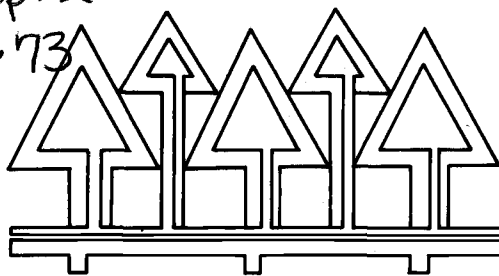


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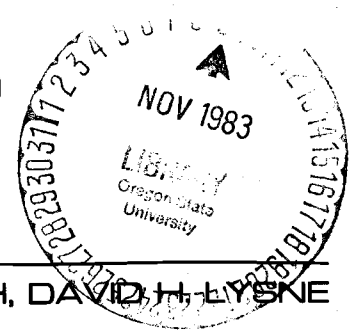


Oregon State University

# FOREST RESEARCH LABORATORY

## (RESEARCH NOTE) 73

### SKIDDING TREETOPS ATTACHED TO MERCHANTABLE LOGS: EFFECTS ON GROUND-BASED LOGGING PRODUCTION



STEVEN D. TESCH, DAVID H. LYSNE

#### ABSTRACT

Logging productivity when treetops are left attached to merchantable logs and skidded to a central landing is compared with productivity when treetop skidding is not required. In a commercial thinning-salvage timber sale where designated skid trails were used, skidding of attached unmerchantable treetops took no extra skidding time, and the delays

associated with top disposal at the landing did not cause a significant loss of production. Comparisons of skidding times when the skidder left designated skid trails to choke logs versus turns when the winch line was pulled to logs from the skid trail indicated no significant difference in time per turn.

#### INTRODUCTION

Designating the location of tractor skid trails before logging begins is an increasingly common practice in the Pacific Northwest as forest managers attempt to minimize soil compaction during harvesting activities. A well-planned system of skid trails limits the portion of the stand compacted by machines to less than 10 percent (Bradshaw 1979, Froehlich et al. 1981), can reduce damage to residual trees (Froehlich et al. 1981), and can prevent future losses of tree growth (Perry 1964, Froehlich 1979).

harvest site with machines may also cause soil compaction. One alternative is to leave treetops attached to the top merchantable log and then skid them to a central landing for burning. However, the cost and effectiveness of this method of slash disposal is not well-known.

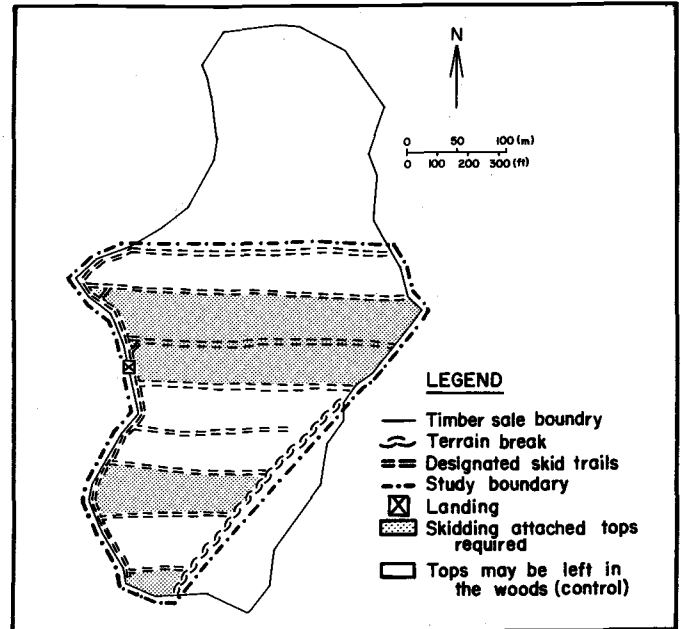
One problem associated with the use of designated trails, however, is disposal of the logging residue, particularly when broadcast burning is not feasible. Piling slash on the

In 1981, a study was begun on the Prospect Ranger District, Rogue River National Forest, to determine the ways in which skidding attached treetops to a central landing would affect: (1) net merchantable timber volume skidded per hour; (2) damage to the residual crop trees; and (3) the amount of slash left after logging. This Note reports on the first objective.

## STUDY AREA

The 6-ha (16-acre) study area is located about 113 km (70 miles) east of Medford, Oregon, in the Cascade Mountains (T.29S., R.4E., Sections 2 and 3, Willamette Meridian), within an 11-ha (28-acre) timber sale (Fig. 1). This sale area contained a young but mature, multistoried, mixed-conifer stand, with numerous old-growth trees. Elevation of the area is 1,250 m (4,100 ft) and the topography is flat. The silvicultural prescription called for harvest of the old-growth trees and removal of enough additional smaller trees to allow adequate growing space for the remaining pine, true fir, and Douglas-fir trees, all of which average about 41 cm (16 in.) in diameter.

FIGURE 1.  
STUDY AREA MAP.



## METHODS

The skid trails were designated by Forest Service personnel before the timber was sold. Because the terrain was nearly flat, the trails were laid out parallel to one another (Fig. 1). The average space between trails was 43 m (140 ft), with a maximum of 56 m (185 ft) and a minimum of 30 m (100 ft) (Fig. 1). Because trails did not connect at the far end of the units, turning areas were necessary in order for vehicles to return to the landing.

The study area was divided into six treatment units, with skid trails as boundaries (Fig. 1). Within every other unit, treetops which did not break off as the trees fell were left attached to the top log and were skidded to a central landing for disposal. Treetop skidding was not required on the other treatment units and tops were generally bucked in the woods (Fig. 1).

Fifteen 0.04-ha (0.1-acre) plots per treatment were established throughout the entire sale area to enable comparison of the treatment areas before logging. We were able to estimate the size and volume of logs which would be removed during the harvest by noting trees marked "to leave." Significant differences in stand characteristics were deter-

mined with t-tests at the 5 percent level of significance.

The skidding time data were collected only when the skid trails located between top-skidding and top-leaving units (measurement trails) were used. The assumption was made that on the average, line-pulling distances and the distribution of logs to be skidded were similar between both types of treatment.

The following data were collected for each skidding cycle (turn):

1. Number of treetops
2. Number of logs
3. Time required to complete turn
4. Unproductive time (coded to separate scheduled delays for breaks and lunch from unscheduled breaks, such as mechanical repairs and disposing of accumulated tops at the landing).

The average net volume per merchantable log, number of logs per turn, and turn time were combined to determine net production per productive hour. Measurements of unproductive time spent disposing of tops were then combined with net production information to establish an effective hour.

## DESCRIPTION OF LOGGING

Skid trails were constructed before falling the timber adjacent to the trails. Typically, the larger trees were felled and skidded first, then the smaller trees. The timber sale contract stipulated directional falling, and a herringbone falling pattern was generally accomplished without the aid of jacks, although wedges were used on some larger trees. Breakage as a result of falling was minimal. The minimum merchantable diameter of trees harvested was 15 cm (6.0 in.) d.b.h. The minimum merchantable log was 2.4 m (8 ft) long and 12.7 cm (5 in.) in diameter, inside bark at the small end.

One rubber-tired skidder (Caterpillar Tractor Model 518) equipped with a blade, winch, and integral arch was used to skid logs. The winch capacity was 72 m (235 ft) of the 16-mm (0.625-in.) cable used to log this area. Five chokers with sliders were attached to the winch line.

At the landing, either the logging foreman or the loader operator acted as a landing sawyer, removing the limb stubs and attached tops immediately after the skidder departed the landing for another turn. Because the hydraulic loader did not have sufficient reach to place them in the burn pile, the tops remained in the landing until the skidder approached with the next turn. As the skidder again approached the landing, the operator would lower the blade slightly, and without significantly reducing speed, push

the tops from the previous turn toward the burn pile (Fig. 2). After unhooking the turn, the skidder operator would continue to push the tops into the burn pile as he left the landing. No delay was recorded when tops were pushed into the burn pile in this manner. A skidding delay was recorded when the skidder operator stopped skidding to consolidate or repile the burn pile, regardless of whether he was using the skidder or a landing tractor.

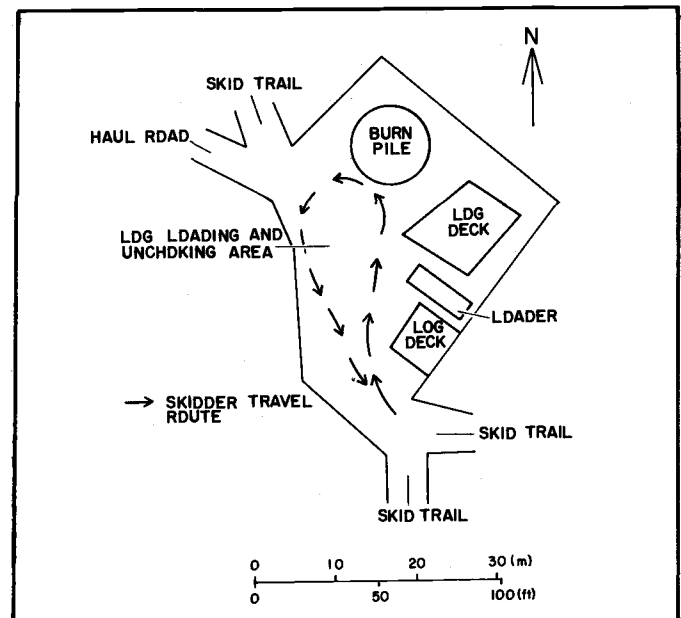


FIGURE 2.  
LANDING CONFIGURATION WITH EXAMPLE  
OF SKIDDER ROUTE.

## RESULTS

### STAND CHARACTERISTICS

Results of the cruise indicated no significant differences in estimated total stand volume or average tree diameter between the top-skidding and top-leaving units ( $P = 0.05$ ) (Table 1). In addition, there were no significant differences in the volume of trees removed or in their average diameter ( $P = 0.05$ ) (Table 1). Therefore, differences in skidding productivity cannot be related to differences in stand characteristics or size of trees harvested.

### LOGGING PRODUCTION

No significant differences in skidding production were measured between the top-skidding and top-leaving units. Mean time required per turn, amount of wood skidded per turn, and amount of wood skidded per effective hour were all statistically equal ( $P = 0.05$ ) (Table 2, Column 1). The average merchantable volume per log used to compute the amount of wood skidded per effective hour was 0.140 thousand board feet (MBF). This amount was based on a summary of scale tickets from log trucks.

The only difference between the treatments was that an average of 2.05 treetops were skidded per turn from the top-skidding units as compared with an average of 0.98 top per turn from the top-leaving units.

While recording skidding time, we realized that the operator was leaving the designated trails frequently. Because this may have affected production data, we kept careful notes on the frequency with which the operator left the trail, as well as an estimate of the distance he traveled off the trail each time.

During an observation period of 54 turns, the skidder left the designated skid trails to choke logs 63 percent of the time (34 turns). The average estimated distance driven off the trail was 6.4 m (21 ft), with one observation estimated as 22.8 m (75 ft) from the trail (Fig. 3). No distance was recorded for two off-trail turns, so Figure 3 represents only 32 turns.

Leaving the trails probably had little effect on the treatment comparison. The operator left the designated trails 67 percent of the time while operating in the top-skidding units and 58 percent of the time while operating in top-leaving units. The average time required per turn was identical (0.179 hours or 10.7 minutes) for on-trail and off-trail turns (Table 2).

## DELAY TIME ANALYSIS

For all components of this study, disposal of tops required 0.046 hour (2.8 minutes) per hour of skidding time. This figure includes collecting tops from skid trail rights-of-way, from areas located adjacent to skid trails within treatment units, and from areas adjacent to measurement skid trails. Delay caused by disposing of tops was recorded on 14 occasions during the skidding of 154 turns of logs, with each delay averaging 0.070 hour (4.2 minutes) (s.d. = 0.082).

TABLE 1.  
SUMMARY OF PRE-LOGGING STAND CHARACTERISTICS AND TREES HARVESTED.

Treatment	D.b.h., mean $\pm$ s.d.		Volume, mean $\pm$ s.d.	
	cm	in.	m <sup>3</sup> /ha	ft <sup>3</sup> /acre
All trees				
Top-skidding	34.3 $\pm$ 19.1	13.5 $\pm$ 7.5	600.8 $\pm$ 340.6	8,586.4 $\pm$ 4,868.8
Top-leaving	36.8 $\pm$ 19.8	14.5 $\pm$ 7.8	558.8 $\pm$ 252.0	7,985.6 $\pm$ 3,692.0
Cut trees				
Top-skidding	31.8 $\pm$ 17.5	12.5 $\pm$ 6.9	385.8 $\pm$ 358.9	5,513.6 $\pm$ 5,130.0
Top-leaving	36.1 $\pm$ 24.1	14.2 $\pm$ 9.5	271.9 $\pm$ 156.6	3,885.9 $\pm$ 2,238.0

TABLE 2.  
LOGGING PRODUCTION SUMMARY.

Production component	Excluding all delays, Mean $\pm$ s.d.	Including delays related to top disposal, Mean $\pm$ s.d.	n
Time required <sup>1</sup> /turn of logs			
Top-skidding units	0.176 $\pm$ 0.046	0.187 $\pm$ 0.058	57
Top-leaving units (control)	.165 $\pm$ .044	.170 $\pm$ .056	68
On-trail turns	.179 $\pm$ .046	--	20
Off-trail turns	.179 $\pm$ .047	--	34
MBF <sup>2</sup> /turn of logs			
Top-skidding units	.759 $\pm$ .205	.759 $\pm$ .205	57
Top-leaving units	.679 $\pm$ .253	.679 $\pm$ .253	68
MBF/hour			
Top-skidding units	4.313 $\pm$ 1.621	4.059 $\pm$ 1.669	57
Top-leaving units	4.115 $\pm$ 1.886	3.994 $\pm$ 1.986	68

<sup>1</sup>Decimal time, hours.

<sup>2</sup>Thousand board feet, merchantable volume.

Remember, however, that not all tops came from the top-skidding units. Top disposal from the top-skidding units required 0.0111 hour per turn (0.7 minute), but top disposal from top-leaving units required 0.005 hour per turn (0.3 minute) as well. Delays for top disposal did not significantly reduce logging production (MBF/hour) for either type of treatment ( $P = 0.05$ ), as indicated by the difference between column 1 and column 2 in Table 2. In fact, the above figures probably slightly over-estimate delay time because disposal of some tops from skid trail rights-of-way and non-measurement skid trails is included in the calculation.

Logger efficiency (LE) was calculated to determine the relationship between productive time and total time. During our observation period, LE was 0.80, meaning 48 minutes per hour were productive, excluding scheduled time for breaks and meals.

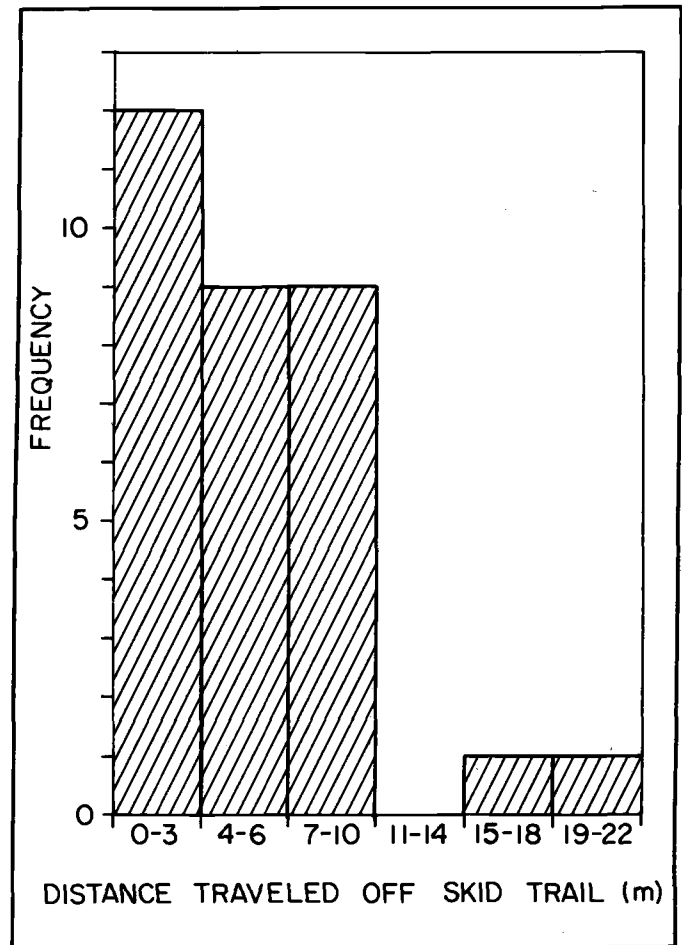


FIGURE 3.  
DISTRIBUTION OF DISTANCES TRAVELED OFF DESIGNATED SKID ROADS TO CHOKER LOGS.

## DISCUSSION

As with most studies of logging production, results must be interpreted carefully because there is a great deal of variability from one logging operation to another. In this case, because the logger frequently left the trail to choke logs, we do not have a carefully controlled study reflecting the use of designated skid trails. However, if loggers have flexibility to leave such trails, these results may be accurate.

During the on-trail versus off-trail skidding time comparison, few large, old-growth logs were involved. Given that smaller trees were skidded, the lack of significant difference in turn time between the on-trail and off-trail turns may perhaps be extrapolated to more typical commercial thinnings. This result agrees with the study by Froehlich

et al. (1981) which found no differences in production between logger's-choice skidding and the use of designated skid trails.

There is no significant difference in skidding time between treatment units when delay time for top disposal is included in the analysis. However, if the sale contract had been written to require all tops of a certain dimension, whether attached or unattached, to be skidded to the landing, more tops would probably have been removed from the top-skidded units. This stipulation would discourage operators from breaking off tops in the process of skidding to minimize handling at the landing. It is interesting to note that, operationally, nearly one top per turn is skidded to the landing, even where this practice is not required.

## CONCLUSIONS

1. In a commercial thinning-salvage sale with mixed-size trees, where some departure from designated skid trails was observed, skidding of attached unmerchantable tree-tops took no extra skidding time and very little additional time for top disposal at the landing. The delays associated with top disposal did not cause a significant loss of production ( $P = 0.05$ ).
2. Comparisons of skidding time when the skidder left designated trails to choke logs versus turns when the winch line was pulled to logs from the skid trail indicated no significant difference in time per turn. Time apparently is spent maneuvering the equipment in one case and in pulling winch line in the other.

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## The Authors

Tesch is Assistant Professor, Department of Forest Science, Oregon State University, and is stationed in Medford, Oregon. Lysne is Forester, USDA Forest Service, Rogue River National Forest; when this research was conducted, he was an Assistant Professor, Department of Forest Engineering, Oregon State University.

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