019960

FIRE INTENSITY & THE BANKSIA GRANDIS POPULATION

BY

N. BURROWS

ABSTRACT

Large mature and over mature *Banksia grandis* displayed a poor capacity to regenerate from rootstock and were killed by fires in excess of 1000 kwm^{-1} under dry summer conditions.

Conversely, small immature *B. grandis* were killed to ground level by fires of up to 4000 kwm^{-1}, the maximum intensity experienced in this study, but quickly regenerated from rootstock.

Immediately following high intensity fire (> 1000 kwm^{-1}) *B. grandis* stand basal area was significantly reduced, but there was no significant reduction in population numbers.

INTRODUCTION

Control of the jarrah dieback disease of which *Phytophthora cinnamomi* Rands is the primary causal organism, may be achieved on some sites by replacing the susceptible proteaceous understorey with a leguminous understorey (Shea & Hopkins, 1973).

Banksia grandis is one such highly susceptible understorey species which is prolific on many sites. Reduction in the competition from the overstorey, disturbance and frequent low intensity spring burning are factors which have probably favoured the development of this lower tree species (Shea, 1975).

Shea & Malajczuk (1977) have suggested that the replacement or partial replacement of the dense *B. grandis* understorey with suitable native legume species can be achieved with fire on some sites. They suggest a higher intensity fire than the current cool spring burns with suitable followup fire treatment to further discourage *B. grandis* development. This study aimed at determining the susceptibility of the *B. grandis* population to a range of one hit fire intensities under summer conditions.

METHODS

This study was a facet of the jarrah summer burning trials, primarily aimed at enhancing fire behaviour knowledge.

Some 60 small (2 ha) plots were experimentally burnt at various intensities (100 - 4000 kwm^{-1}) over the warm dry summer period. In each plot, 20 sub plots each of 80 m^2, were permanently demarcated. The size class-frequency distribution of the *B. grandis* population in each sub plot was determined before and after burning. The three height classes selected represented a compromise between ease of data collection and stratification of physiological development. Post burn assessments were made 1 year after burning.

HEIGHT CLASSES

1. "A" class *B. grandis*

Height class "A" consisted of all immature individuals <1 m which were inactive on the forest floor. These individuals represented future growing stock and would probably show a growth response to overstorey removal. "A" class *B. grandis* had well developed rootstocks which may have been as much as twice the age of the stem, depending on the fire history. Such individuals were 5 - 20 mm in diameter at 30 mm above ground. This class of Banksias was also typified by a lack of protective bark and had instead a toughened epidermis.

2. "B" class *B. grandis*

These individuals represented the non-competitive or suppressed component of the current Banksia overstorey and as such, were 1 - 3 m in height and 20 - 45 mm in diameter at 60 mm above ground. "B" class Banksias had developed substantial rootstocks and a protective bark of 5 - 10 mm thick.

These suppressed individuals showed very poor crown development and it is reasonable to assume that they contributed little to the seed store. This is further evidenced by the very few (2 - 4) seed bearing cones on these individuals.

3. "C" class *B. grandis*

Such Banksias have been dubbed "rogue" Banksias because of their prolific canopy development, their seeding potential and suppression of understorey species. "C" class Banksias range in height and diameter from 3 - 6 m and 60 - 120 mm respectively and have a thick protective bark (10 - 20 mm). This class contributes most to the Banksia seedling population so are most influential in determining Banksia population levels. Such individuals provide a considerable food base for the development and spread of *P. cinnamomi*.

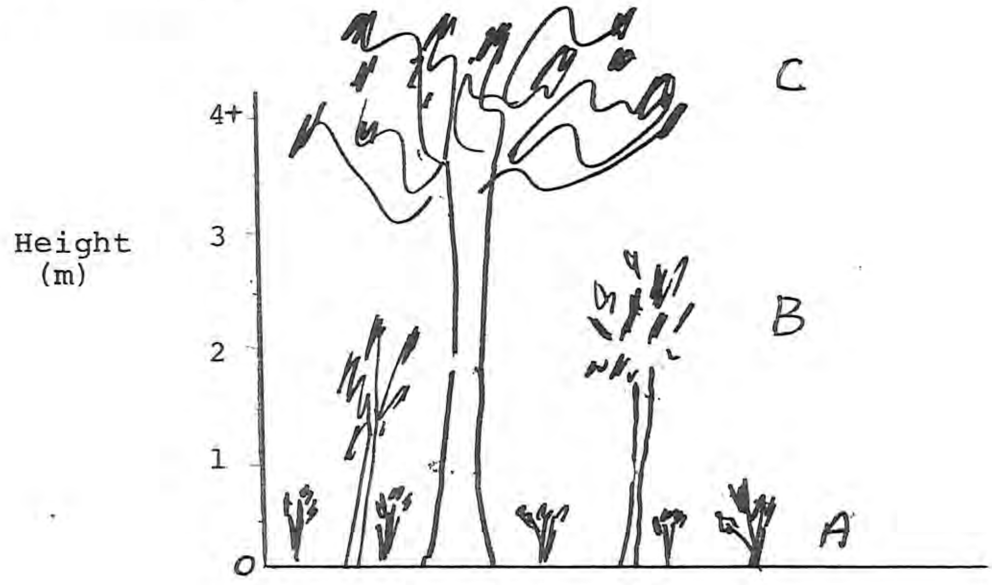

FIG. 1. Typical Banksia grandis development in the study areas

FIRE & OTHER DATA

See appendix for vegetation and fire behaviour variables measured in each sub plot.

INTENSITY

Although not completely satisfied with Byram's (1959) intensity measure, a lack of suitable alternatives left no option but to try to relate this measure to Banksia fire kill.

i.e. $I = H.W.R.$

where I = intensity (kwm^{-1})

H = heat yield (18,600 $kjkg^{-1}$)

W = weight of available fuel (kgm^{-2})

R = fire rate of spread (ms^{-1})

The development of stationary fires (R=0) as a result of burning heavy fuels such as tops and slash necessitated the substitution of $\frac{\text{Flame depth}}{\text{Dwell time}}$ for R in some instances.

RESULTS & DISCUSSION

B. grandis populations in the study areas were typical of many populations, having a high number of individuals in the smaller size class (A) and fewer in the larger size classes (B & C). *"C"* class Banksias contributed most to stand basal area (Fig. 2).

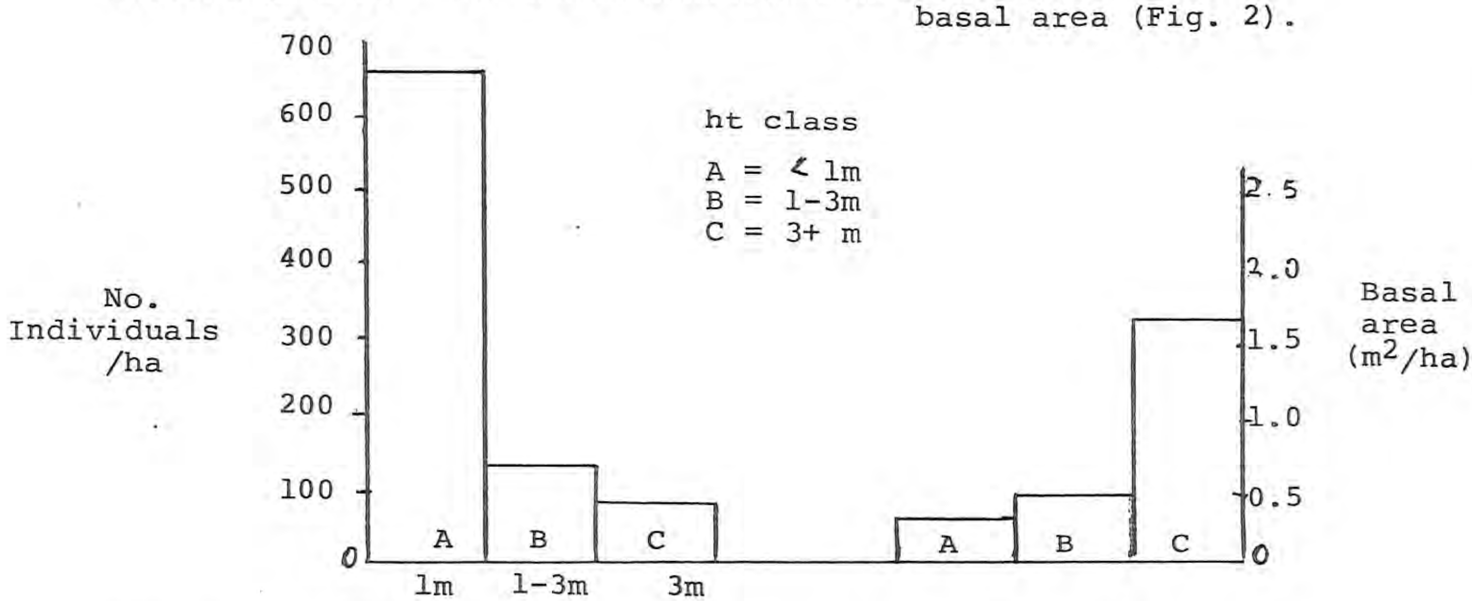

FIG. 2. B. grandis ht class structure on many jarrah sites

The smaller *B. grandis*, having a well developed and viable rootstock insulated deep in the soil prooved highly resistant to fire. Very cool fires (< 100 kwm^{-1}) were sufficient to kill the aerial portions of these small Banksias but within a few months a new dynamic shoot had originated from the rootstock. Rootstock viability appeared to be a function of physiological age, with viability decreasing with age.

The larger "B" and all "C" class Banksias proved more susceptible to fire, even though they were protected by relatively thick bark. Fire intensities in excess of 1000 kwm^{-1} were sufficient to girdle the larger trees which responded with a flush of stem epicormics. This foliage wilted the following summer and the trees died, showing no ability to regenerate from rootstock. Rootstocks of the small Banksias (< 3 m) survived the maximum fire intensities (4000 kwm^{-1}) experienced in this study. Thermocouple soil temperature measurements revealed that, even under these conditions, living tissue buried deeper than 40 mm could survive. Small Banksias had well developed rootstocks down to 70 mm and were killed only by the long and intense soil heating of adjacent burning logs.

Fire intensity frequently fluctuated with changes in fuels and wind speed. For this reason and beacuse of the size of the sample plots, it was difficult to nominate exactly the fire intensity lethel to the larger, older Banksias. Plots experiencing an average fire intensity in excess of 1000 kwm^{-1} and a low intensity variation yielded high mortality rates (> 70%) of the "C" class Banksias. Recent small scale trials have shown that fire intensities of 1000 - 1200 kwm^{-1} under summer conditions are sufficient to kill Banksia cambium protected by up to 20 mm of bark. The comparatively small diameter of Banksias ensures complete girdling under these conditoons. It is probable that summer drought stress lowers the resistance of large Banksias to fire.

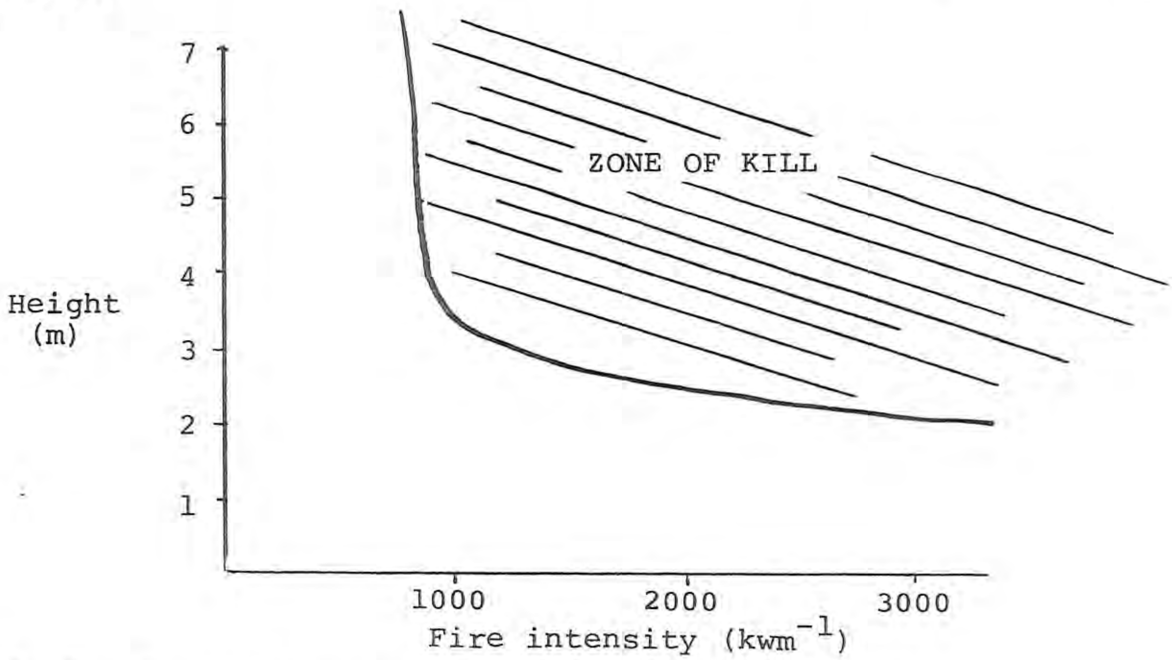

FIG. 3. B. grandis susceptibility to summer fire

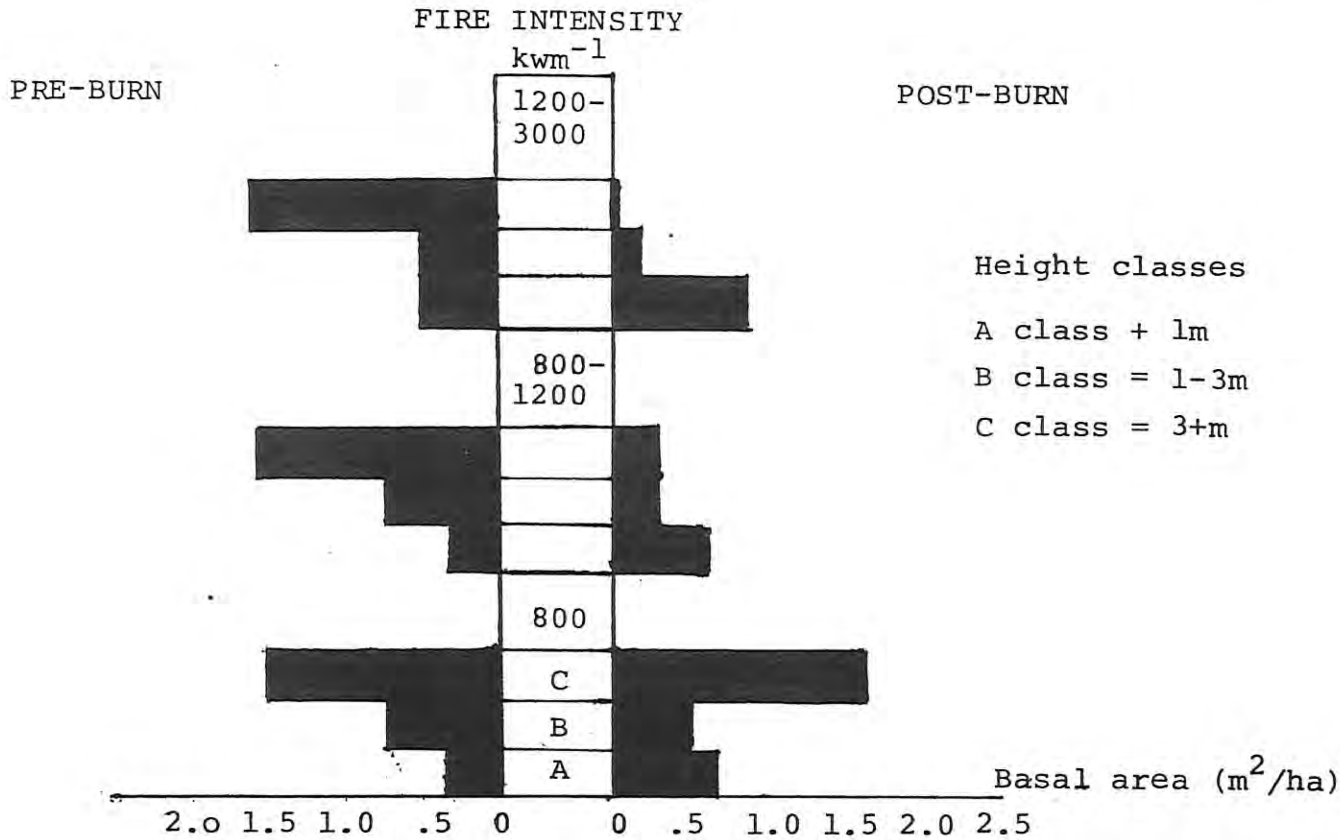

FIG. 4. Short term impact of fire intensity on B. grandis basal area

Following all fires, there was an increase in "A" class Banksias as a result of recruitment from the "B" class and seedlings. The immediate result of high intensity fire was to significantly lower stand basal area. However, considering the high numbers of young eager to replace the killed overstorey, such a reduction may have little consequence in the long term unless there is followup treatment.

CONCLUSIONS

High intensity summer fire will temporarily re-structure the *Banksia grandis* population by killing larger Banksias and reducing others to ground level. Evidence suggests that the age at which the rootstock looses its regenative capacity is near the age at which the tree is capable of high seed production. Further work is needed to substantiate this. If this is the case then an initial high intensity burn to kill the mature Banksias (> 1000 kwm^{-1}) followed by a regime of cooler (< 1000 kwm^{-1}) burns to keep the aerial portion of the tree below flowering age may well reduce the *B. grandis* component.

Preliminary research data suggests that such a fire regime may degrade timber values. Further research will substantiate this.

REFERENCES

Byram, G.M. (1959)

Combustion of forest fuels. In: Forest Fire, Control & Use. (Ed. by K.P. Davis) McGraw-Hill, New York.

Shea, S.R. (1975)

Preliminary investigations of the environment of the northern jarrah forest in relation to pathogencity and survival of *Phytophthora cinnamomi* Rands. W.A. Forests Dept. Bulletin 85.

Shea, S.R. & Hopkins, E.R. (1973)

Environmental factors in relation to distribution, intensity and control of jarrah dieback. A paper presented to the 45th ANZAAS Congress, August, 1973.

Shea, S.R. & Malajczuk, N. (1979)

Potential for control of Eucalypt dieback in Western Australia. Forests Dept. of Western Australia Reprint No 3.

APPENDIX

PARAMETERS MEASURED

LIVE MATTER

1. Species present
2. Canopy cover %
3. Height to canopy top
4. Height to canopy base
5. Diameter at breast height over bark
6. Canopy volume (from above)
7. Stem volume (from above)
8. Fire damage

Upper tree stratum (jarrah, marri etc.)

DEAD MATTER

1. Basal area of dead stems

LIVE MATTER

1. Species present
2. Canopy cover %
3. Height to canopy top
4. Height to canopy base
5. Basal area

Lower tree stratum (Banksia, Persoonia, Casuarina etc.)

DEAD MATTER

1. Basal area of stems

LIVE MATTER

1. Species present (abundance code)
2. Height to canopy top
3. Height to canopy base
4. Ground cover %
5. Biomass / unit area

4 pyro-botanical types recognized

DEAD MATTER

Scrub & litter stratum

1. Weight of leaf litter
2. Volume of leaf litter
3. Leaf litter species
4. Volume of dead logs (by diam.)

Appendix cont.

FIRE BEHAVIOUR

1. Headfire rate of spread
2. Flame height
3. Flame length
4. Flame depth
5. Spotting frequency
6. Smoke colour
7. Smoke direction
8. Approx. height of convection column