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COLLEGE OF FORESTRY-WILDLIFE AND RANGE SCIENCES

LUMBER PRODUCTION FROM "PRECOMMERCIAL" THINNINGS IN NORTHERN IDAHO

by

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INTRODUCTION

Periodic thinnings are desirable in most conifer forests of Northern Idaho to enhance quality and quantity production of wood products. Removal of a portion of the immature forest through thinnings not only provides an opportunity to utilize material which would otherwise be lost due to natural mortality, but also serves to distribute the growth potential of the site among the more desirable residual trees (2) (5).

Most of the timber types in the Northern Rocky Mountain and Intermountain regions tend to overstock. In many cases of severe overstocking, total growth capacity may be dissipated on so many stems that few, if any, will grow large enough to be usable by current standards. Wikstrom and Wellner aptly described the anomaly facing forestry in this area: "unless we deal effectively with the matter of sheer numbers of trees, the very prolificness of nature will sharply limit future timber yields" (4).

In stands that stagnate (a common problem in the lodgepole pine type), thinning will increase both the total yield and the yield of utilizable wood. While thinning in non-stagnating stands does not increase total wood yield, it does concentrate the growth on fewer trees, thereby resulting in larger volumes of utilizable wood. An additional beneficial effect of thinning is to reduce the time required to grow crop trees by assuring optimal site occupancy.

Greatly increased harvest values can be created by thinning. For example, by thinning well-stocked larch stands on good sites, we can more than double their value. On poor sites, thinning can increase the final harvest value four times (4). Thinning is not currently a high priority forestry practice in this region largely because of inadequate financing (1, 3, 4). Thinnings that are made in young second-growth stands in Northern Idaho are usually of a "precommercial" nature; in other words, it is not possible to sell the material removed to defray the costs of the operation. Therefore, desirable cultural measures are either not done at all or delayed until the residual trees are too old to exhibit significant growth response to the treatment.

A private sawmill owner in Sandpoint, Idaho designed a portable mill which is being used to produce rough cut 2 by 4's, 2 by 3's

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and 2 by 2's from logs with small-end diameters from 3 to 7 inches. This mill utilizes four planer heads operated by hydraulic motors to convert round wood material to cants or rough dimension lumber. A circular saw is mounted directly behind the head rigs for ripping cants to produce two pieces. Another similar small-log mill is being manufactured by a firm in Washington. The availability of this type of equipment coupled with the rise in lumber prices, could dramatically alter the complexion of thinning opportunities in Northern Idaho, as well as in much of the Intermountain West. This may occur by changing costly "precommercial" thinnings (or none at all) to "commercial" thinning opportunities with immediate financial returns.

Limited experience has indicated thinning costs ranging from $40 to over $80 per acre for operations in 30- to 80-year-old stands in Northern Idaho.[3] Such expenditures by small private owners are difficult to justify even though significant long-term benefits can be expected. Likewise, public agencies often avoid the high per-acre costs of thinning these stands. Cultural monies are often spent instead on less expensive thinnings in juvenile stands, even though the silvicultural desirability may not be as great.

THE STUDY

The college of Forestry, Wildlife and Range Sciences was requested to monitor a thinning in conjunction with utilization of the thinning material in lumber manufacture by the Don Diehl Mill in Bonner County, Idaho. The thinning done was of a type usually described as "precommercial." Since the average stand diameter was only 5.4 inches most of the stems removed were too small to be considered commercial by present utilization standards except for a limited roundwood market. The purpose of this study was to obtain production data from an ongoing operation so that timberland and mill owners would have some initial baseline information on the possibilities for commercial, or at least less costly, thinnings in young stands. A 20-acre stand of state-owned timber near Athol, Idaho and the portable mill developed by Diehl of Sandpoint were the bases for this case study. Minimum stumpage and the usual slash disposal fees were charged by the State of Idaho Department of Public Lands. The logging crew sold the 8-foot logs to the mill. The 75-year-old stand was thinned and the resulting material was followed through the mill to determine the lumber production obtainable from the kind of thinning needed on many acres of Northern Idaho timberland.

The study consisted of three parts;

1. An inventory was made of all trees on the 20-acre study plot before and after thinning. As a part of the inventory process a series of permanent growth plots was established which will be used to study the long-run effects of the thinning.

[3] Personal communications with U.S. Forest Service personnel and thinning contractors in Northern Idaho.

2. A study was made of the logging operation; the times required to perform each portion of the process were recorded along with the log production. The local 3-man logging crew which contracted to thin the area was given minimal instructions. They were asked to operate in much the same fashion as in other thinnings that they perform. The instructions were to remove diseased, insect-infested, malformed trees, and to reduce crowding. Douglas-fir was to be favored in this mixed stand and western larch trees were to be specifically removed because of larch casebearer infestation. Well-formed crop trees were to be left on an average spacing of 18 feet.

3. An analysis was made of the milling process and the finished products were tallied.

RESULTS

Presented on the following pages are the data obtained from carefully monitoring the entire process from initial stand inventory through the manufacture of lumber from the trees removed in the thinning. The results of this one case study certainly cannot be expected to provide all the data necessary to properly evaluate such a venture. However, the following production information should be of value in analyzing the feasibility of a harvesting and manufacturing system for accomplishing needed thinning with utilization of the thinned material for lumber production.

Stand Inventory

The 75-year-old stand had mixed species composition with Douglas-fir comprising 55% of the basal area. Lodgepole pine with 24% of the basal area and grand fir with 16% were also important in the stand composition. Western larch, ponderosa pine, western white pine and western hemlock were present in lesser amounts. Radial increment, as determined from borings of crop trees, had been very slow for the past 25 to 30 years, averaging 20 rings to the inch. The site quality was medium for Douglas-fir with a Site Index of 50 feet at 50 years.

Table I is a summary of stand data compiled from 100% inventories made before and after the thinning. As shown in the table, 189 stems were removed per acre resulting in a 34% reduction in basal area and 33% removal of total cubic volume.

Logging Operation

A three-man logging crew worked 25 days on this thinning operation. The average working day, including breaks and down time was 8½ hours. The system usually followed was for two of the crew to fall and limb trees for the first half of the day and to buck and stack for the second half. The third man skidded with a horse the full day. The stand thinned was on nearly level terrain and there was an adequate haul road through the area.

On randomly-chosen days during the logging period careful stop-watch checks and production tallies were made on each part

Table I. Stand Values Before and After Thinning

	DF		LPP		WL		GF		PP		WWP		WH		All Species		Total Change	Total Change %
	*BT	AT	BT	AT	BT	AT	BT	AT	BT	AT	BT	AT	BT	AT	BT	AT		
Basal Area per acre (sq. ft.)	62.3	44.7	27.0	11.2	4.7	1.3	18.4	15.9	.84	.72	.10	.09	.01	.01	113.35	73.92	-39.4	-35
Number of stems/acre (>1.5" Dbh	296.0	198.4	172.9	103.9	20.4	7.4	59.7	50.2	1.00	.75	.60	.40	.15	.15	550.75	361.20	-189.5	-34
Average diameter (inches)	5.5	5.6	4.8	3.9	5.9	4.9	6.5	6.5	9.4	10.1	4.25	5.2	3.7	3.7	5.4	5.2	-.2	-4
Average height (ft.)	34	35	37	32	46	42	38	38	46	51	28	39	13	13	36	35	-1	-3
Cubic Vol. per acre	1082	808	620	272	103	32	440	382	24	23	2.4	2.3	.1	.1	2271.5	1519.4	-752	-33
Cubic Vol. per 20 A.	21645	16167	12400	5437	2065	639	8808	7644	476	462	49	47	2	2	45445	30398	-15051	-33

*BT is Before Thin and AT is After Thin

of the procedure. These samples were for one-half day periods. Average daily production for the three-man crew was 106 trees which amounted to 387 cubic feet or 5.3 cords.

An analysis of the woods operation indicated the following:

Skidding production (one man and one horse)
- 82% of skidding was by 1-tree turns
- 18% of turns included 2 or 3 trees
- Average skid distance one way = 88 feet
- Average time per turn = 3.2 minutes
  (not including down time and breaks)
- Average length of log skidded = 35 feet
- Average number of turns per day = 91 (1 log)
  7 (2 or 3 logs)

Total turns per day = 98

Falling production (two fallers)
- Average number of trees cut, limbed, bucked and stacked per man/day = 53
- Daily production per man = 193 cubic feet or 1.8 cords
- Average DBH of trees cut = 6.3 inches
- Average height of trees cut = 49 feet

As indicated above the 3-man crew felled, limbed, skidded, bucked, and stacked an average of 106 trees per working day. Since the average tree contained four 8-foot logs, this amounted to 424 logs per day. Production per day for the crew was 0.8 acre.

Distribution of time among the logging activities listed above is shown in Table II. These activities together accounted for 51.8% of the average working day. The remaining time was used for equipment maintenance and repair, breaks, decision time, walking, haul-road clearing, and site preparation. Column 3 in the table expresses the time distribution on the basis of one man-day. This column indicates that 4.41 hours were spent performing these tasks in an 8½ hour-day resulting in a production of 35.3 trees and 141.3 logs per man.

Table II. Distribution of Time Among Logging Activities

Operation	Time/day for 3-man crew (minutes)	Time/ man-day (minutes)	% of total working day
Felling	88.6	29.5	5.78
Limbing	126.3	42.1	8.25
Bucking	112.1	37.4	7.33
Stacking	123.0	41.0	8.03
Skidding	343.1	114.4	22.43
TOTALS	793.1	264.4	51.83

Log Production

Total 8-foot log production from the 20-acre area was 10,446 pieces. Of these 2062 were too large to be processed by the Diehl mill and were sold to a stud mill. An additional 1903 logs were classified as "culls," leaving 6481 which were actually processed by the small log mill.

Table III shows the actual mill-yard sort for the 8384 logs that were trucked to the Diehl Mill. Although the Diehl mill is portable and can be taken to the harvest area, it was operated at a stationary set-up north of Sandpoint, Idaho for the duration of this study. At the mill site the incoming logs were decked in a storage yard. Logs were then moved to the mill as needed with a fork-lift truck. The logs were hand sorted to comply with the small-end diameter specifications given below. The mill was set to produce a given size of lumber and the appropriate supply of sorted logs was fed into the mill by hand.

Product Class	Minimum Small-End Diameter (inches)
2(2X4)*	5.25
2(2X3)	4.50
1(2X3)	3.25

* The product class designation "2(2X4)" indicates that two "2X4" boards can be produced from logs of this size.

Table III. Small Log Distribution — Actual Mill Sort

PRODUCT CLASS

Diameter Class (inside bark at small end)	2(2X4)	2(2X3)	1(2X3) (number of 8-ft. logs)	Culls	Totals
2		13	10	361	384
3		243	450	1297	1990
4	487	1303	873	198	2861
5	2233	276	34	43	2586
6	528	18		4	550
7	13				13
TOTALS	3261	1953	1367	1903	8384

The "eye-ball" sorting technique resulted in some rather large errors. For example, 13 two-inch logs and 243 three-inch logs were placed in the 2(2X3) product class which has a minimum diameter of 4.5 inches. Likewise, 487 four-inch logs were placed in the 2(2X4) class which has a stated minimum diameter of 5.5 inches. Table IV, the results of a theoretical sort of the same logs, indicates that only 916 logs fall in the 2(2X4) class using measured log diameters while 3261 were put into this class by the mill sort.

Table IV. Small Log Distribution—Theoretical Sort Using Measured Log Diameters.

Product Class	Number of 8-ft. Logs
2(2X4)	916
2(2X3)	3354
1(2X3)	1567
Culls	2301
Studs	246
TOTALS	8384

Table V shows the size class and volume distribution of the 2062 logs that were sold directly to the stud mill.

Table V. Stud Log Distribution

Diameter Class	Number	Bd. Ft. Vol./Class Scribner	Cubic Ft. Vol./Class Rapraeger
5	145	710	284
6	1116	5585	2234
7	566	5670	1134
8	172	1730	519
9	52	1040	208
10	11	330	55
TOTALS	2062	15065	4434

Mill Production

Mill production was monitored on randomly selected occasions spread over a one-month period. Table VI shows the production rates as indicated by these samples. Only 1(2X3) and 2(2X3) product classes were being processed when mill production was monitored.

Table VI. Sample Mill Production Rates

Lumber size produced	No. 8′ logs/min.	No. 8′ boards/min.	No. 8′ boards/hr.	Bd. ft. vol./hr.	Bd. ft. vol. per 8 hrs.
1(2X3)	4.50	4.50	270	1080	8640
2(2X3)	4.75	9.50	570	2280	18240

The feed rate for the machine was apparently little affected by log size within most of its diameter operating range. In fact, for the above data the larger logs were actually processed slightly faster than the smaller ones. This was probably due to factors other than machine capacity. The production rates shown here do not reflect "down" time, but only the production rates while the mill was actually operating. At this mill operation a significant portion of the observed down time was related not to the mill itself, but to peripheral equipment such as the fork-lift. At the feed rate of 4.5 logs per minute the 6481 logs supplied to the mill by this thinning could theoretically have been processed in about 24 hours of mill time. This clearly shows that several logging crews are needed to keep the mill supplied.

The mill tally of board products manufactured from thinning material at the Diehl mill is shown in Table VII. The 37,529 board feet scaled in stud logs represents a total of 52,594 board feet of lumber. This is 2630 board feet of lumber products removed per acre. At an assumed wholesale rate of $110 per thousand this is a lumber value of $289.30 per acre resulting from material that might otherwise be left in the woods.

Table VII. Product Tally from Small-Log Mill

Board Size (inches)	No. 8′ Pieces	Bd. Ft. Vol./piece	Bd. Ft. Vol./class
1X3	1278	2.0	2556
2½X3½	83	5.83	484
2X3	3003	4.0	12012
2X4	4217	5.33	22477
TOTALS	8581		37529

DISCUSSION

From a silvicultural standpoint, the thinning operation could have been improved somewhat. As was mentioned previously, minimal instructions were given to the thinning crew prior to cutting; therefore, it could not be expected that the results would fit a textbook example. It should be noticed from Table I that the average diameter was decreased due to cutting. This would indicate a thinning from above rather than from below. Low thinning would be more desirable in a situation like this if one were managing for optimal production at maturity. However, although the average diameter for the entire stand was slightly decreased, the average diameter of Douglas-fir, grand fir, ponderosa pine and western white pine, the favored species, was increased thus indicating large crop trees were in fact favored in the desirable species.

It should be remembered that the logging crew was contracted by the cord and would obviously be biased toward cutting larger trees for production purposes and leaving the low volume small trees. This could possibly be overcome by marking before cutting or penalizing the crew for taking obvious crop trees.

Woods production rates on similar operations would undoubtedly vary considerably from the production in this study.

It should be noted that the logging crew was not very experienced and had been in the business only a short time before this specific operation. This probably accounts for the high amount of down time in the woods.

From the data presented, it is obvious that the mill potential for production, about 18,000 board feet per 8 hour day, is quite good. To make maximum use of this potential, it is essential that the entire operation be coordinated and scheduled very carefully. One of the primary problems was in keeping an even steady flow of logs from the cold deck area into the mill. A similar problem could easily exist if the mill were operating in the woods. Since this was a new operation, the people involved did not have any previous data to base decisions upon and had to run on "intuition." As time progresses and more information becomes available, the operators should be able to increase total production to the daily potential of the mill by assuring a constant flow situation, rather than a piece-meal operation.

The tendency for the sorters to put marginal logs into the next higher classification seemed to result in more lumber down-grade than necessary. On the other hand, some logs which fell below the minimum diameter for a class produced the indicated lumber for the class. This would infer that some adjustment in product class sizes could be made.

Placing a dollar value on material as it stands in the woods (stumpage price) becomes very difficult mainly because of the unstable nature of the lumber market. One approach is to consider the thinning operation as strictly a silvicultural treatment and assume the stumpage price to be zero. In this case, the only consideration is that the revenues must be great enough to equal the costs incurred. From the woods standpoint, the contract loggers were paid $15 per cord stacked at roadside. Assuming 80 pieces of material per cord, and 324 pieces per acre gives $60.75 that can be incurred in the thinning operation and still break even, considering only the material used by the small-log mill. There also were 103 stud logs per acre, or a total of 15,065 board feet of stud material for the entire 20-acre tract. The woods crew was being paid $30.50 per cord for Douglas-fir and larch, and $25.50 for other species stacked at roadside. At the rate of 38 stud logs per cord this is $76.15 for stud material per acre. Added to the value of the small mill material, this gives a total of $136.90 per acre that could be incurred in the thinning operation and still break even.

Although this project was only a case study, and may therefore lack wide applicability, some general impressions can be stated. The entire process appears to have merit if handled efficiently. Undoubtedly, the reason for decline of small operations in the north

Idaho region must be partially due to inefficient management. Similarly, this relatively low volume operation may also incur financial difficulties if not managed for maximum efficiency.

SUMMARY

Thinning a 75-year-old mixed composition stand to favor about 135 crop trees per acre produced 103 stud logs and 324 smaller logs per acre from which lumber was manufactured. This material had a roadside value in the woods of $136.90 per acre at time of harvest. Another 10 logs per acre were processed in the woods which were not suitable for lumber manufacture, but which might normally reach some other kind of market. It appears from this case study that such stand improvement measures will not only pay for themselves but can result in early income to the landowner and make better utilization of the timber resource.

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