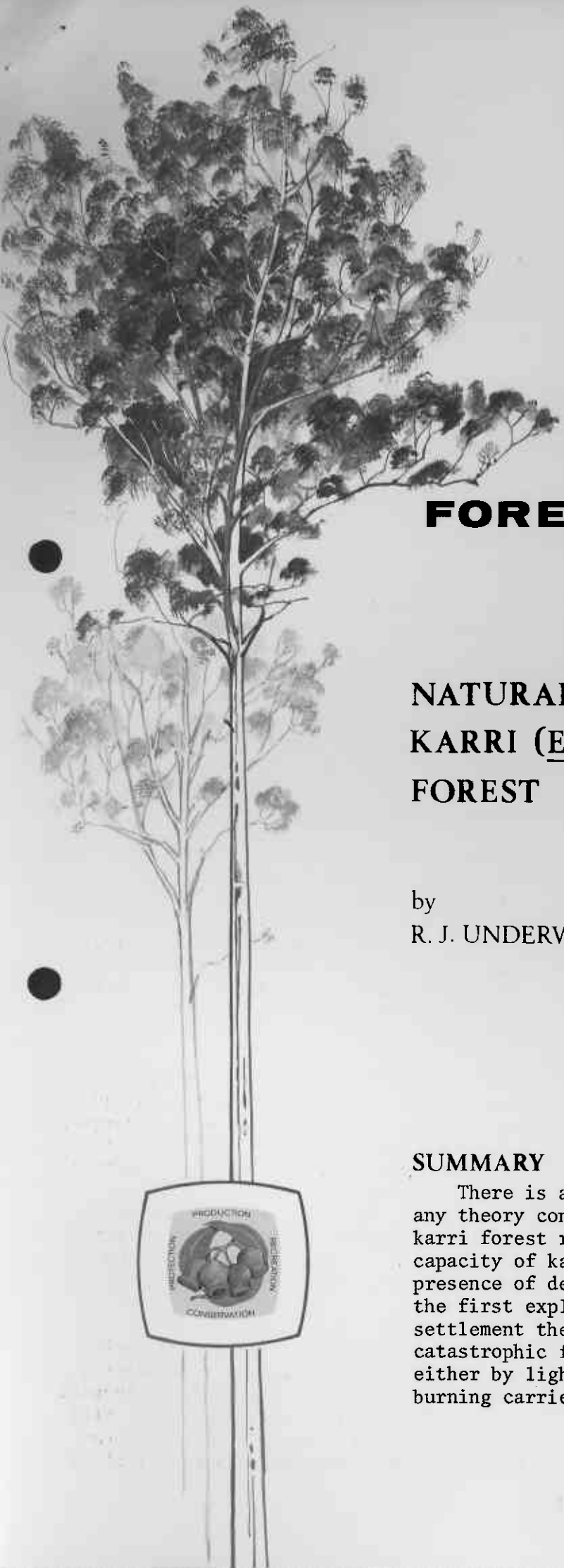

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NATURAL FIRE PERIODICITY IN THE KARRI (Eucalyptus diversicolor F. Muell.) FOREST

by
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SUMMARY

There is a lack of data to support conclusively any theory concerning natural fire periodicity in the karri forest region of Western Australia. However, the capacity of karri to regenerate after fire and the presence of dense understorey vegetation at the time of the first explorers suggest that prior to European settlement the forests were subject to both rare catastrophic fires and irregular milder fires caused either by lightning strikes or resulting from peripheral burning carried out by the Aborigines.

The question of "natural" or pre-European fire periodicity in the karri (Eucalyptus diversicolor F. Muell.) forest of Western Australia has been a popular debating point for years. Interest in the subject has expanded in recent times, particularly since the introduction of aerial prescribed burning for fire hazard reduction, a technique which has for the first time enabled forest managers to manipulate at will fire periodicity over very wide areas of forest.

Growing support for the theory that fire occurred only very infrequently in the karri forest region in pre-European times has come from a number of quarters. Talbot (1973, p.13) has written that "the karri was not burnt as often as it would hold a fire". Hallam (1975) goes further: "It is unlikely that the whole of the jarrah, and above all the karri, forests were burnt through frequently and consistently in the far south" (p.26)... "If the karri forests were burnt at all they were burnt only patchily, for example on their western margin near the Blackwood River, but rarely in the inaccessible interior" (p.27). Hutchins (1916, p.20) stated quite unequivocally that "the karri forest in its natural conditions does not burn."

On the other hand, Evans (1960, p.3) commented on the "constant severe fires" which followed early European settlement in the karri forest as distinct from the situation before settlement when "the natives burned the bush as often as it would hold a fire, consequently no fire was fierce".

Whilst the words "patchily", "frequently" and "consistently" are not defined by these writers, they are obviously used in a relative sense to compare the karri region with the northern jarrah forest, the coastal sandplains, and the savannah woodlands of the south-west. In these areas there is considerable ethnohistorical evidence that the Aborigines carried out regular burning in cycles of between 3 and 5 years (Hallam, 1975; Seddon, 1972).

However, no data have been presented in conclusive support of any of the various theories concerning fire periodicity in the karri forest; each is based on speculation and circumstantial evidence. For example, the key points used by those who advocate very infrequent fire include the following:

(1) Even before white settlement, the native population of the karri region was very small; Meachem (1961) notes that probably no more than 100 Aborigines lived in the area. Apparently they tended to avoid the karri in favour of the coast (in spring and summer) and the inland woodlands (in autumn and winter), thereby minimising the likelihood of fire within the major karri forest belt as a result of human activity.

(2) The first European explorers to enter the karri region in the early 1830's encountered dense thickets of impenetrable scrub in the areas through which they travelled (Talbot, 1973). It has been argued that the density of this "fireweed" undergrowth (mainly Acacia species) indicates the long absence of fire.

(3) Karri regenerates from seed adapted to germination on ashbed (the heavier the better) and to growth in crowded, even-aged stands open to full sunlight. When fire is absent for a long period, seed crops overlap, and massive fuel quantities accumulate on the forest floor; these conditions are right for rare but catastrophic fires followed by heavy natural regeneration.

(4) Young karri trees are relatively intolerant of fire (current Forests Department policy dictates full fire protection for karri regrowth stands until they reach about 15 years of age). This suggests that the forest suffered only infrequent fires, or at least that its "natural" fire periodicity is in excess of 15 years.

On the other hand, it is well established that most of the plants and animals of the karri region have undergone a long and very effective adaptation to an environment in which fire is a natural element (Pentony and Kimber, 1976). Furthermore, lightning strikes during summer thunderstorms are known to start wildfires in the karri region, a point which is often under-rated or even overlooked.

It is worth examining more closely the history of fires caused by lightning strikes in the karri forest area. Forests Department records, including annual fire reports and fire history plans, from the Manjimup, Pemberton and Walpole divisional

headquarters provide details for a 20-year period (1956-57 to 1975-76 inclusive) of the number of fires started by lightning and attended by Forests Department fire control personnel, their date of occurrence and their geographic location.

Eighty-one lightning-caused fires were suppressed by Departmental fire-fighters during this 20-year period. Strikes occurred throughout the summer season from December to April, but with a peak in the period January to March. No marked patterns of geographic location were discernible, although some grouping associated with particular storms was evident in areas south and west of Pemberton and north-east of Quininup.

Care must be exercised in drawing conclusions from these records. In the first place, 20 years is a very short time. Furthermore, the records account for an unknown fraction of the total number of lightning-caused fires within the karri forest, noting only those which were attended by Forests Department staff. There are no records available of strike fires on private property or other lands outside Forests Department jurisdiction.

Nevertheless, the following facts emerge:

(1) Forest fires caused by lightning occurred regularly in the karri forest region over the 20-year period. The "average" was about 4 fires per year, with a range from nil to 24 fires per year.

(2) Strike fires occurred mainly during the period January to March inclusive. This is the period of peak fire danger in the karri forest, when the cumulative drought index reaches its maximum value and fuel moisture contents reach their minimum values.

(3) Strike fires have occurred throughout the whole of the region, within which no particular area seems to be immune.

Many factors must be taken into account in extrapolating from the results of this study to any conclusions about natural fire periodicity in the karri region. Foremost amongst these is the fact that the peripheries of the karri region were burnt regularly both deliberately and accidentally by the Aborigines (Hallam, 1975). It is inconceivable that this peripheral burning would not have resulted in many fires entering the karri forest from the east, north-east or north-west, driven before the hot, dry winds which blow from these quarters each summer. Experience gained by Forests Department officers over 50 years has shown that fires such as these are very difficult to extinguish, even with the assistance of rain. Smouldering logs and dead trees can re-ignite and generate new fires for months; logs sometimes smoulder throughout the winter and then burst into fire the following summer. This peripheral, lingering source of fire, in conjunction with the pattern of lightning fires described above, makes it difficult to sustain the theory that forests in the karri region were rarely, if ever, burnt.

What, then, of conclusions concerning fire periodicity which are based on the evidence of the dense thickets encountered by the first explorers?

Pentony and Kimber (1976), Christensen (1972) and Peet and van Didden (1973) have studied the succession of understorey vegetation in the karri forest after fire. They have shown that the density of "fireweed" thickets is at its peak between 3 and 5 years after fire, after which there is a gradual transition to a more open, grassy understorey with occasional clumps of the long-lived plants such as hazel (Trymalium spathulatum). Peet and van Didden (1973) showed that mild burning of karri forest scrub in the spring led to greater species diversity in formerly dense "fireweed" thickets; however, the 3 "fireweed" species that they studied (Acacia strigosa, A. pulchella and Bossiaea aquifolium) nevertheless continued to predominate, and there is considerable visual evidence from prescribed burning carried out over the last decade that in the karri region, dense thickets of "fireweeds" regenerate after mild spring burning as well as after the more intense summer fires. Christensen (1972) concluded that in the karri forest a relatively open understorey occurs only as a result of very frequent fire (approximately every 2 to 4 years), or else in the absence of fire for very long periods (more than 20 years). It seems probable, then, that the first explorers in the karri area encountered stands at their dense seral stage; this could have been 15 to 20 years after fire in the main karri belt, but alternatively

it could have been only 3 to 5 years after fire.

This leads to the fascinating problem concerning the silvicultural aspects of the relationship between fire and the karri forest. There can be little question that long absence of fire was essential for successful natural regeneration. Although the normal karri seed cycle covers 4 years from bud initiation to production of ripe seed, variations can occur; succeeding cycles can overlap or, in the absence of fire, seed can remain on the trees for 2 summers so that some seed is nearly always present. Even a seed crop which is poor by current forestry standards would be ample for regeneration given heavy fuels and therefore intense fires under 50 or 60 trees per hectare, as would be the case in a mature virgin stand.

With respect to the effect of fire on young karri trees, it has been demonstrated that sapling karri (up to 15 m in height and 250 mm in diameter) cannot stand even the mildest intensity fire without suffering defoliation, severe stem scarring or even death (Peet and McCormick, 1971). However, when the karri has passed this stage (usually at age 12 to 15 years, depending on the site), regrowth stands can be burnt successfully with mild prescribed fires without killing or damaging trees in the mid-crown and upper-crown classes. Furthermore, karri has a phenomenal capacity to regenerate as coppice from the base of young fire-killed stems. For example, a 9-year-old regrowth stand near Quininup which was defoliated by severe wildfire on 20 December 1974 had by 1977 virtually replaced itself by vigorous coppice regrowth, and the Boranup second growth karri forest is considered to have originated mainly as coppice (McKinnell, personal communication) after heavy cutting and uncontrolled fires. Moreover, seedling regrowth karri stands established on ashbed after wildfire or regeneration burning are practically fire-resistant until they are about 5 to 6 years old and start accumulating combustible leaf and trash litter; this was evident in the March 1969 Boorara fire, where on a day of extreme fire danger part of the head fire ceased burning in a 6-year-old stand of karri regeneration during the major run of the fire.

It is clear, therefore, that whilst fire is undesirable in karri regrowth forest between about 7 and 15 years old it is not necessarily capable of eliminating karri trees. The undesirability of fire derives from the forestry rather than the ecological viewpoint.

CONCLUSIONS

The question of natural fire periodicity in the karri forest not only is of biological interest but also has considerable implications for the value of forests and for their management.

The situation prior to European settlement was obviously a complex one and the notion of an "average" fire periodicity is meaningless. Clearly, it is possible that rare, catastrophic fires which would kill a stand and result in even-aged regeneration could co-exist with irregular mild fires started by lightning or penetrating the forest from peripheral areas as a result of burning by the Aborigines. At any one time, there would have been a wide range of fuel ages throughout the forest, the long-unburnt, heavy fuel areas being most likely to support high-intensity fires. In some areas fires may have occurred every 6 to 10 years but in others, such as the deep, moist stands on southern aspects or along the river systems, many decades might have passed before chance and circumstance coincided and a fire able to sustain itself was started.

The relevance of these theories to current prescribed burning practice is of academic interest only, so long as it can be shown that this burning practice has no long-term undesirable effects ecologically or aesthetically. The days have passed when man can afford to let nature take its course - there are too many other community and forest values to consider. Continued research into fire effects is essential and current practices for each forest area must be re-evaluated continually in terms of special features to be protected, acceptable risks, and particular management priorities. In the meantime, prescriptions must be formulated using the most reliable information currently available, which suggests that mild rotational prescribed burning for hazard reduction purposes is not only essential to protect the many forest

and community values in the karri region but is also the only feasible and effective forest fire control policy which has yet been developed.

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