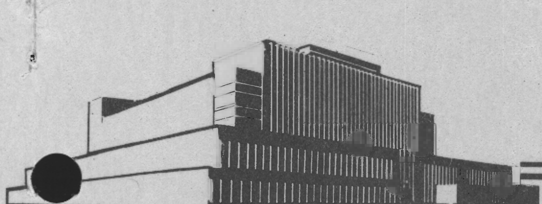
CALIFORNIA BLACK OAK - A UTILIZATION STUDY

January 1962

(Report) No. 2237



FOREST PRODUCTS LABORATORY
MADISON 5, WISCONSIN

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
In Cooperation with the University of Wisconsin

CALIFORNIA BLACK OAK - A UTILIZATION STUDY[1]

By

F. B. MALCOLM, Technologist

Forest Products Laboratory,[2] Forest Service
U. S. Department of Agriculture

Summary

An evaluation of log and lumber quality of California black oak (Quercus kellogii) was made as part of a broad study of the utilization potential of this species. Logs were bucked into lengths up to 16 feet for maximum log quality. The basis for log quality was the Forest Service Standard Hardwood Factory Log Grade Specification. A subsequent study of grade sawing provided information on lumber grade yield recovery by log diameters within log grades, as well as demonstrating that the Forest Service Standard hardwood log grades would perform satisfactorily on this species. A sawing methods evaluation indicated that orienting sawing faces of logs so that major defects came to the edges can result in higher values than orienting sawing faces with major defects in the center.

Introduction

The latest estimates of the volume of California black oak (Quercus kellogii) indicate that about 2 billion feet of sawtimber are available in commercial timberlands in California. Although this is only a fraction of the total volume of sawtimber in the state, it occurs in sufficient quantities in some timberlands to interest some timberland owners in examining closely the marketing potentials of this species.

---

[1] In cooperation with the Diamond National Corporation, the University of California Forest Products Laboratory, and the Pacific Southwest Forest and Range Experiment Station of the U. S. Forest Service.

[2] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

Report No. 2237

California woodworking industries use over 60 million feet of hardwood lumber annually. Over 10 million feet of this volume is oak, practically all of which is shipped from the eastern United States. Basically California black oak has most of the physical characteristics and strength properties that are required of eastern oaks for many end uses; thus, it should compete successfully for a part of this market for oak and possibly expand into other markets. This species has the hardness and finishing characteristics that are needed for flooring, it has grain and figure characteristics that make it attractive for furniture, store fixtures, and paneling, and has strength properties that should make it competitive for such uses as truck body stock, pallets, and similar industrial uses.

Although in the past some prejudice existed in the trade against California black oak, this probably resulted from the lack of knowledge of how to saw and dry it properly, as well as to the operating practices of the small operators who attempt to market it. In the light of current technical knowledge of this species, it should be possible to overcome these prejudices by aggressive, dependable operators using eastern hardwood sawing techniques and adopting good hardwood air and kiln drying practices. One of the timberland owners, Diamond National Corporation (formerly Diamond Match), Chico, Calif., decided to investigate the potential of this species. Specialists in the corporation's forest management division had recognized from their timber inventory that the volume of California black oak was sufficient to investigate its utilization potentials. Consequently, they began an overall study of the species. The study included the compilation of data on logging, sawmilling, and lumber seasoning, as well as products development and survey of market acceptance. This report covers the sawmilling phase that was conducted by the U.S. Forest Products Laboratory.

The lumber produced during the sawing phase was used in conducting lumber seasoning studies by the Pacific Southwest Station and the University of California Forest Products Laboratory. Other information obtained during the sawing included a study of the occurrence of tension wood and an evaluation of its effect on seasoning degrade, the potential yields of veneer flitches, and yields of wood fiber.

The principal objectives of the sawmilling study were to obtain an estimate of the lumber grade yields (National Hardwood Lumber Association rules) that could be developed, an estimate of the performance of the Forest Service Standard Hardwood Log Grade Specifications[3] on California black oak logs, and an analysis of the effect of different sawing methods on lumber grade yields. The sawing methods used in the study involved varying the position of sawing faces in relation to the coarse visible defects--principally the

---

[3] U.S. Forest Products Laboratory Report No. 1737, Hardwood Log Grades and Standards - Proposals and Results. 1959.

coarse knots--when the logs were placed on the carriage for the first slab cut. Three variations of placing the logs for the first cut were used: (1) So that the coarse knots were centered on the sawing face, (2) so that the coarse knots were on the edges of the sawing faces, and (3) by letting the sawyer use his own judgment as to orienting sawing faces with defects. The sawing was done on a sawmill in Stirling City, Calif., that was owned by the cooperating firm.

Procedure

Log Preparation

Logs for the study came from three different logging areas in the vicinity of the sawmill. Two areas had been logged 3 and 6 months prior to the study. Logs from these areas were cold decked and protected by a water spray system to prevent deterioration. The third area was logged just before the start of the study, so the logs did not require cold decking. There was no noticeable degrade in any logs due to effect of the water spray on the cold decks.

Logs were delivered to the mill yard in single and multiple log lengths. Many of the logs were quite crooked, which apparently reflects a characteristic of this species that may be related to growth conditions. The logs were rebucked into lengths that ranged from 6 to 16 feet, with every effort made to develop maximum quality. The nominal 16-foot log length is the maximum length for hardwood logs normally sawn by hardwood sawmills. The rebucking produced 612 logs. These logs were all diagramed in accordance with procedures established by the Forest Products Laboratory for making hardwood log grade studies, and were graded by the Forest Service Standard Hardwood Log Grade Specifications. These specifications provide for only three log grades. Logs that do not measure up to these specifications are considered below grade. Because the study included the full length of trees to a 6-inch-top diameter, a considerable number of below-grade logs were produced. Representatives of the company requested that these be included. Consequently, to identify them in this study, the below-grade logs were designated as grade 4 logs, although this is not an established Forest Service Standard factory log grade.

As each log was diagramed, it was assigned a log-diagram number. The number related the log to its position in the tree or multiple log length, beginning at the butt or large end. When all the logs had been diagramed and graded, they were sorted by the random number procedure into three log decks. Selection of the individual log decks used for each of the sawing methods, as indicated above, was also by the random numbers procedure.

In order that the sawyer would recognize the position of the first face to be sawed (when the log reached the carriage), the face was marked by a red line on both ends of each log. The positions of the other three sawing faces were thus automatically established.

Sawing Procedure

A 9-foot band headrig was used to saw the oak logs. Although the sawmill was designed for softwood production, no major problem was encountered in sawing hardwoods.

All logs were sawed into 4/4 boards on the headrig, thus bypassing the resaw, which helped to simplify keeping track of boards. Since no experienced hardwood bandsaw operators were available in California, it was necessary to recruit a sawyer and edgerman from the East.[4]

The first group of logs sawed were those selected by the sawyer's choice method, which is referred to as Method 1 in the study. This method was run first to avoid the possibility of the sawyers becoming influenced by the other methods. The second group of logs sawed comprised those selected and marked for orienting the defects to the center of the sawing face, referred to as Method 2. The third group consisted of logs selected and marked for orienting defects to the edge of sawing faces, which is referred to as Method 3. Methods 2 and 3 were the same in design, except for the position of the defects in the sawing faces. Orienting defects to the edges of sawing faces is the grade sawing procedure recommended by the Forest Products Laboratory.[5]

Each log, as it came to the sawmill carriage, was assigned a new number to simplify board marking for identification. This was the sawmill log number and was correlated with the log-diagram number. These numbers ran consecutively through the three groups of logs from 1 to 612. The boards sawed from each log were also given a sequence number in the order they were sawed from the individual log. The position and sawing sequence of each board from each log was recorded on a diagram. The log number and sawing sequence number for the log were marked on each board behind the headsaw. Each part of any boards ripped or crosscut was also marked with the original board number. The grade was marked on each board after it had reached the green

---

[4]The top-rated sawyer and edgerman at Nickey Bros., Memphis, Tenn., were made available to the Diamond National Corp. for the study.

[5]Malcolm, F. B., A Simplified Procedure for Developing Grade Lumber from Hardwood Logs, U. S. Forest Products Laboratory Report No. 2056. 1956.

chain. All boards were dip treated for insect and stain resistance as they left the trimsaw conveyor. The grade, scale, and board number of each board was recorded on individual log tally sheets.

Office Procedure

A careful recheck was first made of the log diagrams for log grade determinations and the diagrams of the individual boards sawed from each log were then checked against the lumber tally sheets. This resulted in the rejection of 23 logs from the study. Consequently, the data from 589 logs were used in evaluating the the results of the study. Rejection was for insufficient recorded information for grading logs and for discrepancies in board sequence number and lumber tally data.

The lumber tally sheets for each log were summarized to determine the grade yield and scale. The total scale of each grade of lumber from each log was reduced by 5 percent when grade yields and values were calculated, so as to place the data on a dry lumber basis. This is in accordance with practices followed at the Forest Products Laboratory when grade yield studies are made. For evaluation purposes, monetary values per thousand board feet were computed for each log grade and each method. The lumber prices used for computing the lumber values were based on prices listed in the February 1957 issue of the Hardwood Magazine, Appalachian market quotations for red oak. These prices are as follows: Firsts and Seconds, $227; Selects, $217; No. 1 Common, $153; No. 2 Common, $108, No. 3A Common, $98. No quotation was given for No. 3B Common but a value of $44 was calculated for this grade, using the index value ratio of 0.29 of the price of No. 1 Common as outlined in the Tennessee Valley Authority Technical Note No. 15.[6] Summaries of lumber grade yields and values per thousand board feet were prepared for each log grade sawing method. The values per thousand board feet were used as indices for statistical analysis of the data. Grade yield tables by log diameters for the Forest Service Standard log grades Nos. 1, 2, and 3 were also prepared, as well as the logs below the specification of the Forest Service Standard, the grade 4 logs.

Results

Lumber Grade Yield Recovery

The total volume of lumber obtained from the 589 logs used in the final analysis of the study was 58,558 board feet. This figure is the final dry volume

[6] Tennessee Valley Authority, Division of Forestry Relations, Norris, Tenn., Lumber Price Ratios for Computing Quality Index of Tennessee Valley Hardwoods, Technical Note No. 15.

after the deduction of 5 percent loss for shrinkage. The summary of the grade yield recovery for this total is as follows: Firsts and Seconds, 5.3 percent; Selects, 2.1 percent; No. 1 Common, 19.4 percent; No. 2 Common, 23.8 percent; No. 3A Common, 17.5 percent; and No. 3B Common, 31.9 percent.

These figures cover every quality of log from 7 inches in diameter and up that were obtained from both the cold-decked and the fresh-cut logs. Included are logs graded below the Forest Service Standard Hardwood Log Grade Specifications (referred to as grade 4 logs), as well as the grades 1, 2, and 3 logs. There were 94 logs from the deck of fresh-cut logs that gave a total lumber volume of 10,320 board feet and grade yield recovery as follows: Firsts and Seconds, 10.5 percent; Selects, 3.3 percent; No. 1 Common, 23.9 percent; No. 2 Common, 21.9 percent; No. 3A Common, 12.7 percent; and No. 3B Common, 27.6 percent. The higher grade yield values obtained from the fresh logs can possibly be attributed to such factors as better site-quality and controlled felling and bucking practices. Not enough specific information, however, is available on the site quality of the individual areas to draw any conclusion on this point. On the other hand, there is an indication that better control of felling and bucking of the fresh logs may have had an influence on the higher grade yields. Additional information on the procedure used in felling and bucking the three groups of logs used in the study is contained in a separate report.[7]

The grade yield summaries by log diameter within log grades are contained in tables 1, 2, 3, and 4. In these tables, there are some diameter classes for which there are no data and a good many more where there are data on only a few logs. Thus, the data are very limited in scope insofar as their use for predicting grade yield values is concerned, particularly by diameters within log grades. Therefore, it is recommended that their use be limited to purposes wherein reliable estimates are not essential. A considerably larger sample of logs is required to develop grade yield tables sufficiently reliable to place any confidence in the predictable results.

Performance of Hardwood Log Grade Specifications

Log grade studies made by the Forest Products Laboratory have shown that bark surface characteristics and log end defects, combined with log diameters and lengths, can serve as a very reliable guide for predicting lumber grade

[7]Fobes, E. W., Quality Controlled Log Bucking. Forest Products Journal, August, 1960.

yields. These factors, therefore, are the basis for the Forest Service Standard Log Grade Specifications as set forth in Forest Products Laboratory Report No. 1737, "Hardwood Log Grades and Standards - Proposals and Results."

In the test of the application of these specifications to California black oak, it was assumed that the average lumber grade values for each log grade should follow closely the averages for a comparable commercial oak as contained in Report No. 1737. Because the end uses for eastern upland red oak lumber are essentially the same as those for which California black oak will be marketed, this species was chosen for comparison purposes.

Table 5 gives the results of this comparison in percentage yields of each lumber grade as well as an overall monetary value comparison for each grade based on the market prices for the various grades quoted in Office Procedure previously mentioned. Report No. 1737 does not contain data on logs graded below No. 3, thus no values are available for comparison with grade No. 4 California black oak.

Average values are somewhat lower for log grades 1 and 2 and slightly higher for log grade 3, but the segregation level between grades is considered great enough to conclude that the Forest Service Standard grades can be applied to California black oak with the same degree of confidence that they are applied to all eastern hardwood species.

A few log defect indicators and surface characteristics for this species that were noted during the analysis of the data will require close attention in grading and perhaps will need further study. The lack of full information on the effect of these defects is believed to have influenced the results of this study.

Shake: The occurrence of shake appears to be much more common in California black oak than in eastern upland oak, particularly in the area outside the heart center. Shake was frequently difficult to spot on the ends of fresh-cut logs, and even on the weathered ends it sometimes required close scrutiny to detect it from weather checks. Although no specific record of defects was made when grading the lumber, some attention was given to the occurrence of shake because of the difficulty in finding it when diagraming the logs. Shake was found in lumber from a number of logs that did not indicate shake on the diagrams.

Bark distortions: Medium to heavy concentrations of horizontal bark cracks on the rough bark of mature eastern oak logs are usually an indication of a degrading defect within the outer one-fifth of the diameter of the log. This appeared to be true on certain California black oak logs that had a rough light-grayish bark. Similar bark distortions on logs with similar rough bark, but with the color of the bark a darker, blackish shade, did not appear to have the same degrading effect--the defects apparently were inside the heart area. These logs appear to have come from vigorous, growing trees.

Patches of heavily roughened bark on eastern oak logs with otherwise relatively smooth bark are usually associated with insect damage of some type. This condition of bark distortion apparently did not have the same degrading influence on California black oak. In fact, there appeared to be no evidence of insect holes or characteristic bark pockets associated with insect damage on any of the lumber sawed. On the other hand, this species has a characteristic of developing twin trunks that in some instances grow together for a log length or two. Bark pockets were found to be associated with this condition, although it was not always evident on the ends of the logs.

Knots: Certain kinds of knots (limbs) and knot clusters on certain types of logs do not appear to have so degrading an effect on California black oak as similar knots and knots clusters on eastern oak. Some logs that have a relatively smooth, fresh bark have small limb knots from 3/8 inch to about 1 inch in diameter, which apparently affect only a relatively limited area in the outer one-fifth of the radius of the log and sometimes are removed with the slab. Some of the clusters of such knots similarly affect less than the one-fifth outer zone. On some logs with this kind of knot cluster, when several consecutive boards are sawed from a face, the knots may disappear on the second and third boards sawed, thereby resulting in higher grade boards toward the center or heart of the log. Thus, they appear to have only the effect that adventitious branches under 3/8 inch in diameter have on eastern oak.

Evaluation of Sawing Methods

A surprising coincidence was discovered soon after the sawing phase of the study started, when it was found that the sawyer's method of placing the log for the first cut was essentially the same as the Forest Products Laboratory method--placing defects to the edges of the sawing faces. There was, however, a slight difference in the sawyer's method from the Forest Products Laboratory method, principally in his practice of sawing deeper into the log before turning to adjoining faces; faces that indicated potentially higher grade. The sawyer had had no previous contact with the Forest Products Laboratory method and had only arrived from the East a few hours before the sawing was to start.

The summary of the data on sawing methods, combining all grades of logs, gave slightly higher monetary values for Method 1 than for the other two methods, and the values for Method 3 higher than those for Method 2. Thus, placing the log on the carriage for the first cut so that the major defects will occur at the edges of the sawing faces appears to have an advantage over the method of centering defects on the faces. A comparison of grade yield recovery and monetary value data for the three sawing methods, wherein the data for all grades of logs sawed in a specific method are combined, is presented in table 6.

The statistical analysis of the data indicated that the differences between methods are not great enough to be significant at the 5 percent level. Nevertheless, the evidence for orienting defects to the edges of sawing faces is believed strong enough that it should not be ignored. When the data were summarized by log grades, the same pattern of results occurred for log grades 1 and 4, whereas log grade 2 gave results in favor of Method 3, as can be seen in table 7. The results for grade 4 logs should possibly be ignored, because they contain small-diameter and low-grade logs that many mills would not saw, as well as a few logs of fairly high quality less than 8 feet long that resulted from errors in bucking the logs. Although the results for grade 3 logs give higher values for Method 2, the centering defect method, a review of the log diagrams of this grade indicates that the factor of crook and sweep may have had an influence on these results. This factor was not controlled in the study other than as the log grade specification controlled it. Grade 3 specifications for this factor are very lenient. It is possible, therefore, that sweep and crook have a stronger influence than major knot defects. This point will require more study.

Hardwood Sawmilling Practices

There are some significant points not directly concerned with this study that may require some comment in this report. First, western operators should recognize that production rates for hardwoods will be lower than for softwoods. There are several reasons for this, the first of which is the fact that more time must be taken to obtain the best grade; the highest values are in hardwood factory grades and most of the log is worked up into these grades. Another point is that sawing schedules are somewhat different, since hardwood items usually are less than 2 inches thick while softwoods are mainly 2-inch dimension or thicker. A further point, hardwood log lengths are shorter than western softwoods, as was mentioned earlier in the report. Sawing speeds for hardwoods are slower because the wood is usually harder--California black oak, for instance, is about twice as hard as Douglas-fir--although only about 10 percent heavier. This characteristic of hardwood also requires a slightly different saw fitting job than that for softwoods, and the speed of the saw should be slower. Eastern operators generally consider that hardwood production rates are about one-third less than those of softwoods. Some softwood operators will find it difficult to get used to sawing hardwoods but with sawyers, edgermen, and trimmermen adequately trained in sawing for shop grades, perhaps the transition will not be too great.

Conclusions

1. The grade yield recovery of lumber for California black oak compares favorably with eastern red oak and black oak, although the values are slightly lower than for some of the preferred eastern oaks. Although the grade yield data are limited in scope, it is believed they can be used as indicators of potential yields. These data, however, should not be used for any purposes where a reliable estimate is required. Additional grade yield studies should be made to strengthen the grade yield data for certain diameters.

2. The Forest Service Standard Hardwood Factory Log Grade Specifications appear to perform very satisfactorily on California black oak. Close attention to felling and bucking practices as related to the log grade specification would perhaps result in a greater number of logs in grades Nos. 1 and 2 and likewise would increase the yield of No. 1 Common and Better lumber.

3. Although results of the sawing phase did not show conclusively that orienting defects to the edges of sawing faces is the best procedure in sawing logs for grade, the evidence is sufficiently strong that it should not be ignored.

4. Western sawmill operators will need to recognize that the rate of production for hardwoods is slower than that for softwoods for several reasons, but principally because quality takes precedence over quantity and because hardwood lumber products are usually of smaller dimension than softwood products.

Table 1.--Lumber grade yield recovery by log diameters of California black oak in Forest Service Standard Hardwood Log Grade 1

Log diameter inside bark	Basis: Logs	Basis: Lumber tally	Lumber grade yields (actual): Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common
	No.	Board feet	Percent					
15	2	218	....	2.7	32.1	22.5	19.3	23.4
16	4	553	17.9	4.3	23.7	16.3	15.4	22.4
17	3	401	23.5	7.2	32.7	14.2	2.2	20.2
18	3	422	31.0	5.0	24.9	13.8	9.7	15.6
19	1	161	50.3	8.1	5.0	24.2	5.6	6.8
20	6	1,262	13.3	5.6	46.5	15.9	8.7	10.0
21	1	204	....	....	36.3	33.3	9.8	20.6
22	1	281	35.2	8.5	26.7	8.6	3.9	17.1
23	1	269	5.2	3.0	48.3	28.6	14.9	....
24	2	554	39.5	9.7	24.9	9.2	4.2	12.5
25	1	279	8.6	1.8	29.0	17.9	21.5	21.2
26	....	....	....	....	....	....	....	....
27	....	....	....	....	....	....	....	....
28	....	....	....	....	....	....	....	....
29	....	....	....	....	....	....	....	....
30	....	....	....	....	....	....	....	....
31	1	634	26.7	4.4	34.7	21.8	7.2	5.2
32	1	375	13.6	8.5	33.9	20.3	13.6	10.1
33	1	433	16.4	1.8	29.1	15.0	17.6	20.1
34	1	423	25.1	1.2	35.7	13.7	15.6	8.7
35	....	....	....	....	....	....	....	....
36	1	516	36.8	4.3	37.0	8.1	9.5	4.3

Table 2.--Lumber grade yield recovery by log diameters of California black oak in Forest Service Standard Hardwood Log Grade 2

Log diameter inside bark	Basis: Logs	Basis: Lumber tally	Lumber grade yields (actual): Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common
	No.	Board feet	Percent					
11	6	336	....	....	6.9	38.7	22.0	32.4
12	5	260	....	....	11.5	20.0	14.6	53.9
13	16	1,068	....	1.9	14.2	25.1	15.5	43.3
14	12	1,077	....	1.7	28.4	21.6	16.8	31.5
15	14	1,308	1.7	3.3	20.2	25.8	21.9	27.1
16	14	1,548	1.2	2.1	24.0	30.6	18.1	24.0
17	10	1,155	0.9	2.9	19.3	31.8	19.3	25.8
18	11	1,428	2.2	2.8	32.9	26.3	11.8	24.0
19	8	1,410	0.9	3.0	28.2	28.9	21.1	17.9
20	4	710	6.9	3.0	24.5	23.2	20.6	21.8
21	2	324	14.5	5.2	13.0	28.7	10.5	28.1
22	7	1,314	1.6	2.6	20.3	36.2	14.8	24.5
23	4	954	9.6	2.6	28.9	26.7	17.8	14.4
24	3	579	14.3	4.2	42.0	21.2	8.6	9.7
25	3	691	9.0	1.0	21.3	26.2	21.7	20.8
26	5	1,456	15.6	4.7	37.4	19.8	11.3	11.2
27	2	559	0.9	....	56.0	12.9	10.2	20.0
28	3	954	7.9	5.4	33.1	29.4	4.6	19.6
29	2	856	....	....	35.4	42.1	11.1	11.4
30	....	....	....	....	....	....	....	....
31	....	....	....	....	....	....	....	....
32	....	....	....	....	....	....	....	....
33	[1]2	619	30.9	4.8	25.2	16.0	16.3	6.8
34	1	478	9.2	....	23.2	34.1	6.3	27.2

[1] These are 8-foot logs. Only the 10-foot length limitations keep them out of log grade 1. (Woods crew not trained in log grades.)

Table 3.--Lumber grade yield recovery by log diameters of California black oak in Forest Service Standard Hardwood Log Grade 3

Log diameter inside bark	Basis: Logs	Basis: Lumber tally	Lumber grade yields (actual): Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common
	No.	Board feet	Percent					
8	11	246	...	...	...	8.5	26.4	65.1
9	16	468	...	...	0.6	17.1	12.6	69.7
10	21	807	...	...	4.2	12.8	27.4	55.6
11	27	1,321	...	...	6.4	19.9	26.4	47.3
12	21	1,093	1.2	2.2	7.8	19.1	20.7	49.0
13	24	1,621	0.6	0.6	9.9	27.1	20.8	41.0
14	24	1,861	1.1	1.1	11.5	31.8	21.6	32.9
15	24	1,910	0.2	0.8	9.2	30.0	23.6	36.2
16	14	1,428	0.7	2.1	15.3	24.5	23.2	34.2
17	9	909	1.7	...	10.2	30.8	15.8	41.5
18	9	1,199	2.5	1.1	19.8	28.2	20.4	28.0
19	5	685	0.6	0.6	13.1	37.7	21.2	26.8
20	11	1,488	...	1.0	15.5	27.6	26.1	29.8
21	5	810	1.6	...	10.4	33.0	19.1	35.9
22	3	832	3.1	1.2	26.5	16.8	24.5	27.9
23	7	1,663	8.8	2.9	32.9	25.0	10.4	20.0
24	4	674	...	...	10.1	28.0	18.4	43.5
25	1	216	16.7	4.6	15.3	27.8	34.2	1.4
26	3	832	8.5	1.9	38.6	20.4	12.8	17.8
27	...	...	...	...	...	...	...	...
28	...	...	...	...	...	...	...	...
29	2	599	5.2	2.1	21.2	34.4	7.2	29.9
30	[1]2	543	26.3	6.8	23.2	20.1	7.9	15.7
31	1	377	...	1.6	33.2	19.9	19.6	25.7

[1]These logs have defects that are in a position to prevent (just barely) making cuttings of a length to place the logs in grade 1 or 2.

Table 4.--Lumber grade yield recovery by log diameters of California black oak logs below Forest Service Standard Hardwood Factory Log Grade Specification (Log Grade 4)

Log diameter inside bark	Basis		Lumber grade yields (actual)					
	Logs	Lumber tally	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common
	No.	Board feet	Percent					
7	6	110				6.3	7.3	86.4
8	20	401			0.5	7.5	10.0	82.0
9	19	603			0.5	10.0	14.7	74.8
10	23	884			1.4	8.8	16.5	73.3
11	22	960	0.4	0.4	5.1	16.4	20.7	57.0
12	18	1,030			6.3	14.3	22.8	56.6
13	15	908			1.4	19.4	21.0	58.2
14	12	1,071			5.8	21.6	21.6	51.0
15	10	832	0.7	0.5	10.0	17.3	22.4	49.1
16	11	1,159			6.5	29.6	26.5	37.4
17	10	835		4.6	8.0	21.9	20.5	45.0
18	4	441			6.6	18.8	24.5	50.1
19	4	474			1.3	17.1	20.9	60.7
20	2	346	2.9	3.5	12.1	26.9	2.9	51.7
21	1	187			9.6	36.9	45.5	8.0
22	2	327		2.1	8.9	26.3	22.6	40.1
23								
24	2	339	2.1	5.9	13.8	30.4	13.3	34.5

Table 5.--Comparison of percentages of lumber grade yields of upland red oak[1] and California black oak by log grades

Species	Log grade	Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common	No. 1 Common and Better	Lumber value per MBF
		Percent							Dollars
Upland red oak	1	34.7	8.5	29.0	10.9	5.4	11.5	72.2	163.70
California black oak	1	21.7	5.0	33.6	16.4	10.5	12.8	60.3	145.13
Upland red oak	2	7.9	4.4	32.2	19.7	9.8	26.0	44.5	119.07
California black oak	2	5.2	2.6	26.9	27.2	15.5	22.6	34.7	113.19
Upland red oak	3	0.8	0.6	16.8	23.8	13.3	44.7	18.2	87.22
California black oak	3	2.6	1.3	15.2	25.7	20.2	35.0	19.1	94.94
Upland red oak	4	Forest Service Standard Hardwood Log Grades do not recognize this grade.							
California black oak	4	0.2	0.8	5.5	19.0	20.4	54.1	6.5	[2]75.00

[1]Percentage figures for upland red oak taken from U.S. Forest Products Laboratory Report 1737. It was assumed that the percentages stated in Report 1737 for timbers and square edge and sound material normally would have sawed into grade 3A Common and grade 3B Common, and consequently were equally divided between these grades.

[2]The relatively high value for grade 4 is due to the fact that a number of high value logs were included in this grade because errors in bucking resulted in lengths less than the 8-foot minimum for Forest Service Standard Hardwood Log Grades.

Table 6.--Comparison of lumber grade yields and lumber values produced by the three sawing methods

Sawing method	No. of logs	Total lumber tally	Lumber grade yields: Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common	Lumber value per MBF
		Board feet	Percent						Dollars
1	194	18,703	6.0	2.6	19.1	22.9	17.3	32.1	104.30
2	195	19,005	4.7	1.8	19.5	23.0	18.4	32.6	101.50
3	200	20,850	5.3	1.9	19.6	25.5	16.9	30.8	103.36

Table 7.--Comparison of sawing methods in terms of average lumber grade yields and monetary values for individual log grades

Sawing method	No. of logs	Total lumber tally	Lumber grade yields: Firsts and Seconds	Selects	No. 1 Common	No. 2 Common	No. 3A Common	No. 3B Common	Lumber value per MBF[1]	Range of lumber values per MBF for individual logs
		Board feet	Percent						Dollars	
Grade No. 1 Logs										
1	12	3,112	26.9	6.8	31.4	16.3	9.1	9.5	154.60	80.71 to 185.79
2	9	1,757	15.6	2.0	36.6	17.6	11.3	16.9	132.73	104.70 to 174.76
3	9	2,116	19.1	4.9	34.3	15.3	12.0	14.4	141.04	111.78 to 177.00
Grade No. 2 Logs										
1	46	5,442	3.0	3.1	27.7	25.0	15.1	26.1	109.08	55.00 to 154.74
2	41	6,209	5.7	2.7	26.1	28.2	14.8	22.5	113.62	58.45 to 154.47
3	47	7,433	6.5	2.3	26.9	28.0	16.3	20.0	115.23	54.75 to 160.98
Grade No. 3 Logs										
1	75	6,296	1.7	0.5	13.6	24.2	20.5	39.5	89.41	44.00 to 129.72
2	85	7,744	3.4	1.7	16.9	24.1	21.1	32.8	98.40	44.00 to 142.83
3	84	7,542	2.7	1.4	14.8	28.6	19.0	33.5	94.78	53.42 to 170.48
Grade No. 4 Logs										
1	61	3,853	0.5	1.8	6.0	23.2	21.7	46.8	81.25	44.00 to 155.24
2	60	3,295	....	0.1	4.0	13.2	22.9	59.8	69.35	44.00 to 114.08
3	60	3,759	0.3	0.3	6.3	19.8	16.9	56.4	73.75	44.00 to 111.08

[1]Based on market price quotations given in the text.

SUBJECT LISTS OF PUBLICATIONS ISSUED BY THE FOREST PRODUCTS LABORATORY

The following are obtainable free on request from the Director, Forest Products Laboratory, Madison 5, Wisconsin:

List of publications on Box and Crate Construction and Packaging Data

List of publications on Chemistry of Wood and Derived Products

List of publications on Fungus Defects in Forest Products and Decay in Trees

List of publications on Glue, Glued Products and Veneer

List of publications on Growth, Structure, and Identification of Wood

List of publications on Mechanical Properties and Structural Uses of Wood and Wood Products

Partial list of publications for Architects, Builders, Engineers, and Retail Lumbermen

List of publications on Fire Protection

List of publications on Logging, Milling, and Utilization of Timber Products

List of publications on Pulp and Paper

List of publications on Seasoning of Wood

List of publications on Structural Sandwich, Plastic Laminates, and Wood-Base Aircraft Components

List of publications on Wood Finishing

List of publications on Wood Preservation

Partial list of publications for Furniture Manufacturers, Woodworkers and Teachers of Woodshop Practice

Note: Since Forest Products Laboratory publications are so varied in subject no single list is issued. Instead a list is made up for each Laboratory division. Twice a year, December 31 and June 30, a list is made up showing new reports for the previous six months. This is the only item sent regularly to the Laboratory's mailing list. Anyone who has asked for and received the proper subject lists and who has had his name placed on the mailing list can keep up to date on Forest Products Laboratory publications. Each subject list carries descriptions of all other subject lists.