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VOLUME DISTRIBUTION IN SAW-TIMBER TYPES IN THE PONDEROSA PINE REGION

FROM FOREST SURVEY

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION

U.S. COURT HOUSE PORTLAND, OREGON

Publication of the

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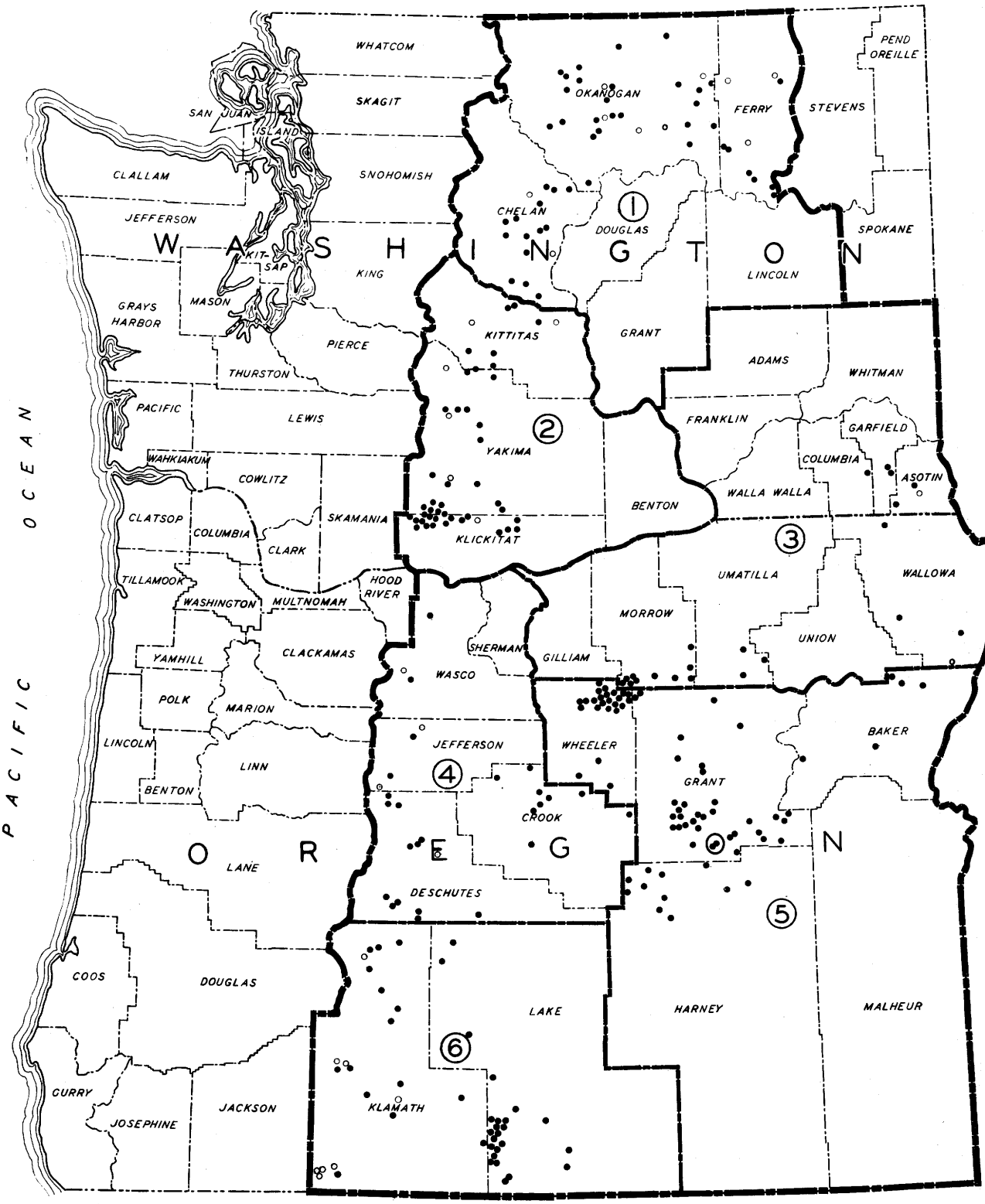
NOTE: Assistance in the compilation of data contained in this report was furnished by personnel of Works Progress Administration official project 701-3-23.

FIGURE 1. LOCATION OF FOREST SURVEY UNITS AND SAMPLE PLOTS IN THE PONDEROSA PINE REGION



1. CHELAN - COLVILLE UNIT
2. YAKIMA RIVER UNIT
3. NORTH BLUE MOUNTAIN UNIT
4. DESCHUTES RIVER UNIT
5. SOUTH BLUE MOUNTAIN UNIT
6. KLAMATH PLATEAU UNIT

• PONDEROSA PINE TYPES 20 AND 20.5

○ OTHER PONDEROSA PINE TYPES

FOREWORD

The forest survey, a Nation-wide project authorized by Congress in 1928, consists of a complete and detailed investigation of the country's present and future forest resources in five major parts: (1) an inventory of the country's existing forest resources in terms of areas occupied by forest-cover types and of timber volumes, by species, in board feet and cubic feet, and a study of conditions on cut-over and on burned forest lands; (2) a study of the depletion of the forests through cutting and through loss from fire, insects, disease, and other causes; (3) a determination of the current and potential growth on forest areas; (4) an investigation of present and prospective requirements of the United States for forest products; and (5) an analysis and correlation with other economic data of the findings of these studies in order to make available to public and private agencies the basic facts and guiding principles necessary to formulate and execute rational plans, national, regional, and local, for orderly, sound management and use of forest resources.

The Pacific Northwest Forest and Range Experiment Station was designated to conduct the forest survey of Oregon and Washington. Field work was commenced in the Douglas fir region of western Oregon and western Washington in 1930 and completed in 1933. In 1934 field work was commenced in eastern Oregon and eastern Washington and completed late in 1936. Previous publications on the survey by this station include forest statistics for each of the forested counties in Oregon and Washington except Stevens, Pend Oreille, and Spokane Counties, Washington; Forest Research Notes No. 13, Forest Resources of the Douglas Fir Region, No. 17, Pulpwood Resources of Western Oregon and Western Washington, No. 20, Forest Growth in the Douglas Fir Region, No. 22, Timber Volume and Type Acreage on the National Forests of the North Pacific Region, and No. 25, Forest Statistics for Eastern Oregon and Eastern Washington. In addition, lithographed $\frac{1}{4}$-inch-to-the-mile maps showing in colors the principal forest cover types for all of Oregon and Washington and 1-inch-to-the-mile detailed type maps for each forested county have been prepared. Spokane, Stevens, and Pend Oreille Counties in northeastern Washington are in the territory assigned to the Northern Rocky Mountain Forest and Range Experiment Station, Missoula, Montana, and the forest inventory of these counties, including publication of county reports, was made by the survey staff of that station.

VOLUME DISTRIBUTION IN SAW-TIMBER TYPES OF THE PONDEROSA PINE REGION

Contents

VOLUME DISTRIBUTION IN SAW-TIMBER TYPES OF THE PONDEROSA PINE REGION[1]

By P. A. Briegleb and E. G. Dunford[2]

Introduction

One of the principal objectives of the forest survey is the determination of the amount and character of remaining saw-timber supplies. Previous publications of this station give the saw-timber volume by species and ownership class. As a result of field work done in connection with the growth phase of the survey and further analysis of the field records of the inventory phase it was possible to compile and analyze supplemental information concerning the region's saw-timber stands, particularly ponderosa pine stands. This report presents the results of that study.[3]

The saw-timber types in the region occupy a total area of approximately 13.5 million acres and contain a saw-timber volume of 127 billion board feet. Saw-timber volume is given for this region in table 1 by forest-survey unit and ownership class. The ponderosa pine saw-timber types, those containing 20 percent or more by volume of ponderosa pine, cover 10.4 million acres. In this region ponderosa pine alone represents 64 percent of the total saw-timber volume or approximately 81.5 billion board feet. Virtually all the sawlogs produced are derived from logging ponderosa pine types and more than 90 percent of the regional total sawlog production is ponderosa pine. Obviously, the pine types are of primary importance in planning wise and effective use of this region's forest resources and far sighted, intelligent study must be given them in preparing forest management plans. The specific objective of this report therefore is to analyze the structure of the important saw-timber types and thus furnish information that will assist in formulating plans for the intelligent

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1/ All that portion of Oregon and Washington east of the summit of the Cascade Range including Klickitat County, Washington, but excluding Hood River and Jackson Counties, Oregon, and Spokane, Stevens, and Pend Oreille Counties, Washington. The last three named counties are in the territory assigned to the Northern Rocky Mountain Forest and Range Experiment Station.

2/ The collection of field data and preliminary computations were supervised by C. H. Willison.

3/ County reports for Spokane, Stevens, and Pend Oreille Counties, Washington, published by the Northern Rocky Mountain Forest and Range Experiment Station include a complete and detailed analysis of saw-timber volume in these counties.

TABLE I.—VOLUME OF SAW TIMBER[1] BY FOREST-SURVEY UNIT AND OWNERSHIP CLASS

MILLION BOARD FEET, LOG SCALE, SCRIBNER RULE

FOREST-SURVEY UNIT	PRIVATE		INDIAN		NATIONAL FOREST				OTHER PUBLIC				TOTAL	
					AVAILABLE FOR CUTTING		RESERVED FROM CUTTING		AVAILABLE FOR CUTTING		RESERVED FROM CUTTING			
	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES
EASTERN WASHINGTON[2]														
CHELAN-COLVILLE	1,247.9	2,194.7	2,619.7	3,997.1	3,456.5	9,839.6	8.4	1,246.0	875.3	2,009.4			8,207.8	19,286.8
YAKIMA RIVER	2,581.7	6,165.6	2,658.1	4,007.6	1,093.8	6,208.4	98.3	585.3	1,021.0	2,113.2	.1	.1	7,453.0	19,080.2
NORTH BLUE MOUNTAIN	154.3	263.8			228.4	758.1	.4	.8	11.6	23.6			394.7	1,046.3
TOTAL	3,983.9	8,624.1	5,277.8	8,004.7	4,778.7	16,806.1	107.1	1,832.1	1,907.9	4,146.2	.1	.1	16,055.5	39,413.3
EASTERN OREGON														
NORTH BLUE MOUNTAIN	2,702.1	4,177.8	62.3	98.7	3,067.4	7,214.2	11.8	83.1	160.0	265.8	.1	5.2	6,003.7	11,844.8
DESCHUTES RIVER	5,370.2	5,811.2	2,246.8	3,026.3	7,247.4	11,310.6	83.5	194.4	271.3	287.2	6.8	15.6	15,226.0	20,645.3
SOUTH BLUE MOUNTAIN	5,107.3	5,801.9			11,622.1	15,238.2	24.1	35.6	566.7	614.1	.8	1.2	17,321.0	21,691.0
KLAMATH PLATEAU	10,050.9	12,247.6	7,361.1	7,928.3	8,902.9	11,668.0	53.3	447.1	347.6	604.0	168.5	603.8	26,884.3	33,498.8
TOTAL	23,230.5	28,038.5	9,670.2	11,053.3	30,839.8	45,431.0	172.7	760.2	1,345.6	1,771.1	176.2	625.8	65,435.0	87,679.9
REGION TOTAL	27,214.4	36,662.6	14,948.0	19,058.0	35,618.5	62,237.1	279.8	2,592.3	3,253.5	5,917.3	176.3	625.9	81,490.5	127,093.2

1/ TREES 12 INCHES AND MORE IN D.B.H.

2/ EXCLUSIVE OF SPOKANE UNIT (SPOKANE, STEVENS, AND PEND OREILLE COUNTIES, WASHINGTON).

management of the region's forest resources. This report will include (1) an analysis of the various saw-timber types showing the average stand per acre by geographic unit, (2) analysis of volume distribution by diameter class in the important old-growth ponderosa pine types, and (3) volume in residual stands on selectively cut-over areas.

Investigations of the economics of ponderosa pine management recently made by Brandstrom[4/] have shown the advantages of a lighter initial cut in the characteristic uneven-aged virgin ponderosa pine forests of this region. As a result of these studies the so-called "maturity selection system" has been formulated. The essence of this system is the removal of the economically and silviculturally most mature trees, usually the older and larger trees which are of good value, but have ceased to make much volume and value increment. Application of the maturity selection system results in an average initial cut of from about 25 percent to 50 percent of the original stand volume. The data presented in this report which dissects the pine saw-timber inventory information should assist in analyzing the implications of the maturity selection system for large areas such as forest-survey units. Application of this system to an operating forest property, however, demands a detailed forest inventory including an intensive cruise by size and quality class, and topographic and type maps of the area under consideration.

The region has been divided into six forest-survey units based on geographic and economic considerations as shown in figure 1. The information on volume per acre of the various types was obtained from the original inventory data. The information on distribution of stand volume by diameter class and by tree class group was compiled from measurements on 277 sample plots scattered throughout the region, aggregating a total sample area of 3,855 acres and 241 miles of strip surveys. Two hundred and forty-seven plots were taken in types 20 and 20.5; the remainder were taken in other pine saw-timber types. The location of these sample areas is shown in figure 1.

Volume Per Acre of Saw-Timber Types

The area occupied and the average volume per acre in all ownerships are given for each of the types by forest-survey unit and State in tables 2 and 3. These data have been assembled for all species as well as for the ponderosa pine alone. Volume computations were made for trees in the 12-inch diameter class and larger.

The average stand per acre for all species in eastern Oregon is 10.0 thousand board feet per acre as compared with 8.2 thousand board

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4/ Brandstrom, A. J. F. The Role of Selective Cutting in Promoting Sustained Yield with Special Reference to Ponderosa Pine. Journal of Forestry, Vol. XXXV, No. 2, pages 142 to 147. February 1937.

TABLE 2.--AVERAGE VOLUME PER ACRE OF SAW-TIMBER TYPES IN EASTERN OREGON BY FOREST-SURVEY UNIT

SUR-VEY TYPE NO.	TYPE DEFINITION	NORTH BLUE MOUNTAIN UNIT			DESCHUTES RIVER UNIT			SOUTH BLUE MOUNTAIN UNIT			KLAMATH PLATEAU UNIT			TOTAL EASTERN OREGON			
			VOLUME PER ACRE			VOLUME PER ACRE			VOLUME PER ACRE			VOLUME PER ACRE			VOLUME PER ACRE 1/		TOTAL VOLUME 1/
		AREA	PON-DEROSA PINE	ALL SPECIES	AREA	PON-DEROSA PINE	ALL SPECIES	AREA	PON-DEROSA PINE	ALL SPECIES	AREA	PON-DEROSA PINE	ALL SPECIES	AREA	PON-DEROSA PINE	ALL SPECIES	PON-DEROSA PINE	ALL SPECIES
		M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	MILLION BD. FT.	
	WOODLAND:																	
5½	PONDEROSA PINE WOODLAND: SCATTERED PONDEROSA PINE STANDS ON POOR SITES	50.7	1.2	1.3	122.4	1.9	1.9	218.5	1.1	1.1	93.9	1.5	1.5	485.5	1.4	1.4	679.7	679.7
	PONDEROSA PINE: FOREST CONTAINING 50% OR MORE OF PONDEROSA PINE																	
20	PONDEROSA PINE, LARGE: 50 TO 80% OF PONDEROSA PINE, MORE THAN 22" D.B.H.	280.9	5.0	8.2	195.9	9.7	14.4	208.4	6.1	9.4	161.4	11.5	17.9	846.6	7.6	11.8	6,434.2	9,989.9
20.5	PURE PONDEROSA PINE, LARGE: 80% OR MORE OF PONDEROSA PINE, MORE THAN 22" D.B.H.	469.2	7.9	8.8	975.0	12.6	13.3	1,551.8	9.7	10.2	1,797.2	12.9	13.7	4,793.2	11.3	12.0	54,163.2	57,518.4
20A	PONDEROSA PINE-SUGAR PINE MIXTURE, LARGE: 50% OR MORE OF PONDEROSA PINE AND 20% OR MORE OF SUGAR PINE, MORE THAN 22" D.B.H.				1.4	8.3	13.6				28.7	11.3	17.9	30.1	11.1	17.6	334.1	529.8
21	PONDEROSA PINE, SMALL: 12 TO 22" D.B.H.	159.6	2.2	2.5	100.6	3.8	3.8	156.0	2.8	3.2	263.8	3.2	3.6	680.0	3.0	3.3	2,040.0	2,244.0
	PINE MIXTURE: MIXED FOREST CONTAINING 20 TO 50% OF PONDEROSA PINE																	
27	PINE MIXTURE, LARGE: 12" OR MORE D.B.H.	202.7	2.2	6.6	78.0	4.5	12.8	109.1	2.3	7.0	59.8	4.7	12.2	449.6	3.0	8.5	1,348.8	3,821.6
208	SUGAR PINE MIXTURE, LARGE: FOREST CONTAINING 20% OR MORE OF SUGAR PINE AND LESS THAN 50% OF PONDEROSA PINE, MORE THAN 22" D.B.H.										35.7	6.5	20.2	35.7	6.5	20.2	232.1	721.1
	SUMMARY PINE TYPES	1,163.1	5.1	7.1	1,473.3	10.3	11.8	2,243.8	7.7	8.6	2,440.5	11.0	12.5	7,320.7	8.9	10.3	65,232.1	75,504.5
	DOUGLAS FIR: FOREST CONTAINING 60% OR MORE OF DOUGLAS FIR																	
6	DOUGLAS FIR, LARGE OLD GROWTH: MORE THAN 40" D.B.H.										5.7		20.9	5.7		20.9		119.1
7	DOUGLAS FIR, SMALL OLD GROWTH: 22 TO 40" D.B.H.	1.0		4.3	25.0		17.8	6.0		5.0	28.1		3.5	60.1		9.6		577.0
8	DOUGLAS FIR, LARGE SECOND GROWTH: 22 TO 40" D.B.H.	14.4		7.1	.2		5.2	2.3		9.4				16.9		7.4		125.1
9A	DOUGLAS FIR, LARGE POLES: 12 TO 20" D.B.H.	30.2		4.0	1.3		1.4	2.2		3.7				33.7		3.9		131.4
	WESTERN RED CEDAR: FOREST CONTAINING 40% OR MORE OF WESTERN RED CEDAR																	
17	WESTERN RED CEDAR, LARGE: 24" OR MORE D.B.H.				.2		7.5							.2		7.5		1.5
	FIR-MOUNTAIN HEMLOCK: FOREST CONTAINING 50% OR MORE OF NOBLE FIR, SHASTA RED FIR, SILVER FIR, OR MOUNTAIN HEMLOCK, OR ANY COMBINATION OF THESE SPECIES																	
23	FIR-MOUNTAIN HEMLOCK, LARGE: 12" OR MORE D.B.H.				128.0		15.0				222.2		10.3	350.2		12.0		4,202.4
	UPPER-SLOPE MIXTURE: FOREST OF VARIOUS MIXTURES OF WESTERN LARCH, DOUGLAS FIR, ENGELMANN SPRUCE, THE BALSAM FIRS, MOUNTAIN HEMLOCK, LODGEPOLE PINE, WESTERN WHITE PINE; OCCASIONALLY OTHER SPECIES																	
27½	UPPER-SLOPE MIXTURE, LARGE: 12" OR MORE D.B.H.	403.6		6.9	51.0		14.1	346.7		6.1	6.7		6.2	808.0		7.0		5,656.0
	WHITE FIR: FOREST CONTAINING 50% OR MORE OF WHITE FIR																	
29	WHITE FIR OR LOWLAND WHITE FIR, LARGE: 12" OR MORE D.B.H.	64.1		8.0	7.1		8.1	15.4		5.9	17.8		8.3	104.4		7.8		814.3
	LODGEPOLE PINE: FOREST CONTAINING 50% OR MORE OF LODGEPOLE PINE																	
25	LODGEPOLE PINE, LARGE: 12" OR MORE D.B.H.	.8		4.2	6.3		4.3	.3		1.0	50.1		2.6	57.5		2.8		161.0
	HARDWOODS: FOREST CONTAINING 50% OR MORE OF HARDWOODS																	
31.5	HARDWOODS, LARGE: 12" OR MORE D.B.H.	3.0		2.1	.8		2.8	2.6		1.2	.5		3.1	6.9		1.9		13.1
	SUMMARY ALL TYPES	1,680.2		7.0	1,693.2		12.2	2,619.3		8.2	2,771.6		12.0	8,764.3		10.0		87,305.4

1/ THE DIFFERENCE BETWEEN REGIONAL TOTALS IN THIS TABLE AND IN TABLE 1 IS ACCOUNTED FOR BY VOLUME IN NON-SAW-TIMBER TYPES. SINCE AVERAGE VOLUME PER ACRE VALUES ARE ROUNDED OFF TO NEAREST 100 BOARD FEET, THE SUM OF UNIT TOTAL VOLUMES COMPUTED BY APPLYING VOLUME PER ACRE TO AREA WILL NOT EXACTLY EQUAL REGIONAL TOTALS.

TABLE 3.—AVERAGE VOLUME PER ACRE OF SAW-TIMBER TYPES IN EASTERN WASHINGTON[1] BY FOREST-SURVEY UNIT

SURVEY TYPE NO.	TYPE DEFINITION	CHELAN-COLVILLE UNIT			YAKIMA RIVER UNIT			NORTH BLUE MOUNTAIN UNIT			TOTAL EASTERN WASHINGTON			
			VOLUME PER ACRE			VOLUME PER ACRE			VOLUME PER ACRE			VOLUME PER ACRE		TOTAL VOLUME[2]	
		AREA	PONDEROSA PINE	ALL SPECIES	AREA	PONDEROSA PINE	ALL SPECIES	AREA	PONDEROSA PINE	ALL SPECIES	AREA	PONDEROSA PINE	ALL SPECIES	PONDEROSA PINE	ALL SPECIES
		M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	M ACRES	M BD.FT.	M BD.FT.	MILLION BD. FT.	
	WOODLAND:														
5½	PONDEROSA PINE WOODLAND: SCATTERED PONDEROSA PINE STANDS ON POOR SITES	275.8	0.9	1.1	49.1	1.3	1.3	9.2	1.0	1.0	334.1	1.0	1.1	334.1	367.5
	PONDEROSA PINE: FOREST CONTAINING 50% OR MORE OF PONDEROSA PINE														
20	PONDEROSA PINE, LARGE: 50 TO 80% OF PONDEROSA PINE, MORE THAN 22" D.B.H.	406.7	5.0	7.6	205.0	7.7	11.4	27.8	3.7	6.1	639.5	5.8	8.8	3,709.1	5,627.6
20.5	PURE PONDEROSA PINE, LARGE: 80% OR MORE OF PONDEROSA PINE, MORE THAN 22" D.B.H.	661.5	7.2	7.9	481.8	9.5	10.2	36.7	6.7	7.0	1,180.0	8.1	8.8	9,558.0	10,384.0
21	PONDEROSA PINE, SMALL: 12 TO 22" D.B.H.	323.5	1.9	2.1	207.6	3.1	3.2	5.0	1.3	1.3	536.1	2.4	2.5	1,286.6	1,340.3
	PINE MIXTURE: MIXED FOREST CONTAINING 20 TO 50% OF PONDEROSA PINE														
27	PINE MIXTURE, LARGE: 12" OR MORE D.B.H.	233.9	2.2	6.6	139.6	4.0	10.8	15.7	1.7	6.1	389.2	2.8	8.1	1,089.8	3,152.5
	SUMMARY PINE TYPES	1,901.4	4.3	5.7	1,083.1	6.9	8.8	94.4	4.1	5.7	3,078.9	5.2	6.8	15,977.6	20,871.9
	DOUGLAS FIR: FOREST CONTAINING 60% OR MORE OF DOUGLAS FIR														
6	DOUGLAS FIR, LARGE OLD GROWTH: MORE THAN 40" D.B.H.				.9		17.7				.9		17.7		15.9
7	DOUGLAS FIR, SMALL OLD GROWTH: 22 TO 40" D.B.H.	153.0		10.5	143.1		17.5				296.1		13.9		4,115.8
8	DOUGLAS FIR, LARGE SECOND GROWTH: 22 TO 40" D.B.H.	65.4		9.2	64.1		14.5				129.5		11.8		1,528.1
9A	DOUGLAS FIR, LARGE POLES: 12 TO 20" D.B.H.	93.5		4.4	20.4		3.7				113.9		4.3		489.8
	WESTERN RED CEDAR: FOREST CONTAINING 40% OR MORE OF WESTERN RED CEDAR														
17	WESTERN RED CEDAR, LARGE: 24" OR MORE D.B.H.	2.3		20.5	1.0		13.3				3.3		18.4		60.7
19A	WESTERN RED CEDAR POLES: 12 TO 24" D.B.H.	.1		5.8							.1		5.8		.6
	FIR-MOUNTAIN HEMLOCK: FOREST CONTAINING 50% OR MORE OF NOBLE FIR, SHASTA RED FIR, SILVER FIR, OR MOUNTAIN HEMLOCK, OR ANY COMBINATION OF THESE SPECIES														
23	FIR-MOUNTAIN HEMLOCK, LARGE: 12" OR MORE D.B.H.	69.0		20.3	192.2		14.2				261.2		15.8		4,127.0
	UPPER-SLOPE MIXTURE: FOREST OF VARIOUS MIXTURES OF WESTERN LARCH, DOUGLAS FIR, ENGELMANN SPRUCE, THE BALSAM FIRS, MOUNTAIN HEMLOCK, LODGEPOLE PINE, WESTERN WHITE PINE; OCCASIONALLY OTHER SPECIES														
27½	UPPER-SLOPE MIXTURE, LARGE: 12" OR MORE D.B.H.	493.0		8.3	265.7		11.8	62.8		6.8	821.5		9.3		7,640.0
	WHITE FIR: FOREST CONTAINING 50% OR MORE OF WHITE FIR														
29	WHITE FIR OR LOWLAND WHITE FIR, LARGE: 12" OR MORE D.B.H.	.5		20.6	3.2		13.0	10.1		5.8	13.8		8.0		110.4
	LODGEPOLE PINE: FOREST CONTAINING 50% OR MORE OF LODGEPOLE PINE														
25	LODGEPOLE PINE, LARGE: 12" OR MORE D.B.H.	9.8		4.2	17.3		2.4				27.1		3.1		84.0
	HARDWOODS: FOREST CONTAINING 50% OR MORE OF HARDWOODS														
31.5	HARDWOODS, LARGE: 12" OR MORE D.B.H.	2.9		7.0	8.5		3.4	.4		1.2	11.8		4.6		54.3
	SUMMARY ALL TYPES	2,790.9		6.9	1,799.5		10.6	167.7		6.1	4,758.1		8.2		39,098.5

1/ EXCLUSIVE OF SPOKANE UNIT.

2/ THE DIFFERENCE BETWEEN REGIONAL TOTALS IN THIS TABLE AND IN TABLE 1 IS ACCOUNTED FOR BY VOLUME IN NON-SAW-TIMBER TYPES. SINCE AVERAGE VOLUME-PER-ACRE VALUES ARE ROUNDED OFF TO NEAREST 100 BOARD FEET, THE SUM OF UNIT TOTAL VOLUMES COMPUTED BY APPLYING VOLUME PER ACRE TO AREA WILL NOT EXACTLY EQUAL REGIONAL TOTALS.

feet in eastern Washington. Moreover, the area occupied by saw-timber types in eastern Oregon is nearly twice that of eastern Washington. An even more pronounced difference in stand volume between the two States is shown for ponderosa pine alone. As a further comparison it will be observed that while the pine types show a higher volume per acre in Oregon than in Washington, the reverse is true for other types. From an examination of the type maps[5/] for this region it is readily apparent that the Douglas fir, hemlock, and balsam fir types are more extensive on the eastern slopes of the Cascade Range in Washington than in Oregon. A preponderance of the latter types is found in both the Yakima River and Chelan-Colville units, being especially noticeable in Yakima and Kittitas Counties. In contrast, the type map of Oregon shows ponderosa pine stands occupying most of the eastern slopes of the Cascade Range as well as a high percentage of the area in the Blue Mountains. The heaviest extensive pine stands in the entire region are found in the Klamath Plateau unit located on the eastern slopes of the Cascade Range in southern Oregon.

It will be observed from the figures in tables 2 and 3 that type 20, ponderosa pine large, and type 20.5, pure ponderosa pine large, occur most extensively and contain by far most of the merchantable timber in this region. Of the total ponderosa pine volume in eastern Oregon, 93 percent is found in these two types while in eastern Washington they include 83 percent of the ponderosa pine total. Commercial logging is at present confined almost entirely to these two types which cover 55 percent of the entire saw-timber area of eastern Oregon and eastern Washington. The five remaining pine types occur much less extensively and contain only a small portion of the total pine volume. Type 5½, ponderosa pine woodland, while having at least 50 percent of its volume in ponderosa pine, is characterized by light stands and averages less than 1,500 board feet per acre. Type 20A, ponderosa pine-sugar pine mixture, and type 20B, sugar pine mixture, usually contain large volumes of ponderosa pine per acre but are limited in range. Type 21, ponderosa pine small, and type 27, pine mixture, generally have a low average volume of ponderosa pine to the acre.

Volume Distribution by Diameter Class

The analysis of the regional distribution of volume by types leads to a question of the spread of volume by tree sizes. Although field samples of diameter-volume distribution were taken for six of

5/ Location and extent of forest types are shown by the Forest Survey type maps. Information regarding 1-inch-to-the-mile county type maps and ¼-inch-to-the-mile lithographed State type maps and how they may be obtained will be furnished upon request. Address Director, Pacific Northwest Forest and Range Experiment Station, 423 U. S. Court House, Portland, Oreg.

the pine types, an analysis was made only for the two most important, types 20 and 20.5. The breakdown of volume by diameter class obtained from the field samples was applied to the figures showing average volume per acre for types 20 and 20.5 in tables 2 and 3, giving an average volume figure for each diameter class. Figures 2 and 3 show the volume by diameter class and figures 4 and 5 give the cumulative distribution for both types in eastern Oregon and eastern Washington. The bar diagrams in figures 2 and 3 show the amount of volume in each diameter class on the average acre. These graphs show a concentration of volume around the 26- to 30-inch diameters and it appears that the volume is fairly symmetrically distributed in diameters above and below this midpoint.

The cumulative distribution of volume by diameter class shown in figures 4 and 5 is of considerable value in determining the percent of volume in various diameter ranges. Table 4, compiled from readings taken on these four cumulative curves gives the spread in diameters for every 10 percent of total volume. The symmetry shown in the bar diagrams is further demonstrated by the fact that 50 percent of the volume is in trees about 28 inches in diameter and less. The curves are very useful in indicating the theoretical minimum diameter limit of cutting that would achieve various percentages of volume removal. Although size is an important factor in tree selection, it must not be forgotten that other factors such as thrift, quality, and location should govern the actual cutting practice on the ground.

Table 4.--Volume distribution by diameter

Percent of total volume	Type 20.5		Type 20	
	Wash.	Oreg.	Wash.	Oreg.
	Inches	Inches	Inches	Inches
10	16.5	18.8	16.8	17.8
20	20.4	22.4	20.1	21.6
30	23.2	25.2	22.7	24.4
40	25.6	27.2	25.0	27.0
50	28.0	29.6	27.5	29.3
60	30.5	31.7	29.9	31.7
70	33.2	34.2	32.4	34.5
80	36.8	37.4	36.0	37.8
90	42.4	42.0	40.4	42.4
100	76.0	74.0	64.0	58.0

FIGURE 2. DISTRIBUTION OF SAW-TIMBER VOLUME IN TYPE 20, LARGE PONDEROSA PINE, BY DIAMETER CLASS

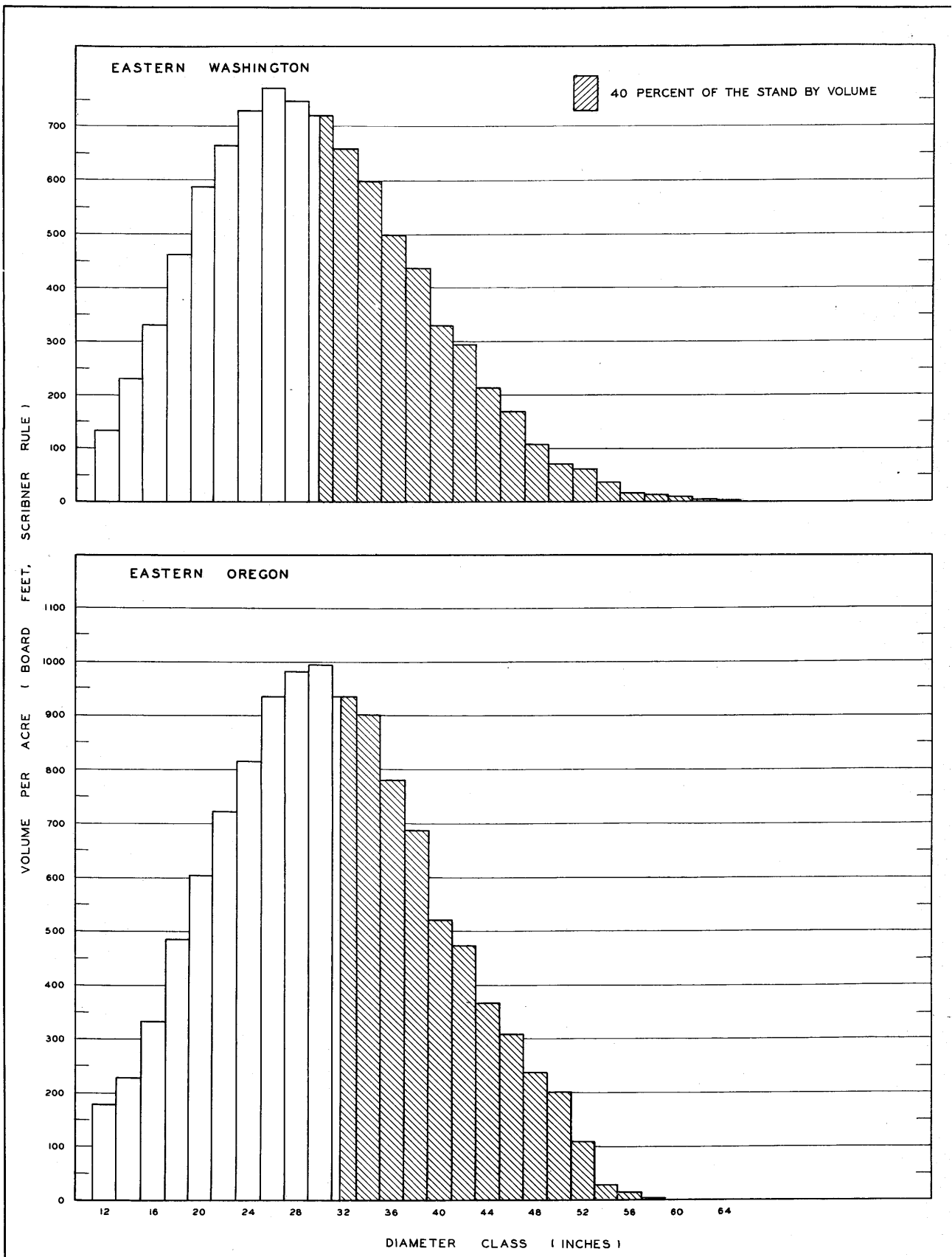


FIGURE 3. DISTRIBUTION OF SAW-TIMBER VOLUME IN TYPE 20.5, PURE LARGE PONDEROSA PINE, BY DIAMETER CLASS

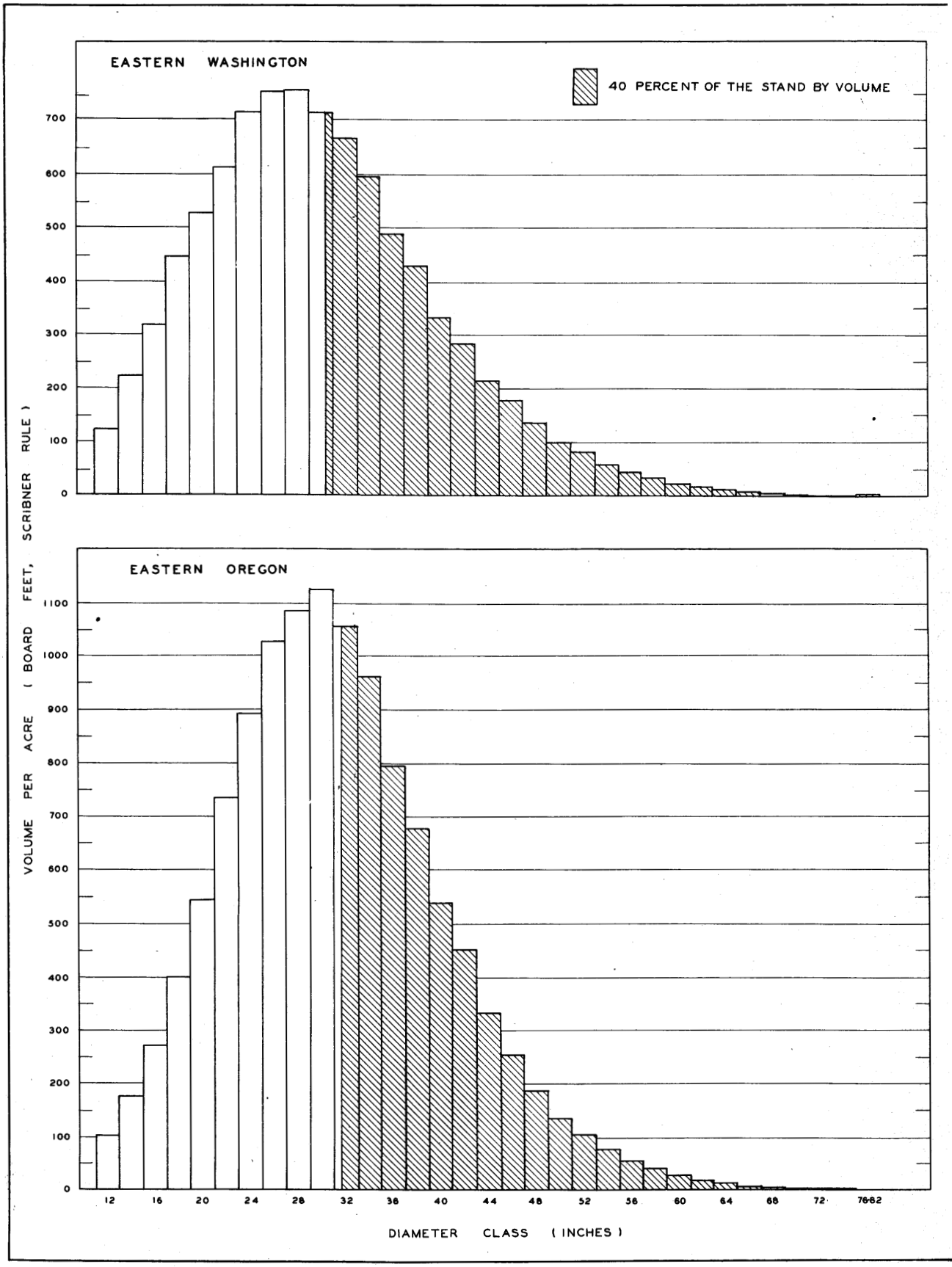


FIGURE 4. CUMULATIVE SAW-TIMBER VOLUME PER ACRE IN TYPE 20, LARGE PONDEROSA PINE, BY DIAMETER CLASS

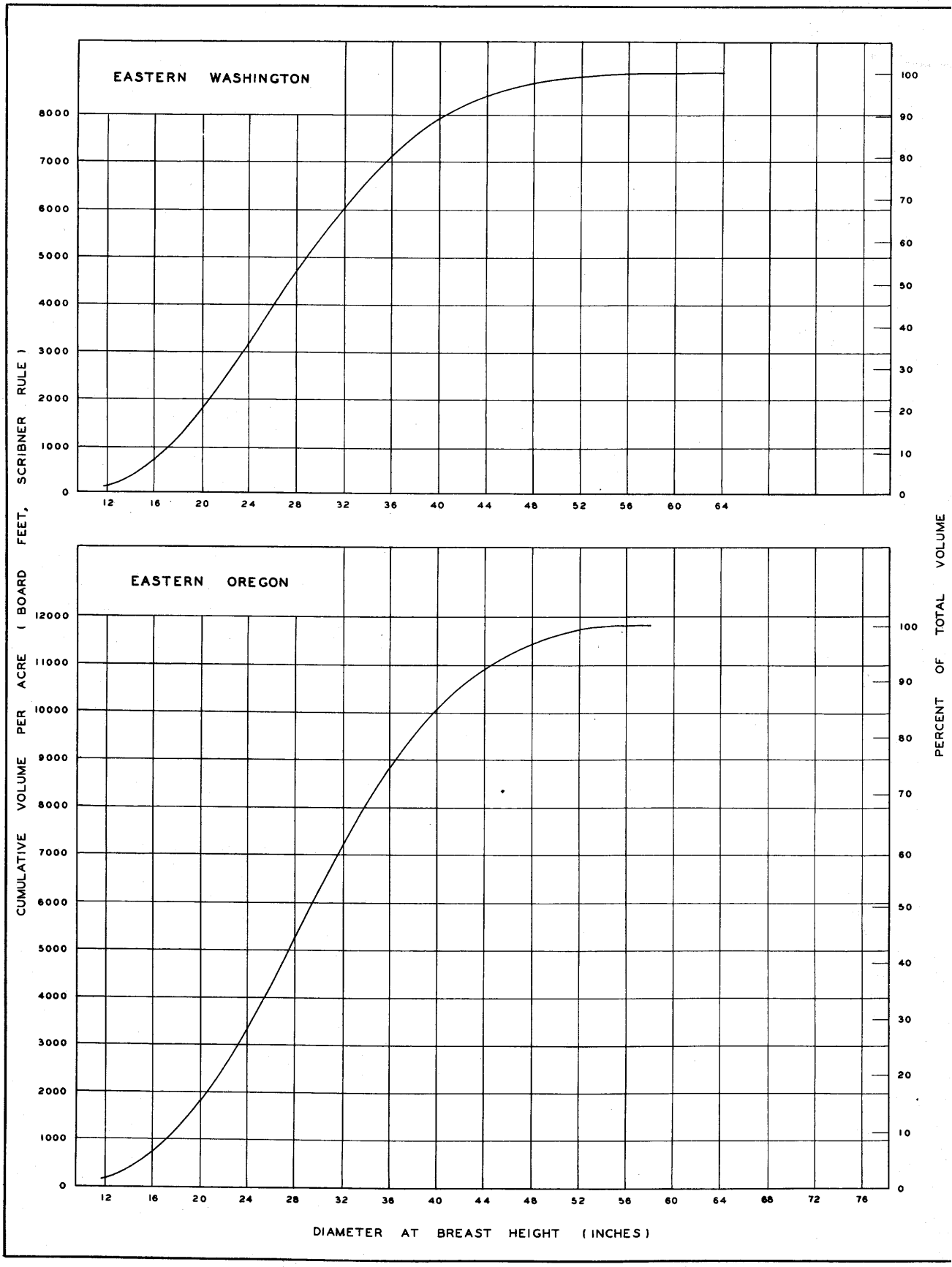
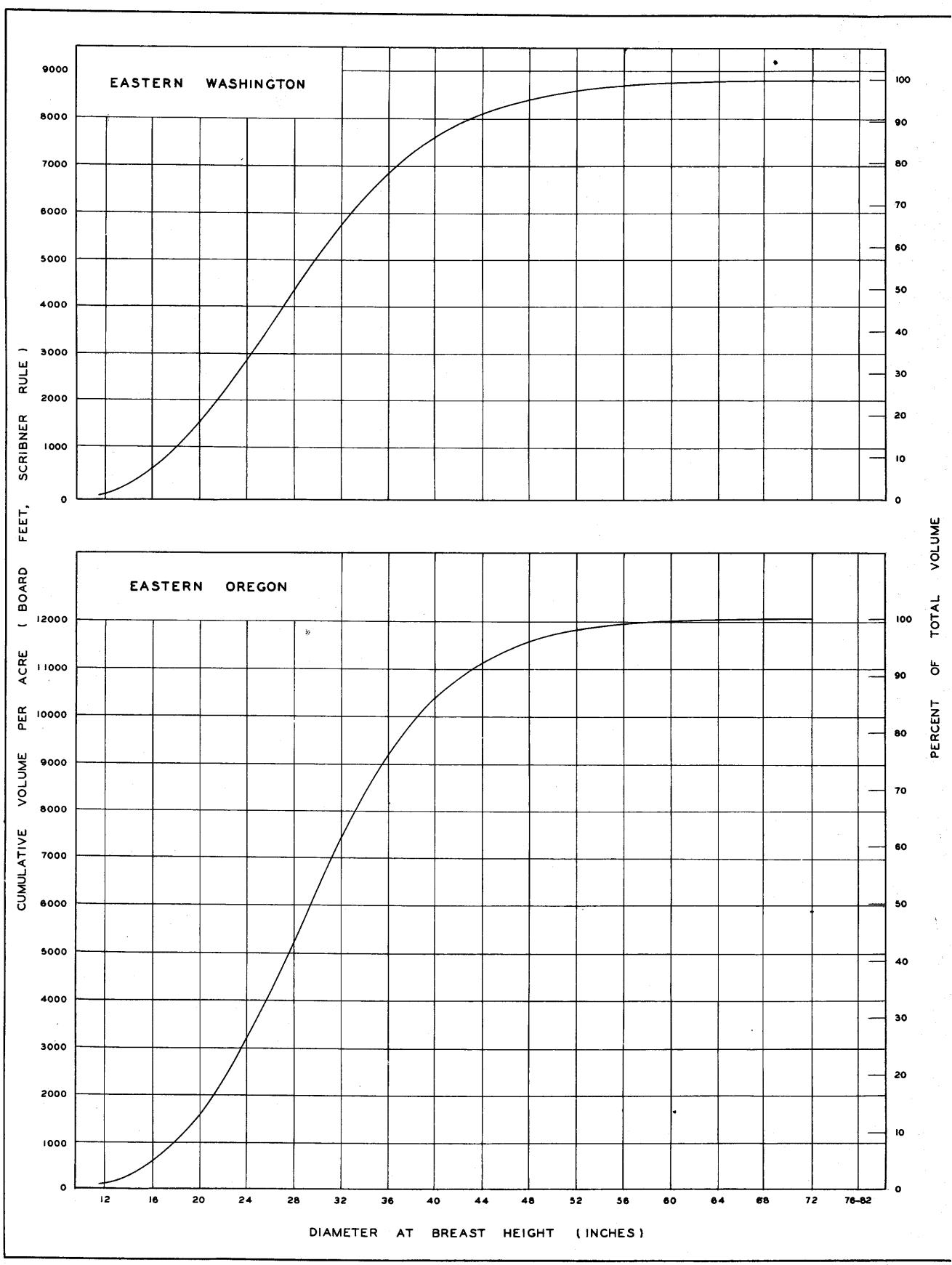


FIGURE 5. CUMULATIVE SAW-TIMBER VOLUME PER ACRE IN TYPE 20.5 PURE LARGE PONDEROSA PINE, BY DIAMETER CLASS



In a study of the application of the maturity selection system to a large operation in the South Blue Mountain unit an initial cut of 40 percent was recommended and it is interesting to note in table 4 that such a cutting program if based on size alone would remove trees having diameters down to about 30 inches. Actual application of the maturity selection system, however, would result in removing smaller trees if low in vigor or high in value and leaving larger trees of high vigor. Other studies indicate an initial cut of from 25 percent to 50 percent. A graphical representation of a 40 percent volume removal, based on size alone, as determined from the cumulative curves, is shown by the shaded areas in figures 2 and 3.

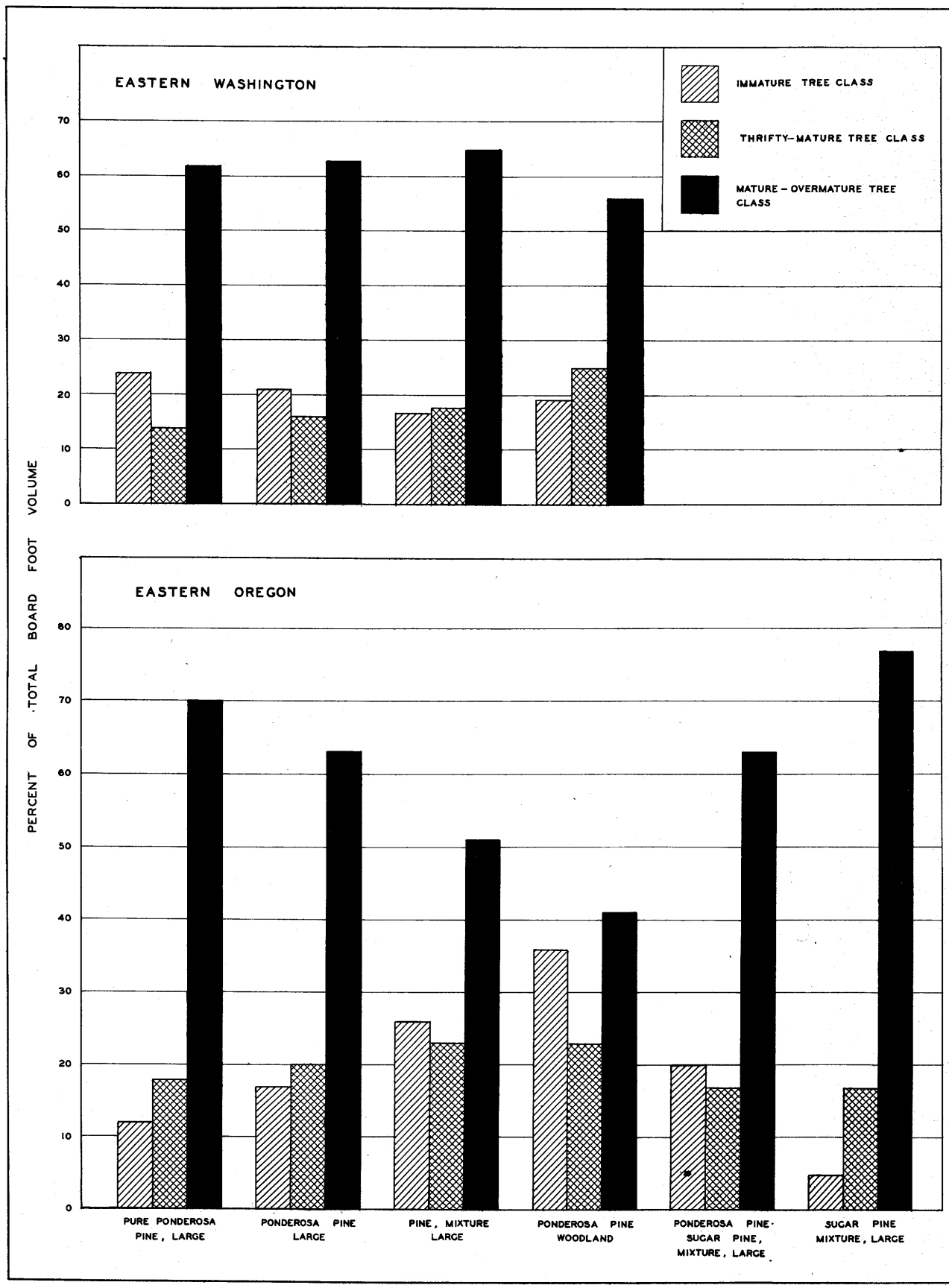
Volume Distribution by Thrift Class

In order to properly evaluate the pine saw-timber volume in the formulation of management plans, some indication of the thrift or growing capacity of the standing timber is necessary. Three "maturity" classes have been recognized, namely: immature, thrifty-mature, and mature-overmature. The percentage by volume in each of these classes has been determined for five pine types and is shown graphically for the region in figure 6. In all types a superabundance of mature-overmature timber is readily apparent. No material amount of net growth can be expected on the areas occupied by these types until the least thrifty trees in the mature-overmature class are harvested, thereby giving release to the remaining stand.

Volume in Residual Stands

Character of the forests has always favored partial cutting of some sort in the pine stands of eastern Oregon and eastern Washington. Selective cutting has been followed for many years on private lands as well as public lands. The degree of selection has varied but it has been generally heavy until recently, with 80 percent or more of the original stand volume removed in the first cut. Selection of trees for cutting on public lands has been based principally upon silvicultural characteristics. On private lands the general rule has been to remove all trees of positive conversion value resulting in the cutting of not only the overmature trees, but also the thrifty mature and many of the rapidly growing immature trees. Analysis of the forest-survey data shows that heavy selection has taken place on 849 thousand acres of pine stands, leaving a residual stand averaging 2,440 board feet to the acre. Almost complete removal or clear cutting has occurred on 964 thousand acres, leaving a residual volume averaging only about 250 board feet to the acre. Although the area included in the former type is somewhat less, the residual volume is almost nine times that remaining on the even more severely-cut areas. Table 5 shows the areas and volume by units for both degrees of cutting. Revisions of the cutting practices, which have resulted in the impoverishment of thrifty,

FIGURE 6. DISTRIBUTION OF SAW-TIMBER VOLUME IN PRINCIPAL PONDEROSA PINE TYPES, BY MATURITY CLASS



growing timber, have been strongly advocated in recent years and where adopted have resulted in residual stands with much greater reserve volume than indicated by the above averages. The objective toward which these cutting revisions are directed is the removal of the overmature and nonproducing elements of the stand, leaving behind, for subsequent development and a relatively early second cut, the thrifty, growing timber.

TABLE 5.--SAW-TIMBER VOLUME[1] IN RESIDUAL PONDEROSA PINE STANDS ON CUT-OVER LANDS IN THE PONDEROSA PINE REGION

FOREST-SURVEY UNIT	TYPE 34-21 PONDEROSA PINE SMALL, 12 TO 22" D.B.H. ON CUT-OVER LAND			TYPE 34-22 PONDEROSA PINE SEEDLINGS AND SAPLINGS, 0 TO 10" D.B.H. ON CUT-OVER LAND		
	VOLUME PER ACRE	AREA	TOTAL VOLUME	AREA	TOTAL VOLUME[2]
	M BD.FT.	M ACRES	MILLION BD.FT.	M ACRES	MILLION BD.FT.
EASTERN WASHINGTON					
CHELAN-COLVILLE	1.9	214.2	407.0	170.4	42.6
YAKIMA RIVER	2.0	100.9	201.8	123.1	30.8
NORTH BLUE MOUNTAIN	1.3	4.8	6.2	17.2	4.3
SUMMARY	1.9	319.9	615.0	310.7	77.7
EASTERN OREGON					
NORTH BLUE MOUNTAIN	2.3	129.4	297.6	150.6	37.6
DESCHUTES RIVER	2.1	61.2	128.5	189.6	47.4
SOUTH BLUE MOUNTAIN	2.7	111.9	302.1	161.5	40.4
KLAMATH PLATEAU	3.2	226.8	725.8	151.5	37.9
SUMMARY	2.7	529.3	1,454.0	653.2	163.3
REGION SUMMARY	2.4	849.2	2,069.0	963.9	241.0

1/ TREES 12 INCHES OR MORE D.B.H. OF ALL SPECIES.
2/ COMPUTED USING AN AVERAGE VOLUME OF 250 BD. FT. PER ACRE FOR ALL UNITS.