

RS
M-1
Mc-Stanislau Branch
Plots 9, 10, 11

METHODS OF CUTTING

California Forest and Range Experiment Station

Stanislau Branch

Plots 9, 10, 11

Progress Report, 1934

By

A. A. Hasel - Assistant Silviculturist
E. Wohletz - Assistant Forester
W. B. Tallmon - Junior Forester

Object of Study

To determine the growth rate and net growth, and to determine the rate of restocking after a light, a moderate and a heavy selection cutting.

Time

Preliminary examinations of the areas were begun April 24, 1929. Logging was done between June 1 and July 24. The trees on the final plots were measured between August 13 and September 21, 1929. Remeasurements were made between August 18 and October 2, 1934.

Methods of Study

The plot boundaries were surveyed with transit and chain prior to logging. Maps were made on a scale of 30 feet to the inch, showing trees 3.6 to 11.5 inches d.b.h. by species and two inch diameter classes, trees 11.6 inches and over by species and serial number, plot boundaries, topography, brush areas, logs and rock outcrops. Three transects of milacre quadrats were mapped for greater detail. The herbaceous vegetation was mapped on every tenth quadrat.

After felling, and again after yarding, the original maps were corrected in the field. Trees killed and seriously injured were shown, and for yarding, areas of partial and complete damage and skid trails mapped.

After logging the milacre quadrats were remapped to show damage.

Within each of the original 15 acre plots final study plots of about 10 acres were laid out with transit and tape. On these, all trees 3.6 inches d.b.h. and over were tagged. A new series of numbers were used for each plot. Diameters were measured at tag height with steel diameter tape to the nearest one-tenth inch. Total height and height to base of crown were measured to nearest foot with Klaussner hypsometer. Height measurements were omitted on most trees with broken tops and on some of the trees of the understory with hidden tops. Iron pipes were set as permanent hypsometer stations. Distances to the trees from these stations were obtained with a range finder. These distances and the station numbers were recorded on the individual tree sheets along with tree number, tree description, tree class, and height and diameter measurements.

Tracings of the original maps were taken into the field. The tree numbers on these were changed to the final series and hypsometer stations shown as the tagging and measuring progressed.

Pictures were taken before and after logging in 1929. A few have been repeated since.

The quadrat strips were remapped following logging in 1929 and yearly through 1931. Changes were found insufficient to warrant the expense of complete remapping, so since 1931, reproduction has been mapped on all quadrats but only every tenth quadrat showing herbaceous vegetation has been completely remapped.

Slash was piled and burned in the fall following logging.

At the remeasurement, in 1934, all diameters were taken and sufficient heights for a height-diameter curve for each species. Changes in tree description were made. New trees over 3.6 inches d.b.h. were tagged and included. Distances from hypsometer stations were recorded, as measured with 100 foot steel tape.

For purposes of computation, the length of the first period has been considered as 5 growing seasons.

Description of the Areas

1. Location. (See sketch map.) The plots are in the Stanislaus National Forest about 32 miles east of Sonora, and $2\frac{1}{2}$ miles southeast of the Stanislaus Branch Experiment Station. They are within the Pickering Lumber Company sale area of Dec 2, 1926.

should be 18 E

The plots lie entirely within the NE $\frac{1}{4}$ of section 28, T. 4 N., R. 10 E., M.D.M., except for the N corner of plot 11 which lies in the S. E. $\frac{1}{4}$ of section 21. Section corner $\frac{21}{28} \frac{22}{27}$ is 6.79 chains N 45° E of coordinate point X 30 Y 15.37 on the northeast boundary of plot 11. Plot 10 lies two chains southwest of plot 11, plot 9, two chains southwest of plot 10.

2. Area. The plots are rectangular with corresponding sides parallel. Plots 9 and 11 contain 10.8 acres each with boundaries lying 12 chains S 45° E and 9 chains S 45° W. Plot 10 contains 9.6 acres and is 12 chains S 45° E by 8 chains S 45° W.

3. Topography. The exposures are northwest. Slopes average 16 percent with a maximum, for a distance of 100 feet, of 50 percent. These pitches occur in all three plots. There are no adverse grades. Elevations range from 5,710 to 5,930 feet. The surface is generally smooth and rounded without loose rock. Fixed boulders and rock outcrops appear in a few places in all three plots.

4. Soil. The soil is a deep, moderately loose, sandy to gravelly loam for the first 12 to 14 inches. Below this depth the soil becomes heavier, and at about 30 inches the parent granite appears. The parent material is weathered and fissured to a great depth. Most of the soil is probably derived from the granite although there is a mixture of lava from the cap above the area.

5. Weather. Climatic data directly applicable to the plots are not available. The records of stations near the plots are not of sufficient duration to be reliable. Sonora and Lake Eleanor are the nearest stations with records kept for some time. Sonora is about 32 miles southwest, at an elevation of 1,825 feet, and has records since 1887. Lake Eleanor is about 23 miles southeast at an elevation of 4,700 feet, and has records dating back to 1910. Two stations, Strawberry Lake and Spring Gap, which are nearer the plots have records since 1922. Strawberry Lake is $1\frac{1}{2}$ miles north at an elevation of 5,620 feet. Spring Gap is 8 miles west at an elevation of 4,875 feet. (Table 1.)

Table 1.- Normal precipitation by months

Station and period	Item	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	Seasons
Sonora 1887-1934	Inches	0.01	0.03	0.46	1.65	3.18	5.12	6.38	5.58	5.82	2.50	1.50	0.35	32.56
	Percent	0.03	0.09	1.41	5.07	9.77	15.72	19.59	17.14	17.88	7.68	4.61	1.01	100.00
Lake Eleanor 1910-1934	Inches	0.12	0.29	0.69	1.75	3.62	5.90	7.61	7.14	5.46	3.29	1.84	0.70	38.41
	Percent	0.31	0.76	1.80	4.56	9.42	15.36	19.81	18.59	14.22	8.56	4.79	1.82	100.00
Strawberry Lake 1922-1934	Inches	0.02	0.03	0.44	1.86	2.87	4.89	4.71	5.91	3.28	3.30	1.69	0.94	29.94
	Percent	0.07	0.10	1.47	6.21	9.59	16.33	15.73	19.75	10.95	11.02	5.64	3.14	100.00
Spring Gap 1922-1934	Inches	0.02	0.01	0.42	1.75	3.97	6.46	6.05	5.96	4.25	3.92	1.64	0.91	35.35
	Percent	0.05	0.03	1.18	4.95	11.23	18.27	17.11	16.86	12.02	11.09	4.64	2.57	100.00

Table 2.- Maximum, minimum and mean temperatures
Strawberry Lake, 1922-1934

Item	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
Mean maximum	87.2	84.8	75.3	63.9	52.5	44.0	42.8	45.3	51.1	56.4	67.6	76.2
Mean minimum	49.3	47.9	42.3	35.2	29.5	24.3	22.7	23.6	27.3	29.9	35.9	42.1
Mean	68.2	66.4	58.8	49.6	41.0	34.2	32.8	34.4	39.2	43.2	51.8	59.2
Maximum	98	100	94	84	70	60	58	62	66	76	90	98
Minimum	36	36	22	17	4	1	-10	0	6	8	14	18

The station at Strawberry Lake is at approximately the same elevation as the plots. The normals at Strawberry Lake, adjusted to the long term normals at Sonora, are therefore used. These normals are hardly reliable but are as good as those for stations at greater distances and at elevations different from the plots.

The adjusted normals for Strawberry Lake show an average yearly precipitation of 37.87 inches (table 3). Only a small proportion of this falls between May 1 and September 1, amounting to 3.41 inches, or about 9 percent of the total for that station. It is apparent that rainfall is light during the growing season, and at the time when reproduction is starting. Table 3 also shows the deviations from normal for the period July, 1927 to June 1932. The yearly average is 20.3 percent below normal, but if only the growing season is considered, the period is not so far below normal - May and June actually having more than normal rainfall.

During the period May 1 to September 1, about 95 percent of the growth occurs. The growing season varies somewhat for different species. The mean maximum, mean minimum and mean temperatures by months for the period 1922 to 1934 at Strawberry Lake are shown in table 2. The highest and lowest temperatures for the period are also shown. Freezing temperatures may occur as late as June 30.

Table 3.- Deviation from the normal precipitation for the period, July, 1927 to June, 1932
Sonora and Strawberry Lake, California.

Station	Item	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Season
Sonora	Actual deviation	1927-32 -0.01	-0.01	-0.33	-0.56	+0.05	-0.44	-1.43	-1.54	-1.90	-0.25	-0.66	+0.43	-6.65
	Percent deviation	1927-32 -100.00	-33.3	-71.7	-53.9	+1.6	-8.6	-22.4	-27.6	-32.6	-10.0	-44.0	+130.3	-20.42
	Adjusted Normal.	0.03	0.09	1.19	2.48	2.99	3.23	6.72	7.03	6.02	2.96	2.53	0.76	37.87
Strawberry Lake	Actual deviation	1927-32 -0.03	-0.02	-0.66	-1.02	-0.10	+0.26	-0.49	-2.62	-2.79	-0.86	+0.02	+0.45	-7.69
	Percent deviation	1927-32 None	-22.2	-55.5	-41.1	-33.4	+5.0	-7.3	-37.3	-34.7	-29.0	+0.80	+59.2	-20.30

• Normal adjusted for 1887-1934 by comparison with Sonora.

6. Site. The site is class I. The larger mature trees were over 175 feet in height. The tallest tree was a ponderosa pine 199 feet in height. Variations in site quality are apparently slight.

7. Forest type and subordinate vegetation. The percentages of total number of trees by species in the original stand were as follows:

Plot	: Ponderosa : pine	: Sugar : pine	: White : fir	: Incense : cedar	: All : species.
3.6 to 11.6 inches d.b.h.					
9	0.9	13.2	51.9	34.0	100.0
10	1.7	16.1	51.3	30.9	100.0
11	1.6	20.2	60.2	18.0	100.0
11.6 inches d.b.h. and over					
9	10.9	18.7	40.6	29.8	100.0
10	3.5	19.8	58.1	18.6	100.0
11	4.4	20.4	61.3	13.9	100.0
3.6 inches d.b.h. and over					
9	4.8	15.3	47.5	32.4	100.0
10	2.3	17.2	53.3	27.2	100.0
11	2.5	20.3	60.5	16.7	100.0

The percentage distributions of the original cover on each of the plots follow. The areas were obtained from the detailed maps by planimeter.

<u>Cover</u>	<u>Plot</u>		
	9	10	11
	<u>Per cent</u>		
Logs	1.5	1.8	2.3
Arctostaphylos	1.3	2.2	1.3
Amelanchier	0.2	0.6	0.1
Ceanothus cordulatus	1.5	2.8	4.1
" integerrimus	0.7	0.0	0.1
" Parvifolius	1.6	0.6	0.6
Castanopsis	0.2	9.6	2.6
Salix	0.0	0.1	0.0
Chamaebatia	19.2	18.8	17.4
Mixed brush	14.5	13.7	7.7
Free	43.0	35.2	43.5
Reproduction (area otherwise free)	16.3	14.6	20.3
Reproduction (mixed with brush) ^{1/}	1.6	3.3	0.8

^{1/} Already listed under brush or mixed brush.

The higher shrubs occupied between 16 and 30 percent of the areas of the plots. Arctostaphylos patula, Castanopsis sempervirens, Ceanothus cordulatus and Ceanothus parvifolius were the more important species of these shrubs. Ceanothus integerrimus, Amelanchier alnifolia, Salix scouleriana and Quercus kelloggii were of less importance.

Chamaebatia foliolosa was the important species of the lower shrubs, covering between 17 and 19 percent of the areas in the pure state besides making up part of the area of mixed. Other species of low shrubs were Symphonicarpus mollis, Rosa gymnocarpa, Ribes roezlii, Ribes nevadense, Prunus emarginata, and Rhamnus rubra.

Herbaceous vegetation included Viola lobata, Carex sp., Monardella odoratissima, Iris hartwegii, Collinsia bicolor, Kelloggia galioides, Hieracium sp., Thalictrum sp., Rubus parviflorus, Gayophytum diffusum, Disporum trachyandrum, Fritellaria pinetorum, Osmorrhiza sp., Vicia sp., Lilium washingtonianum, Adenocaulon bicolor, Silene lemmonii, Cirsium occidentale, Pteris aquilina, Mimulus torreyi, Pirola picta, Vagnera sp., and Smilacina sp. Bromus orcuttianus, a few other grasses, and sedges and rushes occurred sparingly.

Plot 9

The Original Stand.

1. Composition. The plot averaged 121.9 trees per acre 3.6 inches d.b.h. and over, of which ponderosa pine made up 4.8 percent, sugar pine, 15.3 percent, white fir 47.5 percent and incense cedar 32.4 percent (table 4).

The volume averaged 59,336 board feet per acre in trees 11.6 inches d.b.h. and over (Scribner rule). This volume was made up of 26.4 percent ponderosa pine, 30.6 percent sugar pine, 30.2 percent white fir and 12.8 percent incense cedar. The volume was contained in 5.1 ponderosa pines, 8.8 sugar pines, 19.3 white firs, and 14.3 incense cedars, a total of 47.5 trees per acre (figure 1).

Figure 1.- RS., M-1, MC, Stanislaus Branch, Plot 9, STAND PER ACRE BEFORE AND AFTER CUTTING Trees 11.6 inches in diameter and over.

2. Distribution by size classes. Of the 121.9 trees per acre for all species, $\frac{3}{5}$ were in the 4 to 11 inch class, $\frac{1}{5}$ were in the classes between 12 and 23 inches, and $\frac{1}{5}$ were in the classes above 23 inches (table 5). In the small trees there were proportionately more firs and cedars than pines, especially ponderosa pine. About $\frac{2}{3}$ of the firs and cedars, $\frac{1}{2}$ the sugar pines, and only $\frac{1}{9}$ of the ponderosa pines were below 12 inches d.b.h. The four species had about equal proportions in diameters between 12 and 23 inches. Over $\frac{2}{3}$ of the ponderosa pines and $\frac{3}{10}$ of the sugar pines were above 23 inches in diameter and $\frac{2}{5}$ of the ponderosa pines and $\frac{1}{7}$ of the sugar pines were above 35 inches. These were much greater proportions than had by either fir or cedar.

Table 4.-Composition of the original stand by
trees, basal area and volume.

Acre basis								
Species	Trees		Basal area		Cubic foot volume		Board foot volume	
	:	:	:Square	:	:Cubic	:	:Board	:
	:Number	:Percent	:feet	:Percent	:feet	:Percent	:feet	:Percent
Ponderosa pine	5.8	4.8	39.7	16.7	2774	23.0	115682	26.4
Sugar pine	18.7	15.3	57.8	24.3	3375	28.0	18161	30.6
White fir	57.9	47.5	76.7	32.2	3672	30.5	17899	30.2
Incense cedar	39.5	32.4	63.7	26.8	2234	18.5	7594	12.8
All species	121.9	100.0	237.9	100.0	12055	100.0	59336	100.0

Table 5.-Distribution of trees in the original stand by size classes.

Species	Diameter class - inches										All classes			
	4-11	12-17	18-23	24-29	30-35	36+								
	Num- : ber	Per- : cent	Num- : ber	Per- : cent	Num- : ber	Per- : cent	Num- : ber	Per- : cent	Num- : ber	Per- : cent				
Ponderosa pine	0.7	11.1	0.5	9.5	0.6	9.5	0.9	17.5	0.7	11.1	2.4	41.3	5.8	100.0
Sugar pine	9.9	52.5	1.8	9.4	1.7	8.9	1.5	7.9	1.2	6.9	2.6	14.4	18.7	100.0
White fir	38.6	66.7	6.6	11.4	4.9	8.5	3.0	5.1	2.2	3.8	2.6	4.5	57.9	100.0
Incense cedar	25.2	64.1	4.2	10.6	2.7	7.0	2.0	4.9	2.7	6.6	2.7	6.8	39.5	100.0
All Species	74.4	61.0	13.1	10.7	9.9	8.1	7.4	6.1	6.8	5.6	10.3	8.5	121.9	100.0

3. Distribution by tree classes. Of the 121.9 trees per acre in the original stand, about $\frac{1}{4}$ were in class 1, $\frac{3}{10}$ were in class 2 and $\frac{1}{3}$ were in class 6. Classes 3, 4, and 5 together accounted for only about $\frac{1}{7}$ (14 percent) of the total and class 7 for but one percent.

Proportionately more of the cedars and firs were in classes 1, 2 and 6 than pines, especially ponderosa pine. A larger proportion of the pines, mainly ponderosa, were in classes 4, 5 and 7 than of firs and cedars. Ponderosa pine had the largest proportion of any species of trees in class 3, sugar pine the smallest.

Classes 1 and 2 accounted for less than $\frac{1}{5}$ of the original board foot volume on the plot, class 3 for $\frac{1}{5}$, and class 5 for over $\frac{1}{2}$ (table 7). Classes 4, 6 and 7 together contained less than 7 percent of the original volume.

Class 1 contained almost $\frac{1}{5}$ of the total volume of fir and cedar. Class 3 contained $\frac{1}{3}$ of the fir and $\frac{2}{5}$ of the cedar. Class 5 accounted for $\frac{3}{4}$ of the volume of ponderosa pine and sugar pine, but only $\frac{1}{3}$ of the fir and $\frac{1}{5}$ of the cedar.

4. Distribution by area. Most of the trees occurred in irregular groups. Occasional large trees, appeared singly.

5. Condition. The general condition of the original stand was poor. Many of the large trees were overmature and decadent. Repeated fires had caused a great number of scars and allowed entrance of heart-rot, especially in firs and cedars. Mistletoe was bad, and many trees had top injuries. Insect damage was apparently light.

Table 6.- Distribution of trees in the original stand
by tree classes, Acre basis.

Species	Tree Classes														All Classes	
	1	2	3	4	5	6	7									
	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent	No.	Per- cent		
Ponderosa Pine	1.1	19.1	1.1	19.0	0.5	7.9	0.2	3.2	2.1	36.5	0.5	7.9	0.3	6.4	5.8	100.0
Sugar pine	4.0	21.3	4.7	25.2	0.7	3.9	0.6	3.5	2.6	13.9	5.5	29.2	0.6	3.0	18.7	100.0
White fir	12.6	21.8	18.9	32.7	2.9	5.1	0.5	0.8	1.6	2.7	21.2	36.6	0.2	0.3	57.9	100.0
Incense cedar	10.7	27.2	10.6	26.8	2.9	7.3	1.2	3.0	1.0	2.6	12.8	32.4	0.3	0.7	39.5	100.0
All species	28.4	23.3	35.3	29.0	7.0	5.8	2.5	2.0	7.3	6.0	40.0	32.8	1.4	1.1	121.9	100.0

Table 7.- Distribution of board feet in the original stand
by tree classes (Trees 11.6 inches d.b.h. and over) Acre basis.

Species	Tree Classes														All Classes	
	1	2	3	4	5	6	7	1/								
	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-
	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent
Ponderosa	1401	8.9	299	1.9	1461	9.3	314	2.0	11895	75.9	64	0.4	253	1.6	15687	100.0
Pine	1490	8.2	438	2.4	1664	9.2	715	3.9	13711	75.5	110	0.6	41	0.2	18169	100.0
Sugar pine	3469	19.4	1111	6.2	5974	33.4	561	3.1	5948	33.2	731	4.1	100	0.6	17894	100.0
White fir	1401	18.3	345	4.5	3296	43.1	728	9.5	1618	21.1	226	3.0	40	0.5	7654	100.0
Incense cedar	7761	13.1	2193	3.7	12395	20.9	2318	5.9	53172	55.8	1131	1.9	434	0.7	59404	100.0
All Species	7761	13.1	2193	3.7	12395	20.9	2318	5.9	53172	55.8	1131	1.9	434	0.7	59404	100.0

1/ These totals do not check with totals in table — as they are based on different averages.

Table 8.- Original stand and portions cut and left in trees and
board foot volume 11.6 inches d.b.h. and over.

Species	Acre basis							
	Original	:	Cut	:	Left	:	Percent	:
	stand	:	:	:	:	:	cut	:
	Board	:	Board	:	Board	:	Board	:
	Number	:	feet	:	Number	:	feet	:
	Number	:	feet	:	Number	:	feet	:
Ponderosa								
pine	5.1		15682		3.4		13743	
					1.7		1939	
					66.7		87.6	
					33.3		12.4	
Sugar								
pine	8.8		18161		3.6		14367	
					5.2		3794	
					40.9		79.1	
					59.1		20.9	
White								
fir	19.3		17899		8.8		14248	
					10.5		2651	
					45.6		79.6	
					54.4		20.4	
Incense								
cedar	14.3		7594		7.3		6168	
					7.0		1426	
					51.0		81.2	
					49.0		18.8	
All								
Species	47.5		59336		23.1		48526	
					24.4		10810	
					48.6		81.8	
					51.4		18.2	

Methods of Cutting and Treatment.

1. Marking. Plot 9 was marked according to standard Forest Service practice. The object was to have an improvement cutting in all species and size classes for salvage, sanitation, release of pines, spacing for seed trees and improved net growth and composition in the reserve stand.

The net results of marking appear in Table 8 and Figure 1. Of an original stand of 59,336 board feet per acre, 10,810 board feet or 18.2 percent were left. On the basis of percent of volume left, sugar pine was cut the lightest, followed closely by white fir, then incense cedar, and finally ponderosa pine.

About 35 percent of all the trees on the plot or 42.3 trees per acre were cut (Table 9). All firs and over 9/10 of the cedars and ponderosa pines, 36 inches d.b.h. and over were cut. Fairly large proportions of fir and cedar were cut in all classes over 23 inches d.b.h. Both pines were cut lightly in diameters below 36 inches. Below 12 inches there were no trees marked. However, logging removed about 26 percent of the trees of this group. Cutting was not entirely as intended. A 32-inch cedar was marked but not cut. A 20-inch sugar pine and a 22-inch white fir were not marked but cut and not because of logging injuries. Table 10 shows the distribution of the volume cut. About the same proportion of the original volume was removed in each species. Ponderosa pine had the greatest proportion removed, 87.6 percent, sugar pine the least, 79.1 percent.

Table 10.- Distribution of board foot volume cut and the percent cut of the original amount in each diameter class - trees 11.6 inches d.b.h. and over.

Species	Diameter classes - inches										All	
	12-17	18-23	24-29	30-35	36+	12-17	18-23	24-29	30-35	36+	classes	Per-
	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	Board Per-	cent	cent
	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	feet cent	cent
Ponderosa pine	14	12.6	106	49.0	587	54.2	433	37.2	12603	96.2	13743	87.6
Sugar pine	15	6.9	117	20.7	64	6.1	1212	57.2	12959	91.2	14367	79.1
White fir	169	15.8	570	30.7	1240	51.7	3546	92.0	8723	100.0	14248	79.6
Incense cedar	20	8.3	146	29.1	774	91.0	1386	69.3	3842	96.0	6168	81.2
All Species	218	13.3	939	29.9	2665	49.5	6577	72.0	38127	95.2	48526	81.8

Marking and removal in logging made but slight changes in the composition on the plot by trees (table 11). Sugar pine and white fir increased a little mostly at the expense of ponderosa pine, but partly at the expense of incense cedar. The decrease in ponderosa pine was even greater in basal area, cubic foot and board foot volume. Incense cedar gained as well as sugar pine and white fir. White fir with proportionately more trees in the smaller diameter classes had the greatest gain in trees, basal area and board foot volume. Sugar pine with a smaller proportion of trees cut than fir in diameters over 11.6 inches, showed the greatest gain in board foot volume.

2. Logging. Caterpillar — 60 tractors were used in yarding. Main skid roads were located, but little swamping was done. Contrary to instructions some logs were taken out through plot 9 from the adjoining economic selection plot. Thus, some damage occurred that was not rightfully chargeable to the plot.

3. Damage. A total of 238 unmarked trees were cut or destroyed (table 12). Most of them were below 12 inches d.b.h. and, except for the 20 inch sugar pine and 22 inch white fir previously mentioned as cut but not marked, they were destroyed or so severely injured by logging as to necessitate removal. The few large trees accounted for most of the destruction in board foot volume (table 13). For white fir $1/2$ the volume destroyed was contained in two trees, and $4/5$ of the cedar volume destroyed was contained in less than $1/20$ the trees.

Table 11.- Net changes in composition due to logging
based on percent of original stand.

Species	Trees	Basal area	Cubic feet	Board feet
Ponderosa Pine	-2.0	-7.3	-9.0	-8.5
Sugar pine	+1.2	+2.5	+3.2	+4.5
White fir	+1.5	+4.7	+4.3	+3.6
Incense cedar	-0.7	+0.1	+1.5	+0.4
All species	0.0	0.0	0.0	0.0

but cut and destroyed.

218

Table 13.- Distribution of board foot volume of trees marked and trees not marked but cut and destroyed.

Species	Diameter classes in inches					Plot basis	
	12-17	18-23	24-29	30-35	36+	All	Classes
	Marked: Cut and destroyed:	Marked: Cut and destroyed:	Marked: Cut and destroyed:	Marked: Cut and destroyed:	Marked: Cut and destroyed:	Marked: Cut and destroyed:	Marked: Cut and destroyed:
Ponderosa Pine	149	1143	6342	4683	136112	148429	236
Sugar pine	169	1024	236	689	13095	139952	154929
White fir	342	1481	4171	1990	12668	719	36681
Incense cedar	214	1030	551	7106	1259	12977	1983
All	660	1695	7369	2777	26805	1978	67436
							3599
							411767
							514036
							10049

Of the trees destroyed, felling accounted for almost 2/3, (table 14). It caused all the losses in trees over 17 inches d.b.h. and over 3/4 of the loss in trees in the 12 to 17 inch class. It was responsible for 3/5 of the losses in trees below 12 inches d.b.h. Since felling caused the greatest destruction in diameters over 11.6 inches it accounted for 94.8 percent of the board foot volume lost (table 15).

The distribution of damage to the remaining trees on the plot was as follows:

<u>Trees 3.6 to 11.5 inches d.b.h.</u>		<u>Trees 11.6 inches d.b.h. and over</u>		<u>Trees 3.6 inches d.b.h. and over</u>	
Number	Percent	Number	Percent	Number	Percent
91	15.3	36	13.6	127	14.8

About equal proportions of small and large trees were damaged, but the number of small trees damaged was greater.

Table 14.- Distribution of trees destroyed in logging in numbers and percent by diameter classes and causes. (3.6 inches d.b.h. and over)

Plot basis														
Species	Item	Diameter classes in inches										All classes		
		4-11	12-17	18-23	24-29	30-35	36+							
		Trees	Per-	Trees	Per-	Trees	Per-	Trees	Per-	Trees	Per-			
		cent:	cent:	cent:	cent:	cent:	cent:	cent:	cent:	cent:	Trees <td>Per-</td>	Per-		
Ponderosa Pine	Felling	1	50.0:								1	50.0		
	Yarding	1	50.0:								1	50.0		
Sugar Pine	Felling	15	71.4:								15	71.4		
	Yarding	6	28.6:								6	28.6		
White fir	Felling	67	61.5:	6	66.7:	4	100.0:	1	100.0:	1	100.0:	79	63.7	
	Yarding	42	38.5:	3	33.3:							45	36.3	
Incense Cedar	Felling	39	52.0:	4	100.0:	4	100.0:	3	100.0:	3	100.0:	53	59.6	
	Yarding	36	48.0:									36	40.4	
All species:	felling	122	58.9:	10	76.9:	8	100.0:	4	100.0:	4	100.0:	148	62.7	
	Yarding	85	41.1:	3	23.1:	0	00.0:	0	00.0:	0	00.0:	88	37.3	

° Trees cut and unmarked but not destroyed by logging are not included.

Table 15.- Distribution of board foot volume destroyed in logging by diameter classes and causes. (11.6 inches d.b.h. and over)

Plot basis														
Species	Item	Diameter classes in inches										All classes		
		12-17	18-23	24-29	30-35	36+								
		Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	
Ponderosa Pine	Felling													
	Yarding													
Sugar Pine	Felling													
	Yarding													
White fir	Felling	994	67.1	1518	100.0	719	100.0	1616	100.0			4847	90.9	
	Yarding	380	32.9									380	9.1	
Incense Cedar	Felling	214	100.0	551	100.0	1259	100.0	1983	100.0			4007	100.0	
	Yarding	0	00.0	0	0.0	0	00.0	0	0.0			0	0.0	
All species	Felling	1208	71.3	2069	100.0	1978	100.0	3599	100.0	0	0	8854	94.8	
	Yarding	380	23.7	0	0.0	0	0.0	0	0.0	0	0	380	5.2	

4. Slash disposal. Slash was piled following logging and burned late in the fall. In spite of care in placing piles, considerable damage resulted particularly to some of the smaller trees. A few poorly placed piles were left unburned.

A summary of the condition of the plot after logging and slash disposal follows:

<u>Degree or type of damage</u>	<u>Logs</u> ^{1/}	<u>Burns</u> ^{2/} and Slash	<u>Type of cover</u>				<u>Brush</u> and re- production	<u>Free</u>	<u>Total</u>
			<u>Brush</u>	<u>bear clover</u>	<u>Reprod- uction</u>				
			<u>Percent</u>						
Skid trails	24.9	36.2	25.5	35.5	21.4	24.1		33.8	30.5
Bare	1.0	2.9	3.6	2.8	3.0	1.7		4.2	3.5
Partial damage	15.4	24.9	14.9	21.6	10.9	15.9		17.3	16.8
No damage	58.7	36.0	56.0	40.1	64.7	58.3		44.8	49.2
<u>Total</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>	<u>100.0</u>		<u>100.0</u>	<u>100.0</u>
<u>Total area</u> as basis (square feet).	6920	14600	84440	87910	74805	7065		194708	470448

^{1/} Mapped before logging only.

^{2/} These amounts were deducted from the areas of original cover in which they fell.

These values were obtained by planimeter from a composite map of the plot showing cover types before logging and degree and type of damage following logging.

"Skid trails" and "bare" types of complete damage, covered 34.0 percent of the plot, were greatest in "Burns and slash", and "bear clover" and least in "reproduction". Here it should be noted that the values for "burns and slash" were deducted from the areas of other cover types after logging. They are not strictly comparable to the other types since placement of slash piles was necessarily influenced by the type of damage and the relative value of the remaining cover types.

"Partial damage" occurred on 16.8 percent of the plot. About $\frac{1}{4}$ of the area of "burns and slash" was of this type of damage and $\frac{1}{5}$ of the area of bear clover and only about $\frac{1}{10}$ of the area of reproduction.

No damage severe enough to be mapped occurred on half the area "free". Almost $\frac{2}{3}$ of the area of reproduction was under this damage type compared to $\frac{2}{5}$ of the area of "bear clover" and slightly over $\frac{1}{3}$ of the area of "burns and slash".

5. Grazing. Before logging the area was grazed lightly by cattle. Since logging all classes of stock have been kept out.

The Remaining Stand and Results of Cutting.

1. Composition. The remaining stand averaged 80 trees per acre 3.6 inches d.b.h. and over of which ponderosa pine made up 2.8 percent, sugar pine 16.5 percent, white fir 49.0 percent and incense cedar 31.7 percent. These trees averaged approximately 2,800 cubic feet per acre, of which ponderosa pine made up 14.0 percent, sugar pine 31.2 percent, white fir 34.8 percent, and incense cedar 20.0 percent (table 16).

The board foot volume (trees 11.6 inches d.b.h. and over) was approximately 10,800 board feet of which ponderosa pine made up 17.9 percent, sugar pine 35.1 percent, white fir 33.8 percent, and incense cedar 13.2 percent.

Table 16.- Composition of the remaining stand.

Acre basis								
Species	Trees		Basal area		Cubic volume		Board foot volume	
	Number	Per- cent	Square feet	Per- cent	Cubic feet	Per- cent	Board feet	Percent
Ponderosa Pine	2.2	2.8	6.7	9.4	391.0	14.0	1939	17.9
Sugar pine	13.1	16.5	19.2	26.8	871.4	31.2	3794	35.1
White fir	39.0	49.0	26.5	36.9	973.2	34.8	3651	33.8
Incense Cedar	25.3	31.7	19.2	26.9	558.0	20.0	1426	13.2
All species	79.6	100.0	71.7	100.0	2793.6	100.0	10810	100.0

2. Distribution by size classes. Table 17 and figure 2 show that 55.2 percent of the trees were under 12 inches d.b.h. and 69.6 percent were under 18 inches; 1.0 percent were over 35 inches and 3.4 percent were over 29 inches. About equal proportions of white fir and incense cedar trees were below 18 inches (87.4 and 87.6 percent respectively) while sugar pine and ponderosa pine had much smaller proportions of their trees in these diameters (72.6 and 41.6 percent respectively). Except for sugar pine in the 24 to 29 inch class and ponderosa pine in classes over 23 inches, few of the larger trees were left. The distribution appears favorable to good growth.

White fir and incense cedar were in the best positions for growth in basal area with $3/4$ and $2/3$ of their trees respectively below 24 inches d.b.h. (table 18). Proportionately less growth could be expected in the pines with most of their basal area concentrated in trees above 23 inches. Besides the intended seed production of these trees, fairly good quality increment could be expected on this site.

Of the volume, 2,793 cubic feet, in the remaining stand $1/8$ was in trees above 35 inches d.b.h. and $1/3$ in trees above 29 inches. The pines accounted for the greater portion of this (table 19). Over $3/4$ of the volume of fir and $1/2$ the volume of cedar was in trees 29 inches d.b.h. or less — the fast-growing and thrifty trees.

Table 17.- Distribution of remaining trees by size classes

Acre basis														
Species	Diameter classes — inches												All classes	
	4-11	12-17	18-23	24-29	30-35	36+								
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Ponderosa pine	0.5	20.8	0.4	20.8	0.3	12.5	0.4	20.9	0.4	16.7	0.2	8.3	2.2	100.0
Sugar pine	7.9	59.9	1.7	12.7	1.2	9.1	1.4	10.6	0.5	4.2	0.4	3.5	13.1	100.0
White fir	28.5	73.2	5.6	14.2	3.4	8.8	1.3	3.3	0.2	0.5	-	-	39.0	100.0
Incense cedar	18.5	72.6	3.8	15.0	1.9	7.7	0.2	0.7	0.9	3.3	0.2	0.7	25.3	100.0
All species:	55.2	69.4	11.5	14.4	6.8	8.6	3.3	4.2	2.0	2.4	0.8	1.0	79.6	100.0

Acre basis

Acre basis

Species	Diameter classes -- inches													All classes
	4-11	12-17	18-23	24-29	30-35	36+								
	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent		
Ponderosa Pine	0.2	2.6	0.6	9.1	0.6	8.7	1.7	25.8	2.2	32.3	1.4	21.5		
Sugar pine	2.2	11.2	1.8	9.7	2.8	14.6	5.0	26.2	3.3	17.2	4.1	21.1		
White fir	6.6	25.1	6.3	23.6	7.5	28.2	5.1	19.2	1.0	3.9	-	-		
Incense Cedar	4.1	21.1	4.3	22.3	4.4	22.9	0.7	3.7	4.4	22.6	1.4	7.4		
All	13.1	18.2	13.0	18.2	15.3	21.3	12.5	17.5	10.9	15.1	6.9	9.7		

Table 19.- Distribution of cubic foot volume of
the remaining trees by size classes.

Species	Diameter classes — inches												All classes
	4-11	12-17	18-23	24-29	30-35	36+							
	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	
Ponderosa Pine	5	1.2	24	6.2	29	7.4	102	26.2	139	35.4	92	23.6	391 100.0
Sugar pine	41	4.7	63	7.2	120	13.8	236	27.1	182	20.9	229	26.3	871 100.0
White fir	128	13.1	210	21.6	325	33.4	252	25.9	58	6.0	-	-	973 100.0
Incense cedar	57	10.3	115	20.6	135	24.1	25	4.4	169	30.4	57	10.2	558 100.0
All species:	231	8.3	412	14.7	609	21.8	615	22.1	548	19.6	378	13.5	2793 100.0

3. Distribution by tree classes. Tree class 1 accounted for 27.2 percent of the number of trees reserved, class 2 for 32.9 percent, and class 6 for 37.1 percent, while class 3 accounted for but 1.6 percent and classes 4, 5 and 7 for but 1.2 percent (table 20).

Ponderosa pine had the best distribution of any species with 42 percent of its trees in class 1, 33 percent in class 2, 8 percent in class 3 and only 17 percent in the small, intermediate and suppressed trees of class 6. Sugar pine had the next best distribution with 28 percent of its trees in class 1, 30. percent in class 2, 4 percent in class 3 and 32 percent in class 6. Sugar pine had poorer distributions than cedar in class 1, than fir in class 2. Sugar pine had better distribution for future growth than either of these other species. A larger proportion of sugar pine trees were in class 3, and a smaller proportion were in class 6.

Distribution of board foot volume by tree classes is shown in table 21. Distribution was good since over $1/2$ the volume was in vigorous class 1 trees, $1/5$ was in class 3 and $1/8$ was in class 2.

Ponderosa pine again had the best distribution of any species. Almost $2/3$ of it was in class 1 and $\frac{1}{4}$ was in class 3. Sugar pine did not show up as well as either fir or cedar in classes 1 or 2 but in class 3 had proportionately the largest volume of any species. It should be considered as having better distribution than fir which had the smallest proportion of volume of any species in class 3, and the largest proportion in the slower growing class 6 trees. Cedar had fairly good volume distribution by tree classes with 97 percent of its total in classes 1, 2 and 3.

Table 20.- Distribution of trees in the reserve stand
by tree classes.

Species	Tree Classes												All Classes
	1	2	3	4	5	6	7						
	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	
	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	
Ponderosa Pine	0.9	41.7	0.7	33.3	0.2	8.3	-	-	-	0.4	16.7	-	2.2
Sugar pine	3.6	27.5	4.0	30.5	0.4	3.5	0.4	2.8	0.2	1.4	4.2	32.4	13.1
White fir	9.3	23.7	14.0	35.9	0.2	0.5	-	-	-	-	15.5	39.9	39.0
Incense cedar	7.8	31.1	7.5	29.7	0.5	1.8	-	-	-	-	9.4	37.0	25.3
All species	21.6	27.2	26.2	32.9	1.3	1.6	0.4	0.5	0.2	0.2	29.5	37.1	79.6
													100.0

Table 21.- Distribution of board feet in the reserve
stand by tree classes.

(Trees 11.6 inches d.b.h. and over) Acre basis																
Species	Tree classes														All species ^{1/}	
	1	2	3	4	5	6	7									
	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent		
Ponderosa	1230	63.4	155	8.0	503	26.0					51	2.6			1939	100.0
Pine	1466	38.6	374	9.8	1048	27.6	326	8.6	542	14.3	43	1.1			3799	100.0
Sugar pine	2309	63.0	702	19.2	162	4.4					489	13.4			3662	100.0
White fir	840	56.9	152	10.3	364	24.7					114	7.7	5	0.4	1475	100.0
Incense Cedar																
All species	5845	53.7	1383	12.7	2077	19.1	326	3.0	542	5.0	697	6.4	5	0.1	10875	100.0

^{1/} These totals do not ~~include~~ ^{check} with totals of table 16 since they are based on different averages.

4. Distribution on the ground. Most of the remaining trees were in grouped arrangement due to the character of the original stand.

5. Condition of stand. Of the 860 trees over 3.5 inches d.b.h. on the plot after logging, 225 or about 26.2 percent showed defect or disease from one or more causes. The distribution of these is shown in table 22. Over 1/3 of the defects were due to logging wounds on bole and butt, and 1/4 to raked crowns and broken tops from logging. About 3/5 of all defects are chargeable to logging. Mistletoe, fungus (including witches brooms) and dead and broken tops due largely to mistletoe and possibly insects, caused over 1/5 of the defects. Fire caused about 1/8 of the damage and miscellaneous agencies (axe marks, porcupine damage, wounds from unknown causes, etc.) accounted for the remainder. Logging caused most defects in each species, except in ponderosa pine, where all recorded defects were due to fire (table 23). Fire was important in incense cedar and mistletoe in white fir.

The distribution of cull by species and diameter classes appears in table 24. One sugar pine in the 30-35 inch class accounted for over $\frac{1}{2}$ of all cull left on the plot and the largest percent of cull left in any diameter class.

6. Changes in composition. The net results of losses through death and gains in new trees for the first period appear in table 25 and table 26. Ponderosa pine and incense cedar gained slightly in numbers of trees at the expense of sugar pine and white fir. Cedar had the greatest gain, fir the greatest loss.

Table 22.- Distribution of defects by causes
in number and percent.

All species — plot basis						
Defects	3.6 — 11.5 inches d.b.h.		11.6 inches d.b.h. and over		3.6 inches d.b.h. and over	
	Number	Percent	Number	Percent	Number	Percent
Witches broom	7	2.5	1	0.4	8	2.9
Fungus	2	0.7	1	0.4	3	1.1
Insects						
Mistletoe	15	5.4	14	5.0	29	10.4
Logging (butt & bole) wounds	77	27.7	24	8.6	101	36.3
Logging - raked crowns	14	5.1	12	4.3	26	9.4
Logging - broken tops	37	13.3	8	2.9	45	16.2
Broken and dead tops	17	6.1	5	1.8	22	7.9
Fire	17	6.1	17	6.1	34	12.2
Miscellaneous	5	1.8	5	1.8	10	3.6
Total	191	68.7	87	31.3	278	100.0

Table 23.- Distribution of defects by
species and causes.

Plot basis											
Species	Fungus witches broom	Fungus	Insects	Mistletoe 2 m	Logging		Raked crown logging	Broken		Fire	Misc. Total
					wounds boles butt	logs		top log- ging	top or dead		
Ponderosa Pine										2	2
Sugar pine					22	2	7	7	9	2	49
White fir		1		28	51	13	22	10	8	6	139
Incense Cedar	8	2		1	28	11	16	5	15	2	88
All	8	3		29	101	26	45	22	34	10	278

Table 24.- Cull in board feet in the remaining stand
and percent of reserve.

Plot basis												
Species	Diameter classes — inches											
	12-17		18-23		24-29		30-35		36+		All classes	
	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent
Ponderosa Pine	:	:	:	:	:	:	:	:	:	:	:	:
Sugar pine	:	:	:	:	:	:	:	:	:	:	:	:
White fir	:	:	:	:	:	:	:	:	:	:	:	:
Incense cedar	:	:	:	:	:	:	:	:	:	:	:	:
All	:	:	:	:	:	:	:	:	:	:	:	:
	223	1.4	437	1.8	18	0.1	902	3.3	69	0.3	1649	1.4

Table 25.- Changes in composition 1929-35
in numbers of trees.

Acre basis							
Species	Stand 1929	Dead 1929-34	New trees 1929-34	Stand 1934	Percent 1929	Percent 1934	Percent net changes 1929-34
Ponderosa							
Pine	2.2	0.0	0.3	2.5	2.8	3.0	+0.2
Sugar pine	13.1	0.4	0.8	13.5	16.5	16.1	-0.4
White fir	39.0	3.4	4.7	40.3	49.0	47.9	-1.1
Incense Cedar	25.3	0.6	3.1	27.8	31.7	33.0	+1.3
All	79.6	4.4	8.9	84.1	100.0	100.0	

Table 26.- Changes in composition in cubic
foot volume, 1929-35

Acre basis							
Species	Stand 1929	Dead 1929-34	New trees 1929-34	Stand 1934	Percent 1929	Percent 1934	Percent net changes 1929-34
Ponderosa							
Pine	391.0	0	0.2	425.2	14.0	14.1	+0.1
Sugar pine	871.4	34.3	0.7	923.1	31.2	30.5	-0.7
White fir	973.2	51.7	3.5	1060.3	34.8	35.1	+0.3
Incense cedar	553.0	0.6	2.0	614.9	20.0	20.3	+0.3
All	2793.6	86.6	6.4	3023.5	100.0	100.0	

The changes in composition by cubic foot volume are not great. Sugar pine lost somewhat more in volume than in trees. The other species, including fir, gained at the expense of the sugar pine.

7. Growth.

a. Diameter. Average annual diameter increase by diameter classes is shown in table 27. The average for all species and each species except fir was 0.15 inch per year, for fir 0.16 inch per year. The best average increase was made in the 30 to 35 inch class probably because only the most vigorous trees were left in this class for seed production and quality increment. White fir made the best average growth in this class, followed in order by sugar pine, ponderosa pine, and incense cedar. Cedar made its best growth in the 24 to 29 inch class.

Ponderosa pine had the best diameter growth of any species up to 9 inches, white fir from 10 to 14 inches, sugar pine from 14 to 23 inches, incense cedar from 24 to 27 inches and white fir again above 27 inches.

Figure 4.- Average Annual Increase in Diameter. 1929 - 1934

Sugar pine showed the poorest growth up to 8 inches, cedar from 8 to 11 inches, ponderosa pine from 11 to 25 inches, sugar pine from 25 to 26 inches, white fir at 27 inches, and cedar from 28 to 36 inches. Sugar pine above 36 inches showed relatively poorer growth than the other species since it had trees of a larger average diameter and poorer growth.

Table 27.- Average annual increase in diameter
in inches

Plot basis							
	:	Diameter classes -- inches					:
	:						:
Species	:	4-11	12-17	18-23	24-29	30-35	36+ :
Ponderosa pine		0.19	0.06	0.09	0.18	0.21	0.16 0.15
Sugar pine		0.14	0.19	0.20	0.16	0.24	0.12 0.15
White fir		0.15	0.19	0.18	0.17	0.30	- 0.16
Incense cedar		0.15	0.12	0.16	0.19	0.16	0.18 0.15
All		0.15	0.16	0.17	0.17	0.21	0.14 0.15

b. Height. The average annual growth per tree for all species and diameter classes was 0.41 foot (table 28). Trees in the 24-29 inch class maintained the best average. The relation between height and diameter growth is not well defined. The smallest and largest trees grew the least.

The species did not retain the same relative positions they had in diameter growth. Ponderosa pine instead of white fir made the best growth with sugar pine, fir and cedar following in order. Figure 5 shows ponderosa pine had the best average growth in all diameter classes except the 12-17 inch class, where it was exceeded by fir, and the 30-35 inch class, where it was exceeded by both fir and sugar pine. Sugar pine had better growth than fir only in the 4-11 inch class. Cedar in every diameter class had less growth than any other species.

c. Growth rate in basal area. The growth rates in table 29 were obtained by including only the trees of each diameter ~~and tree~~ class which were tagged in 1929 and survived through 1934. The effects of death and entry of new trees were thus excluded.

The average growth rate for the entire stand was 1.416 square feet per acre per year or 2.05 percent. This rate seems low when the quality of the site is considered, but may be explained in part by diameter class distribution and the occurrence of most of the smaller trees in groups.

The best growth percent was made in the 4-11 inch class in all species. Ponderosa pine leads with the highest percent but least growth for any species, and white fir, incense cedar and sugar pine following in order. Ponderosa pine had the least growth of any species or diameter class in the 12-17 inch class. Its growth increased through the following diameter classes apparently because of more favorable tree class distribution, to drop again in the less vigorous trees beyond 35 inches.

Table 28. -Average annual increase in height in feet

Plot basis							
Species	Diameter classes - in inches						All
	4-11	12-17	18-23	24-29	30-35	36+	classes
Ponderosa pine	0.52	0.48	0.67	0.80	0.60	0.70	0.62
Sugar pine	0.43	0.44	0.57	0.68	0.73	0.60	0.49
White fir	0.40	0.57	0.63	0.69	0.80	-	0.46
Incense cedar	0.27	0.37	0.32	0.30	0.29	0.40	0.29
All species	0.36	0.48	0.53	0.68	0.52	0.58	0.41

Table 29.- Growth percent -- basal area
(total growth)

Acre basis																								
Species:		Diameter classes in inches																All						
:	:	4-11				12-17				18-23				24-29				30-35				36+		:
:	:	Square		Per-		Square		Per-		Square		Per-		Square		Per-		Square		Per-		:		
:	:	feet		cent		feet		cent		feet		cent		feet		cent		feet		cent		:		
:	:	Classes		Classes		Classes		Classes		Classes		Classes		Classes		Classes		Classes		Classes		:		

(net growth)

Diameter classes in inches

Species	Diameter classes in inches												All : classes	
	4-11	12-17		18-23		24-29		30-35		36+				
	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent		
Ponderosa pine	0.34	7.06	0.31	1.29	0.46	1.61	2.09	2.05	2.39	1.72	1.24	1.35	6.83	1.75
Sugar pine	2.07	5.01	2.04	3.25	3.07	2.56	-2.87	-1.22	3.54	1.94	2.50	1.09	10.35	1.19
White fir	4.00	3.13	1.44	0.69	5.73	1.76	4.80	1.90	1.44	2.47	-	-	17.41	1.79
Incense cedar	3.22	5.61	2.26	1.97	2.48	1.84	0.41	1.65	2.26	1.33	0.76	1.33	11.39	2.04
All														
Species	9.63	4.16	6.05	1.47	11.74	1.93	4.43	0.72	9.63	1.75	4.50	1.19	45.98	1.65

The growth of sugar pine, fir and cedar decreased through each larger diameter class over 11 inches, except in the 30-35 and 36+ inch classes. Several vigorous sugar pines and two vigorous firs caused rises in the trends of their respective species in the 30 to 35 inch class. Two trees of over average vigor raised the trend of cedar in the 36+ inch class.

d. Cubic feet. Net growth in cubic feet including the volume of new trees which grew into the lower diameter classes is shown in table 30. Growth exceeded loss in all species and diameter classes except sugar pine in the 24-29 inch class. There was a gain of 46.0 cubic feet per acre per year or 1.65 percent on the remaining stand of 2,793 cubic feet.

Cedar showed the largest gain in growth percent, followed in order by fir, ponderosa pine, and sugar pine. However, fir accounted for 37.9 percent of the total increase in volume, cedar 24.8 percent, sugar pine 22.5 percent, and ponderosa pine 14.8 percent -- a result of the distribution by species.

Low loss from death and gains in new trees accounted for the rather favorable net growth. About 3 percent of the total net gain was due to new trees. The death of two sugar pines in the 24-29 inch class accounted for a total loss of 360 cubic feet, the only net loss in any diameter class.

e. Board feet. The average net growth in board feet per acre and percent annually appears in table 31.

Table 31.- Average annual net growth in board feet.

<u>Acre basis</u>		
<u>Species</u>	<u>Board feet</u>	<u>Percent</u>
Ponderosa pine	37.6	1.94
Sugar pine	47.2	1.24
White fir	94.8	2.60
Incense cedar	40.6	2.85
All species	220.2	2.04

The growth rate of 2.04 percent was made on a remaining volume of 10,811 board feet per acre.

8. Losses. Table 32 shows the distribution of average annual losses in trees by diameter classes. Losses have been high, averaging 0.89 trees per acre yearly. Of the total, 77.1 percent was in the 4-11 inch class and 16.6 percent in the 12-17 inch class. No ponderosa pines were lost. One-half the sugar pine loss was in the 4-11 inch and one-half in the 24-29 inch class; 3/4 of the fir loss was in the 4-11 inch and 1/5 in the 12-17 inch class. All cedar losses were in the 4-11 inch class. There were no losses in trees over 29 inches d.b.h.

The annual loss in cubic foot volume has averaged 17.3 feet per acre (table 33). Of this, the largest proportion, 38.5 percent occurred in the 24-29 inch class, the next largest, 29.4 percent, in the 12-17 inch class, and 19.5 percent in the 4-11 and 12.6 percent in the 18-23 inch classes.

Of the sugar pine loss, 97.3 percent was in the 24-29 inch and 2.7 percent was in the 4-11 inch class. In fir, 49.3 percent of the loss was in the 12-17 inch class, 29.6 percent in the 4-11 inch class, and 21.1 percent in the 18-23 inch class. Fir accounted for all the losses in the

diameters between 12 and 23 inches, and sugar pine for losses between 24 and 29 inches. There was an annual loss of 60.0 board feet per acre (table 34).

A summary of losses of trees, basal area, and volume by species in actual amount, percent of losses and percent of stand for the first five-year period, appears in table 35.

Cull in the remaining stand compared to losses for the first five-year period appears in table 36. In the 12-17 and 18-23 inch classes of white fir some of the volume listed as loss may have been cull initially. The total cull amounted to 1.4 percent, just one-half the amount of loss from death in the first period.

Table 37 and table 38 show the distribution of losses by causes for diameter classes and for species. In the 4-11 inch class insects were responsible for 54.1 percent and slash burning for 27.0 percent of the loss, the remainder being due to logging, broken tops, and unknown causes. In the 12-17 inch class 62.5 percent of the loss was due to insects, 25.0 percent to broken tops. Windthrow took out the only tree between 18 and 23 inches, while insects killed both of the trees lost in the 24-29 inch class.

In ponderosa pine there were no losses. (Table 38). In sugar pine 75.0 percent of the losses were due to insects, 25.0 percent to broken tops. In white fir 62.2 percent of the losses were caused by insects, 13.5 percent by slash burning, 10.8 percent by broken tops and the remainder by logging, mistletoe, windthrow and unknown causes. In cedar 71.4 percent of the losses were caused by slash burning, and 14.3 percent each by insects and by logging.

Table 32. - Distribution of average annual losses in trees
by diameter classes.

Acre basis												
		Diameter classes -- inches										
Species		4-11	12-17	18-23	24-29	30-35	36+	All				
		:classes:										
	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-
		cent		cent		cent		cent		cent		cent
Ponderosa												
pine												
Sugar												
pine	0.04	50.0			0.04	50.0			0.08	100.0		
White												
fir	0.51	75.7	0.15	21.6	0.02	2.7			0.68	100.0		
Incense												
cedar	0.13	100.0							0.13	100.0		
All												
species	0.68	77.1	0.15	16.6	0.02	2.1	0.04	4.2	0.80	100.0		

Table 35. - Distribution of average annual losses in cubic foot volume by diameter classes.

Species	Acre basis									
	Diameter classes -- inches									
	4-11	12-17	18-23	24-29	30-35	36+	All classes			
	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent
Ponderosa pine										
Sugar pine	0.18	2.7		6.67	97.3		6.85	100.0		
White fir	3.06	29.6	5.09	49.3	2.18	2.11	10.33	100.0		
Incense cedar	0.13	100.0					0.13	100.0		
All species	3.37	19.5	5.09	29.4	2.18	12.6	6.67	38.5	17.31	100.0

Table 34. - Average annual losses in board feet

Acre basis								
	:	Diameter classes - inches					:	All
	:						:	classes
Species	:	12-17	18-23	24-29	30-35	36+	:	
<u>Board feet</u>								
Ponderosa								
pine								
Sugar								
pine				28.4				28.4
White								
fir		22.6	9.0					31.6
Incense								
cedar								
All								
species		22.6	9.0	28.4				60.0

Table 35.- Summary of periodic losses by species

Plot basis												
Species	Number	Trees			Basal area			Cubic volume			Board volume	
		Percent of losses	Percent of stand	Square feet of losses	Percent of losses	Percent of stand	Cubic feet of losses	Percent of losses	Percent of stand	Board feet of losses	Percent of losses	Percent of stand
Ponderosa pine	0											
Sugar pine	4	8.3	2.8	8.4	30.2	4.1	370	39.6	3.9	1535	47.3	3.7
White fir	37	77.1	8.8	18.7	67.3	6.5	558	59.7	5.3	1709	52.7	4.3
Incense cedar	7	14.6	2.6	0.7	2.5	0.3	7	0.7	0.1	0	0	0
All species	48	100.0	5.6	27.8	100.0	3.6	935	100.0	3.1	3244	100.0	2.8

Table 36.- Cull in remaining stand and mortality for
first period - percent of remaining stand.

Board feet												
Diameter classes - inches												
Species	12-17	18-23	24-29	30-35	36+							
	Cull	Loss	Cull	Loss	Cull	Loss	Cull	Loss	Cull	Loss	Cull	Loss
Ponderosa												
pine												
Sugar												
pine					14.4	9.2			0.5		2.4	3.7
White												
fir	0.4	12.6	1.2	3.5							0.5	4.3
Incense												
cedar	7.7		6.9		2.2						3.0	
All												
species	1.4	7.9	1.8	2.0	0.1	5.2	3.3		0.3		1.4	2.8

Table 37.- Distribution of losses in trees by causes
and diameter classes.

Plot basis									
Diameter:	Causes							Total	
Classes :	Broken Slash							All :	trees as
(inches):	Insects	Mistletoe	Logging	top	burning	Wind	Unknown:	Causes:	basis
Percent									
4-11	54.1		8.1	8.1	27.0		2.7	100.0	37
12-17	62.5	12.5		25.0				100.0	8
18-23						100.0		100.0	1
24-29	100.0							100.0	2
All									
classes	56.2	2.1	6.3	10.4	20.8	2.1	2.1	100.0	48

Table 38.- Distribution of losses in number of trees
by causes and species.

Species	Causes							All causes	Total trees as basis
	Insects	Mistletoe	Logging	Broken top	Slash Burning	Wind	Unknown		
	<u>Percent</u>								
Ponderosa pine								—	0
Sugar pine	75.0			25.0				100.0	4
White fir	62.2	2.7	5.4	10.8	13.5	2.7	2.7	100.0	37
Incense cedar	14.3		14.3		71.4			100.0	7
All species	60.4	2.1	6.3	10.4	20.8	2.1	2.1	100.0	48

For all species and diameter classes insects were the most important cause of loss, contributing 60.4 percent of the total. Following insect damage in importance were slash burning (20.8 percent), broken tops (10.4 percent), logging (6.3 percent), and mistletoe, windthrow and unknown causes (2.1 percent each).

9. Reproduction.

A transect of 100 milacre quadrats was laid out prior to logging. Seedlings and reproduction were recorded by species and size up to 3.6 inches d.b.h. Following logging and yearly thereafter the quadrats have been mapped and changes in seedlings noted.

The number of seedlings and composition based on transect records is shown in table 39. There was an average of 8920 seedlings per acre before logging. Almost 60 percent of these were fir, 32 percent were cedar, less than 8 percent were sugar pine and less than 0.5 percent were ponderosa pine.

Logging reduced the total number of seedlings per acre to 2890. The percentage of fir dropped to less than 50. Cedar increased to a little over 40 percent. Sugar pine increased to almost 10 percent. Ponderosa pine dropped out completely.

In the five years following logging the total number of seedlings rose to 3110 per acre. In spite of this gain fir had an actual as well as percentage loss and made up but 34 percent of the total. Cedar with most of the actual gain made up over 56 percent. Sugar pine dropped slightly while ponderosa pine came back to 0.6 percent of the total.

Table 39.- Number of seedlings per 0.1 acre and composition

Species :	June 1929 Before logging		October 1929 After logging		June 1934	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Ponderosa pine	4	0.4	0	0.0	2	0.6
Sugar pine	69	7.7	28	9.7	28	9.0
White fir	533	59.8	144	49.8	106	34.1
Incense cedar	286	32.1	117	40.5	175	56.3
Total	892	100.0	289	100.0	311	100.0

The distribution of reproduction by size classes is shown in table 40. Over 40 percent were one half foot high or less and about 75 percent were one foot or less. Only one percent were over four feet in height. Fir averaged larger than the other species almost 10 percent being over 2 feet in height compared with 3.5 for sugar pine and 3.4 percent for incense cedar.

Distribution on the ground was fair. Of the 100 quadrats but 58 had one or more seedlings each after logging. New seedlings had raised the stocking to 63 percent by 1934. New seedlings surviving in 1934 amounted to 1120 per acre. Of these 1000 were cedars (61 percent of which germinated in 1932) 60 were sugar pine, 40 were white fir and 20 were ponderosa pine. New seedlings have surpassed losses by death in advance growth only in cedar and ponderosa pine. Losses have greatly exceeded the gains in new seedlings in fir.

Table 40. - Distribution of reproduction after logging by species
and size classes. (basis 0.1 acre)

Height in feet	0.0 — 0.5	0.5 — 1.0	1.0 — 2.0	2.0 — 3.0	3.0 — 4.0	4.0+ to 3.6 inches d.b.h.	Total							
Species	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent						
Ponderosa pine	—	—	—	—	—	—	—	—						
Sugar pine	12	42.9	8	28.6	7	25.0	1	3.5	28	100.0				
White fir	57	39.6	38	26.4	35	24.3	8	5.5	5	3.5	1	0.7	144	100.0
Incense cedar	51	43.6	50	42.7	12	10.3	1	0.9	1	0.8	2	1.7	117	100.0
All species	120	41.5	96	33.2	54	18.7	10	3.5	6	2.1	3	1.0	289	100.0

6221

Plot 10.

The Original Stand

1. Composition. The plot averaged 119.9 trees per acre 3.6 inches d.b.h. and over, of which ponderosa pine made up 2.3 percent, sugar pine 17.2 percent, white fir 53.3 percent and incense cedar 27.2 percent (Table 4).

The volume averaged 63,190 board feet per acre in trees 11.6 inches d.b.h. and over (Scribner rule). This volume was made up of 13.9 percent ponderosa pine, 29.8 percent sugar pine, 45.1 percent white fir and 11.2 percent incense cedar. The volume was contained in 1.2 ponderosa pines, 6.9 sugar pine, 20.6 white fir and 6.6 incense cedars, a total of 35.3 trees per acre. (Figure 6).

2. Distribution by diameter classes. Of the 119.9 trees per acre for all species, almost $3/4$ were in the 4 to 11 inch class, $1/8$ were between 12 and 23 inches, and $1/5$ were in the classes above 23 inches (table 42). There were proportionately more cedars than firs or pines, especially ponderosa pines, in the smaller diameters. An even $4/5$ of the cedars were below 12 inches compared with about $2/3$ of the sugar pines and white firs and slightly over $1/2$ of the ponderosa pines. Over $2/5$ of the ponderosa pines were in diameters above 29 inches -- the largest proportion of any species.

3. Distribution by tree classes. Of the 119.9 trees per acre in the original stand, about $1/5$ were in each class 1 and class 2, about $1/6$ were in classes 3, 4 and 5 together, and over $2/5$ were in class 6 (table 43).

Table 41. -Composition of the original stand by trees,
basal area and volume.

Acre basis								
Species	Trees		Basal area		Cubic foot volume		Board foot volume	
	Number	Per-cent	Square feet	Per-cent	Cubic feet	Per-cent	Board feet	Per-cent
Ponderosa pine	2.7	2.3	19.0	8.4	1487	12.1	8808	13.9
Sugar pine	20.5	17.2	53.8	23.8	3361	27.5	18823	29.8
White fir	64.0	53.3	104.5	46.1	5535	45.2	28494	45.1
Incense cedar	32.7	27.2	49.0	21.7	1862	15.2	7065	11.2
All species	119.9	100.0	226.3	100.0	12245	100.0	63190	100.0

Plot 10

Table 42.- Distribution of trees in the original stand
by diameter classes.

		Diameter classes -- inches										All classes	
Species		4-11	12-17	18-23	24-29	30-35	36+						
	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	
	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	
Ponderosa pine	1.5	53.9			0.1	3.8	0.2	7.7	0.9	34.6	2.7	100.0	
Sugar pine	13.6	66.2	2.2	10.6	0.8	4.1	0.5	2.5	0.4	2.0	3.0	14.6	20.5
White fir	43.4	67.9	6.0	9.4	3.4	5.2	2.8	4.4	3.4	5.4	5.0	7.7	64.0
Incense cedar	26.1	80.0	1.8	5.4	0.6	1.9	0.2	0.6	1.1	3.2	2.9	8.9	32.7
All species	84.6	70.6	10.0	8.3	4.8	4.0	3.6	3.0	5.1	4.3	11.8	9.8	119.9
													100.0

Table 43.- Distribution of trees in the original stand
by tree classes.

Three 56" d.b.h. and over acre basis

Species	Tree classes														All classes
	1	2	3	4	5	6	7								
Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-
cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent
Ponderosa															
pine	0.4	15.4	0.4	15.4		1.1	38.5	0.7	26.9	0.1	3.8	2.7		100.0	
Sugar pine	3.7	18.2	5.2	25.3	0.7	3.5	0.4	2.0	2.4	11.6	8.1	39.4		20.5	100.0
White fir	12.8	20.0	10.1	15.8	5.7	8.8	2.1	3.3	3.2	5.1	29.4	45.9	0.7	1.1	64.0
Incense	7.2	22.0	7.5	22.9	1.2	3.8	0.5	1.6	1.9	5.8	14.3	43.6	0.1	0.3	32.7
cedar															100.0
All species	24.1	20.1	23.2	19.4	7.6	6.3	3.0	2.5	8.6	7.1	52.5	43.8	0.9	0.8	119.9
															100.0

Table 44.- Distribution of board feet in the original stand by tree classes.
(Trees 11.6 inches d.b.h. and over) Acre basis.

Species	Tree classes														All classes
	1	2	3	4	5	6	7								
Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-
feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent
Ponderosa															
pine	117	1.3						8506	96.6			185	2.1	8808	100.0
Sugar pine	911	4.8	134	0.7	2392	12.7	498	2.7	14870	79.0	18	0.1		18823	100.0
White fir	2358	8.2	438	1.5	11370	39.7	2067	7.2	12072	42.2	134	0.5	203.	0.7	28642
Incense															100.0
cedar	370	5.2	88	1.2	1857	26.3	342	4.8	4233	59.9	110	1.6	69	1.0	7069
															100.0
All species	3756	5.9	660	1.0	15619	24.7	2907	4.6	39681	62.7	262	0.4	457	0.7	63342
															100.0

1/ Totals do not check with totals of table 41 as different averages were used.

In class 1, cedar and fir had proportionately the greatest number of trees, class 2, sugar pine and incense cedar, classes 3 and 4 white fir, class 5 ponderosa pine, class 6 white fir and incense cedar, and class 7 ponderosa pine.

Of the board foot volume, $1/5$ was in class 3 and almost $2/3$ in class 5 (table 44). Classes 1, 2, 3 and 4 contained proportionately more fir than any other species. Class 3 alone accounted for $2/5$ of all the fir. Class 5 contained most of the ponderosa pine (97 percent) over $3/4$ of the sugar pine, $2/5$ of the fir and $3/5$ of the cedar.

4. Distribution by area. As for plot 9, most of the trees occurred in irregular groups. Occasional large trees appeared singly.

5. Condition. The general condition was the same as described under plot 9.

Methods of Cutting and Treatment

1. Marking. Plot 10 was marked by Mr. D. T. Mason according to the economic selection system proposed by the firm of consulting foresters, Mason and Stevens. The object was to give the highest returns to the operator per M. and per season for the first cut. Only the larger sizes and better trees were to be cut. There was to be no improvement cutting for sanitation salvage, growth or improvement of composition.

The net results of marking appear in table 45 and figure 6.

Figure 6.- Rs, M-1, Mc, Stanislaus Branch, Plot 10 STAND PER ACRE before and after cutting.

Of an original stand of 63,190 board feet per acre, 37,037 board feet or 58.6 percent were left. On the basis of percent of volume left white fir was cut the lightest followed closely by incense cedar, the total volume of which was removed through logging damage. Sugar pine was cut somewhat heavier and ponderosa pine was cut the heaviest of all.

Table 45.- Original stand and portions cut and left in trees and board/foot volume 11.6 inches d.b.h. and over.

Species	Acre basis									
	Original stand		Cut		Left		Percent cut		Percent left	
	Number	board feet	Number	Board feet	Number	Board feet	Number	Board feet	Number	Board feet
Ponderosa pine	1.2	8808	1.0	8466	0.2	342	83.3	96.1	16.7	3.9
Sugar pine	6.9	18823	2.8	16555	4.1	2268	40.6	88.0	59.4	12.0
White fir	20.6	28494	0.5	746	20.1	27748	2.4	2.6	97.6	97.4
Incense cedar	6.6	7065	0.3	386	6.3	6679	4.5	5.5	95.5	94.5
All species	35.3	63190	4.6	26153	30.7	37037	13.0	41.4	87.0	58.6

Only 9 percent of the trees on the plot 3.6 inches d.b.h. and over or 10.4 trees per acre were cut (table 46). All ponderosa pines 93 percent of the sugar pines. 4 percent of the firs and 2 percent of the cedars 36 inches d.b.h. and over were cut. But $\frac{1}{2}$ of the ponderosa pines and no trees of the other species were cut in the 30 to 35 inch class. No trees below 30 inches d.b.h. were marked but logging removed 4 percent of the firs in the 24 to 29 and 3 percent in the 18 to 23 inch class, 12 percent of the cedars in 12 to 17 inch class and 5 percent of the sugar pines, 8 percent of the firs, and 7 percent of the cedars in the 4 to 11 inch class.

The distribution of the volume cut appears in table 47. Over $\frac{2}{5}$ of the total volume was removed. Almost all of this was in trees 36 inches d.b.h. and over. More than half of the volume in class was removed.

Marking and removal in logging made but slight changes in the composition of the plot by trees, but changes in the composition by basal area, and volume, especially board foot volume were large (table 48). The small cedars and firs removed made up for the large trees removed in the pines. The volume of the pines removed lowered the percentage composition of ponderosa pine 13 percent and sugar pine 24 percent. Fir and cedar gained proportionately, fir 30 percent, cedar 7 percent.

2. Logging. The same type of equipment and procedure was followed as on plot 9.

3. Damage. As mentioned instructions were not followed implicitly. Logs from the upper end of this plot were taken out through plot 9, others through plot 11, the heavy cutting plot. The net result was less damage from logging on this plot than rightfully should be charged. Damage on the adjoining plots was correspondingly too heavy.

Table 46.- Distribution of the trees cut and the percent cut of the original number in each diameter class (trees 3.6 inches d.b.h. and over)

Acre basis														
Species	Diameter classes -- inches												All classes	
	4-11	12-17	18-23	24-29	30-35	36+								
	Trees	Per- cent	Trees	Per- cent	Trees	Per- cent	Trees	Per- cent	Trees	Per- cent	Trees	Per- cent		
Ponderosa pine	0.0	0.0			0.0	0.0	0.1	50.0	0.9	100.0	1.0	38.5		
Sugar pine	0.6	4.6	0.0	0.0	0.0	0.0	0.0	0.0	2.8	93.1	3.4	16.7		
White fir	3.4	7.9	0.0	0.0	0.1	3.1	0.1	3.7	0.0	0.0	0.3	4.3	3.9	6.0
Incense cedar	1.8	6.8	0.2	11.8	0.0	0.0	0.0	0.0	0.1	3.6	2.1	6.4		
All species	5.8	6.9	0.2	2.1	0.1	2.2	0.1	2.9	0.1	2.0	4.1	34.5	10.4	8.7

Table 47.-Distribution of board foot volume cut and the percent cut
of the original amount in each diameter class
-(trees 11.6 inches d.b.h. and over).

Species	Diameter classes - inches												All classes
	12-17			18-23			24-29			30-35			36- 41
	Board feet	Per- cent	Per- cent	Board feet	Per- cent	Per- cent	Board feet	Per- cent	Per- cent	Board feet	Per- cent	Per- cent	
Ponderosa pine	-	-	-	-	-	0	0.0	0.0	185	45.1	8281	100.0	8466 96.1
Sugar pine	0	0.0	0	0	0.0	0	0.0	0.0	0	0.0	16555	97.1	16555 88.0
White fir	0	0.0	30	2.0	110	3.8	0	0.0	606	3.6	746	2.6	
Incense cedar	12	12.1	0	0.0	0	0.0	0	0.0	374	6.4	386	5.5	
All species	12	0.9	30	1.6	110	3.1	185	2.2	25816	53.6	26153	41.4	

Table 48.- Net changes in composition due to logging
based on percent of original stand.

Species	Trees	Basal area	Cubic feet	Board feet
Ponderosa pine	-0.8	-7.6	-11.2	-13.0
Sugar pine	-1.5	-15.5	-20.3	-23.7
White fir	+1.5	+16.1	+24.0	+29.8
Incense cedar	+0.8	+7.0	+7.5	+6.9
All species	0.0	0.0	0.0	0.0

A total of 62 unmarked trees were cut or destroyed in logging (table 49). Of these 56 were below 12 inches d.b.h. The few large trees accounted for most of the destruction in board foot volume. A total volume of 7575 board feet was destroyed of which $\frac{4}{5}$ was in trees above 35 inches d.b.h. (table 50). No ponderosa pines and no sugar pines above 11 inches were destroyed. One tree above 35 inches d.b.h. accounted for $\frac{2}{3}$ of the volume of fir destroyed. One cedar above 35 inches accounted for over $\frac{9}{10}$ of the volume destroyed in species.

Felling was responsible for $\frac{3}{5}$ of the trees destroyed yarding for $\frac{2}{5}$ (table 51). Felling was the more destructive in the 4 to 11 inch class. The two causes were about equally destructive to trees above 11 inches. Felling took out the one tree in the 18 to 23 inch class, yarding the one tree in the 24 to 29 inch class. In board foot volume yarding and felling were about equally destructive (table 52). Yarding was responsible for over $\frac{3}{4}$ of the destruction in the 12 to 17 inch class, for all the destruction in the 24 to 29 inch class and for $\frac{2}{5}$ of the destruction in the 36+ inch class. Felling caused all of the destruction in the 18 to 23 inch class. White fir suffered the most from yarding damage, cedar the most from felling damage.

Table 49.- Distribution of trees marked and trees not marked but cut and destroyed.

Species	Plot basis						
	Diameter classes -- in inches						
	4-11	12-17	18-23	24-29	30-35	36+	All classes
Ponderosa pine	Marked destroyed	Cut & Marked destroyed	Cut & Marked destroyed	Cut & Marked destroyed	Cut & Marked destroyed	Cut & Marked destroyed	Cut & Marked destroyed
Sugar pine	6				1	9	10 0
White fir	33		1	1		1	27 6
Incense cedar	17	2				1	1 0 20
All species	56	2	1	1	1	37	2 38 62

Table 50.- Distribution of board foot volume of trees marked and trees not marked but cut and destroyed.

Species	Plot basis									
	Diameter classes -- inches									
	12-17	18-23	24-29	30-35	36+	All	:classes			
	Marked	Cut & destroyed	Marked	Cut & destroyed	Marked	Cut & destroyed	Marked	Cut & destroyed	Marked	Cut & destroyed
Ponderosa pine				1722	79502		81274			
Sugar pine					158929		158929			
White fir		284		1054	3292	2527	3292	3865		
Incense cedar	122					3588		3710		
ALL species	122	284	1054	1772	241723	6115	243495	7575		

Table 51.- Distribution of trees destroyed in logging in numbers
and percent by diameter classes and causes.
(trees 3.6 inches d.b.h. and over)

Plot basis														
Species	Item	Diameter classes -- inches										All classes		
		4-11	12-17	18-23	24-29	30-35	36+							
Ponderosa pine	Felling	Trees	Per-	Trees	Per-	Trees	Per-	Trees	Per-	Trees	Per-	Trees	Per-	
		cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	cent	
	Yarding													
Sugar pine	Felling	3	50.0							3	50.0			
	Yarding	3	50.0							3	50.0			
White fir	Felling	20	60.6	1	100.0	0	0.0	0	0.0	21	58.3			
	Yarding	13	39.4	0	0.0	1	100.0	1	100.0	15	41.7			
Incense cedar	Felling	12	70.6	1	50.0			1	100.0	14	70.0			
	Yarding	5	29.4	1	50.0			0	0.0	6	30.0			
All species	Felling	35	62.5	1	50.0	1	100.0	0	0.0	38	61.3			
	Yarding	21	37.5	1	50.0	0	0.0	1	100.0	24	38.7			

4. Slash disposal. Slash was piled following logging and burned late in the fall, as described under plot 9. Damage is not believed to have been as severe on plot 10 as a lighter cut made it necessary to dispose of less slash. Damage did result in places, especially to groups of small trees. A summary of the condition of the plot after logging and slash disposal follows:

<u>Degree or type of damage</u>	<u>Type of cover</u>						Free	Total
	Logs ^{1/}	Burns ^{2/} and slash	Brush	Bear clover	Repro- duction	Brush and re- production		
				<u>Percent</u>				
Skid trails	5.8	26.1	12.7	17.9	10.2	5.5	8.9	11.8
Bare	2.3	5.9	2.1	1.4	1.2	0.0	1.2	1.5
Partial damage	3.5	41.5	13.7	7.2	13.8	11.0	7.3	10.5
No damage	88.4	26.5	71.5	73.5	74.8	83.5	82.6	76.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total area as basis (square feet)	7455	6655	107801	77405	60380	13795	144685	418176

1/ Mapped before logging only.

2/ These amounts were deducted from the areas of original cover in which they fell.

These values were obtained by planimeter from a composite map of the plot showing cover types before logging and degree and type of damage following logging.

"Skid trails" and "Bare", types of complete damage covered but 13.3 percent of the plot, were proportionately the greatest in cover types of "burns and slash" and "Bear clover", least in "Brush and reproduction". A gain, as on plot 9, it should be noted that the values for "Burns and slash" were deducted from the areas of other cover types after logging. They are not strictly comparable to the other types since placement of slash piles was necessarily influenced by the type of damage and relative value of cover types remaining.

Table 52.-Distribution of board foot volume destroyed in logging by diameter classes and causes (trees 11.6 inches d.b.h. and over)

		Plot basis											
		Diameter classes in inches											
		All classes											
Species	Item	12-17	18-23	24-29	30-35	36+							
		Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-	Board	Per-
		feet	cent	feet	cent	feet	cent	feet	cent	feet	cent	feet	cent
Ponderosa pine	Felling												
	Yarding												
Sugar pine	Felling												
	Yarding												
White fir	Felling			284	100.0	0	0.0	0	0.0	0	0.0	284	7.3
	Yarding			0	0.0	1054	100.0	2527	100.0	3581	92.7		
Incense cedar	Felling	26	21.3					3588	100.0	3614	97.4		
	Yarding	96	78.7					0	0.0	96	2.6		
All species	Felling	26	21.3	284	100.0	0	0.0	3588	58.7	3898	51.5		
	Yarding	96	78.7	0	0.0	1054	100.0	2527	41.3	3677	48.5		

"Partial damage" occurred on 10.5 percent of the area, was greatest in areas of "Burns and slash" and "Reproduction" least in areas of "Logs". "No damage" was recorded on 76.2 percent of the plot, was proportionately the greatest for "Logs" and for "Brush and reproduction" and least for areas of "Brush" and for "Burns and slash".

5. Grazing. As for plot 9 the area was grazed lightly by cattle before logging. All classes of stock have been kept out since logging.

The Remaining Stand and Results of Cutting.

1. Composition. The remaining stand averaged 109.5 trees per acre, 3.6 inches d.b.h. and over, of which ponderosa pine made up 1.5 percent, sugar pine 15.7 percent, white fir 54.8 percent and incense cedar 28.0 percent. These trees averaged approximately 7800 cubic feet per acre of which ponderosa pine made up 0.9 percent, sugar pine 7.2 percent, white fir 69.2 percent and incense cedar 22.7 percent (table 53).

The board foot volume in trees 11.6 inches d.b.h. and over was approximately 37,000 board feet per acre of which ponderosa pine made up 0.9 percent, sugar pine 6.1 percent, white fir 74.9 percent and incense cedar 18.1 percent.

2. Distribution by diameter classes. Table 54 and figure 7 show that sugar pine was in the best position for growth with half its basal area in trees below 24 inches compared with $\frac{1}{4}$ of the basal area of fir and less than $\frac{1}{5}$ each of ponderosa pine and incense cedar in those diameters.

Of the volume in the remaining stand, 7769 cubic feet per acre, 72.0 percent of the trees were under 12 inches d.b.h. and 80.9 percent were under 18 inches; 7.0 percent were over 35 inches and 11.6 percent were over 29 inches. There were proportionately more small pines in the reserve than firs or cedars; 87.6 percent of the ponderosa pines and 88.5 percent of the sugar pines were below 18 inches, compared with 76.6 percent of the firs and 84.7 percent of the cedars. Only 6.2 percent of the ponderosa pines and 3.6 percent of the sugar pines left were above 29 inches as against 18.0 percent of the white firs and 13.3 percent of the incense cedars. The distribution was not as favorable for growth as it would have been had more of the larger firs and cedars been removed.

Table 53. - Composition of the remaining stand.

Acre basis								
Species	Trees		Basal area		Cubic volume		Board:	Volume
	Number	Percent	Square feet	Percent	Cubic feet	Percent	feet	Percent
Ponderosa								
pine	1.7	1.5	1.3	0.8	69.5	0.9	342	0.9
Sugar								
pine	17.1	15.7	13.5	8.3	557.2	7.2	2268	6.1
White								
fir	60.1	54.8	101.1	62.2	5380.5	69.2	27748	74.9
Incense								
cedar	30.6	28.0	46.5	28.7	1761.9	22.7	6679	18.1
All								
species	109.5	100.0	162.4	100.0	7769.1	100.0	37037	100.0

Table 54. -Distribution of remaining trees by size classes.

Acre basis														
Species	Diameter classes - inches												All	
	4-11	12-17	18-23	24-29	30-35	36+	classes							
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent		
Ponderosa pine	1.5	87.6			0.1	6.2	0.1	6.2			1.7	100.0		
Sugar pine	13.0	75.8	2.2	12.7	0.8	4.9	0.5	3.0	0.4	2.4	0.2	1.2	17.1	100.0
White fir	40.0	66.6	6.0	10.0	3.3	5.4	2.7	4.5	3.4	5.7	4.7	7.8	60.1	100.0
Incense cedar	24.3	79.6	1.6	5.1	0.6	2.0	0.2	0.7	1.1	3.4	2.8	9.2	30.6	100.0
All species	78.8	72.0	9.8	8.9	4.7	4.3	3.5	3.2	5.0	4.6	7.7	7.0	109.5	100.0

Favorable growth in basal area could not be expected as only 24.5 percent of the basal area was in trees below 24 inches (table 55). Over $\frac{1}{2}$ was in trees above 25 inches and $\frac{3}{4}$ was in trees above 29 inches (table 56 and figure 8). The firs and cedars accounted for the quarter portion of this. The pines were proportionately more important in the smaller diameters than the fir and cedar. Almost $\frac{2}{5}$ of the ponderosa pine volume and nearly $\frac{3}{5}$ of the sugar pine volume was in trees below 30 inches — the faster growing thrifty trees — compared with $\frac{1}{5}$ of the fir and slightly more than $\frac{1}{10}$ of the cedar volume in these classes.

3. Distribution by tree classes. Tree class 1 accounted for 21 percent of the trees reserved, class 2 for 20 percent and class 6 for 45 percent (table 57). From the standpoint of future growth, this distribution is rather poor.

From 44 to 45 percent of the trees of each species were in the suppressed or intermediate class, tree class 6. Sugar pine apparently had the best distribution of trees with 52 percent in classes 1, 2 and 3 where good growth could be expected. Ponderosa pine and incense cedar each had 50 percent of their trees in these classes. White fir had the poorest tree class distribution with 45 percent of its trees in classes 1, 2 and 3.

Distribution of board foot volume by tree classes is shown in table 58. Distribution was poor, 43 percent of the volume occurring in class 5 and 51 percent in classes 4 and 5 together. Over $\frac{1}{3}$ (36 percent) of the volume was in class 3. Sugar pine had the best distribution. Over $\frac{2}{3}$ of its volume was in classes 1, 2 and 3, as compared with about $\frac{1}{2}$ the fir volume and $\frac{1}{3}$ each of the ponderosa pine and incense cedar volume in these classes.

Table 55.- Distribution of basal area of remaining trees by size classes.

Acre basis														
Species	Diameter classes -- inches												: : : : All classes	
	4-11	:	12-17	:	18-23	:	24-29	:	30-35	:	36+	:	:	:
	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent	Square feet	Per-cent
Ponderosa pine	0.2	18.6			0.4	29.8	0.7	51.6					1.3	100.0
Sugar pine	2.8	20.7	2.5	18.4	1.8	13.0	2.2	16.3	2.6	19.6	1.6	12.0	13.5	100.0
White fir	9.4	9.3	6.9	6.8	7.6	7.6	10.7	10.6	20.1	19.8	46.4	45.9	101.1	100.0
Incense cedar	5.6	11.9	1.7	3.8	1.4	3.0	0.8	1.8	6.3	13.5	30.7	66.0	46.5	100.0
All	18.0	11.1	11.1	6.8	10.8	6.6	14.1	8.7	29.7	18.3	78.7	48.5	162.4	100.0

Table 56.- Distribution of cubic foot volume of remaining trees by diameter classes.

Species	Diameter classes — inches												All classes
	4-11	12-17	18-23	24-29	30-35	36+							
	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	Cubic feet	Per-cent	
Ponderosa pine	3.	4.9		24	34.2	42	60.9	69					100.0
Sugar pine	50	9.0	82	14.8	66	11.9	114	20.5	150	26.8	95	17.0	100.0
White fir	179	3.3	232	4.3	354	6.6	572	10.6	1171	21.8	2872	53.4	100.0
Incense cedar	79	4.5	48	2.8	45	2.5	27	1.5	241	13.7	1323	75.0	100.0
All	311	4.0	362	4.7	465	6.0	737	9.5	1604	20.6	4290	55.2	100.0

Table 57.- Distribution of trees in the
reserve stand by tree classes.
(Measure 5.6" d.b.h. and over)

Species	Tree classes							All classes						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number	Per-	Number
	cent		cent		cent		cent		cent		cent		cent	
Ponderosa pine	0.4	25.0	0.4	25.0	0.2	1.2	0.4	2.4	0.1	6.2	0.8	43.8	1.7	100.0
Sugar pine	3.5	20.6	5.2	30.3	5.4	9.0	2.1	3.5	3.1	5.2	27.2	45.2	17.1	100.0
White fir	12.2	20.3	9.4	15.6	1.2	4.1	0.5	1.7	1.8	5.8	13.3	43.5	0.7	100.0
Incense cedar	6.6	21.4	7.1	23.1									0.1	0.4
All species	22.7	20.7	22.1	20.2	6.8	6.3	3.0	2.7	5.1	4.6	49.0	44.7	0.8	0.8

Table 58.- Distribution of board feet in the reserve stand
by tree classes (Trees 11.6 inches d.b.h. and over)

Species	Tree classes							All classes						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Board feet	Per-	Board feet	Per-	Board feet	Per-	Board feet	Per-	Board feet	Per-	Board feet	Per-	Board feet	Per-	Board feet
	cent		cent		cent		cent		cent		cent		cent	
Ponderosa pine	117	34.2	134	5.9	494	21.8	498	22.0	208	9.2	18	0.8	2263	100.0
Sugar pine	911	40.3	409	1.5	10996	39.4	2067	7.4	11729	42.0	134	0.5	27896	100.0
White fir	2358	8.5	88	1.3	1857	27.8	342	5.1	3859	57.7	110	1.7	69	1.0
Incense cedar	357	5.4											6682	100.0
All species	3743	10.1	631	1.7	13347	35.9	2907	7.8	16021	43.1	262	0.7	272	0.7

1/ Totals do not check with those of table 55 as they are based on different averages.

Table 59.- Distribution of defects by causes - all species.

Defects	Plot basis					
	:	:	:	:	:	:
	3.6 - 11.5	11.6 inches	All			
	inches d.b.h.	d.b.h. and over	diameters			
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Witches broom	18	6.3	3	1.1	21	3.7
Fungus			6	2.2	6	1.1
Insects	3	1.1			3	0.5
Mistletoe	2	0.7	99	35.7	101	18.0
Logging(butt and bole)	98	34.5	21	7.6	119	21.2
Logging (crown)	80	28.2	32	11.5	112	20.0
Logging (top)	1	0.4			1	0.2
Top injuries						
(other than logging)	58	20.4	59	21.3	117	20.9
Fire	8	2.8	42	15.2	50	8.9
Miscellaneous	16	5.6	15	5.4	31	5.5
Total	284	100.0	277	100.0	561	100.0

4. Distribution on the ground. Most of the remaining trees were in grouped arrangement due to the character of the original stand.

5. Condition of stand. Of the 1052 trees 3.6 inches d.b.h. and over, on the plot after logging, 339 or about 32.2 percent showed defect or disease from one or more causes. The distribution of these is shown in table 60.

About $2/5$ of the injuries were caused by logging. Half were butt and bole wounds, half racked crowns and broken tops. Insects, mistletoe, fungus (including witches brooms) and dead and broken tops, due largely to mistletoe, but occasionally to insects and snow caused over $2/5$ of the defects. Fire caused slightly less than $1/10$ of the injuries and miscellaneous agencies (axe marks, porcupine damage, wounds from unknown causes, etc.) accounted for the remainder.

Logging injuries combined caused the greatest number of defects in each species (table 60). Mistletoe and top injuries from causes other than logging were important in fir. Top injuries from causes other than logging and fire were important in cedar.

The distribution of cull in the reserve stand is shown in table 61. Over 12 percent of the reserve board foot volume was cull. The stand above 35 inches was 18 percent cull. Cedar was in the poorest condition of any species with over $1/3$ of its reserve volume cull. Almost $1/2$ of the cedar in the 24 to 29 inch class and $2/5$ in the 36+ inch class was cull.

6. Changes in composition. The net results of losses through death and gains in new trees for the first growth period appear in table 62 and table 63. Ponderosa pine, white fir and incense cedar each gained slightly in numbers of trees at the expense of sugar pine. Cedar made up the greatest part of the gain. In composition by cubic foot volume white fir decreased, the other species gained. As in trees cedar made the greatest gain.

Table 60.- Distribution of defects by species and causes.

[illegible]

Table 61.- Cull in board feet in the remaining stand and
percent of reserve.

Plot basis												
Species	Diameter classes - inches											
	12-17	18-23	24-29	30-35	36+	All classes						
	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent	Board feet	Per-cent
Ponderosa pine											--	
Sugar pine			248	5.0	120	1.7	277	5.8	645	3.0		
White fir		266	1.9	624	2.4	2420	4.1	17898	11.4	21208	8.0	
Incense cedar		209	17.7	351	45.8	1451	17.0	20351	38.6	22362	34.9	
All species	475	2.7	1223	3.7	3991	5.1	38526	18.0	44215	12.4		

Table 62.- Changes in composition 1929-34 in
numbers of trees.

(Tree 3.6" d.b.h. and over)

Acre basis							
Species	Stand : 1929	Dead : 1929-34	New trees : 1929-34	Stand : 1934	Percent : 1929 1934		Net changes : 1929 - 34
Ponderosa pine	1.7	0.0	0.0	1.7	1.5	1.6	+0.1
Sugar pine	17.1	2.3	1.0	15.8	15.7	14.7	-1.0
White fir	60.1	4.7	4.0	59.4	54.8	54.9	+0.1
Incense cedar	30.6	0.9	1.5	31.2	28.0	28.8	+0.8
All species	109.5	7.9	6.5	108.1	100.0	100.0	0.0

Table 63.- Changes in composition in cubic foot
volume, 1929-34

(Trees 3.6" d.b.h. and over)

Acre basis							
Species	Stand	Dead	New trees	Stand	Percent	Percent	Percent net
	1929	1929-34	1929-34	1934	1929	1934	1929-34
Ponderosa							
pine	69.5	0.0	0.0	77.0	0.9	1.1	+0.2
Sugar							
pine	557.2	37.2	0.7	579.8	7.2	8.1	+0.9
White							
fir	5380.5	941.3	3.1	4742.9	69.2	66.6	-2.6
Incense							
cedar	1761.9	120.7	1.1	1719.1	22.7	24.2	+1.5
All	7769.1	1099.2	4.9	7118.8	100.0	100.0	0.0

6. Growth

a. Diameter. Average annual diameter growth by diameter classes is shown in table 64. The average for all species and diameters was 0.13 inch per year. The best growth was made in the 18 to 23 inch class, the poorest in the 36+ inch class. Ponderosa pine had the best growth, 0.17 inch per year, cedar the poorest 0.12 inch.

Ponderosa pine had too few individuals to establish reliable trends (figure 9). White fir had the best growth of the remaining three species in diameters up to 15 inches, sugar pine the best in diameters above 15 inches. Sugar pine had the poorest diameter growth up to 8 inches, cedar from 8 through 39 inches and fir the poorest above 39 inches.

Sugar pine could be expected to show better growth than either fir or cedar in the larger diameters since most of large, slow growing sugar pines were removed in logging.

b. Height. The average annual growth for all species and diameter classes was 0.41 foot (table 65). Trees in the 30 to 35 inch class maintained the best average. The relation between height and diameter growth is not well defined. Trees in the 18 to 23 inch class, which showed best diameter growth, had poorer height growth than the trees in either of the adjoining diameter classes. The smallest and largest trees showed the least growth both in diameter and height.

Ponderosa pine in height growth as for diameter growth has too few individuals to establish reliable trends (figure 10). The remaining species did not retain the same relative positions they had in diameter growth. Sugar pine had the best height growth in trees up to 13 inches d.b.h. Cedar had the best growth at 14 inches, white fir the best from 15 to 25 inches and sugar pine again the best from 26 to 37 inches and fir the best above 37 inches. Cedar had the poorest height growth in all diameters except at 14 inches where it was better than both sugar pine and fir.

Table 64.- Average annual increase in diameter
in inches.

Plot basis							
Species	Diameter classes - inches						All classes
	4-11	12-17	18-23	24-29	30-35	36+	
Ponderosa pine	0.16	--	-	0.38	0.01	--	0.17
Sugar pine	0.11	0.15	0.25	0.22	0.17	0.19	0.13
White fir	0.12	0.19	0.17	0.13	0.14	0.10	0.13
Incense cedar	0.12	0.13	0.17	0.11	0.10	0.12	0.12
All species	0.12	0.17	0.19	0.15	0.14	0.11	0.13

Table 65.- Average annual increase in height in feet.

Plot basis							
Species	Diameter classes in inches						All classes
	4-11	12-17	18-23	24-29	30-35	36+	
Ponderosa pine	0.46	-	-	1.00	0.60	-	0.51
Sugar pine	0.43	0.56	0.38	0.65	1.00	0.40	0.46
White fir	0.36	0.56	0.60	0.54	0.68	0.60	0.43
Incense cedar	0.30	0.57	0.32	0.40	0.40	0.40	0.33
All	0.36	0.56	0.52	0.57	0.68	0.51	0.41

c. Growth rate in basal area. The growth rates in table 66 were obtained by including only the trees of each diameter and tree class that were tagged in 1929 and survived through to 1934. The effects of death and the entry of new trees were thus excluded.

The average growth rate for the entire stand was 1.792 square feet per acre per year or 1.26 percent. This rate is quite low but is explained by the large proportion of the total basal area in the large slow growing trees and the grouped distribution of the smaller trees.

The best growth percent was made in the 4 to 11 inch class in all species. Ponderosa pine lead in growth percent, but in actual growth was the lowest of any species; white fir, incense cedar and sugar pine followed in order. The growth percent of each species except sugar pine decreased through each succeeding larger diameter class. For sugar pine, 8 trees with better than average vigor in the 18 to 23 inch class and 2 vigorous trees in the 36 $\frac{1}{2}$ inch class caused momentary rises in the trend.

d. Cubic feet. Net growth in cubic feet including the volume of new trees which grew into the 4 to 11 inch diameter class is shown in table 67. There was a net loss on the plot of 130 cubic feet per acre per year or an annual loss of 1.67 percent based on the reserve stand of 7769 cubic feet per acre. Growth exceeded losses for all species in diameter classes up to 23 inches. Above 23 inches losses exceeded growth.

Ponderosa pine and sugar pine showed net growth, fir and cedar, net loss. Ponderosa pine had net growth in all classes represented, sugar pine, net growth in all but the 24 to 29 inch class. Fir had net losses in all classes above 23 inches, cedar in all classes above 17 inches.

Table 66.- Growth percent - basal area
(Total growth)

Species	Acre basis											
	Diameter classes in inches											
	4-11	12-17	18-23	24-29	30-35	36+	All classes					
Ponderosa pine	Square feet 0.013	Per-cent 5.22	Square feet --	Per-cent --	Square feet 0.013	Per-cent 3.24	Square feet 0.001	Per-cent 0.31	Square feet --	Per-cent --	Square feet 0.027	Per-cent 2.10
Sugar pine	0.081	3.51	0.048	2.19	0.046	2.62	0.027	1.47	0.025	0.94	0.017	1.03
White fir	0.354	4.00	0.173	2.68	0.127	1.78	0.098	0.99	0.150	0.88	0.167	0.47
Incense cedar	0.213	3.89	0.033	2.06	0.019	1.67	0.006	0.76	0.031	0.60	0.150	0.52
All species	0.661	3.92	0.254	2.48	0.192	1.91	0.144	1.11	0.207	0.82	0.334	0.50
												1.792
												1.26

Acre basis

Diameter classes in inches														ALL	
Species	4-11		12-17		18-23		24-29		30-35		36+		ALL classes		
	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	
Ponderosa pine	0.25	7.27	—	—	—	0.92	3.86	0.33	0.79	—	—	1.50	2.16		
Sugar pine	0.40	0.79	0.00	0.00	2.12	3.21	-1.65	-1.44	2.50	1.67	1.15	1.21	4.52	0.81	
White fir	7.60	4.26	4.56	1.97	2.85	0.81	-1.00	-0.17	-23.44	-2.00	-118.10	-4.11	-127.53	-2.37	
Incense cedar	3.65	4.59	0.14	0.31	-0.89	-2.01	0.27	1.02	-6.19	-2.56	-5.54	-0.42	-8.56	-0.49	
ALL															
Species	11.90	3.82	4.70	1.30	4.08	0.88	-1.46	-0.20	-26.80	-1.67	-122.49	-2.86	-130.07	-1.67	

The net decrease in cubic feet is explained by the death of many large trees (22 of which were over 23 inches d.b.h.). Gains from new trees amounted to less than one percent of the net loss.

e. Board feet. The average net growth per acre in board feet and percent annually appears in table 68. The growth of -1.87 percent was made on a remaining volume of 37037 board feet per acre.

Table 68.- Average annual net growth in board feet.

Acre basis		
Species	Board feet	Percent
Ponderosa pine	9.8	2.87
Sugar pine	30.6	1.35
White fir	-705.4	-2.54
Incense cedar	-24.4	-0.37
All species	-689.4	-1.87

7. Losses. Losses for the first growth period were high, averaging 1.58 trees per acre yearly (table 69). Fifty-nine percent of the losses were in trees below 12 inches, 25 percent in trees over 29 inches d.b.h. No ponderosa pines were lost. Over 86 percent of the sugar pine losses were in trees below 12 inches. Half the fir losses were in trees below 12 inches and 1/3 were in trees above 29 inches. One of the cedar losses were in trees below 12 inches, 2/5 in trees above 29 inches.

The annual losses in cubic foot volume have averaged 219.8 feet per acre (table 70). Two-thirds of this occurred in trees above 35 inches, 3/4 in trees above 29 inches, and over 4/5 in trees above 23 inches.

For sugar pine 1/2 the losses in cubic feet were in 24 to 29 inch trees, and 1/4 each in 4 to 11 and 12 to 17 inch trees.

Table 69.-- Distribution of average annual losses in
trees by diameter classes.

Species	Diameter classes -- inches												All diameters
	4-11			12-17			18-23			24-29			36+
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	
Ponderosa pine	5	1	1	1	1	1	1	1	1	1	1	1	1
Sugar pine	0.40	86.4	0.04	9.1	1	1	0.02	4.5	1	1	1	1	0.46
White fir	0.48	51.1	0.06	6.7	0.04	4.5	0.04	4.4	0.10	11.1	0.21	22.2	0.93
Incense cedar	0.06	33.4	0.02	11.1	0.02	11.1	1	1	0.05	22.2	0.04	22.2	0.19
All species	0.94	59.2	0.12	7.9	0.06	4.0	0.06	3.9	0.15	9.2	0.25	15.8	1.58
													100.0

Over 9/10 of the fir losses and almost 9/10 of the cedar losses were in trees 30 inches d.b.h. and over. Fir accounted for the largest proportion of the losses in diameters below 30 inches.

There was an annual loss of 11.42 board feet per acre (table 71).

A summary of losses of trees, basal area, and volume by species in actual amount, percent of losses and percent of stand for the first growth period, appears in table 72.

Cull in the reserve stand compared to losses for the first growth period appears in table 73. For firs and cedars over 17 inches d.b.h., much of the volume listed under losses may have been cull initially. The total cull was 12.4 percent of the reserve stand, the losses 15.4 percent.

Table 74 shows the distribution of losses by causes and diameter classes. In the 4 to 11 inch class 42 percent of the losses were caused by insects, 18 percent by suppression, 16 percent by logging injuries, 11 percent by top injuries and the remainder by slash burning, windthrow and unknown causes. Insects caused 2/3 of the deaths in each class from 12 to 29 inches. Logging caused 1/3 of the deaths in the 12 to 17 inch class, suppression 1/3 in the 18 to 23 inch class, and mistletoe 1/3 in the 24 to 29 inch class. In the 30 to 35 inch class mistletoe was mainly responsible for 57 percent of the deaths and insects, logging and old fires each for 14 percent. In the 36+ inch class mistletoe was charged with 42 percent of the losses, wind with 33 percent and insects, logging and old fires 8 percent each.

Table 71.- Average annual losses in board feet.

Acre basis						
Species	Diameter class -- inches					All classes
	12-17	18-23	24-29	30-35	36+	
Ponderosa pine	--	--	--	--	--	--
Sugar pine	6.2	--	15.6	--	--	21.8
White fir	12.1	20.5	40.3	195.8	766.4	1035.1
Incense cedar	1.9	4.4	--	27.0	52.2	85.5
All species	20.2	24.9	55.9	222.8	818.6	1142.4

Table 72.- Summary of periodic losses by species.

Species	Trees			Basal area		Cubic volume		Board volume	
	Number	Percent of losses	Percent of stand	Square feet	Percent of losses	Cubic feet	Percent of losses	Board feet	Percent of losses
Ponderosa pine	—	—	—	—	—	—	—	—	—
Sugar pine	22	29.0	13.3	10.9	5.5	357	3.4	1048	1.9
White fir	45	59.2	7.8	155.1	78.4	9036	85.6	49686	90.6
Incense cedar	9	11.8	3.1	21.8	16.1	1159	11.0	4101	7.5
All species	76	100.0	7.2	197.8	100.0	10552	100.0	54835	100.0
									15.4

Table 73.- Cull in remaining stand and mortality for the first period -
percent of remaining stand.

Species	Board feet											
	Diameter classes - inches											
	12-17	18-23	24-29	30-35	36+	All classes						
	<u>Cull</u>	<u>Loss</u>	<u>Cull</u>	<u>Loss</u>	<u>Cull</u>	<u>Loss</u>	<u>Cull</u>	<u>Loss</u>	<u>Cull</u>	<u>Loss</u>	<u>Cull</u>	<u>Loss</u>
Ponderosa pine												
Sugar pine		11.5		5.0	15.0	1.7		5.8		3.0	4.8	
White fir		6.1	1.9	7.1	2.4	7.3	4.1	15.7	11.4	23.4	8.0	18.7
Incense cedar		10.4	17.7	17.7	45.8	17.0	15.2	38.6	4.8	34.9	6.4	
All species	7.5	2.7	6.9	3.7	8.1	5.1	13.8	18.0	18.3	12.4	15.4	

Table 74.- Distribution of losses in number of trees by causes and diameter classes.

Plot basis													
Diameter classes (inches)	Insects	Mistletoe	Suppression	Logging	Broken: top	Old	Slash	Wind	Unknown	Causes	Total trees as basis		
4-11	42.2		17.8	15.6	11.1		4.4	4.4	4.5	100.0	45		
12-17	66.7			33.3						100.0	6		
18-23	66.7		33.3							100.0	3		
24-29	66.7									100.0	3		
30-35	14.3	33.3		14.3		14.3				100.0	7		
36+	8.3	41.7		8.3		8.3		33.4		100.0	12		
All classes	38.2	13.2	11.8	14.5	6.6	2.6	2.6	7.9	2.6	100.0	76		

Table 75.- Distribution of losses in number of trees by causes and species.

Plot basis													
Species	Insects	Mistletoe	Suppression	Logging	Broken: top	Old	Slash	Wind	Unknown	Causes	Total trees as basis		
Ponderosa pine													
Sugar pine	63.6			4.5	9.1	4.5	4.6	4.6	9.1	100.0	22		
White fir	33.3	22.2		15.6	8.9	8.9		11.1		100.0	45		
Incense cedar				11.1	55.6	22.2	11.1			100.0	9		
All species	38.2	13.2	11.8	14.5	6.6	2.6	2.6	7.9	2.6	100.0	76		

There were no deaths in ponderosa pine. In sugar pine, insects caused 64 percent of the deaths, logging and unknown causes 9 percent each. (Table 75). The remainder was distributed between suppression, broken top, slash burning and wind. In white fir 33 percent of the deaths were caused by insects, 22 percent by mistletoe, 15 percent by suppression, 11 percent by wind and 10 percent by each logging and broken top. In cedar 56 percent of the deaths were caused by logging damage, 22 percent by old fires and 11 percent by each suppression and slash burning. For all diameters and species insects caused 38 percent of the losses, logging 14 percent, mistletoe 13 percent, suppression 12 percent, wind 8 percent, broken tops 7 percent and old fires, slash burning, and unknown causes each 3 percent.

8. Reproduction. A transect of 100 milacre quadrats was laid out prior to logging. Seedlings and reproduction were recorded by species and size up to 3.6 inches d.b.h. Following logging and yearly thereafter the quadrats have been mapped and changes in seedlings noted.

The number of seedlings and composition based on transect records is shown in table 76. There was an average of 3220 seedlings per acre before logging of which 78 percent were firs, 14 percent cedars and 8 percent sugar pines.

Logging reduced the number of seedlings to 1570 per acre. Fir decreased almost 10 percent in composition while cedar and sugar pine each increased about 5 percent.

In the five years following logging the number of seedlings rose to 1970 per acre. Fir dropped in composition to 51 percent, cedar increased to 36 percent and sugar pine decreased to 12 percent. Sugar pine had an actual increase in number of trees, but the increase in cedar was proportionately greater. Ponderosa pine came in the rate of 30 seedlings per acre to make up 1.5 percent of the total.

Table 76.- Number of seedlings per 0.1 acre and composition.

Species	June 1929		October 1929		June 1934	
	Before logging		After logging			
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Ponderosa pine	—	—	—	—	3	1.5
Sugar pine	25	7.8	20	12.7	24	12.2
White fir	252	78.3	108	68.8	100	50.8
Incense cedar	45	13.9	29	18.5	70	35.5
Total	322	100.0	157	100.0	197	100.0

The distribution of reproduction by size classes is shown in table 77. Thirty-seven percent of the trees were one-half foot high or less, and 55 percent were two feet high or less. About 15 percent were over 4 feet high. Fir reproduction averaged larger than the other species, 25 percent being over 3 feet high compared to 15 percent of the sugar pine and 7 percent of the cedars.

Distribution on the ground was only fair. Of the 100 quadrats, but 51 had one or more seedlings each after logging. New seedlings had raised the number of quadrats to 60 by 1934. New seedlings surviving in 1934 amounted to 590 per acre. Of these 420 were cedars (76 percent of which germinated in 1932 and 1933), 80 were sugar pines, 60 were firs and 30 were ponderosa pine. Gains in new seedlings have surpassed deaths in ponderosa pine, sugar pine and incense cedar. Deaths in white fir have exceeded germination at the rate of 80 trees per acre for the five year period.

Table 77.- Distribution of reproduction after logging
by species and size classes. (basis 0.1 acre)

Species	Height in feet.										Total
	0-0.5	0.5-1.0	1.0-2.0	2.0-3.0	3.0-4.0	4.0+					
	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	
Ponderosa pine	0	--	0	--	0	--	0	--	0	--	
Sugar pine	9	45.0	4	20.0	4	2.0	0	--	1	5.0	
White fir	31	28.7	20	18.5	19	17.6	11	10.2	8	7.4	
Incense cedar	18	62.1	4	13.8	4	13.8	1	3.4	0	--	
All species	58	37.0	28	17.8	27	17.2	12	7.6	9	5.7	

PLOT 11.

The original stand

1. Composition. The plot averaged 172.9 trees per acre 3.6 inches d.b.h. and over, of which ponderosa pine made up 2.5 percent, sugar pine 20.3 percent, white fir 60.5 percent and incense cedar 16.7 percent (Table 78).

The volume averaged 66,798 board feet per acre (Scribner inch) in trees 11.6 inches d.b.h. and over. This volume was made up of 12.6 percent ponderosa pine, 32.6 percent sugar pine, 46.3 percent white fir and 8.5 percent incense cedar. The volume was contained in 2.4 ponderosa pines, 11.1 sugar pines, 33.5 white firs and 7.6 incense cedars, a total of 54.6 trees per acre (figure 11).

2. Distribution by diameter classes. Of the 172.9 trees per acre for all species, over $2/3$ were in the 4 to 11 inch class, $1/8$ were in the 12 to 17 inch class and less than $1/5$ were in diameters above 17 inches (table 79). There were proportionately fewer ponderosa pines in the smaller diameters than there were of the other species. Somewhat less than half of the ponderosa pines were below 12 inches, over $2/3$ of the sugar pines and white firs and almost $3/4$ of the incense cedars. Half of the ponderosa pines were below 18 inches compared with $4/5$ of each of the other species. Over $1/4$ of the ponderosa pines were above 35 inches d.b.h.

3. Distribution by tree classes. Of the 172.9 trees per acre in the original stand, less than $1/5$ were in class 1, less than $1/4$ were in class 2, less than $1/10$ were in classes 3, 4 and 5 together, and $1/2$ were in class 6, (table 80).

There were about equal proportions of each species in class 1 trees, the largest proportion being in ponderosa pine (23 percent), the smallest in sugar pine and white fir (18 percent). White fir had the largest proportion of trees in class 2 (26 percent), cedar the smallest (15 percent). Ponderosa pine had proportionately the greatest number of trees in classes 3, 5 and 7, and no trees in class 4. About $1/2$ of the sugar pine cedars and firs were in class 6.

Of the board foot volume, over $1/2$ was in class 5 almost $1/5$ in class 3, and over $1/5$ in classes 1 and 2 together (table 81). Over $1/3$ of the fir volume was in classes 1 and 2, and less than $1/10$ of the ponderosa pine and incense cedar volumes. About $1/4$ of the fir and cedar volumes were in class 3, $1/5$ of the ponderosa pine volume and less than $1/10$ (65 percent) of the sugar pine volume. Just $3/4$ of the sugar pine, $7/10$ of the ponderosa pine over $1/2$ of the cedar and $1/3$ of the white fir was accounted for by class 5.

4. Distribution by area. As on the other two plots, most of the trees occurred in irregular groups. Occasional large trees appeared singly.

5. Condition. The general condition was the same as described under plot 9.

Table 78. Composition of the original stand by
trees, basal area and volume.

Acre basis								
Species	Trees		Basal area		Cubic foot volume		Board foot volume	
	Num- ber	Per- cent	Square foot	Per- cent	Cubic feet	Per- cent	Board feet	Per- cent
Ponderosa pine	4.3	2.5	21.3	8.2	1470	11.0	8396	12.6
Sugar pine	35.0	20.3	68.5	26.3	4051	30.4	21773	32.6
White fir	104.7	60.5	126.5	48.6	6253	46.8	30973	46.3
Incense cedar	28.9	16.7	44.1	16.9	1571	11.8	5656	8.5
<u>All species</u>	<u>172.9</u>	<u>100.0</u>	<u>260.4</u>	<u>100.0</u>	<u>13345</u>	<u>100.0</u>	<u>66798</u>	<u>100.0</u>

Table 79.-Distribution of trees in the original stand by
diameter classes.

Acre basis														
Species	Diameter classes - inches												All classes	
	4-11	12-17	18-23	24-29	30-35	36+								
Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Ponderosa pine	1.9	44.7	0.3	6.4	0.1	4.2	0.4	8.5	0.3	6.4	1.3	29.8	4.3	100.0
Sugar pine	23.9	68.3	4.1	11.9	2.1	5.8	1.3	3.7	1.0	2.9	2.6	7.4	35.0	100.0
White fir	71.2	68.0	15.6	15.0	6.3	6.0	4.1	3.9	3.5	3.3	4.0	3.8	104.7	100.0
Incense cedar	21.3	73.7	2.3	7.7	1.1	3.9	0.8	2.9	1.1	3.8	2.3	8.0	28.9	100.0
All species	118.3	68.4	22.3	12.9	9.6	5.6	6.6	3.8	5.9	3.4	10.2	5.9	172.9	100.0

(Notes 3.6 d.b.h. and over)

-11-

-115-

Acre basis																
Species	Tree classes															All classes
	1		2		3		4		5		6		7			
	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent		
Ponderosa pine	331	3.9	333	4.0	1777	21.2	-	-	5953	70.9	-	-	-	-	8394	100.0
Sugar pine	2590	11.9	713	3.3	1428	6.5	324	1.5	16470	75.6	203	0.9	62	0.3	21790	100.0
White fir	6937	22.4	3663	11.8	7402	23.9	2007	6.5	10253	33.1	487	1.6	200	0.7	30949	100.0
Incense cedar	432	7.6	78	1.4	1557	27.5	361	6.4	3079	54.3	79	1.4	82	1.4	5668	100.0
All species	10290	15.4	4787	7.2	12164	18.2	2692	4.0	35755	53.5	769	1.2	344	0.5	66801	100.0

METHODS OF CUTTING AND TREATMENT

1. Marking. Plot 11 was marked by M. Mills, head faller for the Pickering Lumber Company. The object was to give the highest returns per acre to the land owner who then was to abandon the land. All merchantable trees were to be cut.

The net results of marking appear in table 82 and figure 11. Of the original stand of 66,798 board feet per acre, 6785 board feet or 10.2 percent were left. On the basis of percent of volume left, white fir was cut the lightest followed closely by incense cedar. The two pines especially ponderosa pine, were cut much heavier. Of the original stand of trees on the plot 32.9 percent or 56.9 trees per acre were cut (table 83). All of the ponderosa pines over 17 inches were cut and all the sugar pines over 23 inches. From 75 to 96 percent of the firs and cedars were cut in the diameter classes above 23 inches. About 82 percent of the sugar pines and 50 percent of the firs were cut in the 18 to 23 inch class.

The distribution of the volume cut appears in table 84. About 9/10 of the total volume was removed. Over that amount was removed in each diameter class above 23 inches. Only 3/5 of the volume in the 18 to 23 inch class was removed and less than 1/5 of the volume in the 12 to 17 inch class.

Marking and removal in logging made only small changes in the composition of the stand in numbers of trees, but rather large changes in composition by basal area and volume (table 85). The pines decreased about one percent in number of trees, cedar and fir each gained about that amount. In basal area fir gained 18 percent in the composition at the expense of the two pines. In cubic feet fir gained 26 percent, sugar pine decreased 19 percent, ponderosa pine 10 percent. In board feet fir gained 34 percent mostly at the expense of sugar pine which decreased 25 percent.

Table 82. -Original stand and portions cut and left in
trees and board foot volume 11.6 inches d.b.h. and over.

Acre basis										
Species	Original stand		Cut		Left		Percent cut		Percent left	
	Num- ber	Board feet	Num- ber	Board feet	Num- ber	Board feet	Num- ber	Board feet	Num- ber	Board feet
Ponderosa pine	2.4	8396	2.1	8338	0.3	58	87.5	99.3	12.5	0.7
Sugar pine	11.1	21773	7.5	21284	3.6	489	67.6	97.8	32.4	2.2
White fir	33.5	30973	16.2	25487	17.3	5486	48.4	82.3	51.6	17.7
Incense cedar	7.6	5656	4.2	4904	3.4	752	55.3	86.7	44.7	13.3
All species	54.6	66798	30.0	60013	24.6	6785	54.9	89.8	45.1	10.2

Table 85. -Distribution of the trees cut and the percent cut of the
original number in each diameter class
(trees 3.6 inches d.b.h. and over)

Acre basis																	
Species	Diameter classes - inches																: All classes
	4-11		12-17		18-23		24-29		30-35		36+						
	Trees	Percent	Trees	Percent	Trees	Percent	Trees	Percent	Trees	Percent	Trees	Percent					
Ponderosa pine	0.3	14.3	0.0	0.0	0.1	100.0	0.4	100.0	0.3	100.0	1.3	100.0	2.4	55.3			
Sugar pine	5.3	22.1	0.9	22.2	1.7	81.8	1.3	100.0	1.0	100.0	2.6	100.0	12.8	36.5			
White fir	17.0	23.9	2.5	16.0	3.2	50.0	3.7	90.9	3.3	94.6	3.5	88.4	33.2	31.7			
Incense cedar	4.3	20.0	0.6	25.0	0.0	0.0	0.6	77.8	0.8	75.0	2.2	96.0	8.5	29.5			
All species	26.9	22.7	4.0	17.8	5.0	51.9	6.0	91.5	5.4	92.1	9.6	94.5	56.9	32.9			

Table 84. -Distribution of board foot volume cut and the percent cut
of the original amount in each diameter class.
-(trees 11.6 inches d.b.h. and over)

Species	Acre basis									
	Diameter classes - inches									
	12-17	18-23	24-29	30-35	36+	All classes				
	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent
Ponderosa pine	0	0.0	72	100.0	432	100.0	575	100.0	7259	100.0
Sugar pine	110	21.6	600	87.2	1198	100.0	1529	100.0	17847	100.0
White fir	387	15.2	1306	55.8	3513	93.2	5561	94.7	14720	89.5
Incense cedar	20	18.8	0	0.0	266	81.8	594	72.2	4024	95.8
All species	517	16.1	1978	59.9	5409	94.5	8259	93.8	43850	95.8
									60013	89.8

Table 85. Net changes in composition due to logging
based on percent of original stand.

Species	Trees	Basal area	Cubic feet	Board feet
Ponderosa pine	-0.8	-6.9	-9.6	-11.7
Sugar pine	-1.2	-12.2	-18.9	-25.4
White fir	+1.1	+18.2	+25.7	+34.5
Incense cedar	+0.9	+0.9	+2.8	+2.6
All species	0.0	0.0	0.0	0.0

Logging damage to trees of remaining stand in
number and percent.

3.6"-11.5"		12"+		Total	
<u>Trees</u>	<u>Percent</u>	<u>Trees</u>	<u>Percent</u>	<u>Trees</u>	<u>Percent</u>
256	25.9	82	30.9	338	27.0

Table 86 - Distribution of trees marked and trees not marked
but cut and destroyed

Plot basis											
Diameter classes - in inches											
Species	4-11	12-17	18-23	24-29	30-35	36+	: All classes				
	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-	Cut and des-
	Marked	troyed	Marked	troyed	Marked	troyed	Marked	troyed	Marked	troyed	Marked
Ponderosa pine	3		2	4	3	14	23	3			
Sugar pine	57	1	9	18	14	11	28	72	66		
White fir	184	1	26	33	2	40	35	37	1	146	213
Incense cedar	46		6	7	9	23	1	39	53		
All species	290	2	41	53	2	65	58	102	2	280	335

2. Logging. The same type of equipment and procedure was followed in logging as discussed under plot 9.

3. Damage. As mentioned in the discussion of damage on plot 10, logs from the upper end of that plot were skidded out through plot 11, causing some damage not rightfully chargeable to the plot. The extent of this damage is indeterminate but is not believed to be great except on a small area along the west boundary of the plot where some damage was done by the logs before entering the main skid trail.

A total of 335 unmarked trees were cut or destroyed in logging (table 86). Of these 290 were below 12 inches d.b.h. and 41 were between 12 and 17 inches. A total volume of 12,124 board feet was destroyed (table 87), of which half was in the 36+ inch class, 2/5 was in the 12 to 17 inch class and the remainder was in the 18 to 23 inch class.

No ponderosa pines over 11 inches d.b.h. were destroyed and no sugar pines over 17 inches. Above 17 inches the only trees destroyed were two firs in the 18 to 23 inch class and one fir and one cedar in the 36+ inch class. The fir in the 36- inch class accounted for half the total volume of fir destroyed, the cedar for 9/10 of the total of that species.

Felling was responsible for 61 percent of the trees destroyed, yarding for 39 percent (table 88). Felling caused 60 percent of the destruction in the 4 to 11 inch class, 71 percent in the 12 to 17 inch class, 50 percent in the 18 to 23 inch class and 100 percent in the 36+ inch class. Since felling was the more destructive to the larger trees it caused an even greater proportion of the destruction in volume,— 85 percent of the total (table 89).

Felling caused all of the destruction to trees of ponderosa pine, 54 percent of the destruction of sugar pine, 65 percent of the destruction of white fir and 53 percent of the destruction of incense cedar. By board foot volume felling caused 62 percent of the destruction in sugar pine, 86 percent in white fir and 77 percent in cedar.

Table 87. Distribution of board foot volume of trees marked and trees not marked but cut and destroyed.

		Plot basis									
		Diameter classes - inches									
Species:		12-17	18-23	24-29	30-35	36 +	All classes				
		Cut and	Cut and	Cut and	Cut and	Cut and					
		Marked	destroyed	Marked	destroyed	Marked	destroyed	Marked	destroyed	Marked	destroyed
Ponderosa											
pine											
Sugar											
pine	195	998	6475		12937		16511	192753		228871	998
White											
fir	216	3957	13390	717	37945		60059	154567	4408	266177	9082
Incense											
cedar		214			2877		6415	41627	1830	50919	2044
All											
Species	411	5169	20645	717	58418		89194	467346	6238	636014	12124

-123

Table 88. Distribution of trees destroyed in logging by diameter classes and causes. (Trees 3.6 inches d.b.h. and over.)

Plot basis														
Diameter classes in inches														
Cause of destruction :														
Species	4-11	12-17	18-23	24-29	30-35	36 +	All classes							
	Per-	Per-	Per-	Per-	Per-	Per-								
	Trees	Trees	Trees	Trees	Trees	Trees	cent	cent	cent	cent	cent	Trees	Per	Cent
Ponderosa	Felling	3	100.0										3	100.0
pine	Yarding	0	0.0											
Sugar	Felling	31	54.4	5	55.6								36	54.5
pine	Yarding	26	45.6	4	44.4								30	45.5
White	Felling	116	63.0	20	76.9	1	50.0						1	100.0
fir	Yarding	68	37.0	6	23.1	1	50.0						0	0.0
													138	64.8
													75	35.2
Incense	Felling	23	50.0	4	66.7								1	100.0
cedar	Yarding	23	50.0	2	33.3								0	0.0
													28	52.8
													25	47.2
All	Felling	173	59.7	29	70.7	1	50.0						2	100.0
Species	Yarding	117	40.3	12	29.3	1	50.0						0	0.0
													205	61.1
													130	38.9

527-

527-

5. Grazing. As on the other plots, the area was grazed lightly by cattle before logging. All classes of stock have been kept out since logging.

The remaining stand and results of cutting.

1. Composition. The remaining stand averaged 116 trees per acre, 3.6 inches d.b.h. and over, of which ponderosa pine made up 1.7 percent, sugar pine 19.1 percent, white fir 61.6 percent and incense cedar 17.6 percent (table 89). These trees averaged 2051 cubic feet per acre of which ponderosa pine made up 1.4 percent, sugar pine 11.5 percent, white fir 72.5 percent and incense cedar 14.6 percent.

The board foot volume in trees 11.6 inches d.b.h. and over was approximately 6800 board feet per acre of which ponderosa pine made up 0.9 percent, sugar pine 7.2 percent, white fir 80.8 percent and incense cedar 11.1 percent.

2. Distribution by diameter classes. Table 90 and figure 12 show that 79 percent of the reserve trees were under 12 inches d.b.h. and 95 percent were under 18 inches. Less than one percent were over 29 inches. The pine averaged somewhat smaller than fir or cedar. All of the ponderosa pines, 98 percent of the sugar pine, 94 percent of the white firs and 92 percent of the incense cedars were below 18 inches. There were no ponderosa pines or sugar pines above 23 inches but over one percent of the firs and 3 percent of the cedars were in those diameters.

Favorable growth in basal area might be expected as 36 percent of the basal area was in trees below 12 inches and 68 percent was in trees below 18 inches. Only 14 percent was in trees above 29 inches d.b.h. (table 91). Ponderosa pine and sugar pine with all their trees below 24 inches were in a better position for growth than fir or cedar.

Of the volume in the reserve stand, 2051 cubic feet per acre, over $\frac{1}{2}$ was in trees below 18 inches and less than $\frac{1}{4}$ was in trees above 29 inches (table 92 and figure 13). Fir accounted for almost $\frac{3}{4}$ of the reserve stand.

3. Distribution by tree classes. Tree class 1, accounted for 17 percent of the reserved trees, class 2 for 26 percent and class 6 for 56 percent (table 93). This is poor distribution from the standpoint of future growth.

Ponderosa pine had the best tree class distribution, 38 percent in class 1, 29 percent in class 2 and 29 percent in class 6. Sugar pine had the poorest tree class distribution with 15 percent in class 1, 22 percent in class 2 and 62 percent in class 6.

4. Slash disposal. The methods and results of slash disposal were the same as described under plot 9.

A summary of the condition of the plot after logging and slash disposal follows:

<u>Degree or type of damage</u>	<u>Type of cover</u>						
	<u>Logs</u> ^{1/}	<u>Burns and slash</u> ^{2/}	<u>Brush</u>	<u>Bear clover</u>	<u>Repro- duction</u>	<u>Brush and re- production</u>	<u>Free total</u>
	<u>Percent</u>						
Skid trails	25.8	20.0	31.8	24.3	20.7	8.9	28.4
Bare	23.2	27.0	13.0	28.7	11.1	12.0	17.4
Partial damage	25.0	26.1	22.7	15.6	14.1	26.0	18.7
No damage	26.0	26.9	32.5	31.4	54.1	53.1	35.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total area as basis (square feet)	10890	16265	70310	78945	93795	3545	196698 470448

1/ Mapped before logging only.

2/ These amounts were deducted from the areas of original cover in which they fell.

These values were obtained by planimeter from a composite map of the plot showing cover types before logging and degree and type of damage following logging.

"Skid trails" and "Bare" types of complete damage, covered 46 percent of the plot, were greatest proportionately in areas of "Bear clover" and "Free" and, least in areas of "Reproduction" and "Reproduction and brush". "Partial damage" occurred on 19 percent of the area was proportionately the greatest in "Burns and slash" and "Brush and Reproduction", least in "Bear clover" and "Reproduction". Again it should be noted that areas of "Burn and slash" were deducted from the areas of other cover types after logging and are not strictly comparable since the type of damage occurring previously influenced the placement of the slash piles. "No damage" accounted for 36 percent of the plot. "Reproduction" was proportionately the greatest and "Brush and Reproduction", least under "Burns and slash" and "Logs".

Distribution of board foot volume by tree classes is shown in table 94. Over half the reserved volume was in classes 1 and 2, $1/5$ was in class 5 and $1/3$ in classes 3 and 5 together. This is fairly good distribution from the standpoint of future growth in board feet. All of the ponderosa pine volume was in class 2. About 90 percent of the sugar pine was in classes 1 and 2. Of the white fir 56 percent was in classes 1 and 2, 20 percent in class 5. Cedar had the poorest distribution from the standpoint of future growth in board feet with but 37 percent of its volume in classes 1 and 2, and 37 percent in class 5; the remainder being distributed between classes 3, 6 and 7.

4. Distribution on the ground. Most of the reserve trees were in grouped arrangement due to the character of the original stand.

5. Condition of the stand. Of the 1253 trees over 3.5 inches d.b.h. on the plot after logging, 433 or about 35 percent showed defect or disease from one or more causes. The distribution of these is shown in table 96. Over $2/5$ of the defects were due to logging wounds on bole or butt, and

1/4 to raked crowns and broken tops from logging. Logging injuries combined to make 2/3 of all defects recorded. Mistletoe, fungus, insects (including witches brooms) and dead and broken tops other than those from logging (due largely to mistletoe and possibly to insects) accounted for almost 1/5 of the defects and fire for 1/10. Miscellaneous agencies (axe marks, porcupine damage, wounds from unknown causes, etc.) accounted for the remainder. For each species combined types of logging damage made up from 1/2 to 3/4 of the total injuries recorded. Mistletoe, top injuries from causes other than logging and fire were important in fir, witches broom and fire in cedar.

The distribution of cull by species and diameter classes appears in table 98. Over half the cedar left and almost 1/5 of the fir left was cull. Over 2/5 of the fir volume and all the cedar volume was in trees above 3.5 inches.

6. Changes in composition. The net results of losses through death and gains in new trees for the first period appear in table 99 and table 100. Ponderosa pine, sugar pine and incense cedar gained slightly in numbers of trees at the expense of white fir. Cedar made the greatest part of the gain. In volume there was a gain in the proportion of sugar pine, a loss in white fir and incense cedar.

Table 99. - Composition of the remaining stand.

Acre basis								
Species	Trees		Basal area		Cubic volume		Board foot volume	
	Number	Percent	Square feet	Percent	Cubic feet	Percent	Board feet	Percent
Ponderosa pine	1.9	1.7	0.8	1.3	27.8	1.4	58	0.9
Sugar pine	22.2	19.1	9.0	14.1	235.1	11.5	489	7.2
White fir	71.5	61.6	42.6	66.8	1488.3	72.5	5486	80.8
Incense cedar	20.4	17.6	11.4	17.8	299.8	14.6	752	11.1
All species	116.0	100.0	63.8	100.0	2051.0	100.0	6785	100.0

Table 91. - Distribution of remaining trees by size classes.

Acre basis									
Diameter classes - inches									
Species	4-11	12-17	18-23	24-29	30-35	36+	: All classes		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number
	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
ponderosa									
pine	1.6	85.7	0.3	14.3			1.9	100.0	
Sugar									
pine	18.6	83.7	3.2	14.6	0.4	1.7	22.2	100.0	
White									
fir	54.2	75.8	13.1	18.4	3.1	4.4	0.3	0.5	0.6
Incense									
cedar	17.0	83.6	1.7	8.2	1.1	5.4	0.3	1.4	0.5
							0.1	20.4	100.0
All									
species	91.4	78.8	18.3	15.8	4.6	4.0	0.6	0.5	116.0
							0.4	0.6	100.0

Table 92. -Distribution of basal area of remaining trees by
diameter classes.

Species	Acre basis											
	Diameter classes - inches											
	4-11	12-17	18-23	24-29	30-35	36+	: All classes					
	Square feet	Percent	Square feet	Percent	Square feet	Percent	Square feet	Percent	Square feet	Percent	Square feet	Percent
Ponderosa pine	0.5	60.7	0.3	39.3							0.8	100.0
Sugar pine	4.7	51.9	3.5	39.4	0.8	8.7					9.0	100.0
White fir	14.2	33.4	14.5	33.9	6.3	14.9	1.3	2.9	1.1	2.6	5.2	42.6
Incense cedar	3.6	31.6	1.8	15.8	2.5	22.3	0.7	5.9	1.7	14.7	1.1	9.7
												11.4
												100.0
All species	23.0	36.0	20.1	31.5	9.6	15.1	2.0	3.0	2.8	4.4	6.3	63.8
												100.0

Table 93. - Distribution of cubic foot volume of remaining trees by size classes

Acre basis													
Diameter classes - inches													
Species	4-11		12-17		18-23		24-29		30-35		36+		:All classes
	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	Cubic feet	Per- cent	
Ponderosa													
pine	13	48.0	14	52.0								27	100.0
Sugar													
pine	90	38.2	119	50.6	26	11.2						235	100.0
White													
fir	293	19.7	507	34.0	266	17.9	59	4.0	61	4.1	303	20.3	1489 100.0
Incense													
cedar	49	16.2	46	15.5	77	25.7	21	6.9	63	21.0	44	14.7	300 100.0
All species	445	21.7	686	33.5	369	18.0	80	3.9	124	6.0	347	16.9	2051 100.0

Table 94. - Distribution of trees in the reserve stand
by tree classes

(Tree 3.6" d.b.h. and over)

Acre basis												
Tree classes												
Species	1	2	3	4	5	6	7	: All classes				
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Ponderosa												
pine	0.7	38.1	0.5	28.6	-	-	0.6	28.6	0.1	4.7	1.9	100.0
Sugar												
pine	3.3	15.0	5.0	22.5	-	-	13.8	62.1	0.1	0.4	22.2	100.0
White												
fir	11.6	16.2	20.4	28.5	0.3	0.5	38.8	54.3	0.1	0.1	71.5	100.0
Incense												
cedar	4.3	20.9	3.7	18.2	0.1	0.5	12.0	59.1	0.1	0.4	20.4	100.0
All species	19.9	17.2	29.6	25.5	0.4	0.4	65.2	56.2	0.4	0.3	116.0	100.0

Table 95. - Distribution of board feet in the reserve stand
by tree classes
(Trees 11.6 inches d.b.h. and over)

Acre basis													
Tree classes													
Species	1	2	3	4	5	6	7	All classes ^{1/}					
	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet	Per- cent	Board feet
Ponderosa pine	-	-	58	100.0	-	-	-	-	-	-	58	100.0	
Sugar pine	221	45.4	217	44.5	-	-	40	8.2	10	1.9	488	100.0	
White fir	1654	30.3	1398	25.5	951	17.4	-	1086	19.8	350	6.4	5471	100.0
Incense cedar	202	26.7	76	10.0	55	7.3	-	269	35.6	72	9.5	756	100.0
All species	2077	30.7	1749	25.8	1006	14.9	-	1355	20.0	462	6.8	6773	100.0

^{1/} These totals do not check with those of Table 89 as different averages were used.

Table 96. - Distribution of defects by causes

All species - Plot basis							
Defects	: : 3.6 - 11.5 : inches	: : d.b.h. : inches	: : 11.6 inches : inches	: : d.b.h. and over : inches	: : All : diameters		
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>	
Witches broom	16	3.5	2	1.0	18	2.8	
Fungus	2	0.4	6	3.0	8	1.2	
Insects	3	0.6	4	2.0	7	1.1	
Mistletoe	21	4.6	12	6.1	33	5.0	
Logging (Butt and bole)	218	47.4	60	30.5	278	42.3	
Logging (crown)	38	8.3	22	11.2	60	9.1	
Logging (top)	77	16.7	26	13.2	103	15.7	
Top injuries other (than logging)	40	8.7	18	9.1	58	8.8	
Fire	24	5.2	41	20.8	65	9.9	
Miscellaneous	21	4.6	6	3.1	27	4.1	
All causes	460	100.0	197	100.0	657	100.0	

d 460
t 324

197
109

657
433