Natural Regeneration Response to Initial Treatments

Modified from Gruell and others (1982)

During the 1907 to 1911 harvest, logs were transported to landings by means of log chutes, horse skidding, and steam donkey yarding. Slash was disposed of by piling and burning, which the purchaser considered to be an unnecessary practice (Koch 1998). Usually this type of logging and postlogging treatment results in relatively light site disturbance, and the photo series tends to corroborate this. Some advance natural regeneration, primarily Douglas-fir, was present in the stand prior to logging; most of it became established in the 10 years prior to logging (Boe 1948). However, opening of the stand, site disturbance of the logging, and apparent good seed crops resulted in adequate subsequent tree regeneration. White (1924) stated: "Along about 1912, there was a heavy yellow pine seed crop. That fall, in October, the area was grazed close by sheep." The most successful regeneration period was the first 10 years after logging, with a gradual decline in the second and third decades.

Total subsequent regeneration combining all species was best where reserve volumes averaged about 2,500 bd ft per acre. Lighter volumes resulted in lesser amounts of regeneration. Reserve volumes greater than 2,500 bd ft contributed little or no additional aid in seedling establishment except on southerly aspects where it enhanced Douglas-fir establishment. Apparently, reserve volumes of about 2,500 bd ft provided reasonably good conditions for all species, with an adequate seed source, and shade and moderate competition during the establishment period.

Some conclusions that came out of the evaluations of natural regeneration were (Boe 1948):

1. Douglas-fir reproduction tends to become established in advance of cutting, due to greater shade tolerance. The tendency is more pronounced on the cooler, moister north aspects where Douglas-fir predominates. Ponderosa pine generally regenerates after logging and predominates on the south slopes.
2. It took about 20 years after cutting to restock the area; however, the peak establishment occurred in the first 10 years.
3. Height growth of young ponderosa pine and Douglas-fir was about equal for the first 40 years, each averaging slightly more than 0.6 ft annually. Consequently, if both species become established at the same time, the danger of Douglas-fir crowding out the pine is greatly decreased.

Harvest Cutting Treatments and Thinning Study, 1952 to 1981

James P. Menakis and Gruell and others (1982)

Growth evaluations 35 years after the initial cuttings indicated that a second cutting was needed to better capitalize on growth potential of the site (Roe 1947b). So in the 1950's, additional cuttings were made on a limited portion of the original cutover area. The following cutting methods were imposed on 468 acres within the original 1907 to 1911 cutover area (2,135 acres):

- **Method A (approximately 223 acres)**—Remove old stand in four cuttings; the first in 1907 to 1911, and the other three at 10-year intervals starting in 1952.
- **Method B (approximately 98 acres)**—Remove old stand in three cuttings; the first in 1907 to 1911, half the old residual in 1955, and the other half in 1962.
- **Method C (approximately 147 acres)**—Remove old stand in two cuttings; the first in 1907 to 1911, and the remainder of the residual in 1955.
- **Method D (approximately 10 acres)**—A portion of the 320 acres clearcut in 1907 (private land then). This area is not included in the 468 acre figure as no further cutting was planned so it could be used for comparison purposes.

Crews installed 87 permanent research plots throughout the cutting units (Methods A-C) with the objective of determining which method would best capitalize on the growth potential of the site. In addition, 10 plots were installed in areas treated with Method D to compare the clearcutting to the selective cutting. The research plots were scheduled to be

remeasured every 5 years. Figure 10 shows the diameter distribution in 1948 for the drier habitat types.

At the time of the second cutting in the 1950's, stand volumes averaged about 10,000 bd ft per acre. Method A removed about one-third of the residual volume (left after the 1907 to 1911 cutting) and was completed in 1952. Method B removed about one-half of the residual volume and was completed in 1956. Method C removed all of the residual volume but left one-third of the total volume and was completed in 1956 (fig. 11). The minimum dbh specifying the merchantability of a tree was 14 inches for method A, and 12 inches for methods B and C. Logs were mainly tractor skidded, with a pan under the front of the logs; however, there was some supplemental jammer skidding.

Marking practices to accomplish these partial cuttings were:

1. Remove high-risk trees (those which would not survive 10 to 20 years).
2. Remove damaged or defective trees, with special emphasis on one of the following: spiked tops, lightning scars, butt rots, and leans in excess of 20 degrees.
3. Remove poor quality, merchantable subordinates.
4. Remove extremely slow growing, overmature trees.
5. Release subordinates by removing merchantable overstory trees of lesser quality.
6. Remove all merchantable Douglas-fir.
7. Remove dominant trees from mature and overmature groups.

A stand improvement cut followed the first entries with the objective of providing fast growing, uniformly spaced second-growth ponderosa pine. Crop trees (4 to 9 inches dbh) were released from competing trees at an average spacing of 20 by 20 feet. Stand improvement cuts were completed in 1953 in method A and in 1956 in method B and C. Method A had additional stand improvements that included:

1. Pruning selected crop trees to 17 feet in height, but never removing more then 40 percent of the crown.
2. Thinning saplings (1 to 3 inches dbh) to a spacing that averaged 15 by 15 feet.
3. Removing unhealthy and defective trees 4 to 9 inches dbh (killed by poisoning).

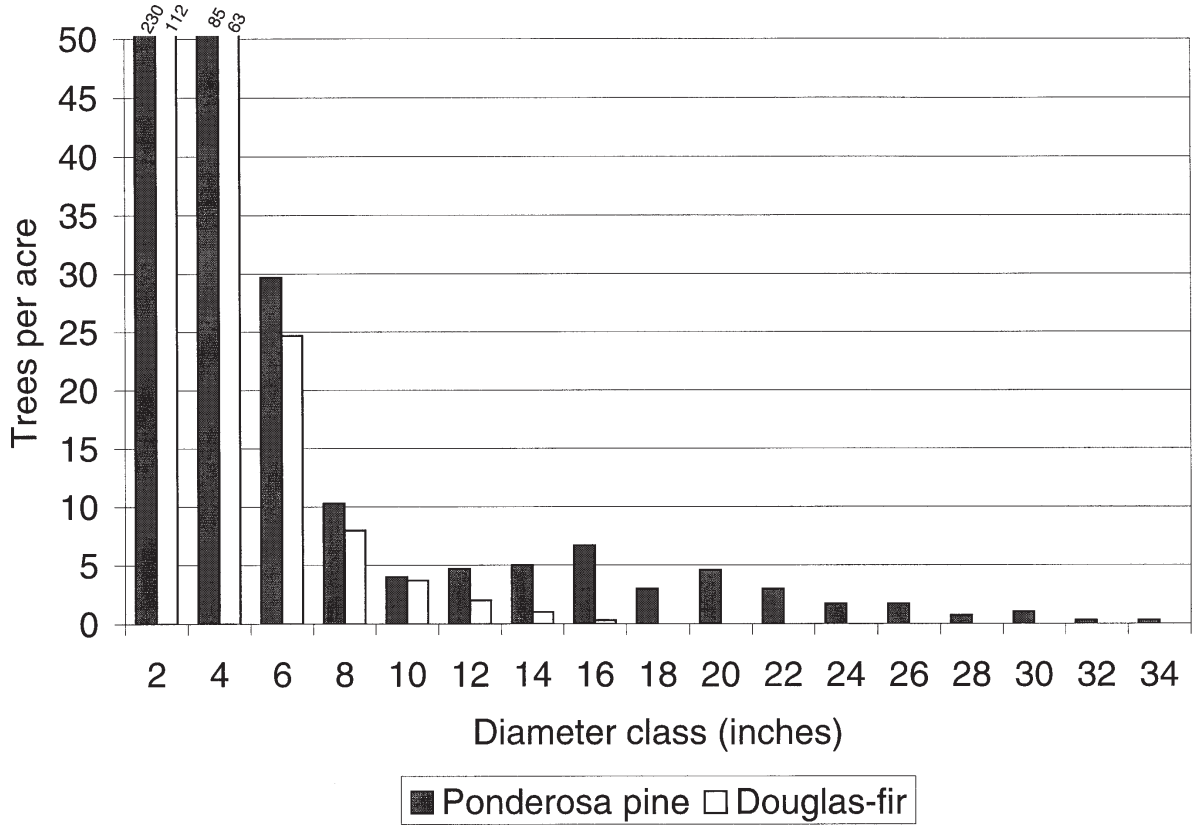

Figure 10—Estimated average diameter distributions for dry habitat type groups at Lick Creek in 1948 (Menakis 1994).

Figure 11—An example of method C before (1955) and 5 years after cutting. Photo at right (1998) shows recovery after 1950's and 1960's cuttings and 1994 underburning.

Response to 1950's Harvest Cutting

Modified from Gruell and others (1982)

Response following the 1950's cutting was similar to that after the original 1907 to 1911 cutting; greatest increases in merchantable volume were in stands with the largest reserve volumes. Net volume growth exceeded that following the original cuttings, ranging from about 150 bd ft per acre in stands with 2,000 bd ft per acre reserve volume to 235 bd ft in stands with 12,000 bd ft reserve stand volume. Ingrowth accounted for about 30 percent of the volume growth in the lightly stocked reserve stand and only about 3 percent in the more heavily stocked reserve stand. About half of the ingrowth was Douglas-fir, in spite of the attempts to enhance ponderosa pine and discourage Douglas-fir.

Lumber recovered from these second cuttings was similar in quality to that from virgin stands. Approximately 15 percent of the lumber was select, 60 percent in two and three common grades, and the remainder in lower grades.

Additional Treatments 1960 through 1981

James P. Menakis

A light stand improvement treatment was applied to method D in 1960. This treatment differed from other stand improvement treatments in that only a few 4- to 9-inch diameter trees were removed that were defective or unhealthy. The treatment was very light and patchy.

The third entry of Method A was completed in 1962. The harvest removed only one-third of the residual (1907 to 1911) trees, instead of the scheduled half, because many of the residual trees were growing well. The marking of trees followed the 1952 sale criteria except for emphasizing the removal of Douglas-fir heavily infected with dwarf mistletoe, and specifying minimum tree merchantability at a dbh of 9.6 inches. The thinning was followed 2 years later (1964) by a stand improvement cut aimed at removing smaller diameter Douglas-fir infected with mistletoe and additional thinning and pruning of crop trees remaining after the 1952 thinning.

Unfortunately, the thinning study was terminated in 1966 because of a restructuring of the USDA Forest Service Research Units. Future cuttings quickly deviated from the 1950's study design, creating several subdivisions in the original methods. Based on the new treatment boundaries (determined during the 1991 remeasurement) method A was subdivided into three groups (A1, A2, and A3), and methods B and C were each subdivided into four and three groups, respectively (labeling similar to method A) (fig. 12).

Methods B1 through B4 were thinned in 1967 following the guidelines in the 1950's study plan. Most of the remaining residual (1907 to 1911) trees were removed, as well as all of the merchantable Douglas-fir. A stand improvement cut, which also included

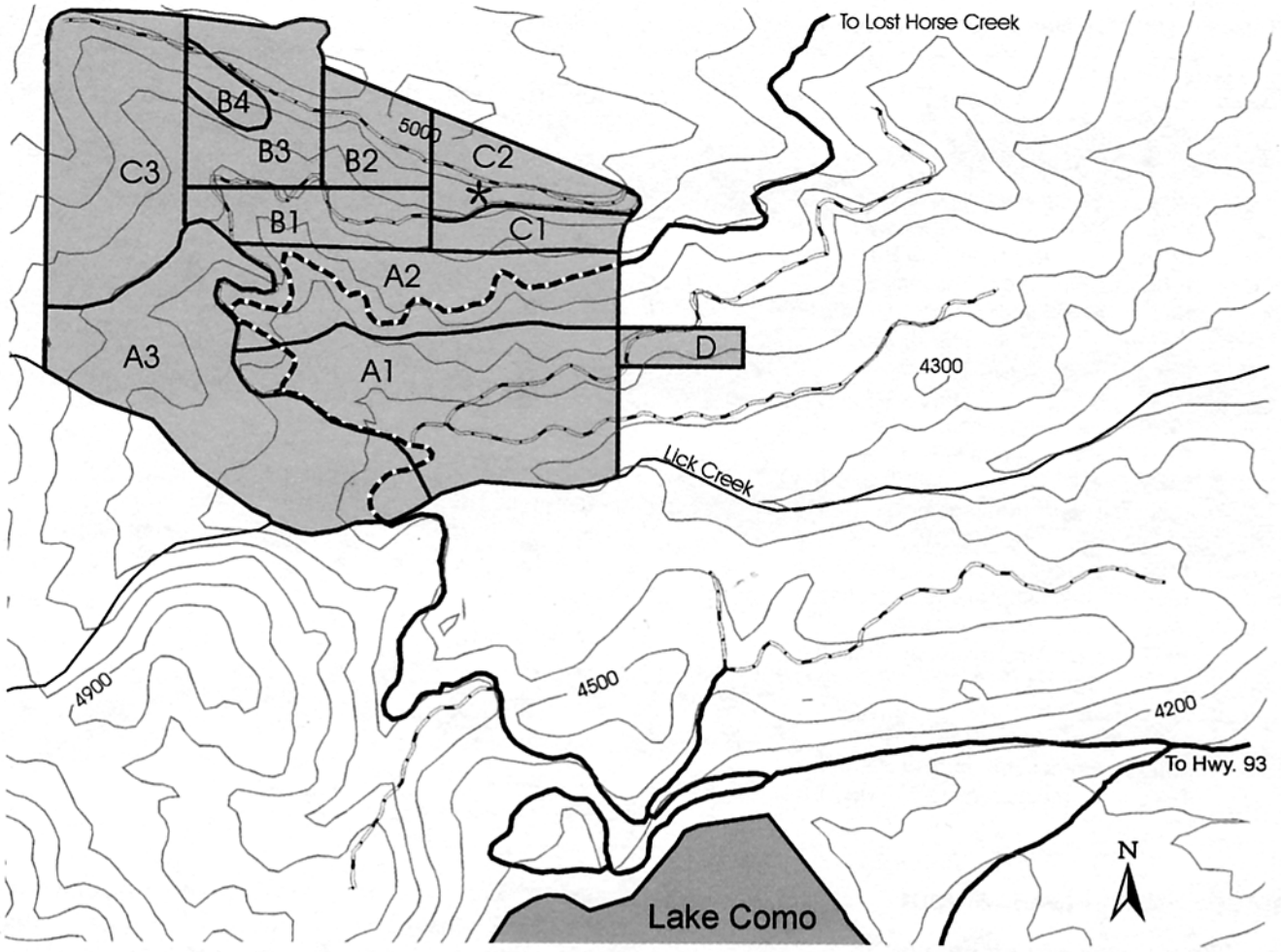

Figure 12—A map of the Lick Creek study area with methods A through D (described in text) delineated (Menakis 1994). Asterisk in area C2 shows location of photopoint for figure 11.

methods C1 and C2, followed the thinning with the objective of pruning and releasing crop trees.

In 1979, a large timber sale occurred on the west portion of the study area, affecting methods A3, B3, B4, and C3. The criteria for selecting trees were:

1. Release healthy, vigorous understory trees.
2. Salvage high risk and overmature trees.
3. Remove diseased and insect damaged trees to provide space for healthy trees.
4. Remove about 50 percent of the crown cover.

The minimum diameter to determine merchantability was 8 inches dbh. The sale was followed (in 1981) by a light and patchy underburn.

In 1980, a light stand improvement thinning was applied to methods A2, B1, B4, and C1. The objective of the thinning was to improve the growing space of sapling trees. The thinning was light and patchy, with saplings being hand piled. The exact extent of this treatment is unknown. Table 3 summarizes the history of the Lick Creek area by Methods.

Summary of Harvest Cutting Treatments

James P. Menakis

In 1991, the permanent plots established in the late 1940's and early 1950's were remeasured in an attempt to evaluate the different treatments. Unfortunately, because of the range of activities that took place and divided the original treatments, any comparison would be inconclusive. Table 4 stratifies methods by the number of commercial cuttings.

Despite the strong effort to limit the number of Douglas-fir trees in the Lick Creek area, by 1991 the percent of basal area per acre of Douglas-fir, when compared to total basal area, had increased by about 18 percent in the drier habitat types. The total number of trees per acre also increased by about four times during this period, with most of this increase in diameters less than 6 inches (fig. 13).

Table 3—Historical management activities by method (see fig. 12) (Menakis 1994).

Date			Method										
Month	Year	Activity	A1	A2	A3	B1	B2	B3	B4	C1	C2	C3	D
	1906	Clearcut											X
	1907	Selective Cutting Starts	X	X	X	X	X	X	X	X	X	X	
	1911	Selective Cutting Ends	X	X	X	X	X	X	X	X	X	X	
7	1948	Installation of Permanent Plots	X	X	X								
6	1952	Remeasurement of Perm. Plots	X	X	X								
6	1952	Commercial Thinning	X	X	X								
11	1953	Stand Improvement Cutting	X	X	X								
5	1955	Installation of Permanent Plots				X	X	X	X	X	X	X	X
12	1955	Commercial Thinning				X	X	X	X	X	X	X	
4	1956	Stand Improvement Cutting				X	X	X	X	X	X	X	
7	1957	Remeasurement of Perm. Plots	X	X	X								
9	1960	Stand Improvement Cutting											X
6	1961	Remeasurement of Perm. Plots				X	X	X	X	X	X	X	X
8	1962	Remeasurement of Perm. Plots	X	X	X								
10	1962	Commercial Thinning	X	X	X								
9	1965	Remeasurement of Perm. Plots				X	X	X	X	X	X	X	X
6	1966	Stand Improvement Cutting	X	X	X								
6	1967	Commercial Thinning				X	X	X	X				
10	1967	Stand Improvement Cutting	X	X	X	X	X	X					
8	1979	Commercial Thinning			X			X	X			X	
9	1980	Stand Improvement Cutting		X		X			X	X			
3	1981	Understory Burn			X			X	X			X	
5	1990	Remeasurement of Perm. Plots											X
11	1991	Remeasurement of Perm. Plots	X	X	X	X	X	X	X	X	X	X	

Immature Stand Management

Modified from Gruell and others (1982)

Cutting and other management of immature stands was started in the 1950's on the Lick Creek study area. More than 5,000 ponderosa pine crop trees (100 per acre) were released and pruned in the area cut with method A of the 1952 partial cutting. Trees were 4 to 9 inches dbh at the time. Release was provided by removing competitors in a 3- to 6-ft radius around the crown of each crop tree. To increase quality of the feature ponderosa pine crop trees, each was pruned to at least 17 ft. Cost of release and pruning at that time was about $0.50 per crop tree, broken down into $0.25 for pruning, $0.16 for release, and $0.09 for supervision, supplies, and transportation costs.

The 5-year evaluations of various intensities of pruning ponderosa pine showed a considerable

Table 4—Number of commercial and stand improvement cuts, and percentage of 1910 residual volume removed by method (Menakis 1994).

Method	Number of commercial cuts	Number of stand improvement cuts	Years of commercial cuts (% of 1910 residual removed)+		
A3	3	2	1952 (33)	1962 (22)	1979 (11)
B3	3	3	1955 (50)	1967 (25)	1979 (20)
B4	3	3*	1955 (50)	1967 (25)	1979 (20)
A1	2	2	1952 (33)	1962 (22)	
A2	2	3*	1952 (33)	1962 (22)	
B1	2	3*	1955 (50)	1967 (25)	
B2	2	2	1955 (50)	1967 (25)	
C3	2	0	1955 (100)		1979 (0)
C1	1	3*	1955 (100)		
C2	1	2	1955 (100)		
D	0	1*	No commercial cutting		

+ - Percent of residual volume removed was based on historical reports and general site estimates.
* - The last stand improvement cut was very light and patchy.

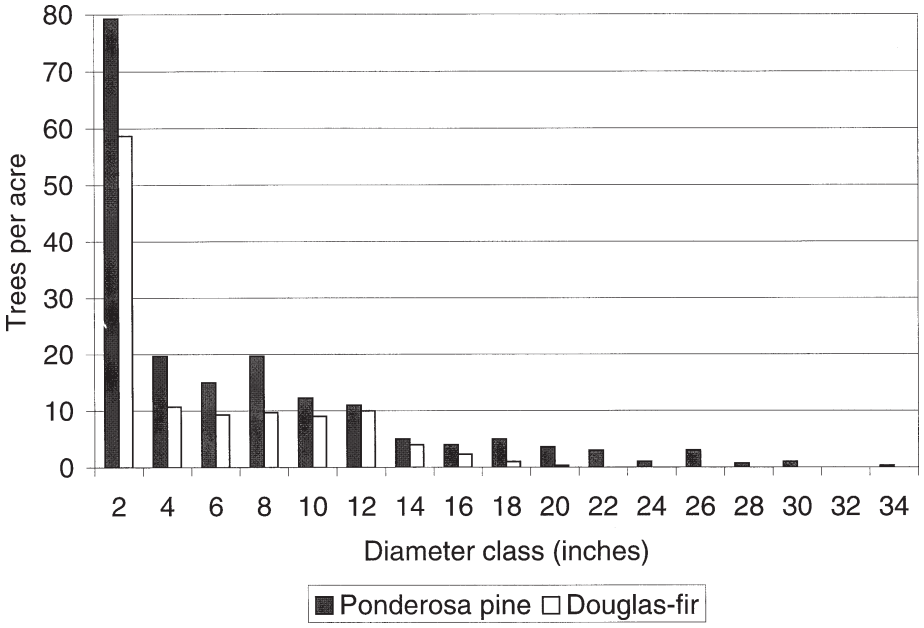

Figure 13—Average diameter distribution for dry habitat type groups by species and 2-inch diameter classes for 1991 (Menakis 1994).

reduction in dbh growth on the severely pruned trees, with proportionately less reduction on the lightly pruned trees (fig. 14). Height growth was not affected.

Cone stimulation studies were also conducted on this area. These studies showed that partial mechanical girdling of young ponderosa pine (50 years old) would substantially increase cone production (Shearer and Schmidt 1970). Older trees (140 to 220 years old), however, showed little additional cone production as a result of girdling treatments.

Summary

Modified from Gruell and others (1982)

In summary, a variety of silvicultural practices have been attempted in the Lick Creek area. The long case histories and observational data of partial cutting, release, pruning, and cone stimulation practices provide valuable clues for management of this important forest type.

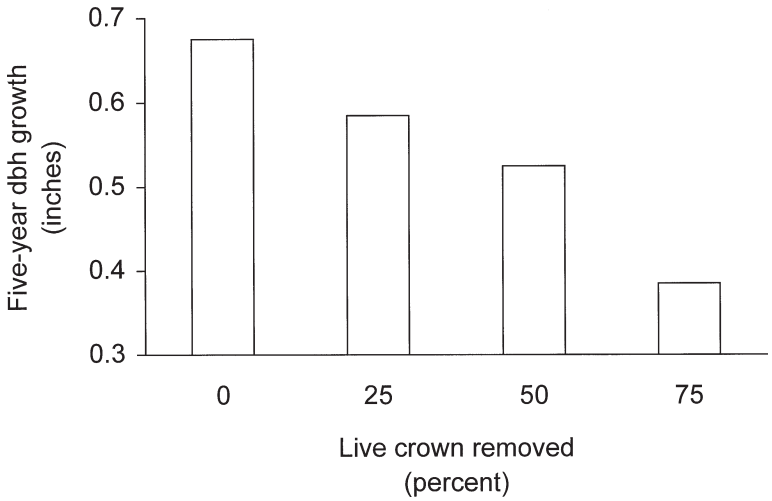

Figure 14—The 5-year diameter growth of 4- to 9-inch dbh ponderosa pine crop trees following release as related to amount of crown pruning (Gruell and others 1982).