

Kangaroo Management in Western Australia

by K.J. McNamara and R.I.T. Prince



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Land Management



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by

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FOREWORD

In 1984 the Western Australian Department of Fisheries and Wildlife established a new publication series entitled "Western Australian Wildlife Management Programs", with the publication of "Kangaroo Management in Western Australia 1984" (Crook and Prince, 1984). This series is being continued by the Department of Conservation and Land Management, formed in March 1985 through the amalgamation of the Wildlife Branch of the former Department of Fisheries and Wildlife with the National Parks Authority and the Forests Department.

This publication revises and updates Wildlife Management Programme No. 1, "Kangaroo Management in Western Australia 1984".

CONTENTS

Foreword	2
Acknowledgements	5
1. Preamble	7
2. Responsible Organisation and Statutory Basis	7
3. Species	7
4. Origins of the Present Kangaroo Management Program	9
4.1 Red Kangaroo and Euro	9
4.2 Western Grey Kangaroo	11
5. Formal Statement of the Aims of the Kangaroo Management Program	13
6. Objectives of this Paper	14
7. Distribution of Kangaroos and the Effects of Land Use on Kangaroo Habitat and Populations	14
7.1 General Considerations	14
7.2 Red Kangaroo	16
7.3 Western Grey Kangaroo	18
7.4 Euro	21
8. Assessment of Kangaroo Population Trends	24
8.1 Red Kangaroo	24

8.2	Western Grey Kangaroo	27
8.3	Euro	28
9.	Determination of Culling Levels	28
10.	Management Procedures	30
	References	31

Tables

1.	Commercial harvest and quota details for red kangaroos, western grey kangaroos and euros, 1970-1985	25
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Figures

1.	Distribution of the Red Kangaroo in Western Australia in Relation to Land Use	17
2.	Distribution of the Western Grey Kangaroo in Western Australia in Relation to Land Use	20
3.	Distribution of the Euro in Western Australia in Relation to Land Use	23

ACKNOWLEDGEMENTS

The following documentation of kangaroo management in Western Australia is a summary of this particular management program to which many people have contributed in the 15 years of its development. These include many officers of the former Department of Fisheries and Wildlife and the present Department of Conservation and Land Management.

Outside of Departmental officers the list grows. Major contributions have been made by officers of the Department of Agriculture, officers and members of the Agriculture Protection Board, members of the Department's Kangaroo Management Advisory Committee, the Pastoralists and Graziers Association, the Pastoral Section of the Primary Industry Association and representatives of the kangaroo industry. Conservation groups too, have played their important part. Western Australian, national and international bodies have maintained an active interest in the management program, especially in recent years.

All these individuals and groups have contributed to the program, which is as it should and should continue to be.

KANGAROO MANAGEMENT IN WESTERN AUSTRALIA

1. PREAMBLE

The following account is a general statement intended for public information of the basis, objectives and mechanisms of the Western Australian kangaroo management program, similar to and updating that of Shugg and Prince (1973) and Crook and Prince (1984). It does not purport to present a rigorous account of kangaroo populations and their distributions or to document in any exhaustive way the evidence accumulated in the 15 years of its operation of the effects of the management program on kangaroo populations. These latter purposes are served by two papers by Dr R.I.T. Prince of the Western Australian Wildlife Research Centre (Prince 1984a, 1984b).

2. RESPONSIBLE ORGANISATION AND STATUTORY BASIS

Kangaroo management in Western Australia is administered by the Department of Conservation and Land Management, according to the provisions of the State's Wildlife Conservation Act (1950, as amended) and Regulations. Prior to the formation of the Department on 22 March 1985, this responsibility rested with the former Department of Fisheries and Wildlife.

3. SPECIES

All twenty-two* species of the Superfamily Macropodoidea (kangaroos and their relatives) which are known to occur, or to have recently occurred, in Western Australia are protected until otherwise declared by the Minister responsible for the Wildlife Conservation Act (1950, as amended).

Four species may be taken for the purpose of containing their effects on other land management practices (i.e. for the purpose of damage mitigation), by virtue of the provisions of Section 14(2)(a) (open seasons) or Section

*The list of species is taken from Strahan (1983).

15(1) and Regulation 5 (damage licences) of the State's Wildlife Conservation Act and Regulations. This management program refers to three of those species, the products of which are exported from Australia in accordance with the Commonwealth Wildlife Protection (Regulation of Exports and Imports) Act 1982, viz:

Red kangaroo	<i>Macropus rufus</i>
Western grey kangaroo	<i>Macropus fuliginosus</i>
Euro	<i>Macropus robustus</i>

The agile wallaby (*Macropus agilis*) is subject to open seasons but, as its products are not exported overseas from this State, it is not dealt with further in this program.

The remaining eighteen species are:

Long-nosed potoroo	<i>Potorous tridactylus</i> ¹ (presumed extinct in Western Australia but survives elsewhere)
Broad-faced potoroo	<i>Potorous platyops</i> ^{1,2} (presumed extinct)
Brush-tailed bettong	<i>Bettongia penicillata</i> ^{1,2}
Burrowing bettong	<i>Bettongia lesueur</i> ^{1,2}
Spectacled hare-wallaby	<i>Lagorchestes conspicillatus</i> ¹
Rufous hare-wallaby	<i>Lagorchestes hirsutus</i> ^{1,2}
Banded hare-wallaby	<i>Lagostrophus fasciatus</i> ^{1,2}
Northern nailtail wallaby	<i>Onychogalea unguifera</i>
Crescent nailtail wallaby	<i>Onychogalea lunata</i> ^{1,2} (presumed extinct)
Black-footed rock-wallaby	<i>Petrogale lateralis</i> ¹
Rothschilds' rock-wallaby	<i>Petrogale rothschildi</i>
Short-eared rock-wallaby	<i>Petrogale brachyotis</i>
Warabi	<i>Petrogale burbidgei</i> ¹
Nabarlek	<i>Peradorcas concinna</i>
Tammar wallaby	<i>Macropus eugenii</i> ¹
Western brush wallaby	<i>Macropus irma</i>
Antilopine wallaroo	<i>Macropus antilopinus</i>
Quokka	<i>Setonix brachyurus</i>

The species marked (1) are included on the list of Western Australian species which are rare or otherwise in need of special protection. The Barrow Island euro *Macropus robustus isabellinus* is also included on that list. Those species marked (2) are included on the official list of Australian Endangered Vertebrates (Burbidge & Jenkins 1984). The conservation of all these species is an important part of the Department's responsibilities but is not dealt with in this program.

4. ORIGINS OF THE PRESENT KANGAROO MANAGEMENT PROGRAM

4.1 RED KANGAROO AND EURO

The foundation for the present program of management of the red kangaroo and euro was established in 1970 by the Minister for Fisheries and Wildlife under the provisions of Section 14 of the State Wildlife Conservation Act by notice in the Government Gazette of 17 April of that year.

The notice permits red kangaroos and euros on pastoral leasehold and private lands in the Local Authority areas in the Schedule attached thereto to be taken by the owners or lessees of the land concerned. Where the animals taken are used for commercial purposes, this is subject to the licensing and tagging provisions of the Wildlife Conservation Regulations and such constraints of management as may be applied from time to time.

The management program was instituted in February 1971. It is based on the principles and guidelines for controlled, commercially-based harvesting principally of red kangaroo on pastoral leasehold lands, set down in the first instance by Arnold (1970) in his unpublished paper "Control of the Kangaroo Industry in Western Australia". The program was first formally documented by Shugg and Prince (1973) in accordance with recommendations of the Ministerial Working Party on Kangaroos set up by the respective State and Commonwealth Government Ministers at their meeting in Melbourne on 9 March 1973.

The legal basis of the program has been modified in some of its details by Government Gazette notice on a number of occasions, most recently on 21 November 1980.

Referring to the red kangaroo, which species is harvested in by far the larger numbers of the two (red kangaroo and euro), the objectives of the program were stated by Arnold (1970) to be as follows:

- "1. To conserve the red kangaroo so that there is always a substantial population in the State and to keep stocks below pest proportions.
2. To allow the red kangaroo populations to be rationally exploited."

In summary, the program instituted in 1970-71 arose from the dual need to control populations and rates of natural increase, so as to limit damage to pastures and crops, and to limit the consequent exploitation of kangaroo populations within biologically sound limits.

During the period 1960-65 the then unregulated kangaroo pet meat and allied dry skins trade in Western Australia may have caused a peak harvesting rate of 100 000 - 150 000 animals of all species (red, euro and western grey kangaroo combined) in any one year.

Exploitation of the three species of kangaroos now subject to commercialisation, is a long one dating back to the early years of European settlement of Western Australia. Its history has been documented in considerable detail by Prince (1984a). Based initially on production of skins for export and latterly on a combination of skin and pet meat production, Prince's study suggests that this exploitation has done little to harm the conservation status (i.e. the long-term stability of distribution and populations) of the wild populations involved.

After 1965, and particularly in the final three years of that decade, however, the pet meat/skin industry expanded and became more heavily dependent on red kangaroos. Hitherto grey kangaroos and a few euros were taken, the take of the latter always being very small because of its hilly and largely inaccessible habitat. Trade in red kangaroo carcasses and skins by local dealers for the period 1967-1970 was:

1967	175 000
1968	175 000
1969	400 000
1970	275 000

The 1969 take, in particular, was considered too large for the population to sustain. It led directly to the institution of the management program in 1970-71.

At the time of formulation of the management program (April 1970) the population of red kangaroos was estimated to be "... between one and two million animals probably in the lower margin of the range - one to one and a half million" (Arnold 1970). For the initial year of the management program (1971) a harvest quota of 225 000 was set. A total of 173 000 was taken.

The population of euros was not estimated, nor a quota applied, the management program for this species being based on two premises:

Firstly, that the relative inaccessibility of its habitat is, in itself, sufficient protection against excessive harvesting; and

Secondly, that the study of euros by Ealey (1967), which suggested the presence of a population of 400 000 animals in the Pilbara alone, and the presence of substantial populations in extensive highland Nature Reserves and National Parks in the euro's range, assured its security in the face of the minimal harvesting levels pertaining at the time.

This situation continues, except that now a quota is set. Euros are shot only when their incursions into areas of favoured sheep rangelands cause damage. They are rarely taken in significant numbers and then only in response to specific rangeland damage situations.

4.2 WESTERN GREY KANGAROO

The grey kangaroo* management program was instituted in 1971 by the Minister for Fisheries and Wildlife under the provisions of Section 14 of the Wildlife Conservation Act by notice published in the Government Gazette of 23 July of that year. The program was first fully documented by Shugg and Prince (1973) in accordance with the recommendations of the Ministerial

*In all cases "grey kangaroo" refers to the Western Grey Kangaroo, *M. fuliginosus*.

Working Party on Kangaroos set up by the respective State and Commonwealth Government Ministers at their meeting in Melbourne on 9 March 1973.

The grey kangaroo management program, based on the declaration of limited open seasons on the shooting of grey kangaroos by landowners on private land in certain Local Authority areas, has subsequently been extended to include private lands in Local Authority areas specified in the Schedule to the notice published in the Government Gazette of 21 November 1980. The limited open season provision supplements a system for issue of "Damage Licences" permitted under Section 15 of the Act and Regulation 5. The latter continues in Shires not covered by the limited open season provision.

The difference in approach between red kangaroo management on the one hand and grey kangaroo management on the other is that the latter was designed fundamentally to respond to specific damage situations, its purpose being to permit landowners to control grey kangaroos which are on their properties and which are perceived to be disadvantaging agricultural production by their grazing of pastures and crops. In the case of red kangaroos in pastoral rangelands, the purpose was to control their populations and rates of natural increase in order to mitigate damage, as well as respond to specific damage situations.

Grey kangaroos are taken by licensed, professional kangaroo shooters under the separate authority of damage licences. Landowners may also acquire damage licences and tags, so permitting carcasses of animals taken to enter the processing trade. The commercial use of grey kangaroos is subject to tagging, licensing and quota controls similar to those applying to the red kangaroo and euro.

Approximately 40 percent of the original range of the grey kangaroo lies within that part of the State which has been developed for intensive agricultural production. Much habitat in this area has been affected by clearing. Grey kangaroos persist in bushland "islands" and margins, however, from which their incursions onto farmlands are frequently perceived as damaging to the interests of landowners.

The basic aim of the grey kangaroo management program is to maintain as high a population of the species as possible, not only in areas where its

habitat is secure, such as in extensive areas of State Forests, National Parks and Nature Reserves within its range, but also in uncleared privately-owned land (Shugg and Prince 1973) and on the margins of intensively farmed lands. The philosophy behind this program is identical to that proposed by the Australian Conservation Foundation (Ratcliffe 1970) in its Occasional Publication No. 4 in which the A.C.F. recommended that "Kangaroos should be allowed to survive at above rarity level, but at a lower density than would cause justifiable anxiety to graziers - *and not as a continually hunted and harried population.*"

By minimising restrictions on the way landowners may manage grey kangaroos on their own land, and at the same time encouraging tolerance of the presence of kangaroos, the program has aimed to assist the establishment of a stable, lasting relationship between land use and wildlife values in the agricultural areas of the State.

5. FORMAL STATEMENT OF THE AIMS OF THE KANGAROO MANAGEMENT PROGRAM

The National Plan of Management for Kangaroos (N.P.M.K.) endorsed by the Council of Nature Conservation Ministers* in May 1985 gives the "Aims of Kangaroo Management" to be:

- " to maintain populations of kangaroos over their natural ranges; and
- to contain the deleterious effects of kangaroos on other land management practices".

This wording has been adopted as a formal statement of the objectives of the Western Australian kangaroo management program, noting that the sense of the statement is nearly identical to that of the objectives laid down by Arnold (1970).

*The Council of Nature Conservation Ministers is composed of all Commonwealth, State and Territory Ministers having responsibility for national parks and wildlife.

6. OBJECTIVES OF THIS PAPER

The objectives of this paper are as follows:

1. To re-document the Western Australian kangaroo management program according to the guidelines set out in the N.P.M.K., to which it is an annex, re-stating and, where necessary, updating the documentation of the program by Shugg and Prince (1973) and by Crook and Prince (1984).
2. To demonstrate that the continuing Western Australian kangaroo management program (1970/71 as amended) conforms to guidelines laid down in the N.P.M.K. and is a management program suitable for approval by the responsible Commonwealth Minister for the purposes of section 10 of the Wildlife Protection (Regulation of Exports and Imports) Act 1982.

The description of the Western Australian kangaroo management program below, follows that set out in Section 3 (Implementation) of PART A of the N.P.M.K., dealing in order, with information under the headings:

- Effects of land use on kangaroo habitat and populations;
- Assessment of kangaroo population trends;
- Determination of culling levels; and
- Management procedures.

7. DISTRIBUTION OF KANGAROOS AND THE EFFECTS OF LAND USE ON KANGAROO HABITAT AND POPULATIONS

7.1 GENERAL CONSIDERATIONS

Unlike the vast majority of medium to larger-sized (i.e. those in the 50 g - 5 kg class and larger) marsupials in Western Australia, many of which are extinct, near-extinct or seriously reduced in range and numbers since European settlement (Burbidge and McKenzie, unpublished data presented at ANZAAS, 1983), the distributions and populations of the kangaroos which are

the subject of this paper have suffered little or no reduction in the same period (Prince 1984a). On the contrary it is apparent that, like a few other notable members of the State's fauna, such as the silver gull, some honeyeaters and the brush-tailed possum in urban and near-urban areas, the red kangaroo in particular has adapted remarkably well to European styles of rural land use. The impact of European land use on the grey kangaroo and euro populations has been less uniform, but these species too have fared remarkably well.

In this connection it should be noted that, even in areas classified in this program as "Type e" with respect to their usefulness as natural habitat to kangaroos according to the N.P.M.K., i.e. areas where the "...habitat has been altered to the extent that it is no longer suitable...", kangaroo populations frequently persist.

This apparent paradox is best explained by example. The Metropolitan Area of Perth, the capital of Western Australia, can only fairly be described as being "Type e" (i.e. unsuitable habitat) according to the broad classification intended in the N.P.M.K. Within this area, however, in National Parks, Nature Reserves, other local reserves and residual blocks of undeveloped privately-owned land, populations of the grey kangaroo persist. The same cannot be said for many other marsupial species native to the area prior to European settlement. Further, it is pleasing to note that, in some areas, these metropolitan populations of grey kangaroos are increasingly coming to the attention and are enjoying the protection of their human neighbours. Whether they will persist remains to be seen, but their continued existence in small reserves attests to their adaptability and their potential as a continuing element of the fauna.

Turning to the agricultural areas, approximately 16 500 000 ha of land in the higher rainfall, south-western part of the State has been cleared for farming, mainly in the last 75 years. This land also has been rendered "Type e" according to the N.P.M.K., and represents a large part of the original range of the grey kangaroo. It is the one significant area in the State where land use has markedly disadvantaged the kangaroo. But even here populations of grey kangaroos persist in bushland remnants including National Parks and Nature Reserves.

In all other areas of Western Australia, a large State five times the size

of Texas and one third the size of the entire United States, the occurrence and abundance of kangaroos have been at least unaffected and in some areas advantaged by human land use.

Some 5.7% of the State, or more than 14 million hectares, had been set aside as National Parks and Nature Reserves as of 30 June 1985. Many of these areas, as well as substantial areas of State Forest and other public land, contain significant populations of kangaroos.

What follows is documentation of a management program which has been in operation in Western Australia for a period of 15 years and which has demonstrated its effectiveness in terms of its objectives in that time. Writing as members of a community whose primary interest is the conservation of wildlife in all its forms, we would add a personal footnote to this introduction: Would that the rest of our fauna in Western Australia and elsewhere could be as well-served by all forms of human attention, from the use of their habitat through the management of their populations to the vigilant oversight of their interest by animal welfare and conservation movements, as are the larger kangaroos.

7.2 RED KANGAROO

Red kangaroos occur in varying density over a range which occupies approximately 75 percent of the State, that is, an area of approximately 1 900 000 km². Figure 1 shows the range of red kangaroos in Western Australia in relation to land use. A description of that range in terms laid down in the N.P.M.K. follows:

- a. Area where habitat is relatively unaltered and the species' populations have been largely unaffected.

Nearly half of the range of the red kangaroo (900 000 km²) is too arid to support any pastoral and agricultural activities. Consequently, it has been relatively unchanged by European man. The occurrence of red kangaroos in this area is widespread and the population naturally sparse for the most part. Hunting for food purposes by Aboriginal people takes place, as it has in the past, particularly in the vicinity of established communities and out stations.

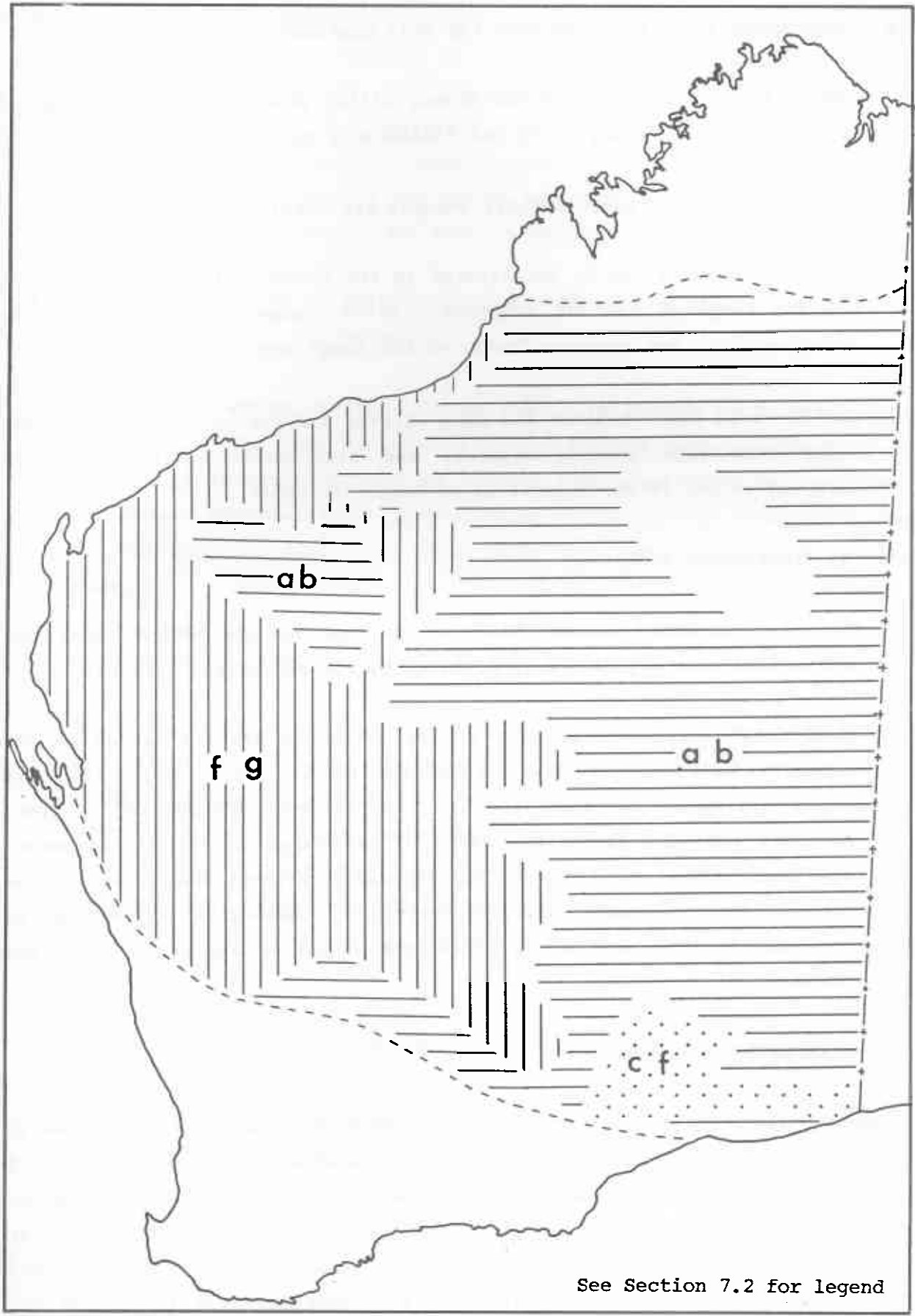


Figure 1 Distribution of the Red Kangaroo in Western Australia in Relation to Land Use

- b. Area where it is expected that (a) will continue.

There is no likelihood of the status of the above part of the range of the red kangaroo changing in the foreseeable future.

- c. Area where future major habitat changes are likely to occur.

No major changes can be anticipated in the foreseeable future over most of the range of the red kangaroo. Minor changes in land use on the south-western and southern limits of the range are possible.

- d. and e. Area where habitat has been altered and the species' populations have been significantly reduced; and area where habitat has been altered to the extent that it is no longer suitable.

No significant area.

- f. and g. Area where current land use has improved the habitat; and area where land uses are adversely affected by the designated species.

This area largely corresponds to the shrubland pastoral areas in the southern half of the State (Jennings et al. 1979, Fig. 4) where sheep-grazing is the main land use. It is about 600 000 km² in area, includes the most favourable parts of the range of the red kangaroo, and encompasses areas where the naturally highest densities of the species have probably always occurred. Commercial harvesting is confined to this area where stock and kangaroos share the rangeland pastures.

7.3 WESTERN GREY KANGAROO

Figure 2 shows the range of the grey kangaroo in relation to land use in Western Australia. As can be seen, a considerable area of the habitat of the grey kangaroo has been lost to the species as a result of clearing for agriculture and development for industrial and urban land use purposes. At the time of the earlier documentation of the management program (Shugg and Prince 1973) the area of agriculturally developed land was 13 740 000 ha. This had increased to approximately 16 500 000 ha in 1985. The increase includes clearing both of previously and newly alienated lands.

The principal strongholds of the grey kangaroo in this State remain the series of State Forests situated in the jarrah and karri belts of the dry and wet sclerophyll forests, and the Nullarbor Plain. The development of pastoral land use on the Nullarbor, with the provision of water and dingo-proof fences has probably improved habitats for the grey kangaroo on a number of large stations of 400 000 ha and greater. A description of the grey kangaroo range in terms laid down in the N.P.M.K. follows:

- a. Area where habitat is relatively unaltered and the species' populations have been largely unaffected.

About 1 800 000 ha of State Forest remain relatively unchanged. It is common knowledge that the species occurs in good numbers throughout the forest. A further 5 600 000 ha (approx.) of substantial National Parks and Nature Reserves (area greater than 20 000 ha) lie within the range of the grey kangaroo and fall into the same "unaltered" habitat category.

- b. Area where it is expected that (a) will continue.

There is little likelihood of the status of the above area changing in the foreseeable future. Shugg and Prince (1973) drew attention to the possible untoward effects of woodchip logging and bauxite mining operations on the State Forest habitat, but these have not eventuated to the extent that was suggested. Bauxite mining operations are followed by rehabilitation programs and woodchip logging has a temporary effect only on suitability of forest areas for grey kangaroos.

- c. Area where future major habitat changes are likely to occur.

Refer to b. above. Some land development will continue at the edges of the present agricultural zone. The rate of development during the last twelve years, referred to above, indicates this to be slowing and there is currently a ban on the release of new areas of public land for agriculture.

- d. and e. Area where habitat has been altered and the species' populations have been significantly reduced; and area where habitat has been

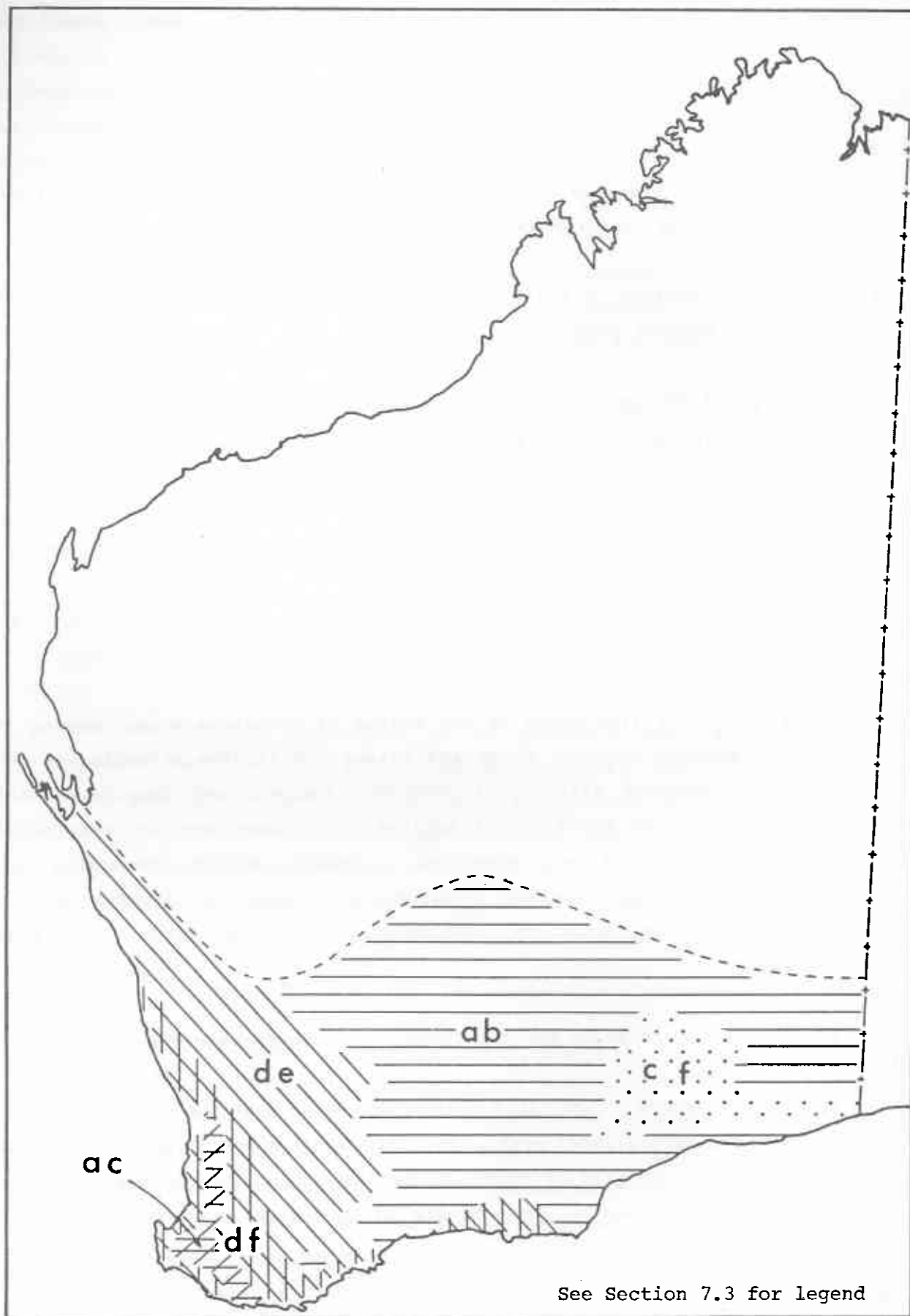


Figure 2 Distribution of the Western Grey Kangaroo in Western Australia in Relation to Land Use

altered to the extent that it is no longer suitable.

Notwithstanding the previous comments with respect to grey kangaroos in farmlands and urban areas (see Section 7.1), approximately 16 500 000 ha, referred to above, have been cleared for agricultural production and farmlands in Western Australia. Together with areas of urban and industrial activity this accounts for approximately 40 percent of the original range of the species.

- f. Area where current land use has improved the habitat.

The pastoral areas of the Nullarbor Plain in particular fit into this category. Provision of water and dingo-proof fencing appears to have allowed grey kangaroos to multiply on these Nullarbor sheep stations.

- g. Area where land use is adversely affected by the species.

Corresponds to f. above. Damage by grey kangaroos to intensive, agricultural lands is limited and isolated in its occurrence.

7.4 EURO

The euro occurs over a wide area in the State but major populations are found in the Pilbara district where it can conflict with domestic grazing stock. It has been closely studied there by Ealey (1967).

Figure 3 shows the range of the species in relation to land use in Western Australia. A description of that range in terms laid down in the N.P.M.K. follows:

- a. Area where habitat is relatively unaltered and the species' populations have been largely unaffected.

The far inland arid areas of the range, which are unsuitable for pastoral production, remain largely unaffected by European man. The distribution and abundance of euros in this area are unaltered.

- b. Area where it is expected that (a) will continue.

No development of the area above is foreseen.

- c. Area where future major habitat changes are likely to occur.

No significant areas are likely to be developed. The population of euros is discontinuous and generally restricted to "hard" country, i.e. rocky outcrops and the highlands. This type of land is unlikely to attract widespread changes of land use in the future.

- d. Area where habitat has been altered and the species' populations have been significantly reduced.

A considerable part of the southern and south-western fringe of the range has been cleared for agriculture. However, this was probably never a very significant part of the range of the species. The area contains outliers or relict populations, many of which are now isolated by large tracts of alienated and cleared land.

- e. Area where habitat has been altered to the extent that it is no longer suitable.

Virtually none. In the main, the natural habitat of the euro is neither amenable to nor suitable for agricultural and pastoral development.

- f. Area where current land use has improved the habitat.

Ealey (1967) records that changes in the environment caused by sheep farming favoured the euro population in the Pilbara district (cited by Ealey, p.10, as 50 000 km²). Ealey's hypothesis that the sheep-induced spread of spinifex and the provision of watering points benefitted euros and allowed a marked increase in their numbers and effective habitat has been widely accepted. This phenomenon, however, appears to be limited to the Pilbara. Recent observations suggest that the drought of the latter part of the 1970s may have substantially reduced this population.

- g. Areas where land use is adversely affected by the species.

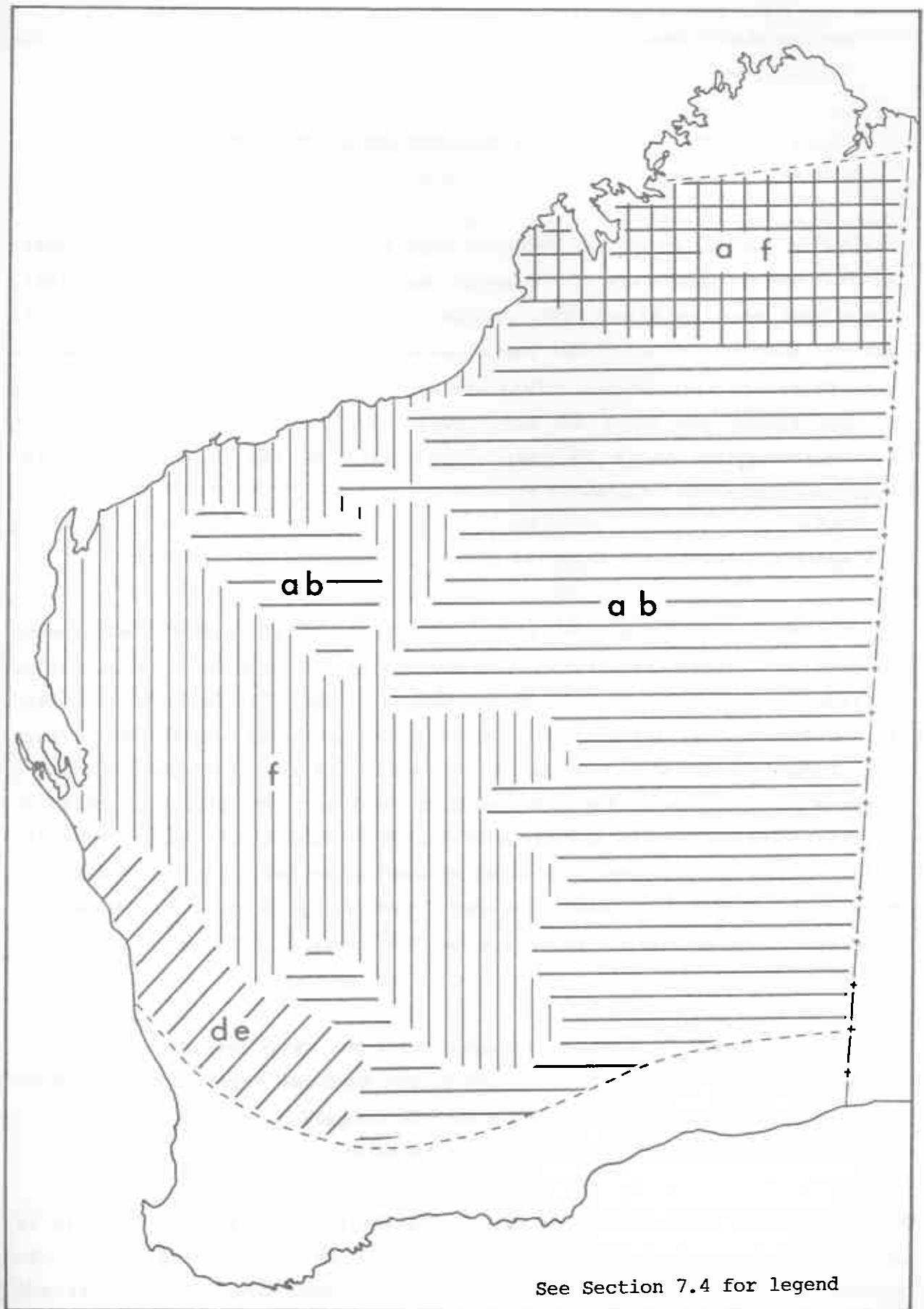


Figure 3 Distribution of the Euro in Western Australia in Relation to Land Use

Negligible. Damage by euros to pastoral rangelands is limited and isolated in its occurrence.

8. ASSESSMENT OF KANGAROO POPULATION TRENDS

Until the aerial survey of kangaroo populations carried out independently of the former Department of Fisheries and Wildlife in the winter of 1981, there had been no history of regular census of kangaroo populations in Western Australia or of direct comparisons of Western Australian populations with those of other States. This aerial census work, reported by Caughley et al. (1983) and Short et al. (1983), therefore, is a most important benchmark against which to judge development of the Western Australian kangaroo management program.

8.1 RED KANGAROO

As has been noted (Part 4, above) the present red kangaroo management program was instituted in 1970/71 following an upsurge in harvesting believed by the former Department of Fisheries and Wildlife to be excessive in relation to prevailing conditions and the estimated population at that time. Two different estimates of the adult red kangaroo population were derived at that time. Both gave similar results. The first was based on extrapolation to Western Australia of ratios of domestic livestock units to red kangaroo populations for western New South Wales and the Northern Territory. Domestic livestock numbers in the pastoral areas of Western Australia were known and the overlap of the areas of kangaroo distribution and pastoral use was clear.

The second estimate was based on knowledge of the abundance of red kangaroos around artificial watering points and the distribution of these water points. For management purposes the kangaroo stock was assumed as a result of these estimates in 1970/71 to be about 1 250 000 animals.

From that time until 1984, red kangaroo harvest rates have continued to be set assuming an underlying stable population or one affected, as in the latter years of the 1970s, by prolonged and severe drought. Harvest and quota details for red kangaroos since 1971 are given in Table 1.

Table 1: Commercial harvest and quota details for red kangaroos, western grey kangaroos and euros, 1970-1985*.

Year	Red Kangaroo		Euro		Western Grey Kangaroo	
	Quota	Harvest	Quota	Harvest	Quota	Harvest
1970	-	275 000	-	9 000	-	17 000
1971	225 000	173 000	-	5 000	-	6 000
1972	260 000	198 000	-	6 000	-	10 000
1973	200 000	119 000	-	2 500	-	11 000
1974	150 000	129 000	-	3 500	-	8 000
1975	142 250	110 000	-	3 000	-	9 000
1976	167 190	144 000	-	3 000	-	15 000
1977	168 000	151 000	-	4 000	-	11 000
1978	152 000	131 000	-	3 500	-	23 000
1979	180 000	151 000	10 000	4 500	30 000	40 000
1980	180 000	100 000	10 000	5 000	50 000	58 000
1981	160 000	136 000	10 000	5 000	88 000	34 000
1982	160 000	138 000	10 000	4 000	70 000	39 000
1983	140 000	162 000	10 000	4 500	50 000	36 000
1984	140 000	137 000	10 000	5 500	50 000	37 000
1985	160 000	N/A	10 000	N/A	50 000	N/A

*Sources: Crook and Prince (1984), Prince (1984b) and Departmental records. Note that while quotas were first set at the Commonwealth level in 1975, a system of quotas for red kangaroos had been implemented in Western Australia in 1971.

If it is assumed that the population was steady at (say) 1.2 million animals (+30%), harvest rates may have varied between extremes of 1:4 and 1:17 during this period, around a mean of 1:8.5 which equates to (approximately) 12% of the assumed population/annum.

This description is an oversimplification, of course. The extent to which the 1970s decade of drought affected the population is by no means certain, but documented experience of the drought in the early 1980s in eastern Australia suggests that mortalities as great as 40-70% of abundant stocks can occur in some situations (Caughley et al. 1984, Grigg et al. 1985).

Although no further attempt was made to actually estimate the population in the 1970s, extensive statistics on harvest rates/unit effort and on sex ratios and carcass weights of harvested animals were collected and progressively analysed as time series over this period. The detailed analysis of these data is the subject of the paper by Prince (1984b).

Many of these data suggest progressive downward trends in average carcass weights, proportions of males in the total harvest and, in some areas, associated rates of take of animals. For example, in the Murchison Management Area average male carcass weights declined from approximately 22.5 kg in 1971 to 21 kg in 1982 while those of females declined from 14 to 13 kg in the same period. The proportion of males in the harvest trended from 55 to 45% and the total number of animals taken per month fell from an average of 3 200 at the beginning to 1 600 at the end of the period.

The significance of figures such as these, which are given as examples only, is difficult to judge.

The population counts reported by Caughley et al. (1983) and Short et al. (1983) are an important benchmark in the Western Australian management program for two reasons:

- The resultant population estimate for red kangaroos of 1 027 000 in 1981 is somewhat less than the estimate on which the management program was based. This is especially so considering that the latter estimate was for the population in pastoral leasehold areas, i.e. that available for active management, while that of Caughley et al. was for the whole State.
- Continuing harvesting of red kangaroos at a median rate of 140 000 animals per year corresponds to a harvest rate of 1:6.5 on the 1981 total population estimate.

From these data together we are left with the conclusion that, during the period of the management program up to 1981, the red kangaroo population subject to harvesting may have remained stable or may have declined somewhat. Whichever conclusion is adopted is dependent on the degree of confidence placed on the 1970 and 1981 population estimates.

If there has been an overall decline, it may have been as great as 10 to 20 percent. Such a decline would be consistent with the combined effects of prolonged drought and continued harvesting during the latter years of the 1970s, but is less than the mortality levels suffered by eastern Australian kangaroo populations during their drought period in the early 1980s (Grigg et al. 1985). Caughley et al. (1983) noted that kangaroo numbers in Western Australia in 1981 were probably well below their long-term average as a result of drought.

Two aerial censuses repeated using the same methods should give figures which can be compared to reveal trends in the population in the intervening period.

Since 1980, the Western Australian rangelands have enjoyed a succession of climatically average-to-good seasons, culminating in heavy general rains during February, March and May 1984. These have been accompanied by an increase in the red kangaroo population to 2 018 000 in 1984, as shown by aerial census (Grigg et al. 1985, plus unpublished data from Australian National Parks and Wildlife Service). Between 1981 and 1984 red kangaroo numbers increased by 98% in those areas common to both surveys (Grigg et al. 1985).

As well as continued collection of the harvest data mentioned previously, it is intended that another aerial survey be conducted, possibly in 1987, in order to monitor trends in the red kangaroo population.

8.2 WESTERN GREY KANGAROO

The only data indicating the likely population of grey kangaroos in Western Australia are those obtained in the 1981 and 1984 aerial kangaroo surveys, which suggested populations in excess of 436 000 (Caughley et al. 1983, Short et al. 1983) and 683 000 (Grigg et al. 1985, plus unpublished data from Australian National Parks and Wildlife Service) respectively.

Harvest data of the type mentioned previously for red kangaroos, are also collected for grey kangaroos taken commercially.

8.3 EURO

No data additional to those provided by Ealey (1967) on numbers of euros are available. The euro's habitat is not amenable to aerial survey. Observations in the same area, however, suggest that the drought of the 1970s may have made inroads into the population and an estimate of the present total population of 100 000 to 200 000 would be a safe one.

9. DETERMINATION OF CULLING LEVELS

As explained previously, culling of populations for the purpose of limiting their rates of natural increase is, in this sense of the term, carried out only in the case of the red kangaroo in Western Australia. While some grey kangaroos and euros are taken this is done only in response to specific occurrences of concentrations of animals which are perceived to be affecting pastoral and agricultural production. The average numbers taken in any one year (c. 30 000 grey and 5 000 euros against quotas of 50 000 and 10 000 respectively - see Table 1), in relation to the total known or estimated populations, reflect the damage control nature of this program.

Red kangaroos, also, are taken in response to specific damage situations. However, the larger proportion of the total shooting activity is aimed at reducing the rate of natural increase of the population which, experience has shown, will result in numbers unacceptable to pastoralists if it is not so controlled. Numbers of each of the three species that may be taken during any one calendar year are set by the State Minister for Conservation and Land Management following consultation with the Kangaroo Management Advisory Committee. This Committee is chaired by the Director of Nature Conservation and comprises members of the policy, administration and research branches of the Department, the Rangeland Management Section of the Department of Agriculture, the Agriculture Protection Board, representatives of local authorities, pastoralist and farmer organisations, kangaroo shooter and kangaroo processor interests, the Conservation Council of Western Australia and the National Parks and Nature Conservation Authority.

Insofar as products from kangaroos taken in the course of this program may enter the export trade, quotas agreed by the State Minister are referred to

the responsible Commonwealth Minister in conformity with the N.P.M.K. and the requirements of the Commonwealth Wildlife Protection (Regulation of Exports and Imports) Act 1982.

Quotas are determined in accordance with the N.P.M.K., i.e. they are set taking into account current population trends, seasonal conditions, previous annual harvests, proportion of the habitat and population not subject to culling, land use practices, trends in land use and the significance of the take outside the commercial quota.

Illegal harvesting of red kangaroos for commercial purposes inside or outside the declared open season areas would be very difficult for the illegal operator to sustain, because:

(i) all kangaroo carcasses in chillers or transported by any means or in processing works, must have a lawful tag attached;

(ii) patrolling by District Wildlife Officers presents a continuous hazard to would-be illegal operators;

iii) unlicensed hunters operating illegally would receive no support from pastoral lessees or from licensed shooters. The same deterrents apply within the open season areas to make illegal harvesting there virtually impossible. The inaccessibility and lack of support systems of any kind in the desert and very arid areas, together with the sparseness of the kangaroos and the uneconomic transport costs involved all help to ensure that the legal protection has practical effect.

Any skins or carcasses found without tags are liable to confiscation. Any person found in possession of skins or carcasses or who consigns or transports them is also liable to prosecution. Royalties are charged at the rate of 20 cents for each kangaroo tag. If the carcass and skin are consigned separately a tag must be fixed to each.

Activities such as sport shooting, use for food purposes by Aboriginal people, and use of kangaroos for farm dog-food are also likely to have minimal effect on kangaroo populations. The number of people and dogs which could be the subject of such activities are very small compared with

the area and number of kangaroos involved.

The same considerations apply to illegal shooting of grey kangaroos and euros.

10. MANAGEMENT PROCEDURES

The taking of kangaroos is controlled through the provisions of the Wildlife Conservation Act and Regulations. The enforcement of these provisions is the whole or part-time responsibility of thirty-two Wildlife Officers appointed under the Conservation and Land Management Act 1984. In addition, police officers and fisheries inspectors are ex officio Wildlife Officers. In the period 1 July 1981 to 30 June 1985, 61 breach reports on offences under the Wildlife Conservation Act relating to kangaroo management were submitted for prosecution action. Of these, 57 related to grey kangaroos, three to red kangaroos and one to euros. Where commercial operations are involved relating to kangaroos, the provisions include the licensing of shooters and processors, registration of chillers, the mandatory tagging of kangaroo carcasses, the regular inspection of processing and shooting operations and provision for weekly and monthly reporting by processors and shooters respectively.

For full details the reader is advised to study the Wildlife Conservation Regulations, in particular, which cover all aspects of licensing, forms of reporting and rules regarding the transport, marking and movement of fauna in the process of "taking" both for commercial purposes and otherwise.

With respect to kangaroos, the prime responsibility of the Department of Conservation and Land Management is their conservation. Where population control is necessary, the Department encourages the highest standards of humanity possible in the killing of animals. The Department is implementing the Code of Practice for the Humane Shooting of Kangaroos, endorsed in principle by the Council of Nature Conservation Ministers in May 1985, as a licence condition.

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