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DISMANTLING OF ACCUMULATIONS OF LOGGING RESIDUE AROUND HAULER LANDINGS

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Figure 1 - Example of a typical bird's nest at a hauler landing

ABSTRACT

Accumulations of woody debris (bird's nests) created during hauler logging on steep slopes can become an environmental hazard and spread over valuable plantable land. A study of a 20 tonne excavator fitted with a rake dismantling these "birds' nests" revealed that the machine was capable of retrieving a substantial proportion of the debris and placing it back on the landing; on average 62% of the total bulk volume in the bird's nest, and clearing 55% of the area covered by them.

The excavator's production rate averaged 18 metres of landing circumference treated per productive machine hour.

INTRODUCTION

In hauler logging operations in several regions of New Zealand unmerchantable material arising from logging operations

are accumulated at the landings in sufficient volume to cause environmental and operational problems. This material consists of branches, heads, slovens and short lengths of waste stem wood. The material is produced gradually during processing of trees into logs. It is then swept over the edge of the landing in small lots during the course of the operation. Over the period of logging a setting, the pile of waste material can build up until it is several metres high and wide, around much of the circumference of a landing (Figure 1).

The make up of the heaps can differ depending on whether delimbing on the landing is done manually or with a mechanical delimber. Where delimbing is done by hand, the branch material is swept off the landing by a rubber-tyred loader with a blade which results in considerable amounts of soil being pushed into the heaps as well as the waste wood. Where delimbing is done mechanically, the branch material is picked up in bunches and placed in the heaps reducing the volume of soil from the landing ending up in the bird's nest.

After logging is completed and a period of decomposition, these heaps can collapse. Typically the collapse will occur during a period of heavy rain, particularly if good post-harvest water run off maintenance is not carried out. These slips can cause damage to crops, reduce planted area, and deposit sediment in streams (Figure 2). As the cost of a collapse can be considerable, some attempts are being made to return the logging residue to the landing surface where it can not slide away. This is achieved by using a hydraulic excavator to drag the debris back on to the landing.

The excavator in this study was a 20 tonne machine fitted with a 2 metre wide rake instead of a bucket. This machine was the subject of a production study with the aim of determining the cost of dismantling birds' nests with this method.

Figure 2 - A section of a bird's nest which has collapsed

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METHODS

Figure 3 - Excavator working on a large bird's nest

The work method of the machine was to walk out on to the bird's nest as far as possible and then reach out and down to retrieve a rakeful of material. This was then lifted, swung sideways and deposited on the formed surface of the landing (Figure 3). When a large heap was created

on the landing it was then spread out by the excavator into a layer of approximately 0.7 - 1.0 m thick.

This machine did not have sufficient reach to be able to retrieve all the material in the birds' nests, but it could substantially reduce them (Figure 4).

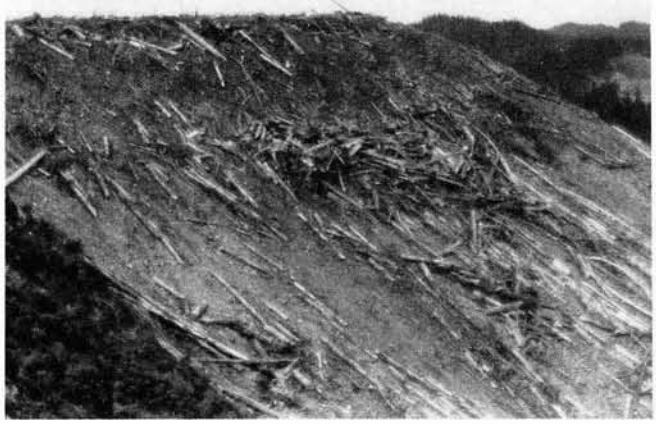

Figure 4 - Remains of a bird's nest after treatment by the excavator

A production study of this machine recorded total time spent on each landing and activity sampling broke time down into the following elements; productive time, travel (landing to landing), breakdowns, repair and maintenance, operational delays and personal time.

The landings were surveyed for area, and the heaps of residue were also surveyed. After treatment by the machine, the areas from which residue had been removed and the bulk volume of the heaps of residue placed on the landing were measured.

Measurement of the volume of solid wood in the birds' nests was not possible due to the very high number of small pieces and the highly unstable nature of the heaps.

RESULTS

The proportion of the area under the bird's nests that was cleared averaged 55%. The proportion of the total bulk volume (TBV) of the heap retrieved averaged 62%.

The length of bird's nest that needs to be retrieved is the simplest predictor for the likely time and cost of treating a landing. On average, the excavator could complete 18 metres of landing edge per productive machine hour (PMH). The cost per landing in this case was $630 at 6.6 PMH.

Whilst the total cost may look high, if it is costed on a per cubic metre logged through the landing, the cost was $0.08 (8 cents) per cubic metre.

The activity sampling study revealed that 70% of the excavator's time was spent on gathering and dumping the residue. It also showed that 9% of the time was spent either broken down or being repaired. Eight percent of the time was spent spreading the residue evenly over the landing. This element is not necessary and could be eliminated to give a gain in production.

The excavator could reach out and down 7.3m from the end of the machine track on a slope of 35°. However, the cleared strip tends to be wider than this as the operator can push material away that he cannot drag up. The machine can also walk out on to the slash, rather than work from the edge of the formed landing.

DISCUSSION

This operation was very hard on the machine. Breaking out a rakeful of material was often difficult as it was matted together and the relief valves were opening frequently. The use of a larger machine, say a 30 tonne machine would reduce this problem.

Table 1 - Summary of data collected from the four landings treated

	Landing 1	Landing 2	Landing 3	Landing 4	Mean
Landing surface area.	0.67	0.88	0.41	0.51	0.62
Setting size (ha).	15.8	18.9	17.0	23.3	18.7
Volume (m^3) thru landing.	5640	6747	6069	8318	6694
Area under birds nest. (ha)	0.10	0.26	0.24	0.22	0.2
Area treated,ha, (% of area under B' nest).	0.08 (80)	0.18 (69)	0.07 (29)	.01 (45)	0.1 (55)
Area Untreated, ha, (%)	0.02 (20)	0.08 (31)	0.17 (70)	0.12 (55)	0.1 (45)
Landing Circumference.	362 m	410 m	250 m	330 m	340 m
Length of landing edge treated. (m).	70 m	150 m	100 m	160 m	120 m
Time to treat landing (PMH).	3.75	6.7	8.07	7.9	6.6
Length of landing edge (m) treated (PMH).	18.7	22.4	12.4	20.2	18.4
Bulk volume retrieved m^3 (% of TBV)	350 (67)	1125 (65)	710 (39)	1280 (77)	870 (62)
Cost per landing, $	356	363	766	750	630
Cost per m^3 logged,($).	0.06	0.05	0.13	0.09	0.08
Estimate of bulk volume unretrieved. m^3 (% of TBV)	170 (33)	610 (35)	1100 (61)	380 (23)	570 (38)

Note : Costs based on $95/PMH, derived using LIRO costing format. (Wells, 1981)

The rake was constantly being pushed into a tangled mess of wood, with the result that hoses and fittings got damaged. This was the reason for the higher than usual amount of time spent broken down.

The residue was made up of a vast number of small pieces, as the rakeful of material was swung up and around, some of it invariably fell off. This was particularly so with the short (0.5 - 2.0m) sections of stem wood.

A hydraulic "thumb" opposite the rake would have stopped a lot of this and could have boosted production significantly (Figure 5).

Despite not being able to reach right to the bottom of the heap, this excavator could recover on average over half the bulk volume of the material in the bird's nest.

Figure 5 - Excavator boom/bucket with a hydraulic "thumb" for grappling logs

This will reduce the weight of the heap. It is reasoned that by reducing the weight of the bird's nest, the likelihood of failure will be reduced.

A lot of soil and gravel is also mixed in with the wood in these heaps as a result of the "sweeping" of the debris from the landing with rubber-tyred front-end loaders fitted with temporary blades. This material does not add to the volume of the heap as it takes up spaces between the pieces of wood.

It may be possible to reduce the amount of soil pushed into the heaps by using logs as blades in preference to the steel ones commonly used, as log blades tend to ride over the surface rather than digging in.

The most difficult material to retrieve and at greatest risk of slipping is that which is pushed over on to the steepest slopes. Unfortunately, the steeper slopes are the easiest place for the loader drivers to push the most residue. If the residue were placed only on the more moderate sloped sections round the landing, slipping would be less likely.

The presence of water and/or heavy rain is reported to be a contributing factor to many of the slumps that have occurred in the past. Cutoffs and drains to prevent build ups of water would also reduce the number and size of slumps (Coker et al, 1990).

RECOMMENDATIONS

If retrieval of birds' nests is necessary, a hydraulic excavator, (20 tonne +), fitted with a rake is an appropriate machine to use.

The fitting of a hydraulic thumb opposite the rake would improve production.

Use a rake designed specifically for the job. The one in the study was designed for site preparation work and the tines had only a moderate curve. Recently another machine dismantling birds' nests was observed for a short time. It was fitted with a rake that had tines with a hooked design. It appeared to be better able to hold on to its accumulated load.

In order to reduce the incidence of slumping and the number of sites where retrieval is necessary, the following options should be considered:

- do not push residue over the steeper slopes around the landing
- use log blades rather than steel ones to reduce the amount of soil in the bird's nests
- control run-off and ponding of water
- place the material in the heap rather than scrape it across the ground, to reduce the amount of soil in the bird's nest

- segregate limbs from stem wood. The stem wood may have value as firewood or short pulp

- bench a track around the skid, at about the level of guy line anchors. This will act as a safety net as the heap will be resting on a flat surface

- use of a hydraulic knuckleboom loader in preference to a rubber-tyred front-end loader would reduce the amount of skid sweeping required

Many of these options have not been assessed and will require major changes to the logging system. These would need to be fully evaluated.

REFERENCES

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

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