LOGGING INDUSTRY RESEARCH ASSOCIATION

ORGANISED FELLING

ITS EFFECT ON SKIDDER PRODUCTIVITY IN 13 YEAR OLD RADIATA THINNING

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INTRODUCTION

An earlier LIRA Report (Gaskin, 1983) described the organised felling concept in thinning Radiata pine. Organised felling involves a disciplined approach to felling to improve extraction. The reasons for developing the system were :

- increasing the drag sizes, thereby increasing the utilisation of the available machine capacity.
- a reduction in hooking and unhooking time.
- faster travel times
- improved recovery of available stem volume.
- decreased stand damage through improved alignment of stems, an improved standard of delimbing, and using slash to protect the base of vulnerable stems.

A trial was undertaken in 13 year old Radiata thinning in Kaingaroa Forest to quantify the improvements. This Report discusses the results of that trial.

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THE TRIAL

The northern end of Compartment 260 in Kaingaroa Forest was used for the trial. The stand prescription is shown below :

Table 1 - Stand prescription

		Before Thinning	Thinning Yield	Residual
Stocking	(sph)	539	302	236
Total stem volume	(m^3/ha)	196	98	97
Mean merchantable volume	(m^3/stem)		0.3	
Average merchantable length	(m)		10.9	
Merchantable volume	(m^3/ha)		83.5	

The trial was divided into four areas of 200 m x 50 m (1 hectare). All areas were of flat topography with windrows running east-west (right angles to the extraction direction) in areas 3 and 4 and north-south (parallel to the extraction direction) in areas 1 and 2. Areas 1 and 2 were felled for butt extraction, while areas 3 and 4 were felled for head extraction.

Areas 2 and 4 were felled conventionally by two fallers from King's gang. Conventional felling consisted of falling the trees roughly in line for extraction, then trimming the branches off the top and sides of the stem. Of the branches beneath the stem, only those easily located were trimmed. For both fallers, a study was conducted on cycle time per tree and length of stem trimmed.

Areas 1 and 3 were felled using the organised felling approach by three LIRA researchers. Organised felling consisted of directionally felling the trees, aligning them for best possible extraction, trimming the stem as close to 100% as was physically possible, and removing the slash from the section of the stem to be attached. Slash removed was, wherever possible, placed around residual crop trees to protect them during extraction. Cycle times and length of stem trimmed were again recorded.

To test the effect of organised felling versus conventional felling, a full day's machine extraction from each area was carried out. The machine used, an Iwafuji T30 (Liley, 1985 in prep.), was equipped with a double-drum winch with four strops per winch rope. All elements within the skidder cycle, and the distance travelled for each drag, were recorded. All drags were scaled at the landing, noting large end diameters, length, and small end diameter. The number of branches still attached to each extracted stem was also recorded.

A Bell Logger was used at the landing to fleet extracted wood.

RESULTS

Felling

For both techniques of felling, the total cycle consisted of the elements listed in Table 2. The dimensions for each stem delimbed were also recorded. Table 2 compares the results of the studies with times recorded in minutes.

Table 2 - Faller cycle times

Element	Average cycle time, min. (Number of observations in brackets) Conventional felling		Organised felling	
Walk and assess	0.26	(69)	0.34	(80)
Clear butt	0.19	(29)	0.32	(16)
Scarf	0.17	(79)	0.27	(80)
Backcut	0.23	(79)	0.36	(80)
Sloven	0.13	(21)	0.12	(72)
Trim	1.55	(79)	2.42	(80)
Clear slash	0.28	(2)	1.27	(69)
Total cycle time *	2.33	(79)	4.60	(80)
Trimmed length (m)	9.73	(79)	13.09	(80)

* Does not include delays or refuelling

The organised felling cycle time was 4.60 minutes, 100% slower than the conventional felling cycle (2.28 min.). However, an examination of the delimbed logs showed the following :

	Conventional felling	*Organised felling*
Average butt diameter, cm	*23*	*23*
Trimmed length, m	*9.7*	*13.1*
s.e.d., cm	*11.9 (200 samples)*	*9.7 (116 samples)*
Merchantable volume, m^3/stem	*0.20*	*0.27*

In the organised felling area, the trees were trimmed down to a nominal 10 cm s.e.d., producing a longer log with greater volume than the conventional felling area, where trees were topped off nearer to 12 cm s.e.d.

Although the cycle times were 100% slower, because there was more volume in the organised felling wood the time per cubic metre was only 50% slower (16.75 min/m^3 organised vs. 11.15 min/m^3 conventional).

Extraction

The sequence in which the four areas were extracted was random (determined by tossing a coin). Full stopwatch study was carried out over the four days. The factors recorded are listed in Table 3. The volume per drag was calculated through scaling at the landing. The results of the study are presented in Table 3.

Table 3 - Skidder extraction cycle time

Element	Average cycle times, min.			
	Butt Pull		Head Pull	
	Conventional	Organised	Conventional	Organised
Travel empty and position	1.76	1.72	2.04	2.00
Hook on [1]	3.96	3.40	3.17	2.60
Breakout	2.03	1.62	1.33	1.34
Travel loaded [2, 3]	1.61	2.30	2.52	2.52
Drop and winch	1.02	0.89	1.47	1.77
Unhook	1.83	1.52	0.92	1.07
Blade	1.81	0.93	0.82	1.45
Total (not including delays)	13.05	11.82	11.29	10.75
Notes :				
1. Pieces hooked on	6.2	6.8	4.8	6.0
2. Average haul distance	71	91	122	98
3. Drag volume, m^3	1.52	2.20	1.47	1.44
4. Number of cycles	31	36	36	38

In both butt and head pull areas, hook on time was less in organised felling wood, even though more pieces were hooked on in each case. Unhooking was faster from organised felling wood in the butt pull area, but slower in the head pull area.

The lack of difference in drag size between areas 3 and 4 indicates that under head pull conditions, a 1.5 m^3 drag was the machine's capacity. There was significant difference in drag size between the two butt extracted areas. This can be attributed to the difference in extracted piece size, through improved recovery of available volume due to the organised felling.

At the completion of the four days extraction, the areas were assessed for bark damage. Bark damage to residual stand :

	Trees damaged (per hectare)	%	*Average size* cm^2	*Average height (cm)*
Conventional	*15*	*6*	*768*	*51*
Organised	*12*	*5*	*518*	*39*

The incidence of bark damage in the organised felling area was similar to that in the conventional felling area. This was higher than expected and higher than had been experienced in previous similar work. This was possibly due to the operator having had limited experience on this skidder. The severity of bark damage was much lower in the organised felling area. This was in spite of the fact that more pieces were extracted in each drag from the organised felling areas.

COSTS

In Table 4, the cycle times and average haul volumes have been used to estimate expected daily production.

The costs of operating the required men and equipment are also estimated,using the LIRA Costing Handbook approach (Wells, 1981). Features of the costing :

- an extra faller has been added to the gang for the organised felling.
- 20% of the daily cost of a Bell Logger and operator is included. This is based on the situation of the trial, and would reflect a full time operation where a Bell was used for other duties, e.g. some extraction, bunching for another skidder, or loading out.

Although the average haul distances vary within the conventional felling operation between head and butt pull, the combined average haul distances are very similar.

Table 4 - Production and cost estimates

	Conventional felling			Organised felling		
	Butt	Head	Combined	Butt	Head	Combined
Haul distance, m	71	122	97	91	98	95
Haul volume, m^3	1.52	1.47	1.5	2.2	1.4	1.8
Cycle time, min.	13.05	11.29	12.2	11.82	10.75	11.3
Add 10% to cycle times to allow for minor operational delays, i.e. cycle time, min	14.4	12.4	13.4	13.0	11.8	12.4
Productivity, m^3 per 7 PMH day	44	50	47	71	50	61
Costs :						
Fallers and saws		220 (2 men)			330 (3 men)	
Machine operator		95			95	
Iwafuji skidder		150			150	
Bell (20% of $125 + $95 = $220/day)		44			44	
Incidentals, transport		120			120	
		629			739	
Unit cost, $/$m^3$	14.30	12.60	13.40	10.40	14.80	12.10

The resulting estimated unit costs show that :

- in butt pull, organised felling resulted in a 27% reduction in logging cost.
- in head pull, organised felling resulted in a 17% increase in logging cost. This was due to the machine being limited to a 1.5 tonne drag while head pulling.
- the combined results of both butt and head pull showed a 10% reduction in logging cost from organised felling.

CONCLUSION

The trial showed that, by using an organised felling method :

- the extra time and effort involved in felling and preparation was more than offset by the improved skidder productivity. The increase in productivity was due to; quicker hooking on of more pieces, and higher realisation of log volume.
- the incidence of bark damage to residual trees was not reduced, but severity of damage was.
- logs extracted to the landing required no further trimming or cleanup.

Ref. Gaskin, J.E. "Organised Felling for Thinning Radiata Pine, LIRA Report, Vol. 8 No. 12 1983

Ref. Wells, G.C. "Costing Handbook for Logging Contractors", LIRA, 1981.

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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