PRESCRIBED BURNING AND NATIVE ANIMALS IN THE NORTHERN JARRAH (*Eucalyptus marginata* Donn. ex Sm) FORESTS

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INTRODUCTION

Early forest managers were in the main concerned solely with timber production. That their methods may have conserved the forest fauna is largely fortuitous. The recognition of environmental values over the past decade has high-lighted the need for attention to more than just the timber crop. Foresters are now faced with the conservation and management of the forest as an ecological entity rather than as a simple timber producer. The situation becomes complex when we take into account the rapidly changing technologies being employed to improve efficiency. A tendency towards clear felling and even-aged management causes temporary destruction of the forest habitat, while the aerial ignition of prescribed burns has resulted in a ten to twenty-fold increase in the area burnt at one time. The investigation of the impact of such management practices on plant and animal communities is being conducted in the forests of Western Australia. An account of the studies into the relationship between fire and some forest animals in the northern jarrah forest is given in this paper.

The jarrah forest has been subjected to fire during historic and prehistoric times (Wallace 1966, Churchill 1968). The fire factor is evident in the plant life-forms that have developed in the ground vegetation. The large majority of the species represented are perennials and show adaptations generally associated with a fire affected habitat. Many of the dicotyledon plants survive fire by means of a woody rootstock homologous with the lignotuber of some eucalypt species (Gardner 1957). Those that

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lack this organ may have seed that accumulates in the soil in a dormant state until subjected to heat (e.g. many legumes), or a fruit that remains closed until subjected to the heat of a fire (e.g. many proteaceaus species). The monocotyledon plants nearly all have apical meristems situated some inches below the soil surface (e.g. Xanthorrhoea gracilis, Lomandra spp.). Species with woody rootstocks or subterranean apical meristems are abundant and reshoot within a few days or weeks of burning. Ground cover is rapidly re-established from this source, and forms a food supply for herbivorous animals.

Prescribed burning was introduced in the Jarrah forest in 1954. From the middle of the 19th century to 1918 little fire control was exercised and irregular, and frequently intense burns were the fire pattern. From 1918 to 1954 a policy of protection from fire of forest units between 500 and 1000 acres was followed. Firebreaks one to two hundred metres wide between the protected units were burnt frequently, and often they were swamps.

Records of animal populations are sparse. A general decline of many marsupials throughout the south-west of the State was noted in the decade 1920 to 1930 (Ride 1970).

THE BASIS OF INVESTIGATIONS

The selection of species for detailed study was based on a classification of the habits and habitat requirements of those known to be present in the area. Those which from the classification appeared most vulnerable to disturbance and habitat alteration by fire, or due to limited mobility, were selected for study.

Classification

Herbivores

Arboreal	Terrestrial
Brush-tailed possum	

Very Mobile		Less Mobile
		Specialised Habitat
Unspecialised Habitat	Specialised Habitat	Quokka, Southern bush rat
Grey Kangaroo Brush Wallaby	Tammar Wallaby Woylie	

Carnivores

Arboreal	Terrestrial	
Phascogale Native cat (partly arboreal) Bats	Unspecialised Habitat	Specialised Habitat
	Native cat (partly terrestrial)	Mardo, Short-nosed bandicoot

The number of species represented in the classification is far from complete, but it gives a starting point and it can be made more comprehensive as more information is accumulated.

Species selected for detailed study were the tammar wallaby (Macropus eugenii), the quokka (Setonix brachyurus), the woylie (Bettongia penicillata) and the southern bush rat (Rattus fuscipes) from the herbivorous group, and the mardo (Antechinus flavipes) and short-nosed bandicoot (Isoodon obesulus) from among the carnivores.

The tammar study has yet to be initiated pending the location of a population within reasonable distance of the research centre. Studying the short-nosed bandicoot has posed problems that have yet to be overcome. It is difficult to trap regularly and females have a tendency to kill their pouched young when confined in a trap.

Studies of the woylie and southern bush rat are directed from the Manjimup Research Station and are not included in this paper. The investigation procedures are generally similar to those described later for the mardo and quokka, but the extreme mobility of the woylie and its habit of damaging itself in a trap have led to the use of radio tracking techniques for this species.

The basis for planning the investigations was the reliance of the animal on vegetation for food, cover, or both. Measurements of vegetation structure and composition are an integral part of the studies. The species selected appear to have the following requirements with respect to vegetation structure in the north jarrah forest.

Tammar - hides by day in fairly dense swamps with thick overhead cover, but sparse cover from ground level for a height of two feet or so to allow relatively unrestricted movement. This confines the tammar to certain swamp types in the more eastern portion of the forest. It moves into more open situations at night to feed.

Quokka - requires dense cover overhead and extending to ground level. Movement is along runs made by regular use of the same route. Almost completely confined to swamps dominated by Agonis linearis. These occur in the more westerly parts of the forest.

Mardo and bandicoot - require dense cover to ground level, but due to their relatively small size this cover need only extend for a limited height. Both species are restricted mainly to swamps during the day, but the bandicoot roves widely over more open upland sites at night.

The aim of the studies is to find the effects of prescribed burning.

1. Prior to burning, measure the vegetation structure and composition of the habitat, and obtain an estimate of animal populations.

2. At the time of burning, determine the fate of the animals. Possible alternatives are

a. They may be killed.

b. They may survive the fire but be left in an unsuitable habitat, or they might find the burnt area suitable.

c. They may leave the burning area and enter an unsuitable habitat, or if they reach a suitable habitat they may create problems of over-population.

3. After the burn, measure vegetation recovery and animal repopulation until the pre-fire equilibrium is reached.

METHODS

The study of both the mardo and quokka involves live trapping the animals. Trapped individuals are weighed, measured (length of ear and hind foot, and for mardos tail and body length), and a note is made of the sex and breeding condition. An estimate is made of the length of small young in the pouch; larger ones free of the teat are measured. To facilitate the handling of the small

and very active mardo it is anaesthetised. Mortality from this procedure is less than 1%.

Mardos are taken in Elliott traps, a small box-type trap constructed in aluminium, which can be folded for easy transportation. The bait is based on peanut paste with an admixture of oatmeal and raisins, but almost any oily or smelly edible substance can be used. Traps are located in pairs to ensure that the capture of one individual does not preclude the capture of a second visiting the location. Each pair of traps is located at alternate points on a 16 metre grid system, and they are moved in rotation every 4 days. Lines of single traps at 20 metre spacing are also used.

A combination of a fence and a funnel trap is used for quokkas. The function of the fence is to intercept the animal and to guide it to the funnel trap. Apples are used for bait. Traps, with the funnel removed, are baited for one week ~~with the funnel removed~~ prior to trapping to allow the animals to become familiar with them. Trapping continues until no new individuals are caught, usually a period of 3 to 4 weeks. Traps are left in situ between trapping periods, but the fence and funnel are removed.

Mardo study areas are trapped for one week every two months in long-term studies, and for two to three week periods for short-term studies involving one trapping session. Trapping for quokkas is carried out twice yearly in autumn and spring.

Vegetation assessments are made at intervals of 6 months to 1 year. Point sampling is used to determine structure in terms of cover percent by 1 foot vertical intervals, basically following the method of Goodall (1952). Species composition is assessed subjectively by recording the 8-10 species contributing the major part of the vegetation cover.

Quokkas are being studied at 5 locations, and mardos at 5 swamp and 1 upland location.

RESULTS

I wish to emphasize that the studies are not complete and many of the results given must be considered trends requiring confirmation.

The mardo.

Pooled results from all locations have indicated a strong seasonal variation in the success of trapping (fig. 1). The dearth of captures from September through December is due to

1. The probable death of most of the male population after mating.

2. The gravid female becoming far less wide-ranging, and remaining so until the young become independent.
This factor limits the value of trapping immediately after fires lit in the spring.

figure 1 here →

One swamp location was completely burnt out in November 1972. Pre burn trapping from February to May 1972 gave a catch rate* of 3.1%. One of 23 individuals marked before burning was caught immediately after the fire, but trapping from February to May 1973 yielded no mardos. Hence the fire, an unusually intense one peaking to an estimated 10,000 Btu/ft/min., did not kill the entire population, but the habitat apparently became unsuitable and any survivors left the area. Repopulation of the swamp by mardos had not started 7 months after the fire.

Three of the swamp locations were partially burnt in October 1971 and their mardo populations compared with an unburnt fourth location. No pre-burn trapping was possible in these swamps. Post burn results for the period November 1971 to June 1973 are shown in table 1. The catch rate in the burnt swamps differed little from that in the unburnt control, and mardos were caught at all three locations immediately after burning.

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* Catch rate is the number of captures per 100 trap nights.

Table 1

Post-burn trapping results for the mardo

(Patchily burnt swamps)

Portion of Swamp Burnt	Catch rate, mardos	Vegetation cover 0-30 cm	
		Pre-burn	Post-burn
0	2.29	420%	-
15%	2.56	435%	305%
80%	3.87	350%	90%
85%	1.60	530%	145%

The upland study has continued from September 1972 to June 1973 giving 1000 trap nights on each of the two sites. One site, subjected to regular prescribed burning and last burnt in November 1972, gave a catch rate of 0.1% from that date to June 1973. The second, adjacent site had remained unburnt for 42 years and yielded a catch rate of 4.2% (21 individuals) over the same period. Pre-burn cover was 128% for the unburnt and 201% for the regularly burnt site. By June 1973, 7 months after the fire, the vegetation had recovered to give 129% cover. In this example the dense litter in the unburnt site, not recorded in vegetation assessments, probably provided the dense cover necessary for the mardo.

The quokka.

Data on the quokka has been collected for only one year and is too meagre for firm conclusions to be drawn. Results to date have suggested population densities of one animal per two hectares of swamp habitat. This figure assumes the entire population has been trapped. It is likely that some individuals are not being trapped and the actual population density is higher

than stated. Pouched young have been noted throughout the year, and it appears that the mainland quokka differs from the Rottnest Island population which shows a fairly well defined breeding season (Dunnett 1962).

Results from burning trials have shown the animals to remain in patchily burnt swamps using the unburnt patches for cover and food supply. Recovery of the swamp vegetation after burning is rapid. Various species of rush, on which the quokka grazes, were found to have green shoots over 5 cm long one week after the fire. The main cover species, Agonis linearifolia, reached a height exceeding 1 metre 6 months after the fire. Quokkas were trapped 7 months after completely burning out one swamp; recolonisation appears to be very rapid.

Some trapping results are shown in table 2.

Table 2

Pre- and post-burn trapping results for the quokka

Date and extent of burn	Pre-burn		Post-burn	
	Catch rate	No. of individuals	Catch rate	No. of individuals
1. Not burnt	Not trapped		12.8	9
2. November 1972				
60% burnt	3.8	12	11.3	13 (1)
3. October 1972				
100% burnt	Not trapped		1.8	7

(1) Includes 10 individuals not trapped prior to the fire.

(2) Trapping periods were

Site 1 - Post-burn 30/6 to 19/7/72, 180 trap nights

Site 2 - Pre-burn 21/8 to 9/11/72, 960 trap nights
Post-burn 5/12 to 21/12/72, 238 trap nights

Site 3 - Post-burn 15/5 to 29/6/73, 765 trap nights

Swamp 1, trapped 5 years after burning, can be regarded as a control. The post-burn catch rate in swamp 3, which was patchily burnt a few months before trapping, is almost as high as that in the control swamp but a large proportion of the capture was of new individuals suggesting an influx of quokkas into the area. The large difference between pre- and post-burn catch rates in swamp 3 supports this point.

In swamp 2 some migration back to the swamp has taken place 7 months after a complete burn, but the low catch rate indicates that the population has yet to reach the level that can be expected in older vegetation. Intensive trapping is continuing here to record the progress of repopulation.

DISCUSSION

The results for both mardo and quokka show severe disruption of populations when swamp habitats are completely burnt. Insufficient data has been collected yet to determine the rate of animal repopulation and vegetation recovery. However, evidence is presented that quokkas have started to return within 7 months, and that mardos will require a longer period.

Incomplete, patchy burns have had no effect on mardo populations (the range tested was from 15% to 85% of the habitat burnt), and appear to have resulted in increased quokka numbers in the case of a 60% burn.

It has become apparent during the course of these studies that nearly all the swamp systems in the northern jarrah forest are uneven-aged in patches; and that the burning out of complete swamps is generally not possible with prescribed burns conducted in mild, spring conditions. Swamp 3 in table 2, for example, was two-aged. Those patches which burnt were 12 years old, and those which did not were 6 years. (Swamp age was determined by ring-counts made on *Agonis linearis* stems.)

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Figure 1. Seasonal variation in catch rate for the mardo

Figure 2. The fence and funnel trap for quokkas

Figure 3. Mardo (Photo by Dick Perry)

Figure 4. Quokka being ear-tagged

Figure 5. A trapped female quokka

Figure 6. Elliott trap for mardos (right), and box trap used for bandicoots

The large mardo population in a long unburnt upland site is indicative of upland burning restricting the range of this species mainly to the dense vegetation of swamps. Other studies have shown the mardo to be widespread over most upland situations, but populations are at a very low level.

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