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Research Note



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LUMBER GRADE RECOVERY

FROM OLD-GROWTH DOUGLAS-FIR

AT A NORTHWESTERN OREGON SAWMILL

by

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A study^{1/} was begun in July 1957 to supplement available data on lumber recovery from old-growth Douglas-fir (Pseudotsuga menziesii) saw logs. This study is part of a continuing program of the Pacific Northwest Forest and Range Experiment Station to develop grade-yield recovery figures for primary products of timber stands in Oregon and Washington.

In the study, 307 long logs were diagramed, graded, scaled, and sawed at a northwestern Oregon sawmill located on the Mount Hood National Forest near Estacada. This mill was equipped with a 20-foot carriage and circular headrig, pony bandsaw, edger, trim saw, and planer. A small log gang was also available but was not used for the study. Average shift production was approximately 70,000 board feet, with about 85 percent dimension items and the balance in boards and crossarm stock or small timbers. Since dry kiln facilities were not available, the bulk of the production was sold surfaced green. Thus, allowance for shrinkage was not required in determining carriage setout.

^{1/}A cooperative project, with Bureau of Land Management, Bureau of Indian Affairs, West Coast Lumber Inspection Bureau, and the U. S. Forest Service participating.

STUDY PROCEDURE

Log Selection

The objective in selecting study logs was to obtain those (1) having surface characteristics of the No. 2 and No. 3 Sawmill grades and (2) well distributed over the diameter range available. Thus, the sample of log grades does not necessarily reflect proportionate availability from the woods. The study logs originated from the upper Clackamas River drainage, where the timber generally available is 250 to 350 years old. Knots in this timber are small and tight, and thus are ideally suited for dimension items. The following tabulation shows the distribution of study logs by diameter class (inches) and grade:

	<u>No. 2</u>	<u>No. 3</u>	<u>Total number</u>
Diameter:			
8-10	--	26	26
11-13	32	13	45
14-16	69	4	73
17-19	79	9	88
20-22	43	2	45
23-25	22	1	23
26-28	4	1	5
29-31	<u>2</u>	<u>--</u>	<u>2</u>
Total	251	56	307

All logs were scaled (Scribner Decimal C rule), diagramed, and graded in the water. Grading and scaling was done in accordance with Official Log Scaling and Grading Rules^{2/} by the U. S. Forest Service representative in charge of scaling and grading for the western regions. Maximum scaling length was 40 feet.

The study logs were bucked into lengths that could be accommodated by the mill carriage, and the resulting short logs were fed into the slip consecutively so that the lumber from them could be tallied as one long log.

^{2/}Currently used by Puget Sound, Grays Harbor, Southern Oregon, and Northern California Log Scaling and Grading Bureaus.

Sawing

The logs were broken down by the circular headrig and the resulting cants were further processed on the pony bandsaw. Since the study logs did not contain an appreciable quantity of clear volume, the bulk of the test lumber was produced in 8/4 and 16/4 thicknesses. Due to the relatively wide kerf of the circular headrig (11/32 inch), company practice is to cut a minimum number of lines so as to reduce waste. Each board carried the color designation and the number of the log from which it originated.

Lumber Tallying

The rough green lumber was graded by a representative of the West Coast Lumber Inspection Bureau in accordance with Standard Grading and Dressing Rules No. 15. Due to the short length of the green chain, there was not enough room to permit tallying the entire output of the mill by log number. Consequently, only a few of the larger production items were graded and tallied on the chain. The balance was pulled into unit packages and piece-sorted, graded, and tallied in the yard following sawing. A separate tally sheet was used on the green chain to record the grade yield from each log. Pieces that were yard-tallied by nominal thickness, width, length, and log number, were later entered on the appropriate tally sheet for each log.

OFFICE PROCEDURE

The grade and dimensions of each study board were punched on a separate data processing card, together with the parent log information. Board volume was determined by electronic computer and also entered on each card. For every log in a log grade, green lumber recovery within each lumber grade was expressed as a percentage of net log scale. These percentages were then plotted over log diameter.

These relations between recovery percentage and log diameter were examined for a linear or a curvilinear expression. If curvilinearity was indicated, whether for a single lumber grade or for the total recovery within a log grade, second-degree curves were computed for all lumber grades. If no curvilinearity was evident for the total recovery or any of the lumber grades, first-degree, straight-line curves were employed.

Occasionally, variation in recovery percentages for a single lumber grade was so great that the line of relation with log diameter

crossed the zero recovery-percentage axis illogically. Since negative recovery percentages cannot be accepted, an adjustment was made by combining the errant grade with a neighboring lumber grade. Due to the additional weight of the combined data, it was possible to establish a more logical curve. The two grades were then separated on the basis of their proportions of the combined total. This technique resulted in two adjusted curves which no longer crossed the zero recovery at an illogical diameter. The adjustment was usually small and of little consequence considering the large variation in the basic data.

RESULTS AND DISCUSSION

Deduction For Defect

The 307 study logs had a gross scale of 142,190 and a net scale of 134,180 board feet (Scribner Decimal C). The following tabulation shows the average diameter and average defect deduction for the log grades studied:

	<u>Average diameter</u> (inches)	<u>Deduction for defect</u> (percentage of gross scale)
No. 2 Sawmill	17.7	4.7
No. 3 Sawmill	<u>12.4</u>	<u>14.3</u>
Average (all logs)	--	5.6

As shown in figure 1, the greatest defect percentage occurs in the larger logs. Largely responsible for this were the 24- and 25-inch logs. Of these 12 logs, 7 were unsound, with an average defect deduction of 26.5 percent. Only two of the seven larger study logs had a scaling deduction. The above tabulation shows that the No. 3 logs required a much higher percentage deduction than No. 2 logs. By combining the grades for figure 1, this relationship was concealed. The principal scaling deductions were due to rough cut^{3/} and felling breaks in the No. 3 logs, and to rot in the No. 2 logs.

^{3/}A rule applied only to extremely rough logs to eliminate the Utility grade lumber from side cuts in squaring up the log. Applied by making a log diameter reduction.

Overrun

Overrun is shown in figure 2 for sound logs, unsound logs, and all logs combined. The 134,180 board feet of logs (net scale) produced 190,095 board feet of lumber, or 41.7 percent overrun. A certain amount of cull and trim volume loss would normally be experienced following surfacing, but this loss should be relatively small for a mill producing only surfaced-green material. Further, an adjustment for cull and trim due to seasoning of the Finish items would be proper. Since less than 5 percent of the total recovery was D and Better, however, the resulting adjustment to the total production would be nil. The company does not develop Finish items in quantities to justify separate merchandising.

Percent overrun is also influenced by log length, with logs of the longest scaling length (40 feet for west-side Douglas-fir) generally yielding the highest overrun. The distribution of study logs by length (feet) and grade was as follows:

	<u>No. 2</u>	<u>No. 3</u>	<u>Total number</u>
Log length:			
14-20	12	5	17
22-26	38	3	41
28-32	31	10	41
34-40	119	21	140
42-48	49	14	63
Over 48	<u>2</u>	<u>3</u>	<u>5</u>
Total	251	56	307

Recovery

Lumber grade recovery for the two log grades is shown in tables 1 and 2. These values are expressed as a percentage of total green-chain tally. Grade recovery is shown graphically in figure 3, but here is expressed as a percentage of net log scale. In this manner, the cumulative recovery includes overrun. It is noted that No. 3 logs under 12 inches in diameter show a higher recovery of Construction and Better lumber than those over 12 inches. This is due to the small logs having small limbs and knots. Because of their size, the logs had to be graded No. 3.

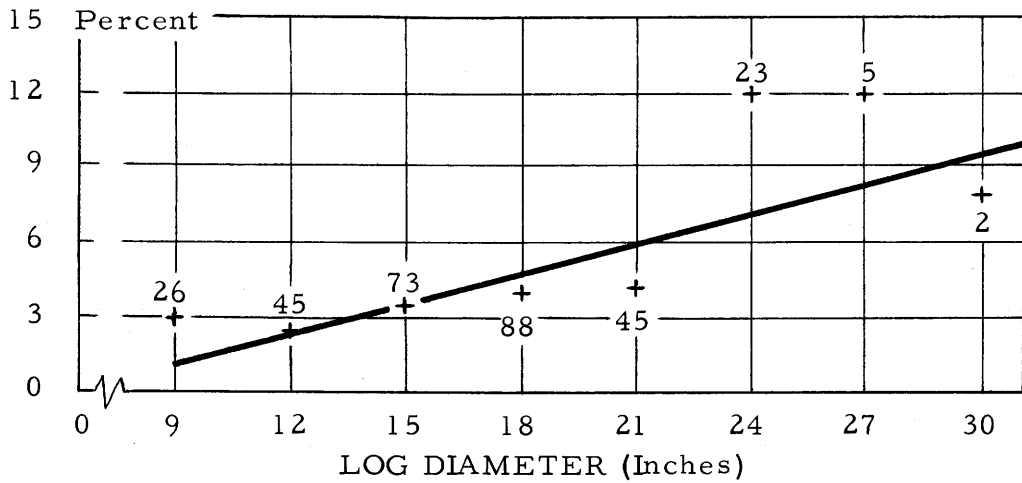
Also, it can be seen from figure 3 that the calculated mean for all but the largest logs of each log grade exceeded the lumber grade yield requirement specified for the respective grade; i. e., at least 65 percent of net log scale in Construction and Better lumber for No. 2 logs and 50 percent Standard and Better for No. 3. Some of the larger logs sampled (both grades) required scaling deductions for rot, which affects the recovery percentage. The rot is deducted, but incipient stain--occurring in the adjacent sound portion of the log--is not. However, stain is a lumber grade defect and therefore is considered in log grading; logs that might otherwise be graded No. 2 are graded No. 3 if an appreciable amount of stain is present.

Due to the character of the timber available to this mill, the leading production item is 8/4 Dimension. From the study logs, the production of 4/4-, 8/4-, and 16/4-inch-thick material was 4.7, 86.3, and 9.0 percent of the total tally, respectively. Table 3 shows in summary the log scale and the volume of lumber tallied, by thickness.

Value

The realization value of lumber from the study logs was determined by applying the 1958 regional average lumber-grade prices used for timber appraisals to the curved recovery percentages. The relation of this value to log diameter is shown in figure 4. These dollar-value curves reflect the value of the lumber as tallied and would apply to mills that make all the grade separations. Where grades are combined for merchandising, realization values by log grade and diameter would differ from those in figure 4.

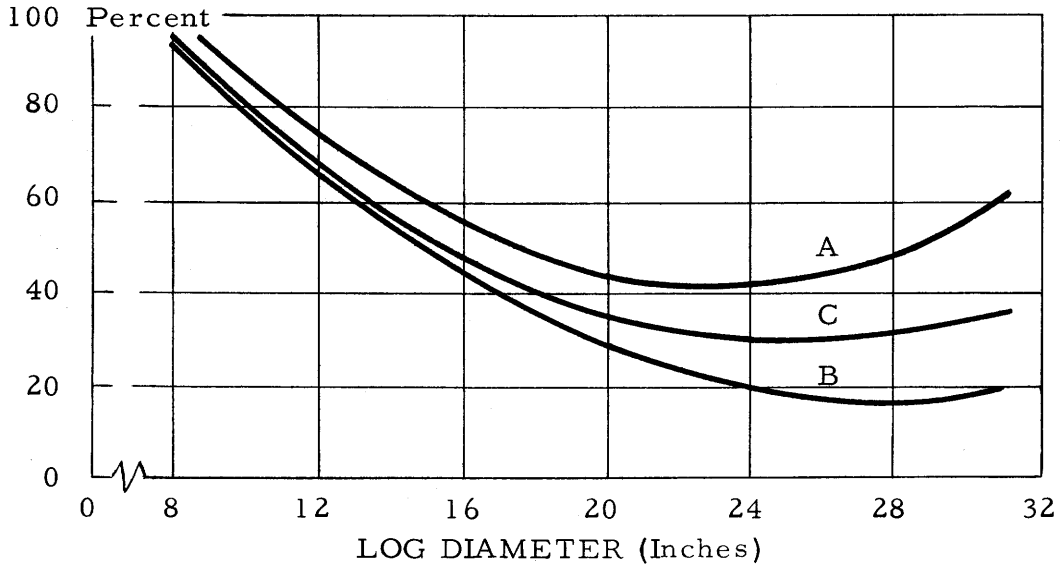
DEFECT



Note: Figures denote number of study logs in diameter class.

Figure 1.--Defect of Douglas-fir logs, by diameter, for No. 2 and No. 3 Sawmill grades combined. Expressed as percentage of gross log scale.

OVERRUN



A = 92 unsound logs (77 No. 2 + 15 No. 3)

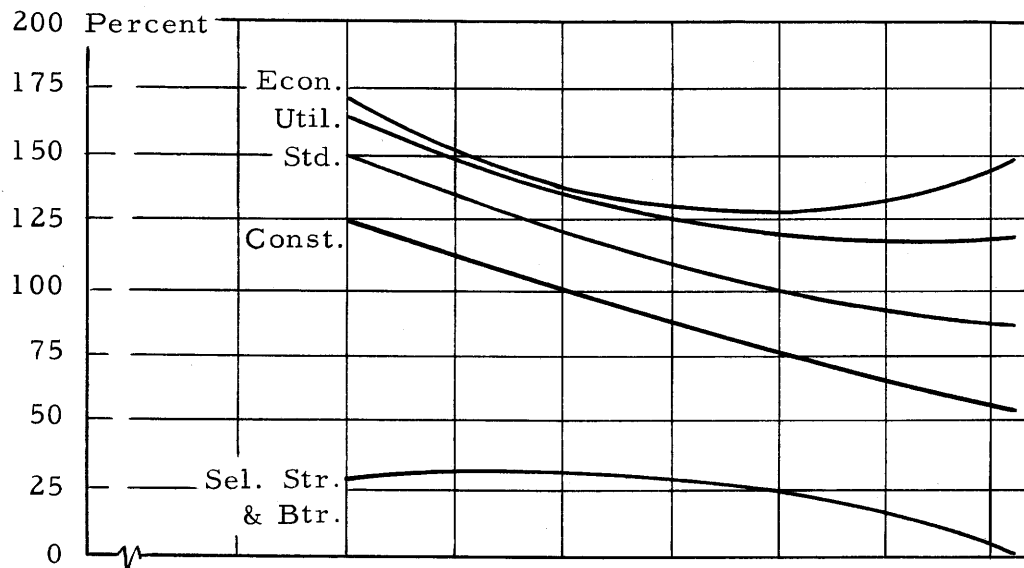
B = 215 sound logs (174 No. 2 + 41 No. 3)

C = 307 total logs (251 No. 2 + 56 No. 3)

Figure 2.--Overrun from 307 Douglas-fir logs, green-chain tally, for No. 2 and No. 3 Sawmill grades combined. Expressed as percentage of net log scale.

NO. 2 LOGS

RECOVERY



NO. 3 LOGS

RECOVERY

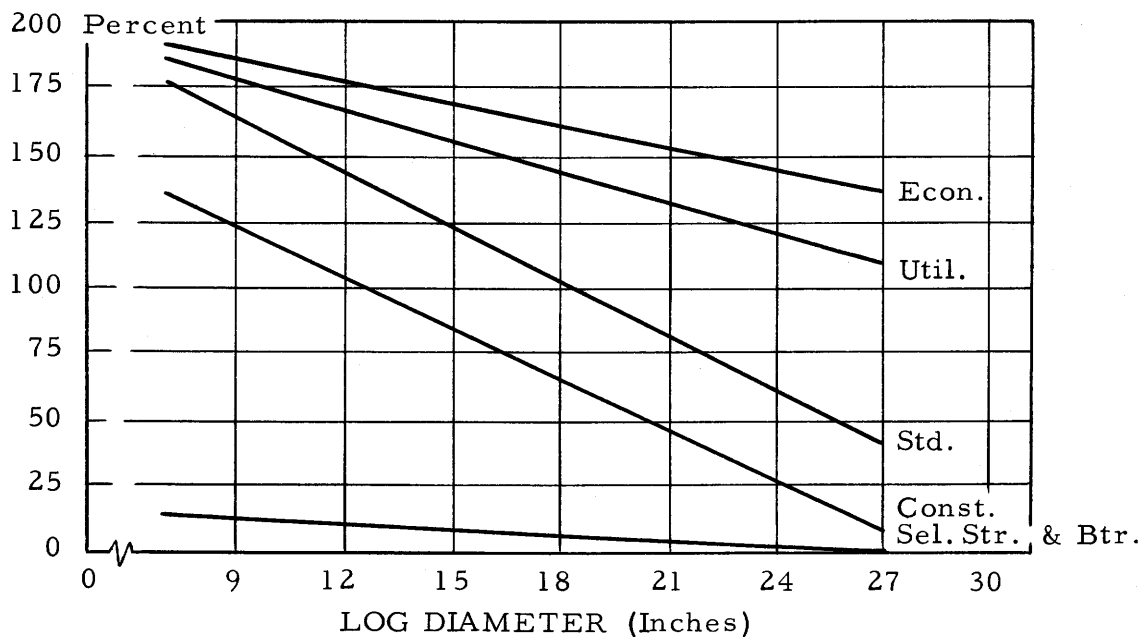
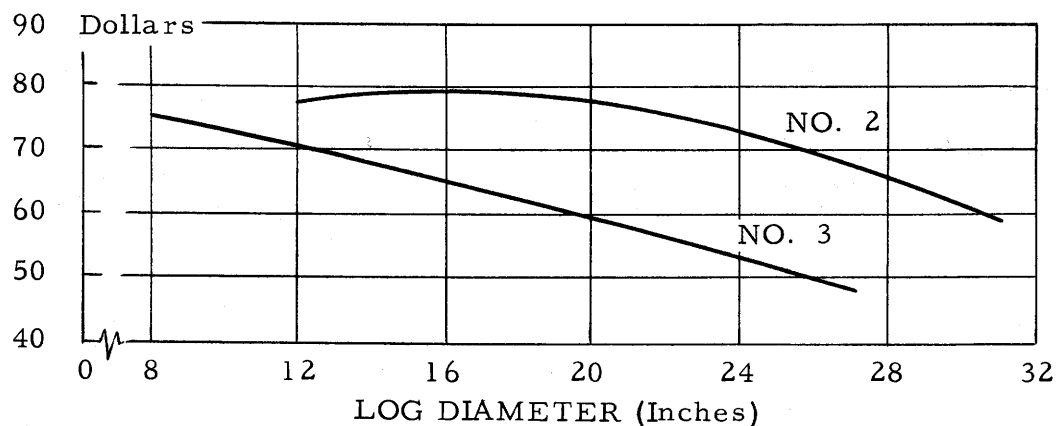


Figure 3.--Cumulative grade recovery, green-chain tally, from No. 2 and No. 3 Sawmill grade Douglas-fir logs. Expressed as percentage of net log scale.

VALUE



Prices used:

D and Better	- \$147.61
Select Structural*	- 98.68
Construction	- 79.34
Standard	- 69.07
Utility	- 45.50
Economy	- 20.09

*Includes Select Merchantable and Crossarm

Figure 4.--Realization value per thousand board feet, green lumber tally, for No. 2 and No. 3 Sawmill grade Douglas-fir logs. Based on 1958 regional average lumber-grade prices.

Table 1.--Estimated lumber recovery, by grade, fromNo. 2 Sawmill grade Douglas-fir logs

(Expressed as a percentage of total green-chain tally)

Log diam- eter (inches)	Num- ber of logs	Lumber grade						
		D and Better	Cross- arm	Sel. Mer. and Sel. Str. ^{1/}	Con- struction	Stand- ard	Util- ity	Econ- omy
12	17	2.7	2.7	11.5	55.5	15.6	7.5	4.5
13	15	3.0	2.9	12.6	54.4	15.6	7.7	3.8
14	22	3.2	3.2	13.5	53.2	15.6	8.0	3.3
15	23	3.4	3.4	14.3	52.0	15.7	8.4	2.8
16	24	3.6	3.6	15.0	50.7	15.8	8.8	2.5
17	16	3.7	3.7	15.5	49.3	16.0	9.4	2.4
18	44	3.8	3.7	15.8	47.9	16.3	10.0	2.5
19	19	3.8	3.8	15.9	46.4	16.6	10.7	2.8
20	20	3.7	3.7	15.8	45.0	17.0	11.5	3.3
21	16	3.7	3.6	15.4	43.7	17.4	12.2	4.0
22	7	3.5	3.5	14.7	42.4	17.8	13.1	5.0
23	10	3.3	3.2	13.9	41.1	18.4	14.0	6.1
24	10	3.0	3.0	12.8	39.9	18.9	14.9	7.5
25	2	2.7	2.7	11.4	38.8	19.5	15.9	9.0
26	2	2.4	2.4	9.9	37.8	20.1	16.8	10.6
27	-	2.0	1.9	8.2	37.0	20.7	17.7	12.5
28	2	1.5	1.4	6.4	36.4	21.4	18.6	14.3
29	-	1.1	1.1	4.4	35.7	21.9	19.5	16.3
30	-	.6	.6	2.4	35.4	22.5	20.3	18.2
31	2	.1	.1	.4	35.1	23.1	21.0	20.2

Note: Average log scaling deduction = 4.7 percent.

^{1/}Select Merchantable and Select Structural.

Table 2.--Estimated lumber recovery, by grade, fromNo. 3 Sawmill grade Douglas-fir logs

(Expressed as a percentage of total green-chain tally)

Log diam- eter (inches)	Num- ber of logs	Lumber grade				
		Sel.Mer. and Sel.Str. ^{1/}	Con- struction	Stand- ard	Utility	Economy
7	1	7.5	63.9	21.1	5.3	2.2
8	7	7.1	61.8	21.2	7.0	2.9
9	7	6.9	59.6	21.2	8.7	3.6
10	11	6.7	57.3	21.3	10.4	4.3
11	9	6.4	55.0	21.4	12.1	5.1
12	3	6.1	52.6	21.5	14.0	5.8
13	1	5.9	50.1	21.6	15.8	6.6
14	1	5.5	47.7	21.6	17.8	7.4
15	1	5.3	45.0	21.7	19.8	8.2
16	2	5.0	42.3	21.8	21.8	9.1
17	5	4.6	39.5	22.0	24.0	9.9
18	3	4.3	36.6	22.1	26.2	10.8
19	1	4.0	33.6	22.1	28.5	11.8
20	1	3.6	30.6	22.2	30.8	12.8
21	1	3.1	27.4	22.4	33.3	13.8
22	-	2.8	24.1	22.5	35.8	14.8
23	1	2.4	20.6	22.6	38.5	15.9
24	-	2.0	17.1	22.7	41.1	17.1
25	-	1.5	13.4	22.9	44.0	18.2
26	-	1.1	9.6	23.0	46.9	19.4
27	1	.6	5.6	23.2	49.9	20.7

Note: Average log scaling deduction = 14.3 percent.

^{1/}Select Merchantable and Select Structural. This particular tally includes a trace of Finish grades.

Table 3.--Log scale and lumber recovery, by thickness,

from No. 2 and No. 3 Sawmill grade

Douglas-fir logs

Log grade	Num- ber of logs	Log scale		Green lumber tally			
		Gross	Net	4/4	8/4	16/4	Total
----- <u>Board feet</u> -----							
No. 2	251	128,440	122,390	7,652	145,637	16,991	170,280
No. 3	56	13,750	11,790	1,305	18,411	99	19,815
Total	307	142,190	134,180	8,957	164,048	17,090	190,095