In Logging Old Growth Douglas Fir

Mobile Yarder Shows Promise in Salvage

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BASAL DAMAGE to a western hemlock is caused by logs being yarded past it.

How Trees Are Injured

SEVERE TRUNK damage to a Douglas fir is caused by cable rubbing against tree.

Logging machines were needed that could move along the roads from setting to setting quickly and cheaply, since small salvage volumes could not bear high fixed costs for rig-up. Commercial mobile yarders offered the means for carrying out the salvage plan.

Objectives of the study were to test the high-lead method for salvaging under old-growth Douglas fir, to measure logging cost and damage, and to see how well the road pattern had provided for management of the leave settings.

In the 285-acre area selected for study, two permanent rock roads constructed for the clear-cut sale served as the primary transportation and operation base. These main roads were supplemented by low standard spurs built to put any dead or down tree within a 500-foot yarding distance. In dry weather logs were yarded to the dirt spurs and in wet weather to the rocked roads, thus minimizing seasonal problems. The spur road farthest up the slope served for the salvage job and also was located as a pioneer road that could be improved if needed to reach the clear-cut units beyond.

Slopes on the study area (see map) range from a flat bench along McRae Creek to 70 percent, averaging about 30 percent. Elevation is 2,000 to 2,800 feet. The heaviest concentration of dead and down timber was on the lower slopes along the creek.

AN ADMINISTRATIVE USE timber sale was made to Bob Kenady's Tuff Luck Logging Company of Blue River, Oregon, which purchased a new Skagit SJ-4 Mobile Logger for the job. To minimize damage to the reserve stand, contract provisions required short logs and special care in guying and yarding. The company was also required to keep time and cost records, so that results could be evaluated in detail.

Two supplementary studies were carried out by the experiment station in cooperation with the Skagit Steel & Iron Works. One was a detailed time study of the yarding and loading phases to learn more about the operation than would be possible from sale records. The other, made after logging was completed, investigated occurrence and severity of damage to the reserve stand.

This article presents information from the 1954 and 1955 sale records and damage study. An analysis of the time study will be published later.

Logging was started in December 1954, when 318,000 board-feet of the most accessible timber was removed in 22 days. Work was resumed in June 1955 and continued into September, when all salvage logs along the lower rocked road and spurs leading from it had been removed. While 111 acres out of the 285 were covered in this time, only 72½ acres were actually included in settings. The balance had no merchantable volume.

Total volume recovered in 1954 and 1955 was 1,063,000 board-feet, including 65,000 board-feet of defective but peelable fir removed as utility logs (Table 1). Salvage per acre actually logged averaged 14,700 board-feet, 95 percent of it Douglas fir. The remainder of the tract, which is tributary to the upper rock-surfaced road, was logged in 1956, but volume and cost figures are not yet available.

The economic importance of salvage is apparent from the fact that $57,385 worth of logs was recovered from the 111-acre area—about $517 per acre—and stumpage returns to the public was $186.06 per acre. Salvage was concentrated more on the 111 acres, however, than for the 285-acre tract as a whole.

THE MOBILE LOGGER functioned as both a yarder and loader and could be moved quickly. Sixty-five percent of the working time was spent in yarding, 22 percent in loading, nine percent in moving the equipment, and four percent in miscellaneous delays and cleanup. Settings averaged only 1.8 acres; the largest was about five acres. About 55 logs totalling 26,000 board-feet net volume were salvaged on each setting. Yarding was mostly uphill but some logs were yarded downhill in order to reach the whole area from the planned road system.

Since sidehill yarding might cause excessive hangups and damage to the

Results of the Experiment

- **High-lead salvage in old growth Douglas fir leave settings is practical, but initial costs may be higher.**
- **A combination of high-lead and tractor equipment probably would be most efficient for salvage yarding in leave areas.**
- **Considerable care is needed to choose landings so that a good volume of logs can be yarded.**
- **Doing a satisfactory job requires skill and care to avoid or minimize damage to the live stand.**
- **A mobile logging machine is well adapted to this type of operation.**

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Mobile Yarder Shows

Loggers and foresters know of the opportunity for salvage in leave settings and along clear-cut boundaries, particularly where ground conditions allow tractors to operate. But most old growth is on steep slopes where tractors can be operated only with difficulty, often cause excessive damage to live trees, and bare too much soil.

Salvage with a mobile high-lead yarder, tested on the H. J. Andrews Experimental Forest, may be the answer to this problem. This 15,000-acre tract in the Willamette National Forest near Eugene, Ore., is being managed in cooperation with the Pacific Northwest Forest and Range Experiment Station as a pilot area for studying problems of intensive management of old-growth Douglas fir. (Research on the Andrews was outlined in a March 1957 article in THE TIMBERMAN, "Can there be orderly harvest of old growth?") Since 1950, sales totalling 92 million board-feet have been made, using the staggered-setting system and a variety of logging methods. A permanent road system is being developed, with 30 miles of construction completed.

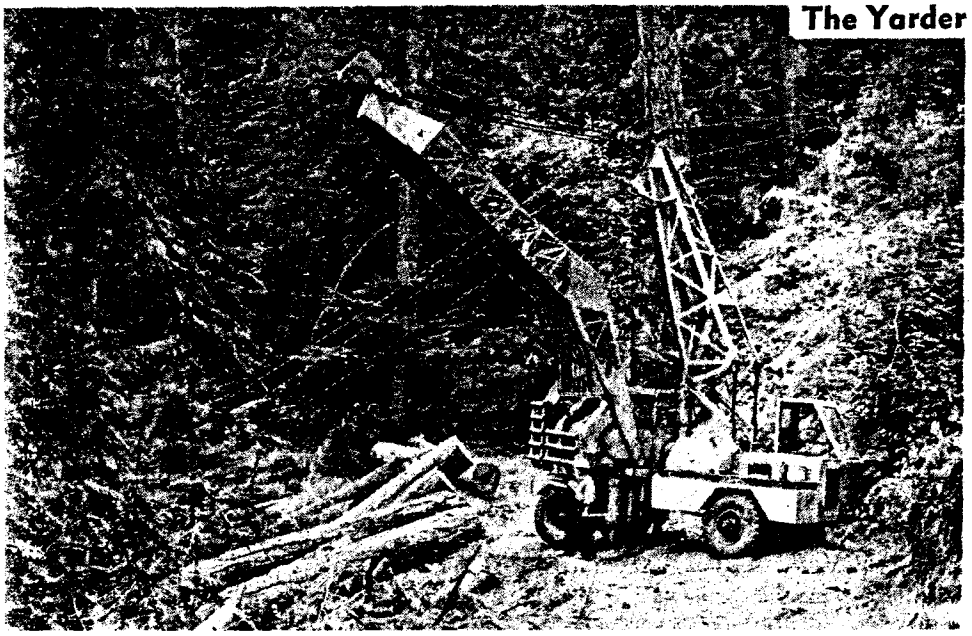
The idea of using high-lead methods for salvage operations in leave settings was developed by Roy R. Silen, at that time in charge of the Andrews, through a series of small salvage sales on this experimental forest beginning in 1951. Objectives were (1) salvage mortality and still practice good watershed management, which meant minimizing soil disturbance, particularly on steep ground, and (2) reduce damage to the live timber. High-lead thinning has been successful in younger timber as reported in "Commercial thinning on steep ground" (by Carl M. Berntsen, June 1954 issue, THE TIMBERMAN). The same technique seemed applicable for salvaging under old growth.

ONE PROBLEM WAS YARDING distance. High-lead yarding through a reserve stand must have short yarding distances, making it impractical to cover the area from the road system established to reach clear-cut units. Efficient road planning has been studied on the Andrews. In a 1951 experimental sale, salvage logging in the leave settings was considered along with clear cutting when the economic spacing of roads at different levels was determined. (Silen, Roy R. More efficient road patterns for a Douglas fir drainage. THE TIMBERMAN, April 1955). Consequently, it was only necessary to build intermediate roads between the rock roads to make the whole area accessible for cable yarding.

Despite the destructiveness of most cable yarding methods when clear cutting, it was thought that damage needn't be excessive if cable yarding roads were oriented uphill and if care were exercised in bringing in logs. There would be less soil disturbance and compaction than with tractors.

The authors gratefully acknowledge the assistance of Richard C. Koenig and Gerhard F. Muerle on field phases of the study, and are especially indebted to Roy R. Silen, who conceived the study and planned the layout of main and spur roads.

TYPICAL SETUP of Skagit SJ-4 Mobile Logger yarding salvage logs to spur road. Machine is self-propelled. At new landing it was located as nearly at right angles to center line of road as possible and still allow boom to swing over trucks. (Photos: U. S. Forest Service)



BUCKING SALVAGE logs (bottom photo) on H. J. Andrews Experimental Forest by Claude Stennett, contractor for Tuff Luck Logging Co.

Promise in Salvage

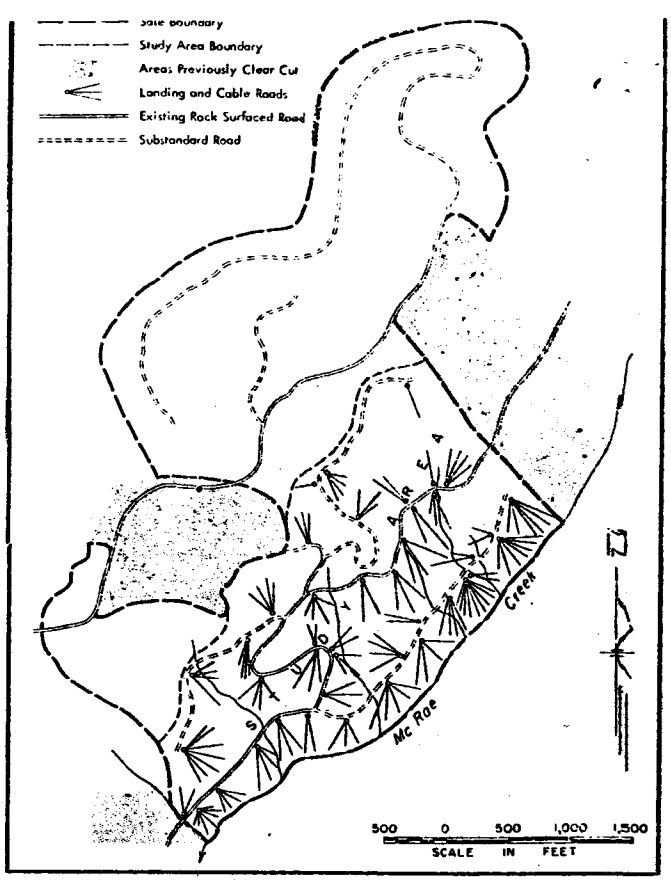


TABLE 2

Salvage logging costs per thousand board-feet compared with conventional high-lead clear-cutting cost on nearby areas, H. J. Andrews Experimental Forest

Cost item	Salvage logging	High-lead clear cutting
	Dollars	
Direct costs		
Felling and bucking	4.28	3.76
Yarding and loading	9.54	6.75
Total	13.82	10.51
Trucking	6.52	11.30
Road maintenance	.20	.80
Fire protection	.80	.62
Slash disposal	1.87	.41
Total	9.39	13.13
Indirect costs		
Scaling	.08	.19
General and administrative	6.02	2.41
Supervision	.61	1.24
Payroll taxes, insurance, vacation pay	.82	.99
Depreciation	16.43	.75
Road construction	1.88	8.78
Total	25.84	14.36
Total logging cost	49.05	38.00

There are 7.5 million acres of old-growth timber left in the Douglas fir region. According to present plans for national forest working circles, cutting of old-growth Douglas fir will be continued for less than 10 to over 90 years. The average is over 50. The average "leave" setting bypassed today must be managed for many years before clear cutting; some, for over 90 years.

There is a similar situation on Bureau of Land Management land and large private holdings. All these settings contain dead and decaying trees, standing or on the ground. Volumes per acre are unusually low, but quality is mostly high. Intensive management of leave areas through salvage of dead timber that has already accumulated and the trees that will die before final clear cutting, would provide an important addition to the timber available from many forest areas.

The staggered-setting system of clear cutting provides an ideal situation for intensive management in leave settings because the initial road system is pushed through the forest in a relatively short time, thus making the whole area accessible.

Douglas fir ran 33% peelers. RIGHT PHOTO: Area shown in photo at left after yarding. Minimum crew for yarding was 4 men: hook tender, who was also choker setter; engineer, unhooker, signalman.

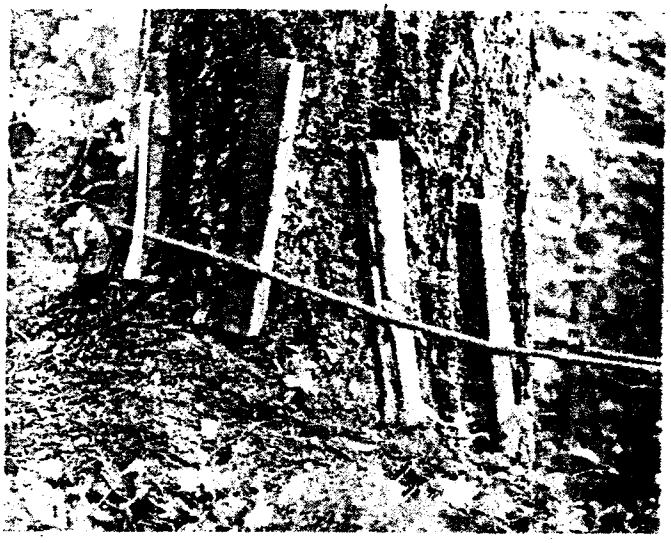
TABLE 1

Salvage volume and value by species and grade, 1954-55

Species & grade	Volume-1/ M board-feet	Value-2/ Dollars
Douglas-fir		
1 peeler	45	4,500
2 peeler	107	9,095
3 peeler	158	11,850
2 sawmill	572	25,740
3 sawmill	68	2,720
Utility	65	1,560
Western hemlock	23	920
Western red cedar	21	840
Pines and true firs	4	160
Total	1,063	57,385

1/ Net scale except for utility logs, for which only gross scale was measured.

2/ On a delivered-log basis.



YEW WOOD blocks were used under guy lines to protect green trees from damage.

residual stand, it was forbidden in the contract. The maximum external distance was 600 feet; yarding distance averaged 225 feet. As many as twelve yarding roads were located at a single setting, but the average was about four. Each yarding road reached about 15 logs on the average, with the range from two to 24. Average volume per road was 7,300 board-feet.

Road changing is an important item of delay in high-lead yarding. While the smaller rigging sizes and shorter roads made this job relatively easy in the salvage study, an average of 17 minutes was consumed by each change, or about 31 minutes per acre yarded.

Because of the large diameter and weight of wet logs and the need to control damage, only one log was brought in with each turn. Yarding production averaged 6.4 logs per hour, or 1.4 man-hours per thousand. This compares with 1.25 man hours per thousand with conventional high-lead equipment on the clear-cut settings. (Carow, John and Silen, Roy R. Using the staggered setting system, what are logging costs? THE TIMBERMAN, April 1957.)

ORDINARILY YARDING PROCEEDED until a truck load of logs had been decked and a truck was at hand. Then the crew would come in and load. The loading boom was lowered from its elevated yarding position and tongs replaced the butt rigging on the main line. However, if a truck arrived when only a few logs remained on the yarding road, the yarding would be completed before loading out.

Loading was done efficiently. With logs averaging 20 feet in length, 26 inches in diameter, and 475 board-feet in net volume, loading proceeded at about 7.2 minutes per thousand on loads that averaged six logs and 2,800 board-feet. There was considerable waiting time by trucks and some delays in yarding while waiting for trucks. This was mostly caused by uncertainties of yarding production due to road changing delays, hangups, and lack of decking. Also, on this operation peeler logs, utility logs, and sawmill logs were loaded separately for different destinations. This caused some truck delay while waiting for full loads.

When all the logs on a setting had been yarded and loaded, the crew brought in the rigging, took in the three guy lines that brace the tower, and prepared the machine for the move to the next setting. Since the SJ-4 is self-propelled, little time was required for the actual move. Upon reaching the new landing, the machine was located as nearly at right angles to the center line of the road as possible and still allow the boom to swing over the trucks when loading.

THEN THE THREE GUY LINES were pulled out to select trees for anchorage. Since these were usually live trees, they were protected from damage by putting yew blocks vertically between the strap and bark. The yarder had special drums for partially tightening the guys and a hydraulic jack levelled the machine, took the weight off the rear wheels, and put tension on the guys.

Final step was to locate the corner and tail blocks, pull the haul-back line through with the straw line, and then attach the butt rigging. Meanwhile the signalman had pulled out his wire and yarding could begin. The average time of 30 moves from completion of loading at one setting to yarding on the next was 72 minutes.

The minimum crew used for yarding was four men: A hook tender who worked as choker setter, an engineer, an unhooker, and a signalman who also kept time records. For loading, the choker setter became head loader, the unhooker became second loader, and the signalman branded and painted the logs. Most of the time a fifth man was used to help set chokers and free hangups.

Experimental salvage logging costs more than conventional high-lead logging (Table 2). However, basic salvage logging costs may be quite close to clear-cutting costs. The depreciation allowance was very high because this was the first year of a fast write-off of the new machine; 61 percent of the 1955 depreciation was allocated to the 50 days worked on this sale. General and administrative costs were also high, partly due to detailed time and cost records that had to be maintained.

Also, Kenady and his crew were familiarizing themselves with a new machine under new conditions. Considerable care was taken to minimize damage to the residual stand, and the delays involved increased yarding costs. Road construction cost $1,385 per mile for the 1.6 miles of spur road built to supplement the existing road network. Spurs were low standard and suitable only for dry weather use.

Some adjustments may be necessary to obtain a better estimate of cost levels over a longer period of operation. For example, yarding and loading would probably be less than the $9.54 per M board-feet found in this study. Trucking, except for minimizing delay time, should not change much. Direct hauling costs were lower than for clear cutting, but this was due to a difference in hauling distance that was compensated for by a difference in stumpage.

General and administrative expenses should be adjusted downward. Com-

puting depreciation by a five-year straight-line method based on a 150-day operating season would reduce this item from $16.43 to $5.35 per M board-feet. Road costs should remain low, unless standards are increased. All things considered, some higher costs of salvage logging were offset by low road construction costs, so that the total was not much higher than for high-lead clear cutting.

Damage to Reserve Stand

Salvage logging in old-growth stands cannot be recommended if damage to reserve trees offsets gains from added utilization. In this test the reserve stand had 43 overstory trees per acre, half of them 400-year-old Douglas fir, one-third hemlock, and the remainder cedar and minor species. The understory of 186 trees per acre was predominantly hemlock. Based on sawtimber volume, there was about 60,000 board-feet per acre, about 85 percent of which was fir.

After yarding was completed in 1955, all settings were mapped and the live stand examined for injury. Eighteen percent of the merchantable trees had been injured to some extent, but injuries averaged less than two square feet in size. Only five percent of the Douglas fir was affected, however, while almost a third of the western hemlock and cedar had wounds.

This difference was attributed to the thick bark of the old-growth fir and to the yarding crew, which favored the more valuable trees. In the understory, about one-quarter of the trees were destroyed; but since they were not expected to reach merchantable size before clear cutting, this was not a serious loss.

GREATEST INCIDENCE of damage was near landings, where the cable roads merged. This was true even though the logs were controlled somewhat by swinging the boom on the SJ-4. One-fourth of the trees 100 to 200 feet from the landing were injured; but only 13 percent were injured in the 300- to 400-foot zone. Incidence was, of course, highest along the cable roads, where 55 percent of the trees were damaged to some extent.

While sidehill yarding was forbidden in the contract, there were some cable roads that had sidehill slopes over part of their length. In these areas logs had a tendency to roll and hang up, and some damage resulted. Here again the resistant Douglas fir showed the least effect. Injured fir trees averaged 20 percent of their circumference bared, whereas injured hemlock and cedar lost bark from nearly a third of their circumference at each injury. Damage usually resulted when incoming logs, or sometimes debris moved by the logs, rubbed against roots and tree bases. There was little damage from falling dead trees but some damage when cables scraped the bark.

This study demonstrated

that high-lead salvage in old-growth Douglas fir leave settings is practical. Direct felling, bucking, yarding, and loading costs were $3.31 per M higher than for clear cutting. High overall costs were partly attributable to a very high depreciation charge and unusual general and administrative costs on the experimental sale. Costs can undoubtedly be reduced substantially. Important controlling factors are volume per acre and log quality. When these go down, costs will surely go up, and at some point along the line salvage logging will become impractical. It is obvious, however, that many thousands of acres in the Pacific Northwest should be salvage logged as soon as possible.

In the experimental sale log quality was good, probably because top logs had decayed, leaving only larger, better quality logs for salvage. Douglas fir (excluding utility logs) averaged 33 percent peelers, and resulting high log values left ample margin for stumpage, profit, and risk.

Only dead material was taken from the study area. Some live trees, however, should probably have come out, since most of their crowns were dead or broken out, they leaned heavily or they were defective and rate of decay exceeded growth. Marking trees of this kind would boost salvage volume and make high-lead salvage economical over a wider area.

THERE WAS LITTLE EVIDENCE in the study that five men did more work than four, although the job was made easier for the hardworking hook tender, who really set the pace. Since the SJ-4 requires only a small crew and men are not available at intermediate locations to shout signals, daily production might be increased considerably if a radio were used to signal the engineer.

A combination of high-lead and tractor equipment would probably be most efficient for salvage yarding in leave areas. Although tractor yarding would have been possible on the gentle slopes, in the study yarding was restricted to high lead to avoid confusing costs of two methods. A tractor, used to build the spur roads, could have supplemented the work of the mobile logger by yarding isolated logs and moving leftover logs from one landing to the next.

In high-lead salvage considerable care is needed to choose landings so that a good volume of logs can be yarded, thus reducing moving costs while at the same time affording good cable roads that will keep damage at a minimum. A temptation to put in sidehill cable roads rather than move more frequently should be resisted, and here the small tractor can help if used to winch in the few logs close to the road between landings. A snatch block to lead logs into the yarding roads would help reduce damage, especially if equipped to release automatically when the butt rigging jammed against it.

LOGGING DAMAGE WAS HELD within reasonable limits on the study area. Doing a satisfactory job of high-lead salvage would require the cooperation of everyone involved, plus considerable skill by the crew in setting chokers and getting the logs past obstructing trees. Even so, a certain degree of damage must be expected as a price for early utilization of down material. The hook tender must be experienced and have a conscientious attitude toward avoiding or minimizing damage to the live stand. His selection of cable roads, skill in setting chokers and extricating hang-ups, and knowledge of timber quality are important to success.