BURNING KARRI REGROWTH STANDS IN ADVANCE OF THINNING

SUMMARY OF BURNING CONDITIONS AND RESULTANT DAMAGE

CASE STUDY No. --: 1970 REGROWTH, GRAY 2, MANJIMUP

Introduction

A forty hectare stand of 1970 seed-tree regrowth at Scatter Road, Gray Block was burnt in late January 1987 as part of a program to evaluate the feasibility of prescribed burning in young, unthinned stands. The burn was undertaken as a collaborative exercise involving Manjimup District and the Fire Research Section from Manjimup Research Centre. Operational-scale burning of regrowth had previously been undertaken at Warren, Crowea and Boorara blocks in Pemberton District during 1985 and 1986 respectively.

The Scatter Road stand is located on a ridge-top, which at the time of the burn was exposed to easterly winds due to the adjacent mature forest having been clearfelled. A steep gully system dissected the eastern half of the stand. These factors made it imperative that the ignition operation be well planned and executed to avoid excessive crown scorch. In addition, rainfall during the winter and spring of 1987 was well below average, resulting in early onset of summer drought conditions. In spite of the high drought index the decision was made to proceed with the burn on the basis that information about the impacts of burning during dry conditions would be important for strategic planning purposes, and for predicting tree damage and mortality following unplanned summer fires.

Fuels

The stand was 17 years old at the time of burning and the fuels consisted of litter and a partially-collapsed understorey of netic (*Bossiaea laidlawiana*). Prior to burning fuels were harvested from five sites at each of which ten 0.04 m^2 quadrats of litter and ten 0.5 m^2 quadrats of elevated twig and bark fuel <25 mm diameter (trash) were collected and subsequently oven dried. Fuel loadings, in t/ha, were as follows:

	Mean	Range
Litter	16.5	13.0 - 19.6
Trash	14.1	10.4 - 19.7
Total	30.7	23.4 - 38.5

Given the dry conditions, >90% of these fuel fractions were consumed.

Burning Conditions

The burn was undertaken on 28 January 1987. The Soil Dryness Index, as determined using rainfall and temperature data for Manjimup, was 1600. Ignition commenced at 1800 hours on a falling hazard with the object of achieving overnight burn-out under cool, moist conditions that would minimise crown scorch. Conditions were as follows:

		1900 hours	*2400 hours*
Air temperature	(°C)	19	13
Relative humidity	(%)	68	94
Wind speed 10m	(km/h)	15 - 20	8 - 10
Wind direction		SW	ESE
SMC	(%)	15	19
PMC	(%)	35 - 60	35 - 60
Trash MC	(%)	16	20
Karri ROS Index	(m/h)	20	12

Lighting was undertaken along boundary tracks and along a central track which divided the stand roughly in half. An incendiary rifle was used to ignite additional spot fires further in from the perimeter.

Fires burnt steadily throughout the evening with average forward spread rates of 20-30 m/h and flame heights of 1-1.5 m. Some minor flaring occurred on upslope fire runs, and on edges exposed to the prevailing easterly winds.

Post-burn impacts

Field assessment methods

Stand characteristics and the incidence of fire-caused stem and crown damage were monitored at the five sites where fuels had been harvested prior to burning. The locations of these plots spanned the range of variation in stand density and scorch height across the compartment (Fig. 1). Plots were circular (10 or 15 m radius) and contained at least 25 trees >10 cm dbhob. In May 1987 dbhob, tree height, maximum crown scorch height, percentage of crown volume scorched (in classes of ten percent), crown condition and epicormic density were recorded for each tree. The heights of the two tallest dominant regrowth trees in each plot were measured with a tape and clinometer, and the heights of the remaining trees then estimated to the nearest metre. Fire-caused stem damage was not evident in May 1987, and any stem damage recorded at this time was therefore attributed to other causes (fallen trees, fungi and insects). In May 1988 and May 1989, crown condition, epicormic density and the incidence and extent of fire-caused stem damage were re-assessed. At the same time, assessors noted the proximity of logs and other woody debris adjacent to the stems of damaged trees and made a judgement as to whether the damage had been caused by prolonged heating from these coarse fuels. The area of cambium killed on the stem was used as an index of the severity of stem damage, and of the likely future extent of wood degrade. For convenience of analysis and presentation wounds were categorised into three classes: small (<0.01 m^2), medium (0.01 - 0.1 m^2) and large (>0.1 m^2).

Results

Air photographs taken two months after the burn revealed that about 10% (ie. 4 ha) of the stand had been fully crown scorched, with the remainder experiencing scorch heights less than the height of the dominant and co-dominant trees. Two years after burning all trees >20 cm dbhob were assessed as having normal primary crown structure that had either been unaffected by the fire, or had recovered from epicormic shoots on the upper stem and small branches. Some crown damage was evident to smaller trees with 30% of stems <15 cm and 20% of stems 15-20 cm dbhob having suffered crown death and depending instead on epicormic shoots originating from the stem.

Stocking, basal area and dominant height varied considerably between plots (Table 1), and were all lowest in Plot 5, suggesting that at the time of regeneration site factors in this area were unfavourable, possibly due to soil compaction or poor fuel consumption during the post-logging slash burn.

Plots spanned a gradation of crown scorch levels from a lower limit of 10% crown volume scorched (Plot 2) to an upper limit of 80% crown volume scorched (Plot 1).

Table 1: Stand characteristics of five plots in 17 year old karri regrowth at Gray 2. Stocking and basal area values represent the condition of the stand in May 1987, prior to the impact of fire-induced mortality.

Plot	Stems/ha > 10 cm	Basal area (m2/ha)	Dominant. height[1] (m)	Mean scorch height (m)	Mean percent crown scorch
1	1146	29.6	22	18	80
2	410	20.7	28	5	10
3	523	21.9	30	16	70
4	828	30.9	28	16	60
5	453	8.2	20	8	30
Mean[2]	582	20.0	n.d.[3]	n.d.	n.d.

1. Height of the two tallest dominant regrowth trees per plot - equates to Dominant Height of Rayner (1991) and Top Height of Bradshaw (1991).
2. Mean stocking and basal area for the stand were calculated from the sum of each parameter for all 5 plots divided by the total sampling area of all plots.
3. n.d. = not determined

Fire-induced mortality was restricted to trees less than 20 cm dbhob, with those <15 cm dbhob being most affected; mean mortality for all plots was 43 stems/ha (Fig. 2). One tree was killed by a stag which fell soon after the fire.

The incidence of stem damage declined with increasing stem diameter (Fig. 2). More than half of the stems <15 cm dbhob which survived two years after the fire were damaged, with the frequency of small, medium and large-sized wounds being roughly equal. With increasing diameter the proportion of stems damaged became less, and large wounds (>0.1 m^2) became less common.

Slightly more than half the small wounds (<0.01 cm^2) were attributed to combustion of coarse fuel adjacent to trees, but medium and large sized wounds were predominantly associated with logs and other debris that caused prolonged heating of the stem (Table 2).

Table 2: Incidence of three sizes of wound on trees of all size classes, and proportion of wounds attributed to coarse fuels burning adjacent to the stem.

Wound area (cm^2)	No. of trees wounded	No. of wounds attributed to burning of coarse fuel	Percent of total
<100	20	11	55
100-1000	26	18	69
>1000	19	15	79

From a silvicultural viewpoint the success of advance burning is contingent upon sufficient dominant and co-dominant trees remaining undamaged so as to permit retention of an acceptable stocking at first thinning. First thinning may be scheduled once top height exceeds 30 m, but given the range of top height across the stand in 1987 (20-30 m) thinning should probably be delayed until at least age 22 (1992+). The strong competition within unthinned regrowth stands makes it unlikely that there would be any appreciable recruitment of smaller, sub-dominant trees (represented by the 10-15 cm dbhob class) into larger size classes in the period between the 1987 burn and first thinning. Dominant and co-dominant trees available for retention at first thinning would therefore correspond to those stems that were 15 cm dbhob or greater in 1987, and which remained undamaged or only suffered minor damage:

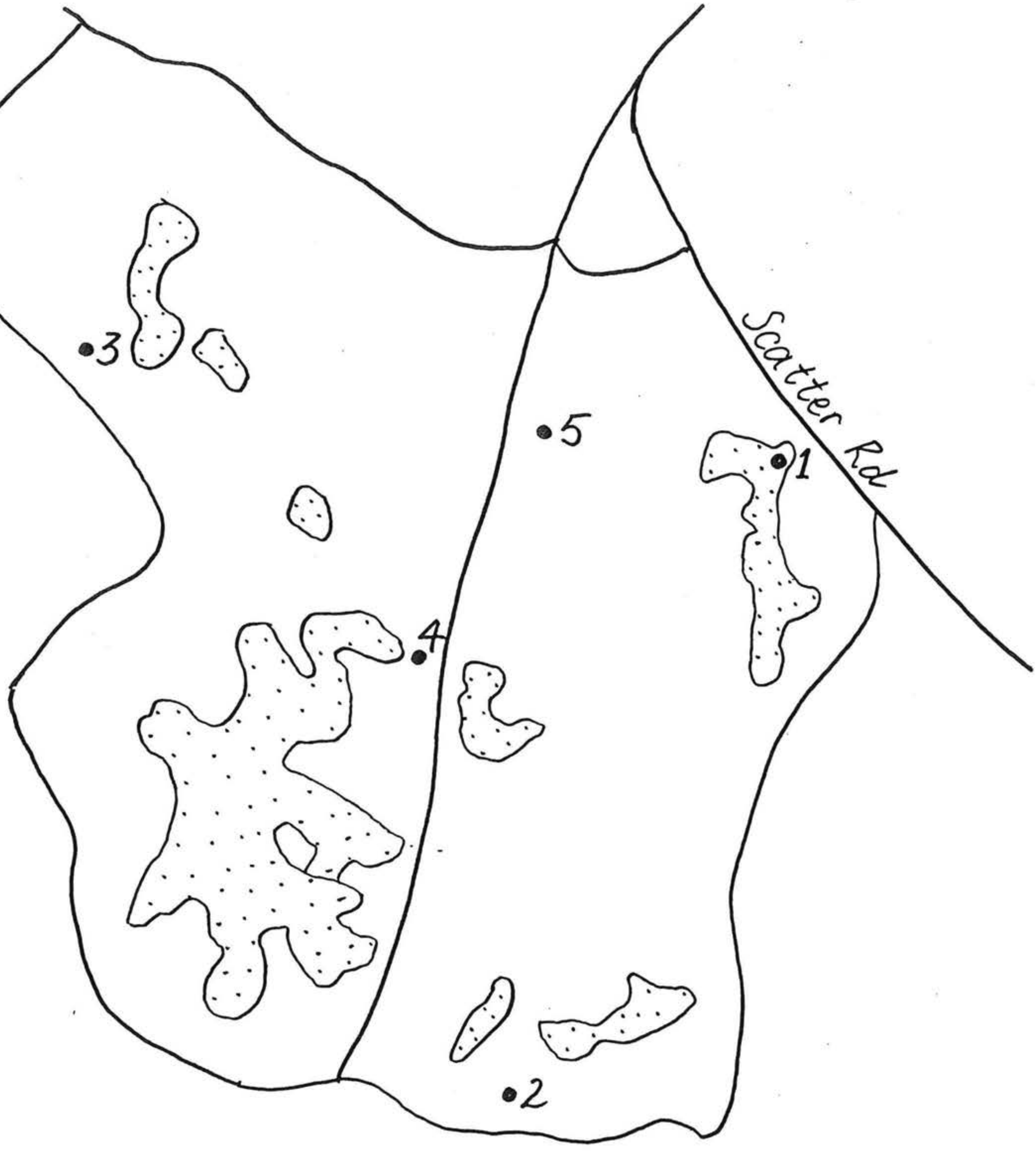
- stocking >15 cm dbhob, undamaged two years after burning = 211 stems/ha
- stocking >15 cmdbhob, with small wounds = 47 stems/ha

Total = 258 stems/ha

This level of residual undamaged stocking is lower than is desirable, and would provide little flexibility to retain trees on account of factors other than damage which may be silviculturrally important; these factors include spacing, form, vigour and the degree of stem damage from other agents such as fungi and wood boring insects. In addition, to achieve a retained basal area of 16 m2/ha after thinning, the level specified in the current prescription (1/92), with a stocking of only 250 stems/ha would require retained trees to have an average dbhob of 29 cm. First thinning would therefore have to be delayed for some years to attain the necessary size class distribution within the stand.

The dry conditions at the time of burning are likely to have been an important contibuting factor to the level of stem damage experienced at Gray 2, and operational burning of regrowth would not routinely be attempted under these conditions. In this sense, the outcome of this burn can be taken as the upper limit of damage likely from low intensity fires.

Fig. 1



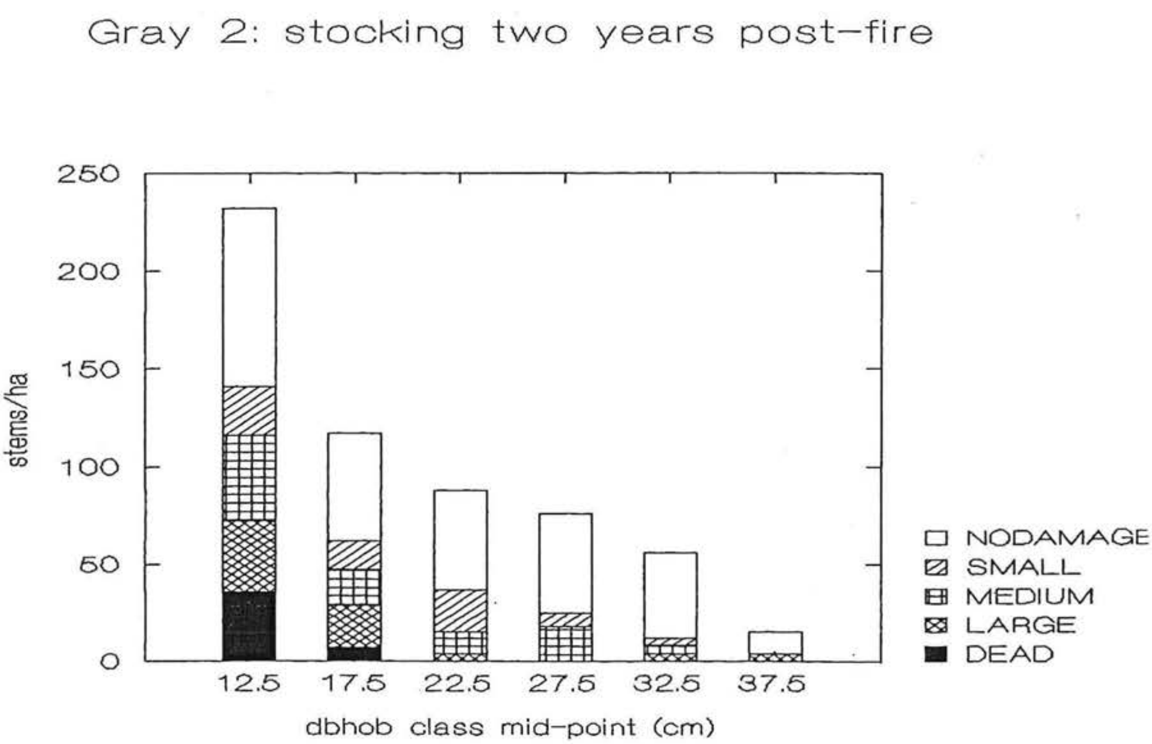
Gray 2 1970 seed tree

HD 72 40 ha approx

Areas of full crown scorch

•1 Location of sample points

Fig. 2


Gray 2: stocking two years post-fire
250
200
150
100
50
0
stems/ha
12.5
17.5
22.5
27.5
32.5
37.5
dbhob class mid-point (cm)
NODAMAGE
SMALL
MEDIUM
LARGE
DEAD