Fire in regenerated karri forest

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2. Background

Young, evenaged stands of karri regenerated following logging are an increasingly important component of Western Australias southern forests. Fire is excluded from regenerated forest until the trees have developed sufficient height and bark thickness to tolerate the use of low intensity fire for fuel reduction. This takes at least 15 years on most sites. Even after this time the intensity of prescribed fires must be carefully controlled to prevent damage to the trees.

Research underway since 1981 has aimed to
(1) develop appropriate prescriptions for fuel reduction burning of young stands,
(2) quantify the effect of fire on stand growth and productivity.

3. Developments since January 1987

3.1 Fuel moisture regime study

Litter fuel moisture content was sampled daily over a 157 day study period from October 1983 to March 1984 in 5 forest stands-

- mature jarrah
- mature karri
- 11 y.o. regenerated karri
- 13 y.o. " "
- 16 y.o. " "

Litter fuels in the 3 regrowth karri stands were consistently moister than in the mature karri stand and all karri stands were moister than the jarrah stand. Within the series of 3 regenerated stands the regime of fuel moisture became progressively drier as stand age increased, probably due to decline in the density of the understorey.

Observed fuel moisture contents in each of the karri stands were compared with predictions made using the 3 models for karri forest available from the Forest Fire Behaviour Tables. Several of the models provided unbiased estimates of the moisture content of surface and profile litter in the mature stand, and of the surface litter in the 2 older regrowth stands. None of the models adequately predicted surface moisture content in the 12 y.o. stand, or profile moisture contents in any of the regrowth stands.

Routine fuel moisture prediction and weather forecast data collected at Pemberton over 5 fire seasons were used to estimate the number of days each season likely to have been suitable for prescribed burning of young (<20 year old) regrowth (Table 1). On average 19 days were estimated to suitable of which about 5 would be expected to be Sundays or public holidays. In reality, opportunities for burning may be futher limited by

- desire to minimse stem damage and mop-up cost by burning before the Soil Dryness Index exceeds 1400,
- committment of resources to other types of prescribed burning and to wildfire suppression,
- possibility of adverse fire weather on subsequent days.

The limited opportunities for burning must therefore be used wisely to achieve maximum strategic protection from each regrowth stand subject to fuel reduction.

3.2 Fuel characteristics and accumulation

Field work has been completed for a study of fuel accumulation in regenerated karri stands. Final analysis and writing up of the work has yet to be undertaken.

3.3 Impact of fire on tree growth and quality

1. Tree growth and stem damage is being monitored in a number of stands burnt at different levels of fire intensity. Two years after burning the main conclusions regarding diameter growth are that -

- growth rates of trees subject to low scorch do not differ significantly from those of unburnt trees,
- growth of fully scorched trees is significantly slower than for unscorched trees; defoliated trees are slower again,
- increment may vary widely from year to year; the extent of fluctuation in annual growth varied considerably between 2 sites that were only separated by 8 km.

Diameter increment data (underbark) for the largest 200 stems/ha are presented in Table 1; similar patterns are evident for the largest 400/ha and for all trees > 10cm diameter.

2. Bark thickness on burnt trees declined successively in the 2 years following burning, while the bark increased in thickness on the unburnt trees (Table 2). Trees subject to full crown scorch lost slightly more bark than those burnt at lower intensity.

3. Physical damage to the stem became less frequent as stem size increased, probably due to the thicker bark on the larger stmes (Table 3). Surprisingly, the incidence of stem damage in fully scorched areas was not consistently greater than in areas burnt at lower intensity. Similar quantities of fuel were consumed in fully scorched and low scorched areas; possibly this factor is more important in determining the level of damage than is the rate at which the fuel is burnt.

3.4 Implementation of research

Up to date findings on fuel conditions, lighting techniques and fire behaviour have been written into a prescription for the Southern Forest Region Operations Manual.

A 44 ha stand of 1970 regrowth was successfully burnt on 28 January this year in conjunction with Manjimup District. Despite steep slopes and the high drought index at the time (1500 approx) full crown scorch was confined to less than 10% of the area and no suppression problems were encountered. Opportunities for burning the 1986/7 season were limited by the particularly dry nature of the season and the commitment of forces to the numerous wildfires in the Region.

4. Future directions

4.1 The scale of fuel reduction burning operations in young regenerated stands is now unlikely to be as extensive as was envisaged in the early 1980's. The main reasons for this altered emphasis are

- the realisation of the limited opportunities for burning in young stands, and
- the likely advent of commercial thinning in young (15-18 y.o.) stands.

However the knowledge gained through the current research program should find useful application in stands not suited to early thinning, or where burning prior to thinning is desirable.

4.2 There are a range of options for fuel management in young stands programmed for commercial thinning, including

- burning prior to thinning,
- burning of thinning slash soon after the operation (a few months),
- delay burning of thinning slash for 2-3 years.

Preliminary evidence suggests that delaying burning for 2-3 years after thinning allows nutrient rich material from the fresh tops to be made available for tree growth. The additional fine fuel created through thinning decomposes rapidly with the

result that fuel conditions in thinned stands are not any more hazardous than those in comparable unthinned areas. Access is also greatly improved in thinned stands.

At this stage the issues raised for fire management by the proposed thinning of young stands appear resolvable without substantial research involvement. This situation should be monitored as the thinning program develops.

4.3 One area worthy of further investigation is the behaviour of fires in young stands under moderate - high levels of fire danger. In particular it would be valuable to understand the conditions necessary for the initiation of crown fires, and the spotting distances likely to be encountered.

A proposal for a small scale research trial on this subject is currently being discussed with Southern Forest Region.

5. Publications

McCaw, W.L. (1986). Behaviour and short term effects of two fires in regenerated karri forest.
CALM Tech. Pap. No.9

McCaw, W.L., Neal, J.E., Smith, R.H., Woods, Y.C. and Low,K. (draft). Fuel moisture regimes in mature and regrowth forest stands in southwestern Australia. Submitted to Forest Ecology and Management.

TABLE 1: Diameter increments (underbark at 1.3m) of the largest 200 stems/ha over 2 years, for trees subject to a range of fire treatment.

Block	Period	Diameter increment in cm (underbark) (X + SEM)			
		Unburnt	Low Scorch	Full Scorch	Defoliated
Warren	1985-6	-	1.3(0.2)	0.6(0.1)	0.2(0.1)
	1986-7	-	1.5(0.2)	0.7(0.1)	0.2(0.1)
Crowea	1985-6	1.2(0.1)	1.3(0.2)	0.4(0.1)	-
	1986-7	0.6(0.1)	0.6(0.2)	-0.2(0.1)	-
Boorara	1986-7	0.7(0.1)	0.9(0.1)	-	-

TABLE 2 Changes in bark thickness over 2 years for trees subject to a range of fire treatment. (Crowea Block)

Tree Diameter (cm)	Year	Bark Thickness (X + SEM)		
		Unburnt	Low Scorch	Full Scorch
11-20	1985	14.3 (0.3)	13.4 (0.4)	12.1 (0.5)
	1986	14.8 (0.3)	11.5 (0.5)	10.8 (0.5)
	1987	16.2 (0.4)	10.8 (0.6)	8.9 (0.5)
	1985-1987	+ 1.9	- 2.6	- 3.2
21-30	1985	16.5 (0.8)	17.3 (0.8)	15.0 (0.8)
	1986	17.5 (1.0)	14.2 (1.0)	13.0 (2.3)
	1987	19.1 (1.3)	13.8 (0.9)	10.7 (1.2)
	1985-1987	+2.6	- 3.5	- 4.3

TABLE 3: Percentage of stems remaining without damage 2 years after fire, for trees subject to low and complete crown scorch (Crowea Block).

Stem diameter (cm)	Percentage remaining undamaged	
	Low scorch	Full Scorch
10-15	43	36
16-20	67	31
21-25	71	83
26-30	87	100