Use of the aerial drip-torch for fuel reduction burning of slash after partial logging operations

G.R. Wilkinson, R. Chuter, M. Davies, B.S. Plumpton and R. Knox
Forestry Tasmania

Abstract

Top disposal burning of logging slash was undertaken in four coupes that had been harvested under partial logging systems. Two coupes were ignited by conventional hand-held drip-torches and the remaining two coupes were ignited by an aerial drip-torch. Assessments indicated that both methods resulted in similar levels of fuel reduction and seedbed preparation. The aerial drip-torch provides forest managers with a flexible and highly efficient option for completing burning programmes within the limited period that is normally available for safe and effective burning.

Introduction

The aerial drip-torch has been the predominant method for the ignition of logging slash in clearfelled coupes since the first unit was introduced to Tasmania in 1987 (P. Bennett, pers. comm.). Recent modifications to the design have resulted in light-weight units which are reliable, easy to operate and suitable for use with smaller helicopters (Photo 1). These changes have reduced the operational costs and increased the availability and flexibility of aerial drip-torches. As a result, the units are now being evaluated as an alternative to other systems of aerial ignition in fire management activities such as wildfire control and planned fuel reduction burning.

The burning of logging slash is usually undertaken for two reasons: to reduce the risk of damage to the new forest by wildfires, and to create a suitable seedbed for seedling regeneration (Forestry Commission 1993). In partially logged forests, the intensity and extent of slash burns must be planned carefully in order to minimise the risk of damage to the retained trees and valuable advance growth such as seedlings, saplings and poles. Mature eucalypts are generally well able to recover from foliar scorch or burning, although tree growth and wood quality may be significantly reduced in severely damaged trees (Wright and Grose 1970; Edwards and Wilkinson 1995). In contrast, young seedlings and saplings of the ash species are likely to be killed by even low intensity fires (Wilkinson and Jennings 1993). The protection of advance growth from fire damage is an important silvicultural objective on harsh sites where the establishment of new regeneration from seed is unreliable (Forestry Commission 1990, 1991).

Currently, logging slash within partially logged forests is burnt as a 'top disposal' operation which involves the ignition of individual slash heaps using conventional hand-held drip-torches. Burning is carried out under conditions of mild weather and moderate to high soil moisture to ensure that the fires do not spread beyond the areas of heavy slash accumulation. Such techniques allow a high level of control over the location and intensity of fires, and are therefore particularly appropriate for areas likely to have a high risk of wildfires. However, the efficiency of hand ignition depends upon the availability of trained personnel during the period of suitable weather and fuel conditions. In many years, the duration of

Table 1. Description of coupes and weather conditions.

Method of ignition	Coupe	Area (ha)	Forest type	Date of burn	Time of day	Temp. (°C)	Relative humidity (%)	Cloud cover (%)	Wind speed (km/hr)	Soil dryness index
Hand lighting	Snow Hill 66C	100	Dry sclerophyll (*Eucalyptus obliqua, E. delegatensis, E. globulus, E. pulchella* and *E. viminalis*)	9 May	1030	10	76	70	NE 0-5	51
					1130	12	76	80	NE 0-5	
					1230	11	77	80	NE 0-5	
					1500	12	78	90	NE 0-5	
					1545	12	78	90	NE 0-5	
				10 May	1030	12	78	60	W 15	
					1130	13	69	20	W 15	
					1330	14	79	30	W 30	
	Snow Hill 41C	65	Dry sclerophyll (*E. delegatensis, E. obliqua, E. globulus, E. pulchella* and *E. viminalis*)	7 May	1130	12	68	60	SW 0-5	51
					1415	11	88	90	NW 0-5	
					1530	10	100	100	NW 0-5	
				8 May	1230	13	76	90	W 10	
					1330	13	68	90	W 0-5	
					1430	13	77	95	W 0-5	
					1500		77	95	W 0-5	
Aerial drip-torch	Swanport 74B	67	Dry sclerophyll (*E. obliqua, E. amygdalina* and *E. pulchella*)	6 May	1530	14	68	n/a	NE 5	40
	Forestier 1B	126	Intermediate forest (*E. obliqua* and *E. regnans*)	7 May	1200	9.5	95	n/a	SW 10	25
					1330	10.5	88	n/a	calm	
				8 May	1145	12	83	n/a	NW 5	

fuel moisture/weather conditions suitable for burning may be limited to only a few days, and the treatment of a large number of scattered and/or isolated forest areas may be beyond the normal resources of field managers. The proportion of dry forests treated by partial logging systems has increased over the last decade (McCormick and Cunningham 1989) and concerns have been expressed about the lack of slash burning within a high proportion of some forest areas (Robson 1993).

The present study was undertaken to evaluate the suitability of an aerial ignition system for slash burning following partial logging operations in dry forests.

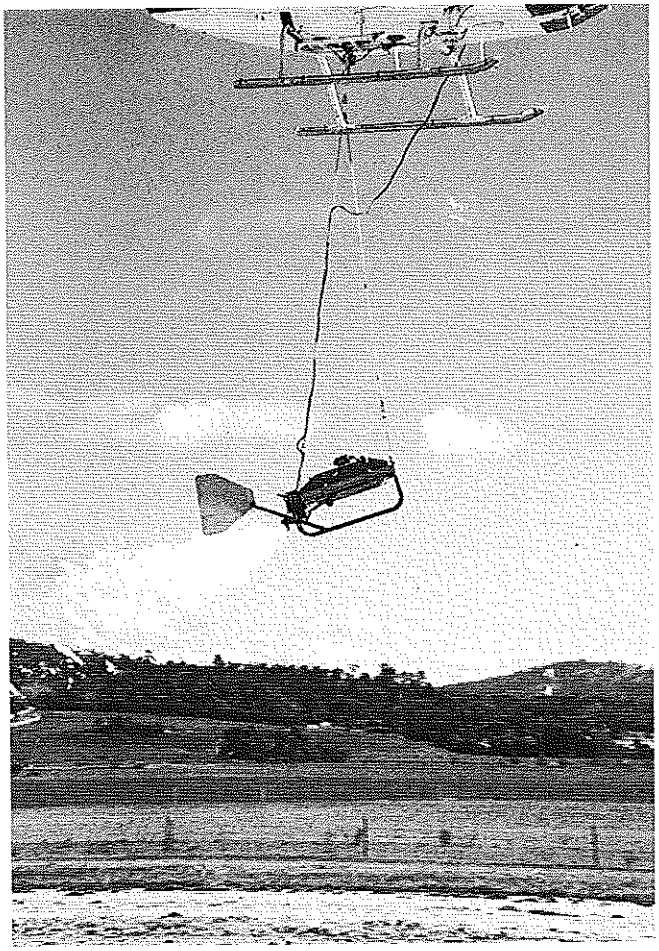


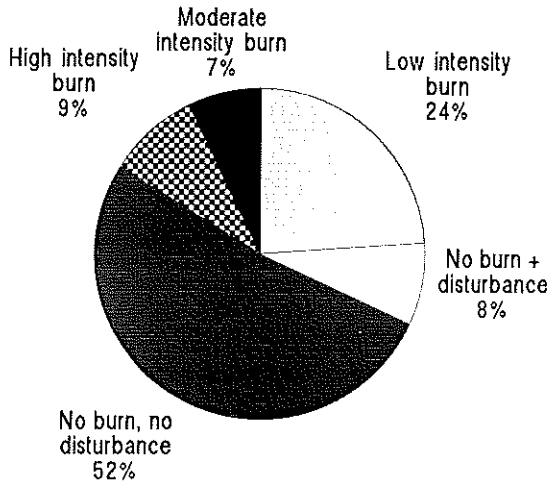
Photo 1. The aerial drip-torch delivering burning gel for aerial ignition operations.

Methods

Operations were undertaken in May 1995 to ignite logging slash in several coupes that had been harvested under various silvicultural retention systems over the previous 12 months. Coupes were ignited either by an aerial drip-torch or by conventional hand-held drip-torches. Assessments of the effectiveness of ignition by the two methods were undertaken one to two months after burning within four coupes. Descriptions of the coupes and weather conditions during the burns are provided in Table 1.

Assessments were undertaken within each coupe by establishing circular plots at intervals of 20 m along transects 100 m apart. Plots were 2 m in diameter and were pegged out with string lines to divide the plot area into four quadrants. Within each quadrant the natural fuel loads (i.e. excluding logging slash) were visually estimated using the standard method of recording percentage cover within each of the following depth classes: ground; ground to knee; knee to hip; and hip to shoulder (Forestry Commission and Tasmania Fire Service 1984). The height of logging slash was assessed visually as a function of the percentage cover, depth and relative density of the material. Quantitative measurements of fuel weight were not taken. The mass of fuel estimated by this method should therefore be regarded as a relative measure which enables comparisons to be made across the assessment area rather than as an accurate measurement of the absolute magnitude of the mass of fuel. Seedbed receptivity within each plot was assessed and assigned to five burn classes (Table 2) using the method of Wilkinson and Jennings (1993). Information on the costs and productivity of each ignition method was collated from operational records.

1.1 Coupes ignited by hand



1.2 Coupes ignited by the aerial drip-torch

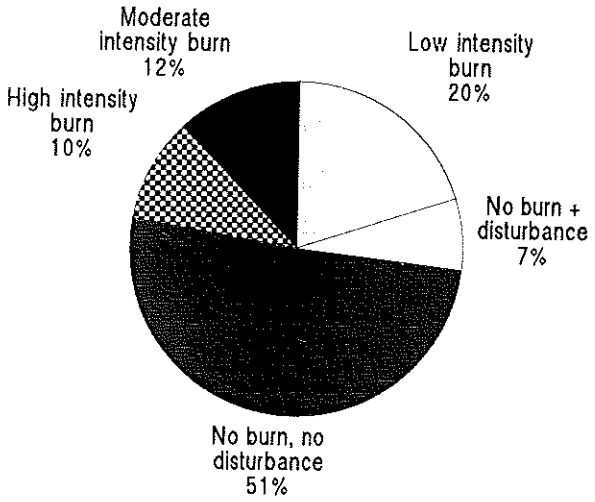


Figure 1. Proportion of ground area covered by various seedbed classes following slash burning in partially logged forests.

Table 2. Comparative fuel loads for areas within various categories of burning following hand or aerial ignition.

Burn category	Comparative fuel loads within each category (mean ± SE (t/ha))	
	Hand ignition	Aerial ignition
control (no logging or burning)	9.0 ± 0.9	10.0 ± 0.5
logging + no burning	81.1 ± 22.5	106.9 ± 32.3
logging + low intensity burning	1.8 ± 0.4	1.3 ± 0.1
logging + moderate intensity burning	0.5 ± 0.1	0
logging + high intensity burning	0	0

Results

Natural fuel loads within the forest areas treated averaged about 9–10 t/ha (Table 2). Logging slash resulting from partial logging operations was not evenly distributed throughout the coupe and the fuels occurred as a mosaic depending upon the intensity of felling and degree of heaping resulting from the harvesting operation. Heaps of unburnt slash contained fuel loads equivalent to about 80–110 t/ha, and slash burning reduced the loads within these heaps to between 0 and 2 t/ha. Overall, slash burning resulted in the reduction of fuels across about 40% of the coupe area (Figure 1). Hand lighting and aerial ignition produced similar results, in terms of the proportions of area burnt and mean fuel loads within various treatment categories (Figure 1, Table 2).

The aerial drip-torch was used over a period of four days to ignite nine coupes with a combined area of 576 ha. Total costs were approximately $40/ha, with an average flying time of about 1.5 hours per coupe (or 40 ha/hr). In contrast, hand lighting cost between $20 and $30/ha and productivity averaged about 12–14 person-days per coupe (or 0.3 ha/person-hour).

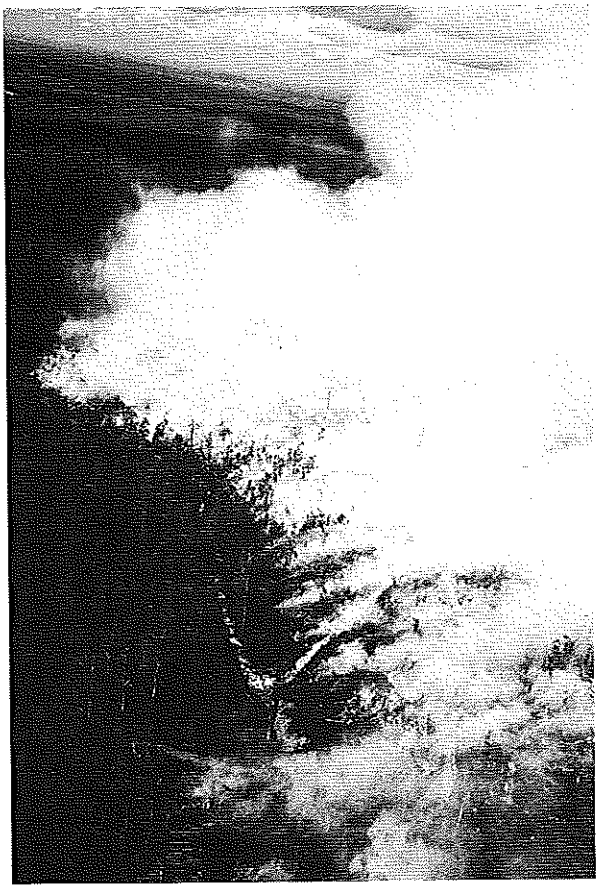


Photo 2. High intensity of ignition points produced by the aerial drip-torch within partially logged forest.

Discussion

Both ignition methods gave similar results in terms of fuel reduction and fire behaviour. Hand ignition allows a high degree of control over the intensity and placement of ignition points within the coupe. In contrast, aerial ignition cannot efficiently target individual heaps of slash and must therefore produce a high intensity of ignition points (Photo 2). Burning should be carried out during the

Photo 3. Reduction of fuels in dry forest after partial logging. The fires have been confined to patches of logging slash, and scorch to the retained trees and advance growth has been minimised.

short days of late autumn under conditions of high humidity, high soil moisture, cool temperatures and low wind speeds in order to ensure that the fires are restricted to the heaps of logging slash and will not burn across normal litter layers (Photo 3). Careful supervision during logging should ensure that such heaps are located away from retained trees, advance growth or other special values.

Costs for aerial ignition are currently higher than for hand ignition. However, with further developments to increase the load capacity and speed of application of the system, it is expected that the operational costs of the aerial drip-torch can be reduced to between $20 to $25/ha. The main advantage of the aerial drip-torch over hand ignition is its capacity to rapidly treat large areas, especially where the coupes may occur in dispersed or isolated locations. The aerial drip-torch can ignite areas at a rate equivalent to 13 fully equipped and trained ground-based personnel. This means that an operational programme of the size reported in the current study (576 ha) could be completed within four days. In contrast, hand lighting would have required 18 days using the personnel currently available to the local forest manager.

Conclusion

Aerial ignition is an effective alternative to the conventional method of ground-based igniting of slash fuels in top-disposal burning operations within partially logged forests. The aerial drip-torch enables the ignition of large or dispersed areas within a short time. This provides forest managers with an effective option for undertaking slash burning operations when either personnel or suitable burning days are limited.

Acknowledgements

The authors thank Tony Blanks and Peter Bennett for their critical review of the draft manuscript.

References

Edwards, L.G. and Wilkinson, G.R. (1995). Recovery of eucalypt regeneration burnt by wildfire. In: *Bushfire '95, Proceedings of the Australian Bushfire Conf*erence, Hobart, Tasmania, 27–29 September 1995. Forestry Tasmania, Parks and Wildlife Service, and Tasmania Fire Service.

Forestry Commission (1990). *High Altitude* Eucalyptus delegatensis *Forests.* Native Forest Silviculture Technical Bulletin No. 2. Forestry Commission, Tasmania.

Forestry Commission (1991). *Lowland Dry Eucalypt Forests.* Native Forest Silviculture Technical Bulletin No. 3. Forestry Commission, Tasmania.

Forestry Commission (1993). *Silvicultural Use and Effects of Fire.* Native Forest Silviculture Technical Bulletin No. 11. Forestry Commission, Tasmania.

Forestry Commission and Tasmania Fire Service (1984). *Guidelines for Fuel Reduction Burning under Dry Forests.* Government Printer, Tasmania.

McCormick, N.D. and Cunningham, J. (1989). Uneven-aged forest management in Tasmania's dry sclerophyll forests. *Tasforests* 1: 5–12.

Robson, D.E. (1993). The use of prescribed fire in fuel management and regeneration practice in dry forests—a review. Forestry Commission, Tasmania.

Wilkinson, G.R. and Jennings, S.M. (1993). Survival and recovery of *Eucalyptus obliqua* regeneration following wildfire. *Tasforests* 5: 1–11.

Wright, J.P. and Grose, R.J. (1970). Wood degrade due to fire. *Aust. For.* 34: 149–166.