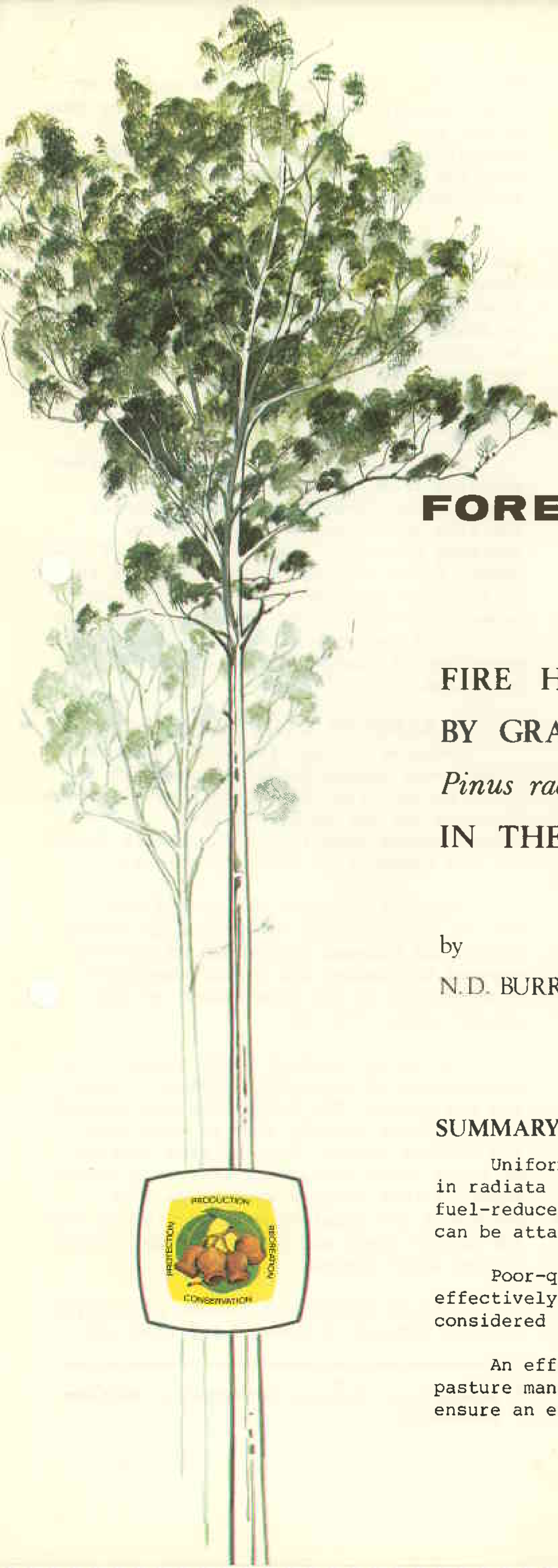

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FIRE HAZARD REDUCTION BY GRAZING CATTLE IN *Pinus radiata* D.Don PLANTATIONS IN THE BLACKWOOD VALLEY

by

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SUMMARY

Uniform and intense grazing of pasture by cattle in radiata pine (*Pinus radiata*) plantations can create fuel-reduced buffers from which plantation wildfires can be attacked.

Poor-quality pastures on steep slopes were not effectively grazed by cattle at the stocking rates considered in this study.

An effective fuel-reduced buffer system requires pasture management, as well as tree management, to ensure an even fuel reduction through grazing.

INTRODUCTION

Some 17 000 ha of farmland in the Blackwood Valley area have been purchased by the Forests Department, Western Australia and subsequently planted with radiata pine (*Pinus radiata* D. Don). Some of the plantation area has been leased for grazing and it is proposed to manage at least 5000 ha on an agro-forestry system (McKinnell and Batini, 1978). The agroforestry areas are planned to serve as fuel-reduced buffer regions, within which a major plantation wildfire could be attacked. This study examines some of the problems involved in achieving worthwhile fuel reductions in grazed areas, and estimates the likely reductions in fire hazard as a result of grazing.

METHOD

A typical grazing lease covering 320 ha of the Ferndale Plantation was selected for study. Radiata pine was planted on the area in 1974 at a density of 1700 stems per ha, and over the 12 month duration of the study, the lease was grazed by 150 steers and cows ranging from ten months to two years in age. In January 1978, 100 cattle were removed,and replaced the following May.

Two distinct site types were identified: lowlands (river flats and gentle slopes up to 5°) and uplands (slopes in excess of 8°). Species on the lowland sites included kikuyu (*Pennisetum clandestinum*), rye grass (*Lolium perenne*), wild oats (*Avena fatua*), blowfly grass (*Briza maxina)* and Giblett grass (Lotus). Silver grass (*Vulpa bromoides*) and rip gut broom *(Bromus diandrus*) dominated the upland slopes.

Various plots were established to exclude grazing: seven small plots (each 5 m^2) and three larger plots (each 150 m^2) were established on the more productive lowlands, and seven small plots were established on the steeper uplands. The three larger plots were established on the river flats to accommodate the higher pasture diversity found here. An additional exclusion plot (150 m^2) was established on the river flats in mid-spring to assess the recovery of previously grazed pasture.

The recording of pasture height began in January 1978 and continued through to February 1979. At monthly intervals, 15 pasture height measurements were made at random locations within a radius of 50 m within each plot. At the same time, five recordings of pasture height were made in the smaller plots and up to ten recordings in the larger plots. These sampling intensities resulted in an acceptable coefficient of variation (30%).

Fifty biomass samples were collected and the corresponding height of the pasture recorded. Pasture height and biomass (oven-dried) were found to be linearly related. This relationship was used to determine pasture weight in tonnes per hectare from pasture height, except where pasture had collapsed as a result of curing or trampling by stock.

Sneeuwjagt's* (personal communication) adaption of McArthur's Grassland Fire Danger Meter (1966) was used to predict the fire behaviour of the grazed and ungrazed pastures. As the Grassland Fire Danger Meter does not account for the efi t of trees on grassland fire behaviour and suppression difficulty, the data presented in Table 2 can only be used to compare the magnitude of change between these two variables.

RESULTS AND DISCUSSION

Pastures on the river flats and lower slopes were grazed heavily throughout the study period (Fig. 1). Cattle were able to suppress the spring growth flush, significantly reducing the available fuels for the coming fire season (Table 1).

Pastures on upper slopes did not attract cattle. The difference in height growth and biomass production of pasture exposed to grazing and pasture excluded from grazing is not significant on the upland sites (Fig. 2).

The wetter lowland sites support assemblages of perennials such as kikuyu and rye grass. The better drained lowland sites support annuals such as wild oats and Giblett grass. Concentrated grazing of these sites throughout the study period suggests that these pastures are more palatable and possibly more nutritious than the silver grass and rip gut broom pasture of the upper slopes.

Pasture height and biomass production are not reduced if lowland pastures are

* Sneeuwjagt, Forests Department, Western Australia

TABLE 1

Biomass (t/ha ODW) of pasture on grazed and non-grazed river flats

Treatment	1978 Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1979 Jan	Feb
Grazed	0.8	1.5	0.8	0.8	0.7	0.7	1.0	1.3	1.3	1.4	1.3	1.2	1.3	1.3
Ungrazed	0.9	0.8	0.8	1.5	0.8	0.8	1.9	2.2	3.7	4.1	7.7	8.0	7.8	7.6
% removed by grazing	-	-	-	-	-	-	*47	*40	*46	*65	*83	*85	*84	*83

* Difference between grazed and ungrazed pasture biomass is significant at the 0.05 probability level (determined by Students "t" test).

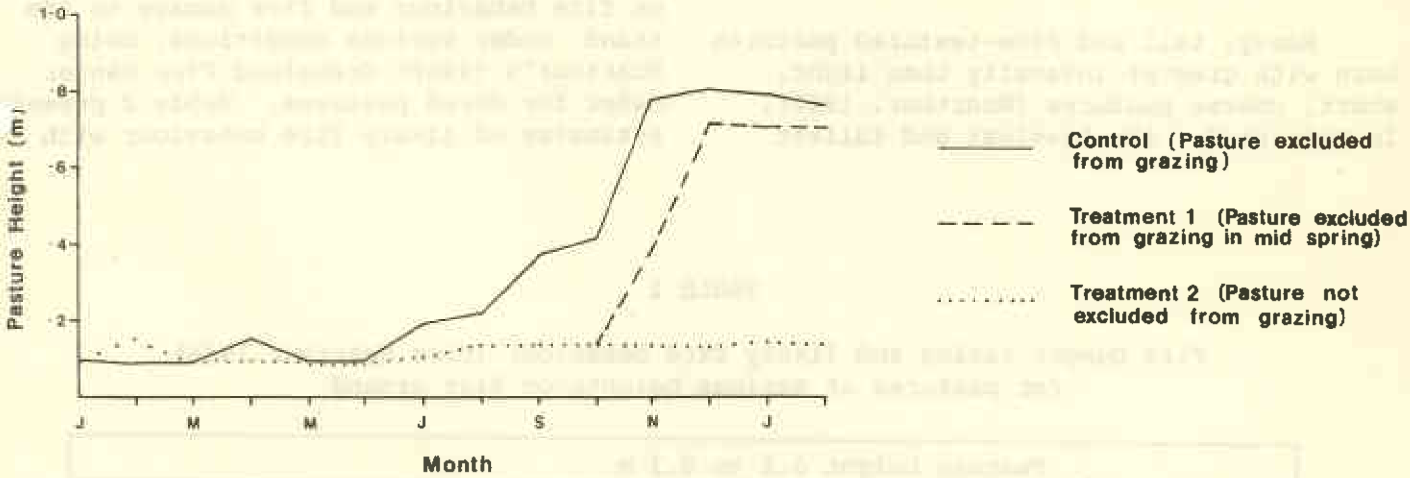

Figure 1: Mean monthly height growth of pasture on river flats
* Significant difference between Control and T^2 after June.
Significant difference between T^1 and T^2 after November.
No significant difference between T^1 and Control after December.

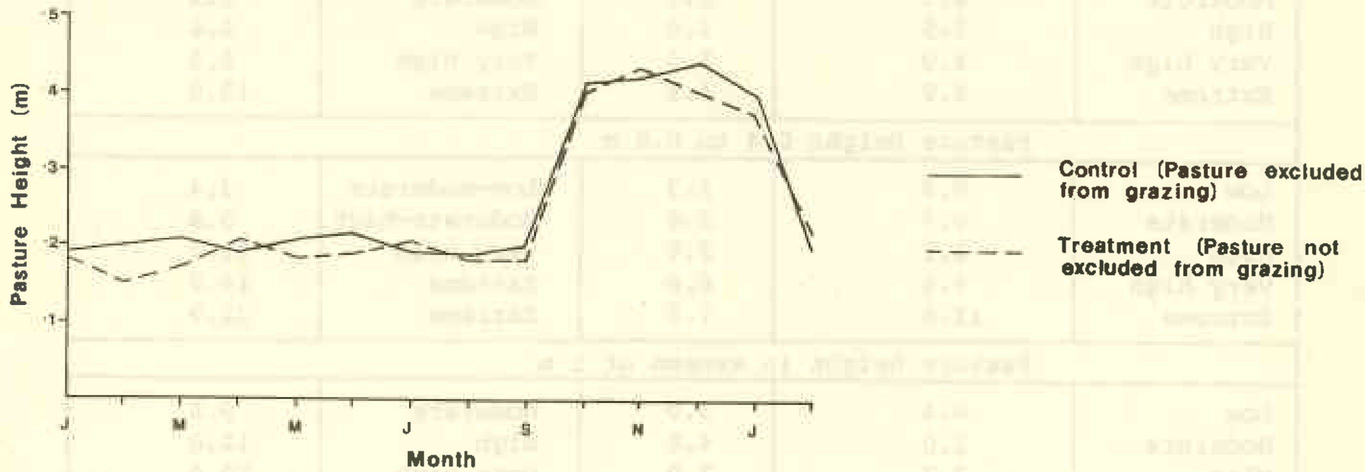

Figure 2: Mean monthly height growth of pasture on upland slopes
No significant difference between Treatment and Control.
(Note pasture collapse on curing)
*Significant at the 0.05 probability level (Students "t" test).

excluded from grazing before the end of the growing season. The increase in height and biomass of both annual and perennial pastures on lowland sites is most effectively prohibited when grazing takes place from early spring to the middle of summer (Fig. 1).

An unknown proportion of pasture height reduction must be attributable to trampling. On a grazed pasture, the effect of trampling could not be isolated, but the trampling of unpalatable species such as *Cirsium* sp was observed. While trampling does not reduce pasture biomass, it does reduce aeration and increase bulk density, thereby reducing the fire hazard (Byram, 1959).

Heavy, tall and fine-textured pastures burn with greater intensity than light, short, coarse pastures (McArthur, 1966). In this study, the heaviest and tallest pastures occurred on the ungrazed upper slopes. If ungrazed, the lowlands would provide approximately 7.6 $t \cdot ha^{-1}$ of flammable fuels (Table 1), whereas the uplands provide 4.2 $t \cdot ha^{-1}$. With the introduction of cattle, the amount of available fuel on the lowlands is reduced to 1.2 $t \cdot ha^{-1}$ by summer (Table 1), but remains unchanged on the uplands. Reduced grazing pressure from January to May 1978 had little impact on pasture height reduction over this period. Heavier grazing pressure at this time could reduce the pasture height on river flats.

Given this degree of reduction in available fuel due to grazing, it is possible to estimate the effect of grazing on fire behaviour and fire damage to the stand under various conditions, using McArthur's (1966) Grassland Fire Danger Meter for cured pastures. Table 2 presen' estimates of likely fire behaviour with

TABLE 2

Fire Danger rating and likely fire behaviour (From McArthur 1966) for pastures of various heights on flat ground

Fire Danger Rating	Forward rate of fire spread (km/hr)	Headfire flame height (m)	Suppression difficulty	Likely scorch height (m) *
Pasture height 0.1 to 0.3 m				
Low	0.2	0.3	Low	1.5
Moderate	0.5	0.6	Moderate	2.2
High	1.5	2.0	High	4.6
Very high	4.0	2.5	Very high	6.5
Extreme	8.0	4.5	Extreme	12.0
Pasture height 0.4 to 0.8 m				
Low	0.3	1.3	Low-moderate	3.4
Moderate	0.7	2.4	Moderate-high	5.8
High	2.1	3.6	Very high	11.0
Very high	5.6	6.6	Extreme	16.0
Extreme	11.0	7.5	Extreme	22.0
Pasture height in excess of 1 m				
Low	0.4	3.0	Moderate	9.8
Moderate	1.0	4.0	High	12.0
High	2.7	7.0	Very high	20.0
Very high	7.2	9.0	Extreme	25+
Extreme	14.0	14.0	Extreme	25+

* Scorch heights are estimated from other field observations.

varying fire danger ratings and fuel conditions.

For grassland fire danger ratings of low and moderate, pasture on flat or gently undulating ground must be grazed to less than 0.3 m in height if the degree of difficulty for fire suppression is to remain low to moderate. It is likely that trees older than 12 years would be resistant to the expected fire behaviour. For grassland fire danger ratings of high, very high and extreme, pasture must be grazed to a height less than 0.1 m to constrain fire behaviour to within the limits tolerated by trees older than 12 years.

Radiata pine stands with a cured pasture understorey of 0.4 to 0.8 m in height would be damaged or killed by fire under grassland fire danger ratings greater than moderate. For cured pasture in excess of 1 m in height, flame heights of 3 m may occur under a grassland fire danger rating of low. Young stands (up to 12 years old) would be severely damaged or killed under these conditions (Table 2).

Fire behaviour and suppression difficulty data presented in Table 2 are expected on flat or gently undulating ground. For steeper slopes, the rate of spread and suppression difficulty will double progressively up to a ten degree slope and will be four times as great up to a 20^{o} slope (McArthur, 1966). Ungrazed pasture on steeper slopes presents a greater fire hazard, even though the available fuel is not as high as that on river flats. In this study area, river flats accounted for 35% of the total plantation area, the remainder being upland slopes.

CONCLUSIONS

Pasture must be heavily and uniformly grazed if plantations are to have effective protection from fire. The deeper loams of the lowland sites, capable of carrying heavy pasture, were heavily grazed by cattle. Upland sites were little affected by grazing and it appears that the pasture on these sites is less palatable. Grazing on this lease did not afford total plantation protection from fire. The heavily grazed lowlands would serve adequately as fuel-reduced buffers, thereby strengthening the fire control network.

Better protection would be possible with the improvement of the upland pastures, or with increased grazing pressure, or a combination of both.

An effective fuel-reduced buffer system requires pasture management, as well as tree management, to ensure an even fuel reduction through grazing.

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