FIRE AND MAMMALS IN HUMMOCK GRASSLANDS OF THE ARID ZONE

Andrew A. Burbidge

Introduction

Hummock Grasslands, commonly called 'spinifex', are very widespread in the arid zone of Western Australia, dominating the vegetation of the Pilbara, Great Sandy Desert, Tanami Desert, Little Sandy Desert, Gibson Desert, Great Victoria Desert and Warburton Region (Beard 1969); together comprising more than half of the State. Hummock Grasslands may be formed by most species of the genus **Triodia** and a few of the genus **Plectrachne**, notably **P. schinzii**. Important species of **Triodia** include **T. basedowii**, **T. pungens** and **T. lanigera**.

Hummock grassland normally contains a number of scattered trees and shrubs (tree steppe), or shrubs only (shrub steppe); the absence of woody plants being a rare condition (Beard in Jessop 1981). It occurs on a wide variety of soil types from loose sand through sandy loams to rocks. The hummocks vary in size and density - some may be up to 1 m high and 2 m across but most are less than 50 cm high. Cover in typical hummock grasslands is around 30% and does not usually exceed 40%, there being significant areas of bare ground between the hummocks. A variety of small woody and herbaceous plants, many ephemeral, occupy some of the space between the hummocks.

In common with many other grasslands, spinifex burns readily. After fire the community is typified by the presence of annuals and short-lived perennials, as well as regenerating **Triodia** or **Plechrachne**. Gradually this develops to a mature hummock grassland with few ephemerals and few woody plants. Hummock grasses regenerate from seed but significantly, older hummocks can regenerate rapidly from root-stock. Depending on rainfall, hummock grasslands can carry a fire as soon as five years after a burn (N.T. Burbidge 1944; Suijendorp 1981).

Because of the high frequency of fire in hummock grassland, fire-sensitive species are largely absent or are restricted to areas that do not burn because of natural protection. In the Pilbara's Hamersley Ranges, for example, there are many species, including endemics, that occur only in the fire protected gorges. **Callitris columellaris** is another example of a fire-sensitive species that is absent from hummock grasslands, being restricted to those parts of ranges where it is afforded protection from fire. Where long-lived overstorey plants are present these are always species which can survive fire, being protected by thick, corky bark (**Allocasuarina decaisneana**, **Hakea suberea**, **Owenia reticulata**) or resprouting from roots, and stems both above or below ground (**Grevillea** spp., **Eucalyptus** spp.) (Maconochie 1982; Hodgkinson & Griffin 1982). One species, **Eremophila gilesii**, is known to avoid fire by suppressing grass growth (Hodgkinson & Griffin 1982).

Most species occurring in hummock grassland are short-lived annuals or perennials which complete their life cycle and set copious seed before the community develops once more to the fire-prone stage. Included in this category are a variety of soft grasses and sub-shrubs, especially legumes. Often germination of such species is promoted by fire.

Hummock grasslands are rich in species of vertebrate animals, the hummocks providing shelter from both extreme temperature and humidity and from predators. The fauna of the Great Sandy Desert, for example, includes at least 37 mammal species (McKenzie & Youngson 1983) and 75 reptile species (Burbidge 1983). The vast majority of these groups live in or under the hummocks.

The Decline of the Mammals

My interest in fire and spinifex developed from an investigation into the reasons for the decline of arid zone mammals. The first modern detailed investigations into the status of desert mammals carried out in the 1970s (Burbidge **et al.** 1976; McKenzie & Burbidge 1979; Burbidge & McKenzie 1983) failed to reveal the presence of a wide variety of mammals which were known to be common in the 1930s and before (Finlayson 1961; Ride 1970). My colleagues and I extended this work to include detailed interviews with the older desert Aborigines who are very familiar with the fauna of their land (Burbidge & Fuller 1979, 1984), paralleling work carried out by Dr K.A. Johnson and colleagues in the Northern Territory (e.g. Johnson & Roff 1982). This work, now almost complete, has for the first time delineated the current and former distribution of the larger (> 50 g) desert mammals and has provided information on the timing of the decline and disappearance of so many species (Burbidge, Johnson, Fuller & Southgate, in prep.). Examples of species which were once widespread and which are now extinct in the arid zone include the Burrowing Bettong (**Bettongia lesueur**), Western Quoll (**Dasyurus geoffroii**), Desert Bandicoot (**Perameles eremiana**) and the Stick-nest Rats (**Leporillus conditor** and **L. apicalis**). All species which have declined or become extinct have mean adult body weights between about 45 g and 5 kg, intermediate between the still abundant small dasyurids and rodents on one hand and the large kangaroos on the other (Burbidge & McKenzie 1983 & in prep.)

The possible causes of decline will be discussed in detail by Burbidge & McKenzie (in prep.) and discussion in this paper will be limited to the hypothesis that a change in the fire regime has been the major cause.

Aboriginal Use of Fire

Desert Aborigines used fire for a variety of purposes:

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(a) Hunting. Fire was used to drive and flush game, both large and small. Finlayson (1943) gives a graphic account of the use of fire to hunt Rufous Hare-wallabies (Lagorchestes hirsutus).

(b) Regeneration of food plants. Aborigines ate a number of different parts including seeds, fruit, leaves, tubers and bulbs of a wide variety of plants. Latz & Griffin (1978) provide data on some of the more than 170 species which were utilised by desert Aborigines, either as food (ca. 100 species), for implements and medicines, or indirectly as hosts for edible invertebrates. Many of these occur abundantly only for a few years after fire.

(c) Signalling. Triodia and Plectrachne burn with a dense, black smoke. Fire enabled different individuals in a group to keep track of each other's movements while hunting or moving across country and it enabled different groups to be aware of each other's presence.

(d) Warmth. Desert winters are cold. As well as for keeping warm fire was used to cook food and fashion spears.

(e) Clearing ground and extension of man's habitat (Jones 1969). It was, and is, common practice for Aborigines to burn the country as they travelled.

There can be no doubt that burning was a common practice amongst desert Aborigines. As well as the recent descriptions by anthropologists of the use of fire (e.g. Jones 1969; Gould 1971; Kimber 1982; Hallam 1985), there are numerous accounts by early European explorers and settlers (e.g. Giles 1889; Carnegie 1898). The result of these practices was to produce a mosaic of patches of country at different stages of recovery from fire. As well as providing habitat for plants and animals which required differing stages of regeneration it also eliminated the risk of extensive wildfires. Fires which were started, either by Aborigines or by lightning, soon ran into areas of low fuel which acted as a firebreak. The fire mosaic provided adjacent areas of old hummocks that were used by many animals as shelter, and regenerating areas that were rich in the soft grasses, other ephemerals and legumes utilised as food by herbivores, which in turn supported carnivores (Bolton & Latz 1978).

It is clear that, consciously or not, desert Aborigines managed the land with fire to maximise food production. Jones (1969) called the use of fire by Aborigines in land management 'fire-stick farming' and suggested that this was the major element of technology that Aborigines had in manipulating their environment.

Changes in Land Management

When Aborigines moved from their traditional lands to European settlements they effectively abandoned enormous areas. The lack of frequent patch burning led to the development of extensive old stands of unproductive hummock grass. Fires which did start were extensive, often running for hundreds of kilometres and leaving little or no country unburnt.

Information collected on the timing of the disappearance of the medium-sized mammals shows that it coincided with the movement of Aborigines to settlements. Johnson & Roff (1982) have discussed the different time of disappearance of Dasyurus geoffroii in different parts of the Western Desert and similar data exist for many other species (Johnson et al. 1983 & pers. comm.; Burbidge & Fuller, unpub.). It is clear that most, if not all, desert mammals persisted until the 1940s and even into the 1950s in areas where Aborigines maintained their traditional lifestyle. This is especially so in those parts of the Gibson Desert of Western Australia occupied by Pintupi people until the 1950s.

The Future

Unfortunately some of the mammals which once occupied the hummock grasslands of Western Australia appear to be extinct e.g. Pig-footed Bandicoot (Chaeropus ecaudatus), Desert Bandicoot (Perameles eremiana), Central Hare-wallaby (Lagorchestes asomatus), Crescent Nailtail Wallaby (Onychogalea lunata) and Lesser Stick-nest Rat (Leporillus apicalis). Others, however, remain in very restricted parts of the arid zone e.g. Dalgyte (Macrotis lagotis), Rufous Hare-wallaby (Lagorchestes hirsutus) and Brush Possum (Trichosurus vulpecula); in adjoining better-watered country, e.g. Golden Bandicoot (Isoodon auratus), Brush-tailed Bettong (Bettongia penicillata), Numbat (Myrmecobius fasciatus) and Red-tailed Phascogale (Phascogale calura); or on islands e.g. Burrowing Bettong (Bettongia lesueur) and Greater Stick-nest Rat (Leporillus conditor). These species could easily be reintroduced to parts of the desert but could not be expected to re-establish unless the land was managed.

Western Australia has made a significant contribution to the conservation of hummock grassland communities by creating a series of large National Parks and Nature Reserves, and more are proposed. Reserves which protect extensive areas of hummock grassland include:

Hamersley Range National Park	617 606 ha
Rudall River National Park	1 569 459 ha
Gibson Desert Nature Reserve	1 859 286 ha
Neale Junction Nature Reserve	723 073 ha
Yeo Lakes Nature Reserve	321 946 ha

Plumridge Lakes Nature Reserve	308 990 ha
Queen Victoria Spring Nature Reserve	272 607 ha
Great Victoria Desert Nature Reserve	2 495 777 ha
TOTAL	8 168 744 ha

Together, these eight reserves comprise about 50% of the total area of land controlled by the Western Australian Department of Conservation and Land Management. The addition of reserves proposed in the Great Sandy Desert (Burbidge & McKenzie 1983) and those proposed by the Conservation Through Reserves Committee (1974) but yet to be declared, would give Western Australia a good representation of hummock grassland communities in protected areas.

At present these parks and reserves are not managed. From the information presented in this paper it follows that the best form of management would be to mimic Aboriginal burning. This can be achieved in part by encouraging Aborigines to use their traditional lands again and such is being gradually achieved by the "outstation" movement now occurring. However, it seems most unlikely that this will lead to the same firing pattern being established since:

(i) Aborigines are occupying fixed settlements or "outstations" and hunt only within a short distance of them and along roads between them.

(ii) Aborigines are now dependent to a large degree on European food and live a semi-European lifestyle, e.g. movement is by vehicle along graded roads.

Thus management by the Department of Conservation and Land Management will be necessary if the habitat in the National Parks and Nature Reserves is to become suitable for the re-establishment of the mammals.

Recently the Department advertised two positions - a Research Officer and a Technical Officer - to be based at Kalgoorlie to start work on resolving this problem. It will be their role to liaise with Aboriginal Communities and to set up experimental programs on the use of fire in the management of desert parks and reserves. The use of aircraft burning will be evaluated. Their task is a large one but we need to make a start now before it is too late to save some of the mammals which still remain in remnant populations.

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