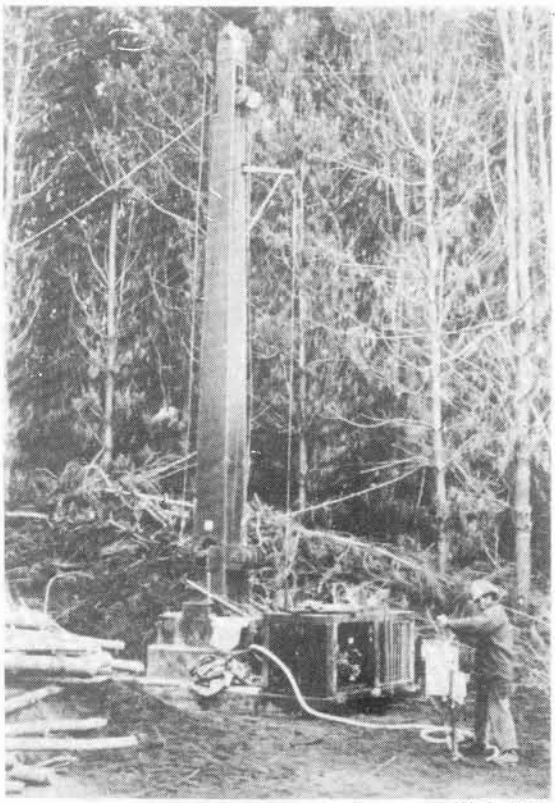
LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND

REPORT

Vol. 4 No. 12 1979

LOTUS EXPERIMENTAL SKYLINE HAULER

(PRODUCTION TRIAL SUMMARY, BY M.McCONCHIE, FOREST RESEARCH INST.)



K.L.C. Photo

Downhill Trials - Tarawera Forest

INTRODUCTION

This report summarises production studies of the Lotus skyline hauler over a six month trial. The study was carried out by the FRI Harvesting Group with assistance from LIRA, for the Lotus development working group.

During the trial the Lotus skyline was operated in thinnings for 4 months in NZFP's Kinleith Forest and 2 months in Tasman's Tarawera Forest.

ACKNOWLEDGEMENT

LIRA is grateful to Mike McConchie of the Forest Research Institute for compiling this report.

The following three systems were studied in detail:

Extraction System	Forest	No. of Cycles Timed	Stocking (stems/ha)	
			Before Thinning	After Thinning
Uphill, tree length (Hot decking)	Kinleith ①	193	765	370
Downhill, tree length (Cold decking)	Tarawera ②	123	1090*	460
Downhill, long length (Cold decking)	Tarawera ②	111	1090*	460

* Included 200 dead or cull trees/ha

① 14 year old radiata regeneration. Mean dbh 22.6 cm. An agricultural tractor with winch removed logs from in front on the hauler every 2-3 cycles and shifted the Lotus during line shifts.

② 17 year old radiata. Mean dbh 27.8 cm. Extraction lines 4 m wide at 20 m centres. Apart from removal of cull trees, little thinning was done between extraction rows.

TABLE 1. DETAILS OF THE LOTUS SKYLINE TRIALS

STUDY RESULTS

PRODUCTIVE CYCLE ANALYSIS

Table 2 gives the average cycle times for the three extraction systems, and divides the times into elements that allow comparison between systems.

Activity	Uphill, tree-length	Downhill, tree-length	Downhill, log length	Time (Mins)
Raise rig				0.25
Out haul	100 m	100 m	100 m	0.50
				0.75
Move in				1.00
				1.25
Choke logs	2.1 logs	2.1 logs	2.4 logs	1.50
				1.75
				2.00
				2.25
Move clear		7 m	6 m	2.50
Break out				2.75
	100 m	93 m	94 m	3.00
In haul				3.25
				3.50
		1.7 logs		3.75
			2.3 logs	4.00
Unhook	2.1 logs			
		3.87		
TOTAL PRODUCTIVE CYCLE TIME (Min)	4.16		4.08	4.25

TABLE 2. PRODUCTIVE CYCLE DISTRIBUTION

- "Raise rig" time in uphill study is less than downhill because the carriage often ran back while the operator was returning to the control after unstropping the logs.

- "Out haul" times are taken over various distances and then standardised by regression analysis to 100 m. (See also Discussion Section on line speeds.) The tree-length studies include some "hesitation time" in the machine control prior to engaging the haul-back rope. This problem was largely overcome before the log-length study.

- "Move in" and "move clear" times are small but necessary parts of the productive cycle, for safety reasons. Their duration depends largely on the breaker-out and the amount of slash on the ground.

- "Choke logs" is the same per log for the downhill studies but longer in the uphill study. This reflects the amount of lateral pulling of slack required to choke logs felled between the extraction rows.

- "Break-out" and "in haul" were not separated in the uphill study. However, the time to break-out would have been longer than in the downhill studies mainly through the increased lateral hauling done.

- "In haul" time is longer in the downhill systems as it includes a "drop" element where, in the "cold deck" situation, the carriage is slowed down and the logs lifted onto the stockpile.

- "Unhook" time per log was higher for the downhill systems, partly because of the stockpiling of the logs.

PRODUCTION DELAYS

Production delays are a part of all logging operations. The total production delay per cycle for the 3 systems and the main components of delay were:

Uphill tree-length:- 1.27 mins. of which 27% was breaking-out; 17% operator doing skidwork; 13% choker tangling; 13% skidder interference; and 22% other delays.

Downhill tree-length:- 0.60 mins. of which 48% was breaking-out; 22% waiting for the rigging to lower in the bush; and 22% other delays.

Downhill log-length:- 0.60 mins. of which 50% was breaking-out; 15% waiting for the rigging to lower in the bush; 12% chokers tangled; and 17% other delays.

The uphill study delay time was mainly in break-out because of poor log preparation in the bush. This also caused the operator to do skidwork and limited the number of logs hooked on per haul. Break-out delay time in the downhill studies resulted when logs slid behind a standing tree.

Chokers becoming tangled around the skyline or mainrope was more common in the uphill hauling when the carriage ran back down the skyline and the rigging raised itself, after the logs had been unhooked.

Lateral pulling of slack for downhill extraction was difficult owing to drum free-wheeling limitations. At Tarawera Forest, where thinning between the rows was light, this problem was not evident in the time distribution.

Waiting for the rigging to lower from the carriage in downhill hauling was also related to drum free-wheeling problems.

Incoming logs fouling with the heads of the previous drag were a problem in the uphill extraction system, although this could be overcome with an intermediate support system near the landing edge.

Skidder interference when removing the logs in front of the hauler occurred only in the uphill tree-length system.

PRODUCTION ESTIMATE

FRI Harvesting Group's standardised calculations of daily production enables direct comparisons of different systems. A productive cycle is obtained from the stopwatch data and this is then adjusted to a standard average haul distance of 100 m in strip thinning. An allowance of 22% for rope-shift time is added as is a further allowance for production delays. The estimated daily production of the three systems studied, using this format, appear in Table 3.

System	Uphill, Tree-length	Downhill, Tree-length	Downhill, Log-length
Total cycle time (480 min/day)	8.13 mins	6.81 mins	7.14 mins
No. of hauls/day	59.0	70.5	67.2
Piece size (m^3)	0.21	0.40	0.27
No. of logs/haul	2.1	1.7	2.3
Haul volume (m^3)	0.44	0.69	0.62
Daily production (m^3)	25.7	48.6	41.7

TABLE 3. AVERAGE STANDARD PRODUCTION ESTIMATE PER 8-HOUR DAY

During the downhill tree-length study there was a 19% log loss due to the operator's inexperience. About 4% log loss is usual and, had this been achieved, daily production from this system would have increased.

Where log lengths were cut in the bush the number of logs choked per haul increased (with a corresponding increase in choking time). This did not compensate for the associated decrease in piece size and therefore average volume was down. This effect may be offset to some extent by advantages occurring with subsequent handling of the stockpiled logs (self-loading trucks), however this was not measured in this study.

DISCUSSION

- The Lotus hauler had a relatively short operator-learning curve. The controls are straight forward with the hydraulic drive giving the operator positive and infinitely variable speed control.

- Accurate directional felling and a good standard of log preparation in the bush are essential if high levels of hauler thinning productions are to be obtained.

- Average piece size strongly affects overall daily production. Where piece size is below about 0.2 m^3 it would be difficult to achieve daily production exceeding 30 m^3, compared with daily production rates approaching 50 m^3 for a piece size of 0.4 m^3. (See Table 3.)

- Extraction rows should be kept to a reasonable length (about 100 m average) to keep non-productive rope shift time to a minimum.

The study also showed up certain areas that require further investigation:

MACHINE RELATED RESEARCH

- The 8 tonne sled-mounted Lotus hauler was difficult to move with a 56 kW skidder on the loose pumice soils in Tarawera Forest. Redesigning of the hauler's undercarriage would probably overcome this problem and the cost should be compared with potential savings.

- Further research is required to determine the difference in forces required to break-out untrimmed, partly trimmed, and completely trimmed logs, which may be uncovered, partly covered, or completely covered by slash or other logs. Power requirements for small hauler design tends to be governed by this.

- Haul-back rope speed on the Lotus hauler is relatively slow. An increase in the drum speed would reduce the "out haul" proportion of the productive cycle.

- Free-spooling drums are necessary to allow lateral slack to be pulled, especially for downhill extraction.

SYSTEM RELATED RESEARCH

- A total system analysis is required to show if the time spent cutting logs to length in the forest is justified.

- Further research is needed to look into use of intermediate supports, to reduce or eliminate production delays occurring at the landing during uphill extraction, and to extend haul distance.

Basic specifications of the Lotus skyline hauler were described in LIRA Report Vol. 4 No. 7 1979.

For Further Information Contact: N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O.Box 147,
ROTORUA, NEW ZEALAND. Phone 87-168