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PREBUNCHING IN THINNINGS

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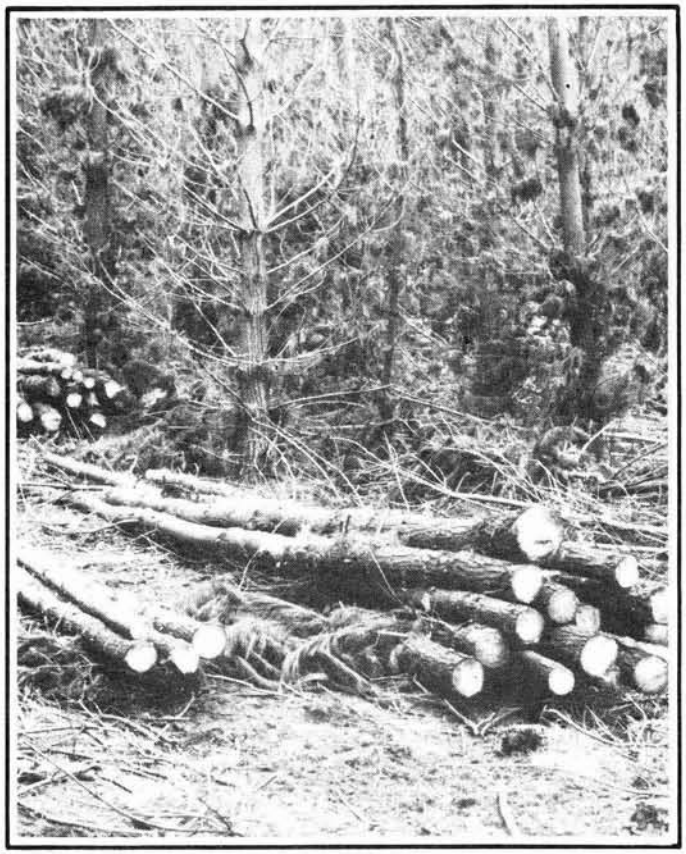

Fig. 1 - Prebunched logs ready for extraction.

INTRODUCTION

One of the major constraints on a thinning operation, caused by small tree size, is the problem of load accumulation. Numerous stems must be handled to build an economic payload. The extraction unit is under utilised if it extracts less than optimum payloads. One approach to load accumulation is to prebunch stems prior to extraction. In this manner, stems are bunched and handled as a unit rather than as individual pieces. Efficient prebunching can lead to significant gains in the overall production of the thinning operation.

The problem is to find a means of economically prebunching the stems prior to extraction. Several options exist including manual labour, animal power, cable winches or mobile grapple machines. The Bell Logger, a three wheeled hydrostatically driven grapple unit has proved capable of bunching small trees, but there is little published data on its prebunching productivity. This report documents a trial in thinnings using this machine. It discusses prebunching productivity and its effect on the productivity and cost of the entire operation.

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THE TRIAL

The trial was conducted on easy terrain (slopes under 25%) in a stand of 12 year old radiata pine at Tarawera Forest. The stand had been thinned at age 9 from 1400 sph down to 950 sph using a one in three outrow pattern. The trial was a second thinning operation, in which the remaining two rows were selection thinned, to reduce stocking levels from 950 sph down to 425 sph yielding approximately 70 cubic metres per hectare. All final crop trees were marked. Average tree size harvested was approximately .16 m^3.

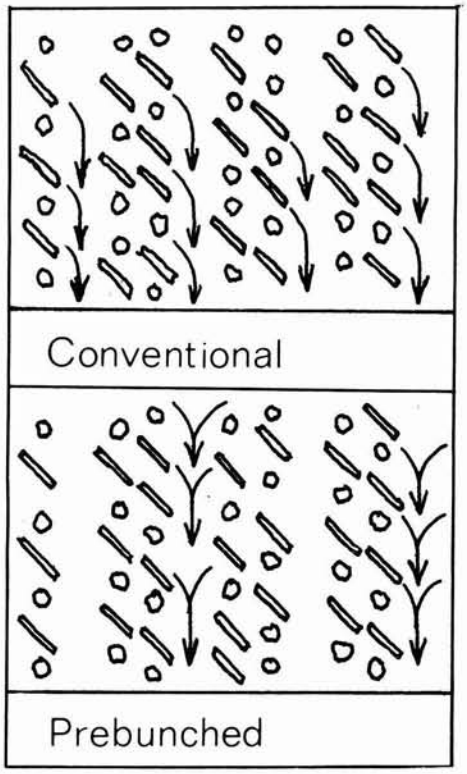


Fig. 2 - Extraction work patterns

The conventional thinning system used a four man gang and a 52 kw skidder. Trees were felled for butt pull extraction, delimbed and processed to either shorts (3.6 - 5.4 m) or longs (7.9 - 11.2 m). Trees were harvested from the two rows on one side of an outrow and each outrow was used as an extraction path for the skidder (see Fig. 2). The skidder (carrying ten strops) then extracted logs to the landing keeping the two log lengths separate.

In the prebunching trials, seven fallers were used to prepare wood which was felled with the lean for butt extraction. (To facilitate this study and comparison, it was decided to retain the conventional falling system). The two rows either side of an extraction row were prepared. Once a sizeable area had been felled, the Bell Logger began to prebunch. Every second outrow became a bunching and extraction row as the Bell acquired wood from either side of the row. A bench of slash and tops was built to support the log ends for later hooking on. Next, long logs were bunched and then the short logs, resulting in two separate bunches at each site. If no short logs were present, two bunches of longs were made. There were an average of twenty stems at each bunch site (range 10-30).

A 52 kw skidder, fitted with three 4.5 m strops and one short 2.0 m strop, was used to extract the prebunched stems. Each bunch was hooked on with a single strop. The skidder travelled down the extraction track hooking on bundles until a full load was accumulated. Having had the logs sorted into longs and shorts prior to extraction, the bunches were then dropped alongside the appropriate stockpile on the landing.

RESULTS

Felling

Working a 6.5 hour productive day, the fallers were capable of felling and delimbing an average of 12.5 m^3each. Production levels were similar for both conventional and the prebunching systems.

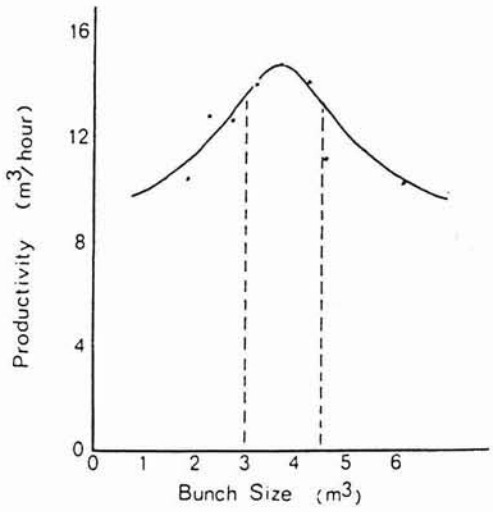
Prebunching

The Bell Logger bunched an average of 13.7 long stems (.20 m^3/stem) and 6.6 short stems (.09 m^3/stem), with an average volume of 3.3 m^3 per bunching cycle. The average Bell prebunching cycle time over 54 bunches is shown below (figures are in observed minutes).

Element	Time	Percentage of Cycle
Build bench	2.48	16 %
Travel empty	2.87	19 %
Acquire stems *	4.56	29 %
Travel loaded to bunch	2.83	18 %
Reposition stems on bunch	1.29	8 %
Clear slash	.71	5 %
Delays	.72	5 %
Total cycle time	15.46 minutes	

* The acquire element occurred an average of 8.9 times per bunch with 2.3 stems per acquire.

Productivity was 13 m3 per productive hour. Given a 6.5 hour day, 85 m3 was bunched. Data analysis showed a relationship between productivity and bunch size. The graph gives an indication that the optimum bunch size for this stand was between 3.0 and 4.5 m3.



Extraction

Extracting prebunched stems resulted in a reduction in cycle time and an increase in payload when compared to the conventional system. This resulted in a major increase in productivity. The average skidder cycle time observed for the prebunched system and the conventional skidder standard (Tasman Work Study) for this stand type are shown below (figures in observed minutes).

	Prebunched		Conventional	
Element	Time	% of Cycle	Time	% of Cycle
Travel empty	1.54	10	1.46	9
Position	.37	3	.65	4
Hook on	4.01	27	5.55	35
Break out	.50	3	1.37	9
Travel loaded	2.91 *	20	1.90 *	12
Unhook on skids	1.27	5	2.06	13
Travel skids	.52	3	.43	3
Fleeting	2.88	19	1.51	9
Delay	1.00	7	1.00	6
Total cycle time	15.00 min		15.93 min	
Volume per cycle	3.5 m3		1.5 m3	
No. of shorts (.09 m3)	7.0		3.0	
No. of longs (.20 m3)	14.5		6.0	

* Average haul distance was 195 m

The productivity was 14 m3 per productive machine hour or 91 m3 per 6.5 hour day for the prebunched system. Productivity of the conventional system would be 5.5 m3 per productive hour or 36 m3 per 6.5 hour day.

COST

The daily cost of each operation was estimated using the LIRA Costing Handbook and is shown on the next page. Assuming that the fallers can keep up, the Bell limits productivity of the prebunching system at 85 m3 per day and the skidder controls the conventional system productivity at 36 m3 per day.

Prebunching System		Conventional System	
	$		$
Skidder	195	Skidder	195
Bell Logger	110	4 men @ $90	360
9 men @ $90	810	3 chainsaws @ $13	39
7 chainsaws @ $13	91	1 transport @ $45	45
2 transport @ $45	90		
Total daily cost	$ 1,296		$ 639
Daily production	85 m3		36 m3
Cost per cubic metre	$ 15.25		$ 17.75

DISCUSSION

The prebunching of stems for extraction increased the productivity of the thinning operation from 36 m3 to 85 m3 per day, and resulted in a cost reduction of $2.50/m3.

Some problems are evident in using the system. The fallers need to be well organised and should completely prepare an area prior to the Bell moving in. This separation of the felling and prebunching operations is necessary and requires good faller supervision.

The operator of the Bell must be organised and maintain a high level of concentration during the operation. The Bell, which was fitted with tyre chains (studded type), was able to climb 25% slopes but productivity was reduced once slopes exceeded 15%.

There was an increase in butt damage on residual trees over the conventional system, occurring during break out on the downhill side trees. With improved bunch position and care during break out, the damage should be reduced to acceptable levels.

CONCLUSIONS

Prebunching was successful at increasing productivity and reducing harvesting costs in this thinning operation. A high level of supervision is required to ensure that all phases of the operation work together smoothly. While all the results from this trial cannot be directly transferred to operations in different areas without further trial work, some of the principles are worth noting :

- through organisation and preparation, each phase should serve to facilitate the following phase of the operation.
- the Bell when prebunching should be restricted to shifting wood over short distances and not act as a pre-extraction unit.
- interference between the fallers, the prebunching machine and skidder must be minimised. Consequently, the operation is best done out of phase.
- productive capacity of all phases must be matched in order to maintain enough wood on the ground ahead of the prebunching unit and skidder.
- bunching productivity is relatively constant in a given stand whereas skidder productivity varies with haul distance.
- bunch size should be of a manageable number of stems for hooking on and matched to the skidder capacity. Emphasis should be on appropriate bunch size or volume rather than number of stems.
- the prebunching operation requires a high level of skill and concentration. Good motor skills alone are not enough to make a good operator.

If any operators or companies are interested in setting up a similar system on a permanent basis, LIRA would be very interested in co-operating on a longer term monitoring of system productivity and cost.

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