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# PILOT TRIALS WITH LOADER LOGGING IN NEW ZEALAND

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*Figure 1 - Sumitomo LS 4300 loader working in log length second crop Kinleith Forest*

*ABSTRACT*

*A Sumitomo LS4300 30 tonne hydraulic loader was used in three brief logging trials to extract both whole tree and log length wood. It was first used to swing 0.4m$^3$ whole trees in windthrow. Up to a distance of approximately 50 metres from the roadside, the loader averaged 140 tonnes per day.*

*The second trial of the machine was in 3.8m$^3$ old crop radiata. On slopes of up to 18° and with a swing distance up to 100 metres, the machine extracted 373 tonnes in seven machine hours.*

*In the third trial the machine was used in 2.1m$^3$ second crop radiata to swing log length wood to the roadside. Working on slopes of up to 13°, the loader produced 195 tonnes per seven machine hour day, with swings up to 125 metres.*

## INTRODUCTION

Developed in the United States and known there as "shovel logging", loader logging is a means of logging using an excavator-based hydraulic loader. Logs are repeatedly swung from the stump to the road edge. Generally, no landings need to be formed, with loadout taking place directly from the roadside.

In the United States it has been found to be competitive with other systems on suitable terrain where timber is of a uniform size and suited to cross-country handling by a hydraulic loader (Hemphill, 1986).

LIRA's trials looked at how a loader would handle a variety of both full tree and log length wood; in particular, its ability to handle second crop cut to log length. Two machine operators were used in the three trials. One had experience as a loader driver but neither had experience of operating the machine on the cutover.

*ACKNOWLEDGEMENTS*

*LIRA wishes to thank operator Alan Franklin; Leespower for supplying the machine; the staff of Tasman Forestry Limited and NZFP Forests Limited. Also the various logging gangs at whose jobs the loader was used.*

## THE MACHINE

The loader was a Sumitomo LS 4300 Link Belt hydraulic excavator base loader. It is fitted with Prentice 610 boom, a Pierce live heel and a Prentice 8-48W continuous rotation grapple. A lifting test conducted by LIRA (Kellogg, 1988) showed a maximum capability of 12.6 tonnes at a radius of 4.35 metres. At a maximum reach (9.75 metres), the loader could lift 5.1 tonnes.

A machine of this size and weight is considered suitable for loader logging. However, as noted by Hemphill (1986) prior to machines being used full time, they must be suitably modified. Guarding to the underside of the machine is essential. Such guarding consists of 19 mm T1 steel plate, under the car body, ribbed inside, with 50 mm x 100 mm T1 steel bars outside and 8 mm T1 steel plate on the underside of the upperworks is recommended. Guarding around the sides and front is also necessary.

High undercarriage maintenance costs are experienced in loader logging. One operator in the United States has found that a set of tracks will last about 4000 to 6000 hours, compared to 16000 hours for a loader not travelling off-road. Cross-country travel causes the links to stretch and there is the potential for a pin to break. Operators find that, after the second break has occurred, more will happen in rapid succession, and the second break is therefore regarded as the time for a new set of track chains.

Limited additional maintenance has been experienced for the upperworks. Extra fatigue can occur to the boom with an inexperienced operator or in tree length logging.

To suitably guard the Sumitomo for loader logging, the following modifications with approximate costs would be required:

| | |
|---|---|
| Belly pans | $1700 |
| Under-carriage guarding | $ 800 |
| Guarding side panels | $2000 |
| | $4500 |

## MACHINE COSTING

Based on a new purchase price of $330,000 including guarding, the LIRA costing format (Wells, 1981) indicates a daily machine and operator cost of $833.

This rate is based on a nine machine hour day and the machine is costed over seven years with a residual value of 25%. The nine machine hours per day consisted of seven hours to produce the logs to roadside and two hours for loading trucks.

## TRIALS

### Area 1 - Wainui Forest - whole tree

The area of Wainui Forest had been windthrown during Cyclone Bola in March 1988. Prior to the loader beginning operation in the forest, manual cutters had been employed to cut the wood at the stump. Wood was then bunched by two Bell Loggers and extracted to the roadside by Cat 518 grapple skidder for delimbing by a Denis delimber. Ground conditions and terrain became unsuitable for efficient operation of the Bell Loggers.

As an alternative, the Sumitomo loader was trialled swinging the wood from the stump to the roadside. The loader worked parallel to existing roads and with the formation of new roads 50 metre strips were completed with an average of four swings. Because the area had been thinned and the distribution of stocking was uneven, the loader had to wander to accumulate trees rather than keep to a strict route. The loader was also able to extract trees from sharp incised gullies and negotiate slopes to about 18°. The live heel was often used to push small tracks and debris or stumps were cleared using the grapple.

A maximum swing distance of 50 metres in this small piece size became evident early in the trial. It soon became apparent that the productivity would be low and the unit cost of the wood at the roadside would be too expensive. The additional cost of establishing extra roads and the effects of road density on site productivity would need to be considered if this system was adopted as an ongoing operation. Based on two days study in 0.4 $m^3$ windthrown trees in Tauhara Forest, the predicted daily productivity is shown in Table 1.

*Table 1 : Loader Productivity - windthrown trees*

| Piece Size | Maximum Swing Distance | Average Daily Productivity |
|---|---|---|
| 0.4$m^3$ | 50 metres | 140 tonnes |

At seven machine hours logging and two hours loading, the extraction and loading cost was $5.95/tonne (based on $833 per day).

### Area 2 - Kinleith Forest - whole tree

The second loader logging trial was carried out in conjunction with a study investigating the Sumitomo working with a Madill 009 (Duggan, 1989). The trees were old crop radiata, with a merchantable size of 3.8 $m^3$.

On three occasions, when not required at the hauler, the loader operator took the opportunity to extract trees (Figure 2). Working on slopes of approximately 18° and distances up to 100 metres, the loader swung whole trees down the hill to the hauler landing.

The trees had been felled downhill towards the hauler. The loader walked uphill, using the boom to assist with climbing where necessary. The heel was used to form a contour track to gain access across the slope. As the loader progressed along the track, trees lying in the path of and up to eight metres above the machine, were swung down the hill (Figure 2). The momentum created by swinging the logs enabled many of the trees to travel the distance to the landing .On return to the landing, the trees were laid out for processing and stacking.

*Figure 2 - Loader logging in whole tree old crop in Kinleith Forest*

*Table 2 : Loader Productivity - old crop whole trees*

| Study No. | Time (hours) | Volume (tonnes) | Production per hour (tonnes) |
|---|---|---|---|
| 1 | 1.5 | 81 | 54 |
| 2 | 3.5 | 202 | 58 |
| 3 | 2 | 90 | 45 |
| Total | 7 | 373 | |

The loader was able to supplement the hauler's productivity during line shifts or mechanical delay, rather than remain idle.

At seven machine hours logging and two hours loading, the extraction and loading cost was $2.20/tonne (based on $833 per day).

**Area 3 - Kinleith Forest - log length**

A 1.5 hectare area of Radiata second crop was selected for a pilot study of log length loader logging. The area was predominantly flat, with 13° slope over about one-third of the area.

The stand had been affected by windthrow and stocking was assessed at approximately 260 stems per hectare. Average tree size from NZFP Forests Limited stand data was approximately 2.1m$^3$.

All trees were felled parallel to the road. Trees in the first twenty metres from the road were measured and cut to log length. Wood beyond that distance was measured and marked to log length but individual logs were not cut. This was to reduce the number of pieces to be handled until the final swing to the roadside. One or two cuts were normally made per tree, leaving pieces between 8 and 20 metres long.

For the trial a minimum number of log grades were selected (Table 3). This minimised the amount of handling by the loader and maximised the sawlog and export grades required at that time.

*Table 3 : Log Grades*

| | Length (metres) |
|---|---|
| "A" grade saw log | 4.3 - 6.1 |
| Japanese export | 8.1 and 12.1 |
| No. 1 pulp < 40cm LED | 1.7 - 13.0 |
| No. 3 pulp > 30cm SED | 3 - 13.0 |

**System Operation (Log Length)**

The loader began about 9 metres or one boom length in from the roadside. Working parallel to it, all logs were stacked by sort, mostly perpendicular to the road (Figure 3).

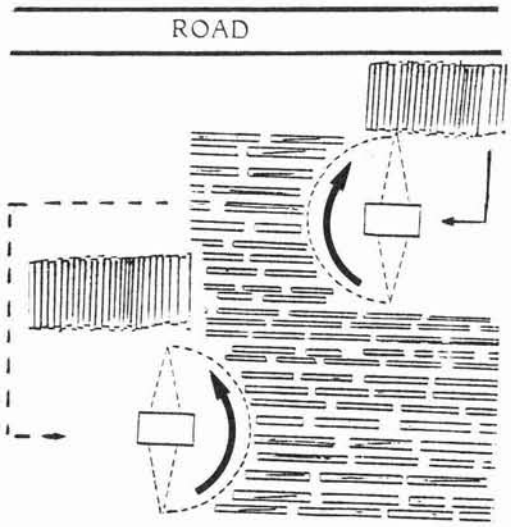


*Figure 3 - System of windrowing the trees perpendicular to the road.*

Another four windrows of logs at 20 metre intervals were completed. Here the logs had to be retrimmed and cut to final log length prior to being stacked for loadout. Once all trees had been windrowed, the loader started at the back of the block and repeatedly swung the trees until they were all at the roadside (Figure 4).

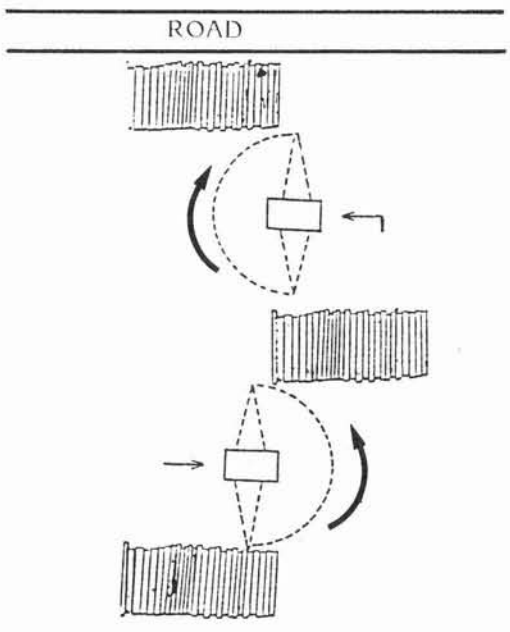


*Figure 4 - Swinging windrowed trees to roadside*

The final processing of the wood did not interfere with the loader operation. There was little problem identifying the paint marks on the logs. Neither was there much re-grading required due to poor log making decisions at the stump. Most re-grading of logs was caused by grapple damage. In some cases export logs were recut to saw logs with the damaged section going to pulp.

In the log length trial area, loader productivity of 195 tonnes per day was good but would certainly have been improved if the trees on the second to last swing had been laid parallel to the road. The loader could have worked its way into the trees and would not have had to walk back to reach short logs cut from the long stems.

Productivity for the log length study averaged 195 tonnes per seven machine hour day.At seven machine hours logging and two hours loading, the extraction and loading cost was $4.30/tonne (based on $833 per day).

The estimated total daily cost of the operation was :

| | |
|---|---|
| Loader and operator | $ 833 |
| 3 fallers @ $150 | $ 450 |
| 3 saws @ $23 | $ 69 |
| Transport, etc. | $ 100 |
| | $1452 |

Three fallers have been included in the costing. Each faller was capable of felling, delimbing and cutting to length approximately 100 tonnes per day. The third man was required on the cutover to retrim as the loader swung the wood and later to finish cutting to the final log lengths.

*Table 4 -Loader Productivity - log length*

| Activity | Time (machine hours) | % of Total Time |
|---|---|---|
| Windrow | 9.3 | 32 |
| Return Swing | 10.5 | 36 |
| Sort and Stack | 9.5 | 32 |
| Total | 29.3 | 100 |

Volume produced : 819 tonnes in 29.3 machine hours. Productivity at 7 machine hours per day = 195 tonnes per day

## DISCUSSION

In the first study in windthrow the machine was briefly tested up to 100 metres but it soon became obvious that loader productivity was low. One of the main reasons for this was that when handling whole trees they were dragged through the swing so less distance was achieved by lack of momentum. The final windrow of wood should be presented parallel to the road.

In the old crop the loader was able to use gravity to its advantage with the large trees. It was often only required to swing the logs enough to give them momentum to travel down the hill themselves. It was during this trial that the loader really showed its potential to supplement the productivity of an operation. By taking advantage of idle time 373 tonnes were produced in seven hours.

More systems development and operator experience would certainly increase the productivity of loader logging in log length trees.

## CONCLUSIONS

To consider using a machine for loader logging, it must be of suitable size and have adequate guarding. Both track gear and track motor life will be reduced because of the harsh operating conditions experienced while loader logging.

Swing distance is a factor that must be considered. As with all logging systems, the shorter the better, but loaders are particularly vulnerable to long swing distance. In the old crop logging trial, due to the large tree size and ground slope, the machine was able to swing 100 metres and still maintain good productivity. In the small trees in Wainui Forest, 50 metres swing distance was considered the maximum for optimum productivity. However, in the log length trial the loader performed well. The operator had no experience on the machine but was able to produce 195 tonnes per day.

With further method development of log length loader logging, volumes higher than those produced could be expected.

Future applications for loader logging in New Zealand are seen to be in existing operations where these machines are used as loaders. By spending between $4000 to $5000 on extra guarding these machines could supplement production by logging roadsides, bunching for the extraction machine or operating on sensitive sites.

In the hauler operation where the loader would have been idle while waiting for line shifts, it used the time to extract wood. This utilisation maximises the potential of these machines.

In ground based operations the loader could supplement productivity when the primary machine is engaged on long hauls tracking or being repaired.

## REFERENCES

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*The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook. They are only an indicative estimate and do not necessarily represent the actual costs for this operation.*

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