska-cedar, 7.8 billion board feet in these two species was not included in the initial allowable cut computation. The entire area inventoried as accessible is not yet operable; loggers will reach more area as economic barriers are removed. An adjustment was made to reflect the difference between scaled volume and inventory volume. Scaled volume is only about 74 percent of inventory volume. The difference between inventory and scaled volume is caused by (1) allowances made for breakage and other residue, (2) use of the 16-foot-log volume table when average scaled length is near 32 feet, and (3) scaling diameters rounded to the last full inch, whereas inventory volumes are based on rounding diameters to the nearest inch. The allowance for these factors reduces the inventory volume estimate by about 20 percent.

In fiscal year 1964, the timber cut from Alaska's National Forests amounted to 417.4 million board feet (Scribner scale), about 48 percent of the allowable cut. It is expected that with the installation of one more large pulpmill, some green veneer production, and some increased sawmill capacity, the total present allowable cut on National Forest lands will be utilized by 1975.

INTERIOR ALASKA

Interior Alaska includes a gross area of 341,999,000 acres. Although this region has an annual rainfall of only 7 to 30 inches, nearly 3 percent of the area, or 9,444,000 acres, is in lakes 40 acres or larger and streams one-eighth mile or more in width.

This immense area has varied topography, vegetative cover, and climatic conditions. Continuous and discontinuous permafrost (permanently frozen ground) is found at varying depths throughout the region (fig. 14), and to a great extent determines the vegetative type and growth patterns. Although the annual precipitation indicates a rather dry region, permafrost holds all moisture near the surface; heavy ground cover of grasses, mosses, shrubs, and trees retards surface runoff. Consequently, except on south-facing slopes, plant growth and plant distribution do not appear to be limited by lack of moisture.

Figure 14.--Throughout much of the interior, permanently frozen ground limits the depth to which plant roots may grow.

FOREST AREAS

Alaska's interior forests cover about 106 nillion acres, or 32 percent of the total and area (fig. 15). Roughly another third onsists of grassland, brush, swamps, and undra, with a small fraction in agricultural crops. The balance is barren rock r ice and snow, largely at high elevations. Although the forests extend to the Arctic lope, the better stands are generally conined to the lower slopes and valleys of he larger rivers and their main tributaries.

The principal forested regions include he complex drainages of the Susitna, Copper, Tanana, Yukon, and Kuskokwim Rivers, and the west half of the Kenai Peninsula. These regions contain most of he 22.5 million acres of commercial forest and in the interior. Commercial forest and is capable of producing 20 cubic feet er acre annually of usable wood (see efinition on p. 54).

Intermingled with the commercial forst land and extending beyond to western nd northern limits of tree growth are 3 million acres of sparse or open woodands, presently considered noncommercial fig. 16). Permafrost, high water tables reated by impervious claypan soils, and hin soils are important factors responsible or the stunted and sparse tree growth ver much of this area. In spite of exremely severe winters and permafrost, orest land extends well into the Brooks Range, primarily along the Porcupine, Chandalar, Koyukuk, and Kobuk Rivers nd their tributaries.

OREST OWNERSHIP

Because of the continuing State landelection program, the ownership of Alasa's forest land, particularly in the interior, is constantly changing. The Alaska tatehood Act of 1958 provided for the ventual transfer of 103.3 million acres the State. The State of Alaska will elect most of this from lands now adinistered by the U.S. Bureau of Land anagement. Through September 1965, nearly 17 million acres had been selected; of this, 1,686,763 acres had been patented. Only lands classified as timberlands will be managed for timber production, and much of the forested land being selected by the State is classified for other than timber use. So far, only 262,445 acres are classified as timberlands.

Although 23 Federal agencies own land in Alaska (U.S. Department of the Interior 1964), 99.9 percent of the land is controlled by 6 agencies:

Agency	Percent
Bureau of Land Management	85.4
Forest Service	5.7 (all in the coastal region)
Fish and Wildlife Service	5.2
National Park Service	1.9
Bureau of Indian Affairs	1.1
Army	.6

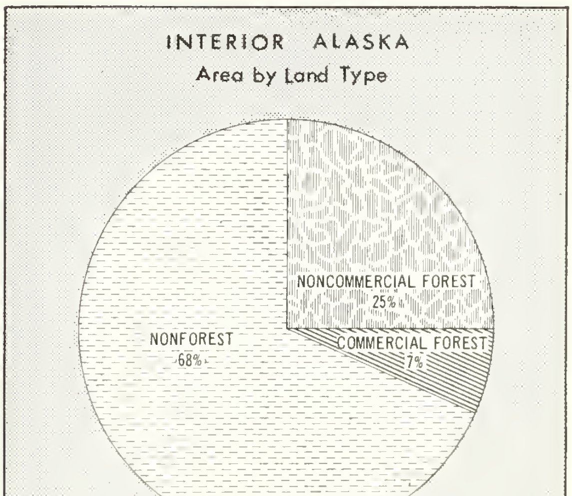

Figure 15.--Twenty-one percent of the interior forest land is commercial.

Figure 16.--Areas like this black spruce bog near Northway were classified as noncommercial forest land. Black spru grows slowly and usually stagnates in very dense sapling stands.

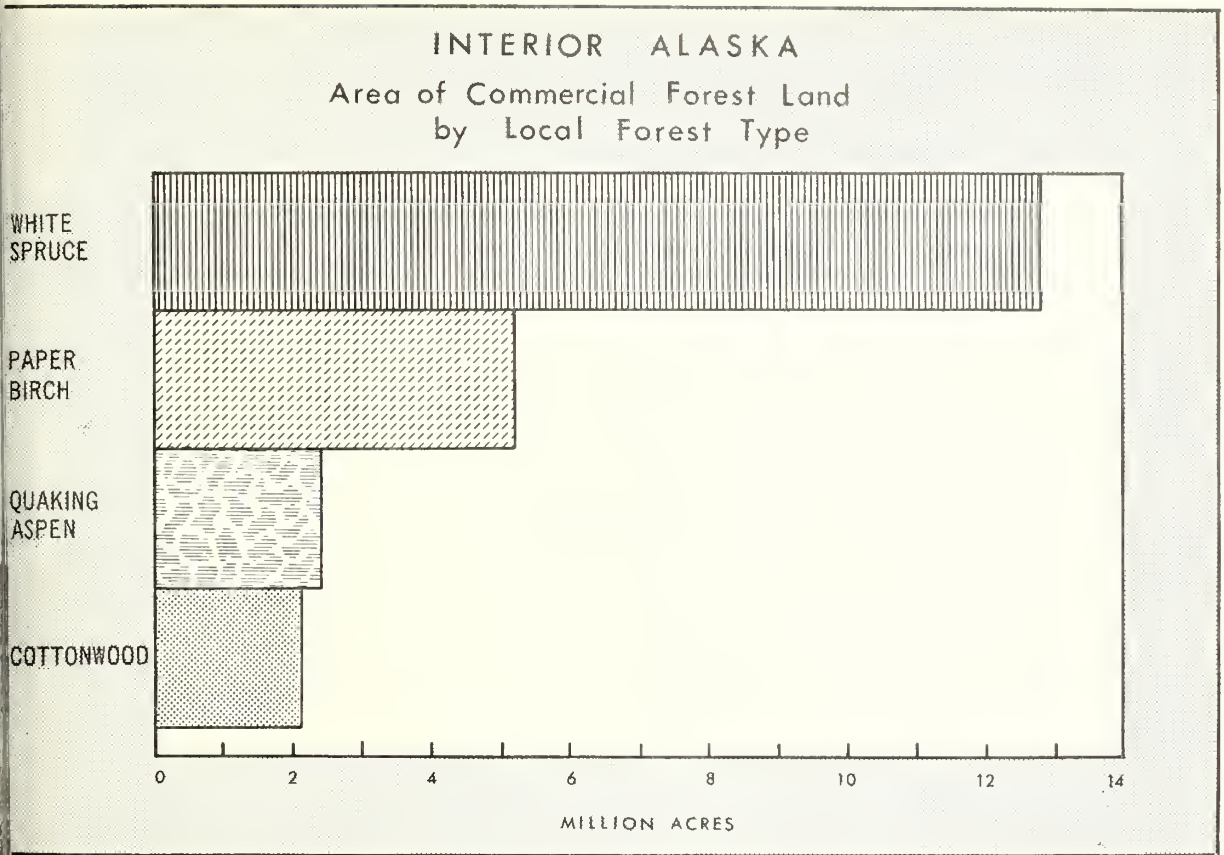

Figure 17.--White spruce is the dominant commercial tree species in the interior. It is found in pure stands and in association with all other species.

After completion of land selection by ıe State, the Bureau of Land Management ·ill probably retain control of nearly 60 ercent of Alaskan land.

Ownership is important to many timber urchasers, for their costs often depend pon the size of timber tracts available. rivate owners generally own such small ·acts of forest land that the larger, more ficient timber buyers and operators are ot interested. Timber in public owner- ıip usually can be offered in amounts to ıit the available timber operators.

FOREST AREA BY STAND TYPES

Interior forest types are generally not pure, but are mixtures of the four major commercial species: white spruce, paper birch, aspen, and balsam poplar. However, stands are classified on the basis of predominant species. The spruce type (primarily white spruce) accounts for about 57 percent of the commercial forest land (fig. 17). Paper birch type accounts for 23 percent; aspen, 11 percent; and balsam poplar and cottonwood, 9 percent.

White spruce is generally recognized as the climax tree on most commercial forest sites of the interior. There are 12.8 million acres of this type. The best stands of white spruce (as well as most other species) are found along the well-drained river bottoms. Stands 95 feet tall, 100-200 years old, and averaging 10,000 board feet per acre are found on good alluvial sites (fig. 18). Tree diameters (d.b.h.) in such stands range from 10 to about 24 inches. White spruce matures at 100 to 150 years of age if not damaged or destroyed by fire. If the spruce is destroyed by fire, the site is commonly seeded by aspen, birch, or white spruce, or a mixture of these species. Being tolerant of shade, white spruce may come in as an understory; eventually spruce becomes the predominant species in the stand.

Paper birch, including varieties and hybrids, is the predominant species on 5.1 million acres. Paper birch is commonly associated with spruce and aspen. However, it seeds or sprouts as a pure stand following a fire. Birch matures at 80 to 100 years, rapidly becomes defective, and sometimes is replaced by spruce which has been growing as an understory. Good sites produce stands of birch sawtimber 60 to 80 feet tall with diameters (b.h.) of the larger trees ranging from 12 to 18 inches (fig. 19). The average diameter of such stands will be 8 or 9 inches. Trees that reach 15-18 inches d.b.h. are mature and usually defective (Gregory and Haack 1965).

Quaking aspen also follows fire, either as a pure stand or in mixture with spruce and sometimes with birch. It is the dominant tree on 2.4 million acres. Aspen is a fast-growing tree that matures in 60-80 years and gradually may be replaced by spruce. Because of its short life span, aspen normally does not grow to be larger than 10 to 14 inches d.b.h. Stands with trees averaging only 6-8 inches are most common. Aspen is found throughout the interior, especially on south slopes and well-drained benches. Stunted stands can be found in protected swales up to about 3,000-foot elevation.

It is difficult to distinguish betweer black cottonwood and balsam poplar. The two closely related species have similar appearance and habits. Fortunately, the two trees have different ranges and seem to overlap only in the Cook Inlet area The volume reported for the interior contains little black cottonwood, and that reported for coastal Alaska contains littl balsam poplar. Balsam poplar may b the most widely distributed tree in the interior where it occurs as the major specie on 2.1 million acres. In scrub form, i is found at higher elevations than whit spruce (Taylor and Little 1950). It als is found at the western limits of tre growth, and projects farther north int the Brooks Range than other species. Bes growth is reached on sandy bottoms c river valleys where trees 80 to 100 fee tall and 24 inches or larger in diamete are found. Balsam poplar trunks are clea and straight and make high-quality log (fig. 20).

FOREST AREA BY STAND-SIZE CLASSES

Stand-size classification is one mea of measuring the stage of developme of our forests. This classification also m indicate commercial importance and t need for certain silvicultural practic In contrast to the coast with more than percent of the commercial forest land old-growth sawtimber, 70 percent of t interior commercial forest lands conta immature stands: 39 percent poletimb 26 percent seedlings and saplings, and percent nonstocked. This amounts to million acres of sawtimber, 8.7 million ac of poletimber, 5.8 million acres of seedlin and saplings, and 1.1 million acres n stocked (fig. 21). These young stands m

Figure 18.--A climax stand of white spruce, about 215 years old, and 70-80 feet tall. The dominant trees range from 11 to 20 inches d.b.h.

respond to silvicultural practices such as thinning, pruning, and selective harvesting (Barrett 1962), in contrast to coastal old-growth sawtimber, the productivity of which is best increased by clearcutting and encouragement of new stands. Coastal stands are being improved by commercial harvesting operations, but to improve interior stands will require an investment of labor and money. Present markets for interior timber do not encourage investment.

Figure 19.--Stands such as this mature paper birch sawtimber along the Chena Hot Springs road near Fairbanks are neither extensive nor common. Usually these stands develop following a fire, with quaking aspen and white spruce intermingled in the stocking. If the spruce can obtain sufficient light, it will become the major component of the stand as the hardwoods mature and die.

Figure 20.--The dominant trees in this mature stand of balsam poplar are 20 to 28 inches d.b.h., about 95 feet tall, and 170 to 235 years old. Many good stands of balsam poplar may be found along the alluvial bottom lands of the interior.

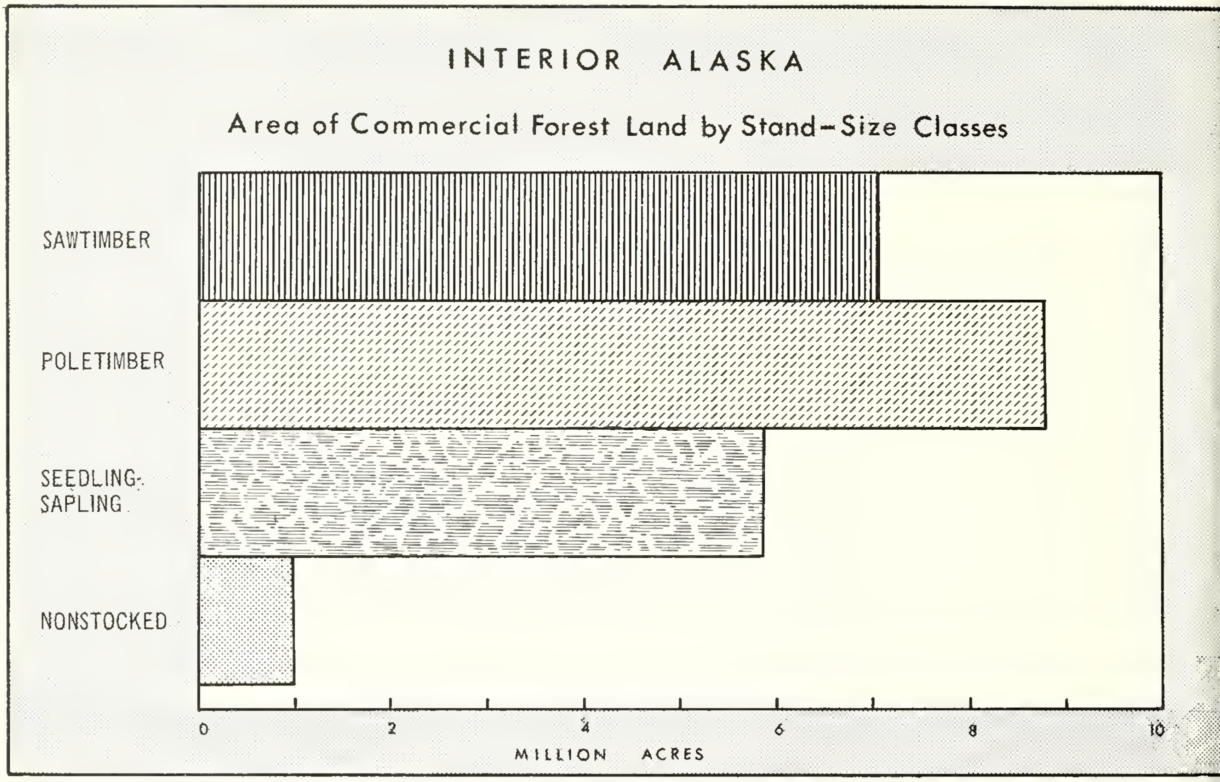

Figure 21.--The past history of the interior probably has much to do with so many acres now being in seedling-sapling and poletimber stand-size classes.

SAWTIMBER VOLUME

Commercial forests of the interior have a total net sawtimber volume of 31 billion board feet. This amounts to an overall average of less than 1,500 board feet per commercial forest acre, but the acreage classed as sawtimber averages 3,270 board feet per acre. In total volume and volume per acre, interior commercial stands are inferior to the coastal stands. This is partly because many acres of interior forest are immature, whereas most coastal stands are large mature and overmature sawtimber. But the major differences lie in species composition and growth characteristics (related, of course, to the climatic and edaphic conditions) of the stands involved. The most common interior tree, white spruce, does not grow to be large. Quaking aspen and paper birch are short-lived trees and do not become large. Balsam poplar and black cottonwood trees become large and grow in stands of 30,000-40,000 board feet or more per acre, but such stands are scarce.

Interior stands are similar to some in the Lake States (Minnesota, Michigan, and Wisconsin) and compare favorably with such stands in volume and quality.

Ninety-three percent of the interior sawtimber volume is in trees less than 21 inches d.b.h. (fig. 22). The 10-, 12-, and 14-inch classes account for 63 percent of the board-foot volume, 19, 24, and 20 percent, respectively. The 16-, 18-, and 20-inch classes account for 30 percent of the volume. This distribution by diameter classes is similar to that of Wisconsin

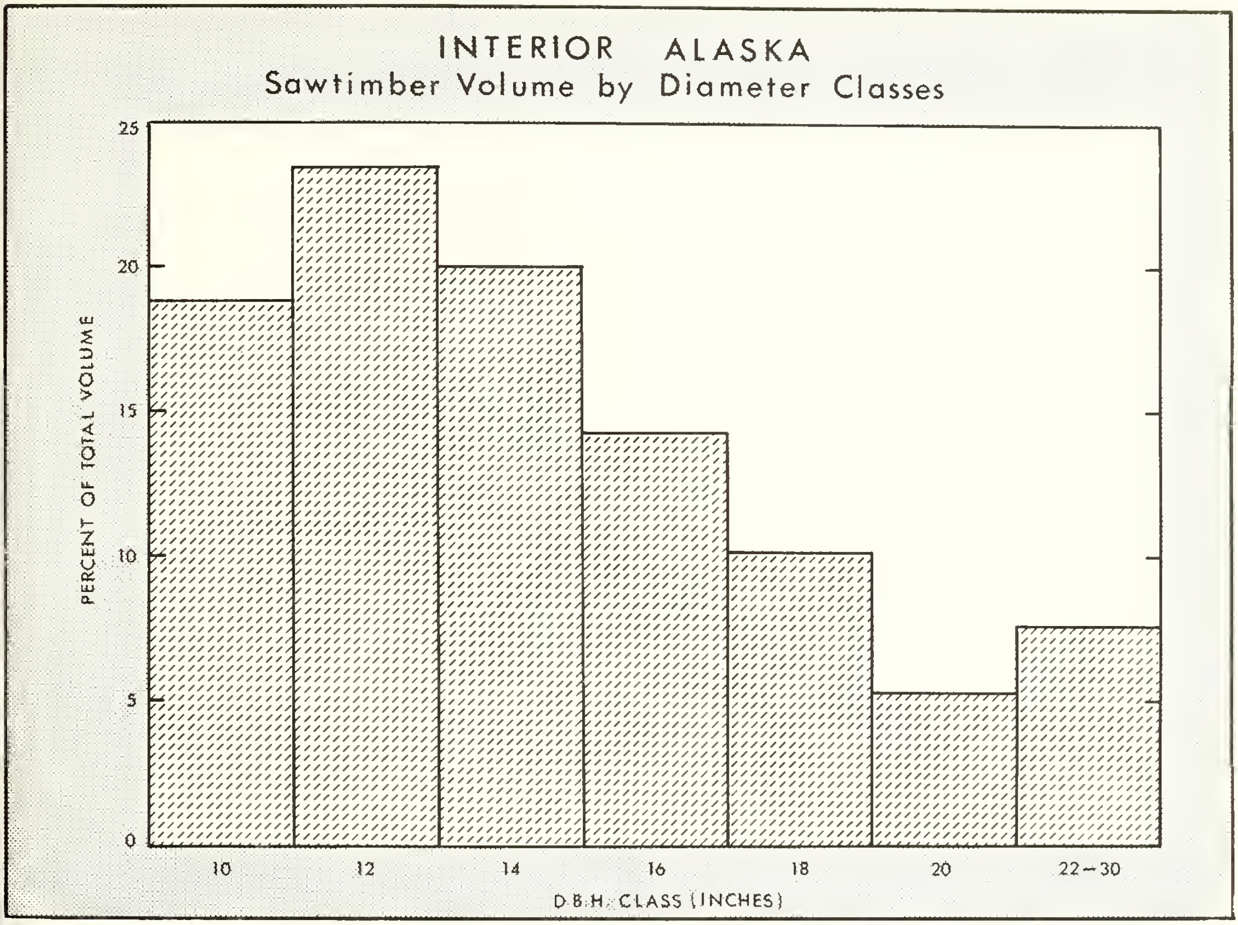

Figure 22.--Trees of the interior are predominantly small.

where the 10-, 12-, and 14-inch classes account for 55 percent of the total sawtimber volume with 33 percent in the 16-, 18-, and 20-inch classes (Stone and Thorne 1961). Very little of the volume is in trees larger than 30 inches in diameter; none were measured in the field sample. The southern tip of the Kenai Peninsula has some Sitka spruce in the 20- to 30-inch diameter class. Along streams, some black cottonwood and balsam poplar range up to 30 inches in diameter with an occasional tree over 40 inches. Few quaking aspen and paper birch trees surpass 16 inches in diameter; when they do, they are usually defective.

Sawtimber stands contain 73 percent of the interior's total sawtimber volume, and 26 percent is in the poletimber stands. Less than 1 percent of the sawtimber volume is scattered in seedling-sapling and nonstocked stands.

White spruce accounts for 81 percent of the interior's sawtimber volume (fig. 23). The only Sitka spruce found in the interior is located on the Kenai Peninsula and along the west shore of Cook Inlet. Nine percent of the sawtimber volume is black cottonwood and balsam poplar, 8 percent is paper birch, and 2 percent is quaking aspen. Many of the quaking aspen and paper birch stands (fig. 24) are immature and should produce a higher proportion of sawtimber in the future.

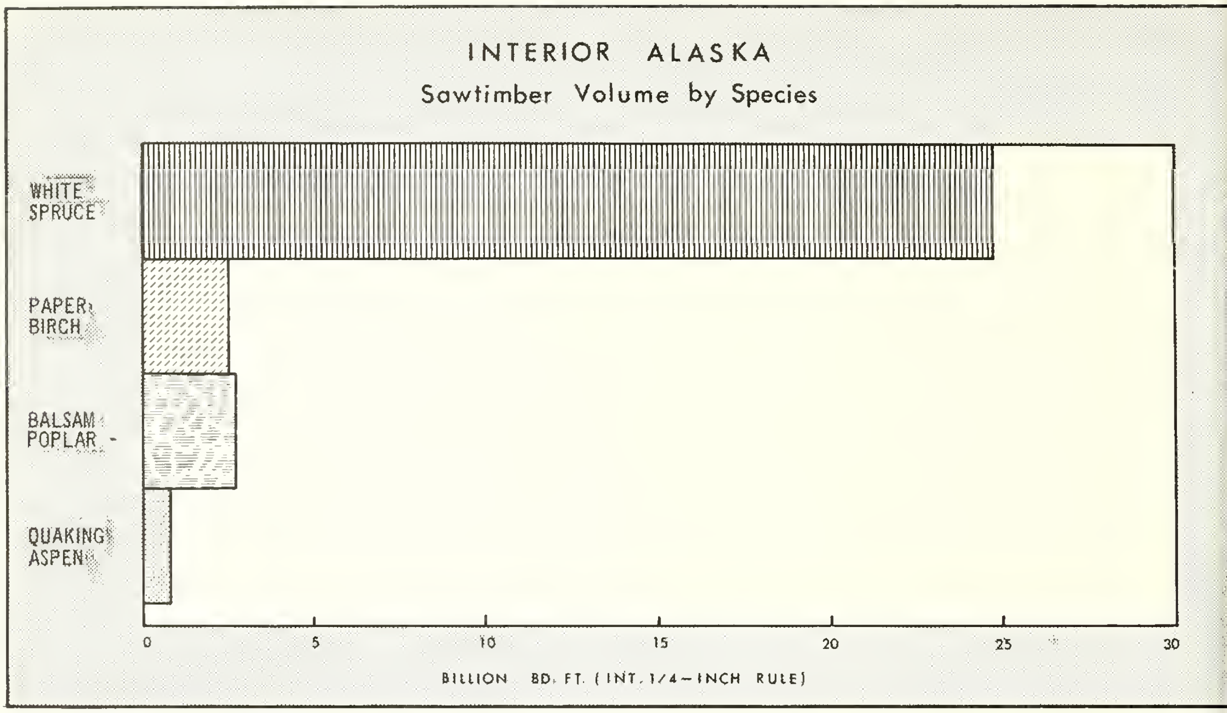

Figure 23.--White spruce is a longer lived tree and more inclined to grow to sawtimber size than either paper birch or quaking aspen. While balsam poplar grows to a larger diameter than any of the other interior species, it is limited in area.

Figure 24.--A well-stocked stand of paper birch poletimber near Chena Hot Springs. The trees are 65 to 70 feet tall and range from 7 to 9 inches d.b.h.

Although the interior stands can produce good logs for lumber and veneer, these stands should not be thought of as potential sawtimber sources. The stand volumes and tree sizes available suggest a pulpwood economy with integrated plants to utilize saw logs for lumber, veneer, and specialty items.

GROWING-STOCK VOLUME

Because most of the interior volume is in small trees, stands are best described by total volume expressed in cubic feet, which gives a more accurate measure of the wood content of small trees. The board-foot measure is not applied to softwood trees below 9.0 inches d.b.h. or to hardwood trees below 11.0 inches d.b.h. Even in sawtimber stands, much of the interior volume is in trees below these diameters.

The total growing-stock volume in trees 5.0 inches d.b.h. and larger is 14.25 billion cubic feet. Sixty-four percent of this volume is spruce, 21 percent paper birch, 9 percent balsam poplar, and 6 percent quaking aspen. Aspen and birch comprise a higher percent of the growing-stock volume than they do of the sawtimber volume, whereas the reverse is true for spruce (fig. 25).

The sawtimber stand-size class has a total volume of 9 billion cubic feet in merchantable trees 5.0 inches d.b.h. and larger, averaging 1,326 cubic feet per acre. This is more than 15 cords per acre, equal to or above the average volume available in sawtimber stands of many Eastern States. However, 40 percent of the volume in the sawtimber stand-size class is in poletimber trees.

The poletimber stand-size class has a total of 5 billion cubic feet, 35 percent of the total growing-stock volume (fig. 26). These stands average 576 cubic feet (about cords) per acre. It is likely that in Wisconsin, and perhaps other States as well, many of these stands would be considered operable for pulpwood. There, a managed stand is considered operable if the trees marked for cutting amount to at least 3 cords per acre (Stone and Thorne 1961). Wisconsin, of course, has the advantage of good road networks for access.

Poletimber trees in all stand-size classes comprise 58 percent of the total growing-stock volume with the remaining 42 percent being sawtimber (fig. 27). The poletimber trees are of the size and age that responds to forest management practices in other regions. If properly protected and managed, they can produce much greater volumes in future stands. It is entirely possible, however, that future management and economics research might indicate that some stands should be managed on a pulpwood or poletimber rotation. This might result, for instance, from a better understanding of the relationship between permafrost and tree growth.

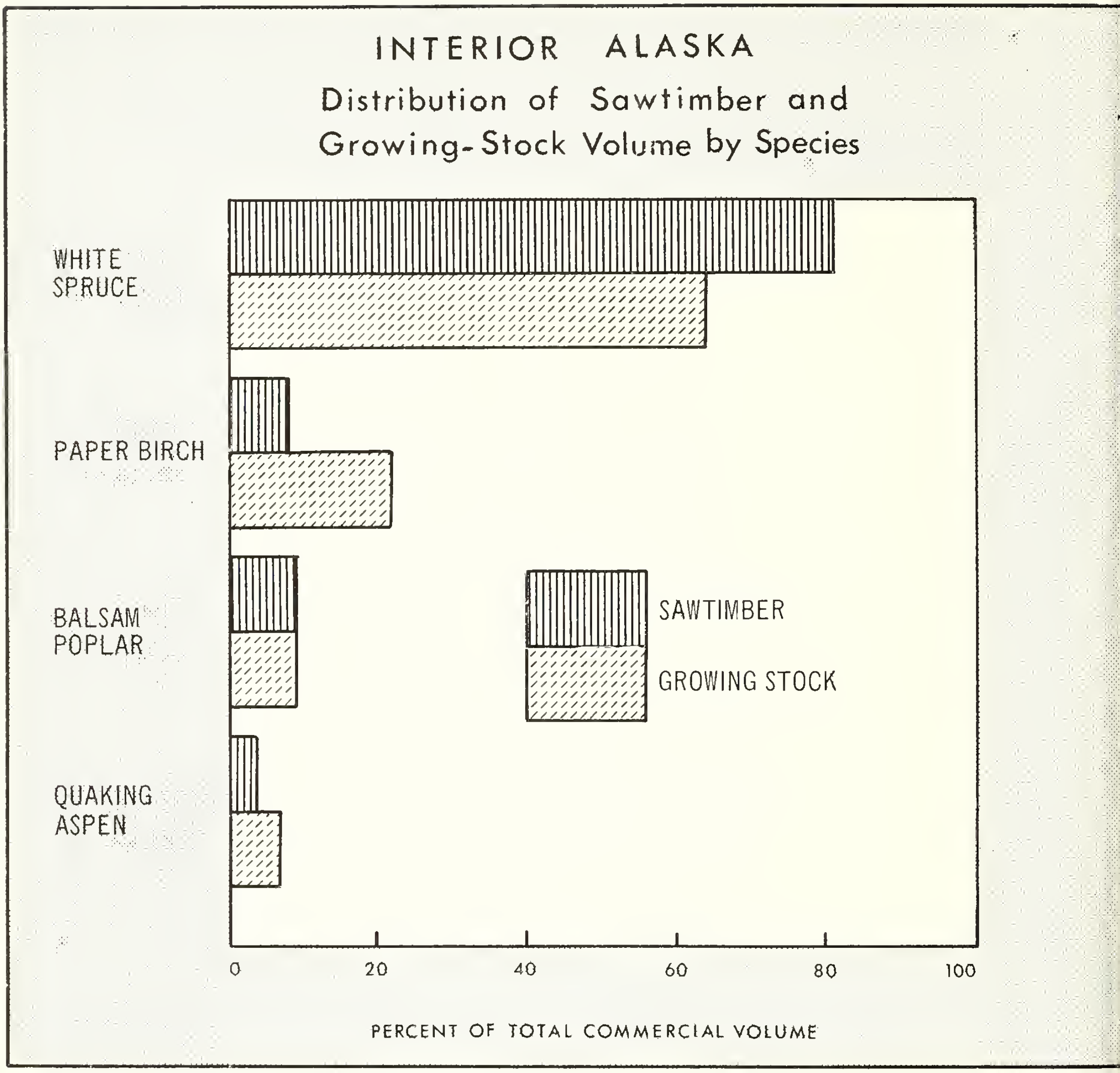

Figure 25.--Birch and aspen reproduce more readily following a fire than does spruce. Alaska's fire history may account for the increase of birch and aspen and the decline of spruce in the growing stock.

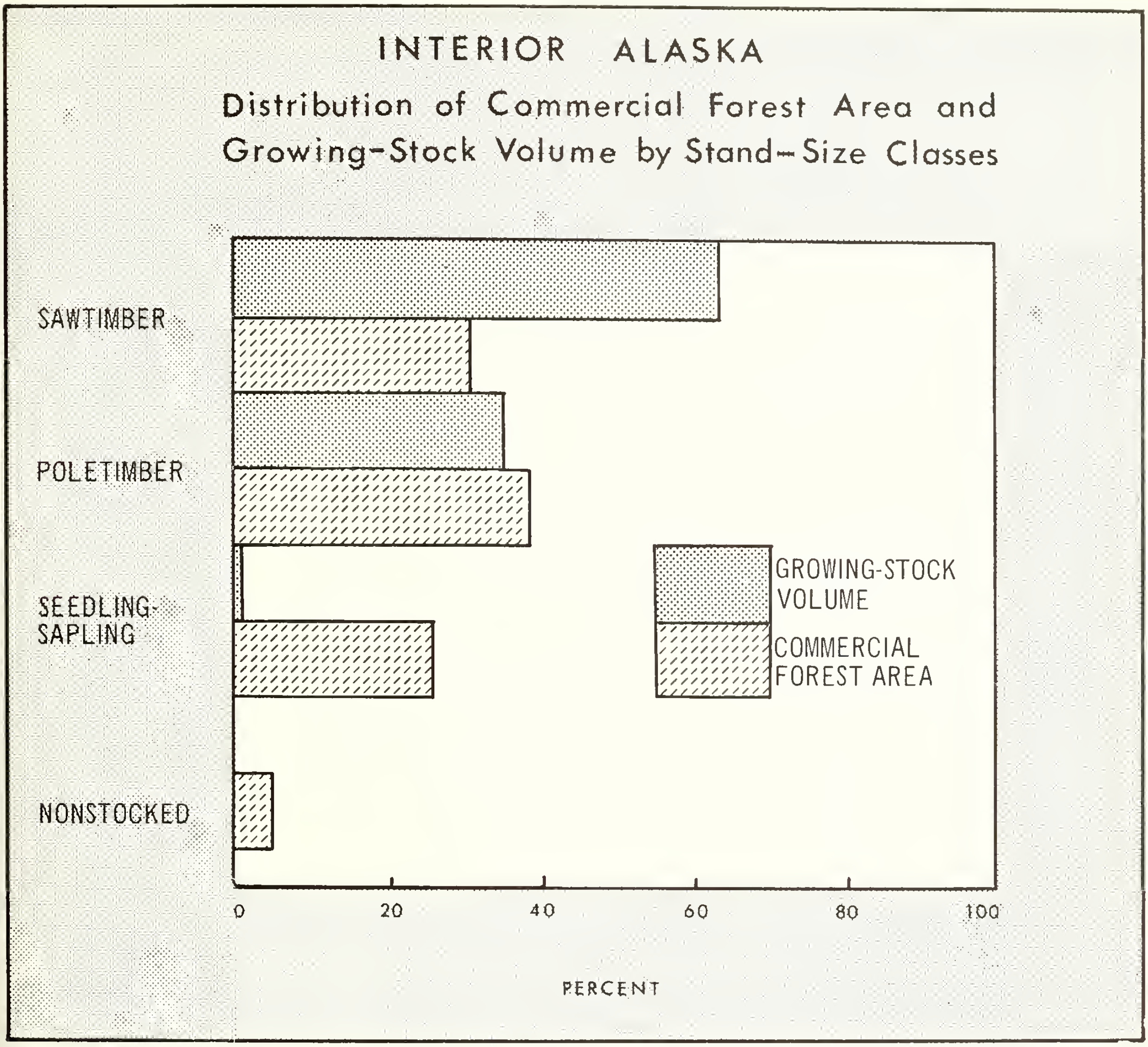

Figure 26.--The poletimber stand-size class has the highest percentage of commercial forest area, but the area in the sawtimber stand-size class contains more volume than all other stand-size classes combined.

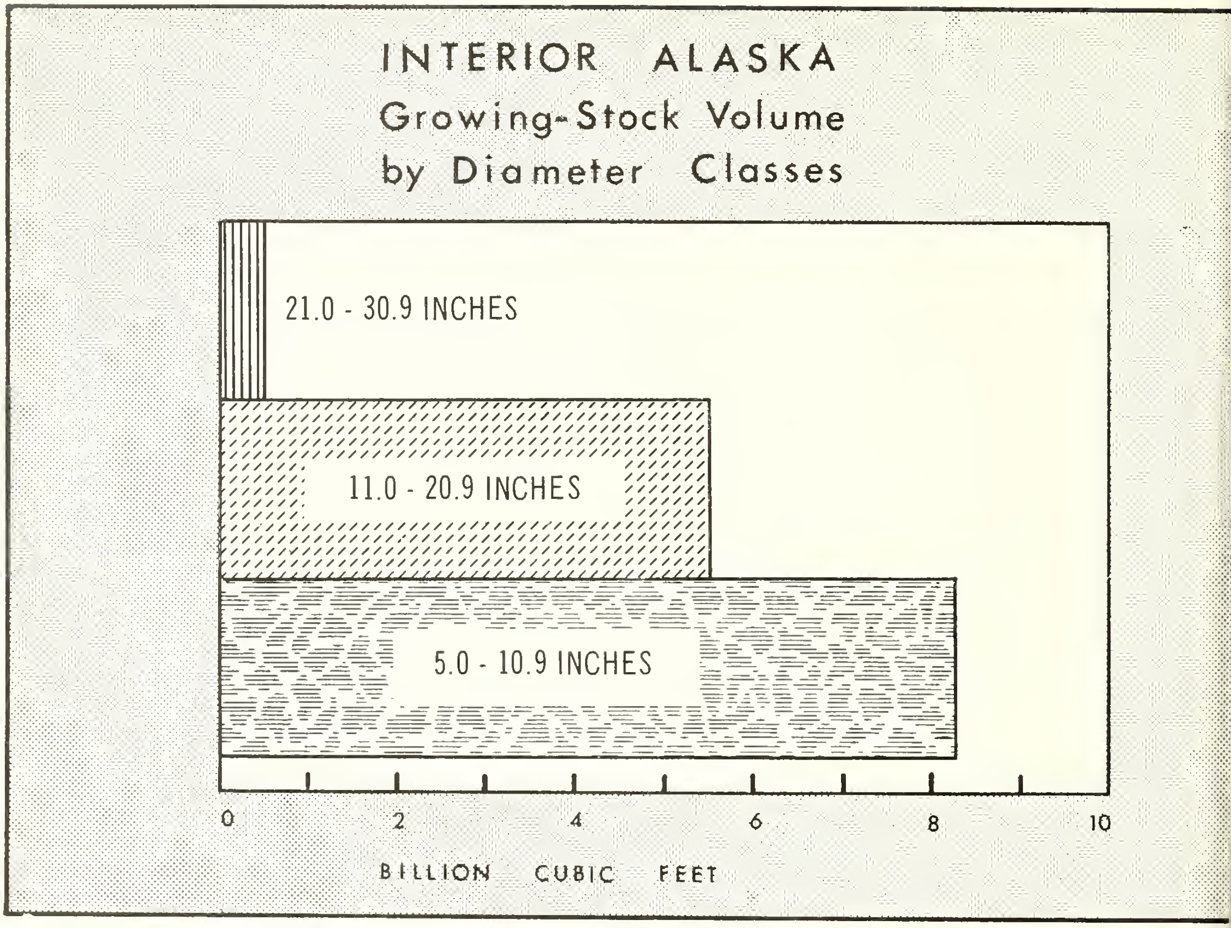

Figure 27.--Because the interior species, particularly paper birch and quaking aspen, mature at a relatively early age, much of the volume in the 5.0- to 10.9-inch class will not grow into a larger class.

LOG QUALITY AND TREE DIAMETERS

A system of grading hardwood logs for sawing into standard factory lumber (Vaughan et al. 1966) was used to estimate the quality of paper birch, balsam poplar, and black cottonwood stands. Although the grading rules do consider other factors than diameter, the distribution of volume by tree diameter classes served well to describe quality for interior Alaska. To qualify above log grade 3, a hardwood log must have a top diameter inside the bark of at least 11 inches. Allowing for bark thickness, the outside diameter would be approximately 12 inches. Hardwood trees will taper about 1 inch from the d.b.h. measurement to the top of the first 16-foot log. Thus, only trees 15 inches d.b.h. and larger can have logs that qualify for grade 1, and trees down to 13 inches may have a log that qualifies for grade 2.

Paper birch. — Thirty-four percent of paper birch sawtimber-size trees were large enough to evaluate higher than log grade 3. Log grade 3 accounted for 84.5 percent of the paper birch sawtimber volume. An additional 1.4 percent of the volume was poorer than grade 3 but still merchantable for local use. The desired logs — log grades 1 and 2 — comprised 5.2 and 8.9 percent of the sawtimber volume, respectively.

One mill study has been made in Alaska to determine the lumber recovery of standard hardwood lumber grades that may be expected from graded paper birch logs.[4] The results indicate that grades 1, 2, and 3 paper birch logs may be expected to yield 63, 48, and 24 percent, respectively, in No. 1 common and better lumber (dry tally). If we assume that this study, made in 1964 near Wasilla, will apply elsewhere in the interior, then on the average each 1,000 board feet of woods-run saw logs should yield about 324 board feet in No. 1 common and better lumber. Some stands, of course, will yield more high-quality lumber than others. If the objective of an operator should be to harvest only grade 1 and 2 logs, it would be necessary to search many acres to obtain an appreciable supply. Usually only butt logs are of high quality, so selective harvesting would cause many grade 3 logs to be cut and left in the woods.

Cutting operations to supply the current market for birch logs result in deterioration of the stands. Only the best trees and logs are harvested. The landowner has no alternative. Either he sells the timber on terms that meet the demand or he doesn't sell it. To remove the remaining low-quality trees and restore the stand to a favorable growing condition would require a considerable investment on the part of the landowner.

Quaking aspen. — Specifications prepared for the Lake States (Zasada 1948) were used to estimate aspen quality. By these criteria a minimum-sized sawtimber tree (11.0 inches d.b.h.) might have grade 1 and 2 logs.

Although aspen does not become a large tree in Alaska, it does grow clear and straight. The inventory placed 35.7 percent of the aspen sawtimber volume in grade 1 logs, 17.9 percent in grade 2, 46.0 percent in grade 3, and 0.4 percent in grade 4 or local use. Thus, over 50 percent of the aspen sawtimber volume is in grade 1 and 2 logs, a sharp contrast to the situation in Michigan where 99 percent of the aspen sawtimber is in grade 3 or poorer logs (Findell et al. 1960).

Balsam poplar and black cottonwood. — A reliable breakdown of volume by log grades could not be made for these species from the initial study because too few trees were obtained in the sample. However, a quality estimate is available for these species from a recent intensive study of the Susitna Valley. Preliminary findings of this study show 14 percent of the net saw-log volume of merchantable trees in log grade 1, 25 percent in log grade 2, 57 percent in log grade 3, and 4 percent in local use logs.

[4] Report in preparation by the Institute of Northern Forestry, Juneau, Alaska.

Because most of the good stands of balsam poplar and black cottonwood are in the Susitna Valley drainage, it would be improper to apply these percentages to the total interior volume of these species. However, the percentage of volume in grade 1 and grade 2 logs (39 percent combined) indicates that cottonwood grows well in interior Alaska. In fact, the better stands appear to compare favorably with good cottonwood stands along the Missouri River drainage. An Iowa report (Thornton and Morgan 1959) shows that 48 percent of the cottonwood (eastern and swamp cottonwood) of that State is in grade 1 and 2 logs.

Although it is difficult to distinguish black cottonwood from balsam poplar, black cottonwood has higher strength properties and appears to be the better saw-log tree. In the interior, black cottonwood occurs only along the lower Susitna Valley drainages in the Cook Inlet area.

White spruce. — The specifications used to estimate the quality of spruce were those of the Northern Hemlock and Hardwood Association (1947). Grade 1 logs must be 16 inches or larger and grade 2 logs at least 12 inches in diameter. In addition, a grade 1 log must be 75 percent clear on each of three faces, whereas a grade 2 must be 50 percent clear on three faces or 75 percent clear on two faces. Because white spruce generally is a small tree with many limbs (fig. 28), most trees could not qualify for high-quality logs. Twenty-nine percent of the sawtimber trees were large enough to consider for at least a grade 2 log.

The results show 1.3 percent of the sawtimber volume in grade 1 logs; 2.1 percent, grade 2; 72.9 percent, grade 3; and 23.7 percent was less than 50 percent sound, but would be suitable for some local uses.

Figure 28.--This stand of white spruce has a total basal area of 180 square feet per acre in trees averaging 9.2 inches d.b.h. The average age is about 170 years, and there are 390 stems per acre. Notice the persistent dead limbs. The trees will not grow to a large enough diameter to overcome a degrade in lumber caused by these limbs.

GROWTH ESTIMATES

All forest area classified as commercial will produce at least 20 cubic feet of wood per acre annually in poletimber and sawtimber trees that would be merchantable if a market existed. The field sample was too restricted to give a good indication of the upper productivity rating, but we believe that there is very little area, if any, producing more than 50 cubic feet per acre annually. Based on an analysis of radial growth measured on increment cores, the interior commercial stands produce a total of 212 million cubic feet annually.

However, average cubic-foot growth per acre amounts to less than half the productivity (20 cubic feet, mean annual increment) expected on commercial forest land. Stocking on 64 percent of the commercial forest land was rated from 10 to 70 percent. Most of the interior forest land is producing far below capacity.

Sawtimber growth averages about 30 board feet per acre annually. However, most of the board-foot growth occurs in sawtimber and poletimber stands which have an average annual growth, respectively, of 56 and 32 board feet per acre.

A study of well-stocked stands (Gregory and Haack 1965) shows that birch stands at age 90, site index 55, will produce about 2,800 cubic feet per acre in trees 4.5 inches d.b.h. and larger. Aspen with the same site index will produce the same volume in about 70 years.

TIMBER LOSSES AND RISKS

The apparent enemy of the interior forests is fire. During some periods, fire losses have averaged more than 1 million acres a year. Fires which destroy such large areas usually occur in remote regions and are difficult to fight. Often weather changes extinguish fires before ground crews can do the job. Accurate information concerning the total area burned, the types of vegetation destroyed, the amount of timber killed, and other damage appraisal information has been difficult to obtain.

In recent years, the Bureau of Land Management has greatly improved its fire fighting organization in Alaska and has reduced losses from fire. Fires are usually detected when small and are reached rapidly by road units and smokejumpers. Larger fires occur usually in remote areas, primarily in high country where little commercial forest land is found. From a 1964 study[5] of fires during one recent 5-year period, it appears that most of the forest area now being burned is of noncommercial quality. Fires that start in low vegetation usually burn rapidly over the brush, grass, moss, and lichen fuels but tend to slow down when they enter better stands of timber where ground fuels are generally green and wet. The study showed that some fires went out upon entering commercial stands. After burning, commercial forest land regenerated satisfactorily to commercial tree species. There is even evidence that some noncommercial forest areas have regenerated to commercial stands after being burned. Apparently this may happen when fire removes the insulating layers of moss and duff, resulting in warmer soil and lowering of the permafrost zone.

Although the study showed that fire damage to commercial forests was light, this does not imply that damage to other vegetative types was light. On the contrary, many acres of lichen and tundra ranges have been destroyed or seriously damaged.

[5] Unpublished report of the Institute of Northern Forestry, Juneau, Alaska.

Less spectacular than fire, but perhaps more destructive, are the diseases that attack the interior trees. A 1957 study showed that 37 percent of white spruce, 47 percent of paper birch, 78 percent of balsam poplar and cottonwood, and 82 percent of quaking aspen trees had decay in the merchantable stem (fig. 29). Much of this decay entered through fire scars and should be charged against the past fire record. The inventory shows that 6.6 percent of the gross volume of live trees is in trees with so much decay that they are classified as rotten cull trees and 0.6 percent is in sound cull trees. Although a high percentage of the live trees have some rotten defect, over 90 percent of the trees are merchantable. Rotten defects in merchantable trees account for about 3 percent of the cubic-foot and 18 percent of the board-foot volume, a loss of 1,360 million cubic feet and 8 billion board feet.

A 3-percent loss due to rot may appear to be relatively small, but what begins as a small defect in young trees becomes greater as the trees reach sawtimber size and maturity. Rot almost always reduces quality. Rot in the center of a log, although amounting to a very small percentage of the total volume, may make it impossible to hold the log on a lathe and thus mean the difference between a rotary veneer log and just another log for the sawmill.

Tree mortality, to some extent, describes the present stage of development of most interior stands. The mortality of sawtimber-size trees averages 6.4 board feet per acre annually, but the annual loss of all trees 5.0 inches d.b.h. and larger amounts to 3 cubic feet per acre. Most of the mortality, then, is in poletimber. Many young interior stands are dense, tending to be overstocked. The mortality figure shows that a natural thinning process is taking place in the poletimber stands.

ALLOWABLE CUT

Determination of allowable cut requires good knowledge of ownership and management objectives as well as knowledge of resource and productivity levels. Ownership status and land management objectives for the interior are so uncertain that any allowable cut estimate must be tentative.

If the commercial forest area as surveyed could be sustained and managed for timber production on a pulpwood economy, the estimated allowable annual cut on a 100-year rotation, by the Kemp formula,[6] would be about 358 million cubic feet. This would amount to an annual supply of about 4.5 million cords of pulpwood. By comparison, in 1963 the Lake States region (Michigan, Minnesota, and Wisconsin) cut about 3.7 million cords of pulpwood (Horn 1964). This pulpwood was supplied to 54 pulpmills, 49 of them in the Lake States region. Approximately 2 cords of wood are required for each ton of pulp production. Thus, a 500-tons-per-day plant would require about 350,000 cords annually. If the present commercial forest area is continued, interior Alaska could sustain at least 10 pulpmills of the 500-tons-per-day class.

Of course, the interior wood-using economy need not be built entirely on pulpwood production and use. The equivalent annual allowable cut of sawtimber amounts to 900 million board feet. Many uses of the sawtimber might be developed and integrated with a pulpwood harvest.

There are 83.3 million acres of noncommercial forest land which can meet some of the wood needs. Within the noncommercial class are 4.6 million acres now producing between 15 and 20 cubic feet of wood annually. These 4.6 million acres have a total growing-stock volume of 1.1 billion cubic feet. Included in this growing stock are 2.8 billion board feet of sawtimber.

[6] For basic Kemp formula, see "Appendix," p. 57.

Figure 29.--A, above, shows the fruiting body and the heart rot caused by the fungus Pholiota. *In B, the rot shown is caused by* Fomes igniarius, *shown here in a paper birch log.*

It is not likely that the allowable cut will be harvested in the interior for many years. The total volume of wood available is more than adequate for important industrial uses, but many economic problems must be overcome before the stands can be utilized. To use the interior stands will require more and better markets, the development of more efficient wood-handling equipment than is now in use, more roads, an experienced labor force, and efficient export facilities.

TIMBER PROCESSING AND MARKETING

Wood-using industries of Alaska harvested 398 million board feet of logs in 1961 (Bones 1963) for a stumpage return of about $1 million. After primary processing, the total end-products value was estimated to be $48 million (Rogers and Cooley 1962). Ninety-nine percent of the log volume was obtained from coastal forests. Even more specifically, the National Forests of the coastal region provided 96 percent of the log volume. Other public lands provided about 3 percent, and less than 1 percent came from private ownerships. Western hemlock accounted for 53 percent of the cut and Sitka spruce 46 percent. By 1964, the timber harvest had increased to about 464 million board feet (Scribner log rule) valued at more than $63 million (Alaska State Development Corporation 1965). Few changes took place, however, in the source of supply and use patterns between 1961 and 1964. Chiefly, the existing plants increased their output.

Although scattered cutting operations have been going on since Russia owned Alaska, substantial use of Alaska's forests is just beginning (fig. 30). Choice Sitka spruce logs were harvested and exported for airplane stock during the First and Second World Wars, but installation of the first important wood-processing plant in Alaska did not occur until 1954. At that time, the Ketchikan Pulp Co. began operation with a 525-tons-per-day plant at Ward Cove near Ketchikan. A second mill, the Alaska Lumber & Pulp Co., began operating at Sitka in 1959 with a plant capacity of 460 tons per day (fig. 31). These two plants used 79 percent of the wood harvested in Alaska in 1961. The present combined capacity of these two plants has increased to 1,100 tons per day (U.S. Forest Service 1965b). As a result of a timber sale made late in 1965 by the Forest Service, a third pulpmill may be installed by 1971 increasing the pulp-producing capacity by about 50 percent.

In addition to the pulpmills, there were 87 sawmills, 1 preservative plant, and 2 house-log plants in Alaska in 1961. Only 67 of the sawmills were active. They were distributed as follows:

	Coastal	Interior
Active	30	37
Inactive	6	14
Total	36	51

Some reduction in the number of sawmills seems to be taking place; the Alaska Branch of Forestry reported 57 sawmills in 1966 (Alaska 1966).

The coastal sawmills cut about 70.5 million board feet of lumber in 1961, 96.8 percent of the total lumber production in the State. Although the interior has more sawmills, most are small, portable, and operate erratically to supply local community needs (fig. 32). These interior sawmills operated at about 10 percent of their rated capacity in 1961, whereas coastal mills operated at about 74 percent capacity.

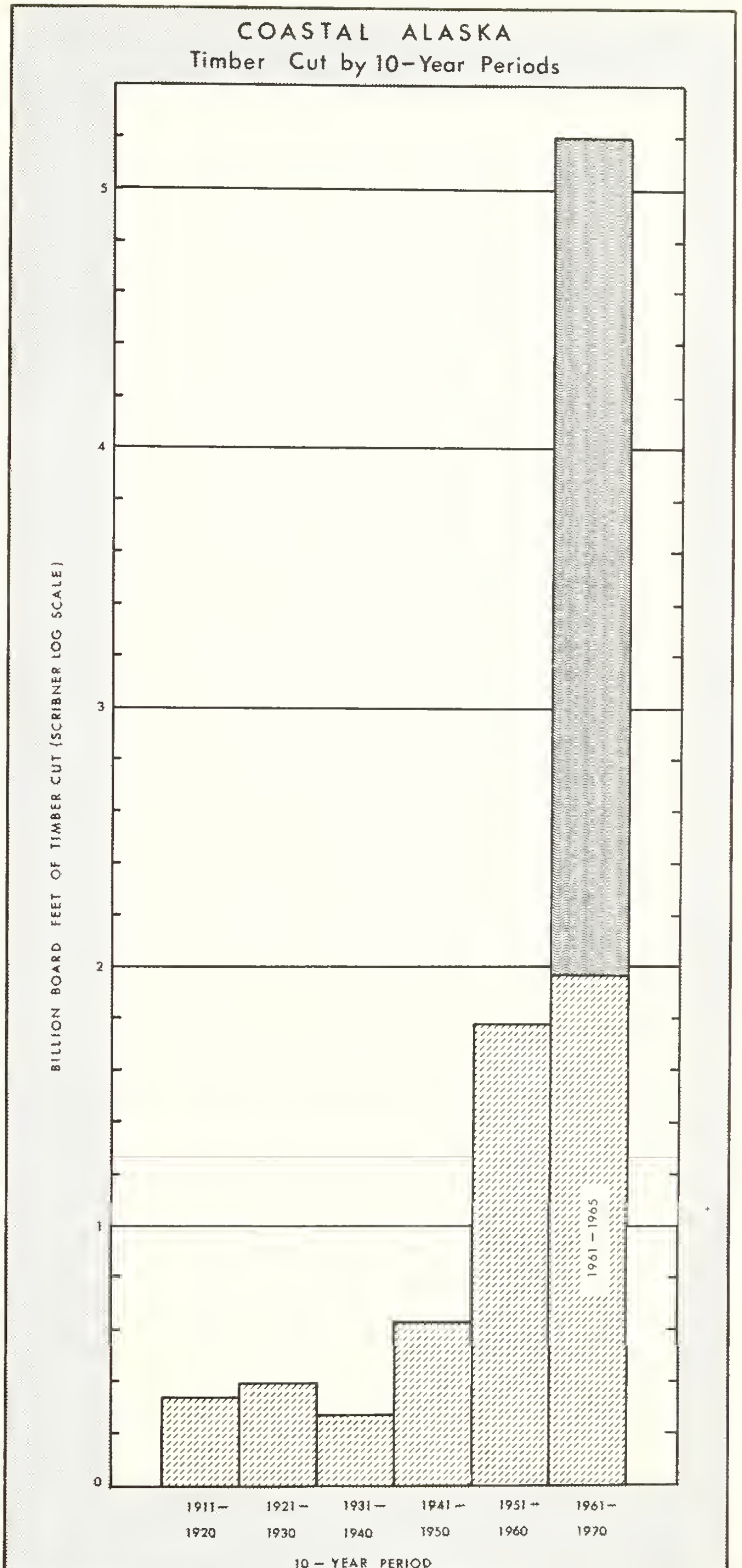

Figure 30.--The timber cut shown here is entirely from National Forests. Long-term sales to the two pulpmills have resulted in a dramatic increase in timber cut during the last 10 years. The cut projected to 1970 is based on recent estimates by the U.S. Forest Service, Region 10.

Figure 31.--The Alaska Lumber & Pulp Co. plant near Sitka.

Figure 32.--This resident of Aniak on the lower Kuskokwim River is building a fish wheel from materials obtained locally--a few boards from a local sawmill and saplings from along the river.

Alaska's wood-using industries depend upon export markets. In 1961, the wood products were distributed as follows:

	Percent
Alaska	7
Other U.S. markets	36
Foreign	57
	100

All of the pulp was exported, 56 percent to foreign markets and 44 percent to other States. About 65 percent of the lumber production was exported also.

Japan continues to be the most important foreign market for Alaska's products, receiving 76 percent of the total exports in 1962, 82 percent in 1963, and 89 percent in 1964. Wood products, primarily pulp and lumber, with a value of $29,708,000, amounted to 83 percent of the total Alaskan export in 1964. Wood products export increased 43 percent over 1962 export, whereas Alaska's total export increased 12 percent in the same period. Pulp exports increased 30 percent in 1964 over 1962 and accounted for 82 percent of the export value of wood products (Alaska University 1965).

In the coastal area, the hemlock-spruce stands are clearcut, primarily to supply the two pulpmills. The best Sitka spruce logs are often sorted from the rafts and either traded or sold to the sawmills. Most of these logs are cut into cants for export (fig. 33). A relatively small volume of standard lumber grades is produced for local markets. The cants are graded in various export grades and shipped to Japan. Fifty-seven percent of Alaska's lumber production went to Japan in 1961 and an even higher percentage since then.

Timber sale contracts made by the Forest Service require primary manufacture of western hemlock and Sitka spruce logs in Alaska. This policy, supporters contend, is responsible for the two pulpmills and several sawmills in Alaska. However, because there is no market for cedar logs in Alaska (fig. 34), the better logs are exported to Japan rather than left in th woods. Whether a local market exists o not, good forest management requires tha cedar and other minor species be cut t provide a favorable seedbed for the regeneration of spruce and hemlock.

Alaska's pulpmills and sawmills ar primary manufacturing plants. Most o their output must be further processed i secondary plants to obtain products wante by consumers. Alaska lacks the dry kilns planing mills, millwork plants, papermills and plywood plants that could prepar more local timber for local use. The pul matte leaves Alaska to be manufacture into rayons, plastics, and the multitude o paper products that eventually reach th consumer market.

For some time to come, any substantia industrial development in Alaska, whethe primary or secondary processing, must b tied to export markets. Alaska's population dictates this. In 1960, the tota population was 226,167 — only 0.4 inhabitant per square mile. Anchorage, th largest city, had a population of 44,23 In 1962, the per capita consumption o lumber in the Nation was 200 board fee If Alaskans use lumber at about the sam rate, one modern, efficient sawmill coul meet Alaska's needs. Per capita consumption of plywood and veneer in the Unite States was 64 square feet in 1962 — two 4x8-foot sheets of 3/8-inch-thick pl wood. The output of one plywood pla could supply Alaska. The manufactur of almost any product must cope with th problem of a local market too small justify the construction of a plant th can compete with production from oth States.

Because of higher production costs Alaska, any industry dependent on a loc market may be vulnerable. Local prod cers of poultry and dairy products find difficult to compete with products fro Seattle. The wood preservative plant th began operation in 1961 closed in 19 because its chief market, railroad cros ties for the Alaska Railroad, was lost a competitor in the Seattle area.

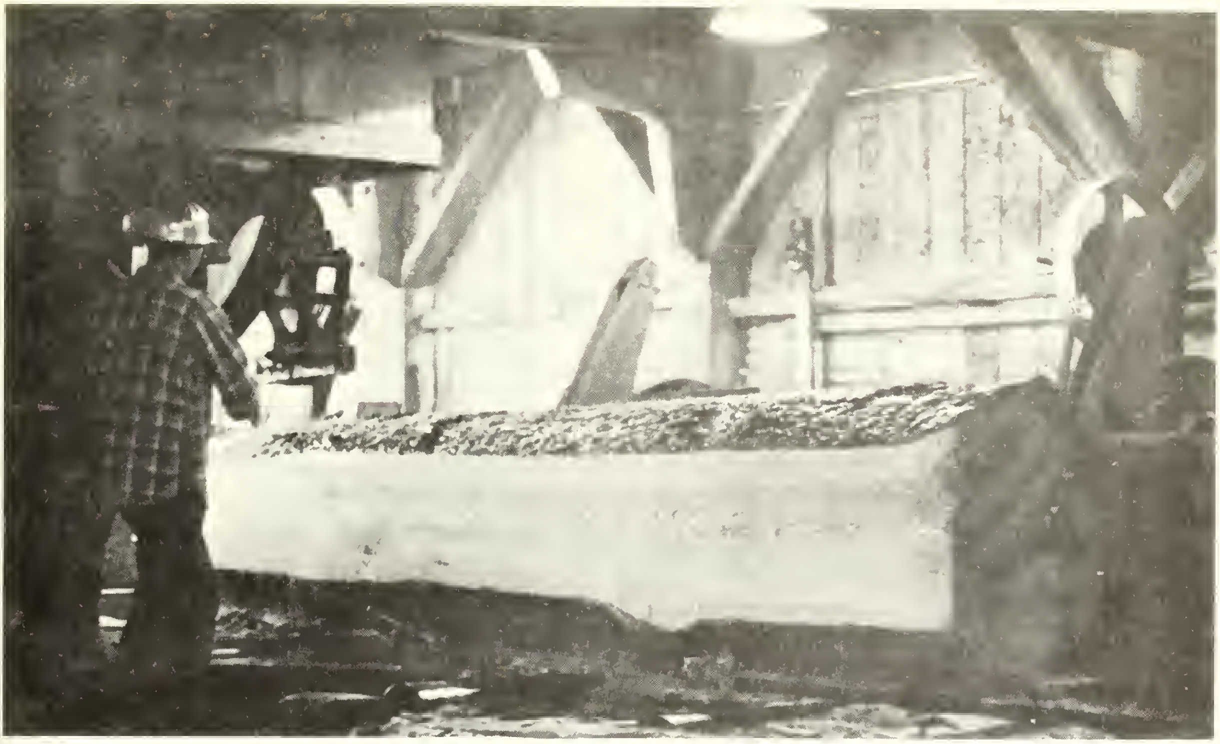

Figure 33.--Large Sitka spruce log being cut into cants (see below) for export to Japan.

Figure 34.--No quality determination was made of Alaska-cedar, but southeast Alaska stands contain many fine trees such as this. The Alaska-cedar being measured is 4 feet in diameter. It is in a stand at Cape Fanshaw north of Petersburg.

Until pioneering ventures in Alaska are established and competitive, it may be necessary and desirable to protect and encourage them in some manner. Many new ventures have failed in Alaska, and this discourages other investors from trying. Reasons for failure can be traced to such things as poor management, lack of experience, undercapitalization, inadequate market research, high production costs, high marketing costs, inefficient and unsuitable equipment, and insufficient knowledge of available resources. Timber industries in the coastal region have obtained their stumpage at a minimum cost of $2 and $3 per thousand board feet, but prices are increasing. Average stumpage rates ranged from $2.56 in the first quarter of 1965 to $4.63 in the last quarter. Stumpage rates have been considerably lower than the price of similar stumpage in Oregon and Washington, but what appears to be an advantage in stumpage price is offset by higher logging, transportation, and milling costs.

The transportation problems of Alaska are important and complex. Means of moving products between Alaska and outside markets are limited. Shipments originating on the Alaska Railroad must transfer to trucks or waterborne vessels to reach outside markets. Truck shipments can travel the long Alaska Highway or transfer to ocean vessels and barges. Some forest products are shipped by rail barge to Prince Rupert, British Columbia, where the sealed cars continue by rail to United States markets. The Jones Act requires that American ships carry all products between American ports. This act, written with the national interest in mind, is believed by some Alaskans to be discriminatory locally. Those taking this view believe that lower rates might be obtained for Alaska by allowing ships of some other countries to compete. Such competition would favor Alaska by reducing the cost of imported goods as well as export costs, thereby reducing costs of production in Alaska which, in turn, would make it possible to export goods to the west coast markets at more competitive prices. Perhaps the steady increase of Alaskan exports to Japan may be attributed, in part at least, to lower shipping costs on Japanese ships.

Local communities and regions benefit greatly from manufacture of logs into products and from a diversified industry. During 1964, the logging, sawmilling, and pulp manufacturing activities in Alaska employed about 2,400 men (Alaska State Development Corporation 1965). This amounted to an average of 5.17 employees for every million board feet of logs processed. About half of this employment was used in the conversion of the logs into green lumber and pulp (U.S. Bureau of Census 1963). Additional labor inputs that Alaska might strive for are indicated by the following:

Average employment per unit of annual wood input in Oregon and Washington:[1]

Activity	Number of employees
Logging[2]	2.27 (west side)
Sawmilling (green lumber)[3]	1.22 - 1.70
Lumber processing (dry lumber)[3]	2.05 - 2.31
Lumber remanufacture[3]	7.89 - 8.28
Veneer[4]	1.71
Plywood[4]	5.21
Other plywood processing[4]	1.17
Pulp[5]	1.07
Paper and paperboard[5]	1.66
Converted pulp products[5]	4.62

[1] Summarized from Smith and Gedney (1965).
[2] Per million board feet of logs harvested.
[3] Per million board feet of lumber production.
[4] Per million board feet of logs used.
[5] Per thousand cords of pulpwood used.

Very little lumber processing in Alaska goes beyond the green stage. By carrying the processing to dry lumber and to remanufacturing stages, another 10 men could be employed for each million board feet of lumber used. Some logs go into lumber and pulp that might be utilized for veneer and plywood. Veneer and plywood plants could provide employment for another eight men for every million board feet of logs used.

Although the two pulp plants have made important changes in the economy of southeast Alaska, a sufficient timber resource exists for much more development and a much more diversified industry.

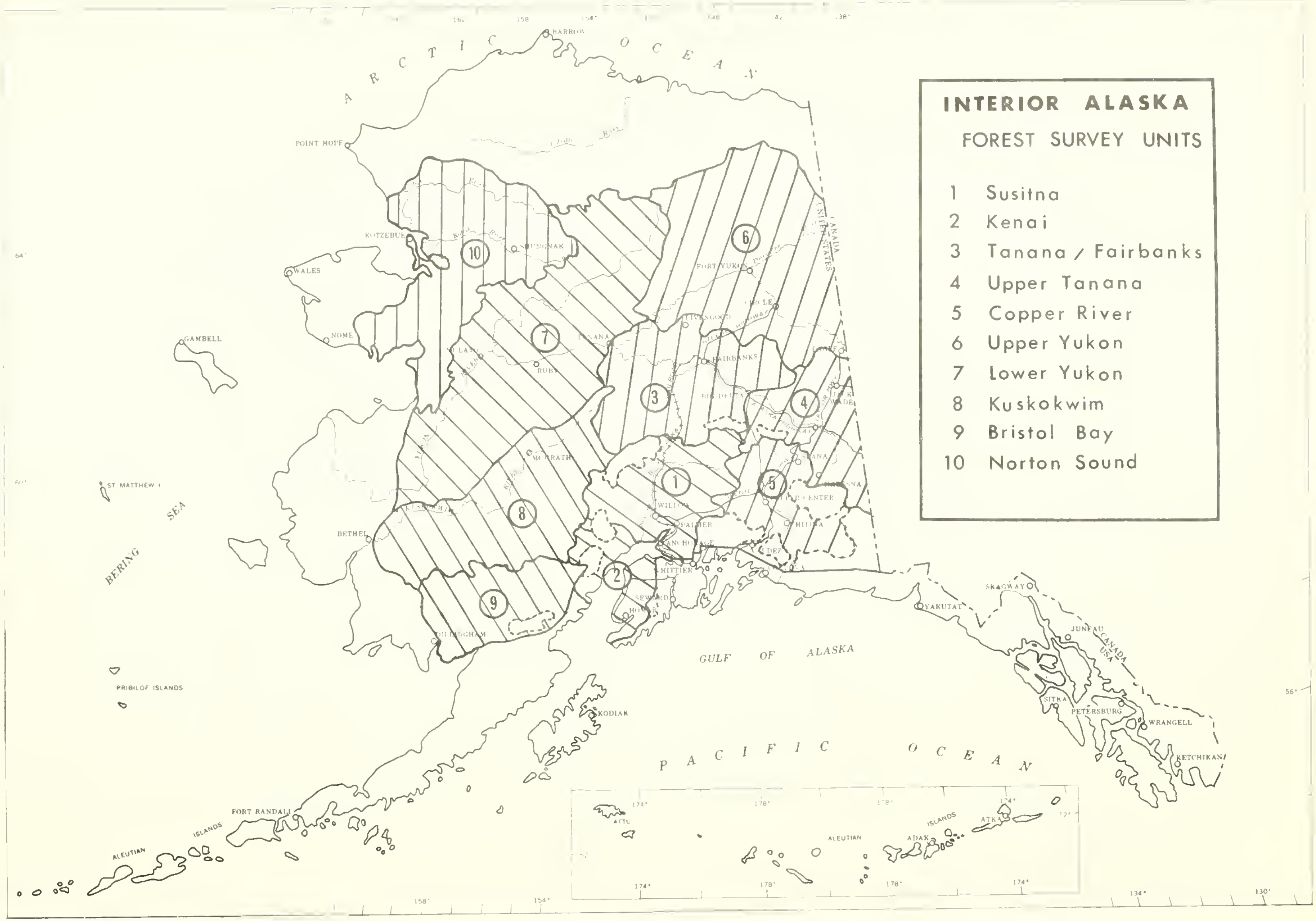

Figure 35.--The exterior boundary of these Forest Survey units indicates the approximate limit of commercial tree growth in the interior. The diagonal lines indicate the approximate location of flight lines to obtain the aerial photography used for

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APPENDIX

FOREST SURVEY METHODS

Coastal Alaska

This region was divided into seven units and inventoried in the following order:

	Year fieldwork completed
1. Juneau	1955
2. Sitka	1956
3. Petersburg	1956
4. Yakutat	1957
5. Ketchikan	1957
6. Cordova and Afognak Island	1961
7. Kenai	1962

These are administrative units recognized by Region 10 of the U.S. Forest Service. Each unit is further subdivided into administrative blocks for summary tables, but sampling was by the unit. Commercial forest lands outside these units were not inventoried at the same intensity (for sampling intensities see table 26). In some instances, the land and cover types of areas outside these units were determined by interpretation of aerial photos, and the average volume-per-acre estimates for adjacent units were applied.

Area estimates. — A point sampling technique on 100-percent aerial photo coverage was used to obtain the area statistics. Sample plots were systematically located on the effective portion of vertical photographs.

Each photo plot was stereoscopically examined and classified as forest or nonforest. The classification for each photo plot was determined on the basis of the 10-acre area immediately surrounding the plot. Next, the forest plots were classified as commercial or noncommercial. Finally, the commercial forest plots were stratified by accessibility, forest type, stand-size, and density classes. The classified plots for each block were then summarized by stratum.

To determine the accuracy of the office photo classification a sample of photo plots was checked in the field. A predetermined number of photos was selected at random, and all of the plots on each photo, called a cluster, were examined.

Volume estimates. — Some photo plots classified as commercial forest land were randomly selected for field examination. At the field locations, survey crews collected such data as species, diameters, merchantable heights, defect, mortality, stand-size class, forest type, etc., on three plots, each one-fifth acre in size at 2-chain intervals.

Sufficient plots were selected at random to attain a specified level of statistical accuracy. The survey was designed for maximum efficiency in estimating total volume to meet the requirements of the Timber Management Division of Region 10 and the Forest Survey.

Accuracy of the estimates. — Errors which affect the accuracy of the area and volume estimates in this report may arise from two sources:

1. *Nonsampling errors.* — These are human mistakes in judgment, measurement, recording, or arithmetic. There is no practical method of finding out just how often such errors occur. These errors are kept to a minimum, however, by a diligent effort to maintain a high degree of accuracy in the collection and compilation of data and by closely checking all phases of the work.

2. *Sampling errors.* — These errors arise from using sampling procedures rather than making a 100-percent inventory. These errors can be measured. They are the only measurable errors involved in computing the reliability of the estimates.

Computed sampling errors of forest area estimates for the major coastal units studied are as follows:

Forest Survey unit	Commercial forest		Noncommercial forest	
	Area	Sampling error	Area	Sampling error
	Thousand acres	Percent	Thousand acres	Percent
Southeast:				
Juneau	820.6	2.5	832.0	2.5
Sitka	540.7	3.3	1,199.5	1.8
Petersburg	1,029.2	2.3	1,327.4	1.9
Ketchikan	1,958.6	1.4	2,297.3	1.3
Yakutat	276.6	4.6	38.6	14.8
Chugach:				
Cordova	335.0	5.0	842.1	2.0
Kenai	189.6	3.0	76.6	5.0
Afognak	230.0	2.2	48.5	6.3
Total	5,377.7	--	6,665.0	--

An additional 371,000 acres of commercial forest land has been estimated by photo interpretation and included in the appendix tables for coastal Alaska. No sampling error can be computed for this area estimate.

Computed sampling errors of volume estimates of growing stock for the major coastal units studied are as follows:

Forest Survey unit	Total volume		Sampling error of total		Sampling error per million cu. ft.
			Bd. ft.	Cu. ft.	
	MM bd. ft.	MM cu. ft.	Percent		
Southeast:					
Juneau	26,764	5,194.9	4.9	4.6	2.0
Sitka	19,470	3,704.5	5.5	5.6	2.9
Petersburg	36,584	7,021.9	5.1	5.9	2.2
Ketchikan	71,155	13,595.8	4.2	3.5	.9
Yakutat	5,731	1,055.6	10.1	7.9	7.7
Chugach:					
Cordova	8,277	1,728.6	9.5	9.3	7.1
Kenai	1,812	459.4	17.8	15.8	23.3
Afognak	5,873	1,187.2	7.1	6.2	5.7

Each survey unit was sampled separately, and sampling error was computed for the total area and total volume estimates of each. As these total estimates are subdivided in the various tables to give values by stand-size class, forest type, diameter class, species, etc., each further breakdown becomes less accurate.

Interior Alaska

This region was divided into 10 units (fig. 35) including a gross area of about 229 million acres. Areas outside the boundaries of these units are beyond the limits of tree growth and were not inventoried.

Aerial photography suitable for forest inventory purposes was not available for interior Alaska. Strip photography at a scale of 1:5,000 was flown at 30-mile intervals across the prevailing drainages. A special study was made to determine the type of film that would result in the most desirable prints for photo interpretation and infrared film exposed with a minus blue filter was chosen. This photographic project was completed in 1960 and resulted in about 11,000 miles of flight lines and 37,000 photographs.

A triple-sample technique was used to determine area and volume. The first sample consisted of interpretation of a ½ acre plot located near the center of each aerial photo. The second sample consisted of an air check of approximately 10 percent of the photo plots. The third sample was drawn from the air-checked plots, and the plots drawn were examined and measured on the ground.

Area estimates. — Land and fores classes were interpreted for the ½-acr plot on each of the aerial photos. The pro portion of land and forest in the variou classes was adjusted by the air-check ob servations. Area estimates are the pro duct of these proportions applied to th total area in each unit.

Volume estimates. — Gross timbe volume estimates were made for each for est location using aerial photo stand vol ume tables. These tables are based o species, stand height, and density. Cor rection factors were computed for eac photo interpreter based on ground plo measurements of stand height and density Total gross volume estimates are the pro duct of area in the various classes an the adjusted average volumes per acre de veloped from the photo plots.

Net volumes were obtained by making deductions at the field locations. These deductions were averaged by species and stand classifications and applied to the gross volume estimates.

The sample. — The number of locations studied on photos, from air observation, and by ground measurement were as follows:

	Forest Survey unit										
	1	2	3	4	5	6	7	8	9	10	Total
Total photo points	2,412	913	3,595	2,258	1,790	6,441	7,623	4,415	2,564	5,166	37,177
Total air-check points	219	94	331	231	205	657	813	457	261	506	3,774
Total ground plots	23	24	39	21	18	67	66	43	21	33	355

DEFINITION OF TERMS

COASTAL ALASKA

Land Use Classes

Forest land. — Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime; (b) land from which trees have been removed to less than 10-percent stocking, and which has not been developed for other use. (Forested tracts and islands of less than 10 acres and isolated strips of timber less than 120 feet wide are excluded.)

Commercial — Forest land which is (a) producing or capable of producing usable crops of industrial wood (will net a minimum of 8,000 board feet per acre, International ¼-inch rule); (b) economically accessible now or in the foreseeable future; and (c) not withdrawn from timber utilization.

Noncommercial. — Forest land incapable of producing usable industrial wood because of adverse site conditions or withdrawn for specified purposes.

Unproductive. — Noncommercial forest land which does not now support or will not produce a minimum of 8,000 board feet per acre.

Productive. — Forest land capable of producing usable crops of industrial wood, but withdrawn for specified purposes through statute, ordinance, or administrative order.

Nonforest land. — All land not qualifying as forest land. Includes land which has never supported forest growth; land from which the forest has been removed to less than 10-percent stocking and has been developed for other use, such as agricultural, residential, or industrial; all land in thickly populated urban and suburban areas; and water areas under 40 acres classified by the Bureau of the Census as land. Glaciers, icefields, marshland above mean high tide, permanent brush fields, muskegs less than 10 percent stocked to trees of any size, and barren mountain tops are examples of lands which have never supported forest growth.

Forest Types

Forest types are classified on the basis of the species or species group that accounts for the major portion of the stand in terms of net board-foot volume for sawtimber, cubic-foot volume for poletimber, and number of trees for seedling-sapling stands.

Sitka spruce. — Forests in which Sitka spruce is predominant.

Hemlock-Sitka spruce. — Forests in which 50 percent or more of the stand is western hemlock but in which Sitka spruce makes up 30 to 49 percent of the stand.

Hemlock. — Forests predominantly western hemlock except when Sitka spruce comprises 30 to 49 percent of the stand.

Hardwood. — Forests predominantly cottonwood or red alder, singly or in combination.

Tree and Stand Classes

Sawtimber trees. — Live trees of commercial species at least 11.0 inches d.b.h. with at least 25 percent of their gross board-foot volume free from rot or other defect and that contain at least one merchantable saw log.

Merchantable saw log. — For softwoods, not less than 16 feet long and contains a minimum of 20 board feet, between a stump height equal to d.b.h. but not exceeding 4½ feet and a merchantable top equal to 40 percent of d.b.h., except in the case of small trees where the minimum top is 6 inches.

For hardwoods, not less than one 8-foot log to a minimum top of 8 inches d.i.b. for small trees and 40 percent of d.b.h. for large trees. After deductions for defect, a saw log must contain a net scale of at least 33-1/3 percent of the gross.

Upper stem. — The section of the bole or main stem of a sawtimber tree from the merchantable top to a minimum top diameter of 4.0 inches inside the bark.

Poletimber trees. — Live trees 5.0 inches to, but not including, 11.0 inches d.b.h. These trees are of sufficiently good form and condition to indicate that they will grow into merchantable sawtimber trees.

Sapling and seedling trees. — Live trees of commercial species less than 5.0 inches d.b.h. and of sufficiently good form and vigor to indicate that they will grow into merchantable sawtimber trees.

Growing-stock trees. — All live trees, except cull trees, of commercial species.

Cull trees. — Live trees 5.0 inches d.b.h. and over that do not qualify as sawtimber or poletimber trees due to poor form, limbiness, rot, or other defect.

Rotten cull trees contain excessive decay.

Sound cull trees have excessive crook, sweep, or large limbs.

Salvable dead trees. — Standing, dead, sawtimber-size trees containing at least one merchantable saw log having sound volume equal to at least 50 percent of the gross volume in the tree.

Mortality trees. — Trees 5.0 inches d.b.h. and larger which died of natural causes and were not cull trees at the time of death.

Sawtimber stand. — Forest stands in which the minimum volume for coniferous types is 8,000 net board feet (Scribner) per acre in growing-stock trees 11.0 inches d.b.h. and larger. For hardwood sawtimber stands the minimum volume is 4,000 net board feet (Scribner) per acre.

Old-growth. — Sawtimber stands in which the majority of volume is in sawtimber trees more than 150 years of age.

Young-growth. — Sawtimber stands in which the majority of volume is in sawtimber trees less than 150 years of age.

Poletimber stand. — Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger growing-stock trees, and with at least half the minimum stocking in poletimber trees.

Sapling and seedling stand. — Stands not qualifying as either sawtimber or poletimber, but having at least 10-percent stocking of trees of commercial species and with at least half the minimum stocking in seedlings and saplings.

Nonstocked and other areas. — Commercial forest land less than 10 percent stocked with growing-stock trees.

Volume Classes

Sawtimber volume. — The net volume in board feet, International ¼-inch rule, of merchantable saw logs in live sawtimber trees of commercial species.

Growing-stock volume. — The net volume in cubic feet of sound wood in live sawtimber and poletimber trees of commercial species from the stump to a minimum 4.0-inch top inside the bark.

Total volume. — The net volume in cubic feet of sound wood in live and salvable dead sawtimber and poletimber trees and in sound and rotten cull trees of commercial species from the stump to a minimum 4.0-inch top inside the bark. Included is the volume of hardwood limbs on sawtimber trees to a minimum diameter of 4.0 inches inside the bark.

Log Grades

Sample western hemlock and Sitka spruce trees were graded in 16-foot log lengths. However, when any 12- or 14-foot section of a log was better than the entire log, the grade of the shorter section was given to the entire log.

The rules used were from the January 1954 edition of Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon, and Northern California Bureaus.

Abbreviations Used

DBH or d.b.h. — Abbreviation for diameter at breast height. This measurement is taken 4½ feet above the ground on the uphill side of the tree.

d.i.b. — Abbreviation for diameter inside the bark. This measurement may be taken at any specified location.

d.o.b. — Abbreviation for diameter outside the bark. This measurement may be taken at any specified location.

2-inch diameter class. — If the classes are expressed as 6, 8, 10 inches, etc., this means that the diameters included are from 5.0 through 6.9, 7.0 through 8.9, 9.0 through 10.9, etc.

Stocking Classes

Stocking is a measure of how effectively the area is being utilized by growing stock. No stocking measure was assigned to old-growth stands. For young-growth stands, ocular estimates were made of the crown cover of sawtimber trees on the 10 acres surrounding each plot location. The stocking of poletimber, saplings, and seedlings was based on the number of stems per acre. The following classes and guides were used:

Poletimber. —

	Percent stocked
210 or more stems per acre	70
120 to 210 stems per acre	40
30 to 120 stems per acre	10

Saplings and seedlings. — Stocking was measured on ten 4-milacre circular plots. Two or more established saplings or seedlings were required to stock a 4-milacre plot. Stocking of the area was determined by the number of 4-milacre locations that were stocked. Thus, if six of the ten 4-milacre locations were stocked, the area was judged to be 60 percent stocked.

Area stocking classes	Percent
Nonstocked	0-10
Poorly stocked	10-39
Medium stocked	40-69
Well stocked	70-100

Volume Measurements

Board foot. — A board 1 foot long, 1 foot wide, and 1 inch thick. The bark is usually eliminated from this measurement. In practice, the working unit is 1,000 board feet and may be abbreviated to M bd. ft., M.B.M., or MBF.

Cubic foot. — A cube 12 inches on a side. The cubic-foot volume of a log or tree is commonly computed by Smalian's formula (Bruce and Schumacher 1950).

International ¼-inch log rule. — A rule used to determine the log volume in board feet (Bruce and Schumacher 1950).

Allowable Cut

"The volume of wood which can be cut under management for a given period of time" (Society of American Foresters 1958).

A number of formulas are available to make this estimate. The Kemp formula is easy to apply with the kind of inventory data available. Usually this formula is applied to areas in which there is a surplus of timber beyond rotation age. The objective is to determine the cut that will achieve an approximately equal distribution of area by age or stand-size classes within a rotation.

The Kemp formula:

$$\text{Annual cut} = \frac{7A + 5A_1 + 3A_2 + A_3}{4R}\ (MA)$$

A = area of sawtimber stands
A_1 = area of poletimber stands
A_2 = area of seedling and sapling stands
A_3 = nonstocked area
$A+A_1+A_2+A_3$ = total commercial forest land area
4 = number of stand-size classes
R = rotation in years
MA = average volume per acre of current sawtimber stands, the A stratum

INTERIOR ALASKA

Only definitions that differ from coastal Alaska are repeated.

Land Use Classes

Forest land. — Same as for coastal Alaska except that 1 acre was the minimum area classified.

Commercial. — Forest land which is producing or capable of producing crops of industrial wood, in excess of 20 cubic feet per acre of annual growth, and not withdrawn from timber utilization.

Noncommercial. — Same as for coastal Alaska.

Unproductive. — Forest land incapable of producing 20 cubic feet per acre of annual growth in industrial wood.

Forest Types

Classified by the predominance of one or more species; based on gross board-foot volume for sawtimber stands, cubic-foot volume for poletimber stands, and crown cover in seedling and sapling stands.

Spruce. — Spruce, usually white spruce, accounts for 50 percent or more of the volume or crown cover. Associated species are black spruce, paper birch, and balsam poplar.

Birch. — Paper birch accounts for 50 percent or more of the volume or crown cover. Associated species are quaking aspen, white or black spruce, and balsam poplar.

Aspen. — Quaking aspen accounts for 50 percent or more of the volume or crown cover. Associated species are white or black spruce, and paper birch.

Poplar. — Balsam poplar accounts for 50 percent or more of the volume or crown cover. Associated species may be white spruce and paper birch.

Tree and Stand Classes

Sawtimber trees. — Live softwood trees 9.0 inches d.b.h. or larger and hardwood trees 11.0 inches d.b.h. or larger of commercial species, containing at least one saw log and with board-foot defect not exceeding two-thirds of the gross log volume.

Merchantable saw log. — For hardwoods, the log must meet the minimum requirements for log grade 4 (tie and timber logs). For softwoods, the log must meet the minimum requirements for grade 3 logs, except that the minimum length is 16 feet.

Upper stem. — The section of the bole or main stem of a sawtimber tree above the merchantable top to a minimum top diameter of 4.0 inches outside the bark, or to the point where the central stem breaks into limbs.

Poletimber trees. — Same as for coastal Alaska, except that for softwoods the d.b.h. range is from 5.0 to 9.0 inches.

Sawtimber stand. — Stands at least 10 percent stocked with growing-stock trees and with sawtimber trees making up at least 25 percent of the stocking.

Poletimber stand. — Stands at least 10 percent stocked with growing-stock trees, with sawtimber trees making up less than 25 percent of the stocking and poletimber trees plus sawtimber trees making up 50 percent or more.

Volume Classes

Same as for coastal Alaska, with th following exceptions:

1. Stump height used was 1 foo
2. Merchantable top was the poi above which no specified grac of saw log could be obtaine (minimum top of 6 inches fo softwoods and 8 inches for har woods).
3. Total volume was to a minimu 4.0-inch top outside bark or t the point where the central ste breaks into limbs.

Log Grades

"Hardwood Log Grades for Standar Lumber" (Vaughan et al. 1966) was use for cottonwood and birch.

The log grades used for aspen we from "Aspen Lumber Grades and Cha acteristics" (Zasada 1948).

The log grades for white spruce we taken from "Specifications for Log Grad of Hardwoods and Softwoods," issued b Northern Hemlock and Hardwood Ass ciation in 1947.

Stand Age Classes

Age was not used as a means of clas ifying interior Alaska stands.

Productivity Rating

Productivity rating for each field loca tion was assigned in the office from an an alysis of increment cores taken fro sample trees on each plot.

ALASKA

Tree Species

Softwoods
- Alaska-cedar *(Chamaecyparis nootkatensis)*
- Black spruce *(Picea mariana)*
- Lodgepole pine *(Pinus contorta)*
- Mountain hemlock *(Tsuga mertensiana)*
- Pacific silver fir *(Abies amabilis)*
- Sitka spruce *(Picea sitchensis)*
- Western hemlock *(Tsuga heterophylla)*
- Western redcedar *(Thuja plicata)*
- White spruce *(Picea glauca)*

Hardwoods
- Balsam poplar *(Populus balsamifera)*
- Black cottonwood *(Populus trichocarpa)*
- Paper birch *(Betula papyrifera)*
- Quaking aspen *(Populus tremuloides)*
- Red alder *(Alnus rubra)*

Species Groups

Hardwood. — Generally, one of the botanical group of trees that have broad leaves, in contrast to the conifers.

Softwood. — Generally, one of the botanical group of trees that in most cases have needles or scalelike leaves; the conifers.

DETAILED TABLES

The tables that follow have been com- iled to show relative importance by re- ion and the State total. No attempt has een made to adjust these regional sta- istics to a common year for the State total. 'hey were accumulated from 1955-62. arge sampling errors are involved for some of the smaller units included, and the factors of change—growth, mortality, decay, cutting—are not known well enough to improve upon the statistics as shown.

If a mean date is desired, 1957 should be used for coastal Alaska and 1962 for the interior.

Table 1.—Area by land classes, Alaska
(Thousand acres)

Land Class	Total Alaska	Coastal	Interior
Commercial forest land	28,218	5,749	22,469
Noncommercial forest land:			
Unproductive	90,633	7,304	83,329
Productive-reserved	200	194	6
Total forest land	119,051	13,247	105,804
Nonforest land[1]	246,430	19,679	226,751
All land[2]	365,481	32,926	332,555

[1] Includes 2,852,000 acres defined as water by Forest Survey but included with land area by Bureau of Census.
[2] From U. S. Bureau of Census, Land and Water Area of the United States, 1950.

Table 2.—Land areas in Alaska, by major class of land and survey unit
(Thousand acres)

Survey unit	Total land area	Forest land				Nonforest
		Total	Commercial	Productive-reserved	Unproductive	
COASTAL						
Southeast:						
Juneau	3,833	1,653	815	6	832	2,180
Sitka	2,433	1,740	541	--	1,199	693
Petersburg	3,287	2,357	1,029	--	1,328	930
Ketchikan	5,566	4,256	1,951	8	2,297	1,310
Yakutat	796	315	276	--	39	481
Hoines-Gustavus	924	226	79	1	146	698
Glacier Bay	2,022	359	--	179	180	1,663
Yakataga	3,292	243	174	--	69	3,049
Public domain	1,995	52	19	--	33	1,943
Total southeast	24,148	11,201	4,884	194	6,123	12,947
Chugach:						
Cordova	3,036	1,177	335	--	842	1,859
Kenai	1,259	266	190	--	76	993
Afognak[1]	567	354	276	--	78	213
Kodiak[2]	2,575	81	47	--	34	2,494
Public domain	1,341	168	17	--	151	1,173
Total Chugach	8,778	2,046	865	--	1,181	6,732
INTERIOR						
Interior:						
Susitna	16,490	4,292	2,023	--	2,269	12,198
Kenai	5,665	2,070	1,481	--	589	3,595
Tanana-Fairbanks	20,266	12,989	3,555	6	9,428	7,277
Upper Tanana	13,633	6,746	1,272	--	5,474	6,887
Copper River	16,424	4,431	1,060	--	3,371	11,993
Upper Yukon	36,929	22,557	4,945	--	17,612	14,372
Lower Yukon	44,976	30,005	4,232	--	25,773	14,971
Kuskokwim	26,564	14,662	2,594	--	12,068	11,902
Bristol Bay	12,877	2,741	704	--	2,037	10,136
Norton Sound	31,113	5,311	603	--	4,708	25,802
Total	224,937	105,804	22,469	6	83,329	119,133
Unsurveyed area	107,618	--	--	--	--	107,618
Total Interior	332,555	105,804	22,469	6	83,329	226,751
Total Alaska	365,481	119,051	28,218	200	90,633	246,430

[1] Includes Afognak, Raspberry, Shuyak, and Marmot Islands.
[2] Includes Kodiak and adjacent islands.

Table 3.—Area of commercial forest land, by ownership classes, Alaska
(Thousand acres)

Ownership class	Total Alaska	Coastal	Interior
National Forest	5,292	5,292	0
Other Federal:			
Bureau of Land Management	--	252[1]	([2])
Indian	--	25	([2])
Miscellaneous Federal	--	4	([2])
Total other Federal	--	281	--
State	--	146[1]	([2])
Miscellaneous private	--	30	([2])
All ownerships	28,218	5,749	22,469

[1] Acreage is as of January 1, 1963.
[2] Ownership of interior Alaska commercial forest land not available.

Table 4.—Area of commercial forest land by stand-size class and major survey unit, Alaska
(Thousand acres)

Stand-size class	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Sawtimber stands:					
Old-growth	4,852	4,852	4,238	614	--
Young-growth	7,266	379	242	137	6,887[1]
Total	12,118	5,231	4,480	751	6,887
Poletimber stands	8,873	199	139	60	8,674
Sapling and seedling stands	6,065	259	208	51	5,806
Nonstocked areas	1,162	60	57	3	1,102
Total	28,218[2]	5,749	4,884	865	22,469

[1] Sawtimber stands of the interior were not classified as old- or young-growth.
[2] Productive-reserved lands not included.

Table 5.—Area of commercial forest land, by stand-volume classes for sawtimber and other stand-size classes, Alaska
(Thousand acres)

Stand volumes per acre	Area by stand-size classes				
	All stands	Coastal		Interior	
		Sawtimber stands	Other stands	Sawtimber stands	Other stands
Less than 1,500 board feet	16,452	--	375	--	16,077
1,500 to 5,000 board feet	6,340	--	221	5,455	664
More than 5,000 board feet	5,426	5,153	--	273	--
All classes	28,218	5,153	596	5,728	16,741

Table 6.—Area of commercial forest land by major forest type, dominant species, and major survey unit, Alaska
(Thousand acres)

Major type by dominant species	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Hemlock-Sitka spruce:					
Sitka spruce	960	960	636	324	--
Western hemlock	2,682	2,682	2,682	--	--
Mixed hemlock/spruce	1,545	1,545	1,049	496	--
Cedar	319	319	319	--	--
Total	5,506	5,506	4,686	820	--
Spruce-fir:					
White spruce	12,806	--	--	--	12,806
Aspen-birch:					
Quaking aspen	2,407	--	--	--	2,407
Paper birch	5,140	18	--	18	5,122
Total	7,547	18	--	18	7,529
Hardwoods:					
Cottonwood	2,149	15	--	15	2,134
Mixed hardwoods	210	210	198	12	--
Total	2,359	225	198	27	2,134
Total all types	28,218[1]	5,749	4,884	865	22,469

[1] Productive-reserved lands not included.

Table 7.—Area of commercial forest land, by stocking classes of growing-stock trees and by stand-size classes, Alaska
(Thousand acres)

Stocking class	All stands	Saw-timber stands		Pole-timber stands		Sapling and seed-ling stands		Non-stocked stands	
		Coastal	Interior	Coastal	Interior	Coastal	Interior	Coastal	Interior
70 percent or more	11,947	4,857	1,896	98	3,168	114	1,814	--	--
40 to 70 percent	12,210	311	4,320	61	4,803	87	2,628	--	--
10 to 40 percent	2,899	63	671	40	703	58	1,364	--	--
Less than 10 percent	1,162	--	--	--	--	--	--	60	1,102
All classes	28,218	5,231	6,887	199	8,674	259	5,806	60	1,102

Table 8.—Area of commercial forest land, by yield and ownership class, Alaska
(Thousand acres)

Annual growth per acre (cu. ft.)	All ownerships	National Forest	Other public	Farmer and misc. private
COASTAL				
120 or more	1,785	1,711	65	9
85 to 120	2,661	2,508	139	14
50 to 85	1,183	977	200	6
Less than 50	120	96	23	1
All classes	5,749	5,292	427	30
INTERIOR				
More than 50	0	0	0	0
Less than 50	22,469	0	22,469[1]	--

[1] Includes an unknown amount in private ownership.

Table 9.—Net volume of timber on commercial forest land, by class of timber, by softwoods and hardwoods, by region, Alaska
(Thousand cubic feet)

Class of timber	All species	Coastal						Interior	
		Total		Southeast		Chugach			
		Softwoods	Hardwoods	Softwoods	Hardwoods	Softwoods	Hardwoods	Softwoods	Hardwoods
Sawtimber trees:									
Saw-log portion	37,520,565	31,969,738	209,815	28,598,999	198,854	3,370,739	10,961	3,987,870	1,353,142
Upper-stem portion	2,063,346	1,384,736	26,464	1,250,139	24,680	134,597	1,784	394,405	257,741
Total	39,583,911	33,354,474	236,279	29,849,138	223,534	3,505,336	12,745	4,382,275	1,610,883
Poletimber trees	10,372,493	2,051,402	63,325	1,671,073	50,916	380,329	12,409	4,781,589	3,476,177
All growing-stock trees	49,956,404	35,405,876	299,604	31,520,211	274,450	3,885,665	25,154	9,163,864	5,087,060
Sound cull trees:									
Sawtimber-size	52,364	37,895	718	32,521	712	5,374	6	9,465	4,286
Poletimber-size	129,517	74,066	1,322	55,171	1,054	18,895	268	12,688	41,441
Total	181,881	111,961	2,040	87,692	1,766	24,269	274	22,153	45,727
Rotten cull trees:									
Sawtimber-size:	817,797	742,611	2,013	711,598	1,926	31,013	87	13,112	60,061
Poletimber-size	348,186	13,968	1,294	9,476	405	4,492	889	33,068	299,856
Total	1,165,983	756,579	3,307	721,074	2,331	35,505	976	46,180	359,917
Salvable dead trees:									
Sawtimber-size	470,086	370,039	--	346,772	--	23,267	--	96,304	3,743
Poletimber-size	12,144	--	--	--	--	--	--	12,144	--
Total	482,230	370,039	--	346,772	--	23,267	--	108,448	3,743
Total, all timber	51,786,498	36,644,455	304,951	32,675,749	278,547	3,968,706	26,404	9,340,645	5,496,447

Table 10.—Net volume of growing stock and sawtimber on commercial forest land, by ownership classes and by softwoods and hardwoods, Alaska

Ownership class	All species	Coastal		Interior[1]	
		Softwoods	Hardwoods	Softwoods	Hardwoods
	Million cubic feet				
Growing stock:					
National Forest	32,867	32,592	275	0	0
Other public	16,903	2,630	22	9,164	5,087
Forest industry	--	--	--	--	--
Farmer and misc. private	186	184	2	--	--
All ownerships	49,956	35,406	299	9,164	5,087
	Million board feet, International ¼-inch rule				
Sawtimber:					
National Forest	169,988	168,815	1,173	0	0
Other public	44,563	13,650	96	--	--
Forest industry	--	--	--	--	--
Farmer and misc. private	963	957	6	--	--
All ownerships	215,514	183,422	1,275	24,949	5,868

[1] No ownership breakdown available beyond National Forest ownership.

Table 11.—Net volume of sawtimber on commercial forest land, by stand-size classes and region, Alaska (Million board feet)[1]

Stand-size class	Total Alaska	Coastal			Interior
		Total	Southeast	Chugach	
Sawtimber stands:					
Old growth	(2)	173,827	157,764	16,063	(2)
Young growth	(2)	10,043	7,495	2,548	(2)
Total sawtimber	206,400	183,870	165,259	18,611	22,530
Poletimber stands	8,866	709	562	147	8,157
Sapling and seedling stands	92	49	10	39	43
Nonstocked areas	156	69	69	--	87
Total	215,514	184,697	165,900	18,797	30,817
Percent	100.0	--	77.0	8.7	14.3

[1] International ¼-inch rule.
[2] Sawtimber stands in interior Alaska were not broken down into old-growth and young-growth classifications.

Table 12.—Net volume of growing stock on commercial forest land, by species and diameter classes, Alaska
(Thousand cubic feet)

Survey unit and species	Diameter class (inches at breast height)					
	All classes	5.0-10.9	11.0-20.9	21.0-30.9	31.0-40.9	41.0 plus
COASTAL						
Southeast:						
Softwoods:						
Hemlock	20,318,700	1,190,235	5,870,213	7,488,685	4,321,631	1,447,936
Sitka spruce	8,928,394	290,460	1,418,581	2,243,948	2,047,538	2,927,867
Redcedar	1,021,073	55,857	286,815	383,970	188,167	106,264
True fir	67,960	754	15,347	24,671	27,188	--
Other softwoods	1,184,084	133,768	546,903	380,531	100,736	22,146
Hardwoods:						
Cottonwood	234,915	42,380	122,633	60,015	9,887	--
Red alder	35,902	7,727	28,175	--	--	--
Other hardwoods	3,633	810	1,698	1,125	--	--
Total, Southeast	31,794,661	1,721,991	8,290,365	10,582,945	6,695,147	4,504,213
Chugach:						
Softwoods:						
Hemlock	1,250,314	158,176	495,778	418,801	156,945	20,614
Sitka spruce	2,632,449	221,600	982,881	867,950	432,979	127,039
White spruce	2,902	554	2,102	246	--	--
Other softwoods	--	--	--	--	--	--
Hardwoods:						
Cottonwood	20,935	9,203	8,685	2,262	785	--
Birch	4,219	3,206	1,013	--	--	--
Total, Chugach	3,910,819	392,739	1,490,459	1,289,259	590,709	147,653
Total, coastal	35,705,480	2,114,730	9,780,824	11,872,204	7,285,856	4,651,866
INTERIOR						
Softwoods:						
Spruce	9,163,864	4,781,589[1]	3,988,047[2]	394,228	--	--
Hardwoods:						
Birch	2,976,341	2,318,515	657,826	--	--	--
Quaking aspen	894,550	732,759	161,791	--	--	--
Balsam poplar	1,216,169	424,903	685,530	105,736	--	--
Total, interior	14,250,924	8,257,766	5,493,194	499,964	--	--
Total, Alaska	49,956,404	10,372,496	15,274,018	12,372,168	7,285,856	4,651,866

[1] 5.0- to 8.9-inch diameter class.
[2] 9.0- to 20.9-inch diameter class.

Table 13.—Net volume of sawtimber on commercial forest land, by species, diameter class, and region, Alaska
(Million board feet)[1]

Survey unit ond species	All closses	Diometer closs (inches ot breast height)			
		11-20	21-30	31-40	41+
Southeast:					
Sitko spruce	54,198	8,474	13,875	12,655	19,194
Western hemlock	101,483	31,288	40,022	22,415	7,758
Other softwoods	8,999	3,367	3,434	1,495	703
Hordwoods	1,220	741	400	79	--
Totol	165,900	43,870	57,731	36,644	27,655
Chugach:					
Sitko spruce	13,350	5,235	4,848	2,519	748
Western hemlock[2]	5,378	2,440	2,070	767	101
Other softwoods	14	13	1	--	--
Hordwoods	55	39	12	4	--
Total	18,797	7,727	6,931	3,290	849
Totol:					
Sitko spruce	67,548	13,709	18,723	15,174	19,942
Western hemlock	106,240	33,179	42,020	23,182	7,859
Other softwood	9,634	3,929	3,507	1,495	703
Hardwoods	1,275	780	412	83	--
Totol coastal (all species)	184,697	51,597	64,662	39,934	28,504
Interior:					
White spruce ond other softwoods	24,949	23,281	1,668	--	--
Poper birch	2,422	2,422	--	--	--
Bolsom poplar	2,642	2,228	414	--	--
Quoking aspen	804	804	--	--	--
Total interior	30,817	28,735	2,082	--	--
Totol Alaska (all species)	215,514	80,332[3]	66,744	39,934	28,504

[1] Internotionol ¼-inch rule.
[2] Includes mountain hemlock.
[3] Includes 7,151 million board feet of softwoods in the 10-inch class (Chugach, 190 million; and interior, 6,961 million bd. ft.).

Table 14.—Volume of sawtimber on commercial forest land, by quality classes for selected species, coastal Alaska (Million board feet)[1]

Survey unit and species	All classes	Log grade			
		Select and peelers	Grade 1	Grade 2	Grade 3
Southeast:					
Sitka spruce	54,198	2,867	6,011	(²)	45,320
Western hemlock	101,483	1,461	3,684	--	96,338
Total	155,681	4,328	9,695	--	141,658
Chugach:					
Sitka spruce	13,350	--	408	3,991	8,951
Western hemlock	4,757	129	192	1,482	2,954
Mountain hemlock	621	--	--	135	486
Total	18,728	129	600	5,608	12,391
Total coastal	174,409	4,457	10,295	5,608	154,049

[1] International ¼-inch rule.
[2] Grade 2 logs in southeast Alaska were not separated from the grade 3 logs. (Official log scaling and grading rules for the Puget Sound Log Scaling and Grading Bureau, Tacoma, Wash.)

Table 15.—Percentage distribution[1] of sawtimber volume on commercial forest land, by quality classes for selected species, coastal Alaska

Survey unit and species	Total	Log grade			
		Select and peelers	Grade 1	Grade 2	Grade 3
Southeast:					
Western hemlock	100	1.4	3.6	(²)	95.0
Sitka spruce	100	5.3	11.1	--	83.6
Total	100	2.7	6.2	--	91.1
Chugach:					
Sitka spruce	100	--	3.1	29.9	67.1
Western hemlock	100	2.7	4.0	31.2	62.1
Mountain hemlock	100	--	--	21.7	78.3
Total	100	0.8	3.2	29.9	66.1

[1] Based on Scribner volumes.
[2] Grade 2 logs in southeast Alaska were not separated from the grade 3 logs. (Official log scaling and grading rules for the Puget Sound Log Scaling and Grading Bureau, Tacoma, Wash.)

Table 16.—Volume of sawtimber on commercial forest land, by quality classes for selected species, interior Alaska (Million board feet)[1]

Species	All classes	Log Grade			
		1	2	3	4
White spruce[2]	24,949	334	524	18,178	5,913
Paper birch[3]	2,422	127	216	2,046	33
Quaking aspen[4]	804	287	144	370	3
Balsam poplar[3]	2,642	([5])	878	1,658	106
Total interior	30,817	748	1,762	22,252	6,055

[1] International ¼-inch rule.
[2] Specifications for log grades of hardwoods and softwoods. Northern Hemlock and Hardwood Association.
[3] Hardwood log grades for standard lumber. U.S. Forest Service Research Paper FPL-63.
[4] Aspen lumber grades and characteristics. U.S. Forest Service Lake States Aspen Report No. 6.
[5] A better sample would have put some volume in log grade 1. A later and more intensive inventory of the Susitna valley puts 43 percent of the gross saw-log volume of this species in log grades 1 and 2.

Table 17.—Percentage of distribution of sawtimber volume on commercial forest land, by quality classes for selected species, interior Alaska

Species	Total	Log grade			
		1	2	3	4
White spruce[1]	100	1.3	2.1	72.9	26.7
Paper birch[2]	100	5.2	8.9	84.5	1.4
Black cottonwood and balsam poplar[2]	100[3]	13.7	25.0	56.8	4.5
Quaking aspen[4]	100	35.7	17.9	46.0	.4

[1] Specifications for log grades of hardwoods and softwoods. Northern Hemlock and Hardwood Association.
[2] Hardwood log grades for standard lumber. U.S. Forest Service Research Paper FPL-63.
[3] Percentages based on net volume of merchantable logs studied in the Susitna valley.
[4] Aspen lumber grades and characteristics. U.S. Forest Service Lake States Aspen Report No. 6.

Table 18.—Net volume of salvable dead sawtimber-size trees on commercial forest land, by softwoods and hardwoods, Alaska (Million board feet)[1]

Species group	Total all Alaska	Southeast	Chugach	Interior
Softwoods	2,657	2,191	123	343
Hardwoods	23	--	--	23
All species	2,680	2,191	123	366

[1] International ¼-inch rule.

Table 19.—Net annual growth and cut of growing stock and sawtimber on commercial forest land, by softwoods and hardwoods, Alaska

Species group	Net annual growth	Timber cut 1961
	– – – – Thousand cubic feet – – – –	
Coastal:		
Softwoods	63,800[1]	97,446
Hardwoods	([2])	([3])
Interior:		
Softwoods	126,147	1,117
Hardwoods	86,259	([3])
All species	276,206	98,563
	– – – – Thousand board feet[4] – – – –	
Coastal:		
Softwoods	379,000	617,433
Hardwoods	([2])	([3])
Interior:		
Softwoods	498,218	6,628
Hardwoods	166,686	([3])
All species	1,043,904	624,061

[1] Growth for young-growth (less than 150 years old) stands only.
[2] No growth data available.
[3] Insignificant amounts of hardwoods cut (less than 0.1 percent).
[4] International 1/4-inch rule.

Table 20.—Annual mortality of growing stock and sawtimber, on commercial forest land, by species, Alaska

Survey unit and species	Growing stock	Sawtimber
	M cu. ft.	M bd. ft.[1]
Southeast:		
Sitka spruce	12,133	77,880
Hemlock	62,416	381,057
Alaska-cedar	2,535	13,353
Redcedar	656	3,905
Silver fir	46	268
Lodgepole pine	86	562
Total softwoods	77,872	477,025
Black cottonwood	252	448
Total, southeast	78,124	477,473
Chugach:		
Sitka spruce	4,491	19,099
White spruce	73	351
Western and mountain hemlock	1,641	5,934
Total, Chugach	6,205	25,384
Total, coastal	84,329	502,857
Interior:		
White spruce and other softwoods	49,533	120,754
Hardwoods (aspen, birch, balsam poplar)	18,017	22,717
Total, interior	67,550	143,471
Total, all Alaska	151,879	646,328

[1] International 1/4-inch rule.

Table 21.—Total output of Alaska's wood processors by product and geographic region, 1961

Survey unit and product		Total output
Coastal:		
Lumber	Million board feet	70.2
Pulp	Thousand air-dry tons	266.5
Poles	Pieces	100.0
Crossties	Pieces	9,352.0
Hause logs	Thousand lineal feet	3.0
Interior:		
Lumber	Million board feet	2.3
House logs	Thousand lineal feet	293.0
Mining stulls	Thousand lineal feet	25.0

Table 22.—Volume of logs consumed in Alaska by management or ownership source, type of plant, and geographic region, 1961

Survey unit and plant type	Volume		Management or ownership source					
			Natianal Forest	Public domain	Tatal Federal	State	Private	All ownership
	M cu. ft.	M bd. ft.[1]	Percent					
Coastal:	66,353	394,026	96.3	1.9	98.2	0.2	0.6	99.0
Pulpmills	53,010	314,791	79.1	0	79.1	0	0	79.1
Sawmills[2]	13,342	79,231	17.2	1.9	19.1	.2	.6	19.9
Treating plant	1	4	(3)	0	(3)	0	0	(3)
Interior:	686	4,071	(3)	.6	.6	.1	.3	1.0
Sawmills	656	3,894	(3)	.6	.6	.1	.3	1.0
House logs	30	177	0	(3)	(3)	(3)	--	(3)
Total	67,039	398,097	96.3	2.5	98.8	.3	.9	100.0

[1] International ¼-inch rule. Scribner log rule volumes can be approximated by multiplying International ¼-inch log rule volumes by 0.8518.
[2] Includes 296,000 baard feet of cottonwood logs fram State lands and 2,348,000 board feet af redcedar from Natianal Forest lands exported in round form.
[3] Less than 0.1 percent.

Table 23.—Volume of logs consumed in Alaska by species, type of plant, and geographic region, 1961

Survey unit and plant type	Volume		Species						
			Western hemlock	Sitka spruce	White spruce	Red-cedar	Paper birch	Cattan-waad	All species
	M cu. ft.	M bd. ft.[1]	Percent						
Coastal:	66,353	394,026	52.6	45.6	0	0.7	0	0.1	99.0
Pulpmills	53,010	314,791	51.6	27.5	0	0	0	0	79.1
Sawmills[2]	13,342	79,231	1.0	18.1	0	.7	0	.1	19.9
Treating plant	1	4	(3)	0	0	0	0	0	(3)
Interior:	686	4,071	0	(3)	0.9	0	0.1	(3)	1.0
Sawmills	656	3,894	0	(3)	9	0	.1	(3)	1.0
House logs	30	177	0	0	(3)	0	0	0	(3)
Tatal	67,039	398,097	52.6	45.6	.9	.7	.1	.1	100.0

[1] International ¼-inch rule. Scribner log rule volumes can be appraximated by multiplying International ¼-inch log rule volumes by 0.8518.
[2] Includes 296,000 board feet of cottonwood logs from State lands and 2,348,000 board feet of redcedar from National Farest lands exported in round form.
[3] Less than 0.1 percent.

Table 24.—Market areas of Alaska's primary wood products, by kind of product and geographic region, 1961

Survey unit and kind of product	Volume	Market area				
		Alaska		Continental United States	Foreign countries	All markets
		Within 100 miles of plant	Over 100 miles from plant			
	M b. m.[1]	Percent				
Coastal:						
Lumber	70,187	2.5	3.7	1.6	11.4	19.2
Export logs	2,435	0	0	0	.6	.6
Pulp	289,908	0	0	34.4	44.8	79.2
Poles	4	(2)	0	0	0	(2)
Crossties	349	.1	0	0	0	.1
House logs	10	(2)	0	0	0	(2)
Total, coastal	362,893	2.6	3.7	36.0	56.8	99.1
Interior:						
Lumber	2,314	.5	.1	(2)	0	.6
House logs	951	.3	(2)	0	0	.3
Mining stulls	93	(2)	0	0	0	(2)
Total, interior	3,358	.8	.1	(2)	0	.9
Total, Alaska	366,251	3.4	3.8	36.0	56.8	100.0

1 Lumber tally equivalent.
2 Less than 0.1 percent.

Table 25.—Volume of plant residue from Alaska's sawmills by use, type of residue, and geographic region, 1961

Survey unit and type of residue	Volume	Use				
		Unused	Fuel		Other[1]	All uses
			Industrial	Domestic		
	M cu. ft.	Percent				
Coastal:	3,850	72.9	15.9	0.8	0.3	89.9
Coarse	2,118	32.7	15.9	.8	.1	49.5
Fine	1,732	40.2	0	0	.2	40.4
Interior:	431	6.5	0	3.0	.6	10.1
Coarse	265	3.4	0	2.5	.3	6.2
Fine	166	3.1	0	.5	.3	3.9
Total	4,281	79.4	15.9	3.8	.9	100.0

1 Other uses include cattle bedding, insulation, and mine shoring.

Table 26.—Sampling intensities of the coastal Alaska forest survey

Survey units	Unit total area	Number of photo points	Acres per photo point	Number of ground plots (CFL)	Acres of CFL	Acres of CFL/plot
SOUTHEAST SUBREGION						
Juneau	3,832,591	5,830	657.39	164	820,558[1]	5,003.4
Petersburg	3,286,606	4,347	756.06	129	1,029,243	7,978.6
Sitka	2,433,280	3,314	734.24	129	540,747	4,191.8
Ketchikan	5,566,080[2]	8,902	625.26	221	1,958,564[3]	8,862.3
Yakutat	795,887	872	912.71	57	276,562	4,852.0
Subtotal	15,914,444	23,265	684.05	700	4,625,674[4]	6,608.1
Outside units:						
Yakutat outside	1,031,406	1,630	632.76	0	19,252	0
Haines-Gustavus	924,385	1,486	622.06	16	80,305	5,019.1
Glacier Bay	2,022,264	3,424	590.61	0	178,956	0
Icefields	963,565	1,686	571.51	0	0	0
Subtotal	4,941,620	8,226	600.73	16	278,513	17,407.1
Subregion total	20,856,064	31,491	662.28	716	4,904,187	6,849.4
PRINCE WILLIAM SOUND SUBREGION						
Cordova	3,035,900	6,124	471.75[5]	74	334,935	4,526.1
Afognak Island	458,800	2,149	213.49	55	230,034	4,182.4
Kenai	1,259,000	5,826	202.98[6]	70	189,593	2,708.5
Subtotal	4,753,700	14,099	321.33[7]	199	754,562	3,791.8
Outside units:						
Kodiak and islands	2,683,497	0	0	0	93,660	0
Yakataga	3,291,824	2,243.58[8]	1,358.37	0	174,022	0
Blying Sound	1,341,391	2,885	464.95	0	16,358	0
Subtotal	7,316,712	5,128.58	1,429.95	0	284,040	0
Subregion total	12,070,412	19,227.58	627.76	199	1,038,602	5,219.1
Total, coastal Alaska	32,926,476	50,718.58	649.19	915	5,942,789	6,494.8

[1] Includes reserved area of 5,846 acres.
[2] Includes 80,964 acres (excluding water area >40 acres) for Annette Island.
[3] Includes reserved area of 8,000 acres.
[4] Includes reserved area of 13,846 acres.
[5] Applies to unit total area less icefield (3,035,900 – 146,900).
[6] Applies to unit total area less icefield (1,259,000 – 76,400).
[7] Applies to unit total area less icefield.
[8] Only 622 photo plots actually used — the rest of the area (rep./1,821.58 points) = icefields.

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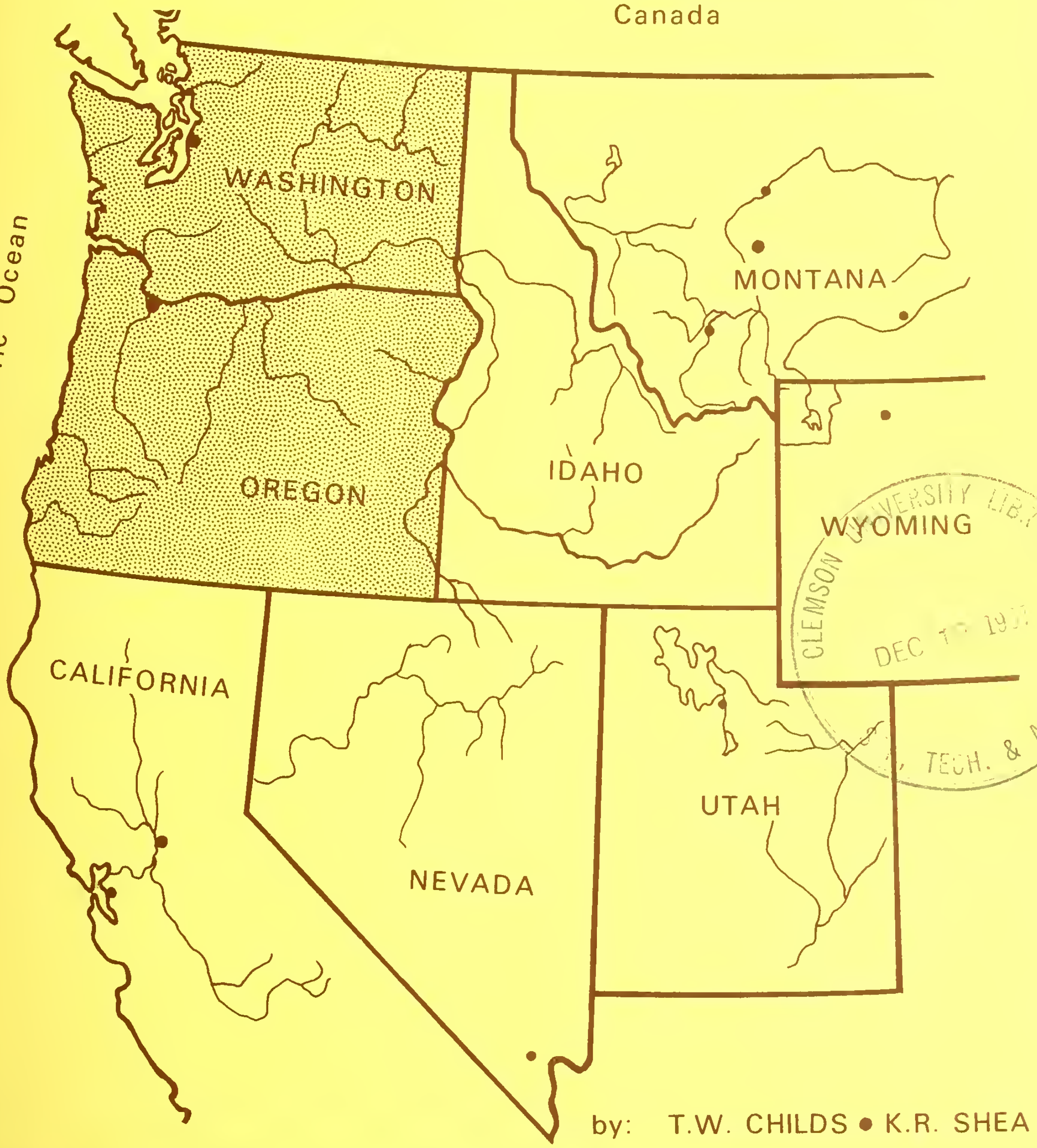
GPO 992-249

ANNUAL LOSSES FROM DISEASE IN PACIFIC NORTHWEST FORESTS



by: T.W. CHILDS • K.R. SHEA

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U.S. DEPT. OF AGRICULTURE · FOREST SERVICE

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FOREWORD

Increasing demands are being made on Oregon and Washington forests for timber and forest-derived products and benefits. To meet these demands, factors influencing the productivity and use of this forest resource must be evaluated. This report was prepared to meet current needs for estimates of losses caused by one of these factors—forest diseases. Precise data on disease-caused losses are not yet available and the authors have relied on a variety of sources and their experience to provide this information. Although more precise estimates are badly needed, this report represents the best available evaluation of disease losses at this time. It should answer an urgent need until more precise estimates can be obtained.

CONTENTS

SUMMARY

This report presents current estimates of annual disease impact on forest productivity of Oregon and Washington. It is concerned exclusively with losses of timber volumes and of potential timber growth in today's forests.

Annual loss from disease in this region is estimated at 3,133 million board feet or 403 million cubic feet. This is about 13 percent of the total annual growth including the mean periodic growth of seedlings and saplings.[1] Of this loss, 162 million cubic feet is potential growth prevented by disease, 129 million is mortality, and 112 million is cull. West of the Cascade Range, annual loss is 234 million cubic feet, of which 92 million is cull from heart rots. East of the Cascades, annual loss is 169 million cubic feet, of which 91 million is growth loss and only 20 million is cull. More than half of the growth loss east of the Cascades is caused by dwarfmistletoes.

Greatest losses occur in Douglas-fir (139 million cubic feet annually), western hemlock (88 million), true firs (62 million), and ponderosa pine (40 million). Principal causes of loss are dwarfmistletoes (148 million cubic feet), root rots (115 million), and heart rots (110 million).

Cubic-volume losses are now about equally divided between young growth and old growth. As young stands replace old ones, cull from heart rots will decrease but growth-reducing diseases will become more important. Effective controls for some diseases are now or will soon be available, but most diseases will continue to cause heavy losses indefinitely unless research efforts are made proportionate to the values at stake.

INTRODUCTION

Diseases seriously reduce forest productivity. Information on the kind and extent of their effects is essential for good forest management.

Losses caused by the various groups of diseases in Pacific Northwest forests were estimated in 1954 for the Timber Resource Review (U.S. Forest Service 1958).[1] Since then, more accurate measurements have been made of forest volumes and growth rates, and some additional data have been obtained on disease effects. This report, prepared at the request of the Northwest Forest Pest Action Council, presents revised estimates of volume loss from diseases from which their economic impact can be calculated.

Estimates in this report represent the consensus of four forest disease specialists familiar with the region: L. F. Roth, Oregon State University; and D. P. Graham, T. W. Childs, and K. R. Shea, U.S. Forest Service.

This report is concerned exclusively with impact of the various diseases on timber volumes, actual and potential, in the principal forest types and two major subregions of Oregon and Washington. Estimates do not include, for example, losses from Christmas tree diseases, decay of forest products, increased logging costs in highly defective stands, or restrictions imposed by disease upon management.

Estimates do not include damage (1) where involvement of disease is not fairly certain—for example, rapid deterioration of residual crowns after partial cuttings; or (2) where disease is only a minor factor in losses caused primarily by such things as environmental stress on senile stands—for example, Pacific silver fir decadence during the early 1950's in northern Washington. On the other hand, disease is a primary factor in part of the mortality often attributed to bark beetles, and some of this mortality is accordingly included in the estimates (but none of the damage caused to reasonably healthy trees by beetle broods that originate in diseased trees).

Mortality and cull estimates consist entirely of losses in trees 11 inches in diameter at breast height (d.b.h.) and larger. All damage to smaller trees is classified as growth loss—that is, reduction of productivity on areas nonstocked, or stocked with smaller or otherwise inferior trees, as a result of disease. Salvaged mortality has not been charged against disease. Cull refers to volume made unusable by disease (principally heart rots and stem cankers); it does not include such things as sweep, sound breakage, or frost cracks. Decay of killed timber has been charged against the cause of death—for example, losses in fire-killed timber are not included here, and losses in windthrows are included only to the extent that root rots contributed to the windthrow.

Five groups — heart rots, root rots, dwarfmistletoes, foliage diseases, and cankers and stem rusts — include most of the parasitic diseases and all of those now causing serious damage in this region. A few others, such as Verticillium wilt of maple, occasionally attack forest trees but cause little damage.

Forest productivity is decreased by physiological disturbances which not only cause injury directly but also predispose trees to attack by parasitic diseases. Estimates of physiological disease impact, however, depend on where the line is drawn between normal and abnormal environmental conditions. No site is ideal and the range of most growth-influencing factors is continuous from the best to the worst conditions. Even if standards of normality are arbitrarily established, the quantitative effects of most physiological diseases are too poorly known to permit reliable estimates of losses; accordingly, we have not attempted to estimate their impact. ("Wetwood" is included in losses from heart rots, even though it may be of physiological origin.)

[1] Names and dates in parentheses refer to literature listed in "Sources of Information," p. 11.

Foliage diseases are almost the only ones that fluctuate widely and rapidly, but mortality from many other diseases tends to be appreciably higher during climatic periods unfavorable to trees than during favorable periods. We have tried to estimate the averages of fluctuating losses, but assumptions about the frequency of periods of damage — for example, by outbreaks of Elytroderma needle cast — are obviously little better than guesses.

Even though our estimates are based on all available information, both published and unpublished, they cannot be considered precise. Quantitative data on impact are still fragmentary, even for the most important heart rots and dwarfmistletoes, and are entirely lacking for some diseases. Where we have had to depend largely on personal observations and vague, qualitative information, we have estimated loss at the lowest probable figure. Disease losses in forests of Oregon and Washington are almost certainly not less, and may be considerably more, than here estimated.

In absolute volumes, the largest errors are probably in estimates of growth loss from root rots. Chronic infections of large roots are common and undoubtedly reduce growth of many trees that survive indefinitely. Agricultural experience gives some grounds for belief that inconspicuous diseases of fine roots may cause about as much growth loss as all other root pathogens combined. But we have very little information on growth impact of chronic infections and none at all on fine-root diseases of forest trees. Accordingly, we ignored fine-root diseases and restricted our growth-loss estimates almost entirely to loss from killing of trees less than 11 inches d.b.h.

Unless specifically stated otherwise, estimates in this report are of average **annual** losses from disease. Most estimates in the text are given in cubic footage but are summarized in both board and cubic footage in appendix tables 1, 2, 3, and 4. Examples of computations are in the appendix.

REGIONWIDE LOSSES FROM DISEASE

Diseases reduce the annual productivity of Oregon and Washington forests by an estimated 3,133 million board feet (Scribner scale), or 403 million cubic feet. This total annual loss equals about 13 percent of the annual growth, including mean periodic growth of seedlings and saplings. The loss consists of 162 million cubic feet of growth loss, 129 million of mortality, and 112 million of cull (fig. 1). Growth loss is caused principally by dwarfmistletoes and root rots (75 and 62 million cubic feet, respectively). Mortality is also caused principally by dwarfmistletoes and root rots (72 and 53 million cubic feet). Heart rots cause all but 2 million cubic feet of the cull.

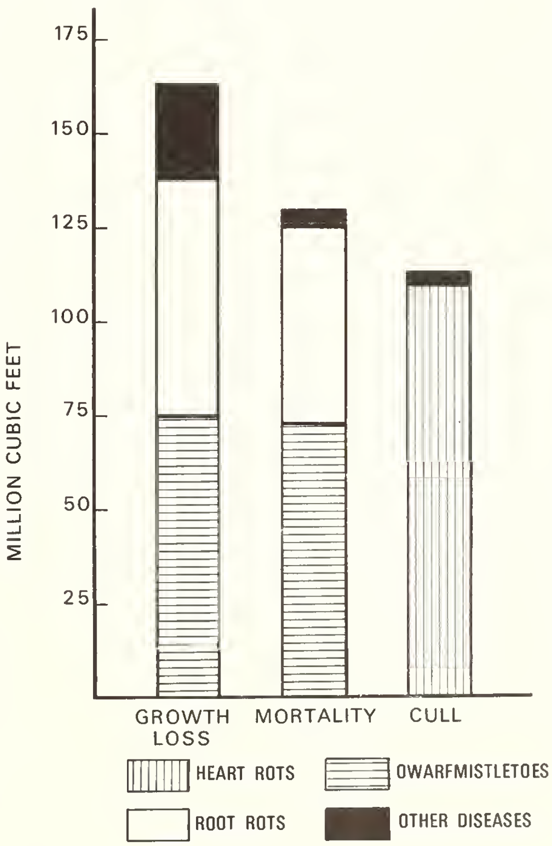


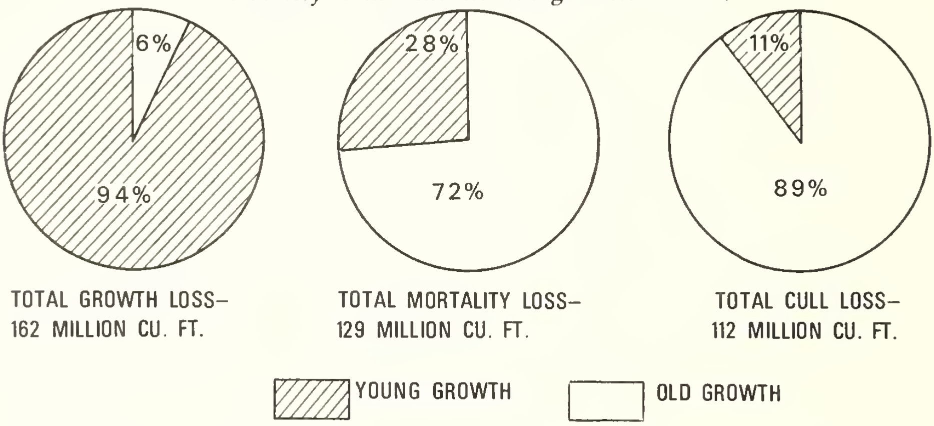
Figure 1.—Total annual losses from disease by form of loss and disease group.

In terms of cubic feet, losses are equally divided between young growth (seedlings, saplings, poles, and sawtimber less than 17 inches d.b.h.) and old growth (trees 17 inches d.b.h. and larger). In board feet, three-fifths of the loss occurs in old growth (deductions for cull are proportionately much greater in board-foot than in cubic-foot scale). Loss of potential growth occurs principally in young-growth stands, and mortality and cull losses principally in old-growth (fig. 2).

Most of the loss is caused by dwarfmistletoes (148 million cubic feet), root rots (115 million), and heart rots (110 million). Other diseases (foliage diseases and cankers including stem rusts) cause an annual loss of 30 million cubic feet.

Of 153 million cubic feet of potential growth lost each year in young growth, 67 million is from dwarfmistletoes and 61 million from root rots (fig. 3). In old growth, dwarfmistletoes cause more than nine-tenths of the 9 million cubic feet of growth loss.

Figure 2.—Growth loss is greatest in young-growth stands; mortality and cull in old-growth stands.



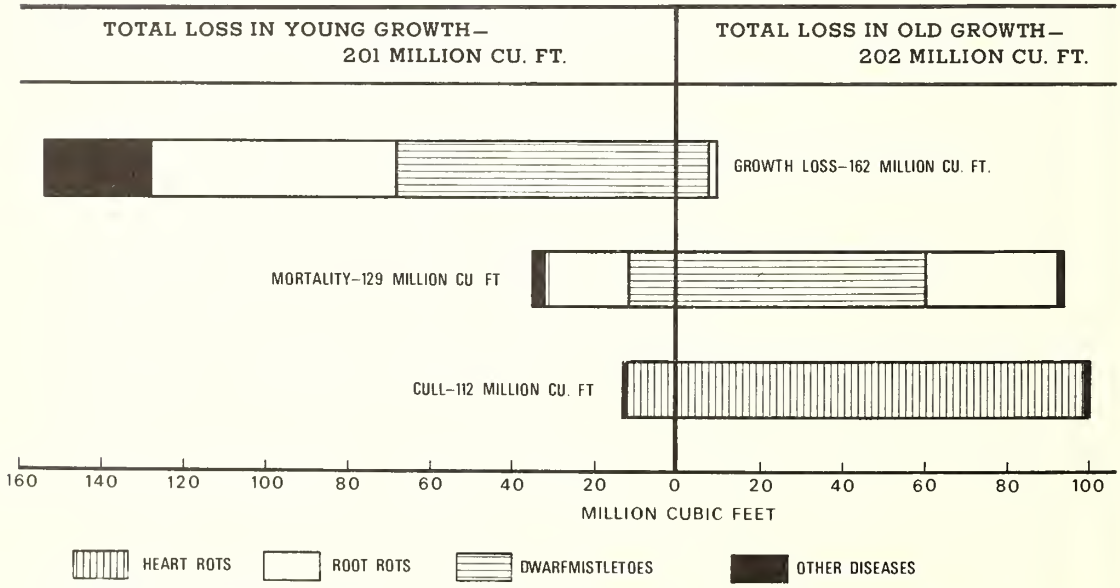


Figure 3.—Principal forms and causes of disease loss in young growth differ from those in old growth.

Young-growth mortality (36 million cubic feet) is caused principally by root rots (20 million) and dwarfmistletoes (12 million). In old-growth mortality (93 million cubic feet), loss to dwarfmistletoes exceeds that to root rots (60 million and 33 million, respectively).

Annual cull losses amount to 12 million cubic feet in young growth (11 million from heart rots) and 100 million in old growth (99 million from heart rots).

LOSSES BY SUBREGIONS AND TREE SPECIES

The Cascade Range divides Oregon and Washington into two subregions that differ markedly in climate, forest types, and disease conditions: the Douglas-fir subregion to the west of the range and the ponderosa pine subregion to the east. To avoid confusion, these subregions will be referred to as "west side" and "east side" instead of by the names of their principal tree species. Noticeable differences in forest types and disease conditions also exist between Oregon and Washington, but we have not estimated losses separately by States.

Total annual loss from disease is 234 million cubic feet on the west side and 169 million on the east side. Volumes and growth rates are considerably lower on the east side than on the west side, however, and disease impact relative to the total subregional forest resource is accordingly greater on the east side (0.4 percent of present cubic-volume inventory, or 23.2 percent of current growth) than on the west (0.2 percent of volume, or 11.6 percent of growth).

Average annual loss per stocked acre is 7.4 cubic feet in young growth and 16.0 in old growth on the west side, and 7.3 in young growth and 12.8 in old growth on the east side.

West of the Cascades, growth loss and mortality are about equal, and cull causes more loss than either (fig. 4). On the east side, growth loss is more than half again as great as mortality, and cull causes considerably less loss than either. In both subregions, growth loss is much greater in young than in old growth, and mortality and especially cull are greater in old growth.

Losses are summarized by tree species in figures 5 and 6. Largest losses occur in Douglas-fir (91 million cubic feet) and western hemlock (88 million) in the west-side subregion and in Douglas-fir (49 million) and ponderosa pine (40 million) in the east-side.

Heavy losses also occur in true firs (32 million cubic feet on the west side and 29 million on the east), and in miscellaneous species (23 million on the west side and 51 million—mostly in lodgepole pine and western larch—on the east). In view of the rapidly increasing importance of these so-called minor species, such losses must be considered a serious drain on the forest resources of the region.

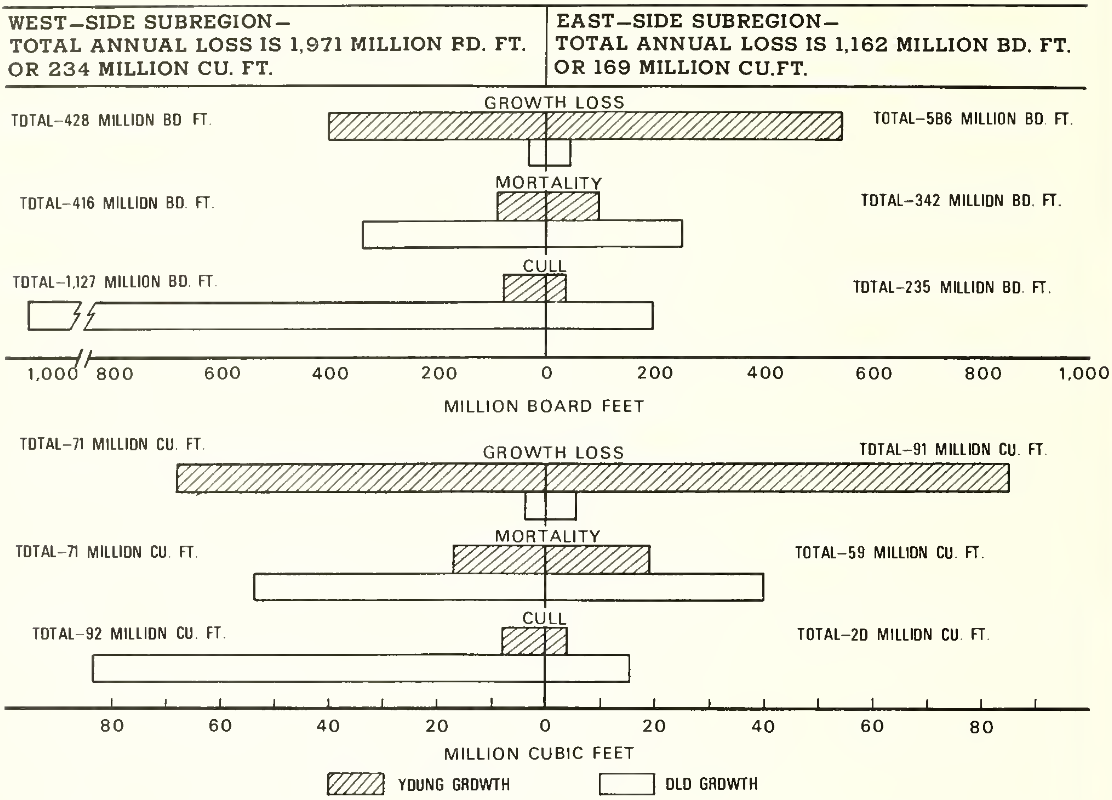


Figure 4.—Annual losses in young growth and old growth by subregion, form of loss, and age class.

LOSSES BY DISEASE GROUPS

Regionwide, heart rots cause more board-foot loss than any other group of diseases but dwarfmistletoes cause more cubic-foot loss (fig. 7). Regardless of unit of measurement, the largest loss in old growth is caused by heart rots. In young growth, dwarfmistletoes and root rots cause about equally heavy losses, and heart rots, foliage diseases, and cankers (including stem rusts) are of much less importance.

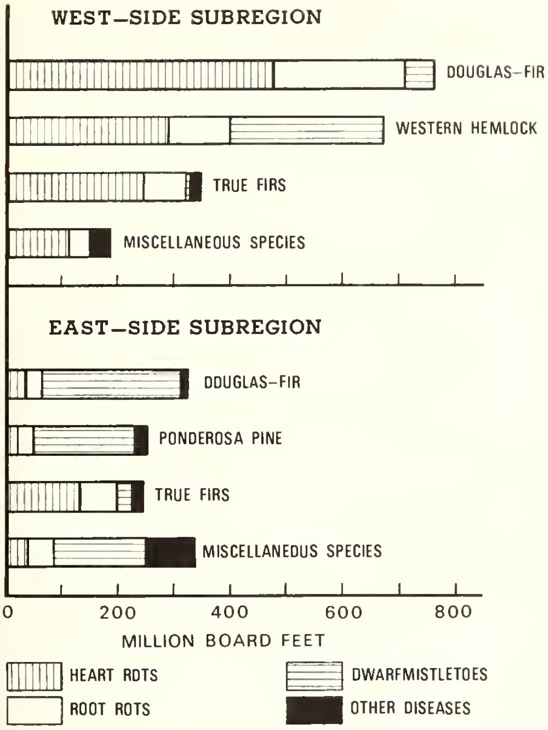


Figure 5.—Annual board-foot losses by subregion and tree species.

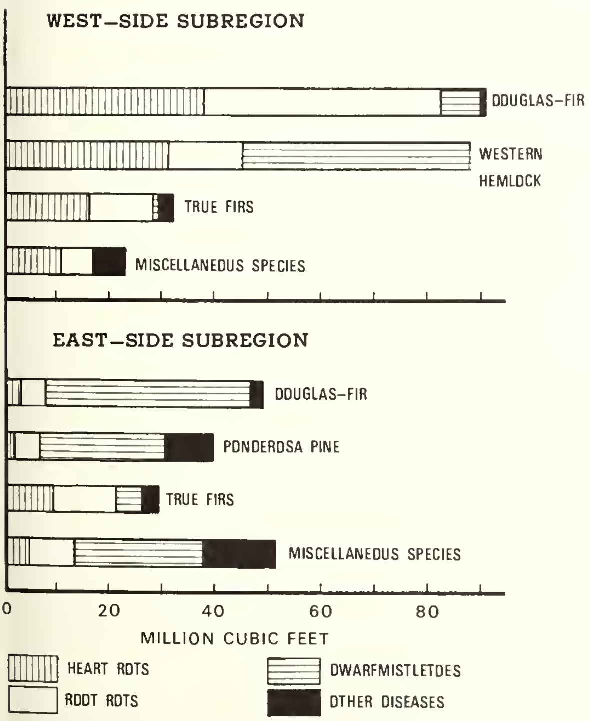


Figure 6.—Annual cubic-foot losses by subregion and tree species.

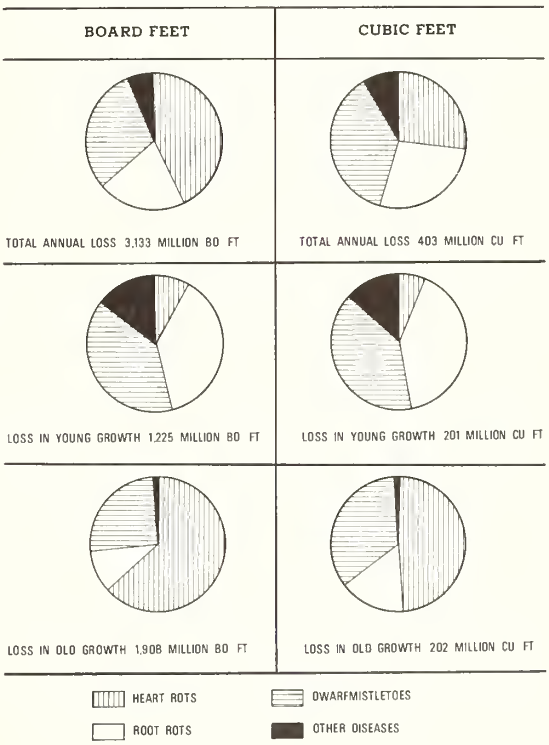


Figure 7.—Relative importance of disease groups by total annual loss and by loss in young growth and old growth.

Subregionally, largest losses on the west side are caused by heart rots and on the east by dwarfmistletoes (fig. 8).

Heart rots.—A few heart-rot fungi also attack sapwood of living trees to some extent, slowly weakening and occasionally even killing their hosts. Loss from heart rots, however, is almost entirely in the form of cull. *Fomes pini* (mostly in Douglas-fir) and *Echinodontium tinctorium* (mostly in western hemlock and true firs) are the most important of the numerous heart-rot fungi in the Pacific Northwest.

Annual board-foot losses from heart rots are greatest in Douglas-fir (511 million), true firs (380 million), and western hemlock (292 million). Ponderosa pine and most of the miscellaneous species are relatively sound (fig. 9).

Dwarfmistletoes.—Dwarfmistletoes cause 75 million cubic feet of growth loss annually, 72 million mortality, but only negligible cull. Losses are almost twice as great on the east side of the Cascades (97 million cubic feet) as on the west side (50 million), and are somewhat greater in young growth (79 million) than in old growth (68 million).

Most of the coniferous species in the region are attacked by dwarfmistletoes, *Arceuthobium* spp. (west of the Cascades, Douglas-fir is attacked only in southwestern Oregon). Losses are greatest in Douglas-fir (46 million cubic feet), western hemlock (42 million), and ponderosa pine (29 million), and are relatively small in true firs (fig. 10). Losses in miscellaneous tree species are principally in lodgepole pine and western larch.

Root rots attack trees of all ages, causing growth loss of 62 million and mortality of 53 million cubic feet annually. (Cull from invasion of butt logs is classed as loss from heart rots.) The most important root-rotting fungi are probably *Poria weirii* (we estimate that this fungus causes an annual loss of about 32 million cubic feet in west-side Douglas-fir alone), *Armillaria mellea*, and *Fomes annosus*.

West-side losses from root rots (83 million cubic feet) are considerably greater than

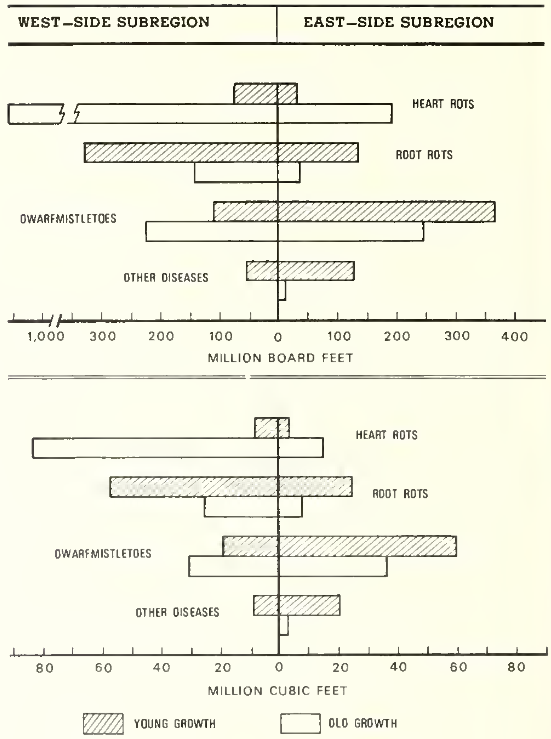


Figure 8.—Annual disease losses by subregions and disease groups.

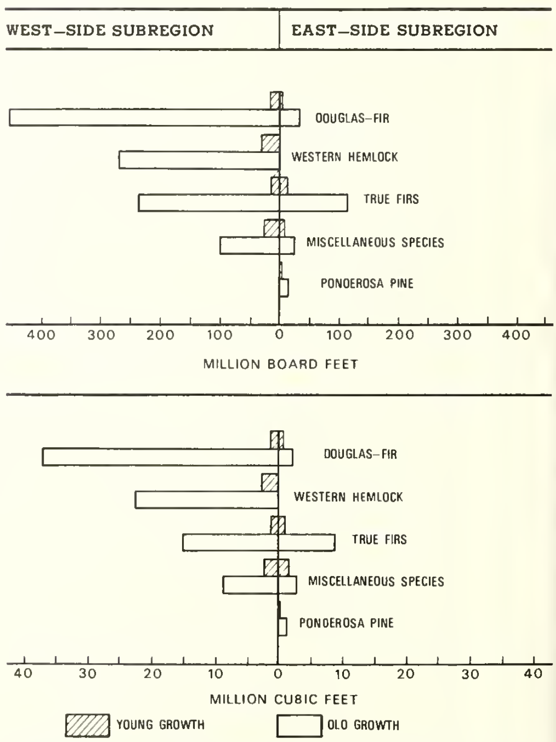


Figure 9.—Annual losses from heart rots by subregion, tree species, and age class.

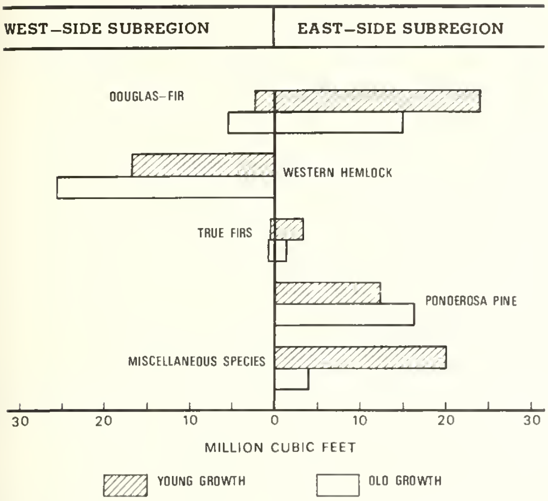


Figure 10.—Annual losses from dwarfmistletoes by subregion, tree species, and age class.

east-side (32 million), and young-growth losses (82 million) exceed old-growth (33 million).

Losses are greatest in Douglas-fir (50 million cubic feet), true firs (25 million), and western hemlock (19 million), and are relatively small in ponderosa pine (fig. 11).

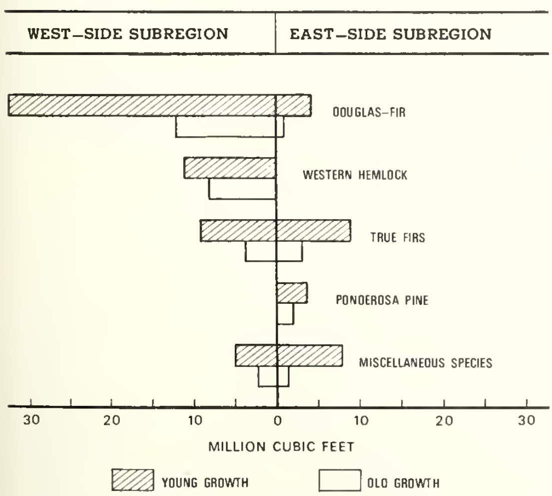


Figure 11.—Annual losses from root rots by subregion, tree species, and age class.

Foliage diseases occur on all tree species throughout the region, but severe damage is usually confined to relatively small localities and to occasional periods following weather conditions exceptionally favorable for infection. Almost all damage is in the form of growth loss.

Annual losses are about 2 million cubic feet in the west-side subregion and 15 million in the east-side. Losses are greatest in lodgepole pine, western larch, and true firs (4 million cubic feet each), and in ponderosa pine and Douglas-fir (2 million each).

Several different fungi cause damaging foliage diseases of lodgepole pine and true firs. On western larch, the most important foliage fungus is *Hypodermella laricis;* on ponderosa pine, *Elytroderma deformans;* and on Douglas-fir, *Rhabdocline pseudotsugae.*

Cankers and stem rusts annually cause losses of 9 million cubic feet of potential growth, 3 million of mortality, and 2 million of cull. Only about 1 million cubic feet of the total loss is in old growth.

By far the most important of these diseases are the stem rusts: white pine blister rust, *Cronartium ribicola*, (5 million cubic feet annually) in west-side forests, and western gall rust, *C. harknessii*, and comandra rust, *C. comandrae*, of lodgepole and ponderosa pines (6 million) in east-side forests.

DISCUSSION

Extension of road systems and improvement of logging equipment will permit increased salvage of scattered mortality. Replacement of old-growth stands by young-growth will reduce losses from heart rots. Intensive management will recover some of the potential productivity of growing space now occupied by diseased trees.

But changes in forest conditions and practices must be expected to aggravate rather than lessen damage by disease. Growth-reducing diseases, especially, will become more important as young stands replace old ones and gross growth increases. Substitution of more or less artificial environments and vegetative successions for natural ones will increase losses from many diseases unless effective countermeasures are taken.

Losses from heart rots in young growth can be largely avoided in the future through prevention of wounds, discrimination against infected trees during cuttings. and shortening of rotations where necessary. Annual losses in old growth, although totaling hundreds of millions of board feet, are so small in relation to the gross volumes in which they occur that they can seldom be given much weight in determining the order of harvest of old-growth stands. The huge volumes of cull now present in old-growth forests are accumulations from many decades of slow deterioration; economic loss from this existing cull can be substantially reduced through better utilization (development of new products and improved milling methods) and through more accurate determinations of cull volumes in stands and location and extent of decay in individual trees.

Much of the heart-rot information needed for both young-growth and old-growth management is already available. Additional information is needed principally on wetwood in true firs and associated species, extent of cull associated with various external indicators in a few of the major commercial tree species, and relationships of heart rots to environmental conditions in young stands.

Dwarfmistletoes will almost certainly be the first group of diseases effectively controlled at reasonable cost, even if no selective herbicide is developed. Recent studies suggest that dwarfmistletoe on ponderosa pine and probably on several other hosts can be controlled by changes in logging and thinning practices. Since control by such methods is practicable only during one or two brief periods in the rotation, and since several million acres must be treated, immediate and drastic reduction of losses is unlikely. However, there is good reason to expect that losses from dwarfmistletoes can be practically eliminated within the next century.

Information most urgently needed at present is (1) How much infection can we leave in sapling stands and still get a satisfactory crop at the end of the rotation? (2) What is the cheapest way to reduce infection to an acceptable level? (3) To what extent are the research results obtained from ponderosa pine dwarfmistletoe also applicable to dwarfmistletoes on western hemlock, Douglas-fir, and other conifers?

The root rot problem is much more difficult, even if we consider only the known diseases of coarse roots and ignore the probable great importance of fine-root diseases. Losses will increase considerably in the next several decades, not only because of increase in quantity of young growth but also because certain cultural practices tend to increase damage by root rots. For effective control, it will be necessary to eliminate the pathogens, or at least keep them from invading new hosts. on persistent infection centers that in the aggregate total thousands of acres now largely nonproductive.

Direct control methods are often ineffective and, in any event. far too costly for general use. Experience in agriculture indicates that satisfactory control is most likely to be obtained by indirect methods—that is, by modifying environmental conditions, especially the soil microflora, to make them unfavorable for the pathogens. This is obviously a long-term effort, but the values at stake more than justify the effort.

For immediate use, we need more accurate measurements of damage rates and better methods for distinguishing local hazard zones; these will facilitate salvage and prevent waste of funds in cultural operations where adequate returns are unlikely. For eventual control, we need detailed information on the complex relationships between root pathogens, their hosts, associated vegetation, and other biological and physical factors of the environment.

Although foliage and canker diseases are less damaging than the other three disease groups, they cause substantial losses, most of which must be tolerated until more serious problems have been solved. As with other diseases, some losses could be prevented by ordinary good management. For example, plantations of nonlocal stock are often destroyed by foliage diseases; when nonlocal plantations survive, large-scale introduction of undesirable genes into the local races may eventually be even more damaging.

A breeding program, now in progress, will soon produce white pine and sugar pine planting stock resistant to blister rust, thereby permitting the production of a valuable crop on thousands of acres where other species are far less productive and rust control by ribes eradication is too expensive to be practical. Little else is being done at present to reduce losses caused by foliage and canker diseases, but research on fungicides would probably yield worthwhile results. For example, a systemic fungicide effective against Elytroderma needle cast of ponderosa pine would eliminate the need for heavy salvage cuts on severe outbreak areas and save much of the million-plus cubic feet lost annually to this disease.

Control of agricultural diseases, almost entirely a result of research during the last century, indicates the benefits obtainable from comparable progress in forestry. Control of forest diseases, even if only moderately effective, will prevent many undesirable side effects of intensive management and reduce current losses from disease by at least one-half.

But control methods cannot be developed overnight, and chances to apply them to a given acre ordinarily occur only at long intervals. Even with present progress, large volumes of valuable timber will be lost annually to disease for several decades to come. Unless development of control measures is hastened, heavy losses will continue indefinitely.

SOURCES OF INFORMATION

To strengthen our basis we sometimes used data from other parts of western North America, modified as necessary to fit the situation in the Pacific Northwest. For example, having little information on foliage diseases of western white pine, we relied to some extent on Shaw and Leaphart's (1960) study, but reduced their estimate of impact because the two diseases they discuss appear less common and probably less damaging here than in Idaho.

Unpublished data and observations by Pacific Northwest Forest and Range Experiment Station personnel and others were used in addition to the following reports:

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1932. Decay and other losses in Douglas fir in western Oregon and Washington. U.S. Dep. Agr. Tech. Bull. 286, 59 pp.

Boyce, John S., and Wagg, J. W. Bruce.
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APPENDIX

Calculations of Losses from Disease

Basic forest resource data were taken from "Forest Statistics for Southwest Oregon" (Hazard and Metcalf 1964), "Timber Resource Statistics for the Pacific Northwest as of January 1, 1963" (U.S. Forest Service 1965), and from timber resource statistics in the Bonneville Power Administration's "Pacific Northwest Economic Base Study for Power Markets" (Gedney et al. 1966). Some adjustments of these data were made to meet special requirements of this report—for example, percentage of acreage in seedlings and saplings east of the Cascade Range was increased because much of the area typed as sawtimber is actually occupied by small groups of young trees.

Necessary breakdowns of basic resource data were made by pro rata apportionment whenever possible. For example, acreage was apportioned among species and among old sawtimber, young sawtimber, and poles on the basis of cubic volumes by species and size classes as given in table 13 of Resource Bulletin PNW-9 (U.S. Forest Service 1965). Definitions and assumptions used in such calculations are as follows:

1. Old sawtimber includes all trees 17 inches d.b.h. and larger; young sawtimber, all trees 11.0 to 16.9 inches d.b.h.
2. West of the Cascade Range, acreage of seedlings and saplings is about equal to that of poles; east of the Cascades it is about half that of poles.
3. Cubic volume per acre of young sawtimber is about half and cubic volume per acre of poles is about one-quarter that of old sawtimber.
4. Growth percent of young sawtimber (in both cubic and board feet) is about four times that of old sawtimber.
5. Mean periodic growth is average annual growth during the rotation (if a stand now 10 years old will yield 40,000 board feet per acre at a rotation age of 100 years, mean periodic growth is 0.4 thousand board feet per acre.)
6. Mean periodic growth per acre of coniferous seedlings, saplings, and poles is about the same as that of young sawtimber, except that board-foot growth of lodgepole is about half that of young sawtimber. Mean periodic growth of small hardwoods is about half that of young sawtimber in cubic-foot volume and about one-quarter that of young sawtimber in board-foot volume.

In some instances it was necessary to estimate the aggregate effect of a group of diseases over the entire acreage occupied by a given host species and age class. For example, since mortality from root rots appears somewhat more common in old-growth western hemlock than in old-growth Douglas-fir in the west-side subregion, we estimated an unsalvaged mortality loss of 20 board feet per year from root rots on the average acre of old-growth western hemlock. In other instances, enough information was available to permit computation of impact factors for specific diseases. For example, *Polyporus tomentosus* is damaging on about 10 percent of the old-growth ponderosa pine acreage and affects about 30 percent of the trees on this infested acreage. We assumed that growth of affected trees is reduced by 20 percent. The product of these percentages is an impact factor of 0.006 (0.6 percent) which, when applied to the annual growth of old-growth ponderosa pine (52 million cubic feet), gives an estimated loss of 0.3 million cubic feet. Other examples follow·

Losses from heart rots in west-side Douglas-fir old growth. About three-fourths of the remaining volume is in Oregon, where stands are more defective than in Washington, but utilization is closer now than at the time of Boyce's (1932) study. So we assumed that 14 percent of board-foot volume (or 8 percent of cubic-foot volume) is cull. Some of Boyce and Wagg's (1953) results suggest that the average tree survives for about 100 years after infection, but theoretical analysis of data from another study indicates that infected western hemlocks and true firs survive for about 200 and 150 years, respectively, and Douglas-fir would be expected to survive at least as long. So we assumed an average survival of 200 years after infection, or an average period, since infection, of 100 years for living infected trees. Then, (14 percent/100 years) × (327,973 million board feet of gross volume) = annual cull loss of 459 million board feet.

Losses from Douglas-fir dwarfmistletoe in southwest Oregon. Infection is present on almost every acre of Douglas-fir type on the Rogue River National Forest, and current mortality on the forest is about 45 million board feet per year (Hopkins 1958). In stands aerially mapped as damaged, 68 percent of the trees were infected and 14 percent had been recently killed; on "check" plots supposedly outside the areas of damage, 56 percent of the trees were infected and 8 percent recently killed (Aho and Anderson 1959). We assumed that half of the Douglas-fir acreage in Josephine and Jackson Counties is damagingly infected, and that average annual mortality loss per acre is 15 cubic feet in old growth and 6 in young sawtimber. (Hopkins' data indicate considerably greater losses, but he is describing some of the most severe infection to be found anywhere; also. much of the killing on the Rogue River National Forest appears to have occurred during the decade immediately preceding the survey, which may have been a peak period for mortality.) Old-growth mortality, then, is 15 cubic feet per acre per year on 50 percent of 0.6 million acres, or a total of 4.5 million cubic feet; young sawtimber mortality is 6 cubic feet on 50 percent of 0.1 million acres, or a total of 300,000 cubic feet.

Losses from dwarfmistletoes in miscellaneous species. Lodgepole pine and western larch constitute more than half of "miscellaneous species" volume and are by far the most commonly and severely infected members of this group. Less than one-third of the lodgepole pine but more than half of the larch stands are moderately or severely infected. Effects of dwarfmistletoe on lodgepole pine growth appear somewhat less severe, but on larch somewhat more severe, than on ponderosa pine. So we assumed that 40 percent of combined larch-lodgepole pine is on moderately or severely infected areas, that 70 percent of the trees on these areas are moderately or severely infected, and that growth of these trees is reduced 35 percent. The resulting impact factor of 0.098 (9.8 percent), applied to 6 million cubic feet of annual growth of these species, gives an estimated annual growth loss of 600,000 cubic feet.

TABLE 1 — *Annual board-foot volume losses from disease by disease group, subregion, form of loss, and age class*

Disease group	Mortality			Cull			Growth loss			Total		
	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total
	Million board feet											
West side:												
Heart rots	0	1.9	1.9	1,053.0	72.0	1,125.0	0	0	0	1,053.0	73.9	1,126.9
Root rots	140.0	65.0	205.0	0	0	0	0	258.0	258.0	140.0	323.0	463.0
Dwarfmistletoes	192.5	14.2	206.7	0	0	0	28.3	93.9	122.2	220.8	108.1	328.9
Other diseases	0	2.6	2.6	0	1.6	1.6	0	47.8	47.8	0	52.0	52.0
Subtotal	332.5	83.7	416.2	1,053.0	73.6	1,126.6	28.3	399.7	428.0	1,413.8	557.0	1,970.8
East side:												
Heart rots	0	0	0	194.0	30.6	224.6	0	0	0	194.0	30.6	224.6
Root rots	40.0	37.0	77.0	0	0	0	2.3	103.7	106.0	42.3	140.7	183.0
Dwarfmistletoes	208.0	43.8	251.8	0	0	0	40.8	323.6	364.4	248.8	367.4	616.2
Other diseases	2.0	10.9	12.9	3.8	6.2	10.0	3.0	112.2	115.2	8.8	129.3	138.1
Subtotal	250.0	91.7	341.7	197.8	36.8	234.6	46.1	539.5	585.6	493.9	668.0	1,161.9
Entire region:												
Heart rots	0	1.9	1.9	1,247.0	102.6	1,349.6	0	0	0	1,247.0	104.5	1,351.5
Root rots	180.0	102.0	282.0	0	0	0	2.3	361.7	364.0	182.3	463.7	646.0
Dwarfmistletoes	400.5	58.0	458.5	0	0	0	69.1	417.5	486.6	469.6	475.5	945.1
Cankers and stem rusts	1.2	13.4	14.6	3.8	7.8	11.6	0	53.6	53.6	5.0	74.8	79.8
Foliage diseases	.8	.1	.9	0	0	0	3.0	106.4	109.4	3.8	106.5	110.3
Total	582.5	175.4	757.9	1,250.8	110.4	1,361.2	74.4	939.2	1,013.6	1,907.7	1,225.0	3,132.7

TABLE 2 — *Annual cubic-foot volume losses from disease by disease group, subregion, form of loss, and age class.*

Disease group	Mortality			Cull			Growth loss			Total		
	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total
	Million cubic feet											
West side:												
Heart rots	0	0.4	0.4	83.7	7.8	91.5	0	0	0	83.7	8.2	91.9
Root rots	25.6	13.1	38.7	0	0	0	0	44.1	44.1	25.6	57.2	82.8
Dwarfmistletoes	27.9	3.0	30.9	0	0	0	3.4	16.0	19.4	31.3	19.0	50.3
Other diseases	0	.5	.5	0	.2	.2	0	7.8	7.8	0	8.5	8.5
Subtotal	53.5	17.0	70.5	83.7	8.0	91.7	3.4	67.9	71.3	140.6	92.9	233.5
East side:												
Heart rots	0	0	0	15.0	3.2	18.2	0	0	0	15.0	3.2	18.2
Root rots	7.3	7.4	14.7	0	0	0	.3	17.1	17.4	7.6	24.5	32.1
Dwarfmistletoes	32.2	9.3	41.5	0	0	0	4.9	50.8	55.7	37.1	60.1	97.2
Other diseases	.3	2.1	2.4	.8	.8	1.6	.4	17.3	17.7	1.5	20.2	21.7
Subtotal	39.8	18.8	58.6	15.8	4.0	19.8	5.6	85.2	90.8	61.2	108.0	169.2
Entire region:												
Heart rots	0	.4	.4	98.7	11.0	109.7	0	0	0	98.7	11.4	110.1
Root rots	32.9	20.5	53.4	0	0	0	.3	61.2	61.5	33.2	81.7	114.9
Dwarfmistletoes	60.1	12.3	72.4	0	0	0	8.3	66.8	75.1	68.4	79.1	147.5
Cankers and stem rusts	.2	2.6	2.8	.8	1.0	1.8	0	8.6	8.6	1.0	12.2	13.2
Foliage diseases	.1	.03	.1	0	0	0	.4	16.5	16.9	.5	16.5	17.0
Total	93.3	35.8	129.1	99.5	12.0	111.5	9.0	153.1	162.1	201.8	200.9	402.7

TABLE 3 — *Annual board-foot volume losses from disease by tree species, subregion, form of loss, and age class.*

Tree Species	Mortality			Cull			Growth loss			Total		
	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total
	Million board feet											
West side:												
Douglas-fir	102.0	45.4	147.4	459.0	13.6	472.6	5.2	138.9	144.1	566.2	197.9	764.1
Western hemlock	200.0	21.5	221.5	267.0	25.0	292.0	22.5	140.0	162.5	489.5	186.5	676.0
True firs	20.5	10.2	30.7	235.0	13.0	248.0	.6	64.4	65.0	256.1	87.6	343.7
Miscellaneous species (including hardwoods)	10.0	6.6	16.6	92.0	22.0	114.0	0	56.4	56.4	102.0	85.0	187.0
Subtotal	332.5	83.7	416.2	1,053.0	73.6	1,126.6	28.3	399.7	428.0	1,413.8	557.0	1,970.8
East side:												
Ponderosa pine	109.3	15.8	125.1	19.2	2.1	21.3	19.9	86.9	106.8	148.4	104.8	253.2
Douglas-fir	87.5	22.0	109.5	34.0	4.3	38.3	18.0	158.9	176.9	139.5	185.2	324.7
True firs	23.0	17.9	40.9	117.0	15.0	132.0	2.0	69.7	71.7	142.0	102.6	244.6
Miscellaneous species (including hardwoods)	30.2	36.0	66.2	27.6	15.4	43.0	6.2	224.0	230.2	64.0	275.4	339.4
Subtotal	250.0	91.7	341.7	197.8	36.8	234.6	46.1	539.5	585.6	493.9	668.0	1,161.9
Entire region:												
Douglas-fir	189.5	67.4	256.9	493.0	17.9	510.9	23.2	297.8	321.0	705.7	383.1	1,088.8
True firs	43.5	28.1	71.6	352.0	28.0	380.0	2.6	134.1	136.7	398.1	190.2	588.3
Miscellaneous species[1] (including hardwoods)	40.2	42.6	82.8	119.6	37.4	157.0	6.2	280.4	286.6	166.0	360.4	526.4
Total	582.5	175.4	757.9	1,250.8	110.4	1,361.2	74.4	939.2	1,013.6	1,907.7	1,225.0	3,132.7

[1] Except west-side western hemlock and east-side ponderosa pine.

TABLE 4 — *Annual cubic-foot volume losses from disease by tree species, subregion, form of loss, and age class.*

Tree Species	Mortality			Cull			Growth loss			Total		
	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total	Old growth	Young growth	Total
	Million cubic feet											
West side:												
Douglas-fir	16.5	9.2	25.7	37.0	1.0	38.0	0.8	26.1	26.9	54.3	36.3	90.6
Western hemlock	31.0	4.4	35.4	23.0	3.4	26.4	2.5	23.2	25.7	56.5	31.0	87.5
True firs	4.0	2.1	6.1	15.0	1.3	16.3	.1	9.7	9.8	19.1	13.1	32.2
Miscellaneous species (including hardwoods)	2.0	1.3	3.3	8.7	2.3	11.0	0	8.9	8.9	10.7	12.5	23.2
Subtotal	53.5	17.0	70.5	83.7	8.0	91.7	3.4	67.9	71.3	140.6	92.9	233.5
East side:												
Ponderosa pine	16.1	3.1	19.2	1.9	.4	2.3	2.7	15.4	18.1	20.7	18.9	39.6
Douglas-fir	14.1	5.0	19.1	2.2	.5	2.7	1.9	25.1	27.0	18.2	30.6	48.8
True firs	4.5	3.6	8.1	8.8	.9	9.7	.3	11.3	11.6	13.6	15.8	29.4
Miscellaneous species (including hardwoods)	5.1	7.1	12.2	2.9	2.2	5.1	.7	33.4	34.1	8.7	42.7	51.4
Subtotal	39.8	18.8	58.6	15.8	4.0	19.8	5.6	85.2	90.8	61.2	108.0	169.2
Entire region:												
Douglas-fir	30.6	14.2	44.8	39.2	1.5	40.7	2.7	51.2	53.9	72.5	66.9	139.4
True firs	8.5	5.7	14.2	23.8	2.2	26.0	.4	21.0	21.4	32.7	28.9	61.6
Miscellaneous species[1] (including hardwoods)	7.1	8.4	15.5	11.6	4.5	16.1	.7	42.3	43.0	19.4	55.2	74.6
Total	93.3	35.8	129.1	99.5	12.0	111.5	9.0	153.1	162.1	201.8	200.9	402.7

[1] Except west-side western hemlock and east-side ponderosa pine.

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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FORESTRY RESEARCH

U.S. Forest Service
Resource Bulletin PNW-21

October 1967

1966 WASHINGTON TIMBER HARVEST

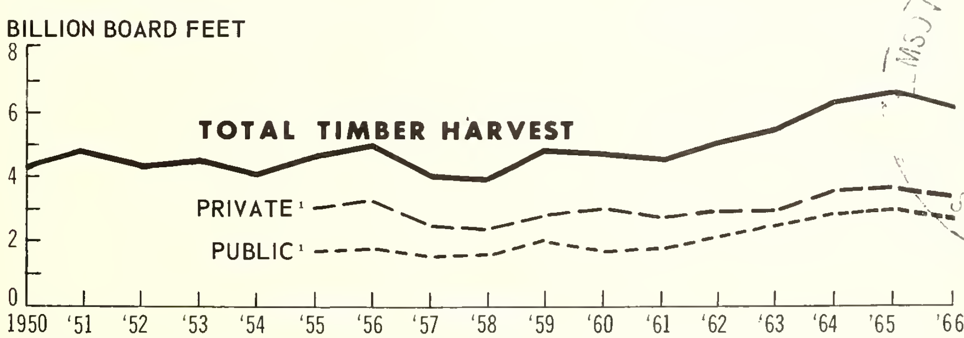
by Brian R. Wall, *Associate Economist*

The 1966 Washington timber harvest of 6.1 billion board feet was 6.8 percent below the 1965 level. This was the first decline since 1961. In part, the lower harvest in 1966 was due to completion of salvage logging of the 1962 blowdown. The volume of dead timber salvaged in 1966 was only 6 percent of the total, compared with 15 percent in 1965. The live timber harvest actually increased by 3 percent in 1966 to 5.7 billion board feet.

Private timber harvests of 3.5 billion board feet were 4 percent below last year. Log production by industrial owners was 2.7 billion board feet, down 3 percent from 1965. The small private owners' production dropped 18 percent to 367 million board feet in 1966, while large private owners with no processing facilities increased their cut 11 percent to 412 million board feet.

Production from public lands in 1966 was 2.6 billion board feet, down 11 percent from 1965. Both the State and the National Forests led the decline with harvest reductions of 147 million board feet, a 21-percent and 9-percent decline, respectively.

Although production of Douglas-fir amounted to 2.3 billion board feet, a 4-percent drop since 1965, its share of total log production increased from 38 to 39 percent during this period. The western hemlock production of 1.9 billion board feet was 9 percent below that recorded in 1965, and its share of total production declined from 32 percent to 31 percent. Red alder accounted for 85 percent of the 149 million board-foot hardwood production in 1966. Black cottonwood ranked second with 13 percent of the total. The total hardwood timber harvest was 21 percent lower in 1966 than in 1965.



[1]Separate data for public and private not available prior to 1955.

WASHINGTON TIMBER HARVEST 1950-66

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

(In thousands of board feet, Scribner log rule)

State and county	Private		State		Bur. Land Management		National Forests		Indian Lands		Other public[3/]		Other Federal agencies[4/]		Total production		
	Live	Dead[2/]	Live	Dead[2/]	Live	Dead	Live	Dead[2/]	Live	Dead[2/]	Live	Dead[2/]	Live	Dead[2/]	Live	Dead[2/]	Live & Dead
Western Washington:																	
Clallam	156,498	826	36,054	90	--	--	60,513	3,100	21,445	3,967	651	--	550	--	275,711	7,983	283,694
Clark	20,683	100	14,213	--	--	--	--	--	--	--	54	--	--	--	34,950	100	35,050
Cowlitz	264,202	142,885	65,260	31,809	--	--	27,600	1,100	--	--	21	--	--	--	357,083	175,794	532,877
Grays Harbor	295,553	7,784	3,240	15	--	--	78,001	3,700	138,282	3,787	10,149	455	110	--	525,335	15,741	541,076
Island	12,902	263	--	--	--	--	--	--	--	--	--	--	--	--	12,902	263	13,165
Jefferson	184,960	655	131,621	816	--	--	52,200	1,900	3,781	149	639	--	200	--	373,401	3,520	376,921
King	188,560	2,035	10,993	--	--	--	47,300	1,000	--	--	26,222	1,240	--	--	273,075	4,275	277,350
Kitsap	14,821	--	1,012	--	--	--	--	--	45	--	833	--	--	--	16,711	--	16,711
Lewis	527,199	52,165	26,533	11,809	--	--	145,585	4,700	--	--	895	--	55	--	700,267	68,674	768,941
Mason	69,494	97	4,433	--	--	--	90,000	10,800	1,311	--	1,866	--	150	--	167,254	10,897	178,151
Pacific	420,525	7,893	9,230	78	--	--	--	--	--	--	--	24	3,693	--	433,448	7,995	441,443
Pierce	265,574	27,734	21,570	1,213	--	--	37,718	1,000	--	--	555	--	14,003	803	339,420	30,750	370,170
San Juan	2,652	--	--	--	--	--	--	--	--	--	--	--	--	--	2,652	--	2,652
Skagit	98,640	1,282	16,621	190	--	--	66,100	1,200	--	--	59	--	--	--	181,420	2,672	184,092
Skamania	74,062	--	--	446	--	--	341,900	4,800	--	--	--	--	--	--	415,962	5,246	421,208
Snohomish	94,185	1,702	29,600	4,328	1	--	93,900	5,900	--	--	--	--	--	--	217,686	11,930	229,616
Thurston	109,167	365	7,489	40	--	--	--	--	--	--	--	--	--	--	116,656	405	117,061
Wahkiakum	78,666	459	25,435	118	--	--	--	--	--	--	--	--	--	--	104,101	577	104,678
Whatcom	64,887	1,641	17,313	1,201	--	--	59,632	5,000	--	--	102	--	--	--	141,934	7,842	149,776
Total	2,943,230	247,886	420,617	52,153	1	--	1,100,449	44,200	164,864	7,903	42,046	1,719	18,761	803	4,689,968	354,664	5,044,632
Total live and dead	3,191,116		472,770		1		1,144,649		172,767		43,765		19,564				5,044,632
Eastern Washington:																	
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	465	--	264	--	--	--	4,600	--	--	--	--	--	--	--	5,329	--	5,329
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	16,078	--	2,176	--	--	--	71,609	400	--	--	--	--	61	--	89,924	400	90,324
Columbia	12,259	--	--	--	--	--	400	--	--	--	226	--	--	--	12,885	--	12,885
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	19,196	--	--	--	2,207	--	53,135	--	79,399	--	--	--	--	--	153,937	--	153,937
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garfield	545	--	--	--	--	--	7,700	--	--	--	--	--	--	--	8,245	--	8,245
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	57,568	--	6,989	--	--	--	49,600	600	--	--	310	--	246	--	114,713	600	115,313
Klickitat	44,536	1,411	6,329	7	--	--	--	1,300	16,859	170	--	--	150	--	67,874	2,888	70,762
Lincoln	1,667	--	381	--	--	--	--	--	--	--	--	--	--	--	2,048	--	2,048
Okanogan	5,080	--	28,601	--	1,905	--	106,400	--	25,324	--	--	--	--	--	167,310	--	167,310
Pend Oreille	18,192	--	3,159	--	19	--	61,644	--	600	--	875	--	--	--	84,489	--	84,489
Spokane	13,733	--	149	--	--	--	--	--	--	--	65	--	110	--	14,057	--	14,057
Stevens	53,694	--	7,423	--	303	--	12,088	--	7,925	--	3,769	--	--	--	85,202	--	85,202
Walla Walla	5,342	24	--	--	--	--	200	--	--	--	--	--	--	--	5,542	24	5,566
Whitman	350	--	--	--	--	--	--	--	--	--	--	--	--	--	350	--	350
Yakima	18,491	--	10,198	--	--	--	58,200	300	127,065	821	--	--	--	--	213,954	1,121	215,075
Total	267,196	1,435	65,669	7	4,434	--	425,576	2,600	257,172	991	5,245	--	567	--	1,025,859	5,033	1,030,892
Total live and dead	268,631		65,676		4,434		428,176		258,163		5,245		567				1,030,892
Total Washington	3,210,426	249,321	486,286	52,160	4,435		1,526,025	46,800	422,036	8,894	47,291	1,719	19,328	803	5,715,827	359,697	6,075,524
Total Washington live and dead	3,459,747		538,446		4,435		1,572,825		430,930		49,010		20,131				6,075,524

1/ Includes volume in logs, poles, piling, cordwood, shingle bolts, etc., as compiled by Washington State Department of Natural Resources.
2/ Includes snags and down material existing prior to initial logging. Salvage of this material does not constitute drain on the volume of the forest inventory of live trees.
3/ Includes timber harvested from lands administered by cities, counties, public utility districts, and State agencies other than the Department of Natural Resources.
4/ Includes lands logged under jurisdiction of Bonneville Power Administration, National Parks, U.S. Army--Fort Lewis, and U.S. Fish & Wildlife Service.

U.S. Forest Service
Resource Bulletin PNW-22

December 1967

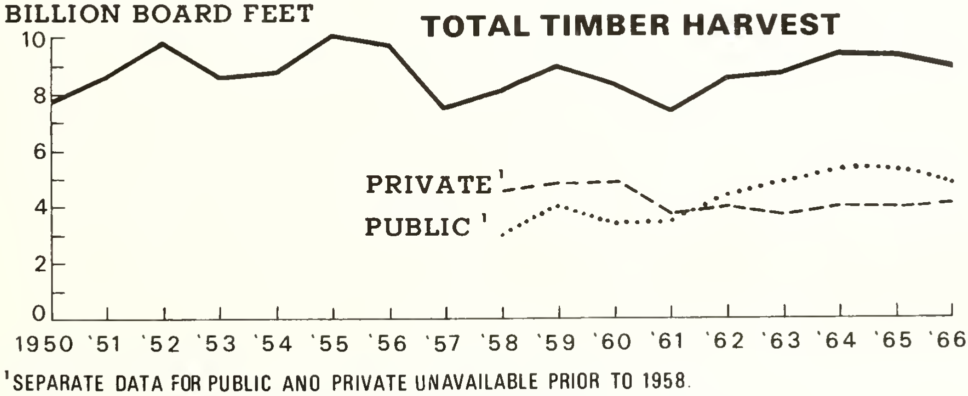
1966 OREGON TIMBER HARVEST

by
Brian R. Wall, *Associate Economist*

The 1966 Oregon timber harvest totaled 8.9 billion board feet, 5 percent less than the harvest in 1965. During 1966, the total public timber harvest declined 10 percent to 4.8 billion board feet. The uncut volume of public timber under contract at the end of 1966 was 7.6 billion board feet, up 1.3 billion board feet from 1965's yearend total. National Forest timber cut during 1966 declined 512 million board feet and the cut from State lands declined 70 million board feet, down 14 percent and 27 percent, respectively. The Bureau of Land Management's log production remained virtually unchanged.

The 1966 private cut increased 2 percent to 4.1 billion board feet with a 4-percent increase in eastern Oregon and a 2-percent increase in western Oregon. Log production on forest industry lands increased by 9 percent (300 million board feet) in 1966 which more than offset the 30-percent reduction (210 million board feet) in harvest from other private lands. In 1966 the private share of the total Oregon timber harvest increased from 43 percent to 46 percent.

The last year in which the timber harvest declined was 1961. However, circumstances behind the 1966 decline and those in 1961 were markedly different. In 1961, a trough year in a national economic contraction, the drop in production came about because of the reduced private timber harvest, whereas in 1966 the drop came because of the decreased public cut. In 1961, demand for roundwood was low with National Forest stumpage prices dropping 16 percent. In 1966 the demand for stumpage was strong, especially at the first of the year, with public stumpage prices rising 10 percent in western Oregon and 14 percent in eastern Oregon.



OREGON TIMBER HARVEST, 1950–66

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Timber Harvest by Ownership in the State of Oregon, 1966[1]

(In thousands of board feet, Scribner log rule)

State and county	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[2]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	30,562	18,313	48,875	53,113	18,900	--	--	10,922	16	131,826
Clackamas	108,060	15,970	124,030	32,662	262,100	--	--	--	1,300	420,092
Clatsop	228,927	9,353	238,280	--	--	--	--	23,833	--	262,113
Columbia	74,761	21,330	96,091	843	--	--	--	977	1,210	99,121
Coos	351,077	29,549	380,626	131,035	70,300	--	4,000	44,954	790	631,705
Curry	192,305	19,675	211,980	20,972	121,500	--	--	585	2,076	357,113
Douglas	629,325	47,336	676,661	379,903	394,700	--	--	31,491	--	1,482,755
Hood River	37,993	1,570	39,563	--	30,700	--	--	--	13,200	83,463
Jackson	201,782	7,380	209,162	135,615	116,200	--	--	--	--	460,977
Josephine	2,545	5,398	7,943	74,566	61,000	--	--	2,115	2,447	148,071
Lane	500,163	38,932	539,095	156,347	693,900	--	280	6,755	115	1,396,492
Lincoln	251,275	33,777	285,052	18,038	121,400	--	--	324	4,750	429,564
Linn	358,459	87,256	445,715	77,223	159,700	--	1,450	3,610	--	687,698
Marion	6,195	7,580	13,775	9,179	55,700	--	--	9,101	--	87,755
Multnomah	2,649	1,649	4,298	23	36,000	--	--	--	--	40,321
Polk	52,442	2,409	54,851	41,301	500	--	--	4,689	--	101,341
Tillamook	90,342	8,585	98,927	28,072	35,200	--	--	40,943	9,260	212,402
Washington	10,724	13,000	23,724	4,662	--	--	--	--	--	28,386
Yamhill	12,191	6,437	18,628	37,401	1,600	--	--	--	--	57,629
Total	3,141,777	375,499	3,517,276	1,200,955	2,179,400	--	5,730	180,299	35,164	7,118,824
Eastern Oregon										
Baker	--	350	350	17	114,900	--	--	--	--	115,267
Crook	2,692	640	3,332	3,243	70,200	--	--	--	--	76,775
Deschutes	40,780	--	40,780	104	87,600	--	--	--	--	128,484
Cilliam	--	--	--	--	--	--	--	--	--	--
Crant	27,378	20,324	47,702	6,951	156,300	--	--	--	--	210,953
Harney	--	--	--	1,297	70,100	--	--	--	--	71,397
Jefferson	1,900	--	1,900	--	16,400	20,786	--	--	--	39,086
Klamath	200,979	17,795	218,774	25,896	178,400	--	--	1,500	--	424,570
Lake	89,485	1,235	90,720	--	167,700	--	--	--	--	258,420
Malheur	--	--	--	--	2,500	--	--	--	--	2,500
Morrow	21,020	5	21,025	--	21,300	--	--	--	--	42,325
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	37,340	28,402	65,742	3,700	40,900	2,357	--	--	--	112,699
Union	21,644	23,970	45,614	--	44,100	--	--	--	--	89,714
Wallowa	32,642	12,887	45,529	45	55,700	--	--	--	--	101,274
Wasco	8,565	1,124	9,689	1,306	55,300	37,098	--	2,000	--	105,393
Wheeler	13,509	1,433	14,942	--	8,500	--	--	283	--	23,725
Total	497,934	108,165	606,099	42,559	1,089,900	60,241	--	3,783	--	1,802,582
Total Oregon	3,639,711	483,664	4,123,375	1,243,514	3,269,300	60,241	5,730	184,082	35,164	8,921,406

[1] Includes volume removed as logs, poles and piling, but not volume removed for woodcutting operations.

[2] Compiled by State Forester.

[3] Compiled by U.S. Bureau of Land Management.

[4] Compiled by U.S. Forest Service, Region 6.

[5] Compiled by U.S. Bureau of Indian Affairs.

Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oreg.

U.S. FOREST SERVICE
Resource Bulletin PNW-23
1968

Preliminary Timber Resource STATISTICS for Humboldt County, California, January 1, 1967

By DANIEL D. OSWALD

PACIFIC NORTHWEST
FOREST & RANGE EXPERIMENT STATION
U. S. DEPARTMENT OF AGRICULTURE . FOREST SERVICE

PREFACE

This report presents the preliminary findings of an inventory of Humboldt County's timber resources completed in 1966. Analysis and interpretation of the findings are underway, and the results of this analysis, with more detailed statistics, will be published in the near future.

This inventory is part of the nationwide Forest Survey, authorized by the McSweeney-McNary Forest Research Act of 1928, amended June 25, 1949. The Forest Survey periodically inventories the extent and condition of the forest lands and their timber resources to determine the resource base, rates of forest growth and use, and trends in supply of raw materials for the wood products industries. Such information is needed in formulation of forest policies and programs.

The Forest Survey is conducted by the Experiment Stations of the Forest Service. In the Pacific Coast States, it is an activity of the Pacific Northwest Forest and Range Experiment Station, with headquarters at Portland, Oregon.

Daniel D. Oswald is the Pacific Northwest Station's Forest Survey representative in California, located at the Pacific Southwest Forest and Range Experiment Station, 1960 Addison Street, Berkeley, California 94701.

THE TIMBER RESOURCE BASE

In 1967, the forested area of Humboldt County totaled 1,850,000 acres, or approximately 81 percent of the county's total land area. Of the total forest land area, 1,701,000 acres, or 92 percent, is commercial forest land; 47,000 acres is productive-reserved forest land in State parks; and 102,000 acres is unproductive forest land.

Over 75 percent, or 1,283,000 acres, of the commercial forest land area is in private ownership with the remaining area in National Forest, Indian, and Bureau of Land Management ownership in order of decreasing magnitude. In terms of volume, the proportion shifts slightly with 66 percent of the sawtimber volume in private ownership and with National Forests owning the greater proportion of timber on public lands.

An earlier inventory of Humboldt County's forest resource was completed in 1948 and published in 1952. The report included information on area and ownership but not volume. Between 1948 and 1967, commercial forest area decreased by 39,000 acres. This 2-percent decline is due to conversions to nonforest uses and withdrawals into productive-reserved status resulting from forest land purchases for expansion of parks, campgrounds, memorial groves, and similar areas.

Direct comparison of area by forest cover type between the 1948 and present inventory cannot be made without conversion of the data because of differences in sampling methods and type definitions. The early cover type definitions recognized only commercially valuable conifer species and assigned unequal weights among these species in the determination of forest cover type for a given area. Redwood was the favored species, and its occurrence as 20 percent or more of the commercial conifer cover resulted in an area being classified as redwood type. Unstocked areas and areas covered with hardwoods were assigned to a conifer type based upon an evaluation of potential species composition.

Under the present Forest Survey definitions, as used in the current Humboldt County inventory, forest cover type is determined on the basis of the species plurality of stocking by all live trees considering both size and spacing. This definition treats all species, including hardwoods, equally, regardless of relative economic values. As a result, the forest cover type information presented in this report reflects the species that actually occupy the forest lands of Humboldt County.

Table 1.--Area by land classes, Humboldt County, California, January 1, 1967

(In thousand acres)

Land class	Area
Commercial forest	1,701
Productive-reserved forest	47
Unproductive forest	102
Total forest	1,850
Nonforest	437
Total area[1]	2,287

[1] From U.S. Bureau of the Census, Land and Water Area of the United States, 1960.

Table 2.--Area of commercial forest land, by ownership classes, Humboldt County, California, January 1, 1967

(In thousand acres)

Ownership class	Area
National Forest	292
Other public:[1]	
Bureau of Land Management	53
Indian	72
State, county, and municipal	1
Total other public	126
Private:	
Forest industry	531
Farmer owned	389
Miscellaneous private	363
Total private	1,283
All ownerships	1,701

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 3.--Area of commercial forest land, by stand-size and ownership classes, Humboldt County, California, January 1, 1967

(In thousand acres)

Stand-size class[1/]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscel-laneous private
Sawtimber stands:					
21.0 inches and larger	896	220	81	296	299
11.0 - 20.9 inches	369	35	20	115	199
Total sawtimber stands	1,265	255	101	411	498
Poletimber stands	66	10	4	5	47
Sapling and seedling stands	276	21	15	82	158
Nonstocked areas	94	6	6	33	49
All classes	1,701	292	126	531	752

1/ A classification of forest land based upon the predominant size class of growing-stock trees on the area:

Sawtimber stand: Stand at least 16.7 percent stocked with growing-stock trees, with half or more of the stocking in sawtimber trees (11.0+ inches d.b.h) or poletimber trees (5.0-10.9 inches d.b.h.), with sawtimber stocking equal to or exceeding poletimber stocking.
Poletimber stand: Stand at least 16.7 percent stocked with growing-stock trees, with half or more of the stocking in poletimber or sawtimber trees, with poletimber stocking greater than sawtimber.
Sapling and seedling stand: Stand at least 16.7 percent stocked with growing-stock trees, with more than half the stocking in trees less than 5.0 inches d.b.h.
Nonstocked: Area less than 16.7 percent stocked by live growing-stock trees.

Table 4.--Area of commercial forest land, by forest type and ownership classes, Humboldt County, California, January 1, 1967

(In thousand acres)

Cover type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscel-laneous private
Douglas-fir	469	155	48	87	179
Redwood	312	--	1	249	62
True firs	70	51	3	5	11
Pines	19	14	--	5	--
Sitka spruce	16	--	--	5	11
Tanoak	458	48	44	111	255
Pacific madrone	76	11	--	5	60
Other hardwoods	187	7	24	31	125
Nonstocked	94	6	6	33	49
All types	1,701	292	126	531	752

Table 6.--Volume of sawtimber on commercial forest land, by species and ownership classes, Humboldt County, California, January 1, 1967

(In million board feet, International 1/4-inch rule)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscel-laneous private
Softwoods:					
Douglas-fir	16,555	5,814	2,318	3,701	4,722
Redwood	10,317	--	2	9,320	995
White fir	1,893	1,647	90	62	94
Grand fir	582	--	--	328	254
Red fir	259	259	--	--	--
Sugar pine	478	417	61	--	--
Ponderosa and Jeffrey pines[1/]	125	101	--	11	13
Sitka spruce	208	--	--	154	54
Western hemlock	208	--	--	208	--
Cedars[2/]	113	80	2	21	10
Total	30,738	8,318	2,473	13,805	6,142
Hardwoods:					
Tanoak	939	89	100	182	568
Pacific madrone	406	42	65	47	252
Other hardwoods	478	50	58	83	287
Total	1,823	181	223	312	1,107
Total, all species	32,561	8,499	2,696	14,117	7,249

1/ Includes small amount of knobcone pine.

2/ Primarily incense-cedar.

Oswald, Daniel D.
1968. Preliminary timber resource statistics for Humboldt County, California, January 1, 1967. U.S. Forest Serv. Resource Bull. PNW-23, 8 pp. Pacific Northwest Forest & Range Exp. Sta., Portland, Oregon.

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Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, the Western States, or the Nation. Project headquarters are at:

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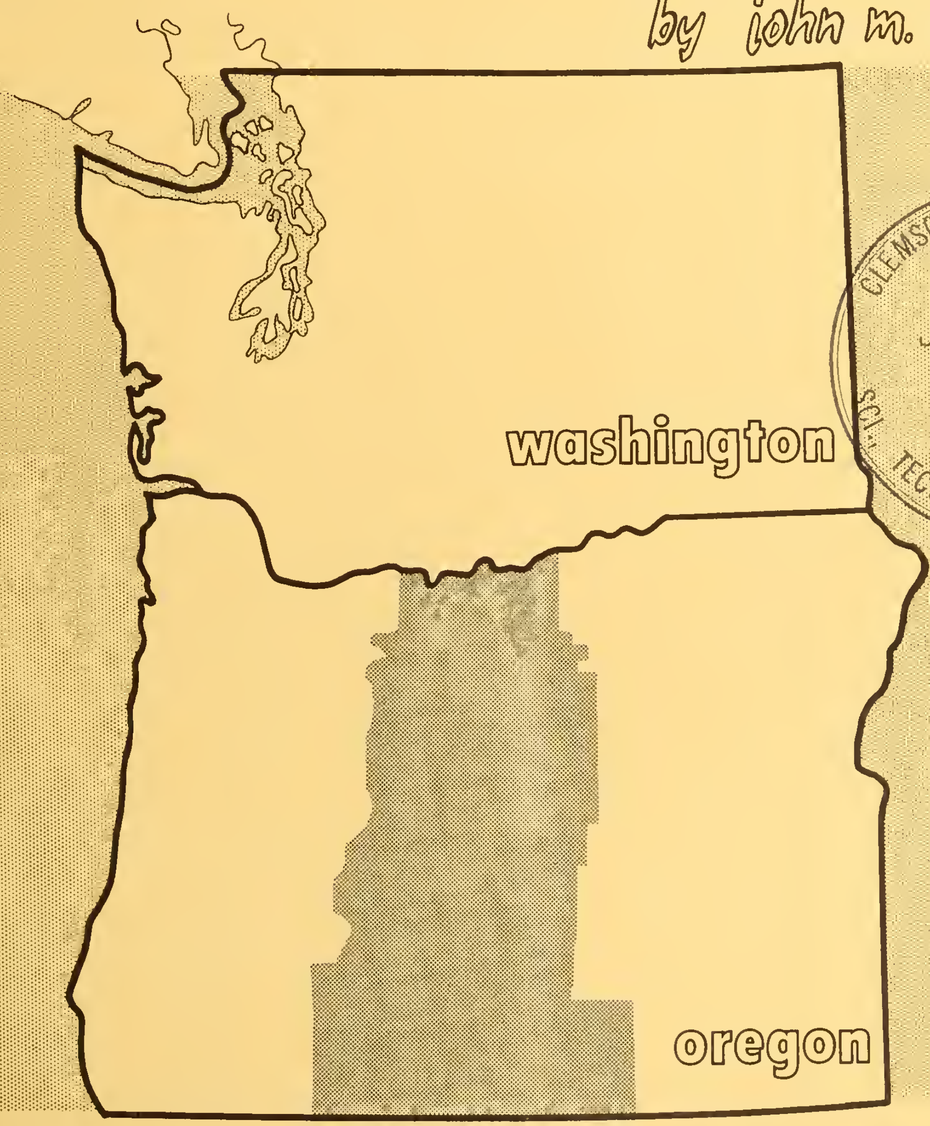
The FOREST SERVICE of the U. S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners,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

TIMBER RESOURCE STATISTICS
for central oregon

by john m. berger



PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U.S. DEPT. OF AGRICULTURE · FOREST SERVICE

U. S. FOREST SERVICE
RESOURCE BULLETIN PNW-24
1968

PREPARED BY

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Acknowledgment is made of the cooperation of the Division of Timber Management, Region 6, U.S. Forest Service, in supplying the field plot data from National Forest lands; of the assistance of the county assessors of the inventoried counties in furnishing ownership information; and of the counties and other public and private agencies in making aerial photography available for photo interpretation.

PREFACE

This publication summarizes the results of the third inventory of the timber resources of nine counties in central Oregon: Crook, Deschutes, Gilliam, Jefferson, Klamath, Lake, Sherman, Wasco, and Wheeler. This block of nine counties is one of 10 such blocks set up in the States of Oregon and Washington by the Forest Survey to facilitate orderly reinventories of the timber resources. Each block will be reinventoried at 10-year intervals and the results published in a single report for the block. The five blocks in Oregon are northwest Oregon, west-central Oregon, southwest Oregon, central Oregon, and eastern Oregon.

The field data for central Oregon were collected for all lands except the National Forests during the summer of 1964; data were summarized as of January 1, 1965. Field data were collected for the Fremont, Malheur, and Winema National Forests and the Crooked River Working Circle of the Ochoco National Forest in 1962. The Deschutes National Forest was inventoried during 1961-62 and the Clackamas-Sandy and East Side Working Circles of the Mount Hood National Forest in 1960. The West Klamath and Rogue Basin Working Circles of the Rogue River National Forest were inventoried during 1957-59. The Burns Working Circle of the Ochoco National Forest was inventoried during 1957-58.

Previous inventories of these counties were made in the years shown below:

County	Initial inventory	First reinventory	Second reinventory
Crook	1936	1952	1964
Deschutes	1934	1953	1964
Jefferson	1934	1953	1964
Klamath	1934	1946	1964
Lake	1934-35	1947	1964
Wasco	1934	1954	1964
Wheeler	1936	1953	1964

The original inventory of central Oregon was conducted during the period 1934-36, and the results were released as a series of pamphlets containing forest statistics for each county. During the period 1946-54, this area was reinventoried and the results issued as a series of separate reports for each county.

Such inventories are a part of the Forest Survey--a nationwide project of the Forest Service authorized by the McSweeney-McNary Forest Research Act of 1928 and subsequent amendments. The purpose of the Forest Survey is to periodically inventory the extent and condition of forest lands and the amount and kind of timber volume on them, to determine rates of forest growth and depletion, to estimate timber cut and probable future trends in timber requirements, and to analyze and make available survey information needed in the formulation of forest policies and programs. Resurveys are made as necessary to keep the basic information up to date.

The Forest Survey is conducted in the various forest regions of the Nation by the Experiment Stations of the U.S. Forest Service. In the States of California, Oregon, Washington, and Alaska, it is the responsibility of the Pacific Northwest Forest and Range Experiment Station at Portland, Oregon.

CONTENTS

SUMMARY TABLES (continued) Page

Page

CENTRAL OREGON'S FOREST RESOURCE IN BRIEF

COMMERCIAL FOREST LAND--

Totals 6,255,000 acres and is 35 percent of the land area;
Is 70 percent publicly owned and 30 percent private;
Has sawtimber stands on 63 percent of its area; and
Is 39 percent ponderosa pine type, 22 percent lodgepole pine, 35 percent other softwood types, and 4 percent nonstocked.

GROWING-STOCK VOLUME--

Totals 13,849 million cubic feet; 82 percent in four species, ponderosa pine, lodgepole pine, white fir, and Douglas-fir;
Is 80 percent publicly owned and 20 percent private;
Is 83 percent in trees of sawtimber size; and
Is 99 percent softwoods.

SAWTIMBER VOLUME--

Totals 65,032 million board feet, International 1/4-inch rule (57,043 million board feet, Scribner rule);
Is 82 percent publicly owned and 18 percent private; and
Is 36 percent in trees 19.0 to 28.9 inches in diameter and 37 percent in trees over 29.0 inches in diameter.

NATIONAL FOREST OWNERSHIP--

Has 62 percent of the commercial forest area;
Controls 60 percent of the sawtimber area;
Has 46,409 million board feet, International 1/4-inch rule; and
Holds 71 percent of the sawtimber volume.

OTHER PUBLIC OWNERSHIP--

Has 8 percent of the commercial forest area;
Controls 8 percent of the sawtimber area;
Has 6,726 million board feet, International 1/4-inch rule; and
Holds 10 percent of the sawtimber volume.

FOREST INDUSTRY OWNERSHIP--

Has 20 percent of the commercial forest area;
Controls 22 percent of the sawtimber area;
Has 9,539 million board feet, International 1/4-inch rule; and
Holds 15 percent of the sawtimber volume.

FARMER AND MISCELLANEOUS PRIVATE OWNERSHIP--

Has 10 percent of the commercial forest area;
Controls 10 percent of the sawtimber area;
Has 2,358 million board feet, International 1/4-inch rule; and
Holds 4 percent of the sawtimber volume.

NET ANNUAL GROWTH--

Totals 196 million cubic feet (780 million board feet, International 1/4-inch rule; 672 million board feet, Scribner);
Is 1.4 percent of growing-stock volume; and
Is 99.9 percent softwood.

AVERAGE ANNUAL MORTALITY--

- Totals 61 million cubic feet (251 million board feet, International 1/4-inch rule; 218 million board feet, Scribner);
- Is 0.44 percent of growing-stock volume; and 62 percent occurs on publicly owned land.

AVERAGE ANNUAL CUT OVER THE PAST 5 YEARS--

- Has been 827.5 million board feet, Scribner rule, of which 34 percent has been private timber.

Table 1.--Area by land class, by county, central Oregon, January 1, 1965

(In acres)

County	All land[1/]	Commercial forest	Productive-reserved forest	Unproductive forest	Total forest	Nonforest
Crook	1,907,000	421,000	--	529,000	950,000	957,000
Deschutes	1,937,000	968,000	42,000	270,000	1,280,000	657,000
Gilliam	774,000	(2/)	--	--	--	774,000
Jefferson	1,148,000	365,000	18,000	223,000	606,000	542,000
Klamath	3,822,000	2,601,000	169,000	257,000	3,027,000	795,000
Lake	5,292,000	1,169,000	13,000	307,000	1,489,000	3,803,000
Sherman	529,000	--	--	--	--	529,000
Wasco	1,525,000	419,000	1,000	130,000	550,000	975,000
Wheeler	1,093,000	312,000	2,000	193,000	507,000	586,000
Total	18,027,000	6,255,000	245,000	1,909,000	8,409,000	[3/]9,618,000

1/ From U.S. Bureau of the Census, Land and Water Area of the United States, 1960.

2/ Less than 1,000 acres. Included with Wheeler County.

3/ Includes 85,000 acres of water according to Forest Survey standards of area classification but defined as land by the U.S. Bureau of the Census.

Table 2.--Area of commercial forest land, by ownership class and county, central Oregon, January 1, 1965

(In acres)

Ownership class	Total	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
National Forest	3,897,000	333,000	815,000	135,000	1,454,000	829,000	198,000	133,000
Other Federal:								
Bureau of Land Management	107,000	11,000	24,000	--	59,000	4,000	--	9,000
Indian	295,000	--	--	136,000	--	--	159,000	--
Miscellaneous Federal	5,000	--	--	--	5,000	--	--	--
Total other Federal	407,000	11,000	24,000	136,000	64,000	4,000	159,000	9,000
State	52,000	--	--	--	52,000	--	--	--
County and municipal	1,000	--	1,000	--	--	--	--	--
Total State and county	53,000	--	1,000	--	52,000	--	--	--
Forest industry	1,250,000	57,000	75,000	59,000	701,000	263,000	15,000	80,000
Farmer owned	354,000	20,000	18,000	22,000	115,000	73,000	23,000	83,000
Miscellaneous private	294,000	--	35,000	13,000	215,000	--	24,000	7,000
Total private	1,898,000	77,000	128,000	94,000	1,031,000	336,000	62,000	170,000
All ownerships	6,255,000	421,000	968,000	365,000	2,601,000	1,169,000	419,000	312,000

1/ Includes Gilliam County.

Table 3.--Area of commercial forest land, by stand-size and ownership class, central Oregon, January 1, 1965

(In acres)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:					
Old-growth[1]	2,252,000	1,650,000	186,000	339,000	77,000
Young-growth[2]	1,690,000	731,000	140,000	507,000	312,000
Total	3,942,000	2,381,000	326,000	846,000	389,000
Poletimber stands	1,504,000	1,028,000	94,000	232,000	150,000
Sapling and seedling stands	567,000	383,000	22,000	113,000	49,000
Nonstocked areas	242,000	105,000	18,000	59,000	60,000
All classes	6,255,000	3,897,000	460,000	1,250,000	648,000

1/ Stands 140 years and older.

2/ Stands less than 140 years old.

Table 4.--Area of commercial forest land, by stand volume and ownership class, central Oregon, January 1, 1965

(In acres)

Stand volume per acre[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Less than 1,500 board feet	1,360,000	887,000	54,000	190,000	229,000
1,500 to 5,000 board feet	1,495,000	736,000	92,000	440,000	227,000
5,000 to 10,000 board feet	1,223,000	699,000	61,000	303,000	160,000
10,000 to 20,000 board feet	1,181,000	786,000	136,000	227,000	32,000
20,000 to 30,000 board feet	527,000	405,000	57,000	65,000	--
30,000 board feet or more	469,000	384,000	60,000	25,000	--
All classes	6,255,000	3,897,000	460,000	1,250,000	648,000

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

Table 5.--Area of commercial forest land, by stocking class of growing-stock trees and by stand-size class, central Oregon, January 1, 1965

(In acres)

Stocking class	All stands	Sawtimber stands	Poletimber stands	Sapling and seedling stands	Non-stocked stands
70 percent or more	4,020,000	2,675,000	1,068,000	277,000	--
40 to 70 percent	1,244,000	792,000	283,000	169,000	--
10 to 40 percent	749,000	475,000	153,000	121,000	--
Less than 10 percent	242,000	--	--	--	242,000
All classes	6,255,000	3,942,000	1,504,000	567,000	242,000

Table 6.--Area of commercial forest land by cubic-foot site class and by ownership class, central Oregon, January 1, 1965

(In acres)

Site class[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
165 cubic feet or more	77,000	--	30,000	47,000	--
120 to 165 cubic feet	156,000	1,000	81,000	61,000	13,000
85 to 120 cubic feet	1,136,000	783,000	59,000	211,000	83,000
50 to 85 cubic feet	4,318,000	2,996,000	232,000	722,000	368,000
20 to 50 cubic feet	568,000	117,000	58,000	209,000	184,000
All classes	6,255,000	3,897,000	460,000	1,250,000	648,000

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

Table 7.--Area of commercial forest land, by forest type and by ownership class, central Oregon, January 1, 1965

(In acres)

Type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Ponderosa pine	2,410,000	1,307,000	170,000	588,000	345,000
Douglas-fir	914,000	685,000	78,000	86,000	65,000
Lodgepole pine	1,392,000	950,000	81,000	260,000	101,000
Spruce--fir	857,000	523,000	77,000	218,000	39,000
Other softwoods	408,000	314,000	32,000	39,000	23,000
Hardwoods	32,000	13,000	4,000	--	15,000
Nonstocked	242,000	105,000	18,000	59,000	60,000
All types	6,255,000	3,897,000	460,000	1,250,000	648,000

Table 8.--Area of noncommercial forest land, by forest type, central Oregon, January 1, 1965

(In acres)

Type	All areas	Productive-reserved areas	Unproductive areas
Ponderosa pine	64,000	64,000	--
Lodgepole pine	108,000	108,000	--
True fir--mountain hemlock	69,000	69,000	--
Other softwoods[1]	4,000	4,000	--
Subalpine	60,000	--	60,000
Juniper	1,685,000	--	1,685,000
Noncommercial rocky	39,000	--	39,000
Noncommercial other[2]	125,000	--	125,000
All types	2,154,000	245,000	1,909,000

1/ Includes Douglas-fir, whitebark pine, nonstocked.

2/ Includes bogs, chaparral, oak-madrone, and others.

Table 9.--Volume of all growing stock and sawtimber on commercial forest land, by county and ownership class, central Oregon, January 1, 1965

County	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - - - - - - -	Million cubic feet	- - - - - - - - -		
All growing stock:					
Crook	939	827	28	61	23
Deschutes	1,821	1,637	34	118	32
Jefferson	1,018	396	518	83	21
Klamath	5,397	3,647	261	1,130	359
Lake	2,456	1,744	1	655	56
Wasco	1,636	955	580	32	69
Wheeler[1/]	582	377	17	101	87
Total	13,849	9,583	1,439	2,180	647
	- - Million board feet, International 1/4-inch rule - -				
Sawtimber:					
Crook	5,091	4,765	140	158	28
Deschutes	7,118	6,388	82	522	126
Jefferson	5,249	2,143	2,715	364	27
Klamath	23,983	16,575	1,175	4,784	1,449
Lake	12,450	9,023	7	3,218	202
Wasco	8,375	5,445	2,523	123	284
Wheeler[1/]	2,766	2,070	84	370	242
Total	65,032	46,409	6,726	9,539	2,358
	- - - - - Million board feet, Scribner rule - - - - -				
Sawtimber:					
Crook	4,551	4,267	128	133	23
Deschutes	6,238	5,605	67	461	105
Jefferson	4,654	1,909	2,405	318	22
Klamath	20,821	14,330	1,032	4,200	1,259
Lake	11,102	8,051	6	2,874	171
Wasco	7,237	4,731	2,176	99	231
Wheeler[1/]	2,440	1,852	76	315	197
Total	57,043	40,745	5,890	8,400	2,008

1/ Includes Gilliam County.

Table 10.--Number of growing-stock trees on commercial forest land, by diameter class and by softwoods and hardwoods, central Oregon, January 1, 1965

(Thousands of trees)

Diameter class (inches d.b.h.)	All species	Softwoods	Hardwoods
5.0 - 6.9	280,284	279,066	1,218
7.0 - 8.9	161,740	160,845	895
9.0 - 10.9	96,261	95,940	321
11.0 - 12.9	52,735	52,659	76
13.0 - 14.9	35,349	35,298	51
15.0 - 16.9	22,737	22,721	16
17.0 - 18.9	16,257	16,248	9
19.0 - 28.9	42,179	42,167	12
29.0 - 38.9	12,412	12,412	--
39.0 and larger	2,658	2,658	--
All classes	722,612	720,014	2,598

Table 11.--Average number of growing-stock trees per acre on commercial forest land, by diameter and ownership class, central Oregon, January 1, 1965

Diameter class (inches d.b.h.)	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
5.0 - 6.9	44.8	50.9	39.3	34.1	32.5
7.0 - 8.9	25.8	29.5	27.2	18.4	17.5
9.0 - 10.9	15.3	16.7	19.3	12.6	10.3
11.0 - 12.9	8.4	8.9	10.9	7.0	6.3
13.0 - 14.9	5.6	5.7	8.3	4.9	4.5
15.0 - 16.9	3.6	3.8	5.1	2.9	2.8
17.0 - 18.9	2.5	2.8	3.8	2.1	1.4
19.0 - 28.9	6.7	7.7	9.5	4.9	2.4
29.0 - 38.9	1.9	2.5	2.1	1.3	.2
39.0 and larger	.4	.5	.5	.3	.1
All classes	115.0	129.0	126.0	88.5	78.0

Table 12.--Number of cull and salvable dead trees on commercial forest land, by diameter class and by softwoods and hardwoods, central Oregon, January 1, 1965

(Thousands of trees)

Diameter class (inches d.b.h.)	Cull trees	Salvable dead trees
Softwoods:		
5.0 - 10.9	38,725	(1/)
11.0 - 20.9	3,435	2,189
21.0 and larger	1,813	886
Total	43,973	3,075
Hardwoods:		
5.0 - 10.9	3,395	(1/)
11.0 - 20.9	534	16
21.0 and larger	32	--
Total	3,961	16
All species	47,934	3,091

1/ Not applicable.

Table 13.--Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, central Oregon, January 1, 1965

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	10,277	10,274	3
Upper-stem portion	774	774	--
Total	11,051	11,048	3
Poletimber trees	2,798	2,789	9
All growing-stock trees	13,849	13,837	12
Sound cull trees:			
Sawtimber-size	62	57	5
Poletimber-size	159	151	8
Total	221	208	13
Rotten cull trees:			
Sawtimber-size	41	41	(1/)
Poletimber-size	2	2	(1/)
Total	43	43	(1/)
Salvable dead trees:			
Sawtimber-size	177	177	(1/)
Total all timber	14,290	14,265	25

1/ Less than 500,000 cubic feet.

Table 14.--Volume of all growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, central Oregon, January 1, 1965

Timber and ownership class	Average volume per acre	Total volume		
		All species	Softwoods	Hardwoods
	Cubic feet	- - - - Million cubic feet - - - - -		
All growing stock:				
National Forest	2,459	9,583	9,575	8
Other public	3,130	1,439	1,439	--
Forest industry	1,744	2,180	2,179	1
Farmer and miscellaneous private	998	647	644	3
All ownerships	2,214	13,849	13,837	12
	Board feet	- - - - Million board feet - - - -		
Sawtimber (International 1/4-inch rule):				
National Forest	11,909	46,409	46,392	17
Other public	14,622	6,726	6,726	--
Forest industry	7,633	9,539	9,539	--
Farmer and miscellaneous private	3,636	2,358	2,358	--
All ownerships	10,397	65,032	65,015	17
Sawtimber (Scribner rule):				
National Forest	10,455	40,745	40,728	17
Other public	12,805	5,890	5,890	--
Forest industry	6,722	8,400	8,400	--
Farmer and miscellaneous private	3,096	2,008	2,008	--
All ownerships	9,119	57,043	57,026	17

Table 15.--Volume of all growing stock and sawtimber on commercial forest land, by stand-size class and by softwoods and hardwoods, central Oregon, January 1, 1965

Stand-size class	Average volume per acre	Total volume		
		All species	Softwoods	Hardwoods
	Cubic feet	- - - - Million cubic feet - - - -		
All growing stock:				
Sawtimber stands	2,907	11,458	11,452	6
Poletimber stands	1,362	2,049	2,044	5
Sapling and seedling stands	561	318	317	1
Nonstocked areas	97	24	24	--
Total	2,214	13,849	13,837	12
	Board feet	- - - - Million board feet - - - -		
Sawtimber (International 1/4-inch rule):				
Sawtimber stands	15,168	59,791	59,782	9
Poletimber stands	2,635	3,964	3,960	4
Sapling and seedling stands	2,062	1,169	1,165	4
Nonstocked areas	448	108	108	--
Total	10,397	65,032	65,015	17
Sawtimber (Scribner rule):				
Sawtimber stands	13,322	52,515	52,506	9
Poletimber stands	2,267	3,412	3,408	4
Sapling and seedling stands	1,802	1,022	1,018	4
Nonstocked areas	391	94	94	--
Total	9,119	57,043	57,026	17

Table 16.--Volume of growing stock on commercial forest land by species and ownership class, central Oregon, January 1, 1965

(In million cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Ponderosa pine	5,603	3,741	387	1,087	388
Douglas-fir	1,574	869	384	219	102
Sugar pine	73	45	3	21	4
Western white pine	126	108	11	7	--
Lodgepole pine	2,334	1,774	128	338	94
Whitebark pine	21	18	3	--	--
White fir	1,843	1,317	86	402	38
California-Shasta red fir	435	416	--	19	--
Grand fir	182	--	148	22	12
Pacific silver fir	101	66	35	--	--
Noble fir	111	93	18	--	--
Subalpine fir	87	85	2	--	--
Engelmann spruce	160	53	106	1	--
Mountain hemlock	825	759	66	--	--
Western hemlock	126	110	16	--	--
Incense-cedar	113	33	14	60	6
Western redcedar	14	7	7	--	--
Western larch	109	81	25	3	--
Total softwoods	13,837	9,575	1,439	2,179	644
Total hardwoods	12	8	--	1	3
Total all species	13,849	9,583	1,439	2,180	647

Table 17.--Volume of sawtimber on commercial forest land by species and ownership class, central Oregon, January 1, 1965 (International 1/4-inch rule)

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Ponderosa pine	31,851	22,935	2,022	5,360	1,534
Douglas-fir	8,547	5,199	1,967	1,032	349
Sugar pine	384	257	15	102	10
Western white pine	707	615	54	38	--
Lodgepole pine	4,900	3,379	330	919	272
Whitebark pine	56	52	4	--	--
White fir	8,062	5,846	407	1,677	132
California-Shasta red fir	2,350	2,270	--	80	--
Grand fir	725	--	600	83	42
Pacific silver fir	334	246	88	--	--
Noble fir	537	462	75	--	--
Subalpine fir	289	282	7	--	--
Engelmann spruce	899	267	632	--	--
Mountain hemlock	3,568	3,267	301	--	--
Western hemlock	707	637	70	--	--
Incense-cedar	452	143	53	237	19
Western redcedar	65	39	26	--	--
Western larch	582	496	75	11	--
Total softwoods	65,015	46,392	6,726	9,539	2,358
Total hardwoods	17	17	--	--	--
Total all species	65,032	46,409	6,726	9,539	2,358

Table 18.--Volume of sawtimber on commercial forest land by species and ownership class, central Oregon, January 1, 1965

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Ponderosa pine	28,598	20,662	1,817	4,785	1,334
Douglas-fir	7,517	4,600	1,732	904	281
Sugar pine	344	232	13	90	9
Western white pine	606	519	51	36	--
Lodgepole pine	3,964	2,725	267	749	223
Whitebark pine	47	43	4	--	--
White fir	7,093	5,143	360	1,479	111
California-Shasta red fir	1,854	1,783	--	71	--
Grand fir	613	--	508	70	35
Pacific silver fir	277	207	70	--	--
Noble fir	455	389	66	--	--
Subalpine fir	248	243	5	--	--
Engelmann spruce	786	228	558	--	--
Mountain hemlock	3,080	2,828	252	--	--
Western hemlock	601	540	61	--	--
Incense-cedar	391	123	46	207	15
Western redcedar	55	34	21	--	--
Western larch	497	429	59	9	--
Total softwoods	57,026	40,728	5,890	8,400	2,008
Total hardwoods	17	17	--	--	--
Total all species	57,043	40,745	5,890	8,400	2,008

Table 19.--Volume of growing stock on commercial forest land, by species and diameter class, central Oregon, January 1, 1965

(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	19.0-28.9	29.0-38.9	39.0 & larger
Softwoods:											
Ponderosa pine	5,603	154	153	190	201	262	289	316	2,005	1,512	521
Douglas-fir	1,574	54	74	83	81	96	76	83	404	324	299
Sugar pine	73	2	2	2	3	1	6	4	18	17	18
Western white pine	126	3	5	7	7	7	8	8	44	29	8
Lodgepole pine	2,334	344	507	521	377	269	150	85	78	3	--
Whitebark pine	21	3	4	3	3	2	4	1	1	--	--
White fir	1,843	96	111	133	128	132	125	133	586	322	77
California-Shasta red fir	435	6	8	12	10	13	19	21	145	145	56
Grand fir	182	16	19	12	15	17	20	19	49	15	--
Pacific silver fir	101	9	12	16	10	10	9	12	19	4	--
Noble fir	111	6	7	7	6	6	8	7	37	21	6
Subalpine fir	87	5	11	11	12	10	12	8	17	1	--
Engelmann spruce	160	3	3	5	7	6	11	15	79	29	2
Mountain hemlock	825	23	41	63	65	79	89	90	285	74	16
Western hemlock	126	3	3	5	6	7	11	11	61	14	5
Incense-cedar	113	3	3	3	3	2	5	5	50	25	14
Western redcedar	14	1	--	1	--	1	1	1	8	1	--
Western larch	109	4	9	9	8	12	7	7	38	10	5
Total softwoods	13,837	735	972	1,083	942	932	850	826	3,924	2,546	1,027
Total hardwoods	12	3	3	2	1	2	--	--	1	--	--
Total all species	13,849	738	975	1,085	943	934	850	826	3,925	2,546	1,027

Table 20.--Volume of sawtimber on commercial forest land, by species and diameter class, central Oregon, January 1, 1965 (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	19.0-28.9	29.0-38.9	39.0 & larger
Softwoods:								
Ponderosa pine	31,851	944	1,215	1,433	1,690	12,306	10,473	3,790
Douglas-fir	8,547	386	475	396	457	2,471	2,200	2,162
Sugar pine	384	10	4	29	20	103	103	115
Western white pine	707	36	39	48	48	283	199	54
Lodgepole pine	4,900	1,762	1,371	815	478	454	20	--
Whitebark pine	56	13	11	19	7	6	--	--
White fir	8,062	591	644	632	697	3,249	1,823	426
California-Shasta red fir	2,350	47	62	93	103	811	883	351
Grand fir	725	78	87	100	107	271	82	--
Pacific silver fir	334	45	46	48	64	105	26	--
Noble fir	537	24	29	40	35	225	143	41
Subalpine fir	289	48	44	56	40	93	8	--
Engelmann spruce	899	35	32	56	85	494	182	15
Mountain hemlock	3,568	272	363	432	451	1,535	420	95
Western hemlock	707	31	38	60	64	378	101	35
Incense-cedar	452	14	9	22	20	215	108	64
Western redcedar	65	5	3	4	4	42	7	--
Western larch	582	41	65	40	44	268	81	43
Total softwoods	65,015	4,382	4,537	4,323	4,414	23,309	16,859	7,191
Total hardwoods	17	4	4	2	2	5	--	--
Total all species	65,032	4,386	4,541	4,325	4,416	23,314	16,859	7,191

Table 21.--Volume of sawtimber on commercial forest land, by species and diameter class, central Oregon, January 1, 1965 (Scribner 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	19.0-28.9	29.0-38.9	39.0 & larger
Softwoods:								
Ponderosa pine	28,598	704	976	1,209	1,469	11,118	9,636	3,486
Douglas-fir	7,517	265	367	325	390	2,200	1,998	1,972
Sugar pine	344	7	3	24	17	91	95	107
Western white pine	606	25	30	41	41	247	173	49
Lodgepole pine	3,964	1,289	1,113	700	426	417	19	--
Whitebark pine	47	10	9	16	6	6	--	--
White fir	7,093	453	534	544	611	2,919	1,647	385
California-Shasta red fir	1,854	43	57	83	90	656	666	259
Grand fir	613	52	68	84	92	242	75	--
Pacific silver fir	277	32	35	39	52	94	25	--
Noble fir	455	17	22	32	29	193	126	36
Subalpine fir	248	38	37	48	36	82	7	--
Engelmann spruce	786	26	26	48	74	441	160	11
Mountain hemlock	3,080	209	303	374	396	1,348	366	84
Western hemlock	601	21	29	49	54	328	88	32
Incense-cedar	391	9	6	17	16	187	97	59
Western redcedar	55	3	2	4	3	37	6	--
Western larch	497	27	50	32	37	238	74	39
Total softwoods	57,026	3,230	3,667	3,669	3,839	20,844	15,258	6,519
Total hardwoods	17	4	4	2	2	5	--	--
Total all species	57,043	3,234	3,671	3,671	3,841	20,849	15,258	6,519

Table 22 --Volume of all growing stock on commercial forest land, by species and county, central Oregon, January 1, 1965

(In million cubic feet)

Species	Total	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
Softwoods:								
Ponderosa pine	5,603	660	692	459	1,850	1,441	246	255
Douglas-fir	1,574	144	18	227	372	--	647	166
Sugar pine	73	--	--	--	66	7	--	--
Western white pine	126	--	15	4	70	14	23	--
Lodgepole pine	2,334	6	604	28	1,307	348	23	18
Whitebark pine	21	--	9	3	4	5	(2/)	--
White fir	1,843	95	130	74	703	580	174	87
California-Shasta red fir	435	--	(2/)	--	430	5	--	--
Grand fir	182	1	13	53	6	1	104	4
Pacific silver fir	101	--	1	21	14	--	65	--
Noble fir	111	--	12	--	27	1	71	--
Subalpine fir	87	--	39	8	37	--	1	2
Engelmann spruce	160	(2/)	10	102	27	--	11	10
Mountain hemlock	825	--	278	16	421	7	103	--
Western hemlock	126	--	--	(2/)	6	--	120	--
Incense-cedar	113	--	--	15	56	40	2	--
Western redcedar	14	--	--	--	--	--	14	--
Western larch	109	32	--	8	--	--	29	40
Total softwoods	13,837	938	1,821	1,018	5,396	2,449	1,633	582
Total hardwoods	12	1	--	--	1	7	3	--
Total all species	13,849	939	1,821	1,018	5,397	2,456	1,636	582

1/ Includes Gilliam County.

2/ Less than 500,000 cubic feet.

Table 23 --Volume of sawtimber on commercial forest land, by species and county, central Oregon, January 1, 1965 (International 1/4-inch rule)

(In million board feet)

Species	Total	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
Softwoods:								
Ponderosa pine	31,851	3,856	4,006	2,587	10,033	8,637	1,309	1,423
Douglas-fir	8,547	657	108	1,214	2,229	--	3,638	701
Sugar pine	384	--	--	--	345	39	--	--
Western white pine	707	--	76	29	410	79	113	--
Lodgepole pine	4,900	9	985	68	2,918	865	38	17
Whitebark pine	56	--	25	5	13	13	--	--
White fir	8,062	365	478	323	3,147	2,596	832	321
California-Shasta red fir	2,350	--	1	--	2,325	24	--	--
Grand fir	725	4	50	195	31	7	426	12
Pacific silver fir	334	--	1	69	57	--	207	--
Noble fir	537	--	55	--	129	2	351	--
Subalpine fir	289	--	105	19	155	--	4	6
Engelmann spruce	899	2	40	608	148	--	52	49
Mountain hemlock	3,568	--	1,187	63	1,790	28	500	--
Western hemlock	707	--	--	(2/)	21	--	686	--
Incense-cedar	452	--	--	53	232	157	10	--
Western redcedar	65	--	--	--	--	--	65	--
Western larch	582	195	--	16	--	--	134	237
Total softwoods	65,015	5,088	7,117	5,249	23,983	12,447	8,365	2,766
Total hardwoods	17	3	1	--	--	3	10	--
Total all species	65,032	5,091	7,118	5,249	23,983	12,450	8,375	2,766

1/ Includes Gilliam County.

2/ Less than 500,000 board feet.

Table 24.--Volume of sawtimber on commercial forest land, by species and county, central Oregon, January 1, 1965 (Scribner rule)

(In million board feet)

Species	Total	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
Softwoods:								
Ponderosa pine	28,598	3,490	3,620	2,337	8,891	7,804	1,171	1,285
Douglas-fir	7,517	569	97	1,083	1,995	--	3,172	601
Sugar pine	344	--	--	--	308	36	--	--
Western white pine	606	--	66	25	344	72	99	--
Lodgepole pine	3,964	7	780	50	2,377	708	28	14
Whitebark pine	47	--	21	4	11	11	--	--
White fir	7,093	308	407	279	2,826	2,276	723	274
California-Shasta red fir	1,854	--	1	--	1,832	21	--	--
Grand fir	613	3	43	161	28	6	364	8
Pacific silver fir	277	--	1	58	56	--	162	--
Noble fir	455	--	45	--	110	1	299	--
Subalpine fir	248	--	88	15	137	--	3	5
Engelmann spruce	786	2	35	537	123	--	42	47
Mountain hemlock	3,080	--	1,033	46	1,568	25	408	--
Western hemlock	601	--	--	(2/)	17	--	584	--
Incense-cedar	391	--	--	46	198	139	8	--
Western redcedar	55	--	--	--	--	--	55	--
Western larch	497	169	--	13	--	--	109	206
Total softwoods	57,026	4,548	6,237	4,654	20,821	11,099	7,227	2,440
Total hardwoods	17	3	1	--	--	3	10	--
Total all species	57,043	4,551	6,238	4,654	20,821	11,102	7,237	2,440

1/ Includes Gilliam County.

2/ Less than 500,000 board feet.

Table 25.--Volume of sawtimber on commercial forest land, by species and log grades, for lands other than National Forest, central Oregon, January 1, 1965

(In thousand board feet)

Species	All grades	Log grades[1/]				
		1	2	3	4	5
Softwoods (International 1/4-inch rule):						
Ponderosa pine	8,825,856	368,230	705,526	1,791,074	216,969	5,744,057
Douglas-fir	3,333,004	545,585	1,675,068	1,112,351	--	--
Total	12,158,860	913,815	2,380,594	2,903,425	216,969	5,744,057
Softwoods (Scribner rule):						
Ponderosa pine	7,853,560	339,003	645,258	1,635,621	183,693	5,049,985
Douglas-fir	2,905,378	476,191	1,433,995	995,192	--	--
Total	10,758,938	815,194	2,079,253	2,630,813	183,693	5,049,985

1/ See "Log Grades," page 32.

Table 26.--Net annual growth of all growing stock and sawtimber on commercial forest land, by species and ownership class, central Oregon, 1964

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
GROWING STOCK	- - - - - - - - Thousand cubic feet - - - - - - - - -				
Softwoods:					
Ponderosa pine	74,010	36,275	6,306	18,649	12,780
Douglas-fir	23,404	6,485	6,569	4,758	5,592
Lodgepole pine	41,310	33,627	3,046	5,353	1/ -716
Other softwoods	57,277	35,401	9,267	11,260	1,349
Total softwoods	196,001	111,788	25,188	40,020	19,005
Total hardwoods	87	99	--	38	1/ -50
Total all species	196,088	111,887	25,188	40,058	18,955
SAWTIMBER	- Thousand board feet, International 1/4-inch rule -				
Softwoods:					
Ponderosa pine	342,441	185,177	24,183	76,052	57,029
Douglas-fir	72,714	21,520	22,726	10,327	18,141
Lodgepole pine	120,760	64,824	9,622	35,850	10,464
Other softwoods	243,601	166,427	42,192	30,143	4,839
Total softwoods	779,516	437,948	98,723	152,372	90,473
Total hardwoods	210	210	--	--	--
Total all species	779,726	438,158	98,723	152,372	90,473
SAWTIMBER	- - - - Thousand board feet, Scribner rule - - - -				
Softwoods:					
Ponderosa pine	297,732	163,110	21,499	65,923	47,200
Douglas-fir	62,937	19,001	20,050	9,728	14,158
Lodgepole pine	100,309	57,327	7,912	27,040	8,030
Other softwoods	210,848	145,379	35,370	26,361	3,738
Total softwoods	671,826	384,817	84,831	129,052	73,126
Total hardwoods	188	188	--	--	--
Total all species	672,014	385,005	84,831	129,052	73,126

1/ Negative growth is result of annual mortality exceeding annual growth.

Table 27.--Net annual growth of all growing stock and sawtimber on commercial forest land, by species and county, central Oregon, 1964

Species	All counties	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
GROWING STOCK	Thousand cubic feet							
Softwoods:								
Ponderosa pine	74,010	8,021	10,803	7,296	30,263	10,557	3,029	4,041
Douglas-fir	23,404	3,245	82	2,462	3,243	--	8,244	6,128
Lodgepole pine	41,310	155	13,623	604	22,501	3,555	426	446
Other softwoods	57,277	2,072	4,303	5,247	23,585	9,279	10,764	2,027
Total softwoods	196,001	13,493	28,811	15,609	79,592	23,391	22,463	12,642
Total hardwoods	87	--	--	--	-38	26	99	--
Total all species	196,088	13,493	28,811	15,609	79,554	23,417	22,562	12,642
SAWTIMBER	Thousand board feet, International 1/4-inch rule							
Softwoods:								
Ponderosa pine	342,441	26,323	43,874	23,815	147,597	71,977	8,465	20,390
Douglas-fir	72,714	4,864	[2/] -49	9,024	5,597	--	38,739	14,539
Lodgepole pine	120,760	370	21,051	3,903	88,454	5,109	930	943
Other softwoods	243,601	5,230	21,924	20,329	102,579	32,061	57,646	3,832
Total softwoods	779,516	36,787	86,800	57,071	344,227	109,147	105,780	39,704
Total hardwoods	210	54	--	--	--	--	156	--
Total all species	779,726	36,841	86,800	57,071	344,227	109,147	105,936	39,704
SAWTIMBER	Thousand board feet, Scribner rule							
Softwoods:								
Ponderosa pine	297,732	23,063	37,921	21,492	127,613	62,740	7,480	17,423
Douglas-fir	62,937	4,410	[2/] -43	7,724	5,246	--	33,169	12,431
Lodgepole pine	100,309	331	18,665	2,921	71,371	5,339	838	844
Other softwoods	210,848	4,685	18,911	16,976	88,483	28,547	49,656	3,590
Total softwoods	671,826	32,489	75,454	49,113	292,713	96,626	91,143	34,288
Total hardwoods	188	49	--	--	--	--	139	--
Total all species	672,014	32,538	75,454	49,113	292,713	96,626	91,282	34,288

1/ Includes Gilliam County.

2/ Negative growth is result of annual mortality exceeding annual growth.

Table 28.--Net annual growth of all growing stock and sawtimber on commercial forest land, by forest type and ownership class, central Oregon, 1964

Forest type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	- - - Thousand cubic feet - - -				
All growing stock:					
Ponderosa pine	86,302	42,957	7,431	21,399	14,515
Douglas-fir	22,066	7,950	5,024	2,848	6,244
Lodgepole pine	37,960	28,813	4,110	5,544	1/ -507
True firs	40,730	24,607	6,737	9,165	221
Other softwoods	10,514	7,427	1,832	1,048	207
Hardwoods	167	29	54	54	30
Nonstocked	1/ -1,651	104	--	--	1/ -1,755
All types	196,088	111,887	25,188	40,058	18,955
	- - Thousand board feet, International 1/4-inch rule - -				
Sawtimber:					
Ponderosa pine	359,968	189,187	29,017	82,216	59,548
Douglas-fir	73,961	31,807	18,688	4,275	19,191
Lodgepole pine	120,349	64,173	9,657	34,109	12,410
True firs	179,417	118,091	33,176	28,320	1/ -170
Other softwoods	48,094	34,421	8,185	3,131	2,357
Hardwoods	763	257	--	321	185
Nonstocked	1/ -2,826	222	--	--	1/ -3,048
All types	779,726	438,158	98,723	152,372	90,473
	- - - - - Thousand board feet, Scribner rule - - - - - -				
Sawtimber:					
Ponderosa pine	313,494	167,600	25,707	71,342	48,845
Douglas-fir	64,920	27,996	17,582	4,301	15,041
Lodgepole pine	99,425	56,192	7,900	25,541	9,792
True firs	153,183	102,907	25,877	24,550	1/ -151
Other softwoods	42,545	29,886	7,765	3,024	1,870
Hardwoods	690	228	--	294	168
Nonstocked	1/ -2,243	196	--	--	1/ -2,439
All types	672,014	385,005	84,831	129,052	73,126

1/ Negative growth is result of annual mortality exceeding annual growth.

Table 29.--Net annual growth of all growing stock and sawtimber on commercial forest land, by forest type and county, central Oregon, 1964

Forest type	All counties	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1]
	- - - - - - - -	- - - - - - - -	- - - - - - - -	Thousand cubic feet	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -
All growing stock:								
Ponderosa pine	86,302	10,718	11,883	7,899	31,923	16,905	3,109	3,865
Douglas-fir	22,066	1,348	72	1,858	2,395	--	10,156	6,237
Lodgepole pine	37,960	70	12,246	2,047	19,785	3,354	216	242
True firs	40,730	1,014	2,628	3,574	21,508	3,869	6,408	1,729
Other softwoods	10,514	343	1,913	228	3,794	1,107	2,560	569
Hardwoods	167	--	--	--	54	--	113	--
Nonstocked	[2] -1,651	--	69	3	95	[2] -1,818	--	--
All types	196,088	13,493	28,811	15,609	79,554	23,417	22,562	12,642
	- - - - - - - -	- - - - - - - -	Thousand board feet, International 1/4-inch rule	- - - - - - - -				
Sawtimber:								
Ponderosa pine	359,968	28,480	44,638	25,057	147,829	85,901	11,579	16,484
Douglas-fir	73,961	4,443	[2] -84	6,312	6,267	--	45,897	11,126
Lodgepole pine	120,349	179	23,275	4,784	88,762	2,060	513	776
True firs	179,417	2,016	10,453	18,597	85,470	21,379	34,601	6,901
Other softwoods	48,094	1,660	8,422	2,321	15,154	3,061	13,059	4,417
Hardwoods	763	63	--	--	321	92	287	--
Nonstocked	[2] -2,826	--	96	--	424	[2] -3,346	--	--
All types	779,726	36,841	86,800	57,071	334,227	109,147	105,936	39,704
	- - - - - - - -	- - - - - - - -	- - - - - - - -	Thousand board feet, Scribner rule	- - - - - - - -			
Sawtimber:								
Ponderosa pine	313,494	25,039	38,515	22,787	127,361	75,313	9,857	14,622
Douglas-fir	64,920	3,981	[2] -74	5,916	5,624	--	39,903	9,570
Lodgepole pine	99,425	160	20,617	3,723	71,958	1,822	451	694
True firs	153,183	1,805	8,909	14,415	73,893	19,244	29,165	5,752
Other softwoods	42,545	1,497	7,403	2,272	13,198	2,876	11,649	3,650
Hardwoods	690	56	--	--	294	83	257	--
Nonstocked	[2] -2,243	--	84	--	385	[2] -2,712	--	--
All types	672,014	32,538	75,454	49,113	292,713	96,626	91,282	34,288

[1] Includes Gilliam County.

[2] Negative growth is a result of annual mortality exceeding annual growth.

Table 30.--Average annual mortality of growing stock and sawtimber on commercial forest land, by species and ownership class, central Oregon, 1959-64

Species	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
GROWING STOCK	- - - - - - - - - Thousand cubic feet - - - - - - - - -				
Softwoods:					
Ponderosa pine	16,406	8,688	570	4,452	2,696
Douglas-fir	6,975	4,256	1,221	1,365	133
Lodgepole pine	16,527	6,337	919	5,511	3,760
Other softwoods	20,495	13,111	2,292	3,933	1,159
Total softwoods	60,403	32,392	5,002	15,261	7,748
Total hardwoods	260	108	--	--	152
Total all species	60,663	32,500	5,002	15,261	7,900
SAWTIMBER	- Thousand board feet, International 1/4-inch rule -				
Softwoods:					
Ponderosa pine	78,907	51,571	2,935	18,184	6,217
Douglas-fir	40,041	27,236	5,167	6,948	690
Lodgepole pine	39,105	15,888	2,730	16,018	4,469
Other softwoods	92,425	64,744	6,440	16,924	4,317
Total softwoods	250,478	159,439	17,272	58,074	15,693
Total hardwoods	198	198	--	--	--
Total all species	250,676	159,637	17,272	58,074	15,693
SAWTIMBER	- - - - - Thousand board feet, Scribner rule - - - - -				
Softwoods:					
Ponderosa pine	71,227	46,619	2,642	16,369	5,597
Douglas-fir	36,087	24,566	4,649	6,251	621
Lodgepole pine	31,914	12,941	2,231	13,090	3,652
Other softwoods	78,858	55,243	5,516	14,582	3,517
Total softwoods	218,086	139,369	15,038	50,292	13,387
Total hardwoods	190	190	--	--	--
Total all species	218,276	139,559	15,038	50,292	13,387

Table 31.--Average annual mortality of growing stock and sawtimber on commercial forest land, by species and county, central Oregon, 1959-64

Species	Total	Crook	Deschutes	Jefferson	Klamath	Lake	Wasco	Wheeler[1/]
GROWING STOCK	Thousand cubic feet							
Softwoods:								
Ponderosa pine	16,406	1,556	1,343	711	4,110	7,040	1,324	322
Douglas-fir	6,975	663	120	1,380	1,918	--	2,039	855
Lodgepole pine	16,527	22	2,041	326	10,081	3,981	56	20
Other softwoods	20,495	808	1,702	1,933	8,592	3,556	3,082	822
Total softwoods	60,403	3,049	5,206	4,350	24,701	14,577	6,501	2,019
Total hardwoods	260	38	--	--	38	184	--	--
Total all species	60,663	3,087	5,206	4,350	24,739	14,761	6,501	2,019
SAWTIMBER	Thousand board feet, International 1/4-inch rule							
Softwoods:								
Ponderosa pine	78,907	8,885	8,571	3,952	19,714	29,794	7,171	820
Douglas-fir	40,041	2,681	804	7,743	11,627	--	11,904	5,282
Lodgepole pine	39,105	60	3,933	1,120	20,312	13,509	171	--
Other softwoods	92,425	4,289	6,599	6,999	41,194	15,803	13,678	3,863
Total softwoods	250,478	15,915	19,907	19,814	92,847	59,106	32,924	9,965
Total hardwoods	198	106	--	--	--	92	--	--
Total all species	250,676	16,021	19,907	19,814	92,847	59,198	32,924	9,965
SAWTIMBER	Thousand board feet, Scribner rule							
Softwoods:								
Ponderosa pine	70,259	8,048	7,844	3,576	17,269	26,359	6,477	686
Douglas-fir	35,762	2,316	721	7,176	10,376	--	10,664	4,509
Lodgepole pine	32,144	44	3,133	814	16,910	11,144	99	--
Other softwoods	79,921	3,675	5,765	5,969	35,197	14,181	11,778	3,356
Total softwoods	218,086	14,083	17,463	17,535	79,752	51,684	29,018	8,551
Total hardwoods	190	102	--	--	--	88	--	--
Total all species	218,276	14,185	17,463	17,535	79,752	51,772	29,018	8,551

1/ Includes Gilliam County.

Table 32.--Average annual mortality of growing stock and sawtimber on commercial forest land, by cause of death and by softwoods and hardwoods, central Oregon, 1959-64

Species	Cause of death					
	Fire	Insects	Disease	Other	Unknown	All causes
	Thousand cubic feet					
Growing stock:						
Softwoods	4,822	20,625	5,180	17,354	12,422	60,403
Hardwoods	38	--	--	222	--	260
Total	4,860	20,625	5,180	17,576	12,422	60,663
	Thousand board feet, International 1/4-inch rule					
Sawtimber:						
Softwoods	5,986	101,268	23,141	67,056	53,027	250,478
Hardwoods	--	--	--	198	--	198
Total	5,986	101,268	23,141	67,254	53,027	250,676
	Thousand board feet, Scribner rule					
Sawtimber:						
Softwoods	4,887	88,478	19,769	58,517	46,435	218,086
Hardwoods	--	--	--	190	--	190
Total	4,887	88,478	19,769	58,707	46,435	218,276

Table 33.--Volume of salvable dead sawtimber-size trees on commercial forest land, by ownership class and by softwoods and hardwoods, central Oregon, January 1, 1965

Ownership class	All species	Softwoods	Hardwoods
	- - - - - - - Million cubic feet - - - - - - - -		
National Forest	106	106	(1/)
Other public	29	29	--
Forest industry	30	30	--
Farmer and miscellaneous private	12	12	--
All ownerships	177	177	(1/)
	- Million board feet, International 1/4-inch rule -		
National Forest	658	657	1
Other public	142	142	--
Forest industry	150	150	--
Farmer and miscellaneous private	59	59	--
All ownerships	1,009	1,008	1
	- - - - Million board feet, Scribner rule - - - -		
National Forest	575	574	1
Other public	126	126	--
Forest industry	133	133	--
Farmer and miscellaneous private	53	53	--
All ownerships	887	886	1

1/ Less than 500,000 cubic feet.

Table 34.--Timber harvest, by ownership class, central Oregon, 1950-64 (Scribner rule)

(In thousand board feet)

Year[1]	Total	Private	State	National Forest	Other public[2]
1950	681,838	256,338		289,500	136,000
1951	814,628	405,528		251,100	158,000
1952	681,828	291,239		275,000	115,589
1953	772,355	340,276		318,300	113,779
1954	752,176	332,584		321,200	98,392
1955	849,595	405,648		310,550	133,397
1956	875,606	314,205		385,000	176,401
1957	680,966	278,575		340,200	62,191
1958	773,417	269,237	1,094	284,005	219,081
1959	887,942	280,831	--	510,984	96,127
1960	824,086	345,192	472	372,348	106,074
1961	728,721	236,114	1,651	439,503	51,453
1962	786,923	272,444	1,380	460,400	52,699
1963	809,788	262,176	1,400	465,200	81,012
1964	988,035	313,301	2,379	562,400	109,955

Source: Reports of the State Forester; U.S. Bureau of Land Management; U.S. Bureau of Indian Affairs; and Division of Timber Management, Region 6, U.S. Forest Service.

1/ For the years 1950-57, data for private and State ownerships were not separated.

2/ For the years 1950-55 timber harvest data for the Bureau of Land Management were included with State and private.

ACCURACY OF THE CURRENT INVENTORY DATA

Forest-Land Area and Timber Volume

The estimates of forest-land area and timber volume in central Oregon were derived by sampling and consequently have sampling error. Sampling errors have been computed for the estimates of commercial forest-land area, noncommercial forest-land area, net cubic-foot volume of growing-stock volume, and net board-foot volume (International 1/4-inch rule) of sawtimber. These are presented in table 35 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 had a 100-percent inventory been taken using the same methods, the results would have been within the ranges shown. For example, the estimate of total commercial forest-land area from a 100-percent inventory would be expected to fall within plus or minus 0.7 percent of 6,255,000 acres, unless a one in three chance of sampling has occurred.

Table 35.--Sampling errors of estimates of forest area and timber volume

Item	Estimated totals	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land.........acres..	6,255,000	±0.7	±1.4
Noncommercial forest land......acres..	2,154,000	±2.2	±4.3
Volume:			
Growing stock............MM cu. ft..	13,849	±1.8	±3.5
Sawtimber (International 1/4-inch rule).........MM bd. ft..	65,032	±2.2	±4.2

In addition to measurable sampling errors, there may be other nonsampling errors due to mistakes in judgment, measurement, and compilation. The magnitude of errors from these sources 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 for the smaller breakdowns can be obtained from table 36, which shows the sampling error to which the estimates are liable, two chances out of three.

Table 36.--Approximate sampling error by size of estimate

Forest area	Sampling error[1]	Cubic volume	Sampling error[1]	Sawtimber volume	Sampling error[1]
M acres	Percent	MM cu. ft.	Percent	MM bd. ft., International 1/4-inch rule	Percent
6,255	0.7				
3,065	1.0	13,849	1.8		
765	2.0	11,300	2.0	65,032	2.2
341	3.0	4,996	3.0	34,960	3.0
191	4.0	2,810	4.0	19,665	4.0
123	5.0	1,799	5.0	12,586	5.0
31	10.0	450	10.0	3,146	10.0
14	15.0	200	15.0	2,517	15.0
8	20.0	112	20.0	787	20.0
5	25.0	72	25.0	503	25.0
3	30.0	50	30.0	350	30.0
		28	40.0	196	40.0
		18	50.0	125	50.0
		5	100.0	31	100.0

1/ By random sampling formula; 68-percent probability.

COMPARISON WITH PREVIOUS INVENTORIES

Tables 37 and 38 present area and volume statistics as reported for three successive Forest Survey inventories in central Oregon. Some of the differences between inventories are due to actual physical changes such as cutting and growth of stands, restocking of forest lands, and the shift of forest land to other uses. Some differences are due to sampling and technique errors and some to changes in definitions and standards of utilization. The latter differences complicate direct comparison of the statistics.

Area.--Although total forest-land area as shown in table 37 has decreased 3.5 percent or 270,000 acres since the first reinventory of 1945-54, this decrease is not all real change. It is due, in part, to changes in definition of land classes between the two inventory periods, 1945-54 and 1964. Acreage figures during the first reinventory were obtained from type maps with a minimum type acreage of 40 acres. Thus, a type island of commercial forest land, 40 acres or larger in size, could contain a large number of 1-acre noncommercial or nonforest areas. The area figures for the 1964 inventory, on the other hand, are based on a minimum area of 1 acre. Some change is also due to expansion of powerline and road right-of-ways and to conversion of some fringe forest areas to agriculture and grazing.

The 46,000-acre reduction in noncommercial productive-reserved forest land is due to reclassification of Waldo Lakes Limited Area in Deschutes County and the Sky Lakes Limited Area in Klamath County from reserved to available.

Table 37.--Comparison of forest area statistics for central Oregon

(In acres)

Land class	Initial inventory 1934-36	First reinventory 1945-54	Current inventory 1964
Commercial forest	6,565,000	6,337,000	6,255,000
Noncommercial forest:			
Productive-reserved	221,000	291,000	245,000
Unproductive	1,295,000	2,051,000	1,909,000
Total	1,516,000	2,342,000	2,154,000
Total forest	8,081,000	8,679,000	8,409,000
Total nonforest	8,371,000	8,063,000	8,315,000
Total all land	16,452,000	16,742,000	16,724,000

Volume.--The results of the 1964 inventory for the nine counties as a whole cannot be compared with the previous inventory for this group of counties made during the period 1945-54. This is due primarily to substantial differences between the techniques, definitions, and standards used in the 1964 inventory of Klamath County compared to those used in preparing the previous estimate in 1946, which was based largely on the earlier 1934 estimate.

Table 38.--Comparison of sawtimber and growing-stock volume statistics for central Oregon

Species	Initial inventory 1934-36	First reinventory 1945-54	Current inventory 1964
GROWING STOCK	- - - - - - - Million cubic feet	- - - - - - - -	
Softwoods:			
Ponderosa pine	--	6,023	5,603
Douglas-fir	--	1,404	1,574
White fir	--	1,388	1,843
Other true firs	--	478	916
Other softwoods	--	1,679	3,901
Total softwoods	--	10,972	13,837
Total hardwoods	--	5	12
Total all species	(1/)	10,977	13,849
SAWTIMBER	- - - - - Million board feet, Scribner	- - - - - -	
Softwoods:			
Ponderosa pine	43,888	34,365	28,598
Douglas-fir	3,723	6,639	7,517
White fir	3,163	4,097	7,093
Other true firs	979	1,484	3,447
Other softwoods	3,871	5,282	10,371
Total softwoods	55,624	51,867	57,026
Total hardwoods	4	15	17
Total all species	55,628	51,882	57,043

1/ Not available for 1934-36.

The current volume in Klamath County is the result of the first complete inventory of that county based on a large sample of carefully measured field sample plots well dispersed over all ownerships in the county. In contrast, previous inventories were based primarily on compilation of previous cruise data. In addition to inventory technique differences, the earlier inventory in Klamath County heavily discounted the usable volume in species other than ponderosa pine. In 1946, the volume in Douglas-fir, true firs, and other softwood species, excluding pine, was estimated to be 3.4 billion board feet; in 1964, the volume for these same species was estimated at 11.9 billion. This difference is responsible, to a large degree, for the apparent increase in volume in Klamath County.

The sawtimber volume in Crook, Deschutes, Jefferson, and Wheeler Counties has declined since the previous inventory, whereas relatively little change has occurred in Lake and Wasco Counties. For the year 1964, growth and cut were relatively in balance in Klamath, Wasco, and Wheeler Counties, while cut substantially exceeded growth in Crook, Deschutes, Jefferson, and Lake Counties.

County	1964 growth (Thousand bd. ft., Scribner)	1964 cut (Thousand bd. ft., Scribner)
Crook	32,538	103,387
Deschutes	75,454	113,381
Jefferson	49,113	92,371
Klamath	292,713	289,886
Lake	96,626	258,807
Wasco	91,282	95,242
Wheeler	34,288	34,961

Table 38 indicates also that the volume of ponderosa pine has declined significantly. This decline occurs in all counties and reflects the concentration of harvesting efforts on this valuable species.

FOREST SURVEY PROCEDURES

This inventory of central Oregon combines the data from all or parts of nine separate inventory projects: Burns Working Circle, 1957-58, and Crooked River Working Circle, 1962, Ochoco National Forest; Rogue River National Forest, 1957-59; Umatilla National Forest, 1958; Winema National Forest, 1958-62; Mount Hood National Forest, 1960; Deschutes National Forest, 1961; Fremont National Forest, 1962; and the remaining area outside the National Forests, 1964. No attempt was made to update the inventories for growth or cut to a common date; however, changes in gross area were made to agree with the most current records available.

National Forest

Field plots on the seven National Forest were distributed on a systematic grid at 1.7-mile intervals. Plots consisted of clusters of three 1/5-acre circular subplots. Estimates of area, volume, and growth were obtained from the field sample plots.

Outside National Forest

The area outside National Forests in central Oregon was inventoried by Forest Survey during the summer of 1964.

A systematic sample of field plots was distributed across all owners other than National Forest. Field plots, located on a 3.4-mile grid, were supplemented by a more intensive sample of photo plots. The ratio of photo to field plots was approximately 16 to 1. 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. The summation of the 10-point tally expressed the resources and conditions for that acre and was used with the photo sample to provide area, volume, growth, and mortality statistics.

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 10 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest-Land Area

Land that does not qualify as forest 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 qualifies as commercial forest land.

Unproductive. Forest land incapable of yielding crops of industrial wood products (usually sawtimber) because of adverse site conditions. Unproductive forest land is divided into the following classes:

- Subalpine. Forest stands at the upper elevational limits of tree growth.

- Noncommercial rocky. Forested areas within the commercial forest zone so steep and rocky that they are incapable of producing usable wood products.

- Juniper. Forest stands at the lower elevational limits of tree growth in which the predominant species is juniper.

- Noncommercial other. Other areas within the commercial forest zone unsuitable for producing usable wood products due to poor drainage, shallow, infertile soils, etc.

Types

Forest-land 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 inches d.b.h. and larger). Live trees of commercial species that contain at least one 12-foot coniferous saw log with a top diameter not less than 6 inches inside bark, or one 8-foot hardwood saw log with a top diameter not less than 8 inches inside bark and with not less than 25 percent of the board-foot volume in the tree free of defect for either conifer or hardwood.

Poletimber trees (5.0 to 10.9 inches 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 them from becoming growing-stock sawtimber trees.

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

Nongrowing-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 died from natural causes 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 coniferous or 8-foot hardwood saw log.

Stand-Size Classes

Sawtimber Stand

Stand at least 10 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 inches 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 inches d.b.h.

Poletimber Stand

Stand at least 10 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 10 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 10 percent stocked with growing-stock trees.

Stocking

Stocking is an effort to express the extent to which growing space is effectively utilized by present or potential growing-stock trees of commercial species. "Percent of stocking" is synonymous with "percentage of growing space occupied" and means 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 125 percent. Sites with less than 100-percent stocking represent understocking with less than full site occupancy. Overstocking is characterized by sites that have over 125-percent stocking.

Rotation Ages

Rotation ages used to determine tree class are as follows:

Species type	Rotation age
Hardwoods	50
Lodgepole pine	80
All other east-side types	120
All other west-side types	100

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 the Pacific Northwest.

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.

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.

Log Grades

A classification of logs based on external characteristics as indicators of quality or value.

The following grading rules were used:

Ponderosa pine. "Improved System for Grading Ponderosa Pine and Sugar Pine Saw Logs in Trees," Technical Paper 75, 1962, issued by Pacific Southwest Forest and Range Experiment Station.

Douglas-fir. "Grades for Inland Douglas-Fir Saw Logs in Standing Trees," Research Note PNW-19, December 1964, issued by Pacific Northwest Forest and Range Experiment Station.

Only the butt logs were graded in the field. The distribution of total tree volume by log grade was derived from separate studies showing the relationship between the grade of the butt log and grades in the upper stem.

Growth

Net Annual Growth

The increase in 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 volume of trees reaching the size class during the year minus the 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 Forests 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 lands other than forest industry or farmer-owned lands.

TREE SPECIES

Tree species found in central Oregon include:

Softwoods:

California red fir *(Abies magnifica* var. *magnifica)*
Douglas-fir *(Pseudotsuga menziesii)*
Engelmann spruce *(Picea engelmannii)*
Grand fir *(Abies grandis)*
Incense-cedar *(Libocedrus decurrens)*
Lodgepole pine *(Pinus contorta)*
Mountain hemlock *(Tsuga mertensiana)*
Noble fir *(Abies procera)*
Pacific silver fir *(Abies amabilis)*
Ponderosa pine *(Pinus ponderosa)*
Shasta red fir *(Abies magnifica* var. *shastensis)*
Subalpine fir *(Abies lasiocarpa)*
Sugar pine *(Pinus lambertiana)*
Western hemlock *(Tsuga heterophylla)*
Western larch *(Larix occidentalis)*
Western redcedar *(Thuja plicata)*
Western white pine *(Pinus monticola)*
Whitebark pine *(Pinus albicaulis)*
White fir *(Abies concolor)*

Hardwoods:

Aspen *(Populus tremuloides)*
Black cottonwood *(Populus trichocarpa)*
Golden chinkapin *(Castanopsis chrysophylla)*
Oregon white oak *(Quercus garryana)*
Red alder *(Alnus rubra)*

RECENT FOREST SURVEY PUBLICATIONS

Number	Title	Date
Resource Bulletins:		
PNW-23	Preliminary Timber Resource Statistics for Humboldt County, California, January 1, 1967	1968
PNW-22	1966 Oregon Timber Harvest	Dec. 1967
PNW-21	1966 Washington Timber Harvest	Oct. 1967
PNW-18	1965 Washington Timber Harvest	Dec. 1966
PNW-17	Forest Industries of Eastern Washington	1966
PNW-16	1965 Oregon Timber Harvest	June 1966
PNW-15	Timber Resource Statistics for Southwest Washington	1965
PNW-14	1964 Washington Timber Harvest	Dec. 1965
PNW-13	1964 Oregon Log Production	Sept. 1965
PNW-12	The Timber Situation and Outlook for Northwest Oregon	1965
PNW-11	Hardwood Timber Resources of the Douglas-fir Subregion	1965
PNW-10	Forest Statistics for West-Central Oregon	1965
PNW-9	Timber Resource Statistics for the Pacific Northwest	1965
PNW-8	Forest Statistics for Southwest Oregon	Aug. 1964
PNW-7	Forest Statistics for Northwest Oregon	July 1964
PNW-6	1962 Washington Log Production	Dec. 1963
PNW-5	Forest Statistics for Chelan and Douglas Counties, Washington	May 1963
PNW-4	Forest Statistics for Northeast Washington	May 1963
PNW-3	Toward Complete Use of Eastern Oregon's Forest Resources	May 1963
PNW-2	1962 Oregon Log Production	Apr. 1963
PNW-1	1961 Washington Log Production	Jan. 1963
Research Papers:		
PNW-28	Manpower Use in the Wood-Products Industries of Oregon and Washington 1950-63	1965
PNW-5	Timber Trends in Western Oregon and Western Washington	Oct. 1963

Available from:

Pacific Northwest Forest & Range Experiment Station
P.O. Box 3141
Portland, Oregon 97208

Berger, John M.
1968. Timber resource statistics for central Oregon. U.S. Forest Service Resource Bull. PNW-24, 38 pp. Pacific Northwest Forest & Range Experiment Station, Portland, Oregon.

A summary, as of January 1, 1965, of the results of the third inventory of the timber resources, area, volume, growth, cut, and mortality, of nine counties in central Oregon: Crook, Deschutes, Gilliam, Jefferson, Klamath, Lake, Sherman, Wasco, and Wheeler. Data were collected during summer of 1964.

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Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, the Western States, or the Nation. Project headquarters are at:

College, Alaska
Juneau, Alaska
Seattle, Washington
Olympia, Washington
Wenatchee, Washington
Portland, Oregon
Bend, Oregon
La Grande, Oregon
Corvallis, Oregon
Roseburg, Oregon

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.

U.S.D.A. Forest Service
Resource Bulletin PNW-25

August 1968

1967 WASHINGTON TIMBER HARVEST

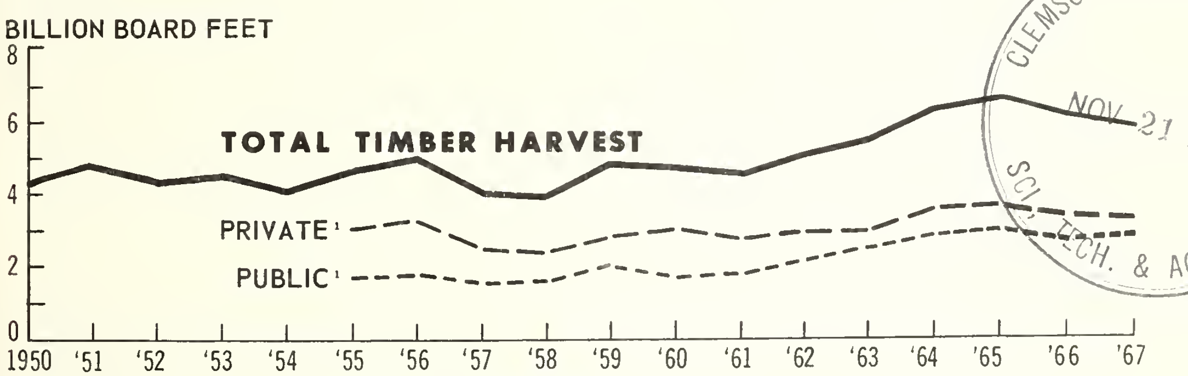
by

Brian R. Wall
Associate Economist

Washington's 1967 timber harvest declined to 5.9 billion board feet, 2.3 percent below the 1966 harvest. The cut on public lands remained about the same as in 1966 with a 6.7-percent increase in public cut in eastern Washington, offsetting a 2.2-percent decrease in western Washington. The Indian lands had the greatest increase in harvest, up 35 million board feet, followed by National Forest lands with an increase of 27 million board feet. The 71-million-board-foot drop (13 percent) in cut on State lands was accompanied by a 297-million-board-foot increase (45 percent) in the uncut volume of State timber under contract at the end of 1967 compared with the 1966 year-end total. This increase of uncut material is in contrast to the average situation on all public lands where the sold but uncut volume under contract declined 4.4 percent (230 million board feet).

The private cut in Washington declined 4.3 percent to 3.3 billion board feet in 1967. Eastern Washington's private cut dropped 6.6 percent whereas western Washington's cut declined 4.1 percent. Industrial owners accounted for 78 percent of Washington's total private log production in 1967. The large nonindustrial private owners contributed 12 percent of the private cut, and small private owners accounted for the remaining 10 percent. The timber harvest declined on all classes of private land in 1967 with industrial cut declining 4 percent (103 million board feet). Large private owners' cut declined 6 percent (24 million board feet) and the small private cut declined 6 percent (22 million board feet).

Douglas-fir was the leading species, accounting for 37.5 percent (2.2 billion board feet) of timber harvest in 1967. Western hemlock production amounted to 1.8 billion board feet (30.1 percent of the total cut). In 1967, hardwood production totaled 119 million board feet.



[1]Separate data for public and private not available prior to 1955.

WASHINGTON TIMBER HARVEST 1950-67

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

(In thousands of board feet, Scribner log rule)

State and county	Private		State		Bur. Land Management		National Forests		Indian lands		Other public[3]		Other Federal agencies[4]		Total production		
	Live	Dead[2]	Live	Dead[2]	Live	Dead	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live	Dead[2]	Live & dead
Western Washington:																	
Clallam	204,402	68	45,710	227	--	--	68,380	1,120	16,546	--	--	--	100	--	335,138	1,415	336,553
Clark	11,078	--	4,652	--	--	--	--	--	--	--	--	--	--	--	15,730	--	15,730
Cowlitz	359,454	16,096	49,543	77	--	--	13,532	3,468	--	--	--	--	--	--	422,529	19,641	442,170
Grays Harbor	251,710	1,125	4,753	30	--	--	73,277	3,923	165,233	1,311	15,007	220	640	--	510,620	6,609	517,229
Island	9,810	--	--	12	--	--	--	--	--	--	--	--	--	--	9,810	12	9,822
Jefferson	148,001	186	156,210	1,830	--	--	57,691	2,909	2,139	--	80	270	--	--	364,121	5,195	369,316
King	247,182	70	2,849	--	--	--	48,606	3,794	--	--	38,852	--	6,388	--	343,877	3,864	347,741
Kitsap	17,997	--	460	--	--	--	--	--	--	--	85	--	--	--	18,542	--	18,542
Lewis	562,547	12,690	14,333	4	--	--	144,759	5,741	--	--	1,105	--	--	--	722,744	18,435	741,179
Mason	54,843	--	4,184	--	--	--	82,401	1,799	--	--	210	--	--	--	141,638	1,799	143,437
Pacific	376,210	2,336	14,478	20	--	--	--	--	--	--	580	20	85	--	391,353	2,376	393,729
Pierce	241,128	16,448	10,858	1,073	--	--	53,126	8,174	--	--	3,084	229	10,899	330	319,095	26,254	345,349
San Juan	1,445	--	--	--	--	--	--	--	--	--	--	--	--	--	1,445	--	1,445
Skagit	122,886	247	16,389	418	--	--	62,636	6,764	--	--	257	--	--	--	202,168	7,429	209,597
Skamania	75,374	--	10,823	7	--	--	333,198	25,802	--	--	--	--	752	--	420,147	25,809	445,956
Snohomish	105,579	490	12,837	--	--	--	87,234	7,566	--	--	294	--	--	--	205,944	8,056	214,000
Thurston	56,851	2,953	12,523	15	--	--	--	--	--	--	250	--	959	--	70,583	2,968	73,551
Wahkiakum	87,946	1,067	14,636	--	--	--	--	--	--	--	38	--	--	--	102,620	1,067	103,687
Whatcom	71,256	160	15,919	36	--	--	42,871	12,629	32	--	--	--	--	--	130,078	12,825	142,903
Total	3,005,699	53,936	391,157	3,749	--	--	1,067,711	83,689	183,950	1,311	59,842	739	19,823	330	4,728,182	143,754	
Total live and dead	3,059,635		394,906		--		1,151,400		185,261		60,581		20,153				4,871,936
Eastern Washington:																	
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	1,556	--	--	--	--	--	--	--	--	--	--	--	--	--	1,556	--	1,556
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	7,222	--	4,258	135	--	--	60,934	6,266	--	--	--	--	--	--	72,414	6,401	78,815
Columbia	6,696	--	88	--	--	--	9,930	370	--	--	--	--	--	--	16,714	370	17,084
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	13,701	--	5,264	--	2,376	--	50,876	--	73,743	150	7,097	--	--	--	153,057	150	153,207
Franklin	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Garfield	302	--	--	--	--	--	12,683	117	--	--	--	--	--	--	12,985	117	13,102
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	56,980	--	5,849	147	--	--	38,330	870	--	--	--	--	--	--	101,159	1,017	102,176
Klickitat	56,145	75	8,097	5	--	--	1,345	55	15,708	--	680	--	--	--	81,975	135	82,110
Lincoln	45	--	--	--	--	--	--	--	--	--	--	--	--	--	45	--	45
Okanogan	5,479	--	23,083	--	793	--	120,630	670	38,145	350	--	--	--	--	188,130	1,020	189,150
Pend Oreille	14,628	--	4,084	--	4	--	52,870	12,940	6	--	--	--	--	--	71,592	12,940	84,532
Spokane	8,589	--	830	--	--	--	--	--	--	--	15	--	--	--	9,434	--	9,434
Stevens	47,960	--	10,832	--	231	--	14,316	--	16,239	10	--	--	--	--	89,578	10	89,588
Walla Walla	2,986	--	--	--	--	--	--	--	--	--	--	--	--	--	2,986	--	2,986
Whitman	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yakima	28,595	--	9,521	--	--	--	64,490	310	135,318	1,112	1,150	--	--	--	239,074	1,422	240,496
Total	250,884	75	71,906	287	3,404	--	426,404	21,598	279,159	1,622	8,942	--	--	--	1,040,699	23,582	
Total live and dead	250,959		72,193		3,404		448,002		280,781		8,942		--				1,064,281
Total Washington	3,256,583	54,011	463,063	4,036	3,404	--	1,494,115	105,287	463,109	2,933	68,784	739	19,823	330	5,768,881	167,336	
Total Washington live and dead	3,310,594		467,099		3,404		1,599,402		466,042		69,523		20,153		5,936,217		5,936,217

1/ Includes volume in logs, poles, piling, cordwood, shingle bolts, etc., as compiled by Washington State Department of Natural Resources.
2/ Includes snags and down material existing prior to initial logging. Salvage of this material does not constitute drain on the volume of the forest inventory of live trees.
3/ Includes timber harvested from lands administered by cities, counties, public utility districts, and State agencies other than the Department of Natural Resources.
4/ Includes lands logged under jurisdiction of Bonneville Power Administration, National Parks, U.S. Army, and the U.S. Fish and Wildlife Service.

The Timber Resources of HUMBOLDT COUNTY

IFIC NORTHWEST
AND RANGE EXPERIMENT STATION
RTMENT OF AGRICULTURE

U.S.D.A. FOREST SERVICE
RESOURCE BULLETIN PNW-26
1968

PREPARED BY

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THE TIMBER RESOURCES OF HUMBOLDT COUNTY, CALIFORNIA

by

Daniel D. Oswald

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
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FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

PREFACE

This report presents the first complete inventory of Humboldt County's timber resources. Past Forest Survey inventories have included Humboldt County, but they were not designed to obtain volume estimates for an individual county. Humboldt County is part of a survey unit which also includes Del Norte County.[1/] There are eight such inventory units in California; and each unit, composed of a group of counties, will be reinventoried and reported upon at 10-year intervals.

The field data for this Humboldt County inventory were collected for all lands during the summer of 1966 and are presented as of January 1, 1967. Data for the Six Rivers National Forest were collected by National Forest personnel. Field data for all other ownerships of forest lands in the county were collected by Forest Survey personnel.

This inventory is a function of the Forest Survey--a nationwide project of the Forest Service, U.S. Department of Agriculture, authorized by the McSweeney-McNary Forest Research Act of 1928 and subsequent amendments. The purpose of the Forest Survey is to periodically inventory the extent and condition of forest lands and the amount and kind of timber on them, to determine rates of forest growth and depletion, to estimate timber cut and probable future trends in timber requirements, and to analyze and make available survey information needed in the formulation of forest policies and programs. Resurveys are made to update basic information.

The Forest Survey is conducted in the various forest regions of the Nation by the Experiment Stations of the Forest Service. In the States of California, Oregon, Washington, Alaska, and Hawaii, it is the responsibility of the Pacific Northwest Forest and Range Experiment Station at Portland, Oregon.

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[1/] Oswald, Daniel D., and Walton, Gerald S. Forest statistics for Del Norte County, California, 1965. Pacific Southwest Forest & Range Exp. Sta. U.S.D.A. Forest Serv. Resource Bull. PSW-5, 12 pp. 1968.

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INTRODUCTION

Humboldt County has been an important source of raw material for wood products for over 100 years. This county, which has the largest sawtimber inventory and second largest commercial forest area of all California counties, is largely responsible for California's position as a leading State in production of wood products. Since 1920, Humboldt County's forests have yielded over 33 billion board feet of roundwood for manufacture of wood products, 20 billion board feet of it in the last 15 years. In 37 of the last 47 years, Humboldt County has led all other California counties in roundwood harvest and lumber production and has never ranked lower than third during the remaining 10 years.

Humboldt County today leads the State in the production of lumber, softwood veneer and plywood, and woodpulp. It accounts for one-quarter of the State's annual timber harvest, and its sawmills provide more residue for pulping than any other county.

However, of more importance than the contribution of Humboldt's forest resource to the large and diversified California economy is its contribution to the economic well-being of the county itself and the local area. Seventy-four percent of the county's land resources are currently committed to timber production as a primary use. The timber resource and the forest industry make up much of the tax base upon which local government and public services are dependent. Over 90 percent of the value added by manufacture derives from wood products, and over 40 percent of all employment is directly involved in wood and wood products manufacture. In addition, a majority of the employment in service industries depends on the employment and income generated by forest industries.

Humboldt County's long reign as a major primary product manufacturing center for wood products has been supported by the large old-growth stands of redwood and, since the mid-1940's, Douglas-fir. After over 100 years of logging, the available old-growth resource has been reduced to the level where the transition to young-growth harvesting operations is on the horizon.

Currently, resource planners from both industry and government are studying alternative routes through the transition period and their probable impacts on the wood products industry and the local economy. The findings of the 1966 inventory, the first in which the entire Humboldt County timber resource has been reported, provide valuable background and a concrete starting point from which to evaluate those alternatives.[2]

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[2] Area statistics for Humboldt County were first reported in the report titled "Area and Ownership of Forest Land in Humboldt County, California," California Forest & Range Exp. Sta. Forest Surv. Release No. 16, November 1952.

THE TIMBER RESOURCE

Commercial Forests Occupy Three-Fourths of Humboldt County's Land Area

Humbolt County has a total land area of 2,287,000 acres, of which 1,701,000 acres or 74 percent is commercial forest land. The commercial forest area contains 32.6 billion board feet of sawtimber, International 1/4-inch rule. Productive-reserved forest lands in State parks total 47,000 acres. Unproductive forest lands, incapable of producing commercial timber crops, total 102,000 acres.

Three-Fourths of Commercial Forest Area Is in Private Ownership

In Humboldt County, three-fourths of the productive forest land is in private ownership, and management of this land will largely determine the county's future timber-oriented economic activity. Almost 60 percent of the 1,283,000 acres of privately owned commercial forest land and 7.2 billion board feet of sawtimber--22 percent of the county's total--is controlled by the farmer and miscellaneous private owner group. This ownership group is characterized by small, fragmented ownership tracts. Many of these owners have little interest in long-term timber management objectives.[3/] But regardless of the reason for these individuals' ownership of forest land, much of this land has contributed significantly to the county's large annual timber harvest. The harvesting of timber from these lands resulted in immediate income, tax relief, and in many cases, offered the possibility of increasing an alternative use, primarily grazing.

These farmer and miscellaneous private owners, comprising the largest ownership category in terms of numbers of owners as well as acreage controlled, represent an important and unpredictable element in Humboldt County's future levels of wood products-based economic activity.

The lands owned by forest industry are managed with timber production as the primary objective. These lands have contributed greatly to the large annual timber harvest, and can be expected to do so in the future. Although this owner class represents the smaller part of the private sector in terms of acreage, it contains over 14 billion board feet of sawtimber--44 percent of the county total--and the most productive forest lands in the county.

National Forests account for 292,000 acres of commercial forest, and other public ownerships, primarily Indian trust lands and public domain, account for the remaining 126,000 acres. The public lands combined contain

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[3/] Poli, Adon, and Baker, Harold L. Ownership and use of forest land in the redwood—Douglas-fir subregion of California. U.S.D.A. Forest Serv. Calif. Forest & Range Exp. Sta. Tech. Pap. No. 7, 76 pp., illus. 1954.

11.2 billion board feet of sawtimber, over one-third of the county total. Public lands, due to lack of redwood, have a brief logging history, but are becoming increasingly important, partly because of the relatively recent importance of Douglas-fir in the county's timber economy. Although the Douglas-fir type is well distributed across all ownerships, it comprises a majority of all coniferous types on National Forest and other public lands, as well as on farmer and miscellaneous private lands. The public lands, managed under the multiple use concept, have made significant contributions to the county's annual timber harvest in recent years, and will continue to provide a flow of raw material that is compatible with competing uses for the land.

Forest Industry and Public Lands Will Be Increasingly Important in Future

Seventy percent of the public lands and 52 percent of the forest industry lands have stands of timber exceeding 10,000 board feet per acre. Only 27 percent of the commercial forest area in farmer and miscellaneous private ownership is in stands of more than 10,000 board feet per acre. This distribution of volume in industrial and public ownerships indicates that timber harvesting in the near future will be concentrated on the public lands and those in forest industry ownership. The largest ownership category, farmer and miscellaneous private, which has made a large contribution to the country's timber harvest in past years, will play a decreasing role in the near future.

Douglas-fir Is Most Important Forest Type

Of Humboldt County's commercial forest area, 469,000 acres or 28 percent is in Douglas-fir type, making Douglas-fir the county's most abundant softwood type and most important timber species--in recent years accounting for almost two-thirds of the annual timber harvest. Its importance is further enhanced by its distribution among all ownerships, across a wide range of site conditions.

Redwood Forest Type Is Privately Owned

The other important softwood forest type, coast redwood, comprises 312,000 acres or 18 percent of the commercial forest area. All of the redwood type acreage is on private land, primarily in forest industry ownership. Historically, coast redwood supported the wood products industry in Humboldt County from its inception in the 1840's until the mid-1940's, when Douglas-fir became a large factor in the timber harvest.

Hardwood Forest Type Is Almost Half of Commercial Forest Area

Hardwood forest types occupy 721,000 acres or 42 percent of Humboldt County's commercial forest area. Tanoak, the most abundant species, occupies 458,000 acres, and Pacific madrone is second in importance, comprising 76,000 acres. The hardwood forest type is concentrated on private land, primarily in farmer and miscellaneous private ownerships.

Cutting Is Largely Responsible for Hardwood Acreage

Where hardwoods are present in coniferous stands, they frequently become the dominant stand component when the conifers are removed by cutting or fire. Inventory data related to cutting history indicate that cutting has been a major factor affecting type succession; and where cutting is not followed by prompt restocking of conifers, hardwoods are the most likely successors. Hardwood forest types now occupy 53 percent of the cutover commercial forest area, but only 28 percent of areas where no previous cutting has occurred. Most of the hardwood type area is inherently capable of supporting softwood types. Over 90 percent of the area now in hardwood type is classified as capable of growing merchantable stands of coniferous timber.

Information on cutting history in Humboldt County, gathered during the 1966 inventory, indicates that over half of the area clearcut in the previous 5 years has successfully restocked with coniferous species through both natural and artificial regeneration. Hardwoods occupy only 11 percent of the recently clearcut area,and almost 40 percent is still nonstocked. The data also show that most of the area that fails to restock with conifers during this initial period eventually restocks with hardwoods. In areas that were clearcut more than 5 years before the inventory, 41 percent of the area is now softwood type, 53 percent is in hardwood types, and 6 percent is nonstocked.

Partially cut areas are about one-third conifer types, almost 60 percent hardwood types, and less than 10 percent nonstocked. In many of these areas, the timber removed was that which was marketable at the time of harvest. This practice has, in many instances, resulted in the removal of one or more species from the stand composition. What is left in partially cut stands becomes the dominant factor in stocking of an area, in terms of both presence of mature trees and seed source for regeneration. Prior to the 1940's, when Douglas-fir first became a major marketable commodity in the north coastal area, it became the successor to redwood in some forest stands. Now that both redwood and Douglas-fir are major merchantable species, hardwoods are frequently the principal species left on many areas formerly stocked with coniferous species.

The intrusion of hardwoods is most pronounced in the farmer and miscellaneous private ownerships--59 percent of the commercial forest area in this class is in hardwood forest types. This is the result of two important characteristics of these ownerships: (1) generally lower sites and associated higher proportions of hardwoods in the original conifer stands, and (2) a history of cutting on most of the area.

Two-Thirds of Sawtimber Is on Private Land

Humboldt County's commercial forests contain 32.6 billion board feet of sawtimber, 11 percent of the State's total. Two-thirds of this sawtimber volume is in private ownership, 14 billion board feet on forest industry lands and 7 billion board feet on farmer and miscellaneous private lands. Public owners hold the remaining 34 percent, 26 percent on National Forest lands and 8 percent on other public lands.

Sawtimber Volume Per Acre Is Low on Farmer and Miscellaneous Private Lands

The following tabulation shows the average board-foot volume per acre (International 1/4-inch rule) in stands of large and small sawtimber in Humboldt County:

Ownership:	Small sawtimber stands	Large sawtimber stands
National Forest	18,700	35,000
Other public	13,100	29,400
Forest industry	11,400	42,200
Farmer and miscellaneous private	7,000	18,600

The low average stand volumes in farmer and miscellaneous private sawtimber stands are due to the high proportion of hardwood type (68 percent) in these stands.

Volumes Are Low in Hardwood Types

Although the hardwood types occupy 42 percent of the commercial forest land in Humboldt County, they contain only 14 percent of the total sawtimber volume. The 4.6 billion board feet of sawtimber on 721,000 acres of hardwood type represent an average of only 6,400 board feet per acre. By contrast, softwood types, which comprise 52 percent of the commercial forest area, have an average sawtimber volume per acre of 31,000 board feet.

The hardwood forest types in Humboldt County are characterized by a mixture of hardwoods and softwoods. Most of the hardwoods tend to be small, resulting in small contributions to sawtimber volume but significant contributions to cubic-foot volume of growing stock. Consequently, 71 percent of the sawtimber volume in hardwood types is in conifer species, but 52 percent of the cubic-foot growing-stock volume in these stands is in hardwood species.

Sawtimber Volume Is Concentrated in Softwood Species

Softwoods account for 30.7 billion board feet or 94 percent of the sawtimber volume in Humboldt County. This softwood volume is largely concentrated in two species, Douglas-fir and redwood, which comprise 54 and 34 percent of the total, respectively. The Douglas-fir volume is almost evenly divided between public and private ownerships. Coast redwood, the other softwood species of major importance, has a sawtimber volume of 10.3 billion board feet, virtually all in private ownership.

Hardwoods, which dominate stocking on 42 percent of the commercial forest area total only 1.8 billion board feet or 6 percent of the sawtimber volume. Sixty-one percent of the total hardwood sawtimber volume is on farmer and miscellaneous private lands.

Volume Is Concentrated in Large Softwood Trees

The distribution of growing-stock volume, which includes all trees 5 inches and larger in diameter and is expressed in cubic feet, illustrates that Humboldt County's timber resource is concentrated in sawtimber-size trees. Of the 5.4 billion cubic feet in softwoods, half is in trees 39 inches or larger in diameter, and 47 percent is in trees from 11 to 39 inches in diameter. Of the 893 million cubic feet of hardwoods, 23 percent is in trees from 5 to 11 inches in diameter, and 72 percent is in trees from 11 to 39 inches in diameter. In a growing export market for small softwood sawtimber, almost all of the softwood volume is of marketable size.

Tanoak Is Most Abundant Hardwood Species

Tanoak, the most abundant hardwood in Humboldt County, totals 939 million board feet, 52 percent of the hardwood sawtimber volume. Pacific madrone, next in abundance, totals 406 million board feet or 22 percent of the hardwood volume. Ten other hardwood species account for the remaining 478 million board feet of hardwood sawtimber volume

GROWTH AND CUT

Average Net Annual Growth Is 390 Million Board Feet

Average net annual growth of sawtimber on commercial forest land in Humboldt County totaled 390 million board feet, International 1/4-inch rule, in 1966. Average annual mortality for the period 1961-66 totaled 160 million board feet, 54 percent--primarily in blowdown--attributed to weather and 20 percent to fire.

The growth of growing stock totaled 86 million cubic feet, 72 percent in softwood species and 28 percent in hardwood species. With relatively little volume in poletimber, softwood sawtimber and growing stock are both growing at the same rate of 1.1 percent of inventory volume. On the other hand, the growth rate of hardwood growing stock is 2.7 percent of inventory volume; that of hardwood sawtimber is 2.3 percent. The difference in these two growth rates is indicative of the substantial hardwood volume in poletimber-size trees. Although the growth rate of hardwoods is significantly greater than that of the softwoods, the contribution of hardwoods to total growth is relatively low because of the low hardwood volumes per acre in the hardwood types.

Forest Industry Lands Have Highest Growth Per Acre

Net annual growth of sawtimber on forest industry lands averages 371 board feet per acre. Growth per acre on farmer and miscellaneous private lands averages 168 board feet; on National Forest land, 262 board feet; and on other public land net growth is negative because of a high mortality rate. The high net growth on forest industry land is due mainly to well-stocked young redwood stands which occur on high-site lands. Redwood has an average growth per acre of 519 board feet and accounts for 47 percent of all softwood sawtimber growth. The net growth in young redwood stands approaches 5 percent of current inventory volume, but is negligible in old-growth redwood stands.

Annual Cut Exceeds Growth

The annual cut in Humboldt County in recent years has been in excess of 1,300 million board feet, International 1/4-inch rule. The cut has been entirely from softwood species and exceeds the current net annual growth of softwoods by 270 percent. However, most of the cut is still concentrated in old stands containing large sawtimber which contribute little net growth. As these stands are replaced by young stands, total net growth in the county will increase.

Fifteen-Year Private Supply of Large Sawtimber Is Available at Current Cutting Levels

Large softwood sawtimber stands have been the center of harvesting activities in Humboldt County for over 100 years. Though the area and volume of such stands have been greatly reduced, harvesting activities continue to be concentrated in them, with the present cutting level not much below alltime highs. In the north coastal area of California in recent years, well over 70 percent of the sawtimber harvest has come from softwood trees greater than 39 inches in diameter. In Humboldt County, where private cut accounts for almost 90 percent of the county's annual cut, current cutting levels of large sawtimber trees can continue for about 15 years, at which time essentially all of the current inventory of these large softwood sawtimber trees on private lands will have been cut. Although levels and distribution of cut will probably change from the current ones, it is evident that the transition to an industry based on younger and smaller timber is no longer in the distant future. The conversion from old-growth to young-growth stands has spanned more than 100 years in Humboldt County. On private lands, where such cutting has been centered, that conversion is reaching a conclusion, and the harvest of young sawtimber stands has begun.

CONCLUSION

What Does the Future Hold?

Although detailed projections of the forest resource and the level of cut it will support are not within the scope of this publication, some general observations can be made based upon the findings of the recent Humboldt County inventory. The county's sawtimber inventory will continue to decline as it has for many years, until the time when essentially all of the old-growth reserves on private lands have been removed. That time is in the near and foreseeable future. If present cutting levels continue, the county's annual cut can be maintained at current levels for about 15 years, followed by an abrupt decrease to levels based upon the allowable cut on public forests and sustainable levels of cut on privately owned young-growth forests. Or the cut might gradually decrease over a longer period to sustainable levels based upon a young-growth timber resource. The sustainable level of cut, based upon growth in the young stands, will depend upon the management objectives and resultant actions of the owners of the county's commercial forest lands.

Coast redwood currently accounts for about one-third of the Humboldt County annual cut; Douglas-fir, most of the other two-thirds. However, redwood occupies the most highly productive forest areas in the county, primarily on forest industry lands managed for timber production. Redwood currently accounts for almost half of the softwood sawtimber growth. And since a century of cutting was concentrated in the redwood type, many of the mature young softwood sawtimber stands are redwood. So, although the total harvest of redwood will decline, its relative contribution to the total cut should increase with the transition of cutting activities to young stands of timber.

Humboldt County's hardwood type seems to pose the biggest question for the future. There is little present demand for hardwoods and the value for hardwoods will probably always be less than for softwoods. Hardwood stands are characterized by low volumes per acre and hardwoods occupying those sites capable of growing softwoods are not producing the volume of wood such sites are capable of producing.

Eventually, such lands often revert to softwoods as the hardwoods are overtopped. This process could be accelerated if markets for hardwoods would expand. This could create an economic opportunity for reestablishment of softwood stands by means of cutting and conversion to softwoods. The natural progression to softwood stands is slow, effectively removing these lands from production for a long time. The softwood stands resulting from this slow evolution may well be poorly stocked, and it is not likely that their level of cut will approach their productive potential within the foreseeable future.

The hardwood problem is closely tied to land ownership. The farmer and miscellaneous private owner group owns 61 percent of the hardwood type area and that area in turn accounts for 59 percent of the commercial forest land within the owner group. Management objectives of this group are often not oriented toward timber production. The eventual contribution of this area to future levels of cut is difficult to forecast but is probably of diminishing importance.

For the near future, and perhaps in the long run, timber harvesting activities and the resultant economic activities in Humboldt County will depend primarily on the timber resources on the forest industry and publicly owned lands.

Table 1.--Area by land class, Humboldt County, January 1, 1967

(In thousand acres)

Land class	Area
Forest land:	
Commercial	1,701
Productive-reserved	47
Unproductive	102
Total forest	1,850
Nonforest land[1/]	437
Total area[2/]	2,287

1/ Includes swampland, industrial and urban areas, other nonforest land, and 18,000 acres classed as water by Forest Survey standards but defined by the U.S. Bureau of the Census as land.

2/ Source: United States Bureau of the Census, Land and Water Area of the United States, 1960.

Table 2.--Area of commercial forest land, by ownership class, Humboldt County, January 1, 1967

(In thousand acres)

Ownership class	Area
National Forest	292
Other public:[1/]	
Bureau of Land Management	53
Indian	72
State, county, and municipal	1
Total other public	126
Private:	
Forest industry	531
Farmer owned	389
Miscellaneous private	363
Total private	1,283
All ownerships	1,701

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 3.--Area of commercial forest land, by stand-size class and ownership class, Humboldt County, January 1, 1967

(In thousand acres)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Sawtimber stands:					
Old-growth	522	168	60	179	115
Young-growth	743	87	41	232	383
Total	1,265	255	101	411	498
Poletimber stands	66	10	4	5	47
Sapling and seedling stands	276	21	15	82	158
Nonstocked areas	94	6	6	33	49
All classes	1,701	292	126	531	752

Table 4.--Area of commercial forest land, by stand volume and ownership class, Humboldt County, January 1, 1967

(In thousand acres)

Stand volume per acre[1]	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Less than 1,500 board feet	333	21	13	71	228
1,500 to 5,000 board feet	313	8	17	111	177
5,000 to 10,000 board feet	282	47	18	75	142
10,000 to 20,000 board feet	236	47	29	78	82
20,000 to 30,000 board feet	196	53	30	53	60
30,000 to 40,000 board feet	99	42	--	27	30
40,000 to 50,000 board feet	51	19	2	18	12
50,000 to 60,000 board feet	61	23	3	25	10
60,000 to 70,000 board feet	42	9	8	20	5
70,000 to 80,000 board feet	28	12	--	10	6
80,000 to 90,000 board feet	22	6	6	10	--
90,000 board feet or more	38	5	--	33	--
All classes	1,701	292	126	531	752

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

Table 5.--Area of commercial forest land, by stocking class of growing-stock trees and by stand-size class and ownership group, Humboldt County, January 1, 1967

(In thousand acres)

Stocking class	All stands		Nonstocked		Seedling and sapling stands		Poletimber stands		Small sawtimber stands		Large sawtimber stands	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Overstocked (133 percent or more)	22	114	--	--	--	21	--	5	--	15	22	73
Fully stocked (100 to 132 percent)	145	285	--	--	10	26	5	21	23	99	107	139
Medium stocked (60 to 99 percent)	194	436	--	--	18	93	6	21	27	110	143	212
Poorly stocked (16.7 to 59 percent)	45	366	--	--	8	100	3	5	5	90	29	171
Nonstocked (less than 16.7 percent)	12	82	12	82	--	--	--	--	--	--	--	--
All stocking classes	418	1,283	12	82	36	240	14	52	55	314	301	595

Table 6.--Area of commercial forest land, by cubic-foot site class, forest-type group, and ownership, Humboldt County, January 1, 1967

(In thousand acres)

Site class[1/] and forest-type group	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
225 cubic feet per acre or more:					
Softwood	207	--	1	171	35
Hardwood	16	--	--	5	11
Nonstocked	6	--	--	6	--
Total	229	--	1	182	46
165 to 224 cubic feet per acre:					
Softwood	194	51	3	86	54
Hardwood	59	2	2	24	31
Nonstocked	17	--	--	5	12
Total	270	53	5	115	97
120 to 164 cubic feet per acre:					
Softwood	220	64	23	69	64
Hardwood	243	17	15	50	161
Nonstocked	35	3	--	22	10
Total	498	84	38	141	235
85 to 119 cubic feet per acre:					
Softwood	151	53	16	11	71
Hardwood	260	31	20	44	165
Nonstocked	25	3	6	--	16
Total	436	87	42	55	252
50 to 84 cubic feet per acre:					
Softwood	111	49	9	15	38
Hardwood	143	16	31	23	73
Nonstocked	11	--	--	--	11
Total	265	65	40	38	122
20 to 49 cubic feet per acre:					
Softwood	3	3	--	--	--
Hardwood	--	--	--	--	--
Nonstocked	--	--	--	--	--
Total	3	3	--	--	--
All classes and groups	1,701	292	126	531	752

1/ A classification of forest land based on culmination of mean annual increment of fully stocked natural stands. Yields may be substantially higher under intensive management.

Table 7.--Area of commercial forest land, by forest type and ownership class, Humboldt County, January 1, 1967

(In thousand acres)

Type	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Douglas-fir	469	155	48	87	179
Redwood	312	--	1	249	62
True firs	70	51	3	5	11
Pines	19	14	--	5	--
Sitka spruce	16	--	--	5	11
Tanoak	458	48	44	111	255
Pacific madrone	76	11	--	5	60
Other hardwoods	187	7	24	31	125
Nonstocked	94	6	6	33	49
All types	1,701	292	126	531	752

Table 8.--Area of commercial forest land, by stand age, ownership class, and forest-type group, Humboldt County, January 1, 1967

(In thousand acres)

Stand age (years)	All ownerships		National Forest		Other public		Forest industry		Farmer and miscellaneous private	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
1 - 9	66	149	8	8	--	3	30	45	28	93
10 - 19	17	63	--	--	1	15	5	16	11	32
20 - 29	42	20	--	--	--	4	31	6	11	10
30 - 39	47	17	--	5	--	--	35	--	12	12
40 - 49	52	10	5	--	--	--	31	--	16	10
50 - 59	31	13	--	2	5	--	10	--	16	11
60 - 69	15	25	--	--	--	--	10	--	5	25
70 - 79	13	24	3	2	--	--	--	--	10	22
80 - 89	--	5	--	--	--	--	--	--	--	5
90 - 99	--	8	--	3	--	--	--	--	--	5
100 - 199	16	6	3	--	13	1	--	5	--	--
200 - 299	38	8	24	3	3	--	11	--	--	5
300 and more	113	12	--	--	6	--	91	7	16	5
Uneven, under rotation age1/	223	244	53	28	10	22	65	35	95	159
Uneven, over rotation age	213	117	124	15	14	23	32	33	43	46
Total, all ages	886	721	220	66	52	68	351	147	263	440
Nonstocked	94		6		6		33		49	

1/ Rotation age is defined as 50 years in hardwood stands, 100 years in conifer stands.

Table 9.--Area of commercial forest land, by area condition and ownership classes, Humboldt County, January 1, 1967

(In thousand acres)

Area condition class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Class 10 Areas fully stocked with desirable trees and not overstocked.	5	--	--	5	--
Class 20 Areas fully stocked with desirable trees, but overstocked with all live trees.	40	--	--	12	28
Class 30 Areas medium to fully stocked with desirable trees, and with less than 30 percent of the area controlled by other trees and/or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.	10	5	--	5	--
Class 40 Areas medium to fully stocked with desirable trees and with 30 percent or more of the area controlled by other trees and/or conditions that ordinarily prevent occupancy by desirable trees.	217	13	27	119	58
Class 50 Areas poorly stocked with desirable trees, but fully stocked with growing-stock trees.	264	49	16	75	124
Class 60 Areas poorly stocked with desirable trees, but with medium to full stocking of growing stock trees.	399	52	39	140	168
Class 70 Areas poorly stocked with desirable trees, and poorly stocked with growing-stock trees.	436	34	7	111	284
Class 80 Stands over rotation age and with 40 percent or more of the stocking in desirable trees.	87	39	14	11	23
Class 90 Stands over rotation age with less than 40 percent of the stocking in desirable trees.	243	100	23	53	67
All classes	1,701	292	126	531	752

Table 10.--Area of commercial forest land, by cutting treatment and forest-type group, and by ownership, Humboldt County, January 1, 1967

(In thousand acres)

Cutting treatment and forest-type group	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Uncut:					
Softwood	520	211	52	143	114
Hardwood	207	58	47	11	91
Nonstocked	5	--	--	--	5
Total	732	269	99	154	210
Clearcut, 0 to 5 years:					
Softwood	28	3	--	19	6
Hardwood	6	6	--	--	--
Nonstocked	21	6	--	15	--
Total	55	15	--	34	6
Clearcut, over 5 years:					
Softwood	130	5	--	84	41
Hardwood	167	--	1	56	110
Nonstocked	17	--	--	6	11
Total	314	5	1	146	162
Partial cut, 0 to 5 years:					
Softwood	68	--	--	40	28
Hardwood	107	--	10	31	66
Nonstocked	17	--	--	--	17
Total	192	--	10	71	111
Partial cut, over 5 years:					
Softwood	140	1	--	65	74
Hardwood	234	2	10	49	173
Nonstocked	34	--	6	12	16
Total	408	3	16	126	263
All treatments and groups	1,701	292	126	531	752

Table 11.--Area of noncommercial forest land, by forest type, Humboldt County, January 1, 1967

(In thousand acres)

Type	All areas	Productive-reserved areas	Unproductive areas
Douglas-fir	11	11	--
Redwood	35	35	--
Hardwoods	1	1	--
Noncommercial rocky	13	--	13
Noncommercial low site	19	--	19
Noncommercial oak-madrone	25	--	25
Noncommercial chaparral	26	--	26
Noncommercial other[1/]	19	--	19
All types	149	47	102

1/ Primarily noncommercial because of adverse location.

Table 12.--Volume of all growing stock and sawtimber on commercial forest land, by timber and ownership class and by softwoods and hardwoods, Humboldt County, January 1, 1967

Timber and ownership class	Volume per acre	Total volume		
		All species	Softwoods	Hardwoods
	Cubic feet	------------ Million cubic feet ------------		
All growing stock:				
National Forest	5,014	1,464	1,346	118
Other public	4,000	504	396	108
Forest industry	5,068	2,691	2,534	157
Farmer and miscellaneous private	2,162	1,626	1,116	510
All ownerships	3,695	6,285	5,392	893
	Board feet	------------ Million board feet ------------		
Sawtimber (International 1/4-inch rule):				
National Forest	29,106	8,499	8,318	181
Other public	21,397	2,696	2,473	223
Forest industry	26,586	14,117	13,805	312
Farmer and miscellaneous private	9,640	7,249	6,142	1,107
All ownerships	19,142	32,561	30,738	1,823
Sawtimber (Scribner rule):				
National Forest	27,490	8,027	7,850	177
Other public	20,317	2,560	2,342	218
Forest industry	25,262	13,414	13,108	306
Farmer and miscellaneous private	9,088	6,834	5,748	1,086
All ownerships	18,128	30,835	29,048	1,787

Table 13.--Net volume of growing stock on commercial forest land by species and ownership class, Humboldt County, January 1, 1967

(In million cubic feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	2,708	915	373	596	824
Redwood	2,015	--	1	1,800	214
White fir	331	286	13	15	17
Grand fir	92	--	--	48	44
Red fir	41	41	--	--	--
Sugar pine	78	70	8	--	--
Ponderosa and Jeffrey pines[1]	27	20	--	4	3
Sitka spruce	38	--	--	27	11
Western hemlock	40	--	--	40	--
Cedars[2]	22	14	1	4	3
Total softwoods	5,392	1,346	396	2,534	1,116
Hardwoods:					
Bigleaf maple	11	2	2	1	6
Red alder	27	--	--	6	21
Pacific madrone	215	26	36	23	130
Golden chinkapin	16	7	1	5	3
Tanoak	462	64	45	103	250
California live oak	15	2	6	2	5
Canyon live oak	25	5	4	3	13
Oregon white oak	34	([3])	3	4	27
California black oak	48	9	9	5	25
California white oak	10	3	--	--	7
Interior live oak	6	([3])	--	3	3
California laurel	24	--	2	2	20
Total hardwoods	893	118	108	157	510
Total all species	6,285	1,464	504	2,691	1,626

1/ Includes a small amount of knobcone pine.
2/ Primarily incense-cedar.
3/ Less than 500,000 cubic feet.

Table 14.--Volume of sawtimber on commercial forest land, by species and ownership class, Humboldt County, January 1, 1967 (International 1/4-inch rule)

(In million board feet)

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
Softwoods:					
Douglas-fir	16,555	5,814	2,318	3,701	4,722
Redwood	10,317	--	2	9,320	995
White fir	1,893	1,647	90	62	94
Grand fir	582	--	--	328	254
Red fir	259	259	--	--	--
Sugar pine	478	417	61	--	--
Ponderosa and Jeffrey pines1/	125	101	--	11	13
Sitka spruce	208	--	--	154	54
Western hemlock	208	--	--	208	--
Cedars2/	113	80	2	21	10
Total softwoods	30,738	8,318	2,473	13,805	6,142
Hardwoods:					
Bigleaf maple	26	4	5	6	11
Red alder	90	--	--	8	82
Pacific madrone	406	42	65	47	252
Golden chinkapin	53	20	2	19	12
Tanoak	939	89	100	182	568
California live oak	10	3	--	2	5
Canyon live oak	61	5	17	9	30
Oregon white oak	48	1	9	8	30
California black oak	99	14	18	11	56
California white oak	10	3	--	--	7
Interior live oak	27	--	--	14	13
California laurel	54	--	7	6	41
Total hardwoods	1,823	181	223	312	1,107
Total all species	32,561	8,499	2,696	14,117	7,249

1/ Includes small amount of knobcone pine.
2/ Primarily incense-cedar.

Table 15.--Average sawtimber volume per acre, by stand-size class and ownership class, Humboldt County, January 1, 1967

(International 1/4-inch rule)

Stand-size class	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	Board feet				
Nonstocked	3,500	0	5,700	3,400	3,700
Seedlings and saplings	1,600	4,000	1,100	2,200	1,000
Poletimber	2,800	5,800	0	2,600	2,500
Small sawtimber	9,800	18,700	13,100	11,400	7,000
Large sawtimber	31,400	35,000	29,400	42,200	18,600
All stands	19,100	29,100	21,400	26,600	9,600

Table 16.--Volume of timber on commercial forest land, by class of timber and by softwoods and hardwoods, Humboldt County, January 1, 1967

(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Sawtimber trees:			
Saw-log portion	5,212	4,527	685
Upper-stem portion	676	676	--
Total	5,888	5,203	685
Poletimber trees	397	189	208
All growing-stock trees	6,285	5,392	893
Sound cull trees	140	25	115
Rotten cull trees	374	307	67
Salvable dead trees:			
Sawtimber-size	164	156	8
Total all timber	6,963	5,880	1,083

Table 17.--Number of growing-stock trees on commercial forest land, by species and diameter class, Humboldt County, January 1, 1967

(Thousand trees)

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	33,298	6,368	5,899	3,283	2,379	2,067	2,350	1,867	1,695	3,278	2,167	1,945
Redwood	26,204	3,991	3,398	3,975	2,603	2,751	1,946	1,586	1,323	2,499	819	1,313
White fir	7,448	1,652	1,472	853	666	571	507	353	219	618	394	143
Grand fir	753	--	136	--	127	--	41	23	76	192	105	53
Red fir	648	398	70	--	31	19	--	12	10	30	36	42
Sugar pine	1,462	258	630	40	75	106	32	48	73	81	65	54
Ponderosa and Jeffrey pines1/	1,349	453	279	336	56	20	30	47	21	88	11	8
Sitka spruce	553	--	--	217	--	--	57	45	89	124	15	6
Western hemlock	832	154	112	76	--	207	36	23	--	161	59	4
Cedars2/	1,144	450	279	42	135	--	60	12	--	73	68	25
Total softwoods	73,691	13,724	12,275	8,822	6,072	5,741	5,059	4,016	3,506	7,144	3,739	3,593
Hardwoods:												
Bigleaf maple	1,336	439	417	90	139	16	174	--	20	32	9	--
Red alder	1,142	--	475	200	116	114	60	52	38	66	11	10
Pacific madrone	10,419	1,675	2,861	1,588	1,445	890	712	364	218	471	137	58
Golden chinkapin	1,109	556	206	69	27	20	32	50	64	58	27	--
Tanoak	45,257	17,717	11,073	5,451	3,173	1,964	1,990	1,144	853	1,512	342	38
California live oak	3,209	1,675	918	343	112	112	29	11	9	--	--	--
Canyon live oak	2,490	634	787	355	237	78	164	93	47	76	4	15
Oregon white oak	6,176	2,904	1,712	759	398	81	154	24	19	109	16	--
California black oak	3,796	469	1,092	746	614	383	166	79	62	158	27	--
California white oak	2,220	1,047	917	122	112	--	--	--	--	7	15	--
Interior live oak	284	172	--	--	--	44	--	27	--	20	11	10
California laurel	3,039	662	618	636	686	107	82	95	42	98	8	5
Total hardwoods	80,477	27,950	21,076	10,359	7,059	3,809	3,563	1,939	1,372	2,607	607	136
Total all species	154,168	41,674	33,351	19,181	13,131	9,550	8,622	5,955	4,878	9,751	4,346	3,729

1/ Includes small amount of knobcone pine.
2/ Primarily incense-cedar.

Table 18.--Volume of growing stock on commercial forest land, by species and diameter class, Humboldt County, January 1, 1967

(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	2,708	19	43	44	54	67	102	106	120	386	527	1,240
Redwood	2,015	5	13	29	32	54	60	72	80	241	163	1,266
White fir	331	4	7	8	9	14	16	16	13	70	101	73
Grand fir	92	--	1	--	2	--	1	1	5	24	27	31
Red fir	41	(1/)	(1/)	--	1	--	--	1	1	4	10	24
Sugar pine	78	1	3	(1/)	1	2	1	2	4	11	16	37
Ponderosa and Jeffrey pines 2/	27	1	1	4	1	(1/)	1	2	1	8	3	5
Sitka spruce	38	--	--	3	--	--	3	3	7	15	3	4
Western hemlock	40	(1/)	(1/)	1	--	4	1	1	--	17	14	2
Cedars 3/	22	1	1	(1/)	1	--	2	(1/)	--	4	9	4
Total softwoods	5,392	31	69	89	101	141	187	204	231	780	873	2,686
Hardwoods:												
Bigleaf maple	11	1	2	1	1	(1/)	3	--	1	1	1	--
Red alder	27	--	3	2	2	3	2	2	2	6	2	3
Pacific madrone	215	4	15	15	22	20	22	15	12	41	24	25
Golden chinkapin	16	1	1	1	(1/)	(1/)	1	2	3	4	3	--
Tanoak	462	28	38	35	34	33	49	38	37	114	47	9
California live oak	15	4	4	3	1	2	1	(1/)	(1/)	--	--	--
Canyon live oak	25	1	4	3	3	1	3	2	1	4	(1/)	3
Oregon white oak	34	5	6	5	4	1	3	(1/)	1	7	2	--
California black oak	48	1	4	5	7	7	4	3	2	12	3	--
California white oak	10	2	4	1	1	--	--	--	--	(1/)	2	--
Interior live oak	6	1	--	--	--	(1/)	--	1	--	1	1	2
California laurel	24	1	3	4	6	1	1	1	1	5	(1/)	1
Total hardwoods	893	49	84	75	81	68	89	64	60	195	85	43
Total all species	6,285	80	153	164	182	209	276	268	291	975	958	2,729

1/ Less than 500,000 cubic feet.
2/ Includes small amount of knobcone pine.
3/ Primarily incense-cedar.

Table 19.--Volume of sawtimber on commercial forest land, by species and diameter class, Humboldt County, January 1, 1967 (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	16,555	142	240	433	510	628	2,308	3,484	8,810
Redwood	10,317	64	211	276	343	397	1,251	852	6,923
White fir	1,893	36	64	80	82	72	413	659	487
Grand fir	582	5	--	2	5	26	142	172	230
Red fir	259	2	2	--	4	5	23	67	156
Sugar pine	478	3	8	4	11	21	64	106	261
Ponderosa and Jeffrey pines[1]	125	2	2	4	10	5	48	19	35
Sitka spruce	208	--	--	12	15	38	93	22	28
Western hemlock	208	--	18	6	4	--	88	83	9
Cedars[2]	113	8	--	5	1	--	22	52	25
Total softwoods	30,738	262	545	822	985	1,192	4,452	5,516	16,964
Hardwoods:									
Bigleaf maple	26	3	1	10	--	2	7	3	--
Red alder	90	4	9	7	7	10	26	10	17
Pacific madrone	406	46	43	51	36	29	103	57	41
Golden chinkapin	53	1	1	2	5	12	18	14	--
Tanoak	939	60	73	121	100	100	319	136	30
California live oak	10	2	4	2	1	1	--	--	--
Canyon live oak	61	6	3	9	7	5	16	2	13
Oregon white oak	48	11	3	8	1	2	18	5	--
California black oak	99	13	14	10	7	7	36	12	--
California white oak	10	3	--	--	--	--	1	6	--
Interior live oak	27	--	1	--	2	--	5	7	12
California laurel	54	14	3	3	4	3	21	3	3
Total hardwoods	1,823	163	155	223	170	171	570	255	116
Total all species	32,561	425	700	1,045	1,155	1,363	5,022	5,771	17,080

1/ Includes small amount of knobcone pine.
2/ Primarily incense-cedar.

Table 20.--Volume of sawtimber on commercial forest land, by species and diameter class,

Humboldt County, January 1, 1967 (Scribner 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	15,643	119	205	381	458	568	2,135	3,293	8,484
Redwood	9,796	56	185	246	310	362	1,151	796	6,690
White fir	1,758	30	56	70	73	65	380	622	462
Grand fir	548	4	--	3	4	24	131	162	220
Red fir	246	2	2	--	3	5	21	63	150
Sugar pine	452	2	7	4	10	19	59	100	251
Ponderosa and Jeffrey pines1/	116	2	1	3	9	4	45	18	34
Sitka spruce	192	--	--	10	13	34	87	21	27
Western hemlock	193	--	15	5	4	--	81	78	10
Cedars2/	104	6	--	4	1	--	19	49	25
Total softwoods	29,048	221	471	726	885	1,081	4,109	5,202	16,353
Hardwoods:									
Bigleaf maple	26	4	1	10	--	2	6	3	--
Red alder	88	4	8	6	7	10	26	10	17
Pacific madrone	398	44	42	50	35	28	102	57	40
Golden chinkapin	52	1	1	2	5	11	18	14	--
Tanoak	920	58	71	118	97	98	314	135	29
California live oak	10	2	4	2	1	1	--	--	--
Canyon live oak	60	5	3	9	7	5	16	2	13
Oregon white oak	47	11	3	8	2	2	17	4	--
California black oak	97	13	14	9	6	7	36	12	--
California white oak	9	2	--	--	--	--	1	6	--
Interior live oak	27	--	1	--	2	--	5	7	12
California laurel	53	13	3	3	4	3	21	3	3
Total hardwoods	1,787	157	151	217	166	167	562	253	114
Total all species	30,835	378	622	943	1,051	1,248	4,671	5,455	16,467

1/ Includes a small amount of knobcone pine.
2/ Primarily incense-cedar.

Table 21.--Net annual growth of all growing stock on commercial forest land, by species and ownership class, Humboldt County, 1966

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	Thousand cubic feet				
Softwoods:					
Douglas-fir	22,356	5,878	[1]-1,385	7,850	10,013
Redwood	30,531	--	37	22,627	7,867
True firs	5,299	4,501	[1]-746	968	576
Sugar pine	507	472	35	--	--
Ponderosa and Jeffrey pines	91	187	--	140	[1]-236
Sitka spruce	1,732	--	--	1,126	606
Western hemlock	733	--	--	733	--
Other softwoods	10	148	3	55	[1]-196
Total softwoods	61,259	11,186	[1]-2,056	33,499	18,630
Hardwoods:					
Pacific madrone	4,896	344	703	659	3,190
Tanoak	14,328	930	1,607	4,829	6,962
Other hardwoods	5,169	293	472	717	3,687
Total hardwoods	24,393	1,567	2,782	6,205	13,839
Total all species	85,652	12,753	726	39,704	32,469

1/ Negative growth is the result of annual mortality exceeding annual growth.

Table 22.--Net annual growth of sawtimber on commercial forest land, by species and ownership class, Humboldt County, 1966

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	------- Thousand board feet, International 1/4-inch rule				---------
Softwoods:					
Douglas-fir	131,182	43,409	1/-12,082	45,638	54,217
Redwood	162,464	--	138	125,863	36,463
True firs	36,030	25,971	1/-3,544	7,768	5,835
Sugar pine	3,234	2,973	261	--	--
Ponderosa and Jeffrey pines	212	985	--	273	1/-1,046
Sitka spruce	11,487	--	--	7,687	3,800
Western hemlock	4,033	--	--	4,033	--
Other softwoods	178	648	17	299	1/-786
Total softwoods	348,820	73,986	1/-15,210	191,561	98,483
Hardwoods:					
Pacific madrone	7,953	485	1,695	1,014	4,759
Tanoak	21,539	1,413	2,032	4,086	14,008
Other hardwoods	11,951	553	842	1,333	9,223
Total hardwoods	41,443	2,451	4,569	6,433	27,990
Total all species	390,263	76,437	1/-10,641	197,994	126,473

1/ Negative growth is the result of annual mortality exceeding annual growth.

Table 23.--Net annual growth of sawtimber on commercial forest land, by species and ownership class, Humboldt County, 1966

Species	All ownerships	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	Thousand board feet, Scribner rule				
Softwoods:					
Douglas-fir	124,090	40,730	[1]-11,067	42,744	51,683
Redwood	150,210	--	124	116,219	33,867
True firs	35,105	26,192	[1]-3,377	7,031	5,259
Sugar pine	3,117	2,863	254	--	--
Ponderosa and Jeffrey pines	219	936	--	236	-953
Sitka spruce	10,833	--	--	7,254	3,579
Western hemlock	3,775	--	--	3,775	--
Other softwoods	200	630	16	297	[1]-743
Total softwoods	327,549	71,351	[1]-14,050	177,556	92,692
Hardwoods:					
Pacific madrone	7,775	478	1,654	992	4,651
Tanoak	21,173	1,412	2,003	3,957	13,801
Other hardwoods	11,765	547	835	1,327	9,056
Total hardwoods	40,713	2,437	4,492	6,276	27,508
Total all species	368,262	73,788	[1]-9,558	183,832	120,200

[1] Negative growth is the result of annual mortality exceeding annual growth.

Table 24.--Average annual mortality of growing stock and sawtimber on commercial forest land, by ownership class and by softwoods and hardwoods, Humboldt County, 1961-66

Species	Total	National Forest	Other public	Forest industry	Farmer and miscellaneous private
	Thousand cubic feet				
Growing stock:					
Softwoods	26,656	3,716	5,970	8,594	8,376
Hardwoods	2,116	252	278	1,060	526
Total	28,772	3,968	6,248	9,654	8,902
	Thousand board feet, International 1/4-inch rule				
Sawtimber:					
Softwoods	154,732	21,521	38,405	45,512	49,294
Hardwoods	5,495	543	798	3,475	679
Total	160,227	22,064	39,203	48,987	49,973
	Thousand board feet, Scribner rule				
Sawtimber:					
Softwoods	146,817	20,440	36,302	43,865	46,210
Hardwoods	5,404	531	778	3,425	670
Total	152,221	20,971	37,080	47,290	46,880

Table 25.--Average annual mortality of all growing stock and sawtimber on commercial forest land, by species, Humboldt County, 1961-66

Species	All growing stock	Sawtimber	
		International 1/4-inch rule	Scribner rule
	--Thousand cubic feet-	---------- Thousand board feet	-------------
Softwoods:			
Douglas-fir	16,795	103,264	97,231
Redwood	6,965	36,215	35,141
True firs	1,788	10,255	9,740
Sugar pine	319	1,845	1,752
Ponderosa and Jeffrey pines	278	1,316	1,205
Other softwoods	511	1,837	1,748
Total softwoods	26,656	154,732	146,817
Hardwoods:			
Pacific madrone	445	464	460
Tanoak	1,495	4,430	4,359
Other hardwoods	176	601	585
Total hardwoods	2,116	5,495	5,404
Total all species	28,772	160,227	152,221

Table 26.--Average annual mortality of growing stock and sawtimber on commercial forest land, by cause of death and by softwoods and hardwoods, Humboldt County, 1961-66

Species	Cause of death							
	Fire	Insects	Disease	Weather[1]	Suppression	Logging[2]	Miscellaneous and unknown	All causes
	Thousand cubic feet							
Growing stock:								
Softwoods	5,342	1,349	1,776	14,106	113	1,236	2,734	26,656
Hardwoods	--	--	--	1,364	35	--	717	2,116
Total	5,342	1,349	1,776	15,470	148	1,236	3,451	28,772
	Thousand board feet, International 1/4-inch rule							
Sawtimber:								
Softwoods	36,288	6,813	11,139	81,572	--	5,956	12,964	154,732
Hardwoods	--	--	--	4,241	--	--	1,254	5,495
Total	36,288	6,813	11,139	85,813	--	5,956	14,218	160,227
	Thousand board feet, Scribner rule							
Sawtimber:								
Softwoods	34,283	6,454	10,499	77,946	--	5,439	12,196	146,817
Hardwoods	--	--	--	4,172	--	--	1,232	5,404
Total	34,283	6,454	10,499	82,118	--	5,439	13,428	152,221

1/ Mainly wind damage.
2/ Trees dying more than 1 year after logging.

ACCURACY OF THE CURRENT INVENTORY DATA

Forest-Land Area and Timber Volume

The estimates of forest-land area and timber volume in Humboldt County were derived by sampling and consequently 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 are presented in table 27 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 if a 100-percent inventory had been taken, using the same methods, the results would have been within the ranges shown. For example, the estimate of total commercial forest-land area from a 100-percent inventory would be expected to fall within plus or minus 1.4 percent of 1,701,000 acres, unless a one in three chance of sampling has occurred.

Table 27.--Sampling errors of estimates of forest area and timber volume

Item	Estimated total	Sampling error in percent	
		68-percent probability	95-percent probability
Commercial forest land	1,701,000 acres	±1.4	±2.7
Noncommercial forest land	102,000 acres	±17.0	±33.3
Volume:			
Growing stock	6,285 million cubic feet	±6.1	±12.0
Sawtimber (International 1/4-inch rule)	32,561 million board feet	±6.7	±13.1

In addition to measurable sampling errors, there may be other nonsampling errors due to mistakes in judgment, measurement, and compilation. The magnitude of errors from these sources 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 28, which shows the sampling error associated with smaller estimates.

Table 28.--Approximate sampling error by size of estimate

Commercial Forest Land		Growing Stock		Sawtimber	
Area	Sampling error[1/]	Volume	Sampling error[1/]	Volume	Sampling error[1/]
M acres	Percent	MM cu. ft.	Percent	MM bd. ft., International 1/4-inch rule	Percent
1,701	1.4				
833	2.0				
370	3.0				
208	4.0				
133	5.0	6,285	6.1	32,561	6.7
33	10.0	2,339	10.0	14,617	10.0
15	15.0	1,039	15.0	6,496	15.0
8	20.0	585	20.0	3,654	20.0
5	25.0	374	25.0	2,339	25.0
4	30.0	260	30.0	1,624	30.0
		146	40.0	9,135	40.0
		94	50.0	5,846	50.0
		23	100.0	1,462	100.0

1/ By random sampling formula; 68-percent probability.

COMPARISON WITH PREVIOUS INVENTORIES

An earlier inventory of Humboldt County's forest resource was completed in 1948 and published in 1952. The report included information on area and ownership but not volume. Some of the differences in the area statistics between the original and the new inventory are undoubtedly due to real change such as the shift of forest land to other uses and to different ownerships. Some differences are due to sampling and technique errors and some to changes in definitions and standards of utilization. These differences complicate direct comparisons of the statistics.

Acreage figures during the first reinventory were obtained from type maps with a minimum type acreage of 40 acres. Thus a type island of commercial forest, 40 acres or larger in size could contain a large number of 1-acre noncommercial or nonforest areas. The area figures for the 1967 inventory, on the other hand, are based on a minimum area of 1 acre. The differences between inventories thus should not be used to determine exact magnitude of change, but these differences when reinforced with study of present inventory data can be used to indicate direction of change.

Between 1948 and 1967, the commercial forest area decreased slightly. This was due to conversions to nonforest uses and withdrawals into productive-reserved status resulting from forest-land purchases for expansion of parks, primarily the Humboldt and Prairie Creek Redwood State parks. These withdrawals and conversions to nonforest uses have been on private holdings. During this same period of time, substantial shifts in ownership were occurring in the private and other public sectors of forest-land ownership. Forest industry ownership increased at the same time the acreage in farmer and miscellaneous private commercial forest land decreased. Other public ownerships, mainly State and Indian lands, decreased in size through disposition of some of their holdings to private ownership. The acreage of commercial forest on National Forest land remained unchanged during the period.

The early cover type definitions recognized only commercially valuable conifer species and assigned unequal weights among these species in the determination of forest cover type for a given area. Redwood was the favored species, and its occurrence as 20 percent or more of the commercial conifer cover resulted in an area being classified as redwood type. Unstocked areas and areas covered with hardwoods were assigned to a conifer type based upon an evaluation of potential species composition.

Under the present Forest Survey definitions, as used in the current Humboldt County inventory, forest cover type is determined on the basis of the species plurality of stocking by all live trees considering both size and spacing. This definition treats all species, including hardwoods, equally, regardless of relative economic values. As a result, the forest cover type information presented in this report reflects the species that actually occupy the forest lands of Humboldt County.

Although the magnitudes of type changes cannot be determined due to the differences in sampling techniques and type definitions, study of the inventory data indicates that, since 1948, there have been large decreases in the acreages of redwood and Douglas-fir types and a substantial increase in the acreage of hardwood types.

The planned 1977 reinventory of Humboldt County with remeasurement of 1967 inventory plots and standardized definitions should provide a firm basis for quantitatively evaluating changes in forest-land use, ownership, and forest cover types.

FOREST SURVEY PROCEDURES

This inventory of Humboldt County combines data from the Six Rivers National Forest inventory project and the Forest Survey inventory project. Field data for both inventory projects were collected during the summer of 1966. The same sampling design and field procedure were used throughout the county.

A systematic grid of photo points was printed on a set of aerial photographs covering the entire county. Each photo point was classified by major land use --commercial forest land, noncommercial forest land, and nonforest land.

The commercial forest-land photo points were further classified into stand volume classes.

A stratified random sample of field plots, proportional to stratum area, was then selected from the photo points. This sample of photo points was visited in the field, and the accuracy of the photo classification of land use and ownership was checked. At each location falling on commercial forest land, an inventory plot was established.

The inventory plot consisted of 10 sample points distributed systematically over an acre. The variable-radius-plot sampling principle was used at each sample point to select the trees to be tallied. The summation of the 10-point tally expressed the resources and conditions for that acre and were used with the photo sample to provide area, volume, growth, and mortality statistics.

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 10 percent stocked by trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Minimum area of forest land recognized is 1 acre.

Nonforest-Land Area

Land that does not qualify as forest 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 qualifies as commercial forest land.

Unproductive. Forest land incapable of yielding crops of industrial wood products (usually sawtimber) because of adverse site conditions. Unproductive forest land is divided into the following classes:

Noncommercial rocky. Forested areas within the commercial forest zone so steep and rocky that they are incapable of producing usable wood products.

Noncommercial low site. Forest lands of such low site quality that they are incapable of producing 20 cubic feet per acre per year of usable wood products.

Noncommercial oak-madrone. Areas currently stocked with low quality oaks and madrone and which are not now, nor show any evidence of ever having been, stocked with trees of commercial species and quality. Trees on these sites are usually poorly formed and suitable only for fuelwood.

Noncommercial chaparral. Areas covered with heavily branched, usually evergreen, dwarfed trees or shrubs, that at maturity form a crown canopy covering more than 50 percent of the ground.

Noncommercial adverse location. Generally inaccessible areas of productive forest land, often containing stands of merchantable timber but, because of physical location, cannot be harvested. Timber-bearing ledges are an example of such locations.

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.

Acceptable trees. Growing-stock trees of commercial species that meet specified standards of size and quality, but not qualifying as desirable trees.

Desirable trees. Growing-stock trees of commercial species (a) having no serious defects in quality limiting present or prospective use for timber products, (b) of relatively high vigor, and (c) containing no pathogens that may result in death or serious deterioration before rotation age.

Sawtimber trees (11.0 inches d.b.h. and larger) Live trees of commercial species that contain at least one 12-foot coniferous saw log with a top diameter not less than 6 inches inside bark, or one 8-foot hardwood saw log with a top diameter not less than 8 inches inside bark and with not less than 25 percent of the board-foot volume in the tree free of defect for either conifer or hardwood.

Poletimber trees (5.0 to 10.9 inches 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 them from becoming growing-stock sawtimber trees.

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

Nongrowing-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 died from natural causes 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 coniferous or 8-foot hardwood saw 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 inches 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 inches 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" is synonymous with "percentage of growing space occupied" and means 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 under-stocking with less than full site occupancy. Overstocking is characterized by sites that have over 132-percent stocking.

Stand 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, under or over rotation age.

Rotation age. The period of years between establishment of a stand of timber and the time when it is considered ready for cutting and regeneration. Rotation age in softwood stands is 100 years; in hardwood stands, it is 50 years.

Old-growth sawtimber stand. Sawtimber stand in which 50 percent or more of the growing-stock stocking is in trees at least 100 years old.

Young-growth sawtimber stand. Sawtimber stand in which more than 50 percent of the growing-stock stocking is in trees less than 100 years old.

Area Condition Classes

Area condition classes represent a classification of the current condition of commercial forest land in terms of stocking by desirable trees and conditions affecting the establishment and development of these trees.

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 California. Scribner volume in Humboldt County 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.

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.

Growth

Net Annual Growth

The increase in 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 volume of trees reaching the size class during the year minus the 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 Forests 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 lands other than forest industry or farmer-owned lands.

TREE SPECIES

Principal tree species found on the commercial forest land in Humboldt County include:

Softwoods:

California red fir (*Abies magnifica* var. *magnifica*)
Douglas-fir (*Pseudotsuga menziesii*)
Grand fir (*Abies grandis*)
Incense-cedar (*Libocedrus decurrens*)
Jeffrey pine (*Pinus jeffreyi*)
Knobcone pine (*Pinus attenuata*)
Ponderosa pine (*Pinus ponderosa*)
Port-Orford-cedar (*Chamaecyparis lawsoniana*)
Redwood (*Sequoia sempervirens*)
Shasta red fir (*Abies magnifica* var. *shastensis*)
Sitka spruce (*Picea sitchensis*)
Sugar pine (*Pinus lambertiana*)
Western hemlock (*Tsuga heterophylla*)
Western redcedar (*Thuja plicata*)
White fir (*Abies concolor*)

Hardwoods:

Bigleaf maple (*Acer macrophyllum*)
California black oak (*Quercus kelloggii*)
California-laurel (*Umbellularia californica*)
California live oak (*Quercus agrifolia*)
California white oak (*Quercus lobata*)
Canyon live oak (*Quercus chrysolepis*)
Golden chinkapin (*Castanopsis chrysophylla*)
Interior live oak (*Quercus wislizenii*)
Oregon white oak (*Quercus garryana*)
Pacific madrone (*Arbutus menziesii*)
Red alder (*Alnus rubra*)
Tanoak (*Lithocarpus densiflorus*)

Oswald, Daniel D.
1968. The timber resources of Humboldt County, California. U.S.D.A. Forest Serv. Resource Bull. PNW-26, 42 pp. Pacific Northwest Forest & Range Experiment Station, Portland, Oreg.

This report presents the first complete inventory of Humboldt County's timber resources. The field data were collected in 1966. Accompanying the 28 tables of detailed forest area, volume, and ownership statistics for Humboldt County is an analysis of the present timber resource and the problems that affect present and future timber production.

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Oswald, Daniel D.
1968. The timber resources of Humboldt County, California. U.S.D.A. Forest Serv. Resource Bull. PNW-26, 42 pp. Pacific Northwest Forest & Range Experiment Station, Portland, Oreg.

This report presents the first complete inventory of Humboldt County's timber resources. The field data were collected in 1966. Accompanying the 28 tables of detailed forest area, volume, and ownership statistics for Humboldt County is an analysis of the present timber resource and the problems that affect present and future timber production.

RECENT FOREST SURVEY PUBLICATIONS

Number	Title	Date
Resource Bulletins:		
PNW-25	1967 Washington Timber Harvest	Aug. 1968
PNW-24	Timber Resource Statistics for Central Oregon	1968
PNW-23	Preliminary Timber Resource Statistics for Humobldt County, California, January 1, 1967	1968
PNW-22	1966 Oregon Timber Harvest	Dec. 1967
PNW-21	1966 Washington Timber Harvest	Oct. 1967
PNW-18	1965 Washington Timber Harvest	Dec. 1966
PNW-17	Forest Industries of Eastern Washington	1966
PNW-16	1965 Oregon Timber Harvest	June 1966
PNW-15	Timber Resource Statistics for Southwest Washington	1965
PNW-14	1964 Washington Timber Harvest	Dec. 1965
PNW-13	1964 Oregon Log Production	Sept. 1965
PNW-12	The Timber Situation and Outlook for Northwest Oregon	1965
PNW-11	Hardwood Timber Resources of the Douglas-fir Subregion	1965
PNW-10	Forest Statistics for West-Central Oregon	1965
PNW-9	Timber Resource Statistics for the Pacific Northwest	1965
PNW-8	Forest Statistics for Southwest Oregon	Aug. 1964
PNW-7	Forest Statistics for Northwest Oregon	July 1964
PNW-6	1962 Washington Log Production	Dec. 1963
PNW-5	Forest Statistics for Chelan and Douglas Counties, Washington	May 1963
PNW-4	Forest Statistics for Northeast Washington	May 1963
PNW-3	Toward Complete Use of Eastern Oregon's Forest Resources	May 1963
PNW-2	1962 Oregon Log Production	Apr. 1963
PNW-1	1961 Washington Log Production	Jan. 1963
Research Papers:		
PNW-28	Manpower Use in the Wood-Products Industries of Oregon and Washington 1950-63	1965
PNW-5	Timber Trends in Western Oregon and Western Washington	Oct. 1963

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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.

U.S.D.A. Forest Service
Resource Bulletin PNW-27

October 1968

1967 OREGON TIMBER HARVEST

by

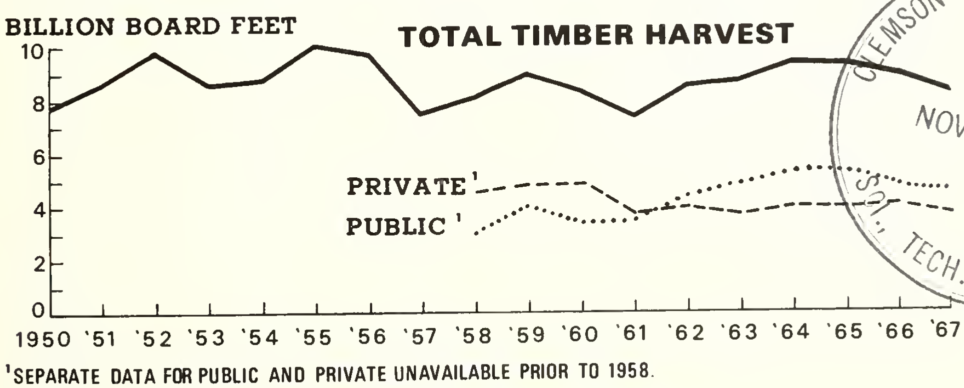
Brian R. Wall, *Associate Economist*

Oregon's timber harvest was 8.4 billion board feet in 1967, 6.3 percent below the 1966 harvest. The total private harvest declined 7 percent in 1967 with a 153-million-board-foot (4.3-percent) decrease in western Oregon and a 138-million-board-foot (22.7-percent) drop in eastern Oregon. Forest industries had the greatest decline in production of all owners; their harvest of 3.2 billion board feet was down 405 million board feet (11.1 percent). By contrast, the other private lands increased their harvest in 1967 to 598 million board feet, up 114 million board feet (23.7 percent).

The 1967 public timber harvest declined 5.7 percent with a 9.7-percent decline in western Oregon offsetting the 6.3-percent increase in eastern Oregon. The Bureau of Land Management had the greatest production decline (151 million board feet) among public agencies followed by the National Forests with an 89-million-board-foot decline. Harvest on the State's lands dropped 57 million board feet and the other public cut decreased by 21 million board feet. The timber harvest on Indian lands increased by 49 million board feet (82 percent) due to increased production on the Warm Springs Indian Reservation.

While log harvest and public stumpage prices declined, the uncut volume of public timber under contract rose from 7.6 billion board feet in 1966 to 8.1 billion board feet at yearend 1967. This 6-percent increase in available wood supply under contract follows an even larger rise of 21 percent in 1966.

In 1967, 60.4 million board feet of hardwood was harvested in Oregon with red alder accounting for 66 percent of this total.



[1]SEPARATE DATA FOR PUBLIC AND PRIVATE UNAVAILABLE PRIOR TO 1958.

OREGON TIMBER HARVEST, 1950–67

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Timber Harvest by Ownership in the State of Oregon, 1967[1]

(In thousands of board feet, Scribner log rule)

State and County	Private[2]			Bureau of Land Management[3]	National Forest[4]	Indian[5]	Other Federal[2]	State[2]	Other public[2]	Total
	Forest industry	Other	Total							
Western Oregon:										
Benton	14,025	19,617	33,642	50,201	16,700	--	--	3,783	--	104,326
Clackamas	95,788	10,635	106,423	24,577	227,400	--	--	500	--	358,900
Clatsop	208,364	6,905	215,269	--	--	--	--	28,047	688	244,004
Columbia	73,007	20,111	93,118	91	--	--	--	3,975	775	97,959
Coos	260,561	35,298	295,859	86,652	71,800	--	--	26,064	1,082	481,457
Curry	196,696	18,259	214,955	19,652	143,400	--	--	237	502	378,746
Douglas	668,449	42,563	711,012	401,998	333,100	--	--	25,358	150	1,471,618
Hood River	5,712	1,408	7,120	--	31,700	--	--	273	3,991	43,084
Jackson	150,257	3,940	154,197	96,526	180,200	--	--	--	--	430,923
Josephine	3,498	3,316	6,814	90,033	59,100	--	--	25	1,964	157,936
Lane	574,044	40,603	614,647	113,812	572,100	--	--	3,985	373	1,304,917
Lincoln	250,426	24,364	274,790	9,857	133,300	--	--	231	425	418,603
Linn	231,623	189,331	420,954	52,732	162,100	--	--	1,566	--	637,352
Marion	11,380	5,088	16,468	8,626	42,600	--	--	2,357	--	70,051
Multnomah	1,302	689	1,991	--	20,300	--	--	--	--	22,291
Polk	32,378	4,371	36,749	19,609	5,400	--	--	1,552	--	63,310
Tillamook	113,742	8,990	122,732	58,205	42,700	--	--	27,871	1,723	253,231
Washington	5,500	8,538	14,038	3,010	--	--	--	69	--	17,117
Yamhill	19,602	4,084	23,686	29,412	5,000	--	--	--	2,693	60,791
Total	2,916,354	448,110	3,364,464	1,064,993	2,046,900	--	--	125,893	14,366	6,616,616
Eastern Oregon:										
Baker	--	2,747	2,747	439	93,000	--	--	--	--	96,186
Crook	10,998	--	10,998	--	81,800	--	--	--	--	92,798
Deschutes	48,974	--	48,974	1,313	90,400	--	--	--	--	140,687
Gilliam	--	--	--	--	--	--	--	--	--	--
Grant	32,377	40,724	73,101	8,668	178,800	--	--	--	--	260,569
Harney	200	--	200	1,832	69,500	--	--	--	--	71,532
Jefferson	7,107	--	7,107	--	26,500	16,832	--	--	--	50,439
Klamath	78,848	46,466	125,314	10,260	144,800	--	--	10	--	280,384
Lake	34,282	--	34,282	2	204,200	--	--	--	--	238,484
Malheur	--	150	150	--	--	--	--	--	--	150
Morrow	14,832	12,304	27,136	--	9,800	--	--	180	--	37,116
Sherman	--	--	--	--	--	--	--	--	--	--
Umatilla	4,485	14,139	18,624	186	45,000	246	--	--	--	64,056
Union	30,551	22,226	52,777	4,355	54,700	--	--	--	--	111,832
Wallowa	48,703	7,219	55,922	256	76,200	--	--	--	--	132,378
Wasco	60	180	240	--	54,100	92,538	--	---	--	146,878
Wheeler	6,951	3,888	10,839	--	5,100	--	--	1,170	--	17,109
Total	318,368	150,043	468,411	27,311	1,133,900	109,616	--	1,360	--	1,740,598
Total Oregon	3,234,722	598,153	3,832,875	1,092,304	3,180,800	109,616	--	127,253	14,366	8,357,214

1/ Includes volume removed as logs, poles and piling, but not volume removed for woodcutting operations.

2/ Compiled by State Forester.

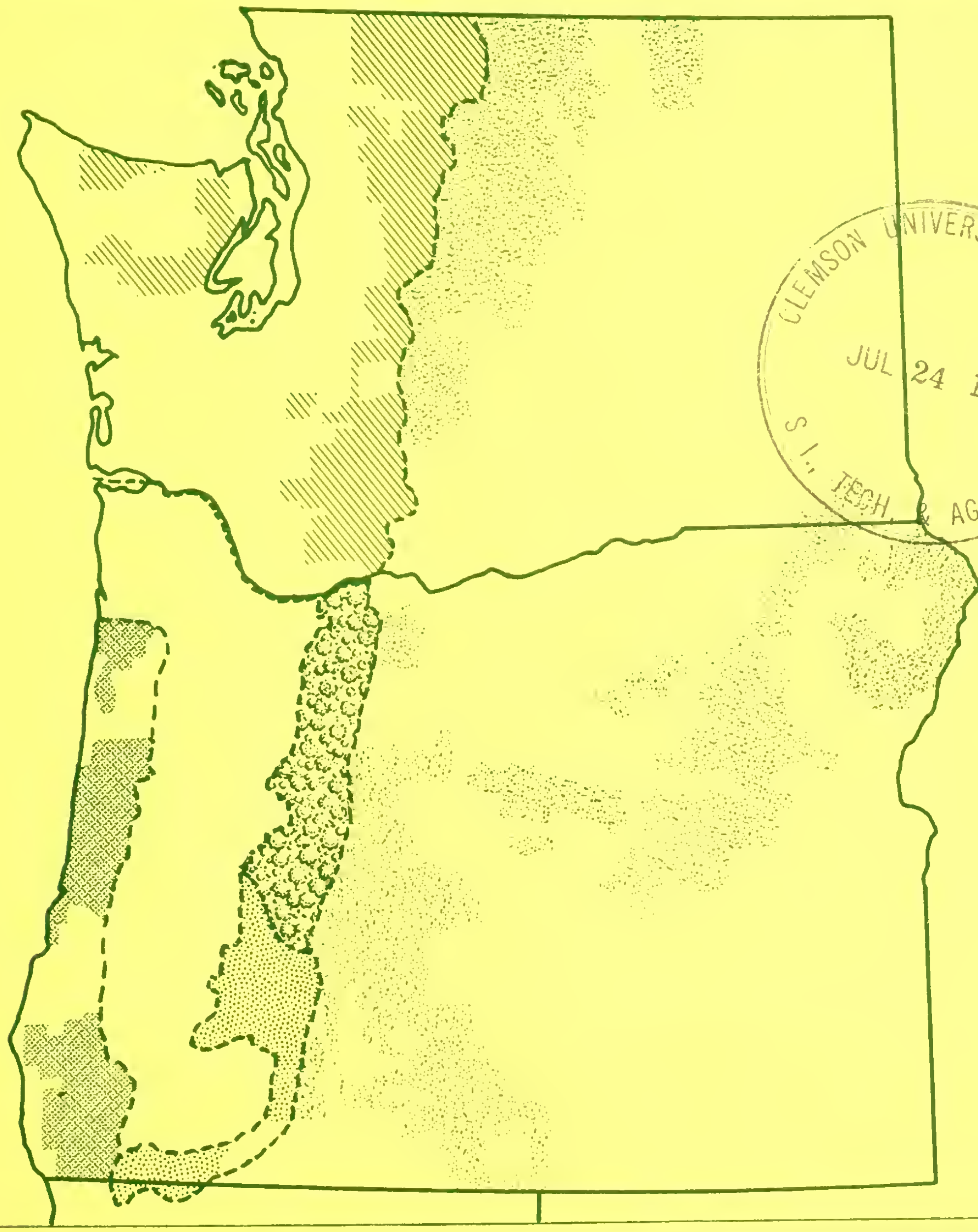
3/ Compiled by U.S. Bureau of Land Management.

4/ Compiled by U.S. Forest Service, Region 6.

5/ Compiled by U.S. Bureau of Indian Affairs.

Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oreg.

Animal Damage to Conifers on National Forests in the Pacific Northwest Region...



PACIFIC NORTHWEST FOREST & RANGE EXPERIMENT STATION
U.S. DEPARTMENT OF AGRICULTURE · FOREST SERVICE
U.S.D.A. FOREST SERVICE RESOURCE BULLETIN PNW-28 · 1969
PORTLAND, OREGON

by

Glenn L. Crouch

This study was conducted with the approval and cooperation of the Regional Forester, Pacific Northwest Region.

CONTENTS

INTRODUCTION

Animal damage to conifers is a timely topic in the Pacific Northwest. Foresters in this Region are increasingly concerned and perplexed by damage caused by animals to natural and planted seedlings and larger growing stock. Nearly every animal inhabiting forest land is believed to injure seedlings and small trees to some degree. Mice[1/] girdle small trees, and bears girdle larger ones. Pocket gophers pull seedlings down into their burrows, and elk pull them up out of the ground. Hare and rabbits clip trees near the soil surface, and mountain beaver cut them several feet up the stem.

At present, animal-conifer relationships are ill defined and poorly understood. Nevertheless, these relationships are of great importance to foresters working on areas where animals prevent individual trees and stands of trees from producing maximum crops of wood products.

This study was conducted to provide a current assessment of animal-conifer problems on National Forests in the Pacific Northwest Region. Its basic objective was to compile animal damage information available at the field level pertaining to (1) kinds of damage being incurred, (2) species of animals causing damage, (3) locations of problems, and (4) related management factors. In addition, information was sought about problem-area site conditions that might be used to develop useful animal-site relationships.

METHODS

To assemble information on the kinds of injuries and animals causing them on National Forests, we prepared and mailed questionnaires to all Ranger Districts in the Pacific Northwest Region. Each District received 10 copies of the questionnaire, and we asked that appropriate timber and wildlife management personnel prepare one copy for each of the 10 most troublesome animal-conifer problem areas on their District. A problem area was described as one clearcut, plantation, or similar definable unit, preferably less than 100 acres in size. For their answers, District personnel were instructed to consult available office records but not to undertake additional fieldwork to obtain information.

Questionnaires contained 34 questions, some of which required multiple answers. Subject matter groupings were as follows:

Category	Number of questions
Legal and administrative descriptions	5
Animal damage	5
Descriptive site factors	14
Deforestation	7
Reforestation	3

1/ Scientific names of animals are given on page 6.

We expected to receive sizable numbers of replies to 20 of the questions and that answers to the remainder would be variable, depending upon the importance of animal damage to the overall workload of individual Districts.

RESULTS

A total of 1,080 questionnaires were mailed, and 587 or 55 percent were returned as shown by the following tabulation:

Area	Number mailed	Number returned	Percent returned
West side:			
Western Washington	220	121	55
West-central Cascades	140	110	79
Southern Cascades	120	96	80
Oregon coast	100	81	81
Total	580	408	70
East side	500	179	36
Region:			
Washington	350	151	43
Oregon	730	436	60
Total	1,080	587	55

Responses were received from every District in the Region. Numbers of returned questionnaires per District varied from 10 to none. Some Districts where problems were acute expressed difficulty in selecting only 10 areas to report.

In general, responses to the basic 20 questions were adequate to permit their inclusion in an overall regional analysis. Numbers of replies to the remainder were variable as expected. Questions about site conditions on problem areas elicited the poorest responses but nevertheless, in many instances, provided usable information. For analysis, each returned questionnaire was given equal weight, regardless of the size of the problem area described or severity of damage. Percentages shown in tables and figures were derived by dividing replies in a question category by the total number of replies to that question.

As a first step in data analysis, replies were grouped according to five geographic subregions having relatively similar problems and problem area types (fig. 1). In addition; problem areas were classified according to their location east or west of the Cascade Range crest. Results summarized in table 1 show that the return rate was highest in western Oregon, intermediate in western Washington, and lowest on east-side forests. Logical interpretation of these values suggests that incidence of animal damage is higher on west-side forests, particularly in Oregon, and lower on the east side. On a statewide basis, animal problems on National Forests appear to be more important in Oregon than in Washington.

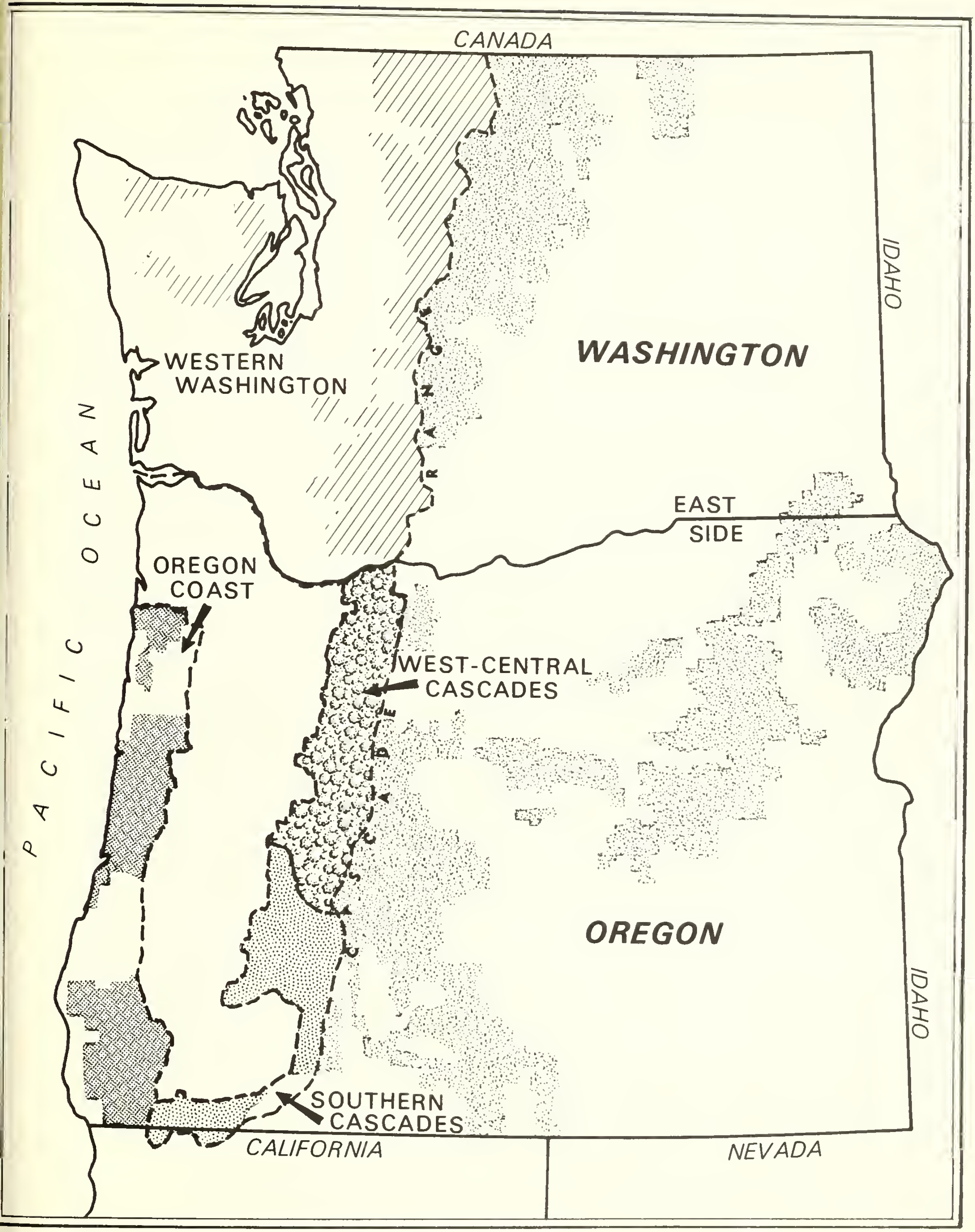


Figure 1.--Geographic distribution of subregions.

Table 1.--*Geographic distribution of replies by problem types reported*

Area	Foliage browsing	Stem barking	Root gnawing	Stem clipping	Tramp-ling	Tree loss	Other
	Percent						
West side:							
Western Washington	62	26	0	31	6	0	2
West-central Cascades	68	26	8	9	3	0	0
Southern Cascades	38	47	24	15	13	0	0
Oregon coast	91	9	0	36	10	0	1
Weighted average	64	28	19	22	7	0	1
East side	51	39	43	13	6	5	1
Region:							
Washington	56	31	5	25	7	0	1
Oregon	61	31	23	17	7	2	1
Weighted average	60	31	19	19	7	1	1

KINDS OF PROBLEMS

Problem types are shown in table 1. Browsing was the most common problem regionwide. Browsing was also the most frequently reported injury in each geographic area except the southern Cascades. The browsing category includes foliage removal by deer, elk, and livestock.

Regionally, barking was second in importance. Barking includes fraying, girdling, and bark removal by porcupine, pocket gophers, bear, mountain beaver, and other small rodents. In western Washington, bear caused most barking problems, whereas porcupine and pocket gophers were usually responsible for this damage in the remainder of the Region.

Root gnawing and stem clipping were equally important regionally. Pocket gophers are accountable for all root gnawing and also part of the stem clipping of smaller trees. Hare, rabbits, mountain beaver, porcupine, and other small rodents like ground squirrels also clip stems and branches of seedlings. Root gnawing was unreported from western Washington and Oregon coastal forests but increased in importance southward in the Cascades and was a major cause of damage on the east side. Clipping incidence was higher on western Washington and Oregon coastal forests than on other areas and appeared to be somewhat more prevalent in Washington than in Oregon.

Trampling injures small seedlings and is generally attributable to elk and domestic livestock. Reports of trampling damage were relatively uniform throughout the Region.

Tree losses reported here are usually the result of removal by pocket gophers, although severance of seedlings at or just below ground level may be caused by several animals. Reports of tree losses were low regionwide and were received only from east-side forests.

Additional kinds of damage included flooding of trees growing in lowland areas behind beaver dams and pulling up of seedlings by elk. Only two instances of each of these were reported.

SEASON OF DAMAGE

Damage while conifers were dormant exceeded that occurring during the growing season in all subregions except western Washington where growing season problems were more prevalent. Many areas sustained damage during both dormant and growing seasons.

SITE CLASS FOR DOMINANT SPECIES

Regionally, problem areas were located mostly on lands classed as sites III and IV. However, as expected, site classes were generally higher on west-side forests. More than two-thirds of west-side problem areas were reported as site III or better, whereas only one-quarter of those on the east side met this criterion. Oregon coast and west-central Cascade forests contained problem areas on highest site lands.

DEFORESTATION

The majority of all problem areas had been deforested less than 10 years with the greatest number included in the 6- to 10-year category. Results from east- and west-side forests were similar except that more areas had been deforested longer than 15 years on east-side forests. Among geographic subregions, the southern Cascades reported fewer areas deforested less than 5 years.

More than three-quarters of all problem areas were clearcut. Wildfire accounted for 15 percent and partially cut or thinned areas made up 6 percent of all reports. Over 90 percent of west-side, but less than half of east-side problem areas were clearcut. Burning was five times more frequent as the cause of deforestation on east-side compared with west-side forests where wildfire was only an incidental cause, except on western Washington forests.

Slash was burned on 95 percent of all logged problem areas.

REFORESTATION

Planting was used to reforest most problem areas. Only 6 percent of the returns reported successful regeneration from natural seed fall. Eight percent of the areas were seeded, but nearly all of these were subsequently planted or interplanted. Results were similar on east- and west-side forests. Replanting or interplanting or both was required on nearly 30 percent of the areas. The greatest amount of replanting has been necessary on Oregon coast forests and the least in western Washington and on the east side.

Douglas-fir was the leader among the many species planted on problem areas. Ponderosa pine was second, followed by true firs and other pine species. Douglas-fir was planted on almost 90 percent of west-side areas with the proportion nearing 100 percent on western Washington, west-central Cascade, and Oregon coastal forests. Ponderosa pine was planted more frequently in the southern Cascades and on east-side forests.

Many areas have been planted and replanted with several species in an effort to overcome adverse site conditions, including animals.

PROBLEM ANIMALS[2/]

The following animals were reported to be damaging trees:

Deer	*Odocoileus* spp.
Porcupine	*Erethizon dorsatum*
Gophers	*Thomomys* spp.
Snowshoe hare	*Lepus americanus*
Black-tailed jackrabbit	*Lepus californicus*
Rabbits	*Sylvilagus* spp.
Elk	*Cervus canadensis*
Cattle	*Bos* sp.
Domestic sheep	*Ovis* sp.
Domestic goats	*Capra* sp.
Horses	*Equus* sp.
Mountain beaver	*Aplodontia rufa*
Bear	*Euarctos americanus*
Voles	*Microtus* spp.
Beaver	*Castor canadensis*
Chipmunks	*Eutamias* spp.
Ground squirrels	*Citellus* spp.
Western gray squirrel	*Sciurus griseus*
Wood rats	*Neotoma* spp.

Many animals were listed only once but, nevertheless, the length of the list illustrates the complexity of the animal damage problem. Results presented in table 2 give a good indication of the relative distribution of major injurious animals and a general picture of areas where particular species are causing or are likely to cause problems.

Thirty-five percent of all returns listed two or more animals causing problems on the same area. Further analysis disclosed the following distribution of multiple animal problems: two animals, 26 percent; three animals, 6 percent; four animals, 2 percent; and six animals, 1 percent of the total number of replies.

2/ Common and scientific names are those used by Ingles, L. G. Mammals of the Pacific States. Stanford Univ. Press. Stanford, Calif. 506 pp. 1965.

Deer

Based on numbers of replies, deer were the most troublesome animals on National Forests in the Pacific Northwest (table 2). Deer problems were consistently high throughout the region and were approached in frequency of reports only by porcupine in the southern Cascades and gophers on east-side forests. Deer problems were particularly important in the west-central Cascades and coastal forests in Oregon.

Deer browsed trees during both dormant and growing seasons (table 3). Winter use predominated on southern Cascade and east-side forests, whereas browsing occurred more often during the growing season in western Washington and coastal Oregon. Browsing during both seasons was prevalent in the west-central Cascades.

Twenty-two percent of the deer problem areas were classified as site I or II. All were on west-side forests. Forty percent were site III; 31 percent, site IV; and the remainder, site V. Nearly three-fourths of the west-side units were site III or better, whereas the same proportion of east-side units were site IV or poorer.

Regionally, about one-third of the deer problem areas had been deforested from 1 to 5 years, 44 percent from 6 to 10 years, and 25 percent longer than 10 years. Over 80 percent of the west-side and half of the east-side areas were deforested from 3 to 10 years. More than 80 percent of the deer problem areas were clearcut; 5 percent, partially cut; and the remaining 13 percent, burned by wildfire. Virtually all west-side but only one-third of the east-side areas had been clearcut. However, 46 percent of the east-side areas were on burns, and these combined with the clearcut areas totaled 81 percent of all east-side areas that were essentially nontimbered.

Table 2.--*Geographic distribution of replies by problem animals reported*

Area	Deer	Porcupines	Gophers	Hare and rabbits	Elk	Livestock	Small rodents	Mountain beaver	Bear
	Percent								
West side:									
Western Washington	55	12	0	17	17	0	3	11	17
West-central Cascades	69	17	8	8	6	0	1	2	2
Southern Cascades	39	38	28	7	9	20	3	6	0
Oregon coast	88	1	0	27	24	21	6	16	0
Weighted average	61	17	9	14	13	9	3	9	5
East side	46	25	43	14	12	17	13	1	1
Region:									
Washington	50	15	7	15	15	4	5	9	14
Oregon	59	21	23	14	12	14	6	5	1
Weighted average	57	19	19	14	13	11	6	6	4

Table 3.--*Replies to selected questions classified according to animals reported*

Category	Deer	Porcupines	Gophers	Hare and rabbits	Elk	Livestock	Small rodents	Mountain beaver	Bear
	Percent[1]								
Season of damage:									
Dormant	61	82	78	82	64	0	74	83	19
Growing	67	38	42	38	38	100	26	27	91
Site classes:									
I	3	0	0	5	4	5	3	3	0
II	19	10	3	18	10	18	10	39	0
III	40	41	25	39	54	22	24	42	50
IV	30	39	65	31	25	40	50	16	27
V	8	10	7	7	7	15	13	0	23
Years deforested:									
1-5	31	8	17	19	35	34	15	9	0
6-10	44	26	46	38	48	33	35	17	0
11-15	14	31	16	19	13	22	26	21	0
16-25	4	20	8	7	4	2	6	3	25
26-50	7	14	10	16	0	7	18	50	63
50+	0	1	3	1	0	2	0	0	12
Deforestation cause:									
Clearcut	82	72	75	71	78	74	60	88	47
Partial cut	5	9	6	4	12	7	14	0	6
Wildfire	13	19	19	25	10	19	26	12	47
Reforestation methods:									
Natural seeding	2	13	0	5	1	0	5	6	33
Artificial seeding	11	7	9	7	13	15	18	9	6
Planting	98	87	99	95	97	99	92	94	61
Replanting or interplanting	34	31	45	43	37	43	37	53	0
Species planted:									
Douglas-fir	75	39	26	65	71	59	23	94	100
Ponderosa pine	31	71	87	41	32	59	80	12	0
Others	11	10	27	15	11	14	11	15	0

[1] Percentages are of replies reporting the particular category.

Ninety-eight percent of all deer problem areas were planted at least once, and 34 percent of the total were replanted or interplanted. Eleven percent were seeded, but nearly all of these were subsequently planted or interplanted. Only 2 percent of the units were successfully restocked by natural seed fall. Replanting or interplanting was required more often on Oregon than on Washington forests.

Douglas-fir was planted on three-fourths of all deer problem areas, ponderosa pine on 31 percent, true firs on 5 percent, and other species on 6 percent of the planted areas (table 3). Ninety-six percent of west-side and 9 percent of east-side units were planted with Douglas-fir. Ninety-four percent of east-side and 11 percent of west-side areas were planted with ponderosa pine.

Porcupines

Regionally, porcupines and gophers ranked second to deer. Of the two, porcupine damage was more widespread, since reports were received from all geographic subregions (table 2). The highest proportion of porcupine problem areas was reported from southern Cascade forests and the lowest from the Oregon coast region. A surprisingly large number of porcupine reports were received from west-side forests. It is difficult to assess the importance of porcupine problems from our survey, because damage is usually spotty over wide areas which, to some extent, nullifies evaluations on the basis of cutting units or sale areas of 100 acres or less.

Dormant season damage was reported from more than 80 percent of all porcupine problem areas while growing season injuries took place on 38 percent (table 3). Nearly 90 percent of west-side and 70 percent of east-side reports listed damage during the dormant season. On the other hand, growing season injuries occurred on 65 percent of east-side but only 25 percent of west-side areas.

About one-half of all porcupine problem areas were site III or better. Three-quarters of the west-side units were site II or III, and the same proportion was site IV or V on east-side forests.

Regionally, one-third of the replies involved areas which were deforested or thinned less than 10 years. One-half were deforested from 10 to 25 years, and the remainder had been logged or burned longer than 25 years.

Nearly three-quarters of the areas damaged by porcupines were clearcut; 9 percent, partially cut or thinned; and the remaining 19 percent were burned by wildfire. Over 90 percent of west-side and 38 percent of east-side units were clearcut. Burns deforested 46 percent of east-side but only 4 percent of west-side problem areas.

Eighty-seven percent of all porcupine problem areas were planted, and 31 percent were replanted or interplanted. Thirteen percent were restocked naturally, and 7 percent were seeded. Ponderosa pine was the species used on nearly three-fourths of the planted areas (table 3). Douglas-fir was planted on 57 percent of west-side and 6 percent of east-side forests, whereas ponderosa pine was planted on 97 percent of east-side and 57 percent of west-side problem areas.

Gophers

Intensified field observations in recent years have revealed that pocket gophers are much more injurious to conifers than previously realized. In addition, as a result of better identification techniques, we suspect that gophers are responsible for many of the injuries and losses previously attributed to porcupine.

Seasonally, gopher damage was reported on more than three-fourths of all problem areas when the conifers were dormant and on 42 percent when they were growing (table 3). Dormant season damage was similar in extent on east- and west-side forests, but growing season problems were reported more often (46 percent) on east-side than on west-side (32 percent) problem areas.

Almost 75 percent of all areas damaged by gophers were site IV or V; 25 percent, site III; and the remaining 3 percent, site II. There was little difference between east- and west-side forests.

Nearly two-thirds of the gopher problem areas had been deforested less than 10 years. No west-side units were deforested less than 5 years, half were logged or burned over from 6 to 10 years, and the remainder longer than 15 years. One-quarter of the east-side areas were cut or burned less than 5 years, nearly two-thirds had been deforested 6 to 15 years, and the remaining 14 percent longer than 15 years.

Three-quarters of the gopher problem areas were clearcut--89 percent on west-side and 69 percent on east-side forests. Nineteen percent were burns--22 percent of the east-side and 11 percent of the west-side units.

Nearly all pocket gopher problem areas were planted. None were reforested from natural seed fall. Nine percent were seeded, but virtually all of these were also planted. Results were similar regionally, except that more west-side areas have been replanted.

Ponderosa pine (87 percent) has been planted on more gopher problem areas than any other species (table 3). Douglas-fir was planted on one-quarter of the areas and other species on 27 percent. Douglas-fir (52 percent) and other species (55 percent) were planted more frequently on west-side areas but on only 15 percent of east-side plantations. A total of 13 species other than ponderosa pine and Douglas-fir have been planted. Mixed-species plantings were mostly on southern Cascade and east-side forests.

Hare and Rabbits

Hare and rabbit problems were reported from all subregions with Oregon coast forests having the highest frequency. West-central and southern Cascade forests reported the fewest areas (table 2). Incidence of problems caused by these animals was similar in Oregon and Washington and on east- and west-side forests.

More than 80 percent of the hare and rabbit problem areas sustained dormant season clipping (table 3). Thirty-eight percent received clipping while conifers were growing. Dormant season clipping was reported on 93 percent of east-side and 79 percent of west-side areas. One-quarter of west-side but only 7 percent of east-side areas had growing season problems.

Almost one-quarter of the areas were located on sites I or II, and 70 percent were sites III or IV. All site I and II units were on west-side forests, whereas 83 percent of east-side areas were sites IV or V.

Regionally, 57 percent of all areas damaged by hare and rabbits had been deforested less than 10 years, 26 percent from 11 to 25 years, and the remainder more than 25 years. On the west side, 84 percent had been logged or burned less than 15 years, whereas 54 percent of east-side areas were in this category.

Almost three-quarters of all hare and rabbit problem areas were clearcut. Eighty-seven percent of west-side but only 36 percent of east-side units were clearcut. Burns deforested 56 percent of east-side and 11 percent of west-side areas.

Five percent of the areas were reforested by natural seed fall, and 7 percent were seeded. However, 95 percent were planted or interplanted, including all seeded units. Over 40 percent of the areas required replanting or interplanting.

Douglas-fir was planted on two-thirds, ponderosa pine on 41 percent, and other species on 15 percent of all planted sites (table 3). All east-side and 16 percent of west-side problem areas were planted with ponderosa pine. Over 90 percent of west-side but no east-side areas were planted with Douglas-fir.

Elk

Reports of elk problems closely paralleled those of hare and rabbits with Oregon coast forests having the highest proportion of returns (table 2). Fewest reports were received from the west-central Cascade subregion. East- and west-side forests reported similar percentages of elk problems.

Dormant season injuries were reported on 64 percent of all elk problem areas (table 3). Almost three-quarters of west-side and one-third of east-side areas sustained elk browsing at that time. Growing season damage was reported on two-thirds of east-side and 29 percent of west-side units.

Fifty-four percent of all elk problem areas were site III. Fourteen percent, all on west-side forests, were sites I or II. Almost 80 percent of the areas were sites III or IV on both east- and west-side forests.

All elk problem areas had been deforested less than 25 years with the majority (83 percent) in the 1- to 10-year class. Reports from east- and west-side forests were similar.

More than three-quarters of all areas were clearcut--91 percent on west-side and 37 percent on east-side forests. Forty-two percent of east-side and only 2 percent of west-side elk problem areas were partially cut. The remaining 21 percent of east-side and 7 percent of west-side areas were deforested by wildfire.

Natural regeneration was successful on only 1 percent of the elk problem areas. Thirteen percent were seeded, but 97 percent of elk problem areas were subsequently planted, and 37 percent of these were replanted or interplanted.

Douglas-fir was planted on nearly three-quarters of elk problem areas--94 percent of west-side and 10 percent of east-side units. All east-side and 6 percent of west-side areas were planted with ponderosa pine. Other species were planted on 11 percent of the units on both sides of the Cascades.

Livestock

Livestock problems were reported only from Oregon and eastern Washington forests, and, interestingly, reports from the Oregon coast forests were more frequent than those from the east-side "cow country" (table 2). Regionally, east-side forests had about twice the proportion of livestock problem areas as west-side forests.

All livestock problems occurred during the growing season, which might be expected since legal livestock use of National Forests is usually limited to summer range permittees.

Nearly one-quarter of the areas damaged by livestock were classified site I or II. All of these were on west-side forests. Regionally, 62 percent were sites III or IV. All east-side areas were site III or poorer.

Almost 90 percent of the areas had been deforested less than 15 years with the majority (67 percent) less than 10 years. Results were similar on east- and west-side forests, except that more sites were deforested more recently on west-side forests.

Nearly three-quarters of all livestock problem areas were clearcut, 7 percent were partially cut, and 19 percent were burned by wildfire. Almost 90 percent of west-side and 56 percent of east-side areas were clearcut. One-third of east-side but only 8 percent of west-side sites were burns.

Ninety-nine percent of the areas damaged by livestock were planted, and 43 percent were replanted or interplanted. Fifteen percent were seeded, but virtually all of these required planting or interplanting. Results regionwide were similar except that 53 percent of west-side but only 15 percent of east-side areas needed replanting or interplanting.

Regionally, Douglas-fir and ponderosa pine were planted on the same percentage of livestock problem areas (table 3). However, Douglas-fir was planted on 86 percent of west-side and only 21 percent of east-side areas. On the other hand, ponderosa pine was planted on 86 percent of east-side and 36 percent of west-side areas.

Small Rodents, Mountain Beaver, Bear

Desriptive details of small rodent, mountain beaver, and bear problems and problem areas are shown in tables 2 and 3. Further interpretation of the data is not made because relatively few replies were received for these animals.

DISCUSSION

Although there was a tendency to completely dissect the mass of data that was received, the rather obvious opportunity for bias here, as in many surveys, effectively ruled out blanket interpretations. On the other hand, the widespread, consistent occurrence and magnitude of answers to certain questions did allow discussions of these facets with minimal chances for error.

Strong evidence indicates that trees in many areas are exposed to animal injuries from seedling through pole or larger size classes. During postlogging stand development on a west-side Washington clearcut, planted Douglas-firs may be subjected to injuries by small rodents, mountain beaver, snowshoe hare, deer, elk, and bear. In eastern Oregon, ponderosa pines might be damaged by jackrabbits, gophers, deer, elk, livestock, and porcupine before reaching maturity.

On a given area, damage to the same size-class of tree by more than one animal species may greatly complicate control efforts. A good example was the often reported occurrence of injuries from big game and snowshoe hare, where poisoning to alleviate hare damage could expose the game animals to similar poisoning hazards.

Although a relatively large number of problem animals was reported, it is probably safe to suggest that nearly every animal inhabiting forest land has inherent potential for injuring conifers. The main reason all possible animal species do not appear in these results might be that field foresters have not yet detected economic losses attributable to them.

Damage to trees occurred during all seasons of the year. On a given area, the same animals can be injurious year around, or one species may cause injuries during one season, and a second or third species at other times. One species or subspecies of animal may damage trees in different seasons in different locations. Deer reportedly browsed conifers mainly during the winter on some Oregon coastal areas, in the growing season in the southern Cascades, and during both periods in the central Cascades of Oregon. Most species, whose members have limited ranges like mountain beaver, pocket gophers, and snowshoe hare, exhibited similar seasonal use patterns in all of those subregions where they caused damage.

Nearly all species except deer, livestock, and bear injured conifers primarily during the dormant season. This seems to support the generally accepted assumption that many animals feed on conifers when kinds and quantities of other plants, especially green plants, are relatively limited.

Among management practices, clearcutting was a consistent precursor of animal problems throughout the Region. Wildfire, which often produces similar environmental conditions, particularly after salvage logging, was also closely tied to animal problems. Methods to control wildfire are developing slowly, and it appears that exploration of harvesting methods other than clearcutting may hold a key to prevention of a large share of potential animal problems.

In conclusion, we believe that results of the study represent a reasonably accurate, up-to-date picture of animal damage problems on National Forests in the Pacific Northwest. Effects of damage on forest-land productivity and resulting economic losses have not been evaluated because the information needed to make these evaluations is not now available.

According to the Timber Management Division, Pacific Northwest Region, about 25 percent of all reforestation work must be redone (Harold A. Dahl, personal communication). Animal damage makes necessary much of this costly supplementary work.

The magnitude of re-treatment costs, plus additional unsurveyed mortality and productivity losses, demands that foresters make accurate assessments of animal-caused losses and, where economically necessary, use all available means for controlling problem animals. In addition, research must be accelerated to evaluate effects of observed animal injuries and to devise more effective methods for alleviating and preventing damage.

Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The Station's mission is to provide the scientific knowledge, technology, and alternatives for management, use, and protection of forest, range, and related environments for present and future generations. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, Hawaii, the Western States, or the Nation. Project headquarters are at:

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La Grande, Oregon	Wenatchee, Washington

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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U.S.D.A. Forest Service
Resource Bulletin PNW-30

July 1969

1968 WASHINGTON TIMBER HARVEST

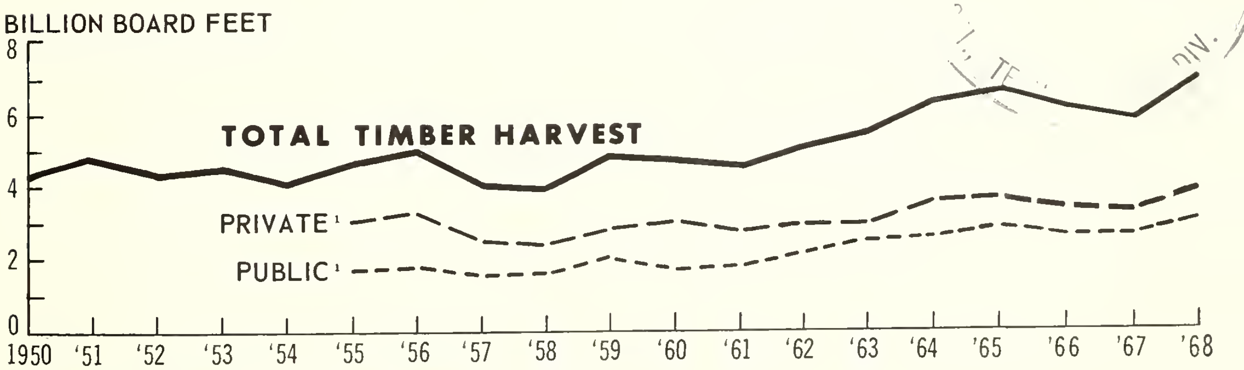
by
Brian R. Wall, *Associate Economist*

Washington's 1968 timber harvest of 6.97 billion board feet was the largest since 1929 when a record 7.38 billion board feet was produced. Private harvests increased 16.5 percent in western Washington and 15.7 percent in eastern Washington for an average increase of 16.5 percent, 45.5 million board feet above the private harvest in 1967. Forest industries in Washington increased their log production by 538.3 million board feet (20.9 percent) and other private owners increased their production by 7.2 million board feet (1.0 percent).

Public agencies' harvests increased 22.9 percent in western Washington and 9.0 percent in eastern Washington for a total public increase of 489.1 million board feet (18.6 percent) in 1968. State lands had the largest production increase of 213.8 million board feet (up 45.8 percent), followed by the National Forests' increase of 195.4 million board feet (12.2 percent), and an increase of 63.7 million board feet (up 13.7 percent) from Indian lands. Other Federal agencies more than doubled their harvest with a 22.4-million-board-foot increase, and the Bureau of Land Management increased its harvest by 640,000 board feet in 1968. The "Other public" 1968 timber harvest dropped 6.8 million board feet (9.8 percent) below the 1967 figure.

The 17.4-percent rise in total 1968 harvest above the 1967 figure was accompanied by public stumpage price increases of 48.7 percent in western Washington and 59.1 percent in eastern Washington. Total public stumpage sold increased 13 percent in 1968, and the volume of public uncut timber under contract declined 5.8 percent.

In 1968, Douglas-fir was the leading species, accounting for 38.2 percent (2.7 billion board feet) of the timber harvest. Western hemlock production represented 31.3 percent (2.2 billion board feet) of the Washington total. The hardwood harvest totaled 149.7 million board feet in 1968 with red alder accounting for 86.2 percent of this total.



[1] Separate data for public and private not available prior to 1955.

WASHINGTON TIMBER HARVEST 1950–68

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director
Portland, Oregon

FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Timber Harvest by Ownership in State of Washington, 1968[1]

(In thousands of board feet, Scribner log rule)

State and county	Private[2]: Industrial Live	Industrial Dead[3]	Other Live	Other Dead[3]	Total private Live	Total private Dead[3]	State[2] Live	State[2] Dead[3]	Bureau of Land Management[4] Live	Bureau of Land Management[4] Dead[3]	National Forests[4] Live	National Forests[4] Dead[3]	Indian lands[4] Live	Indian lands[4] Dead[3]	Other public[2] Live	Other public[2] Dead[3]	Other Federal[2/5] Live	Other Federal[2/5] Dead[3]	Total production
Western Washington:																			
Clallam	170,485	15	28,826	20	199,311	35	75,646	3,787	--	--	88,643	5,847	13,754	871	--	--	--	--	387,894
Clark	15,788	--	10,791	--	26,579	--	4,544	240	--	--	--	--	--	--	--	--	--	--	31,363
Cowlitz	492,677	--	25,436	30	518,113	30	87,428	214	--	--	13,548	1,245	--	--	530	--	--	--	621,108
Grays Harbor	195,439	10	91,740	96	287,179	106	9,634	96	--	--	100,996	7,278	195,521	6,254	15,408	251	--	--	622,723
Island	3,249	--	6,712	8	9,961	8	474	83	--	--	--	--	--	--	--	--	265	--	10,791
Jefferson	115,656	235	42,175	30	157,831	265	199,797	2,658	--	--	41,221	21,545	8	--	165	--	1,660	70	425,220
King	202,935	--	49,274	240	252,209	240	16,965	16	--	--	41,675	1,920	--	--	35,480	--	--	--	348,508
Kitsap	2,115	--	17,588	--	19,703	--	945	--	--	--	--	--	--	--	473	--	570	--	21,691
Lewis	592,026	--	65,205	116	657,231	116	26,205	2	--	--	157,511	8,027	--	--	--	--	4,860	--	853,952
Mason	49,258	--	23,972	20	73,230	20	9,115	6	--	--	85,089	795	--	--	2,454	--	2,154	--	172,863
Pacific	533,896	250	11,960	175	545,856	425	23,615	72	--	--	--	--	--	--	--	--	3,872	--	573,840
Pierce	234,502	--	43,584	3	278,086	3	10,110	35	--	--	30,675	11,041	--	--	2,764	--	23,453	116	356,283
San Juan	590	--	2,836	--	3,426	--	--	--	--	--	--	--	--	--	--	--	--	--	3,426
Skagit	124,958	46	13,155	812	138,113	858	27,041	174	--	--	70,742	7,317	--	--	1,509	--	--	--	245,754
Skamania	4,808	325	58,609	28	63,417	353	17,872	259	--	--	437,084	30,257	--	--	--	--	--	--	549,242
Snohomish	47,748	539	38,508	133	86,256	672	22,191	18	--	--	94,701	16,412	--	--	814	--	344	--	221,408
Thurston	48,403	--	30,857	--	79,260	--	12,661	20	--	--	--	--	--	--	2,365	--	1,149	--	95,455
Wahkiakum	89,380	--	10,407	20	99,787	20	6,312	183	--	--	--	--	--	--	--	--	--	--	106,302
Whatcom	56,286	--	10,624	--	66,910	--	30,239	--	--	--	40,216	8,488	--	--	212	--	--	--	146,065
Total	2,980,199	1,420	582,259	1,731	3,562,458	3,151	580,797	7,863	--	--	1,202,101	120,172	209,283	7,125	62,174	251	38,327	186	
Total live and dead	2,981,619		583,990		3,565,609		588,660		--		1,322,273		216,408		62,425		38,513		5,793,888
Eastern Washington:																			
Adams	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Asotin	--	--	1,783	--	1,783	--	--	--	--	--	4,645	173	--	--	--	--	--	--	6,601
Benton	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chelan	10,074	--	2,705	--	12,779	--	--	--	--	--	70,249	2,470	--	--	--	--	--	--	85,498
Columbia	160	--	2,410	--	2,570	--	--	--	--	--	10,450	481	--	--	--	--	--	--	13,501
Douglas	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ferry	15,972	--	10,107	--	26,079	--	9,050	--	591	--	34,981	--	107,569	2,439	--	--	--	--	180,709
Franklin	--	--	781	--	781	--	--	--	--	--	--	--	--	--	--	--	--	--	781
Garfield	--	--	--	--	--	--	--	--	--	--	7,479	159	--	--	--	--	--	--	7,638
Grant	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Kittitas	16,521	--	43,902	--	60,423	--	6,824	--	--	--	72,287	1,109	--	--	--	--	--	--	140,643
Klickitat	56,810	--	7,128	73	63,938	73	14,773	147	--	--	425	67	1,585	--	--	--	700	--	81,708
Lincoln	--	--	514	--	514	--	17	--	--	--	--	--	--	--	--	--	--	--	531
Okanogan	2,373	--	6,393	--	8,766	--	21,711	--	1,532	--	118,386	3,203	34,135	--	--	--	--	--	187,733
Pend Oreille	7,576	--	13,968	--	21,544	--	2,122	--	--	--	65,831	342	628	--	--	--	--	--	90,467
Spokane	--	--	12,677	--	12,677	--	1,292	--	--	--	--	--	--	--	282	--	272	--	14,523
Stevens	13,277	--	36,549	--	49,826	--	20,867	--	1,921	--	26,115	--	14,342	--	--	--	3,081	--	116,152
Walla Walla	--	--	7,436	--	7,436	--	--	--	--	--	--	--	--	--	--	--	--	--	7,436
Whitman	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Yakima	11,339	--	9,922	--	21,261	--	15,391	--	--	--	52,545	946	149,561	3,063	--	--	--	--	242,967
Total	134,102	--	156,275	73	290,377	73	92,047	147	4,044	--	463,693	8,850	307,820	5,502	282	--	4,053	--	
Total live and dead	134,102		156,348		290,450		92,194		4,044		472,543		313,322		282		4,053		1,176,888
Total Washington	3,114,301	1,420	738,534	1,804	3,852,835	3,224	672,844	8,010	4,044	--	1,665,794	129,022	517,103	12,627	62,456	251	42,380	186	
Total Washington live and dead	3,115,721		740,338		3,856,059		680,854		4,044		1,794,816		529,730		62,707		42,566		6,970,776

1/ Includes volume in logs, poles, piling, shingle bolts, etc.
2/ Compiled by the Department of Natural Resources.
3/ Includes snags and down material existing prior to initial logging.
4/ Compiled by respective agencies, U.S. Bureau of Land Management, U.S. Forest Service, U.S. Bureau of Indian Affairs.
5/ Includes lands logged under jurisdiction of Bonneville Power Administration, National Parks, U.S. Army and U.S. Fish and Wildlife Service.

Prepared by Forest Survey Project, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.