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THE WARATAH 240 HTH - DEBARKING AND LOG-MAKING TREE-LENGTH EUCALYPTUS REGNANS

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Figure 1 - Waratah 240 debarking and processing Eucalypt

ABSTRACT

Two Waratah 240 HTH processors were evaluated debarking and log-making Eucalypt stems in Pouakani North, Kinleith Forest. Both operations were located in the same stand and studies were undertaken within one week of each other in order to minimise topography, piece size and seasonal variations.

Mechanical availability was the same for both processors at 92%, but machine utilisation was 71% and 78% respectively, mainly due to operational delays specific to the different overall logging systems employed.

Productivity for both processors was 31 tree-lengths (25m³) per productive machine hour under the study conditions. Total processing time per tree-length was found to be independent of extracted piece size. Variation was attributed to the comparative levels of bark remaining on extracted stems, and relative difficulty of bark removal.

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INTRODUCTION

The Eucalypt resource in and around Kinleith Forest is approximately 7,500 hectares which, based on a merchantable volume of 600m³ per hectare, will generate an available harvest of 200,000m³ per annum for the next 20 years. Establishment of Eucalypt was discontinued in 1993.

The logging of Eucalypts in Kinleith Forest began in 1991, with production destined for the chipwood market in Japan. The processing of chipwood requires the delivery of debarked logs to the chipping site. Due to the tendency of Eucalypt bark to stick to the cambial layer if left for even relatively short periods, it was decided to undertake the debarking operation "in bush".

Previous trials of debarking of Eucalypt logs have centered on manual debarking or using skidder tyres fitted with chains and, for a short period, the use of New Zealand manufactured Crab Grabs. A comparatively recent introduction to Kinleith's Eucalypt harvesting programme has been the Waratah Hydraulic Tree Harvester Model 240 HTH (Waratah 240).

Two Waratah 240s are currently working successfully in Eucalypt clearfelling operations within Kinleith Forest. This report describes their work methods and details productivity and factors that affect production.

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MACHINE DESCRIPTION

The Waratah 240 harvesting head, manufactured by Waratah Engineering Limited in Tokoroa, is capable of processing logs up to 55cm diameter. Driven by four hydraulic rollers with special "breaker bars" for bark removal, it is capable of feed speeds up to 3.5 m/sec. With an operating weight of 1.45 tonnes, it can be fitted to most excavators of 18 to 22 tonne. Both Waratah 240s were mounted on Cat EL240 bases (Figure 1).

Both operators were experienced, with at least six months in Eucalypt clearfelling. Prior to the study, they maintained a consistent performance record, indicating they were through the initial learning curve.

SITE DESCRIPTION

Pre-harvest inventory data (October 1992), for the 21 year old *Eucalyptus regnans* stand estimated stocking at 787 stems per hectare with a recoverable volume of 532 m³/ha underbark. Mean top height was estimated at 38m with a mean diameter at breast height (DBH) of 27cm. The terrain was flat to rolling. The study was undertaken during June, 1994.

Both operations were located in the same stand and the studies occurred within one week of each other. Topography and piece size were similar.

Weather conditions varied during the study period but were considered unlikely to have had a significant effect on processing time, as the system was mechanised.

HARVESTING SYSTEMS

The two Waratah 240s studied worked in quite different logging systems.

System 1:

Two fallers working separate faces felled, trimmed off major limbs, cut crutches and heads off the trees. Most slovens were removed at the stump. A Valmet F65 cable skidder extracted from one face and deposited the tree-lengths at a transfer point on the cutover about 100m from the landing. A John Deere 648E grapple skidder extracted loads alternately from the second face and the transfer point. Tree-lengths were deposited by the edge of the landing.

The Waratah 240 then processed these from right to left on to a loadout stack. Three log sorts were produced: shorts of 1.6m to 7.0m and longs of 7.0m to 15.0m with diameters between 10cm and 50cm, (not separated), plus oversize in 3m to 6m lengths where diameter at any point on the log exceeded 50cm. The operation was running on a "just in time" principle, whereby stems in front of the processor were not allowed to accumulate, and generally averaged less than 20 stems. Slash was periodically removed by the grapple skidder.

Debarked logs are normally cold decked as the freshly debarked logs are slippery and difficult to handle so, for safety reasons, it is preferable for them to be left a week or so to dry out on the skid before loadout.

System 2:

Felling, log types and loadout were the same as described for System 1. A Valmet F65 cable skidder and a Cat D4H TSK tractor extracted tree-lengths from either felling face to the edge of the landing. This combination enabled some steeper ground to be worked, but with no grapple machine there was no convenient way of removing slash accumulating around the processor. A surge pile representing approximately half to one day's processing was maintained in front of the processor.

The Waratah 240 operated from a base of built up slash, and processed stems from right to left on to a loadout stack based on the ground almost two metres below the height of the processor. For improved visibility, the operator preferred to position the processor adjacent to the butts in the surge pile, and work his way back through the stack from left to right (viewed from the butt).

STUDY METHOD

Both Waratah 240s were studied for two days using continuous timing. The productive work cycle was split into defined elements and supporting data including the number of logs cut per tree and tree volume were collected. Tree volume processed was estimated using an Ellis 3D formula (1982) derived from trees scaled at the transfer point and surge pile. Detailed sectional measurement of 30 Eucalypt logs, estimating volume via Smalian's formula, allowed a correction factor to be determined and applied to initial volume calculation with Ellis 3D. Three volume classes (<0.75m^3, 0.75m^3 - 1.60m^3, >1.60m^3), were used in regression analysis. All delay times were specified and recorded.

RESULTS AND DISCUSSION

The results indicated that the productive cycle time for the Waratah 240s in both systems are not significantly different once allowance was made for the fact that one machine had a number of log slovens to remove. Tree size handled was also very similar between systems. As a result, all productive cycle data was pooled for analysis. However, non-productive time varied a great deal between the two operating systems, specifically operational delays. Overall study details and merchantable stem data are shown in Tables 1 and 2.

Table 1 - Basic study details

	System 1	System 2
Study Time (hours)	17.89	17.69
Productive Time (hours)	12.70	13.73
Mechanical Availability	92%	92%
Machine Utilisation	71%	78%
No. of Stems Processed	399	414

Table 2: Stem data summary (pooled data)

No. of Stems Processed	813
Average Volume *	0.82 m^3 (±0.51 m^3)
Stem Volume Range	0.08 m^3 - 3.61 m^3
Total Production	663 m^3
Average Length	23.8 m
Average Butt Diameter	28.5 cm
Average Logs Cut Per Stem	2.25

* Standard Deviation in brackets.

Approximately two-thirds of the productive cycle time was spent removing the bark from the stem. The remaining time was mainly spent picking up the tree length to process it, cutting up, and stacking and sorting the logs. Regression analysis indicated that total processing time (delay free) was independent of extracted piece size. The wide variation in processing time per stem was attributed to the comparative levels of bark remaining on extracted stems, and difficulty of bark removal. Productivity details are shown in Table 3.

The frequency of mechanical delays and overall mechanical availability was similar for both Waratah 240s. (It should be noted, however, that short studies are not reliable indicators of a machine's long term mechanical availability).

Table 3 - Productivity details

Average Productive Cycle Time	1.95 minutes
Tree-lengths Processed / PMH*	30.8
Productivity / PMH*	25.2 m^3
Daily Production (6.0 PMH's)*	151 m^3

* Estimates based on a Productive Machine Hour.

Personal delays including "smoko breaks", were similar between systems, accounting for close to 10% of the total study time.

The difference in operational delays recorded for the two Waratah 240s (System 1 = 124 minutes, System 2 = 52 minutes), was the single most important factor causing production differences. A breakdown of the operational delays recorded is shown in Table 4.

Table 4 - Operational delay breakdown

Element	System 1 (mins)	System 2 (mins)
Clear Slash	39.4	15.0
Manual Debark	16.0	1.7
Wait for Tree-lengths	7.8	0
Interference	36.6	5.6
Travel on Skid	13.8	18.7
Other	10.8	10.6
TOTAL	124.4	51.6

The ability of the grapple skidder (System 1), to remove slash from around the Waratah 240 regularly and effectively meant more time was jointly spent on this activity. The operational benefit of this was that the Waratah 240 had closer access to the loadout stack, and could build tidy log stacks more efficiently. Conversely, the Waratah in System 2, being forced to work on a built-up slash pile, was not able to work as close to the loadout stack. Being above, and away from the log pile reduced its ability to stack the logs. This necessitated one instance of moving around the log stack on the skid to tidy up pieces that had slid off the front of the stack.

The most effective way to remove limited amounts of stubborn bark is for the operator to dismount and remove it manually. The Waratah 240 operator in System 2 was more reluctant to do this.

The "just in time" supply of tree-lengths evaluated in System 1, had the inherent risk of the Waratah 240 running out of wood. There was little margin observed for unscheduled delays to the supply of stems to the processor. By operating with no buffer, the grapple skidder caused substantially more interference to the Waratah 240. However, this method did allow the Waratah 240 to remain more stationary, improving its ability to form high log loadout stacks.

The fallers working in System 2 did not remove all slovens, although they had sufficient capacity to do it. This passed on work to the processor, which although it could make the sawcut faster and with less effort, still took unnecessary time, with less ability to minimise waste.

Both operators appeared to be working at an acceptable level. The operator working System 2 seemed to alter his work approach more often, in that a new stem was sometimes started before returning to complete a more difficult piece or section. This had little effect on overall efficiency.

CONCLUSIONS

The productivity of the Waratah 240 in either system described was similar, debarking and log-making an estimated 31 tree-lengths (25m³) each productive machine hour, under the study conditions.

Variation in daily production, mainly due to operational delays linked to the overall logging system, suggest features which could be adopted for an efficient operation. The following are recommended "best practices" that could be encouraged:

- all slovens should be removed at the stump by the fallers
- ensure at least one half day's wood is kept ahead of the processor. This ensures that interference with the extraction machine is minimised, and the processor is never idle waiting for wood. However, remember that freshness of wood is essential for ease of debarking
- on easy country, a grapple skidder allows for a more flexible, efficient extraction operation. Its ability to remove slash gives operational benefits to the processor, by allowing closer access to the loadout stack.

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