California FORESTRY Note

State of California
The Resources Agency
Department of Forestry

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NO. 95 JANUARY 1985

CAN HORSES COMPETE WITH TRACTORS?

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INTRODUCTION

During the summer of 1983, two commercial thinnings were conducted on Latour Demonstration State Forest, 52 miles east of Redding, California. Horses skidded logs in one operation and a tractor was used for skidding in the other operation. Economic and environmental impacts of horse logging and tractor logging for commercial thinning on moderate terrain in high density true fir stands were compared.

K & S Logging of Burns, Oregon, was contracted to harvest an area using horses and Sutter Logging was contracted to harvest an adjacent area with a rubber-tired skidder. Both contractors had experience logging young, dense timber stands.

A Latour staff member was at the operating sites at all times, recording skidding distances in 100-foot increments, size and volume of each log, daily and hourly production, and the number of personnel and horses or equipment working. The contractors submitted their itemized costs at the conclusion of the operations.

STAND AREA AND DESCRIPTION

The area selected for both studies was a dense true fir stand at the 5,800-foot elevation, containing more than 1,000 trees per acre, of which 91% were true fir and 9% were pine species. Basal area averaged 320 square feet per acre. The stand had not been previously logged. Slopes ranged from 0-27% with the average being 12% on the horse operation and 8% on the tractor operation. The timber site was class II with well-drained soils of the Windy soil series. Erosion hazard rating was moderate.

The 23.7-acre study stand was divided into two sections. A 12.2-acre area was thinned using horses to skid the logs. An adjacent 11.5-acre area was thinned using a rubber-tired tractor for log skidding.

DESCRIPTION OF HORSE OPERATION

Six horses worked the sale, four registered Belgians and two Shire-Belgian crosses. Four of the horses were experienced at logging; the other two were trained on the job

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Acknowledgment

The authors express special appreciation to Joe Kintz of K & S Logging and Stan Sutter of Sutter Logging for their cooperation in making this study possible and for a job well done.

with the experienced horses. The horses weighed 1700 to 2000 pounds each, and ranged from five to twelve years in age. Each working animal consumed about 40 pounds of hay, 15 pounds of grain, and 30 gallons of water daily. Temporary corrals were built adjacent to the operation to contain the horses during nonworking hours.

The horse sale began June 24, 1983, and was completed July 9, 1983, for a total of 14 working days. The operator worked six days per week, beginning at 7 a.m. and ending at 4 p.m., with an hour for lunch.

The work was organized with one man falling and bucking, one man driving a team, and one man using a single horse. In dense areas of small diameter trees, one man with a single horse would work alone, while the team stayed with the faller in more open areas. Trees were cut and skidded, beginning from the back of each area and progressing to the road to minimize slash accumulation in the skid trails, making it easier for the horses to maneuver. Areas were not felled in advance of skidding to avoid slash accumulation. When logging along each skid trail was nearly completed, the final few trees to be cut were felled into the trail so the tops and slash would help prevent soil erosion. Since skid trails were narrow and had little soil disturbance, waterbars were not necessary. All slash was lopped down to 24 inches above the ground.

An independent trucker with a self-loading logging truck hauled the logs 22 miles to a mill. This eliminated the need to construct landings and employ a separate loader and operator. Skidded logs were placed along roads, natural openings, and wide areas for pick up by the self-loading truck. Since volume removed was insufficient to keep a truck working full time, a problem evolved when roads and openings were filled with logs while the trucker intermittently hauled for other contractors.

DESCRIPTION OF TRACTOR OPERATION

The tractor sale began on July 19, 1983, and was completed on August 2, 1983, for a total of 10 working days. The operator worked five days per week. A typical day started at 6 a.m. and ended at 4 p.m., with half an hour for lunch. Trees were felled before and during the sale, from 6 a.m. to 2 p.m. In calculating the average skidding time, only actual hours worked were counted, omitting lost time due to breakdowns.

Equipment consisted of a front-end loader, a rubber-tired tractor and a logging truck. The rubber-tired tractor, a Clark 667 with winch, is the size skidder normally used in this area. Fallers provided their own chain saws, gas, and oil.

Skid trails were predesignated at approximately 100-foot intervals. Trees were felled toward the skid trails and winched out to the tractor. To minimize damage to remaining trees, the tractor was not allowed off the main skid trails. All slash was lopped to 24 inches above the ground. Upon completion of the sale, skid trails were water barred and slash on landings was piled. Logs were loaded at two landings and hauled 22 miles to the mill. No minor products, such as firewood or posts, were produced.

FINDINGS

Total net volume removed was 254,240 board feet with 126,750 board feet removed from the horse operation and 128,900 board feet from the tractor operation. Both areas were

reduced to 140-160 square feet of basal area per acre. All trees selected for removal were marked and recorded by two-inch diameter classes (Table 1). A total of 1,880 trees were removed, including trees damaged in logging. Thinning was primarily from below with some dominants and co-dominants removed to achieve the desired basal area. Trees harvested ranged from 10-40 inches in diameter at breast height (DBH) with the average being 13.2 inches for the horse operation and 13.3 inches for the tractor operation.

Some road work was necessary, but it is not included in the time and cost summaries.

PRODUCTION - HORSES

Daily production varied with the number of men and horses working (Table 2). Maximum skidding distance was 925 feet with the average being 334 feet. Average log length was 24 feet with an average small end diameter of nine inches. Average volume per log was 86 board feet. Eighty-three percent of the logs were skidded singly with the remainder being skidded two at a time. Actual skidding time averaged 7.1 hours per day. Average volume per day was 9,050 board feet. A total of 27 loads were taken off of the sale.

Table 1. Trees marked by diameter class.

Diameter Breast Height (inches)	Number of Trees Marked	
	Horse Unit	Tractor Unit
10-14	702	762
16-20	157	184
22-24	24	31
26-30	5	5
32-34	2	2
36-38	3	0
40 +	2	1
TOTAL NUMBER OF TREES	895	985

Table 2. Volume production by men and horses.

Men and Horses	Average Daily Production (Board Feet)	Average Number of Logs	Average Skidding Distance (Feet)
1 Team, 1 Single, 1 Faller	9,530	94	347
1 Team, 2 Singles, 1 Faller	9,250	107	330
2 Teams, 1 Faller	7,530	101	400
2 Singles, 1 Faller	9,160	97	192
1 Team, 1 Single, 2 Fallers	10,810	142	228

PRODUCTION - TRACTOR

Daily production varied with hours worked and skidding distance. Maximum skidding distance was 1,050 feet with the average being 474 feet. Average log length was 26 feet with an average log diameter at the small end of eight inches. Average volume per log was 91 board feet. Logs were skidded one to four at a time with an average of three logs per skid. Average daily production was 12,890 net board feet for seven hours of actual skidding time per day. A total of 28 loads were hauled from the sale. Loading time was the same for both operations, 45 minutes per load.

GROUND DISTURBANCE

Horse skidding caused considerably less ground disturbance than tractor skidding. Horse skid trails were only 4-6 feet wide while tractor skid trails were 10-12 feet wide. Water bars were needed on the tractor operation, but not on the horse operation. More mineral soil was exposed with the tractor. Where the horse trails were totally exposed to bare mineral soil, the operator would place slash in the trail upon completion to help prevent erosion. Exposure of mineral soil for natural regeneration can be beneficial, but was not needed in these well stocked stands.

STAND DAMAGE

Fewer trees in the residual stand were damaged when logs were skidded with horses than when skidded by tractor. Horse skidding damaged 11 trees larger than 10" DBH, but none required removal; whereas, tractor skidding damaged 179 trees over 10" DBH, with 35 requiring removal. If 50 percent of the bole was damaged the tree was removed. Although damaged trees less than 10 inches DBH were not counted, we observed that the tractor knocked down and damaged a greater number of small trees than did horses. Horses maneuver better in smaller areas than do tractors, resulting in less skidding damage. For instance, a team of horses can pass through a six-foot opening, whereas, a tractor needs a 10-12-foot opening. Since horses move slower, logs being skidded bump against residual trees less often. Damage from falling was about average for high density stands.

COMPARISONS

A comparison of the daily averages for the horse and tractor operation is given in Table 3.

Table 3. Daily averages - horse vs. tractor logging.

Item	Horse	Tractor
Hours Worked	7.1	7.0
Net Volume Removed	9,050 Board Feet	12,890 Board Feet
Average Distance per Skid	334 Feet	474 Feet
Average Log Length	24 Feet	26 Feet
Average Log Diameter	9.48 Inches	8.75 Inches
Number of Logs Per Day	104	144
Number of Logs Per Skid	1	3

Average daily production was 30% higher using a tractor, mainly because the tractor skidded three logs to one for the horses. Logs were not decked with the horses and this at times increased skidding distances and time to locate a place to put the log.

The average tractor skidding distance was 140 feet more than the average horse skid, because the tractor skidded into a landing whereas the horses skidded logs directly to the road. This added 200-300 feet to the tractor skidding distance in some cases. Also, the tractor had an area in which logs were skidded over 1,000 feet.

COSTS

These operations were profitable to both operators and the State Forest. Costs for both the operators are given in Table 4. Overall logging costs were $92.61 per thousand board feet for the horse operation and $100.44 per thousand board feet for the tractor operation.

Table 4. Logging costs for horse and tractor operations.

	Total Cost Horse Logging	Cost/Thousand Board Feet	Total Cost Tractor Logging	Cost/Thousand Board Feet
Trucking & Loading	$ 5,205.20	$41.07	$ 6,788.57	$ 52.67
Falling, Bucking & Lopping	2,981.00	23.52	3,017.33	23.41
Skidding*	3,455.44	27.26	3,040.00	23.58
Yield Tax	96.71	.76	101.24	.78
Total Costs	$11,738.35	$92.61	$12,947.14	$100.44

*Feeding and fuel costs and wages are included.

Trucking costs were 28% higher on the tractor operation due to the additional cost of the loader and loader operator. If a self-loading truck had been used on the tractor side, loading and trucking cost would have been approximately $41.82 per thousand board feet, comparable to loading and trucking on the horse operation.

Skidding costs were 16% higher on the horse operation primarily because the horses averaged one log per skid while the tractor averaged three logs per skid and moved faster.

The combined falling, bucking, and lopping costs were nearly the same on the horse and tractor operations. Administration costs were higher on the horse operation because it took longer to complete.

Table 5. Management cost of sale layout and administration.*

	Horse Sale Total Cost	Cost/Thousand Board Feet	Tractor Sale Total Cost	Cost/Thousand Board Feet
Layout and Marking	$411.51	$3.25	$440.56	$3.42
Marking Paint	70.47	.56	72.90	.56
Administration	127.50	1.01	75.00	.58
Total Costs	$609.48	$4.82	$588.46	$4.56

*Cost of production study not included.

CONCLUSION

This study demonstrated that horse logging can economically compete with tractor logging in dense stands. Horse logging is generally considered more expensive and less productive than tractor logging. In this study it was more economical to log with horses, but only because the loading and trucking method was cheaper.

Horse logging is slower than tractor logging because horses move slower and usually can skid only one log at a time, whereas tractors move faster and can skid several logs at a time. When skidding distances are long, horses get tired and need to be stopped and rested. Where high production is desired, it would be more practical to use a tractor.

The most apparent difference in this study was the amount of residual stand damage and visual impact. Damage to residual trees is an important consideration when the stand is composed of tree species that are susceptible to disease and wood decay from bole wounds. The tractor damaged more trees and some had to be removed. If the stand had been cut heavier to begin with, there probably wouldn't have been as much damage. Less damage may have occurred if a smaller tractor had been used, but the tractor used was the average size currently available to small landowners. The increased damage and higher ground disturbance created a larger visual impact to the stand.

Horse logging provides a viable alternative for small landowners who are concerned with the visual impact of logging, and when production is not a main concern. The maneuverability of horses allows more trees per acre to be left.

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