ISSN 0085-8129

ODC 151:146

Vertebrate Fauna in The Southern Forests of Western Australia

A Survey

P. CHRISTENSEN, A. ANNELS,
G. LIDDELOW AND P. SKINNER

FORESTS DEPARTMENT OF WESTERN AUSTRALIA
BULLETIN 94, 1985

ERRATUM

Forests Department of W.A.

Vertebrate Fauna in the Southern Forests of Western Australia

P, Christensen, A. Annels, G. Liddelow & P. Skinner

The following corrections should be made:

Page 8 - Under the heading (1) High Open Forest; end of first paragraph, *Bossiaea aquifolium* should read *Bossiaea laidlawiana*.

Page 9 - Reverse Plate 3b and Plate 4. The image then on Plate 4 is incorrect.

Page 80 - Under the heading *PROTEACEAE, Banksia quercifolia* R. Br. should not be referred to as being surveyed in sunklands.

ISSN 0085-8129

ODC 151:146

Vertebrate Fauna in The Southern Forests of Western Australia

A Survey

P. CHRISTENSEN, A. ANNELS,
G. LIDDELOW AND P. SKINNER

FORESTS DEPARTMENT OF WESTERN AUSTRALIA
BULLETIN 94, 1985

Vertebrate Fauna in The Southern Forests of Western Australia

A Survey

By

P. CHRISTENSEN, A. ANNELS,
G. LIDDELOW AND P. SKINNER

Edited by
Liana Christensen M.A. (W.A.I.T.)

Prepared for Publication by
Andrew C.A. Cribb B.A. (U.W.A.)

P.J. McNamara
Acting Conservator of Forests

1985

FRONT COVER

The Bush Rat *(Rattus fuscipes):*
the most abundant of the native mammals
recorded by the survey teams
in Western Australia's southern forests.

Cover photograph: B. A. & A. G. WELLS

Printed in Western Australia
Published by the Forests Department of Western Australia
Editor Marianne R.L. Lewis
Assistant Editor Andrew C.A. Cribb
Design Trish Ryder

CP19425/7/85 — By Authority WILLIAM BENBOW, Acting Government Printer, Western Australia

C1/1M85

Contents

		Page
SUMMARY		
SECTION I—INTRODUCTION		
Historical Background		1
Recent Perspectives		1
SECTION II—DESCRIPTION OF SURVEY AREA		
Boundaries and Physical Features		3
Geology		3
Soils		3
Climate		6
Vegetation		6
Vegetation Types		8
SECTION III—SURVEY METHODS		13
SECTION IV—SURVEY RESULTS AND LIST OF SPECIES		16
(A) MAMMALS	: Discussion of Findings	16
	List of Species	
	(i) Indigenous Species	17
	(ii) Introduced Species	30
(B) BIRDS	: Discussion of Findings	32
	List of Species	34
(C) REPTILES	: Discussion of Findings	47
	List of Species	49
(D) AMPHIBIANS	: Discussion of Findings	55
	List of Species	55
(E) FRESHWATER FISH	: Discussion of Findings	59
	List of Species	
	(i) Indigenous Species	59
	(ii) Introduced Species	61
SECTION V—GENERAL DISCUSSION		63
ACKNOWLEDGEMENTS		68
REFERENCES		69
APPENDICES		
I—Results from Fauna Surveys 1972-1982		72
II—Results from Other Research Studies Within The Survey Area 1970-1982		74
III—Plant Species Collected In The Survey Area since 1968		76

IV—List Of Vertebrates Recorded On Surveys — *Page*
(A) Mammals 92
(B) Birds 93
(C) Reptiles. 97
(D) Amphibians 98
(E) Freshwater Fish 98

V—Vertebrates recorded in each of the Faunal Zones
(A) Mammals 99
(B) Birds 100
(C) Reptiles. 106
(D) Amphibians 108
(E) Freshwater Fish 109

Plates

1 High open forest of karri *(Eucalyptus diversicolor)*. Note the dense understorey. . . . 9
2 High open forest of red tingle *(E. jacksonii)* with a dense understorey of karri wattle *(Acacia pentadenia)* near Walpole 9
3a Open forest of jarrah *(E. marginata)* and marri *(E. calophylla)* near Manjimup. Note comparatively open understorey 9
3b Open forest of jarrah on infertile grey sand 9
4 Wandoo *(E. wandoo)* woodland. 9
5 Flat-topped yate *(E. occidentalis)* woodland, found only in restricted areas of the south near the Hay River 9
6 *Casuarina fraserana* and *Banksia attenuata* woodland on deep sandy soils in the south of the survey area. 11
7 Woodland of *Banksia illicifolia* on sandy soils in the south of the survey area 11
8 Low open woodland of *Melaleuca priessiana* on swampy ground. Note the flowering *Beaufortia sparsa* in the foreground. 11
9 Closed scrub of *Melaleuca viminea* on shallow soils in the upper reaches of the Perup River. Colonies of Tammar Wallabies *(Macropus eugenii)* live in these thickets 11
10 Low, closed scrub of *Agonis parviceps, Beaufortia sparsa,* and *Leptospermum firmum* on moist peaty flats in the Mitchell River area 11
11 Open coastal heath on the south coast 11
12 Sedgeland or south-coastal flat. Low woodland occurs as a fringe to these flats. . . . 12
13 Granite outcrop and *Eucalyptus megacarpa*, Mt. Lindesay. 12
14a Coastal lake near Yeagarup, on the south coast 12
14b Wetlands: a pool on the Frankland River 12
15 *Pinus radiata* plantations in the Blackwood Valley 12
16 "Box" or "Possum" trap with a Western Quoll *(Dasyurus geoffroii)* caught in the Perup . 15
17 Collapsible bat trap constructed after the design of Tiedemann and Woodside (1978). . . 15
18 Survey team searching woodland and closed heath for frogs, small fish, and other vertebrates . 15
19 Nest of the Common Dunnart *(Sminthopsis murina)*, constructed with the soft bark of the paperbark *(Melaleuca preissiana)*, inside the hollow stem of a dead blackboy *(Xanthorrhea preissii)* 15
20 Spotlight survey team searching for nocturnal animals 15
21 Extensive thickets of heartleaf poison bush *(Gastrolobium bilobum)* 23
22 Western Pygmy-possum *(Cercartetus concinnus)* 23
23 Honey-possum *(Tarsipes rostratus)* on *Banksia attenuata*. 23
24 Common Dunnart *(Sminthopsis murina)*. 27
25 Tawny Frogmouth *(Podargus strigoides)* on its nest in coastal low open woodland. . . . 33
26 Red-eared Firetail *(Emblema oculata)* 33
27 Splendid Fairy-wren *(Malurus splendens)*. 33
28 Golden Whistler *(Pachycephala pectoralis)*. 44
29 Red-legged Skink *(Ctenotus labillardieri)*. 48

		Page
30	Mourning Skink *(Egernia luctuosa)*.	48
31	*Sphenomorphus australis*	48
32	Little Brown Snake *(Elapognathus minor)*.	48
33	Mueller's Snake *(Rhinoplocephalus bicolor)*	48
34	Green and Gold Tree Frog *(Litoria moorei)*	56
35	*Geocrinia lutea*	56
36	Salamanderfish *(Lepidogalaxias salamandroides)*	60
37	Nightfish *(Bostockia porosa)*.	60
38	Brush-tailed Bettong or Woylie *(Bettongia penicillata)*.	64
39	Numbat *(Myrmecobius fasciatus)*	64

Figures

1	Location of surveys	4
2	Land use in the survey area.	4
3	Major geological formations.	5
4	Distribution of rainfall in the survey area	7
5	Major vegetation formations.	7
6	Mean numbers of Brush Wallabies *(Macropus irma)* and Grey Kangaroos *(Macropus fuliginosus)* seen on two evening transects.	19
7	Known distribution of the Quokka *(Setonix brachyurus)* and Tammar Wallaby *(Macropus eugenii)*	20
8	Capture percentages of the Brush-tailed Bettong *(Bettongia penicillata)* at two locations in the Perup forest.	20
9a	Possum sightings on spotlight surveys: Yendicup Block	21
9b	Possum sightings on spotlight surveys: Boyicup Block.	21
10	Capture percentages of *Isoodon obesulus* at two locations in the Perup forest	25
11	Capture percentages of *Dasyurus geoffroii* at two locations in the Perup forest	25
12.	Incidental sightings of the Numbat *(Myrmecobius fasciatus)* in the north-east of the survey area	27
13	Mean numbers of Emus *(Dromaius novaehollandiae)* seen on two evening transects	35
14a	Diagrammatic representation of the results of ordination of 25 surveys, based on data for all vertebrate species.	66
14b	Diagrammatic representation of the results of ordination of 25 surveys, based on mammal data	66
14c	Diagrammatic representation of the results of ordination of 25 surveys, based on reptile data	66

Tables

1	Gazetted rare flora in the survey area (Rye and Hopper, 1981)	6
2	Percentage of survey time allocated to each major vegetation type	13
3	Surveys allotted to faunal zones	65
4	Comparison between faunal zones: total species numbers	67
5	Comparison between faunal zones: species in common	67
6	Comparison between faunal zones: numbers of restricted species	67

APPENDICES

A.I (a)	Number of trap nights for all trap types in each area surveyed	72
A.I (b)	Fauna type and capture rate per trap type	72
A.I (c)	Time spent on types of survey work.	73
A.II (a)	Number of trap nights for all trap types in each study.	74
A.II (b)	Number of captures for each fauna type, and total capture rate for all studies.	74
A.II (c)	Spotlight survey results from other research studies in the survey area, 1970-1982	75
A.II (d)	Results of evening vehicle transects, from other research studies in the survey area, 1970-1982	75
A.II (e)	Time spent on bird counts in the survey area, 1979-1982	75

Summary

The forested land to the south of the Blackwood River, including the Donnybrook Sunkland to the south and east of Busselton was surveyed for flora and fauna over a 12-year period between 1970 and 1982. A total of 19 surveys were carried out during the period.

Results of these surveys indicate that the area contains a rich and varied flora and fauna, a high proportion of which are species endemic to the south-west. Some of these species are entirely restricted to the survey area.

Several areas of outstanding flora and fauna values are identified. Distinct trends in the distribution of fauna, which were related to climatic factors, were recognized, but no faunal regions or zones could be identified.

The area, consisting largely of State Forest, is an outstanding reserve for many plants and animals unique to the south-west.

Introduction

HISTORICAL BACKGROUND

Since European colonization, many changes have affected the fauna and flora of the southern forests. Clearing of the forests for farming, townships and plantations, as well as the introduction and spread of exotic species throughout the area, have all had their effect. Few records of fauna numbers and distribution have been kept, and there are few data on these changes; what few that are available, however, provide some background information to our survey.

The widespread disappearance of native mammals following European settlement is an Australia-wide phenomenon, from which the forest areas have suffered less than have the more arid woodland areas. Masters recorded impressive numbers of mammals from the south-west of Western Australia between 1866-69 (Glauert, 1948), but only a short while later Shortridge (1909) notes the disappearance of many species, "said to have been first noted about 1880, being most sudden and unaccountable. . .". He states that such disappearances were chiefly in the drier parts of the country; the mammals of the south-west had not vanished in the same extraordinary way. One exception was in the Lake Muir district in the southern forests where, in 1911, it was noted that Brush-tailed Bettongs, or Woylies *(Bettongia penicillata),* and Burrowing Bettongs *(B. lesueur)* were becoming scarce (Kitchener *et al.,* 1978). Kitchener *et al.* (1978) consider that, whilst introduced diseases cannot be discounted, the domestic Cat *(Felis catus)*, widespread throughout Australia, almost certainly played the principal role in this first disappearance of fauna — an opinion we endorse.

A subsequent decline in numbers of native fauna, between 1933 and 1944 (Perry, 1973; Serventy, 1954; White, 1952), caused a marked reduction, and restriction of range in a number of forest species, such as the Quokka *(Setonix brachyrus)*, the Brush-tailed Bettong, the Common Brushtail Possum *(Trichosurus vulpecula)* and the Tammar Wallaby *(Macropus eugenii)*. Christensen (1978 and 1980a) presents strong circumstantial evidence to suggest that the introduced Fox *(Vulpes vulpes)* was responsible for this decline.

Despite these declines in number, however, few species within the survey area have become extinct. One possible exception is the Potoroo *(Potorous tridactylus)*, which may have occurred in dense thickets in the southern high rainfall area and along the south coast (Kabay and Start, 1975/1976). 'Sub-fossil' remains of the Potoroo have been found in 'blow-outs' in southern coastal sand dunes. These remains, bone and tooth material, occur along with those of other, extant, species such as the Quokka, the Common Ringtail Possum *(Pseudocheirus peregrinus)* and the Western Quoll *(Dasyurus geoffroii)*; they appear fairly recent.

Another mammal species, the Burrowing Bettong, which was noted in the Lake Muir district, east of Manjimup is now also extinct in the survey area (Kitchener *et al.,* 1978). Two others, the Bilby *(Macrotis lagotis)* and the Red-tailed Phascogale *(Phascogale calura)* appear to have occurred in the area and are no longer present.

Two bird species may have become extinct: the Ground Parrot *(Pezoporus wallicus)* and the Noisy Scrub-bird *(Atrichornis clamosus)*. The former occurred on the southern coastal flats, and the latter near Margaret River, and possibly in southern coastal thickets. The last recorded sighting (1952) of the Ground Parrot in the survey area was of four birds near the Bow River, south of the forests (Serventy and Whittell, 1976). There have also been unconfirmed sightings of the Ground Parrot near Torbay in recent years. The last record of the Noisy Scrub-bird within the survey area was at Wallcliffe, near Margaret River, in the 1800s.

RECENT PERSPECTIVES

By the late 1960s, despite the dense settlement of the south-west, and the high number of animal species with a very restricted distribution, no systematic biological surveys or extensive fauna collections had taken place.

At that time, organizations and government agencies involved with management and research on wildlife had priorities other than the study of forest fauna. The CSIRO Wildlife Division concentrated its efforts upon selected individual species, particularly animals that were considered agricultural pests, such as the Wedge-tailed Eagle *(Aquila audax)* and the Dingo *(Canis familiaris)*. The research section of the Department of Fisheries and Wildlife was in its infancy, and engaged full-time in surveying and stocktaking the considerable area of reserves under its jurisdiction in other parts of the State. The University of Western Australia centred almost all its zoological research upon the study of macropods on Western Australia's off-shore islands, particularly Rottnest Island. Consequently, little or no information about forest ecology existed, and this prompted the Forests Department of Western Australia (F.D.) to initiate studies in that field.

The wildlife studies of the F.D. centre around the effects of forest management practices, particularly prescribed burning and felling practices, upon forest fauna. Comprehensive data are necessary for this research. Biological surveys are an ongoing part of the F.D. flora and fauna research programme.

This bulletin summarises the detailed information on vertebrate species' distribution and habitat preference collected during surveys between 1972 and 1982, in the southern forests and adjacent areas. Results from other research studies in the area are also included where relevant.

Description Of The Survey Area

BOUNDARIES AND PHYSICAL FEATURES

The survey area consists of some 3 242 339 ha, only 1 568 042 ha of which were considered for surveys. The total encompasses the area generally known as the 'Southern Forests', which includes the State Forests and vacant Crown Lands west of Albany Highway and south of the Blackwood River, as well as those forests areas, such as Grimwade and the Donnybrook Sunklands, south of latitude 33° 33 ½'. (See Figs 1 & 2).

We included: all major occurrences of high open karri *(Eucalyptus diversicolor),* the tingles *(E. jacksonii, E. guilfoylei* E. brevistylis), the southern jarrah *(E. marginata)* forests, the marri *(E. calophylla)*, some of the wandoo *(E. wandoo)* woodlands and the exotic pine plantations, mainly *Pinus radiata*, in the Blackwood Valley.

The survey area forms a part of the south-western edge of the Great Plateau, which occupies more than 90 per cent of the area of Western Australia. The dominant physical feature of this region is the reticulate pattern of deeply-incised watercourses flowing off the plateau. The major rivers which flow through the area are the Hay, Denmark, Kent, Frankland, Deep, Warren, Donnelly, Blackwood and Margaret Rivers.

Along the coast, on the lower reaches of these rivers, the landscape is distinguished by low undulating hills and consolidated sand dune country, covered variously in low heathland, open forests or woodland. Further inland on the middle reaches of the rivers, in particular the Blackwood, Donnelly and Warren Rivers, and to some extent on the Deep, the landscape becomes more deeply incised.

This area roughly encompasses the main occurrence of high open forest, and includes some of the open forest in the north of the survey area.

To the south of the Warren River, inland from the coast, and in the high open forest area on the lower Deep, Frankland and Denmark Rivers, the landscape is comprised of open, treeless flats with 'islands' of forest. The flats support seasonally wet sedgelands, and forest develops only on the elevated areas, often around protruding granite monadnocks. Typically high open karri forest grows on the younger erosional soils around the granite outcrops, with open jarrah forests growing on podzolic soils further downslope, and banksia woodlands in the leached sands on the margins of the flats.

Further inland, towards the upper reaches of the rivers, in the lower rainfall areas, the country is more undulating, and characterized by broad, flat valleys separated by low ridges. These low ridges support open forests or woodlands of jarrah and marri, with wandoo often occurring in the valleys.

GEOLOGY

The Pre-Cambrian basement outcrops over most of the survey area and is composed largely of Archaean rocks. These rocks are a complex of crystalline igneous and metamorphic rock, dominantly granite and gneisses with minor amounts of basic igneous and schistose metasedimentary formations (Fig. 3).

In the north-western sector of the survey area the basement is overlain by the southern extension of the Perth Basin, an area of sedimentary rocks of variable age and depth. In this sector, the Basin is enclosed between the Darling and Dunsborough faults, and is composed primarily of the Cretaceous Donnybrook sandstones. An outcrop of Cretaceous basalt at Black Point on the coast is evidence of past igneous activity in the Basin.

To the east and north-east of Denmark on the south coast, the formations are of Tertiary age. Younger deposits from the Quaternary period occur along the south coast from Broke Inlet to Augusta, near Busselton, around Lake Muir in the east and in several small areas around the Perup and Tone Rivers in the north-east.

SOILS

Several soil surveys have been carried out in different sections of the survey area: Hoskings and Burvill (1938) on the Denmark estate, Smith (1951a and 1951b) in the Lower Blackwood and Margaret River districts, and the Frankland River valley, and McArthur and Clifton (1975) in the Pemberton area.

The most extensive survey was made by McArthur and Clifton, who described the soils according to Northcote (1971), and recognized six main groups which are represented throughout the survey area.

(1) Laterites and Ironstones

The laterites and ironstones which are typical of the Darling Scarp occur with less frequency in the survey area. Nevertheless, laterites are present, particularly in the northern sector. These soils are characterized by a surface layer of light brown sand or sandy loam dominated by ferruginous gravel or blocks of duricrust; yellow mottled clay usually occurs within the first metre. Laterites are generally found high in the landscape,

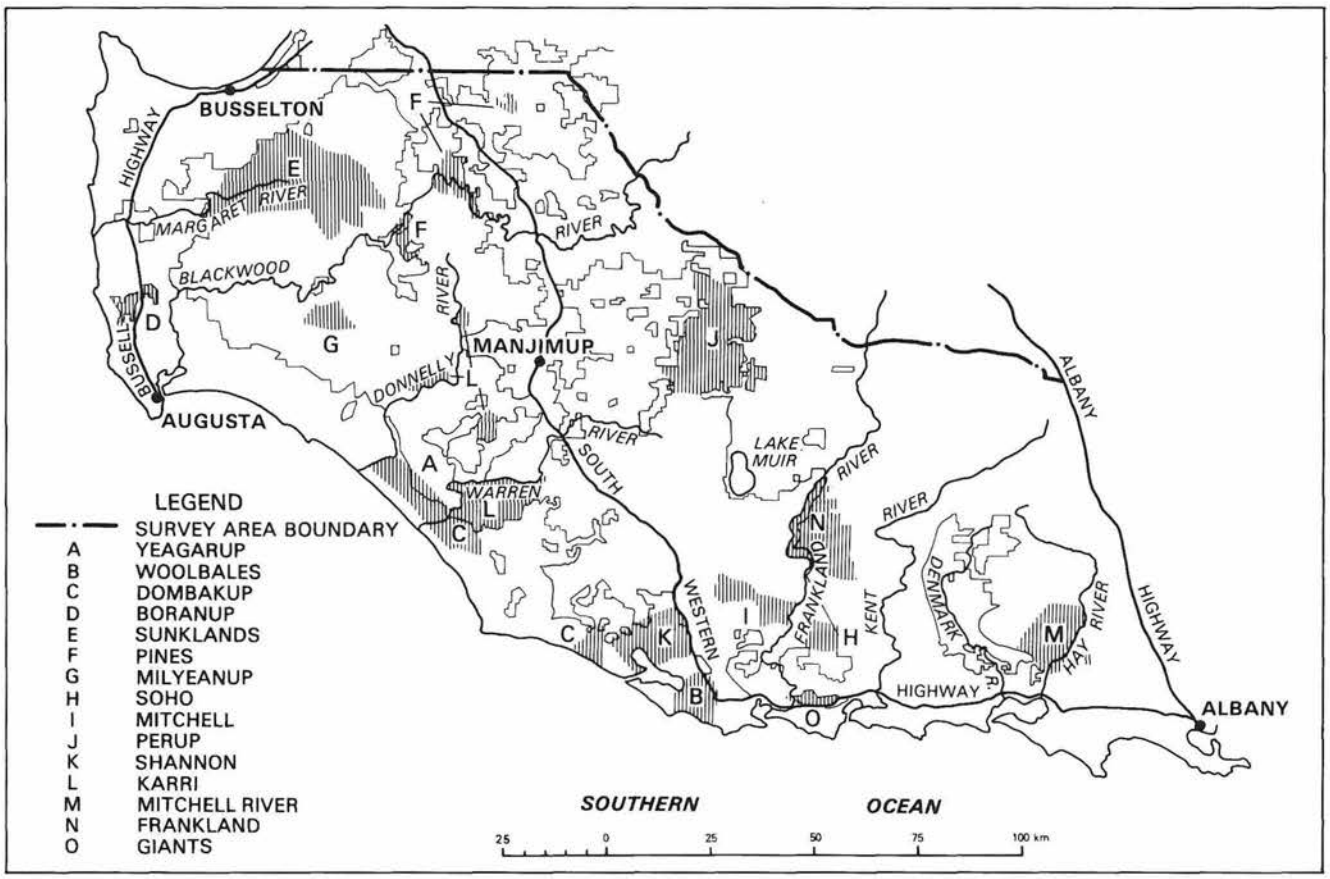

Figure 1: Location of surveys.

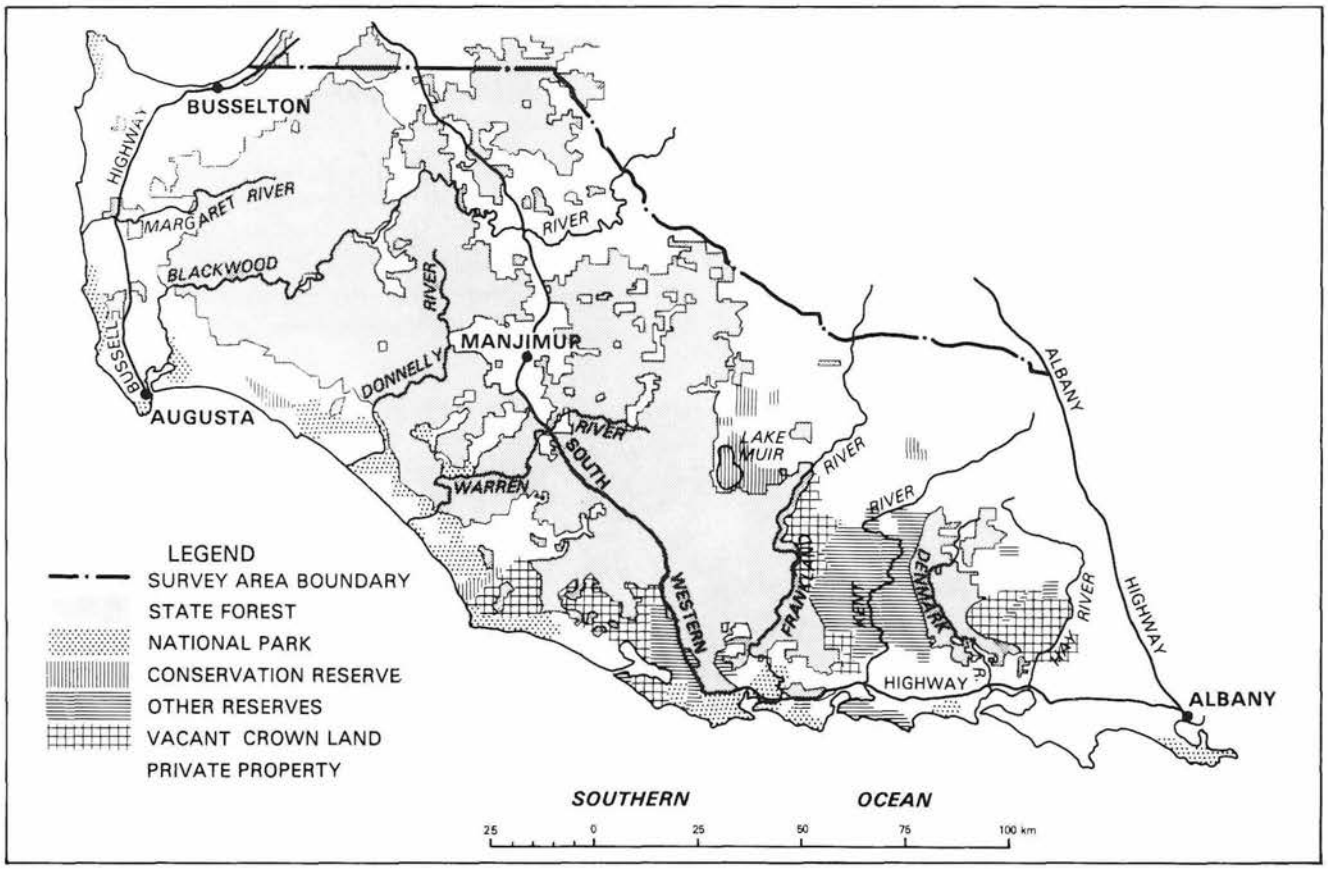

Figure 2: Land use in the survey area.

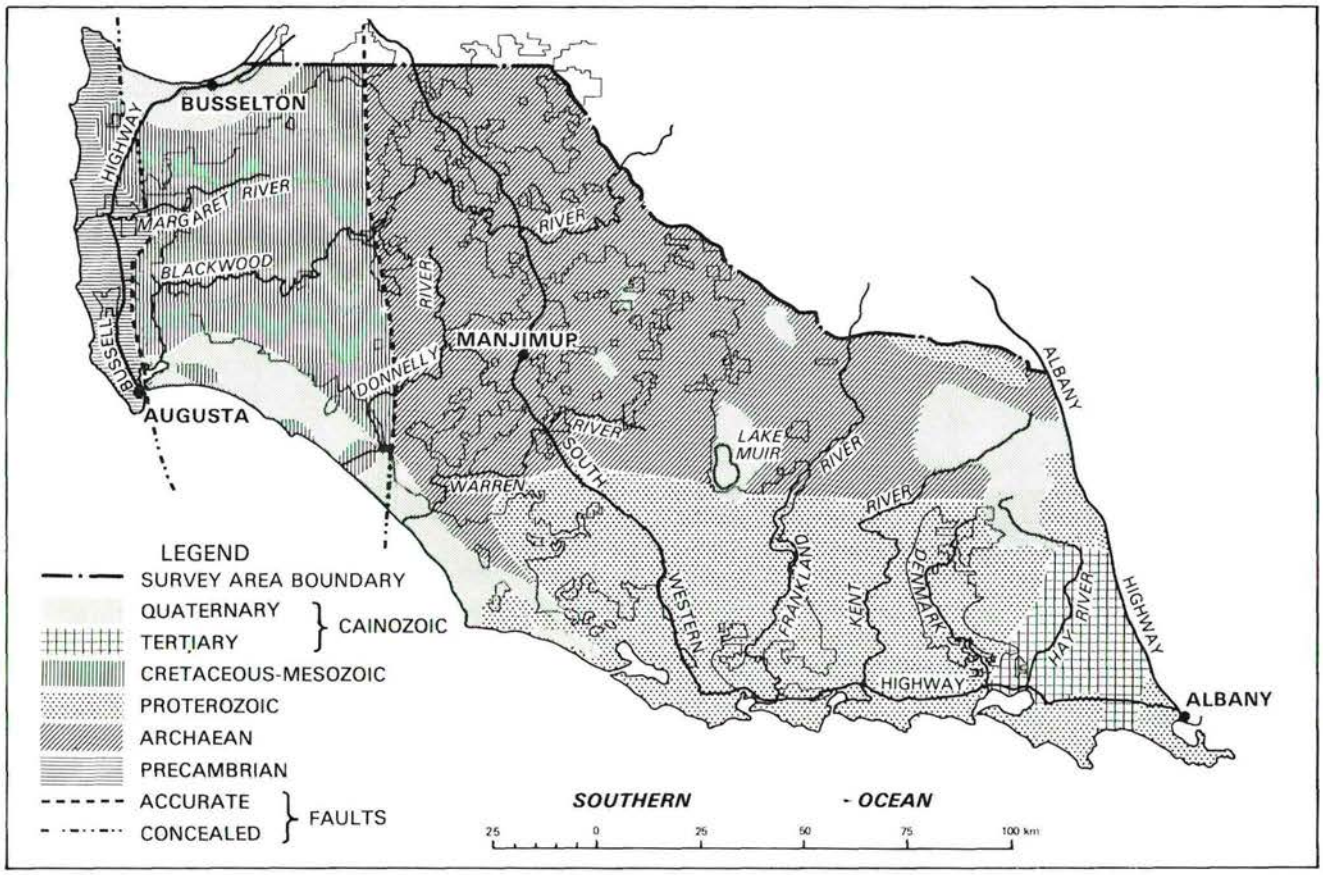

Figure 3: Major geological formations.

where there is less erosion. Forests on these soils are typically jarrah or jarrah/marri mixtures, with *Banksia grandis* as a common understorey species.

(2) Red Earths

These younger soils typically develop in a dissected landscape. They consist of a reddish-brown loam or sandy loam surface which changes gradually to a red clay at a depth of 50 cm. Red earths support high open forests of karri, or, where rainfall is insufficient, open forest of blackbutt *(E. patens)* or jarrah. These soils occur when a basic or acidic type of rock has been exposed by stream truncation, which removes the laterite formation and allows new soils to develop.

(3) Podzols

Podzolic soils occur in the middle and lower landscape positions and appear to be formed in a dissected laterite landscape. There are several distinct types of podzols:

(a) Red Podzolics: These soils have surface layers of red-brown sandy loam with an abrupt change to a red clay horizon at 40 cm depth. They support jarrah or jarrah/marri open forests and, in wetter areas, high open forest of karri/marri.

(b) Yellow Podzolics: The common feature of these soils is the distinct change in texture from the topsoil to a yellow, mottled clay subsoil. They cover a wide range of sites in the survey area, and one common form has a brown sandy loam surface. Yellow podzolics appear to have developed from the exposed mottled zone of the laterites, and are thus widespread in areas of intermediate relief.

The yellow-podzolic soils support a wide range of landscapes, from treeless flats in the swampy drainage lines to high open forest of marri/karri in the most favourable situations, and marri/jarrah and wandoo in drier eastern areas.

(c) Another minor form of podzol has developed on certain swampy upland sites. These soils have a dark-grey peaty sand surface and a plain mottled clay subsoil. Water-rounded quartz stone is often associated with the minor forms of podzols, which suggests that these soils consist partly of transported materials. They are often underlain by quartzite.

(4) Undifferentiated Sands

Sandy soils often develop downslope from the lateritic ridges. The colour of these soils may vary from pale yellow through to reddish-brown, and ironstone gravel may be present in the subsoil. This type of sand generally supports low woodlands of *Banksia* spp. or *Casuarina*. A grey, leached form of these sands, often suporting a sedgeland community, occurs in broad drainage lines.

(5) Calcareous Sands

Along the coast, southwards from Boranup, a zone of soils derived from calcareous beach sands occurs in the form of unconsolidated sand dunes. Calcareous sands support a vegetation of coastal scrubland, herbland and open forest of jarrah, peppermint *(Agonis flexuosa)* and yate *(E. cornuta)*.

(6) Alluvial Soils

A minor soil type, the alluvial soils occur as narrow bands along major streams. They are extremely variable, the only common characteristics being a medium texture throughout the soil profile, high organic content and a dark brown or dark grey colour.

CLIMATE

The climate of the southern forests is best described as mild Mediterranean, with warm summers, mild winters, and only occasional frost.

During the winter months mean temperatures over the survey area appear to be dependent on distance from the coast. Isotherms are generally parallel to the coast, and temperatures decrease with increasing distance from the sea. In summer, mean temperature appears to be more affected by latitude than proximity to the coast (Meteorology, Bureau of, n.d., 1962, 1965).

There is a distinct rainfall pattern for winter, with most of the rain falling between May and October. Limited summer rainfall may be experienced along the south coast, but generally summers are dry.

Rainfall isohyets are approximately parallel to the coastline, ranging from over 1397 mm in the south-west to less than 635 mm in the north-east of the survey area, which is the furthest from the coast (Fig.4). An anomaly in the rainfall pattern occurs around Margaret River, where there is an isolated region of higher rainfall.

VEGETATION

Seven major vegetation formations have been recognized in the survey area: high open forest, open forest, woodland, low woodland, open and closed heathland and sedgeland (Fig. 5). In addition, three distinctive habitats have been recognized, namely granite monadnocks, lakes and swamps, and the Blackwood Valley pine plantations.

Several of the vegetation associations within these formations are unique to the survey area, such as the karri and tingle forests (the only extensive occurrences of high open forest), the woodlands of red flowering gum *(Eucalyptus ficifolia)* and many heath and sedgeland formations. *Casuarina fraserana* occurs mainly within the survey area, and some Albany blackbutt *(E. staeri)* woodland, much of which has been cleared in the Albany region, survives in the south-east of the area.

Only the open forests of jarrah and marri and some of the woodlands such as wandoo and flat-topped yate *(E. occidentalis)* are common outside the survey area. Even in these four, however, the understorey plant associations are often unique, being much denser than the understorey of similar forest formations further to the north.

A list of plant species recorded in the area, together with the major vegetation associations in which they have been found, is presented in Appendix III. The highest number of plant species and families were recorded in the open forest and woodland communities, and the least in the sedgelands, waterways and wetlands, pines and closed scrub communities.

Although the list of plants is incomplete, it does provide information about occurrence and distribution of the main plant species in the survey area.

The flora of the survey area, like that of the south-west generally, shows a high degree of endemism. There also appears to be some degree of local endemism (Beard, 1970). Chippendale and Wolf (1981) list five of the eucalypts in the survey area as rare or restricted: the three tingles, the coastal mallee *(E. calcicola)* and the red flowering gum.

Certainly these eucalypts all have a restricted distribution, but none of them could be considered rare. Two tingles, *E. guilfoylei* and *E. jacksonii,* form substantial forests in the southern portion of the survey area. The red flowering gum is also common, though restricted to certain woodlands of the south.

Coastal mallee has a very limited distribution along a few kilometres of coastal scrub to the west of the Boranup karri forest. It is, however, common within this region, forming extensive, dense thickets with other species, particularly yate. Rate's tingle *(E. brevistylis)* is perhaps the most restricted species, occurring only in a few isolated stands amongst jarrah forest immediately to the north of the main tingle and karri forests on the south coast.

Twelve species of understorey plants in the survey area have been gazetted as rare flora (Rye and Hopper, 1981), seven of which we collected (Table 1).

TABLE 1

GAZETTED RARE FLORA IN THE SURVEY AREA

(Rye & Hopper, 1981)

Adenanthos detmoldii
*Aponogeton hexatepalus**
Eucalyptus calcicola
Franklandia triaristata
Grevillea cirsiifolia
Grevillea drummondii
*Kennedia glabrata**
*Kennedia macrophylla**
*Lambertia orbifolia**
Lambertia rariflora
*Melaleuca baxteri**
Pentapeltis silvatica

*Species not collected by the F.D. Survey Team

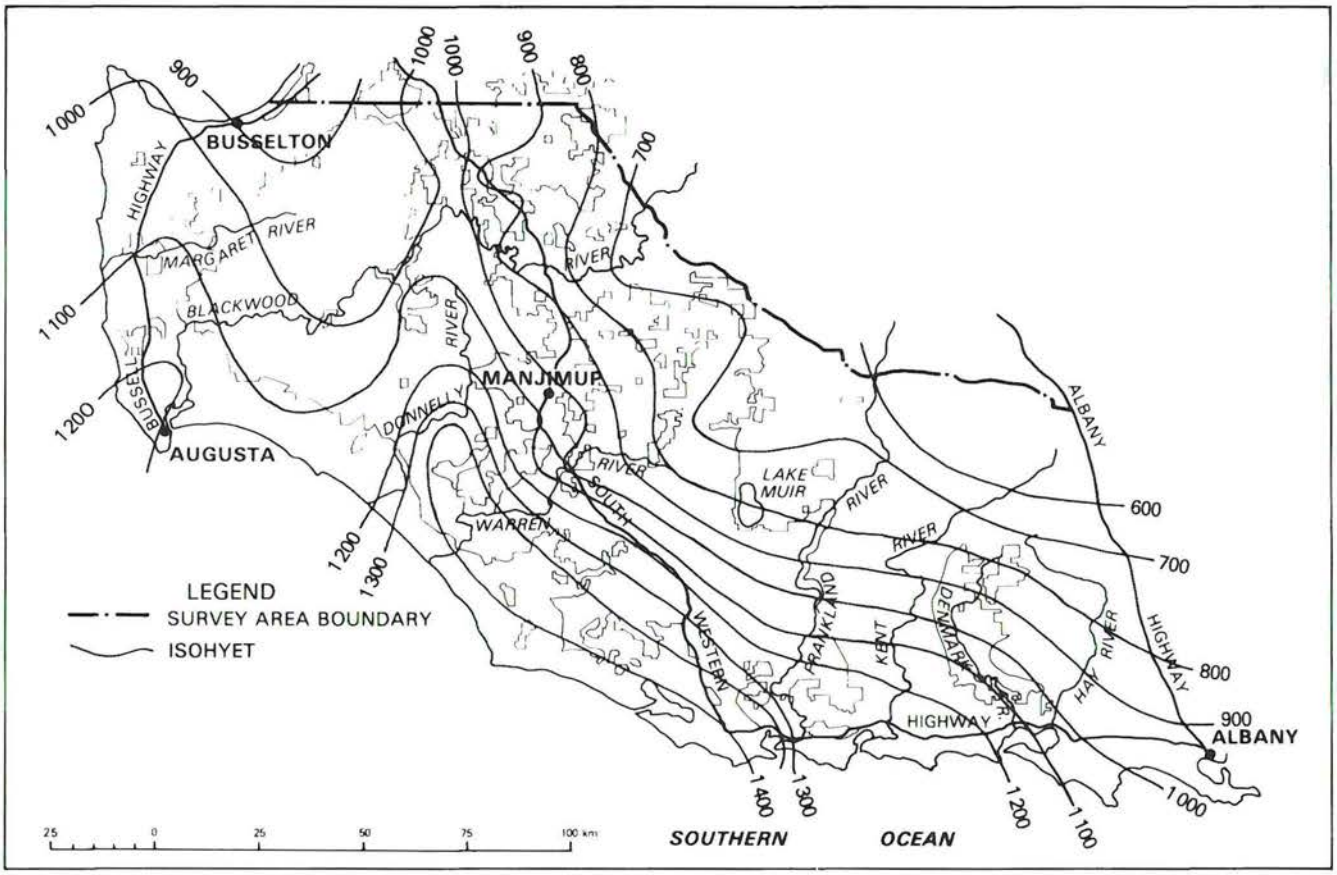

Figure 4: Distribution of rainfall in the survey area.

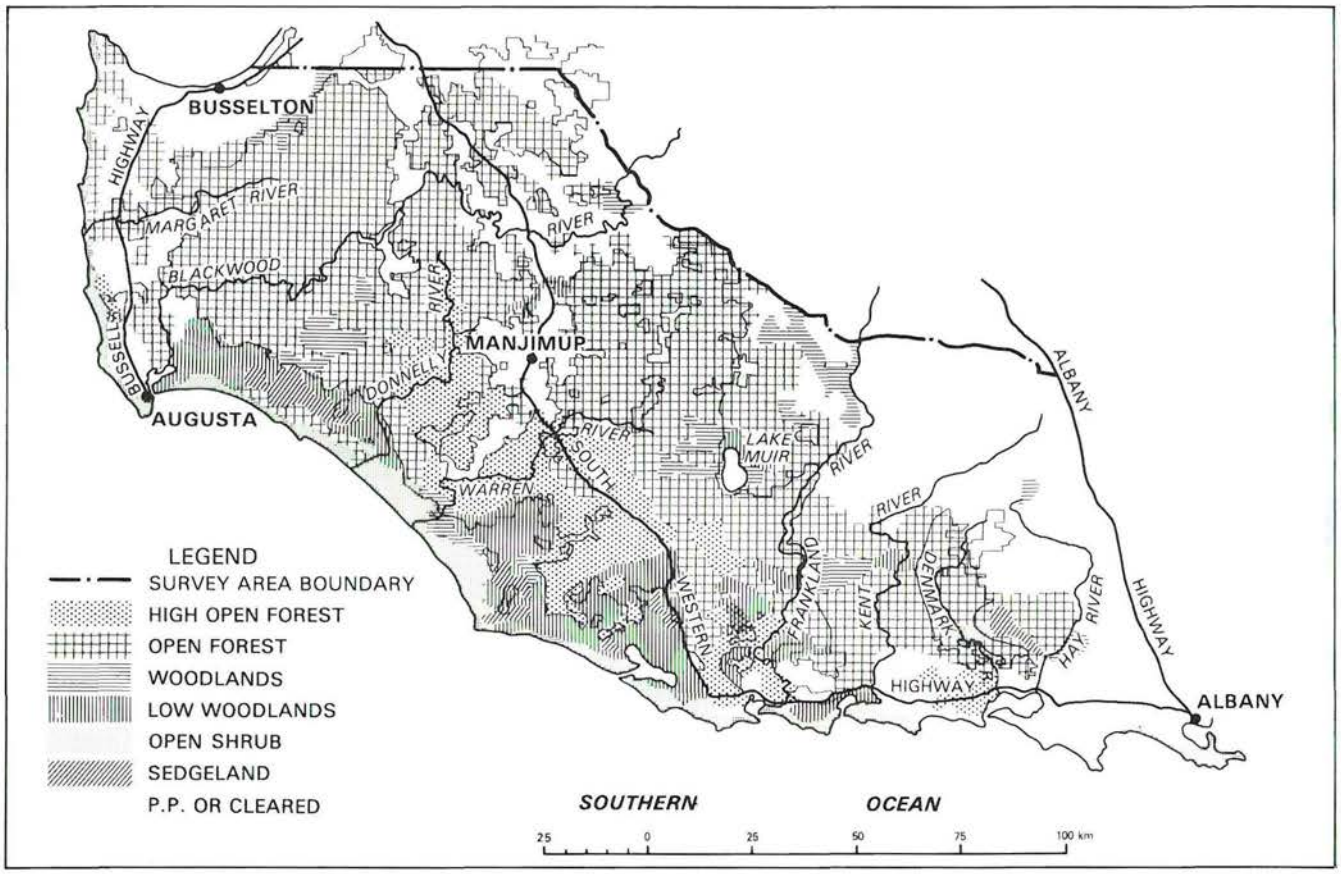

Figure 5: Major vegetation formations

One of these species, *Pentapeltis silvatica,* has since been removed from the "rare or otherwise in need of special protection" list (Government Gazette W.A., 8 April 1983), as F.D. collections show it to be widespread and common in the survey area. The five plants not collected are coastal species (coastal habitats were not well covered by our plant collections).

Besides the gazetted rare flora, there are a few other plant species that are worth mentioning because of their restricted distribution. *Reedia spathacea*, which is much sought after for floral arrangements, grows in isolated patches on the peaty sandy flats near the south coast and in the Frankland River valley. It is confined to the area between Scott River and Torbay.

A most attractive paperbark tree, unofficially known as *Melaleuca baxteri* grows near a small creek to the east of Lake William near Torbay. Another generally uncommon species is *Grevillea cirsiifolia,* known only from one location on the Corbalup road and an old collection from Mt. Lindesay (circa 1892).

Other specimens have been collected from the farming areas of Darken, Tenterden and Cranbrook. *Lasiopetalum cordifolium,* previously known only to occur in the Stirling Range, South West Plantagenet and Albany (1901) is in fact locally common in poor jarrah forest on clay soils to the east of Tone River.

The tree fern, *Cyathea cooperi,* occurs in two localities in the forest west and south-west of Manjimup. A few individual plants are growing in each locality. The origins of these plants are unknown, and they may have been introduced from the eastern states.

Another species of fern recently discovered in the survey area has been tentatively identified as a species of *Lastreopsis,* another eastern states genus.

Three acacias, *Acacia scapelliformis, A. stenoptera* and *A. gilbertii,* are all widespread throughout the survey area, but they only occur occasionally, singly or in small groups. *Acacia scapelliformis* superficially resembles *A. urophylla,* with which it is often associated, and so it may easily be overlooked.

VEGETATION TYPES

The vegetation formations and plant associations recognized in this survey have been classified using structural criteria, life-form, height and density, as used by Smith (1972). The vegetation formations have been further subdivided on the basis of species' composition or floristics. There are ten distinct types.

(1) High Open Forest

High open forests are typically karri (Plate 1) forest or karri and marri forests, less frequently mixed with jarrah and W.A. blackbutt. Near Walpole, yellow tingle *(E. guilfoylei),* red tingle *(E. jacksonii)* (Plate 2) or Rate's tingle *(E. brevistylis)* may be present. The main understorey tree species are karri oak *(Casuarina decussata)* and W.A. peppermint *(Agonis flexuosa).* Common shrub species are *Acacia urophylla, Trymalium spathulatum, Albizia distachya, Pimelea clavata, Thomasia quercifolia, Chorilaena quercifolia* and *Agonis parviceps.* In the south-easterly sections of the survey area, *Acacia pentadenia, Lepidosperma tetraquetrum* and *Lepidosperma effusum* are the dominant shrub species, while in the northerly sections of the survey area, in the Donnelly River valley, *Bossiaea aquifolium* is more common.

High open forests have developed on the better soils within the survey area in regions where annual rainfall is greater than 1016 mm.

(2) Open Forest

The open forest is generally composed of jarrah (Plates 3a & 3b) or jarrah/marri mixtures, with W.A. blackbutt, flooded gum, and yate occasionally occurring in small patches by themselves. Common understorey species that may also be present throughout the survey area include *Banksia grandis, Casuarina fraserana, Persoonia longifolia* and *P. elliptica.* On grey sands, *Banksia attenuata* and *Xylomelum occidentale* may occur, and on damper sites *Agonis flexuosa* may be present. Common shrub species are *Bossiaea linophylla, B. ornata, Macrozamia riedlei, Hakea amplexicaulis, Xanthorrhoea preissii* and *X. gracilis, Acacia pulchella* and *Agonis parviceps.* On the drier sections, *Hakea lissocarpa, H. undulatum* and *Trymalium ledifolium* are common species.

Open forests grow on lateritic and podzolic soils, and in drier regions.

(3) Woodlands

Woodlands are most common in the more easterly sections of the survey area, and are mainly composed of wandoo (Plate 4) or jarrah or a mixture of these species. Both yate and flat-topped yate (Plate 5) occur as woodlands on suitable sites, and marri may be present on the sandier soils in the low lying areas. On very sandy soils in the higher rainfall areas, *Casuarina* spp. can form woodlands, frequently in association with stunted jarrah or *Banksia* spp. In the south-east of the survey area Albany blackbutt grows as a woodland either alone or in association with jarrah, *Casuarina fraserana* and *Banksia attenuata* (Plate 6). A notable woodland formation occurring in the Nornalup area is that of the red flowering gum, which is confined to this locality, and only grows on consolidated dunes or, away from the coast, on sandy gravels.

The scrub layer in the wandoo woodland is frequently sparse and quite variable in species' composition. In the jarrah and marri woodlands, the understorey is less open and clumped, with species such as *Bossiaea ornata* and

Plate 1▲ High open forest of karri *(Eucalyptus diversicolor).* Note the dense understorey.

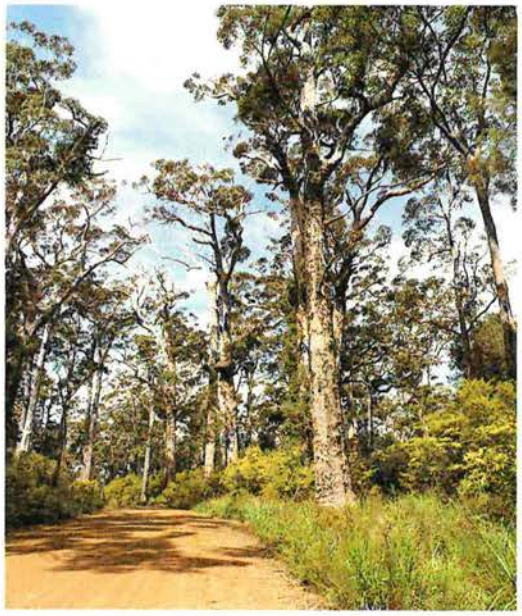

Plate 2▲
High open forest of red tingle *(E. jacksonii)* with a dense understorey of karri wattle *(Acacia pentadenia)* near Walpole.

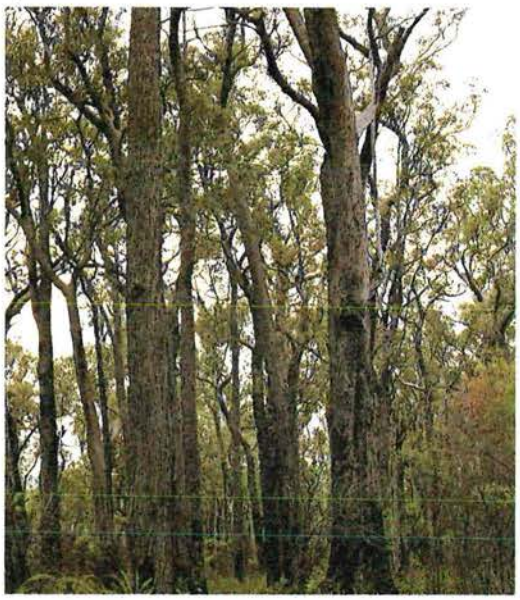

Plate 3b▲ Open forest of jarrah on infertile grey sand.

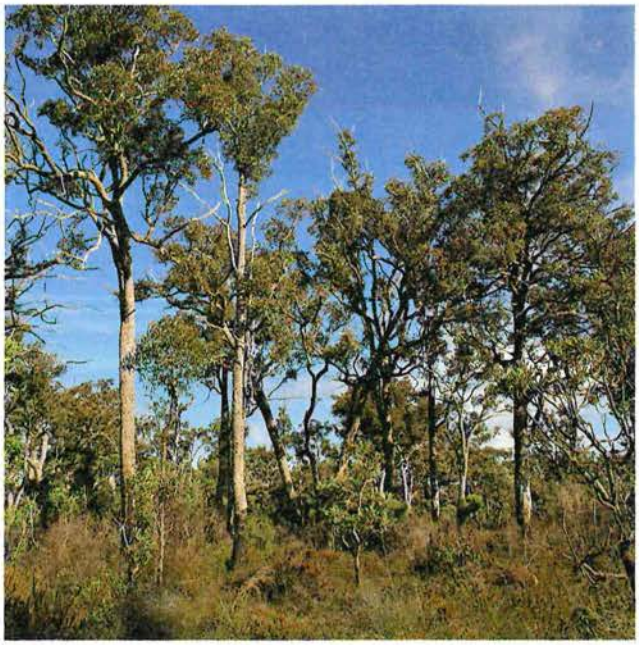

Plate 4▲ Wandoo *(E. wandoo)* woodland.

Plate 5▲
Flat-topped yate *(E. occidentalis)* woodland, found only in restricted areas of the south near the Hay River.

Plate 3a ◄ Open forest of jarrah *(E. marginata)* and marri *(E. calophylla)* near Manjimup. Note comparatively open understorey.

Hakea lissocarpa being common. Flat-topped yate generally has an understorey of sedges, as this habitat is seasonally waterlogged. In the *Casuarina* woodlands, the understorey is dense, with species such as *Anarthria scabra* and *Beaufortia decussata,* being prominent. Where Albany blackbutt occurs with *Casuarinas, Beaufortia anisandra* is usually present in the scrub layer.

(4) Low Woodlands

These vegetation types, which occur throughout the survey area, vary greatly in both species' composition and soil types.

Banksias are a common component of the low woodlands. On dry sandy sites, *Banksia attenuata, B. ilicifolia* (Plate 7), or *B. grandis* are generally present. On wetter sites, such as peaty sands, these species are often replaced by *B. littoralis* and *B. quercifolia,* frequently in association with *Nuytsia floribunda* or *Melaleuca* spp. On some wet sites *Melaleuca* spp. (Plate 8) may form low woodlands, with common species being *M. preissiana, M. rhaphiophylla* and *M. cuticularis.* Near the coast on stabilized sand dunes, *Agonis flexuosa* is the major species, although it may be associated with several *Melaleuca* spp. On extreme sites, generally constituted on very shallow soils over rock or clay or consolidated dunes, jarrah, marri, yate, bullich *(E. megacarpa)* and flooded gum *(E. rudis)* may all form low woodlands.

In the Whicher Ranges, woodlands and low woodlands are composed mainly of mountain marri *(E. haematoxylon)*, the distribution of which is restricted to the Ranges (on sandy lateritic gravels) and to a few occurrences further north along the Darling Scarp.

(5) Closed Scrub — Heath

This formation is generally associated with permanently moist sites characterized by such species as *Melaleuca* (Plate 9) and *Agonis* (Plate 10), *Kunzea ericifolia, Banksia quercifolia* and *Leptospermum firmum.* On the calcareous dunes near Karridale, the mallee *E. calcicola,* together with a mallee form of bullich and yate, form patches of closed scrub in association with *Melaleuca huegelii, Diplolaena dampieri, Scaevola nitida* and *Acacia decipiens.*

(6) Open Scrub — Heath

Limited areas of the mallee eucalypts *E. anceps* and *E. decipiens* occur in some of the eastern sections of the survey area. Scattered patches of jarrah, marri and W.A. blackbutt grow on 'islands' a few centimetres higher than the surrounding sedgelands. These species occur in seasonally wet areas along the coast eastward from Augusta. In some localities, notably the Sunklands and the catchments of the Kent, Frankland and Hay Rivers, large open areas with scattered stunted jarrah and marri, *Kingia australis* and *Casuarina humilis* occur on very shallow clayey soils (Plate 11).

(7) Sedgelands

Sedgelands (Plate 12) comprised of mixed monocot species are found on the upper reaches of the Margaret River, around Lake Muir and associated lakes, and on some of the large peaty sub-coastal flats where drainage is impeded. Consequently, sedgelands are under water during the winter months.

(8) Granite Monadnocks

A number of granite monadnocks, consisting of huge granite boulders, occur in the southern portion of the survey area. The vegetation on these granite outcrops is different from that of the surrounding forest, often comprising high numbers of endemic species. Species commonly found in association with these rocks include *E. megacarpa, Lepidosperma effusum* and a variety of ferns, mosses and lichens (Plate 13).

(9) Waterways and Wetlands

Waterways and wetlands form a variety of specialized, permanently moist habitats, ranging from reed swamps *(Cladium* spp.) and paperbark swamps *(Melaleuca* spp.) to riverine habitats dominated by *Agonis juniperina, Oxylobium lanceolatum* and *Banksia* species (Plates 14a and 14b).

(10) Pine Plantations and Associated Farmland

Along the Blackwood River valley and its tributaries upstream from Nannup, large areas that were formerly farmland have been planted with the exotic softwood, *Pinus radiata* (Plate 15).

Pine plantations combine with small areas of pasture and remnant blocks of eucalyptus forest to form a distinctive forest habitat. Much of the ground cover in this habitat is composed of introduced grasses and weeds, and very little understorey remains.

Plate 6 ▲
Casuarina fraserana and *Banksia attenuata* woodland on deep sandy soils in the south of the survey area.

Plate 7 ▲
Woodland of *Banksia illicifolia* on sandy soils in the south of the survey area.

Plate 8 ▲
Low open woodland of *Melaleuca priessiana* on swampy ground. Note the flowering *Beaufortia sparsa* in the foreground.

Plate 9 ▲
Closed scrub of *Melaleuca viminea* on shallow soils in the upper reaches of the Perup River. Colonies of Tammar Wallabies *(Macropus eugenii)* live in these thickets.

Plate 10 ▲
Low, closed scrub of *Agonis parviceps, Beaufortia sparsa,* and *Leptospermum firmum* on moist peaty flats in the Mitchell River area.

Plate 11 ▲
Open coastal heath on the south coast.

Plate 12▲
Sedgeland or south-coastal flat. Low woodland occurs as a fringe to these flats.

Plate 13▲
Granite outcrop and *Eucalyptus megacarpa*, Mt. Lindesay.

Plate 14a▲
Coastal lake near Yeagarup, on the south coast.

Plate 14b▲
Wetlands: A pool on the Frankland River.

Plate 15▲
Pinus radiata plantations in the Blackwood Valley.

SURVEY METHODS

From 1972 to 1982, 19 surveys were undertaken, in 15 separate localities (Fig. 1). The survey area is very extensive, and the locations of surveys were selected subjectively, with a view to obtaining the best possible coverage of the major site-vegetation types. Vegetative associations are known to be a major factor influencing the distribution and abundance of vertebrate fauna in the south-west (Kitchener *et al.*, 1980a, 1980b, 1981; and Kitchener, 1982). The percentage of survey time allocated to each major vegetation type is shown in Table 2.

On each survey, four to six persons camped out in the survey area for one to two weeks during autumn or spring. During this period, each group was trapping, searching, numbering, collecting and recording. The basic methods employed include:

(1) Pre-planning

(a) Examination of relevant data, maps, plans, aerial photographs, published material or other sources of information.

(b) A pre-survey ground inspection to determine the different vegetation associations present, to assess the condition of roads and tracks, and to select a campsite.

(c) Selection of trap lines in different vegetation types, preferably those that had been used least for trapping on previous surveys.

(d) Placement of traps.

(2) Trapping

Trapping was carried out using the trap-line technique (Giles, 1971), with traps set at specific intervals along forest tracks and other access routes. A variety of traps (such as funnel, box, Elliot, conibear and snap traps) were used in order to capture as wide a range as possible of fauna species (Plates 16 and 17). One of the most successful types was the pit trap allied with a drift fence. These were used extensively on the more recent surveys.

On the earlier surveys, only trapping results were quantitative. Species recorded by all other techniques were listed by all the vegetation types in which they had occurred. Consequently, we have comparative data on the efficiency of different traps (Appendix I), but none on the effectiveness of other techniques. The survey effort included 23 119 trap nights (Appendix I). A further 52 652 trap nights were used during other research studies in the area (Appendix II), between 1970 and 1982. Results from these are included where relevant.

TABLE 2
PERCENTAGE OF SURVEY TIME ALLOCATED TO EACH MAJOR VEGETATION TYPE

SURVEY AREA	YEAR	SEASON*	VEGETATION TYPES (1) HIGH OPEN FOREST	(2) OPEN FOREST	(3) WOODLAND	(4) LOW WOODLAND	(5) CLOSED SCRUB-HEATH	(6) OPEN SCRUB-HEATH	(7) SEDGELAND	(8) GRANITE MONADNOCKS	(9) WATERWAYS WETLANDS	(10) PINES
Yeagarup	1972	A	10	30		10	15	15			20	
Woolbales	1972	A	10	5	15	20	10	20		20		
Dombakup	1972	A	10		15	20	20	10		5	20	
Perup	1972	A		50	25		20				5	
	1983	S										
Boranup	1973	Sp	40	20			20	20				
Sunklands	1974	S&Sp		30		30	15	20			5	
Pines	1974	S&Sp		20							10	70
Milyeannup	1976	Sp		50	30			15			5	
Soho	1975	Sp	10	10	20	20	15		10	10	5	
Mitchell	1977	A	10	20	20	5	5	10	15	10	5	
Shannon	1979	A	25		25	5	15	15	5	5	5	
Karri	1974	A	80								20	
Mitchell River	1980	A	5	20	20	15	10	15	5	5	5	
Giants	1981	S	40	20	15	10	5			5	5	
Frankland	1981	A		25	25	10	15		20		5	
			240	300	210	145	165	140	55	60	115	70
Mean Percentage			16	20	14	9.6	11.3	9.3	3.6	4	7.6	4.6

*SEASON Sp = Spring S = Summer A = Autumn

(3) Taking a Census of Birds

Birds were recorded mainly during the first two hours after sunrise each day, usually by two observers in different places. On earlier surveys, only lists of birds were kept; however, we recently adopted the transect method (recommended by the Royal Ornithological Society), which allows the use of quantitative data.

Bird recording took 338 man hours (Appendix I, Table A I[c]) during surveys, and 457 man hours during other research in the survey area (Appendix II, Table A II[e]).

(4) Searching

This was one of the most effective techniques used; it involved looking for animals underneath rock, stones and bark, in logs, hollow trees and in many other places (Plate 18). Another useful method was interpreting evidence of animal activity such as burrows, footprints, scats and runnels (Plate 19).

These searching techniques were quantified, and detailed records of the numbers of each species found in each vegetation type were recorded for each hour of searching.

During surveys, 1 138 man hours were spent on searching activities (Appendix I, Table A I [c]), and many hours of searching have also taken place outside survey times.

(5) Spotlight Surveys

Night spotlighting surveys were used to record certain species, such as the Common Ringtail Possum *(Pseudocheirus peregrinus)*, Owls *(Tyto and Ninox* spp.) the Tawny Frogmouth *(Podargus strigiodes)* and the Owlet Nightjar *(Aegotheles cristatus)*, that are not otherwise easily recorded (Plate 20).

Spotlight surveys took 208 hours during the surveys (Appendix I, Table A I[c]), and 123 hours during other research in the survey area (Appendix II, Table A II[c]).

(6) Plant Collections

On all of the later surveys, a collection of plants was also made. We concentrated on angiosperms, especially the woody scrub species; smaller plants and herbs were also collected whenever possible. Duplicates of each specimen were collected, one for the Manjimup F.D. Research Herbarium to retain and the other for the Western Australian Herbarium to identify.

Each species of plant has been listed, along with each major vegetation formation in which it has been recorded or is known to occur. The list is not exhaustive, nor is the absence of a species from any major vegetation formation an indication that it does not occur there. We merely present a check list of plants recorded over the ten-year survey, inside and outside survey times (Appendix III).

(7) Assorted Methods

In addition to the above methods, we also employed: scoop nets, for capturing small fish from ponds and streams; hair analysis of fox scats and other sources; and the analysis of the stomach contents of predators such as foxes, cats and snakes. The hair analysis technique (Brunner and Coman, 1979; and Valente and Woolley, 1982) has proved particularly valuable in detecting the presence of shy species of mammals. Evening vehicle transects, made during other research studies in the area, provided 202 hours recording numbers of kangaroos and wallabies (Appendix II, Table A II[d]).

PRESENTATION OF RESULTS

Each species is treated separately in the data. Its distribution and abundance within the survey area, its habitat preferences, and any information of general interest discovered during our surveys, or other studies of the species, are discussed. Comparisons are made with Museum distribution data, and other published information on each species. Information published elsewhere is only referred to where it is considered pertinent to the species' distribution.

Observations of fauna, particularly birds or the more unusual mammal species, have been made on many private properties, National Parks and Flora and Fauna Reserves; this information is included wherever relevant.

Specimens of all fauna species were catalogued and sent to the Western Australian Museum (W.A.M.) for positive identification. Museum numbers of these specimens are quoted in the text wherever applicable.

We used nomenclature from the following sources:

Mammals	— Ride (1970); Kitchener and Vicker (1981); and Strahan (1983).
Birds	— Royal Australian Ornithological Society (1978).
Reptiles	— Snakes: Glauert (1967); and Cogger (1975).
	— Skinks: Storr *et al.* (1981).
	— Others: Glauert (1961); and Cogger (1975).
Frogs	— Main (1965); and Cogger (1975).
Fish	— Allen (1982).

Distribution and abundance are defined by the following terms:

Distribution Ratings

Widespread	— distributed over a sizeable proportion of the survey area
Local	— a distribution confined to a particular locality or localities within the survey area
Restricted	— distribution occurring in only one or two localities.

Abundance Ratings

Common	— numerous individuals present
Rare	— few individuals present

Plate 16▲
"Box" or "Possum" trap with a Western Quoll *(Dasyurus geoffroii)* caught in the Perup.

Plate 17▲
Collapsible bat trap constructed after the design of Tiedemann and Woodside (1978).

Plate 18▲
Survey team searching woodland and closed heath for frogs, small fish, and other vertebrates.

Plate 19▲
Nest of the Common Dunnart *(Sminthopsis murina)*, constructed with the soft bark of the paperbark *(Melaleuca preissiana)*, inside the hollow stem of a dead blackboy *(Xanthorrhea preissii)*.

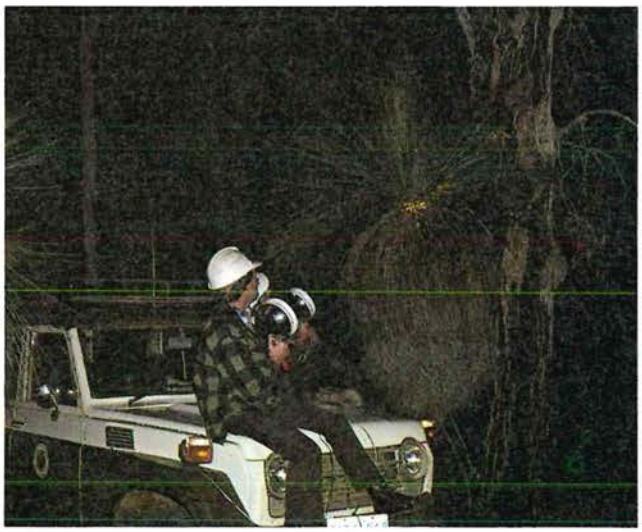

Plate 20▲
Spotlight survey team searching for nocturnal animals.

Survey Results And Lists Of Species

(A) MAMMALS

DISCUSSION OF FINDINGS

A total of 27 species of native mammals: five macropods, four possums, four dasyurids, the Southern Brown Bandicoot, the Numbat, the Echidna, two rodents and nine bats were recorded on the surveys. In addition, a total of ten species of introduced mammals, including the Dingo, occur in the survey area.

Of the native species, only the Western Grey Kangaroo *(Macropus fuliginosus)* and perhaps two species of bat, the Great Pipistrelle *(Pipistrellus tasmaniensis)* and the King River Eptesicus *(Eptesicus regulus)* appear to be distributed throughout the entire survey area.

All the other mammal species have limited distributions occurring only in specific habitats or forest types. The most abundant species is undoubtedly the Bush Rat *(Rattus fuscipes)*, which occurs throughout the southern part of the survey area, and in the north wherever there is a suitable habitat. Of the introduced species only the Fox *(Vulpes vulps)* and the House Mouse *(Mus musculus)* occur throughout the area in all forest types, the latter being common in most forest types only after recent fires.

Several mammal species are of special interest because of their comparative rarity outside the survey area. These include the Brush-tailed Bettong *(Bettongia penicillata)*, the Numbat *(Myrmecobius fasciatus)* and the Quokka *(Setonix brachyurus)*. The colonies of Brush-tailed Bettongs in the survey area represent the largest surviving population of this species. As the total population of Brush-tailed Bettongs is unlikely to exceed 5 000 animals, and that of the Numbat is almost certainly less than 1 000 animals, both species may be in danger of extinction. Quokka populations, although small and isolated, are comparatively numerous and represent a large proportion of the surviving populations of this species.

Many of the other mammal species are common in the survey area, which is an important refuge for them, even though they may be present in reasonable numbers elsewhere.

Species that have been reported in the area since the arrival of Europeans, and that were not recorded on surveys include:

(1) *Bettongia lesueur,* found at Lake Muir prior to 1911 (Kitchener, *et al.* 1978).

(2) *Macrotis lagotis,* found at Bridgetown between 1931 and 1933 (Western Australian Museum Nos. 001399 and 001749, respectively).

(3) *Phascogale calura,* from the Bridgetown area in 1910 (Museum No. 016026).

(4) *Potorous tridactylus* specimens obtained by Gilbert (1842) and labelled "Albany King George's Sound". Later (1866-69), George Masters obtained further specimens that were labelled "vicinity of King George's Sound" and "at King George's Sound and Salt River". This leaves some doubt as to the exact location of the specimens.

Bettongia lesueur and *Macrotis lagotis* are extinct in the survey area. *Phascogale calura* is also probably extinct in the area, although there is a slim possibility that it may be present in the north-eastern section.

The Potoroo was the subject of an intensive search by the Department of Fisheries and Wildlife between 1975 and 1976 (Kabay and Start, 1975/76). No evidence of the species' survival in the south-west was found, but the reports concluded that it may still inhabit the area. This seems, however, a very remote possiblity.

Museum records show that the following species have been collected in the vicinity of the survey area. *Perameles bougainville, Sminthopsis crassicaudata, S. granulipes, Notomys mitchelli, Potorous platyops, Onycholgalea lunata, Pseudomys occidentalis, P. shortridgii, P. albocinereus* and *Nycticeius greyi.*

It is considered that two of these species, *P. albocinereus*, collected from Mt. Manypeaks in 1967 (M008123) and Narricup in 1957 (M003417), and *N. greyi*, collected from Contine in 1964 (M007615), could occur within the survey area. However, it is unlikely that any of the other species are present, because they are predominantly inland species from lower rainfall areas.

Of the forest types within the survey area, the richest in mammal species are the north-eastern, jarrah-wandoo woodlands of the Perup and the southern, low open woodland areas. The former contain populations of every species of native mammal recorded on surveys, excepting only the Quokka and the Honey-possum *(Tarsipes rostratus)*.

The southern, low open woodlands do not contain the medium-sized, open woodland species such as the Brush-tailed Bettong and the Numbat, but are rich in small mammals, including *Rattus fuscipes, Tarsipes rostratus, Sminthopsis murina* and *Antechinus flavipes.*

Compared with the forested areas on the northern Swan Coastal Plain, where only 12 species of native mammal were recorded on recent surveys (Kitchener *et al.*, 1978), the survey area contains a large variety of mammal species. It is believed that there are two main reasons for this:

(i) Dense ground cover over much of the survey area, a consequence of the region's comparatively high rainfall.

(ii) The presence of extensive thickets of heartleaf poison bush *(Gastrolobium bilobum)* in the jarrah-wandoo woodland areas of the Perup.

The influence of the introduced predators, the Red Fox and the Cat, on native mammals was mentioned in the introduction. We believe that the dense ground cover over much of the southern forests has been a major factor in the survival of many native species, in the face of these introduced predators.

In addition, the poisonous compound sodium fluoroacetate, which occurs in certain species of plants belonging to the genus *Oxylobium* and *Gastrolobium* (Aplin, T.E.H., n.d.) is believed to have played a role in the survival of certain species of native mammals (Fisheries and Wildlife, 1980; Christensen, 1980a).

Native mammals show a very high degree of tolerance to sodium fluoroacetate (King *et al.*, 1978; Mead *et al.*, 1979; and Oliver *et al.*, 1979). Introduced species, however, are highly susceptible, and predators such as the Fox and Cat may succumb to secondary poisoning from feeding upon native fauna whose diet includes poisonous plants. Certain native species appear to have survived in substantial numbers in areas where poison plants of the genus *Oxylobium* and *Gastrolobium* occur (Plate 21).

A decline in the numbers of medium sized marsupials in the survey area in 1973/74 was attributed to an increase in Fox numbers (Christensen, 1978 and 1980a).

At the time of writing it appears that once again some species are increasing in numbers. Monitoring by trapping and spotlighting suggests growing populations of Brush-tailed Bettongs and Common Brush-tailed Possums in the Perup area. Sightings of Numbats have also increased over the last two years. We do not know whether these population increases are linked with a decline in Fox numbers in these areas, or whether there are other reasons.

Few bats were collected on the surveys, and consequently knowledge of their distribution is fragmentary. Mist nets, which were used on some of the earlier surveys, were set over small waterholes. A shotgun was also used to collect specimens whilst spotlighting. Some bats were collected from hollow blackboys and one or two road casualties are also included.

More recent work by the Forests Department suggests that long-eared bats are probably more common than survey records would indicate. It appears that bats may be less common in the high open forest areas and most common in the eastern woodland areas. The most common species in the survey area are *Pipistrellus tasmaniensis* and *Eptesicus regulus.*

LIST OF SPECIES

(i) INDIGENOUS SPECIES

Order Marsupialia

Family Macropodidae

Western Grey Kangaroo *(Macropus fuliginosus)*

This species was recorded on all surveys, in all major vegetation types, and was the most widely distributed native mammal in the survey area. It was very common on the coastal plains, the southern flats and in the open woodland areas of the Perup forest, and less common in the karri forest and high rainfall areas where the understorey is excessively dense. Populations in these latter areas often increase locally and temporarily following felling or prescribed burning operations.

Some indication of kangaroo numbers is provided by biannual surveys, over two separate 40 km routes, which have been carried out regularly since 1973. On one of these surveys, to the south of Lake Muir, in open jarrah forest with a dense understorey, the numbers of Western Grey Kangaroos sighted averaged one kangaroo per 1 km in summer, and one kangaroo per 2 km in winter.

On the other survey, in the Perup area in jarrah/wandoo woodland with an open ground cover, sightings averaged a little better than one kangaroo per 1 km in both seasons. Sightings of kangaroos along both transects increase markedly on recently burnt areas, and in the vicinity of farmland where there is access to introduced pasture.

These records indicate that the kangaroo populations have remained steady over the last 12 years (Fig 6). Kangaroos occur most often in family groups consisting of male, female and joey. Sometimes individuals may be sighted, and occasionally groups of six or more kangaroos may congregate on pasture or recently burnt areas. They are most active in the early morning and late evening, but may be present at any time.

Western Brush Wallaby *(Macropus irma)*

This species is very common in jarrah forest with an open understorey, typical of the northern section of the survey area. It was not recorded on seven of the surveys, namely those which covered the karri forest and south coastal communities. This confirms observations by the authors that the Western Brush Wallaby is absent from high rainfall areas where there is dense closed understorey scrub layer. The species favours more open forest with a low clumped or open understorey, and is

very common in low lying areas with a ground cover of grassy monocotyledons.

Western Brush Wallabies are most often seen in pairs, but individuals and groups of three are also common. They do not seem to congregate on pasture or burnt areas like the kangaroo, but they are attracted to recently burnt areas.

Brush Wallabies are most active in the early morning and late afternoons and may also be seen feeding during the day. They are seldom, however, seen on spotlight surveys. The population of this species also appears to have remained fairly steady over the last 12 years (Fig 6).

Western Australian Museum records date back to 1912, and are mostly concentrated in the farming areas to the east and north-east of Manjimup, along the South-west Highway, and in the area between Busselton and Margaret River. There are no records of the Brush Wallaby from the area to the south of Manjimup and the Muir Highway, or from the Donnybrook Sunklands where the species is known to be common.

Recent Museum records include: M005446, Shannon (1962); M006207, Manjimup (1963); M013587, Margaret River (1968); M008335, Augusta (1968); M008026, Busselton (1969); M012635, Yallingup (1975); M014523, S.W. Highway (1976); M014941, Perup River (1976); M014677, Moses Rock (1978).

The Tammar Wallaby *(Macropus eugenii)*

The Tammar Wallaby has a restricted distribution, and was recorded only on the Perup survey. There are unconfirmed records of its occurrence on St. John's Brook west of Nannup, and on one of the surveys an animal which may have been a Tammar was flushed in a heartleaf *(Gastrolobium bilobum)* thicket in this region.

The Tammar's distribution is restricted by its special habitat requirements. It prefers thickets that provide a minimum of 20 per cent overhead cover and that have a very high proportion of bare ground or low grassy understorey. Grasses must also be present in the immediate vicinity of the thickets to provide a food source (Christensen 1980b).

Suitable Tammar thickets formed by heartleaf or *Melaleuca viminea* occur primarily in the Perup area. Thickets of a more limited extent, which appear to be suitable habitats, occur in two other localities: *M. viminea* thickets along Sheepwash Creek on the Hay River and heartleaf thickets on St. John's Brook. The latter thickets have been reduced by cool spring burns which do not regenerate heartleaf. The *M. viminea* thickets on Sheepwash Creek are more extensive, but no Tammars were recorded on the survey in that area.

In the Perup area several colonies of some hundreds of Tammars still occur, and densities of one individual per two or three hectares are common.

Tammars are most easily observed darting across tracks in their thickets during the early morning or late evening.

Older residents in the south-west maintain that Tammars occurred in the Donnelly River area near Glenoran and along St. John's Brook in the Donnybrook Sunklands, prior to the introduction of the Fox in the 1930s. The species is now uncommon on the mainland in Western Australia (Fig 7).

Museum records include: M06, Dunsborough (approx. 1896); M016441-43, Lake Muir (prior to 1912); M001568, Cape Leeuwin (1931).

Quokka *(Setonix brachyurus)*

The Quokka is widespread, being recorded on nine surveys, but only locally common — always in areas of very dense cover, often in streamside vegetation of ti-tree *(Agonis linearifolia)* and rushes such as sword grass *(Lepidosperma effusum)* or *L. tetraquetum.*

In the jarrah forest this species more often occurs in ti-tree thickets on sandy soils, in the broad upper reaches of small creek systems. In the karri they were frequently found in the dense streamside beds of rushes, on alluvial flats near the junction of smaller streams and larger rivers. They were located several times in young karri regeneration resulting from clear felling, and may also occur in low numbers on the ridges in karri and tingle forests.

This species occurs in small colonies, often no more than one or two dozen individuals being sighted. They make distinctive 'pads' or 'runnels' through the dense undergrowth, which are easily recognizable if the Quokkas are present in sufficient numbers.

Quokkas are difficult to trap without pre-baiting, and their presence in low numbers may be easily overlooked. Hair analysis from Fox scats proved to be one of the best methods of detecting their presence.

Figure 7 shows the species' distribution in the south-west survey.

Recent Museum records include: M012517/002, Augusta (1970); M010235, S.W. Highway (1972), M010237, Kronkup (1972); M010236, Walpole (1973); M013404, Windy Harbour (1974); M013934-39, Denmark (1975); M015260, Wilson's Inlet (1975); M018221, Tin Mine Gully (1976); M0118220, Pemberton (1978); M018611-02, Pemberton (1980).

The Brush-tailed Bettong or Woylie *(Bettongia penicillata)*

This species was recorded only on the Perup survey. Small colonies of Brush-tailed Bettongs also exist east of Yornup, and on the Tone River east of the Tone settlement. The only other existing colonies of this once widely distributed species are at Tuttanning and in the Dryandra forest.

The Brush-tailed Bettong occurs in jarrah and wandoo forest on well-drained sandy gravels which support a low clumped understorey. Occasionally, Bettongs are flushed by an observer walking through the bush. The simplest method of detecting them, however, is by searching for their elaborate and distinctive nests (Christensen, 1980b; and Christensen and Leftwich, 1980). In addition to the nests, characteristic diggings which the animals make during their search for hypogean fungi and other foods indicate their presence in an area.

Brush-tailed Bettongs are solitary and strictly nocturnal; they never leave their nests before dusk and always return before dawn. They are easily captured and may be seen on spotlight surveys.

Brush-tailed Bettong populations suffered a severe decline in the Perup area in the early 1970s, but they are now increasing rapidly. The present rate of population increase is so dramatic (Fig 8) that it appears almost certain that the Bettongs will suffer another severe drop in numbers.

The Brush-tailed Bettong may be a species which undergoes regular cyclic fluctuations in numbers. It is likely, however, that changes in levels of the Fox population accentuate these flucuations (Christensen, 1978 and 1980a).

Prior to the early 1930s the Brush-tailed Bettong was common in the Donnybrook Sunklands (Christensen, 1980b), but since then it seems to have disappeared. It is unlikely that the species ever occurred in the high rainfall areas with dense understorey vegetation.

Museum records include: M006276, M00017, M00023/002, M000113, Mammoth Cave (1914); M001084, M001086, Karridale (1928); M001340, M001351, Karridale (1930); M001723-24, Elleker (1933); M00213, Chokerup Siding (1936); M005235, Manjimup (1962); M000153, Bokerup Swamp (undated). Other records include specimens mostly to the east of State forest, on the Albany Highway.

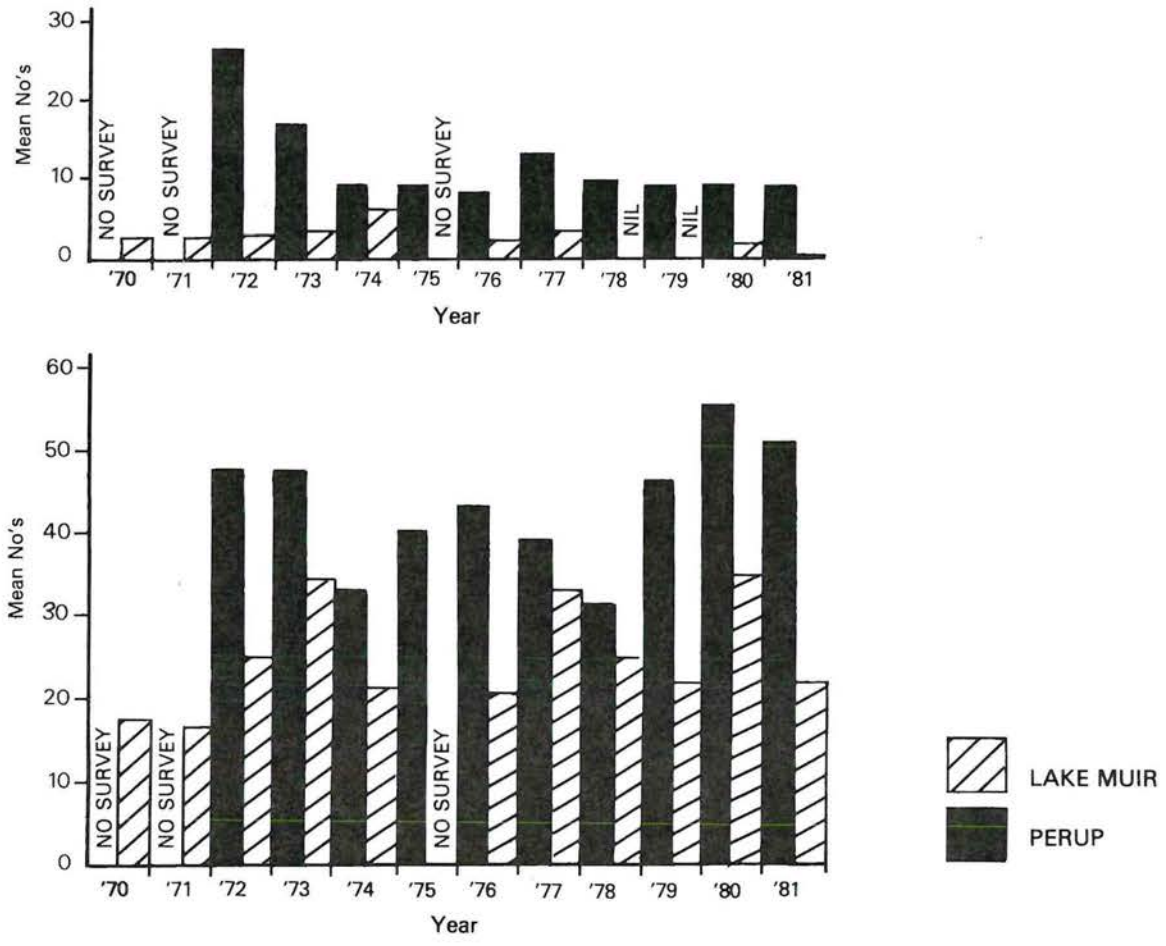

Figure 6
Mean numbers of Brush Wallabies *(Macropus irma)* and Grey Kangaroos *(Macropus fuliginosus)* seen on two evening transects.*

*Each transect of 40km is done regularly twice a year.

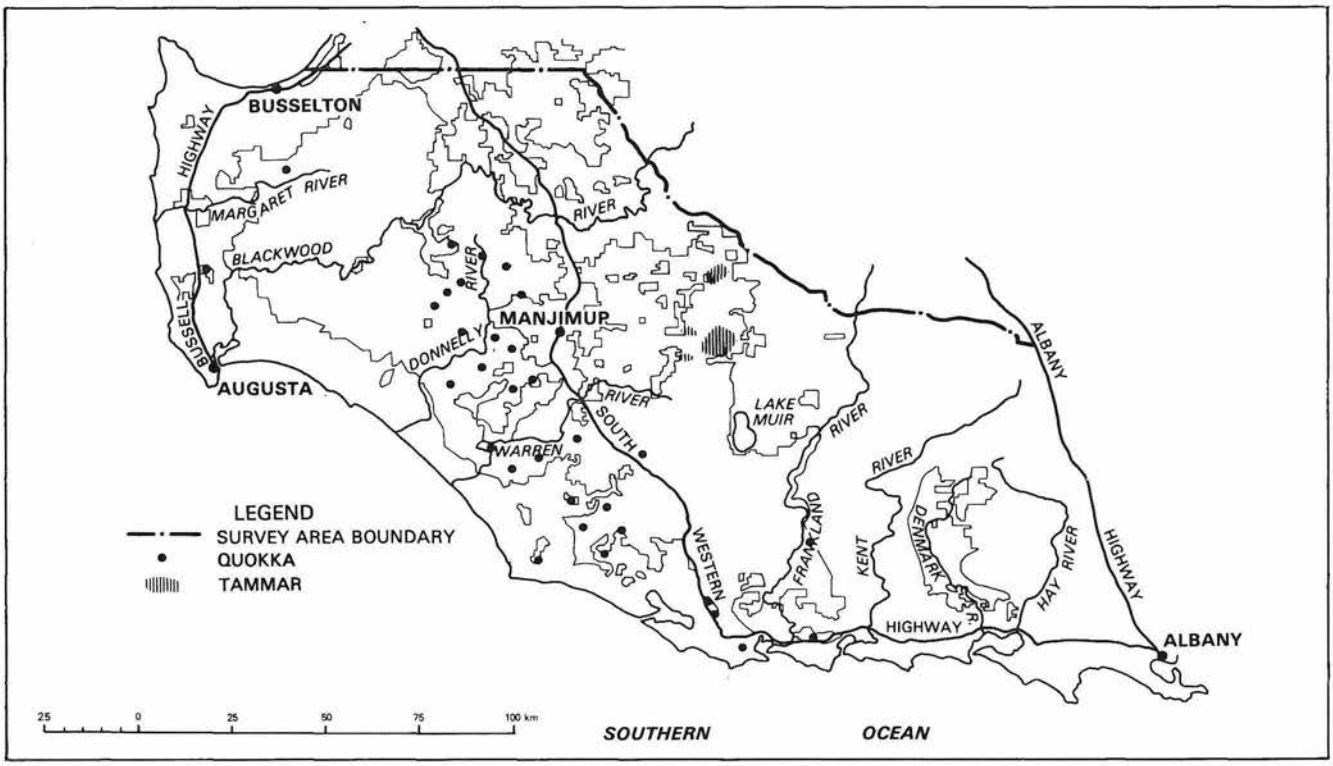

Figure 7: Known distribution of the Quokka *(Setonix brachyurus)* and Tammar Wallaby *(Macropus eugenii)*

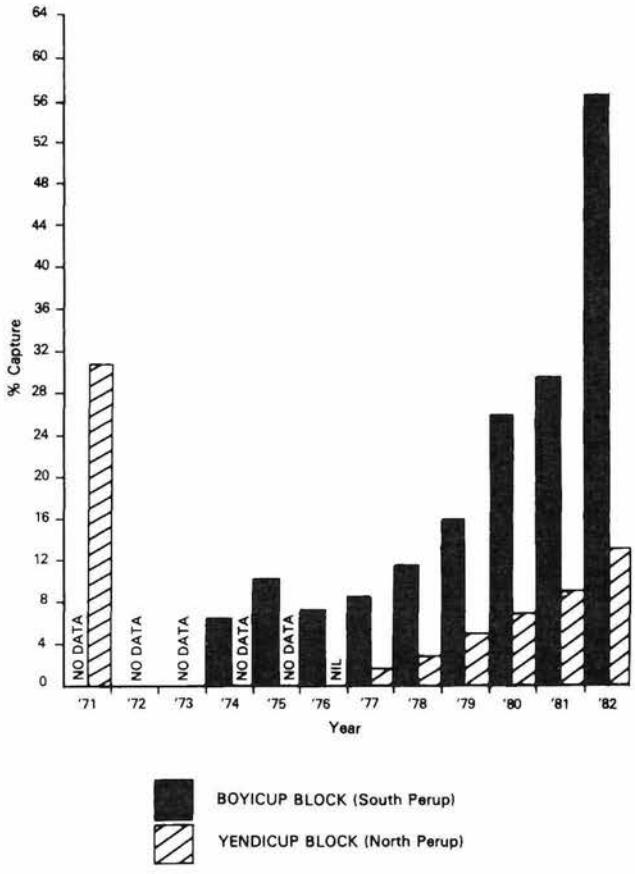

Figure 8: Capture percentages of the Brush-tailed Bettong *(Bettongia penicillata)* at two locations in the Perup forest.

Family Phalangeridae

Common Brushtail Possum *(Trichosurus vulpecula)*

The Brushtail Possum is locally common, particularly in the Perup forest area, but is found only in very low numbers throughout the survey area. It was recorded on seven of the surveys, and road kills and occasional sightings over the last decade have also contributed information on the species' distribution.

The species occurs in high numbers only in the Perup area. Low populations exist in the Donnybrook Sunklands, along the Blackwood River, at Margaret River, in the Yornup area to the north of Manjimup, and on the Hay and Kent Rivers. There have been two recordings from the karri forest, one individual captured near Pemberton in 1972 and another recorded during felling operations at Keystone Hill, near Walpole, in 1973.

'Possum trees', or trees with visible possum 'tracks', are usually a sign of high population densities, and are rarely obvious where the species exists only in low numbers. Possums are not easily observed by spotlight unless their population density is reasonably high.

Although road kills around Bridgetown and Kirup occurred frequently prior to 1973/74, since that time Brushtail Possum numbers appear to have declined in some areas. Even in the Perup their numbers have fluctuated (See Figs. 9a and 9b)

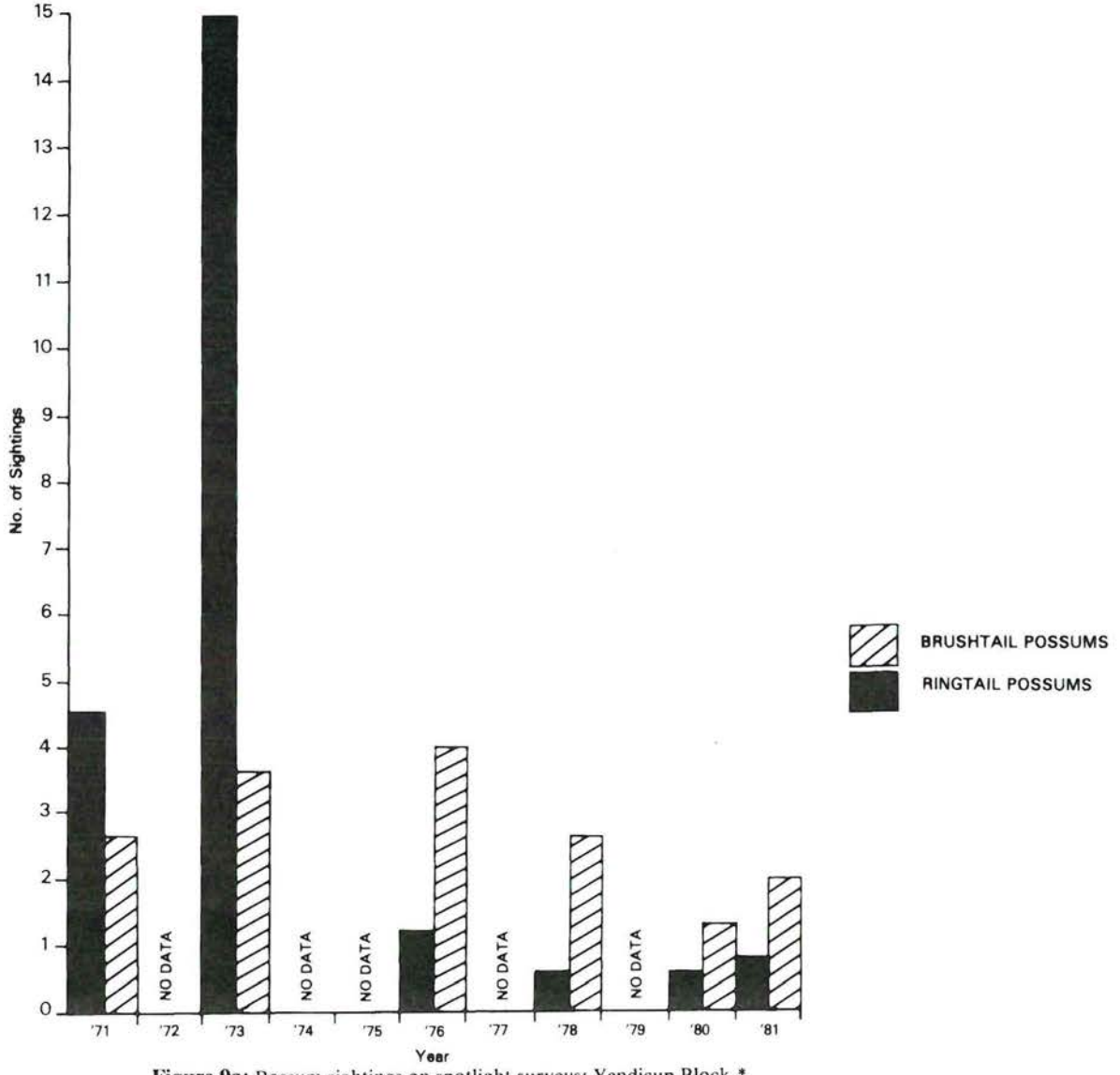

Figure 9a: Possum sightings on spotlight surveys: Yendicup Block.*
*Two surveys approx. 3-4km each are done regularly twice a year. These figures are standardized to sightings/5km.

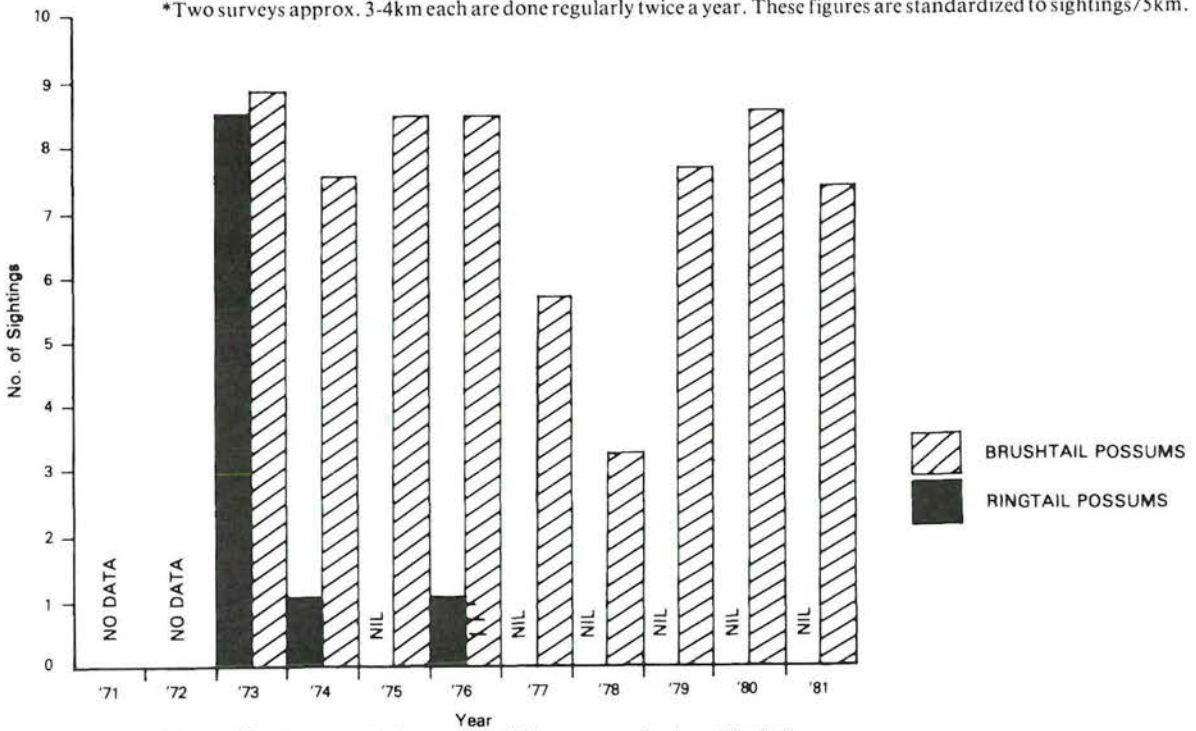

Figure 9b: Possum sightings on spotlight surveys: Boyicup Block.*
*Two surveys of approx. 3-4km are done regularly twice a year. These figures are standardized to sightings/5km.

More recent records include: M007216, Busselton (1965); M006826, S.W. Highway (1966); M006936, M006963-65, M007002-3, M007428, Donnybrook (1966); M007699, Manjimup (1967); M008371, Busselton (1969); M012631-32, Yallingup (1975); M013666, State forest (1975).

Family Petauridae

Common Ringtail Possum *(Pseudocheirus peregrinus)*

The Common Ringtail Possum appears even more restricted in distribution than the Brushtail Possum, and also suffered a similarly severe decline in numbers in 1973/74. Prior to this, sizeable colonies of Common Ringtail Possums were known to occur in the Perup, and in the coastal tuart *(Eucalyptus gomphocephala)* and peppermint *(Agonis flexuosa)* forest near Dunsborough and Busselton. This species is present in low numbers in these places, but is rare elsewhere.

In addition to the Perup, Common Ringtail Possums were recorded on only three other surveys. One sighting was in a pine plantation near Nannup, another was located in a dead stump in young karri regeneration near Pemberton, and the last record was of a nest or drey in a *Melaleuca preissiana* tree on the Mitchell River.

Other recent records include sightings of the Common Ringtail Possum in an isolated patch of riverine vegetation on farmland near Manjimup (1972), in a blackberry thicket on Four Mile Brook in the karri forest to the west of Manjimup (1975), and in clear felled jarrah forest near Wheatley (1977). It would seem that isolated, small colonies may occur throughout the survey area, particularly in riverine habitats.

The Common Ringtail Possum is not often recorded, since, unlike the Brushtail Possum, it does not enter traps and is not always detected on spotlight surveys unless population densities in the area are high (Figs 9a and 9b). The species appears not to build dreys very often, preferring to nest in hollow trees like the Brushtail Possum. An exception to this is in the tuart forest near Busselton where it often builds dreys in peppermint trees.

The relatively few Museum records from the area include: M004255, Manjimup (1958); M008386/002, Karri Hill (1961); M004974, Pemberton (1962); M006564, M007192, M007202, Busselton (1965); M007962, Yallingup (1969); M012507, M012517/004, Augusta (1970); M012630, Yallingup (1975); M016834-35, Hardy Inlet (1980). There are also a few older records.

Family Burramyidae

Western Pygmy-possum *(Cercartetus concinnus)*

Recorded on eight of the surveys, and almost always captured in pit traps, the Western Pygmy-possum (Plate 22) does not appear common, but is widespread in distribution. It seems to favour coastal and sub-coastal banksia woodland and heathland. There is some evidence that this species' numbers may fluctuate widely. In 1972, on the Woolbales survey, several dozen individuals were collected in coastal banksia woodland near Crystal Springs, amongst which were several pregnant females. They were collected from hollow trees, underneath loose bark, in hollow logs, and in dead blackboy stumps. A search through the same area a year later failed to locate a single individual.

Apart from survey records, specimens are occasionally brought in by domestic cats in the area. In 1978, one was also captured in a pit trap in karri forest near Pemberton. Another was collected, in 1981, in the pine plantation at Dombakup near Pemberton.

Museum records include: M012991, Kudarup (1975); M014855-56, Jardee (1975); M015200, Northcliffe (1976); M015201, Pemberton (1976); M018207, Milyeannup Road (1977).

Family Tarsipedidae

Honey-possum *(Tarsipes rostratus)*

The Honey-possum (Plate 23) appears to be locally common in coastal and sub-coastal areas. It was recorded on eight of the surveys, most recordings being within 15 to 20 km of the coast. The species is mostly found in open woodland of *Banksia attenuata*, or sheoak *(Casuarina fraserana)*, or areas of heathland with bottlebrush *(Beaufortia sparsa)* on sandy soils. A characteristic of these plant communities is that there is invariably at least one major species to be found flowering at any time of the year. Wooller *et al.* (1981) consider that *Tarsipes* is confined to areas where the flowering seasons of nectar-producing plants overlap, which ensures the animal a constant food supply throughout the year.

The species is readily captured in pit traps, particularly those allied with a drift fence. It appears not to occur in the northern part of the survey area, or in the karri forests. It does, however, occur in the extensive areas of woodlands and heathland in the Donnybrook Sunkland.

Most of the Museum records are from the Albany area, with a few from around Denmark, Walpole and Busselton. Most of the more recent records are from within the forested areas, and were collected by Forests Department survey teams.

Recent records include: M009000, Wilson Inlet (1972); M010919, Kent River (1973); M012473, Ridge Road (1974); M013992, Walpole (1975); M013993, Soho (1975); M018208, Quininup (1976); M018173, Mitchell Block (1977); M015473, Dunsborough (1977); M018485, Pt. D'Entrecasteaux (1978).

Plate 21 ▲
Extensive thickets of heartleaf poison bush *(Gastrolobium bilobum).*

Plate 22 ▲
Western Pygmy-possum *(Cercartetus concinnus).*

Plate 23 ▲
Honey-possum *(Tarsipes rostratus)* on *Banksia attenuata.*

Family Peramelidae

Southern Brown Bandicoot or Quenda *(Isoodon obesulus)*

This species is widespread throughout the survey area, occurring wherever there is suitable dense undergrowth. It was located on all but the Pines and Milyeannup surveys. In the jarrah forest, in the northern part of the survey area, the Southern Brown Bandicoot is largely restricted to dense streamside vegetation and low, dense cover around rocky outcrops. In the southern jarrah and karri forest, coastal woodlands, heaths and flats, where the vegetation is dense, it is not restricted to riverine habitats.

The Southern Brown Bandicoot appears to prefer sandy soils, where its characteristic 'conical' diggings are commonly seen. The species is comparatively easy to trap, and hair analysis shows it to be a common dietary item of the Fox. On one occasion, two young nestling Bandicoots were found in the stomach of a very large Dugite *(Pseudonaja affinis)* killed near Northcliffe.

Trapping records do not reveal any pattern in population fluctuations, probably because of the low capture rate of the species in the area from which records are available (Fig. 10).

There are many Museum records from the survey area. Most of the earlier records are from the South-west Highway north of Manjimup and between Busselton and Augusta, and more recent Forests Department collections are from forests further to the south.

Recent records include: M012517/003, Augusta (1970); M010935, Boya (1971); M012173/001, Yallingup (1971); M011353, Kent River (1974); M011452, Rocky Gully (1974); M012146, Northern Road (1974); M012475-76, Sabina Road (1974); M013991, Talbott Road (1975); M014517, Shannon (1976); M014519, Fish Creek Road (1976); M014528, Thomson Road (1976); M014755, Scott River (1976); M014756, Cape Leeuwin Lighthouse (1976); M014829, Walpole (1976); M014830, Shannon (1976); M018170, M018181, M018197, M018198, Mitchell Block (1977); M018199, Pemberton (1977); M018201, Chesapeake Road (1977); M018202, Vasse Highway (1977); M014686, Leeuwin National Park (1978).

Family Dasyuridae

Western Quoll or Chuditch *(Dasyurus geoffroii)*

The Western Quoll (Plate 16) would appear to be locally common only in the Perup, where a total of 20 have been trapped since 1974. In addition, there have been several sightings of the species on spotlight surveys, and one road kill recorded in the Perup during the last decade. One other survey record exists, a male was captured near Jarrahwood during the Sunkland survey in 1974. Individuals are rarely retrapped, even in areas where there are permanent lines.

The only other confirmed record in the survey area during the last decade is of a Quoll obtained near Pemberton in 1971. Other records include sub-fossil material from coastal dune deposits on the south coast. The age of these remains is unknown. Trapping records do not reveal any pattern in population fluctuations, probably because of the low capture rate of this species in the area from which records are available (Fig. 11).

It appears that the species may prefer the more open northern jarrah forest and eastern woodland areas of the survey area. There are few Museum records from the survey area, and, with the exception of M006769, Denmark (1964), all were taken north-east of Manjimup. Two of these records are recent — M005123, Donnybrook (1962) and M006520, Jarrahwood (1963), but all the others were obtained prior to the 1930s.

Brush-tailed Phascogale or Wambenger *(Phascogale tapoatafa)*

A most difficult species to trap, the Brush-tailed Phascogale was recorded on only one survey, in karri forest on the Donnelly River. Nevertheless, it appears to be widespread, though not common, throughout the survey area. Over the last ten years, 15 specimens, mostly road casualties, have been forwarded to us, and six sightings have been reported. Most of the specimens came from the tall open forest types in the vicinity of Manjimup and Pemberton. However, Phascogales have been recorded using nest boxes erected for birds in open forests in the Perup area. Radio tracking studies in the Perup suggest that the species has a large home range area and may travel several kilometres nightly in search of food.

This species is frequently sent to the Museum, perhaps because of its small size and unusual appearance. Most of the records are from the north of Manjimup on the South-west Highway and the area between Busselton and Augusta.

More recent Museum records include: M011173, Rocky Gully (1970); M010226, Brockman Siding (1971); M011172, Augusta (1971); M008972, Green Hill (1972); M010908, Perilulup Well (1972); M010989, Sue's Road (1972); M012157, Diamond Tree (1974); M013974, Burma Road (1975); M013975, Manjimup (1975); M018362, Mt. Frankland (1979); M018749, Augusta (1980); M018908, Ludlow (1980).

The Yellow-footed Antechinus or Mardo *(Antechinus flavipes)*

Recorded on seven of the surveys, this species is widespread throughout the survey area. It was found from the eastern jarrah/wandoo woodlands through to the dense karri forest areas. The densest populations exist in karri pole stands, which have remained unburnt

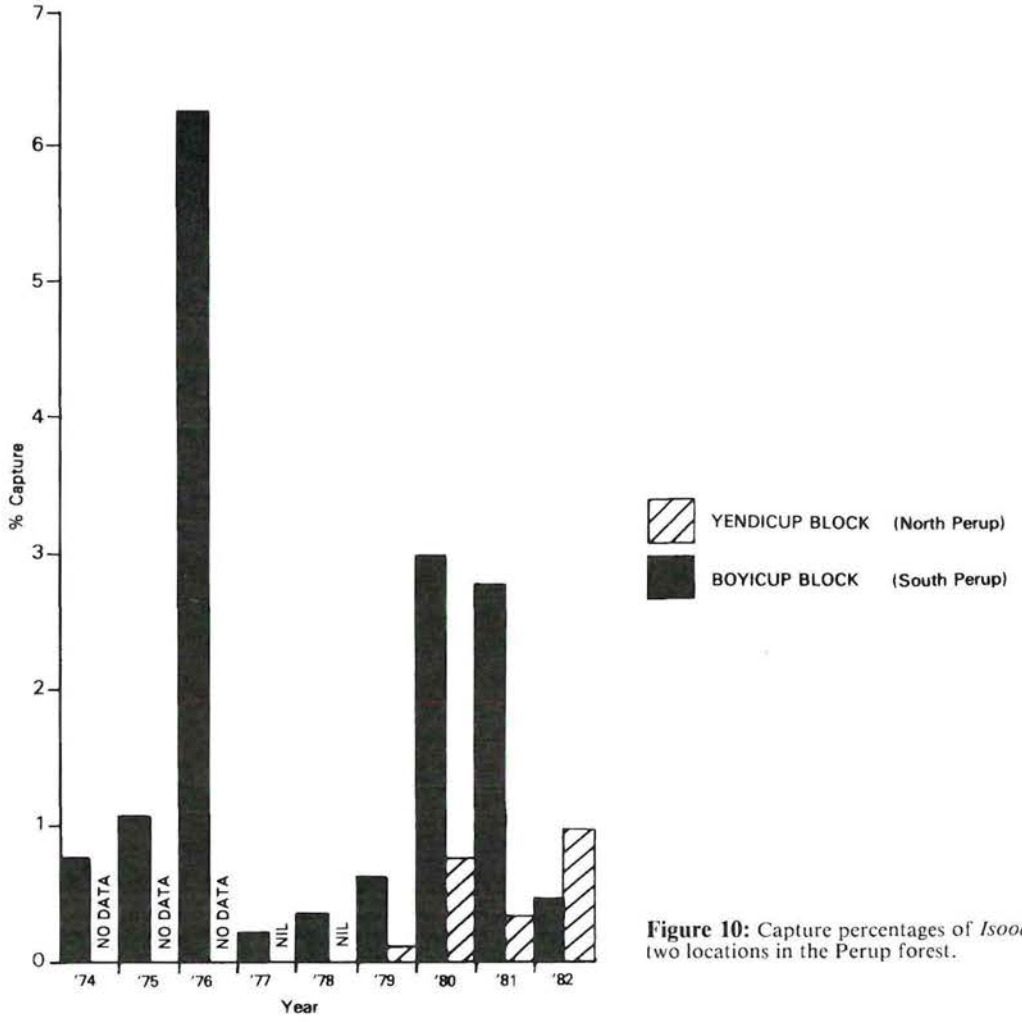

Figure 10: Capture percentages of *Isoodon obesulus* at two locations in the Perup forest.

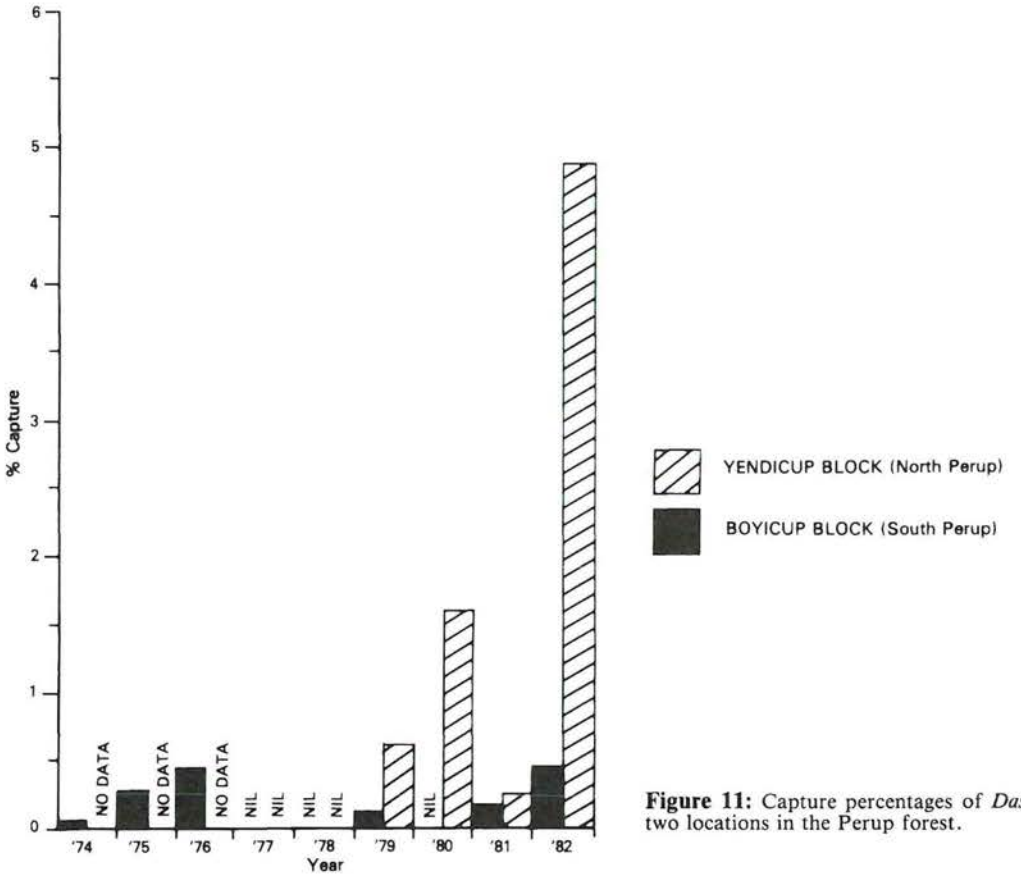

Figure 11: Capture percentages of *Dasyurus geoffroii* at two locations in the Perup forest.

since regeneration (1930) in Big Brook near Pemberton. The species is also common in dense sword grass growing along fracture lines in granite rocks on many monadnocks to the south of Shannon. It is readily caught in Elliot and snap traps, and was most frequently captured in unburnt forest areas.

The Mardo feeds primarily on litter insects, and appears to occur only in areas where there is a deep forest litter layer (Sawle, 1979; and Hindmarsh, 1976). Recent Forests Department radio telemetry studies reveal that this species makes its nests in old logs or dead trees.

Most records for the survey area come from F.D. surveys. Museum records include: M015456, Manjimup (1970); M010227, Walpole (1972); M010990-93, Mt. Lindesay (1973); M015203, Milyeannup (1976); M015205, Big Brook (1976); M018206, Pemberton (1977).

Common Dunnart *(Sminthopsis murina)*

The Common Dunnart (Plates 19 and 24) is the most common of the Dasyurids recorded on all surveys. The species was collected mostly by hand, usually in the hollow stems of old dead blackboys, but occasionally underneath loose bark and in old stick ants' nests. It is rarely caught in either Elliot or snap traps, but may be captured in pit traps.

The species is particularly common in areas of low open woodland on the edge of heathlands and sedgelands in the south of the survey area. It is also common in heathland types, coastal scrub and to a lesser extent in the karri and tingle forests.

Nests made from a variety of materials, most often strips of paperbark *(Melaleuca* spp.), were frequently found in the hollow stems of dead blackboys. These nests were very common in Soho block, near the Frankland River, on the edge of a Mitchell grass *(Avandra aristata)* flat which had been burnt two years previously. There is some evidence to suggest that Common Dunnart populations in the south-west may be highest in recently burnt areas.

Museum records were distributed evenly throughout the survey area, and include these, more recent, records: M008402, Walpole-Nornalup (1971); M010228 Chitelup Hill (1971); M010229, Mt. Burnside (1971); M010231, Pemberton (1971); M013010, Walpole (1972); M013194, Silver Mt. (1972); M010232, Cambray (1973); M011074, Augusta (1974); M012474, Ridge Road (1974); M011350, Kent River (1974); M013986-89, Walpole (1975); M014436, Shannon (1975); M014854, Manjimup (1975); M014956, Augusta (1977); M015169, Leeuwin National Park (1977); M018162-3, M018183-84, M018192, Mitchell Block (1977); M018118, Wapet Road (1978).

Family Myrmecobiidae

The Numbat or Banded Anteater *(Myrmecobius fasciatus)*

This species was recorded only on the Perup survey, but records over the last 10 years indicate that it is also present in other areas to the east of Manjimup (Plate 39).

Recent radio tracking work and recorded sightings by the Forests Department (Christensen *et al.*, 1984) indicate that most of the Numbats in the survey inhabit the jarrah forest. These results conflict with those of Calaby (1960), who suggests that the Numbat is restricted to the wandoo areas.

The radio tracking studies also indicate that the Numbat has a very large home range area which may be in excess of one square kilometre. Thus it is unlikely that total numbers of Numbats in the survey area exceed a thousand individuals.

In 1973-75 there was a drastic decline in the number of Numbat sightings, but numbers appear to be recovering (Fig. 12).

There are only two Museum recordings from within the survey area: M001982, Manjimup (1935) and M010234, Corbalup Road (1972). The Manjimup specimen is likely to have come from somewhere else, probably the Perup area. There are two other records from just outside the survey area in the vicinity of the Denmark and Hay Rivers: M001808, Narikup (1934) and M002494-8, Pardelup Prison Farm (1941). There have been no recent sightings reported in these areas, and much of the land has since been cleared for agriculture. There are many early Museum records from areas further to the east, now also agricultural land.

Order Rodentia

Family Muridae

Bush Rat *(Rattus fuscipes)*

The Bush Rat is the most common of all the mammals in the survey area, although it is not the most widespread. It was recorded on all except the Pines survey, and is common in most vegetation types except the open jarrah and wandoo forest in the northern parts of the survey area. It does, however, occur in these open forests types wherever there is dense ground cover, for example, in swamps in the Perup area.

In the jarrah forest the species is restricted to dense stream-side vegetation and swamp edges. In the karri forest and much of the southern higher rainfall area the Bush Rat occurs throughout, although it is more abundant in moist situations. Capture rates of 40 per cent are quite common in the karri forest, and in one area in Soho block capture rates of 100 per cent were recorded. In this latter area Bush Rats were springing traps throughout the day, an unusual occurrence since the species normally confines its activities to the night.

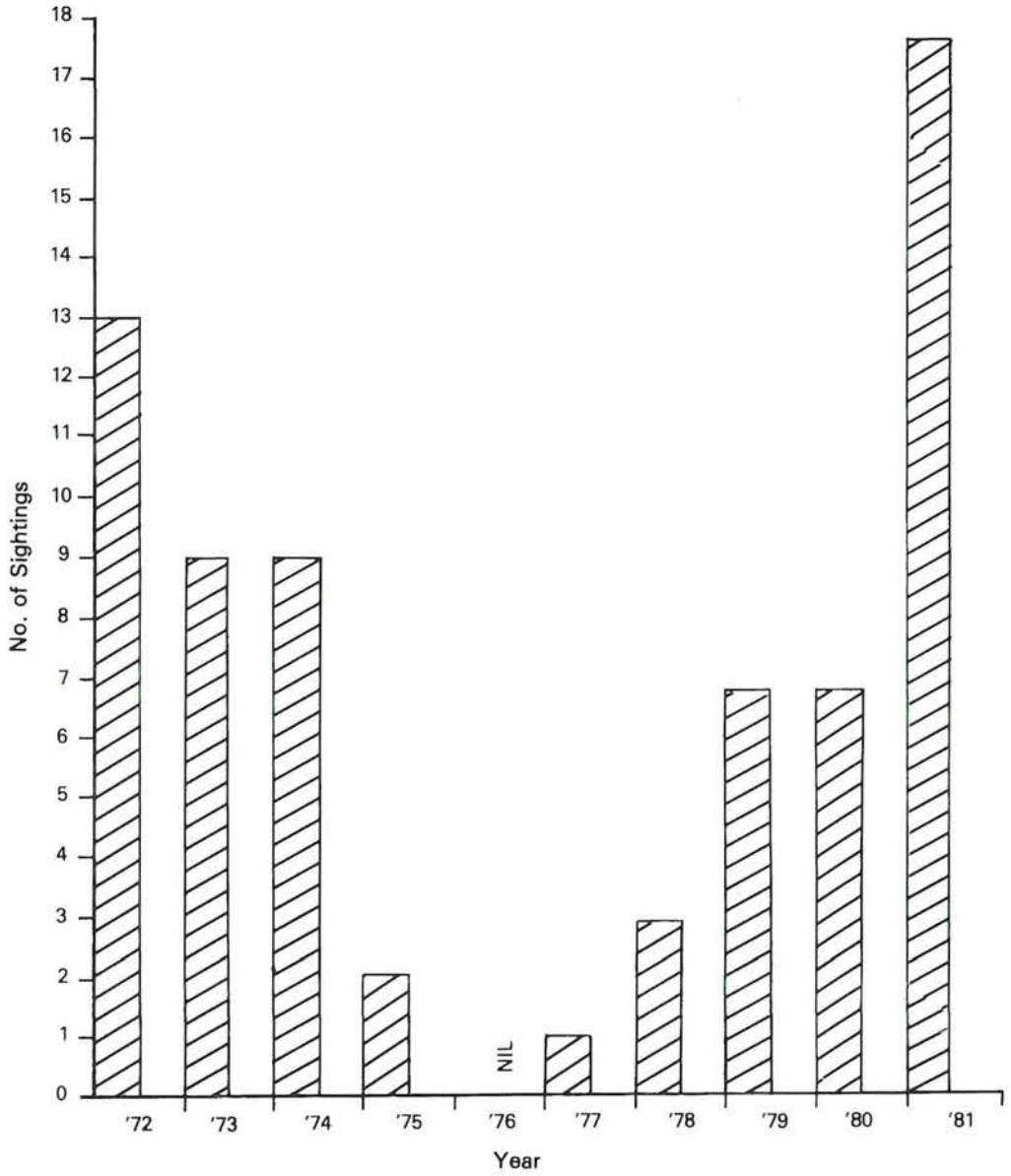

Figure 12: Incidental sightings of the Numbat *(Myrmecobius fasciatus)* in the north-east of the survey area.

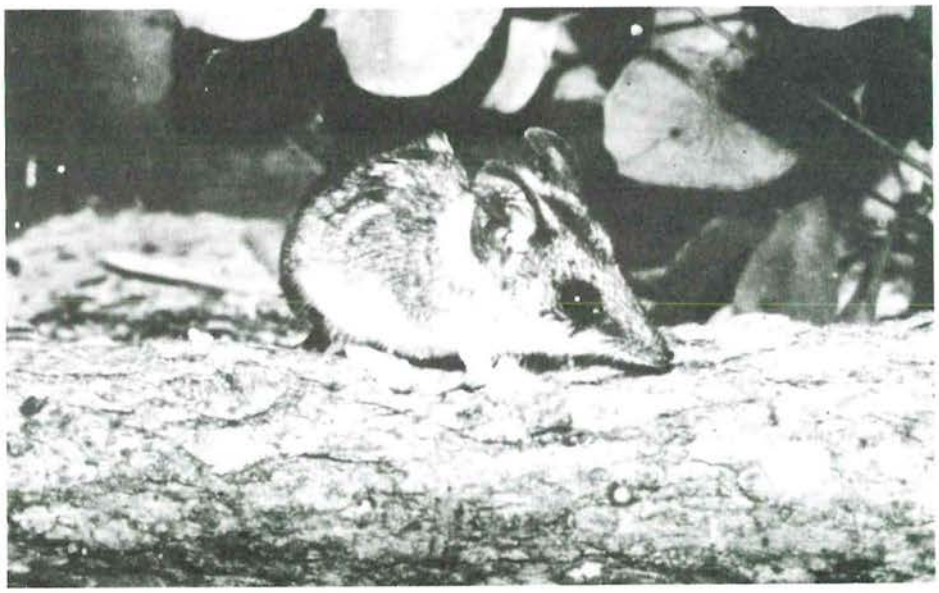

Plate 24 ▶
Common Dunnart *(Sminthopsis murina).*

The presence of this species is easy to detect since they make distinct runnels, unlike the only other rat in the survey area, *Rattus rattus*. The small mound of soil at the entrance to their burrows is also a conspicuous feature in areas where the Bush Rat occurs.

Museum records exist for most of the survey area, many of them recent collections from Forests Department surveys. These records also suggest that this species is generally uncommon in the forest area to the north of the survey area, except in some coastal and swamp habitats.

Water-rat *(Hydromys chrysogaster)*

The Water-rat was detected on eight surveys. Often the only sign of the species' presence was the discovery of empty fresh water mussel shells discarded by the rat on logs and rocks in streams and rivers. Footprints in the mud along the edges of streams and watercourses were also found in many places. However, the species was only captured on two surveys, the Yeagarup and the Karri, although one was seen swimming in the Frankland River.

The species is believed to be fairly common, occurring in all the major rivers and in most of the larger streams as well as bodies of permanent water in the survey area.

The water rat apparently travels considerable distances from water at times. For example, on one occasion a recently dead specimen was found in an empty concrete settling tank, just above a Public Works Department weir on a dried-up creek in the karri forest to the south of Quininup. There was no source of water within several kilometres of this creek, and the animal must have travelled a considerable distance over land to reach the weir. On a separate occasion another specimen was found some distance from water on the edge of the Deanmill football oval.

Those few Museum records from the survey area which exist are mostly from the Busselton, Margaret River and Albany regions. Six of them are recent: M002861, Pemberton (1951); M006381, Busselton (1963); M01183, Nannup (1972); M013859, State Forest (1975); M015207, Bridgetown (1976); M015173 (1977).

Order Chiroptera

Family Molossidae

White-striped Mastiff-bat *(Tadarida australis)*

This high flying species was not collected on any surveys. Specimens were shot on Forests Department surveys outside the survey area in Dryandra forest 1978 (M018212) and at Collie in 1982. The White-striped Mastiff-bat's presence in an area is usually indicated by the distinct and very high-pitched sound it emits, a characteristic not associated with other bats. If our interpretation of its sound is correct then the species is present in most places throughout the survey area.

Hall and Richards (1979) describe it as a southern Australian species from below the tropic of Capricorn.

Museum specimens include: M005420, M005459, Wheatley (1963); M007611, Nannup (1965).

Little Mastiff-bat *(Mormopterus planiceps)*

The Little Mastiff-bat was collected recently from the Perup and Nyamup, but was not collected on any survey. Hall and Richards (1979) describe the distribution of the Little Mastiff-bat as throughout southern Australia excepting Tasmania.

There are no Museum records for the survey area, the nearest one being: M004388, Woodanilling (1961).

Family Emballonuridae

Yellow-bellied Sheathtail-bat *(Taphozous flaviventris)*

Although the Yellow-bellied Sheathtail-bat was not collected on any surveys, there exists a single Museum record from Manjimup (M003001, 1954). The Museum collection indicates that it is a northern Australian species. Hall and Richards (1979) describe it as widespread in Australia, except for Tasmania.

Family Vespertilionidae

Greater Long-eared Bat *(Nyctophilus timoriensis)*

This species was collected on only two surveys. On the Yeagarup survey two Greater Long-eared Bats were found roosting inside the hollow trunk of a dead blackboy and on the Mitchell survey a bat was shot. From Museum records the Greater Long-eared Bat appears to be fairly widespread in the survey area, but not very common, or what is more likely, infrequently collected.

The species also occurs in the Perup area (Sawle, personal communication*).

Museum records from the area include: M000036, Nannup (1913); M000222, Margaret River (1914); M001247-48, Wonnerup (1930); M002955, M002958, Albany (1953); M018216, Manjimup (1976); M018486, Nornalup/Walpole Road (1978).

Lesser Long-eared Bat *(Nyctophilus geoffroyi)*

This species was recorded on three surveys: one specimen was collected by mist netting in the Perup (M009970, 1972) and the others were shot on the Yeagerup survey and the Mitchell survey (M018182, 1977). In addition, a colony of nine individuals was found roosting inside a dead blackboy trunk in jarrah forest to the south-east of Lake Muir. Another specimen, a road casualty, was collected in Manjimup township in 1971 (M008457). The species has also been collected at Perup.

The Lesser Long-eared Bat appears to be widespread, but fairly uncommon or rarely collected.

*Sawle, M. Department of Zoology, University of Western Australia

Museum records include: M002956-57, Albany (1953); M003780, Mammoth Cave (1959); M007666, Vasse (1968); M008457, Manjimup (1971); M009970, Perup (1972); M011168, Nannup (1974); M015232, Boyicup (1976); M018356, Augusta (1978).

Gould's Wattled Bat *(Chalinolobus gouldii)*

This species was collected on five surveys: Perup, Sunklands and Mitchell River, Boranup and Frankland.

Gould's Wattled Bat is a widespread species which is common throughout the survey area.

Museum numbers for the survey specimens include: M011364, Margaret Road (1974); M012481, Cambray (1974); M018593, Mt. Lindesay (1980).

Other records from the area include: M01073-77, Mitchell River (1973); M010932, Nannup (1973); M011445, Rocky Gully (1974); M014679, M014691, Hardy Inlet (1977); M014683, Forest Grove (1977); M19602, Frankland (1981).

Chocolate Wattled Bat *(Chalinolobus morio)*

This species was collected on three surveys: the Mitchell, M018179 (1977) and M018188 (1977), and Perup and Shannon M19042. Western Australian Museum records would suggest that the Chocolate Wattled Bat is a southern species. Hall and Richards (1979) describe it as a southern coastal species in the eastern states. It appears to be widely distributed in the survey area, but less common, or perhaps less frequently collected, than the White-striped Mastiff-bat *(Tadarida australis)*.

Other Museum records from the area include: M001361, Chorkerup Siding (1931); M003786-88, Mammoth Cave (1959); M004051, Pemberton (1960); M008554, Manjimup (1971); M012787, Moses Rock Cave (1975); M018359, Denmark (1979).

Great Pipistrelle *(Pipistrellus tasmaniensis)*

As the Great Pipistrelle was collected on eight surveys, it is probably the commonest bat in the survey area. This interpretation may be erroneous, however, since there is some evidence of seasonal variation in numbers. All Museum specimens of this species appear to come from within the lower south-west forested areas. Hall and Richards (1979) state that the species has a preference for gullies with tall, wet sclerophyll vegetation.

Most survey specimens were collected from jarrah forest or woodland formations, including: M009967-68, Perup (1972); M013004, Walpole (1972); M012996-98, M13001-03, Silvermount (1972); M009890-91, Boranup (1973); M012481-82, Cambray (1974); M018178, Mitchell (1977); M018594-85, Mt. Lindesay (1980).

Other Museum records include: M004059, M004182, Boranup (1961); M005456-58, Wheatley (1963); M006328, Donnelly River (1963); M007443, Nannup (1965); M007444, Carey Brook (1965); M011352, Kent River (1974); M012636, Walpole (1975).

King River Eptesicus *(Eptesicus regulus)*

This species was recorded on nine surveys, and was also frequently observed on spotlight surveys. It is easily recognised because of its small size.

The King River Eptesicus appears to be one of the most common species in the survey area. Hall and Richards (1979) also state that it is very common in southern Western Australia.

Most of the survey specimens came from the jarrah forest, including: M009971, Perup (1972); M018176, M018180, M018186, M018189, M018190, Perup (1977); M018592, Mt. Lindesay (1980); M19603-06, Frankland (1980).

Other Museum records include: M000977, Pemberton (1928); M000983, Manjimup (1928); M004183, Boranup (1961); M004687, Denmark (1961); M015377, Jasper Road (1965); M007821, Manjimup (1968); M010045, Windy Harbour Road (1971); M008848-50, Morbrup (1972); M011349-51, Kent River (1974); M011446-48, Rocky Gully (1974); M012981-82, Augusta (1974); M013947, Mt. Romance (1975); M014687, Deep River (1977); M01561, Donnelly River (1977); M015479, Albany Post Office (1978); M018360, Denmark (1979).

Order Monotremata

Family Tachyglossidae

Short-beaked Echidna *(Tachyglossus aculeatus)*

The Echidna appears to be rare in the survey area. Although none were sighted on any of the surveys, evidence of the species' activities was recorded on the Perup survey. Also, over the last decade there have been five records of the species from the survey area.

An Echidna was sighted in wandoo forest on the Perup river in 1972. Two years later, another was found in the mill yard of Bunnings Timber Ltd., and handed in at the Manjimup Wildlife Sanctuary. It was not possible to trace its origin, but it was presumed to have been brought in from the bush inside a hollow log. In 1979, the capture of an individual in the karri forest on the Warren River near Pemberton was reported to the local Fisheries and Wildlife Warden. Another individual was also captured near Yornup in 1981, and there was an unconfirmed sighting of a further individual seen crossing the South-West Highway in jarrah forest near Shannon.

There is only one Museum record for the survey area: M002868, Bridgetown (1951).

(ii) INTRODUCED SPECIES

Order Rodentia

Family Muridae

Black Rat *(Rattus rattus)*

Recorded on 13 of the 15 surveys, this species is widespread throughout the survey area. It is very common in disturbed habitats, around human habitation, near farmlands, and in the vicinity of creeks, watercourses and lakes.

The highest populations of the Black Rat were recorded in remnant pockets of native vegetation along streams in the Blackwood pine plantations. It is also commonly found in the vegetation along major river courses.

The species may be found in association with the Bush Rat *R. fuscipes,* particularly near rivers and streams and close to farmland areas, and it does not appear to be displacing the latter species. Most of the densely vegetated areas in the southern forests have high populations of *R. fuscipes,* and *R. rattus* is present only in certain areas, which contrasts with the northern jarrah forest, where *R. rattus* is common in most streamside areas and *R. fuscipes* is completely absent.

The Black Rat has never been trapped in Elliot traps, and, apparently, will only enter box or snap traps.

House Mouse *(Mus musculus)*

This species is widespread throughout the survey area, and was trapped on all but the Milyeannup survey. In undisturbed habitats it most often occurs in very low numbers. The House Mouse is capable of very rapid colonization of disturbed sites, however, and large numbers invade and breed on burnt areas only a few months after fire. These populations breed rapidly for a year or two and then decline to very low numbers in later successional stages.

Many House Mice were captured in the Blackwood Valley pines and in the coastal areas around Crystal Springs where cattle grazing is prevalent and there is a high proportion of introduced weed and grass species.

Order Lagomorpha

Family Leporidae

Rabbit *(Oryctolagus cuniculus)*

The Rabbit is widespread throughout the survey area. It was recorded on most of the surveys, but is largely restricted to the vicinity of farmlands and the coastal dune area. Away from farmland it occurs in isolated colonies, often in woodland areas with sandy soils. Rabbits also invade the karri forest following clear felling; these populations may persist for a time; but eventually disappear as the young saplings occupy the site.

Order Carnivora

Family Felidae

Cat *(Felis catus)*

This species is widespread throughout the survey area. Cat footprints in sandy soils were recorded on all the surveys. It has only been captured twice on surveys, in Woolbales and Perup, and has been caught only three times during F.D. fauna studies. Road casualties are also rare. It is sighted occasionally, and has been seen in the karri forest and coastal areas.

Family Canidae

Dingo *(Canis familiaris dingo)*

Neither pure-bred Dingoes nor those of mixed origin are common in the survey area. Over the last decade only a few of this species have been sighted, but footprints were recorded on seven surveys. Small Dingo populations appear to exist on the south coast, between Augusta and Walpole, and in the eastern areas on the Frankland River and further to the east. Two almost pure-bred Dingoes have also been sighted in the Perup area in recent years.

The few Museum records are mainly from coastal areas: M003180, Lake Cave 1956); M003847, Skull Cave (1959); M003868, Boranup Hill (1959); M004204, Margaret River (1959); M007875-76, Westcliffe Pt. (1967).

Fox *(Vulpes vulpes)*

The Fox is widespread throughout the survey area, being recorded on all surveys. The species is not often sighted away from farmland, and its numbers are not generally high in forest areas. They occur in moderate numbers, however, in all habitats. The highest Fox populations were recorded in the Blackwood Valley pines and on the south coast. Both these areas contain high population densities of Rabbits.

There was a dramatic rise in the Fox population within the survey area in 1973-74, after the abandoning of 1080 rabbit poisoning in south-west areas. Before 1973 Fox sightings and road kills in the area were comparatively rare. Now this species is sighted regularly and road kills are common throughout the survey area. The rise in Fox populations had a drastic effect on many species of medium-sized native mammals in the areas (Christensen, 1980a).

Hair analysis from Fox scats collected on surveys is a valuable addition to mammal distribution data.

The Fox has been in the survey area at least since the late 1920s (Long, n.d.).

Family Mustelidae

Ferret *(Mustela putoris)*

One Ferret, a full grown male, was killed by a dog on a farm a few miles to the east of Manjimup in 1981. This is the only record of this species from the survey

area in recent years. It is assumed that this specimen was from a wild population, but this has not been confirmed.

There are no Museum records for the survey area; the nearest one is Kojonup, which is some distance to the north-east of the survey area: M002261 (1938).

Order Artiodactyla

Family Bovidae

Feral Goat *(Capra hircus)*

Herds of Feral Goats are known to exist in the high open marri and karri forest on the Donnelly River between Palings Bridge and the Pemberton/Nannup Road, and in open jarrah forest near Lake Muir. Groups of up to 30 individuals have been sighted on the Donnelly River, and 12 goats were captured at Lake Muir by the Agricultural Protection Board in 1980.

The Donnelly River goat herd has been in existence for at least the last ten years.

Family Suidae

Feral Pig *(Sus scrofa)*

Feral Pigs were recorded only on the Pines survey at Grimwade, where they were known to have been established for some time. There are indications that this species is extending its range rapidly. Since the Pines survey (1977), Feral Pigs have been reported at Lewana on the Blackwood River, and at the Sunklands (1974) in McCorkhill Block.

It seems likely that this species will spread further in future. Pig hunters seeking to expand the population catch small pigs and relocate them in new areas (Masters, 1979).

Order Perissodactyla

Family Equidae

Horse *(Equus caballus)*

Evidence of Horses was recorded on the Sunklands survey, where hoof prints and droppings were noted. Their presence as a herd in the Sunklands has not been confirmed and the horses may only have been a few strays. Horses were also recorded on the Frankland survey: a fairly stable population of wild Horses exists in the area immediately to the south and east of Lake Muir and on the Frankland River. There is ample evidence in this survey area, including hoof prints, droppings and even permanent trails. Horses have been sighted on several occasions in the Frankland area.

The Frankland herds, which are well established, are kept in check by catchers who capture excess stock when populations build up.

There were also unconfirmed reports of a wild herd to the south-east of Donnelly Mill.

(B) BIRDS

DISCUSSION OF FINDINGS

Only birds actually sighted or recorded during surveys are discussed in this section; other species known to occur within the survey area are simply listed. Coastal species are not mentioned except where they were recorded on surveys taken close to the sea.

A total of 129 birds species was recorded on the 15 surveys, and a further 16, which are known to occur in the survey area, are listed.

The overall pattern and consistency of sightings indicate more about the species than the recording of a single bird on a survey. Species that are rare, more local in their occurrence, occupy specific and restricted habitat types or are simply more difficult to observe were recorded less often. The season in which the survey was conducted also influenced the sightings, for example, more migratory birds are sighted in spring. However, individual recordings, or absence of recordings, may also be important, and all sightings should be treated on their merits and considered carefully before they are dismissed.

Factors affecting recordings were taken into account when compiling the notes on each species, but some general trends, as well as some individual species, are worth discussing.

Of the major vegetation types in the area, the open forest, open woodlands and low open woodland areas contain the richest assemblage of birds. The high numbers of bird species in the jarrah forest are attributed to the extensive area covered by this forest type within the survey area. In the case of the woodland, the variety of birds is mainly a consequence of the diversity of habitat and plant species present in this forest type.

The high open forest, heathlands and sedgelands contained the least variety of birds, probably because these forest types have less diversity of habitat and a smaller area. Some trends in these major vegetation formations are worthy of mention.

High Open and Open Forests

The high open and open forest formations appear to be the stronghold of the *Psittaciformes* (Parrots and Cockatoos). The Western Rosella *(Platycercus icterotis)* in particular is very common in the karri forest, and the White-tailed and Red-tailed Black Cockatoos *(Calyptorhynchus* spp.*)* are most common in the open jarrah and marri forests. Birds of prey are poorly represented, both in numbers and species, in these forests.

The White-breasted Robin *(Eopsaltria georgiana)* and the Red-winged Fairy-wren *(Malurus elegans)* are perhaps more common in the high open karri forest than in any other forest type. The Varied Sittella *(Daphoenositta chrysoptera)*, the Rufous Treecreeper *(Climacteris rufa)* and the Tawny Frogmouth *(Podargus strigoides)* (Plate 25) are perhaps the most common of the open jarrah forest birds in the survey area.

Although the Crested Shrike-tit *(Falcunculus frontatus)* and the White-browed Babbler *(Pomatostomus superciliosus)* are more common in the wheat-belt, they were recorded in the survey area. The former, listed as "rare, or otherwise in need of special protection" (Government Gazette W.A., April 8th, 1983), is a species from the lighter timbered country (Serventy and Whittell, 1976), but is also common in the high open forests.

It was sighted on several occasions, and has been recorded breeding in the Middlesex area (D. and M. Brown, personal communication*). These records do not support the contention that the Crested Shrike-tit is simply another species that shows some penetration along the coastal corridor (Serventy and Whittell, 1976). It is the authors' opinion that there is a stable, albeit low, population of this species in the high open forests.

Records of the White-browed Babbler in the survey area are not consistent with Serventy and Whittell's (1976) comment that there are a ". . . few isolated colonies on the south coast (Busselton, Pemberton, the lower reaches of the Warren River, Irwin's Inlet, Denmark) . . .". This species is common in the survey area wherever a suitable habitat, such as the tall dense understorey of karri/wattle *(Acacia pentadenia)*, is present. Its nests are common throughout much of the karri forest.

Another species which is listed as "rare, or otherwise in need of special protection (Government Gazette, April 8th 1983), the Red-eared Firetail *(Emblema oculata)* (Plate 26), is found in dense vegetation along creeks in the high open forest.

Open Woodland and Low Open Woodlands

These associations contain the highest number of bird species. The number of Honeyeaters in particular is high because of the large number of suitable flowering plants such as the banksias.

Unusual records in these associations include the White-winged Triller *(Lalage sueurii)*, which was recorded invading jarrah forest following wildfire, even though it is a species that does not normally occur in forest areas. Similarly, a pair of Grey Butcher-birds *(Cracticus torquatus)*, normally occurring to the north

*D. and M. Brown. Middlesex Field Study Centre, Manjimup, W.A.

of the survey area, and Hutton's Shearwater *(Puffinus huttoni)*, a New Zealand and Eastern States species, were recorded near Crystal Springs on the south coast.

Shrubland, Heath and Sedgelands

The closed shrubland and heath, open heath and sedgeland associations also contain high populations of honeyeaters. In these vegetation types, the honeyeaters are more seasonal, depending on the flowering of certain plants such as the bottlebrush *(Beaufortia sparsa)*. These associations are also the main stronghold of the fairy wrens, particularly the Splendid Fairy-wren *(Malurus splendens)* (Plate 27), and many of the diurnal birds of prey, especially the Marsh Harrier *(Circus aeruginosus)* and the Australian Kestrel *(Falco cenchroides)*. Shrubland, heath and sedgelands also provide the natural habitat for such species as Richard's Pipit *(Anthus novaeseelandiae)*, the Stubble Quail *(Coturnix novaezelandiae)* and the Brown Quail *(C. australis)*. Quail are common in the survey area, particularly in the woodlands to the north-east and in the heathlands to the south. As positive identification of quail in the field is difficult, the three species of quail which were recorded may be more common than is apparent, although the Pipit is now more common in farmland areas.

Plate 25▲
Tawny Frogmouth *(Podargus strigoides)* on its nest in coastal low open woodland.

Plate 26▲
Red-eared Firetail *(Emblema oculata)*.

Plate 27▲
Splendid Fairy-wren *(Malurus splendens)*.

The rare recordings include: the Spotted Harrier *(Circus assimilis)*, which was recorded over coastal heath near Walpole; the Spotted Nightjar *(Caprimulgus guttatus)*, a road kill specimen in heathland north of Walpole; and the Malleefowl *(Leipoa ocellata)* sighted to the east of the Frankland River.

Attempts to locate the Ground Parrot *(Pezoporus wallicus)*, last sighted in 1952 in sedgeland near Irwin's Inlet (Serventy & Whittell, 1976), were unsuccessful.

A number of bird species which were not recorded on any of the planned surveys have been recorded in the survey area in recent years. These include: the Great Crested Grebe *(Podiceps cristatus)*, Hooded Robin *(Melanodryas cucullata)*, Yellow-billed Spoonbill *(Platalea flavipes)*, Hardhead *(Aythya australis)*, Baillon's Crake *(Porzana pusilla)*, Australian Crake *(Porzana fluminea)*, Greenshank *(Tringa nebularia)*, Buff-banded Rail *(Rallus philippensis)*, Black-winged Stilt *(Himantopus himantopus)*, Rufous Songlark *(Cinclorhamphus mathewsi)*, Brown Songlark *(Cinclorhamphus cruralis)*, Singing Honeyeater *(Lichenostomus ornatus)*, White-fronted Chat *(Ephthianura albifrons)*.

There are undoubtedly other bird species that have not been sighted, such as some overseas species that may visit the area, and coastal species that dwell in an area that was superficially covered during surveys.

Since the arrival of Europeans, bird populations have undergone substantial changes within the survey area. Opening of the forest areas for farming has allowed the expansion of many bird species into the survey area, some on a seasonal basis, others to form stable breeding populations. These include: the Banded Lapwing *(Vanellus tricolor)*, Long-billed Corella *(Cacatua tenuirostris)* and the Australian Magpie-Lark *(Grallina cyanoleuca)*.

Populations of other species already occurring in the area have expanded, examples include: the Pacific Heron *(Ardea pacifica)*, Mountain Duck *(Chenonetta jubata)*, Black-shouldered Kite *(Elanus notatus)*, Australian Kestrel *(Falco cenchroides)*, Dusky Moorhen *(Gallinula tenebrosa)*, Purple Swamphen *(Poryphyrio poryphyrio)*, Elegant Parrot *(Neophema elegans)*, Richard's Pipit *(Anthus novaeseelandiae)*, Black-faced Cuckoo-shrike *(Coracina novaehollandiae)*, White-winged Triller *(Lalage sueurii)*, Clamorous Reed-Warbler *(Acrocephalus stentoreus)*, Yellow-rumped Thornbill *(Acanthiza chrysorrhoa)*, Rufous Whistler *(Pachycephala rufiventris)*, Silvereye *(Zosterops lateralis)* and the Australian Raven *(Corvus coronoides)*.

Undoubtedly, many true forest species have declined in absolute numbers due to the destruction and alteration of their habitats by farmland clearing. Also, selective logging in the jarrah forest and clear felling in the karri forest have affected, and continue to affect, the composition of bird communities.

The effects of such forest operations are not easy to predict, for birds may alter their behaviour to suit environmental changes. For example, the numbers of some forest canopy species may stay relatively unaltered in clear felled and regenerated areas because the birds have adapted to the regenerated crown cover (Unpublished data).

LIST OF SPECIES

Order Struthioniformes

Family Dromaiidae

Emu *(Dromaius novaehollandiae)*

Common throughout the survey area, Emus were recorded on all surveys. Their numbers in the survey area appear to vary seasonally, birds being sighted more often in the autumn months. Emu sightings recorded on regular Forests Department kangaroo surveys appear to indicate some sort of cyclic fluctuation in numbers (Fig. 13). Emus usually occur in pairs, with occasional flocks, consisting of parents and chicks, of up to ten birds. They often congregate in areas following fire to feed on the fresh growth. They appear to be one of the main agents in spreading blackberries *(Rubus fructuosus)* throughout the forest.

Order Podicipediformes

Family Podicipedidae

Hoary-headed Grebe *(Poliocephalus poliocephalus)*

Only one pair of Hoary-headed Grebes was observed, on the Shannon survey. The species is generally distributed throughout the State (Serventy & Whittell, 1976), but is apparently not very common in the survey area.

Australasian Grebe *(Tachybaptus novaehollandiae)*

This species was observed on six surveys, usually in pairs. They were common wherever areas of open water, fresh or brackish, occur. They nest on seasonal or permanent water and are common on many farm dams throughout the survey area.

Order Procellariiformes

Family Diomedeidae

Hutton's Shearwater *(Puffinus huttoni)*

One bird of this species was mistakenly shot on the Woolbales survey near Walpole in 1972. The bird was observed at night, 6 km inland from the coast, flying low over *Banksia attenuata* woodland. Unfortunately, the specimen was lost before it could be lodged with the W.A. Museum.

Hutton's Shearwater is a rare visitor to the State, with only three specimens from the south-west being recorded (Serventy & Whittell, 1976).

Order Pelecaniformes

Family Pelecanidae

Australian Pelican *(Pelicanus conspicillatus)*

This species is common on coastal estuaries in the survey area, and was recorded on two surveys: the Shannon, on Broke Inlet; and the Giants, on the lower Frankland River. The bird has, however, been sighted on most of the other estuaries in the survey area, as well as on Lake Muir and nearby Red Lake.

Family Anhingidae

Darter *(Anhinga melanogaster)*

Although the Darter is uncommon in the forested area of the lower south-west, it was sighted on seven of the surveys. Two of these records, from the Sunklands and Pines surveys, were on the Blackwood River. The other five were on the upper Tone River (Perup survey), Lake Yeagarup (Yeagarup survey) and the Frankland River (Frankland and Giants surveys), and a small lake, (Woolbales survey).

The species has also been recorded in the Middlesex area south of Manjimup (D. and M. Brown, personal communication*).

Serventy and Whittell (1976) state that the darter ". . . is less common further south, but a few are to be seen at the Hardy Inlet (Augusta), and on the south coast it does not reappear in strength until the Pallinup

*See p.32

Estuary . . .". Therefore, all these sightings, with the exception of those on the Blackwood River, represent a southward extension of the species' known range.

Family Phalacrocoracidae

Great Cormorant *(Phalacrocorax carbo)*

The Great Cormorant is common, having been recorded on three surveys: the Shannon, on Broke Inlet; the Giants, on Walpole Inlet; and on the Frankland River, north of Mt. Roe. It is a coastal species not often sighted within the survey area.

Pied Cormorant *(Phalacrocorax varius)*

This species was recorded on two surveys: the Boranup, on the Wonnerup Estuary; and the Shannon, on Broke Inlet. This Pied Cormorant is essentially a coastal species, and is rare south of Cape Naturaliste (Serventy & Whittell, 1976).

Little Black Cormorant *(Phalacrocorax sulcirostris)*

This essentially riverine and estuarine species does not appear to be common in the survey area. It was seen on only three surveys, on the Margaret, Frankland and Perup Rivers.

Little Pied Cormorant *(Phalacrocorax melanoleucos)*

This is the most common cormorant seen on surveys. It was recorded on nine different surveys, from the coastal region at Boranup inland to the Perup River. It was most frequently observed flying above the water along rivers, or perched on rocks or branches along the edges of rivers and lakes.

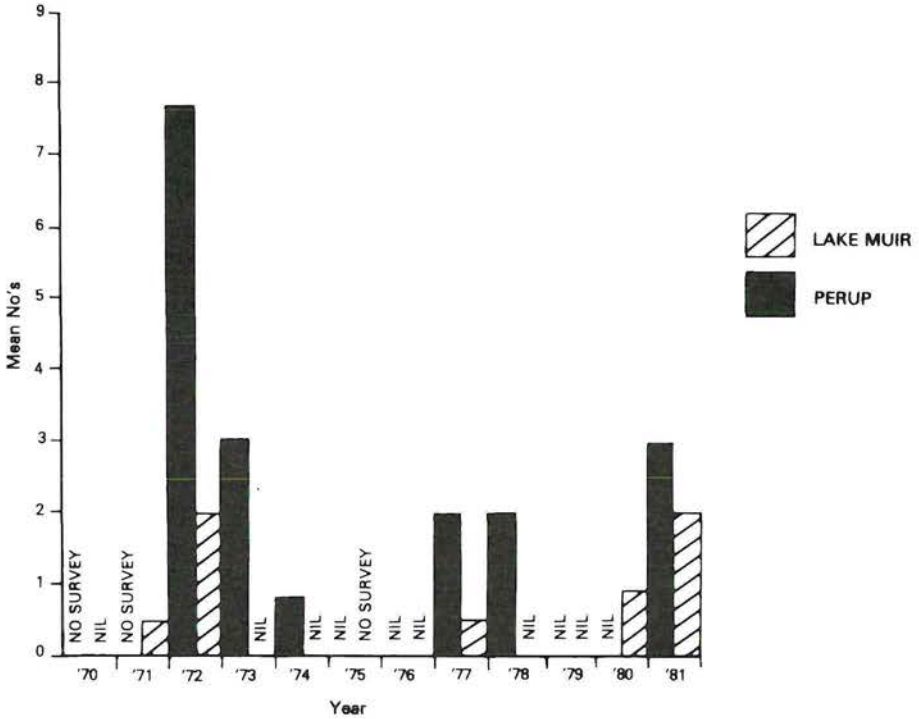

Figure 13: Mean numbers of Emus *Dromaius novaehollandiae* seen on two evening transects.*
*Each transect of 40 km is done regularly twice a year.

Order Ardeiformes

Family Ardeidae

Pacific Heron *(Ardea pacifica)*

The Pacific Heron is a seasonal visitor, mainly seen in spring and winter. It occurs singly, in pairs, and occasionally in flocks. It was recorded on six surveys, and all records were from farmland areas, usually inundated pasture or farm dams.

This is not a common bird in the survey area, but occasionally large congregations may been seen. One flock of 50 or more were observed in 1973 at Cowerup swamp to the north of Lake Muir, when the lake was being drained for peat mining operations.

White-faced Heron *(Ardea novaehollandiae)*

This species is very common, having been seen on thirteen surveys. It occurs throughout the survey area wherever suitable habitat is available. It may also be seen on wet pasture areas, farm dams, roadside pools, rivers and lakes, and almost anywhere there is standing water.

Great Egret *(Egretta alba)*

This species is uncommon in the survey area. The bird was seen on only two surveys: the Woolbales, near Crystal Springs; and the Sunklands, near Nannup. In both cases the Egret was seen on inundated pasture.

Occasionally, some Egrets may also be seen in flooded pasture areas and dams near Manjimup during winter and spring.

Rufous Night Heron *(Nycticorax caledonicus)*

This heron is widely distributed but uncommon in the survey area, being recorded on only three surveys: at Lake Yeagarup and on the Frankland and Perup Rivers. A young bird was also caught in the netting at the Pemberton Trout Hatcheries in 1972. All sightings have been of single birds.

Black Bittern *(Dupetor flavicollis)*

This species is widely distributed but uncommon in the survey area. Single birds were recorded on three occasions, twice on the Frankland River and once on the Tone River.

Australasian Bittern *(Botaurus poiciloptilus)*

A single Bittern was sighted on the Sunkland survey, on St. John's Brook. This species was also recorded on the Naeanup swamp on the Yeagerup survey, and on Blue Lake in the Denmark River catchment. The Australasian Bittern is confined to the south-west corner of Western Australia (Serventy & Whittell, 1976).

Family Plataleidae

Sacred Ibis *(Threskiornis aethiopica)*

This species is rare and was only sighted on the Yeagarup survey, when a small flock of about eight or nine birds were seen at Lake Yeagarup, in 1972. The Sacred Ibis has also been sighted on a Forests Department survey slightly to the north of the survey area, when four birds were seen feeding in pasture near Ludlow in 1973. This is a northern Australian species which has extended its range into the south-west only in recent years (Serventy & Whittell, 1976).

Straw-necked Ibis *(Threskiornis spinicollis)*

This is not a forest species, but it is locally common in farming country throughout the northern portion of the survey area. It was recorded on four surveys: Yeagarup, Boranup, Pines and Perup. All sightings were of small flocks seen on pasture or flying over pasture land. Large flocks of several dozen birds are frequently observed flying over the Manjimup area during autumn.

Order Anseriformes

Family anatidae

Black Swan *(Cygnus atratus)*

The Black Swan is common in inlets and estuaries in the survey area. The species was recorded on three surveys: the Perup, on a farm dam at Twin Lakes; the Shannon, on Broke Inlet; and the Pines, on a seasonal swamp on pasture.

Swans are very common on the south coastal estuaries during the summer and autumn months. Large numbers may also be seen on Lake Muir and nearby Red Lake. Occasional pairs of swans are often sighted on dams and lakes throughout the survey area.

Freckled Duck *(Stictonetta naevosa)*

This species is rare, being sighted only on the Yeagarup survey in 1972. One individual was sighted amongst a group of four Musk Ducks on Lake Yeagarup.

Australian Shelduck *(Tadorna tadornoides)*

The Australian Shelduck is very common, though not abundant, throughout the survey area. Pairs of ducks may be seen on waterways and wetlands almost anywhere, but they favour brackish water. The species was recorded on five surveys, mainly those in the northern part of the survey area. It is not a forest species, being more common on farms, particularly in the north-eastern part of the survey area, and on coastal estuaries.

Pacific Black Duck *(Anas superciliosa)*

This is the duck most common throughout the survey area. On coastal estuaries and lakes they occur in flocks; however, on rivers, dams and small waterholes they most often occur in pairs. The species was recorded on all but two of the surveys, and the birds showed no preference for fresh or brackish water.

Grey Teal *(Anas gibberifrons)*

According to Serventy & Whittell (1976), this Teal rivals the Pacific Black Duck in abundance throughout the State. However, the species was recorded on only three surveys: the Dombakup, seen flying over coastal

lakes; the Perup, on the Tone River; and the Shannon, on Broke Inlet. The Grey Teal has also been observed on Wilson's Inlet, where it is common in summer and autumn.

The Grey Teal appears uncommon in the survey area, apart from coastal estuaries, where it may occur in large numbers.

Chestnut Teal *(Anas castanea)*

The Chestnut Teal is rare within the survey area and was not sighted on any surveys. Several pairs were sighted amongst large concentrations of duck and waterfowl on Wilson's Inlet in 1973. The species was also sighted by Forests Department survey teams on the Wonnerup Estuary, to the north of the survey area, in 1973. This species prefers brackish waters (Serventy & Whittell, 1976).

Australasian Shoveler *(Anas rhynchotis)*

Rarely sighted in forest areas, this species was recorded only on the Dombakup survey, when one bird, amongst a flock of Black Ducks, was seen flying over a small coastal lake. It was also sighted to the north of the survey area on the Wonnerup Estuary.

Maned Duck *(Chenonetta jubata)*

The Maned Duck is common in the survey area, though it is not a forest species. It is frequently seen on farm dams and pastures, particularly to the east of Manjimup. Flocks of up to 50 birds have been seen standing on farm dam embankments. Farmers consider the species a problem because in such large numbers they foul the waters of small farm dams. The species was recorded on six surveys, and was often seen feeding on pasture.

Blue-billed Duck *(Oxyura australis)*

A rarely sighted bird, the Blue-billed Duck was recorded on one survey only, on Lake Yeagarup. It was also recorded in 1973 just to the north of the survey area, on the Wonnerup Estuary.

Although it is a south-west species (Serventy & Whittell, 1976), the Blue-billed Duck does not appear to be common in the survey area.

Musk Duck *(Biziura lobata)*

The Musk Duck is common, though not abundant, throughout the survey area, being recorded on eight surveys. Usually seen in pairs on small lakes or dams, they also congregate in large numbers on estuaries and lakes during the non-breeding season. Large numbers of birds were recorded on Lake Yeagarup and Broke Inlet during surveys.

Order Accipitriformes

Family Pandionidae

Osprey *(Pandion haliaetus)*

This rare coastal species was sighted only once when a single individual was seen flying over Broke Inlet on the Shannon survey. In 1982, a pair of Ospreys was seen nesting in a karri tree on the South-West Highway a few kilometres to the east of Walpole, and another pair was also observed nesting in karri forest near Torbay.

Family Accipitridae

Black-shouldered Kite *(Elanus notatus)*

Uncommon in the survey area, this species was not seen on any of the surveys, but was recorded in Walpole in 1969 and in the Manjimup area. Two pairs hunted over farmland immediately to the east of the Manjimup townsite between 1974 and 1977.

Square-tailed Kite *(Lophoictinia isura)*

The Square-tailed Kite is one of the State's rarest hawks, and was recorded only on the Dombakup survey, when a single bird was seen flying low above the canopy of coastal jarrah.

Whistling Kite *(Haliastur sphenurus)*

The Whistling Kite is the commonest hawk in the State, and was recorded on most surveys. This species was sighted singly or in pairs, and shows no preference for forest or farmland areas.

Brown Goshawk *(Accipiter fasciatus)*

The Brown Goshawk is common throughout the survey area, though it prefers the woodlands of the north-east and low open woodlands of the south and east coastal areas. It was recorded on nine surveys, usually singly, but on one occasion a pair was seen harassing a flock of New Holland Honeyeaters *(Phylidonyris novahollandiae)*.

Collared Sparrowhawk *(Accipiter cirrhocephalus)*

This species is not as common as the Brown Goshawk which it resembles, and was recorded on only three surveys. Single Sparrowhawks were observed on the Pines and Milyeannup surveys and a pair was seen 'playing' with a group of Australian Magpies *(Gymnorhina tibicen)* near Pemberton.

White-bellied Sea Eagle *(Halliaeetus leucogaster)*

The White-bellied Sea Eagle was sighted on two surveys. On the Shannon survey one bird was sighted over Broke Inlet and another at West Cliff Point, 10 km to the west. One bird was also sighted flying over the coastal heathland at West Cliff Point on the Dombakup survey.

This species is restricted to coastal areas, and appears to be comparatively rare even along the southern coastline.

Wedge-tailed Eagle *(Aquila audax)*

The Wedge-tailed Eagle is common throughout the survey area, though it is most frequently seen in the woodlands to the north-east and along the lightly timbered coastal areas. This bird was recorded on all but two surveys, and was seen usually singly or in pairs.

Little Eagle *(Hieraaetus morphnoides)*

This species is rare in the survey area, with only single birds being seen on four surveys: Sunklands, Soho and Mitchell, and Perup. In all cases the birds were observed over areas of open woodland.

Spotted Harrier *(Circus assimilis)*

The Spotted Harrier is rare in the survey area, and only one bird was sighted over the coastal heaths during the Woolbales survey. This species is essentially an arid country bird that is seldom recorded in the lower south-west.

Marsh Harrier *(Circus aeruginosus)*

This species is locally common in the south of the survey area, where suitable habitat occurs. The Marsh Harrier was recorded on three surveys. Sightings of single birds flying low over sedgelands were made near the mouth of the Shannon River and in Giants block, north-east of Walpole. The third record was a sighting over low open woodland to the east of the Frankland River near Lake Surprise.

Family Falconidae

Peregrine Falcon *(Falco peregrinus)*

The Peregrine Falcon is rare in the survey area. Single birds were sighted on the Woolbales survey to the west of Walpole, and on the Soho survey in the vicinity of Mt. Frankland.

Australian Hobby *(Falco longipennis)*

This species is locally common in the survey area, although it appears to avoid the more heavily timbered areas. Single birds were recorded on four surveys, and on one occasion a pair was sighted in Banksia woodland on the coastal heaths near Walpole. The Australian Hobby was also sighted in jarrah-wandoo woodlands at Perup and amongst young pines at Balingup.

Brown Falcon *(Falco berigora)*

This species is the most common of the small birds of prey, and was recorded on twelve surveys. It was sighted in almost all forest types from coastal heaths, through open woodland, to high open forest of karri and tingle.

Australian Kestrel *(Falco cenchroides)*

The Australian Kestrel is found throughout most of the survey area, rivalling the Brown Falcon in abundance. Usually single birds were sighted flying over pasture, coastal heath and low, open woodland areas, although an occasional pair was seen.

Order Galliformes

Family Megapodiidae

Malleefowl *(Leipoa ocellata)*

The species is rare and restricted within the survey area, and was not found on any surveys.

In 1972, a Malleefowl nest was discovered east of Frankland River, on the edge of a disused forest track in an extensive area of dense heathland vegetation dominated by *Melaleuca* spp. and *Banksia quercifolia*. Three years later a check was made on the nest and it was found that it had been recently abandoned.

In 1977, examination of aerial photographs, followed by aerial and ground inspections, failed to locate further nests in the area. During the search, however, two young birds were flushed, and flew heavily for a very short distance before dropping into dense cover.

Family Phasianidae

Stubble Quail *(Coturnix novaezelandiae)*

The Stubble Quail is common in the south-west (Serventy & Whittell, 1976), and was positively identified on three surveys: the Mitchell, the Shannon and the Mitchell River. Small flocks, usually comprised of three to six birds, were most often sighted on forest tracks. Occasionally, one or two birds were flushed in heathland.

Sightings were most often in closed or open heathland communities. One sighting of four birds was made in karri forest on Weld Road.

Brown Quail *(Coturnix australis)*

This species is locally common throughout the south-west, in suitable habitats (Serventy & Whittell, 1976). Positive identification was made only once, on the Frankland River survey to the north of Lake Surprise, when two birds were trapped. Seventeen quail were sighted in the survey area, and it was assumed that these were either Brown Quail or Stubble Quail. The birds were found in open sedgeland.

Order Gruiformes

Family Turnicidae

Painted Button-quail *(Turnix varia)*

The Painted Button-quail is widespread but uncommon in the survey area. Positive identification of this species was made on two surveys: the Perup and the Mitchell River surveys. Since 1972, 12 birds have been captured in funnel traps set for Tammar Wallabies *(Macropus eugenii)* in the Perup area.

The Painted Button-quail is locally common in open jarrah-wandoo woodland with an understorey of *Bossiaea ornata* scrub or heartleaf. This species' characteristic scratchings in the litter may be seen in the heartleaf thickets during the late autumn and summer months when the plants have seeded.

Serventy & Whittell (1976) state that the Painted Button-quail is an insect-eater. Though not confirmed by stomach analysis, observations suggest that the birds in the Perup area may be seed eaters. The food preferences of this species need to be investigated.

Family Rallidae

Spotless Crake *(Porzana tabuensis)*

This species is common in suitable habitats throughout the survey area. Although this secretive bird was not sighted in the field on any of the surveys, specimens were recorded on the Yeagarup, Dombakup, Sunklands, Milyeannup and Karri surveys, when birds were captured in snap traps set for small mammals. The Yeagarup and Dombakup specimens were from typically swampy areas, but the latter three, the Sunklands, Milyeannup and Karri specimens, came from densely vegetated creek systems containing permanent water.

Dusky Moorhen *(Gallinula tenebrosa)*

This species was only sighted once, on a small dam, during the Pines survey. However, the Dusky Moorhen is common in the survey area, and has been seen on dams, particularly amongst bullrushes at Smith's Brook, south-east of Manjimup and in the Pemberton and Northcliffe district. It has also been seen on Lake Muckipoo to the north of Manjimup.

Purple Swamphen *(Porphyrio porphyrio)*

The Purple Swamphen is common in suitable habitats throughout the survey area, and was recorded on five surveys. It appears to be less secretive than supposed by Serventy and Whittell (1976); it is often sighted on farm dams. It also appears to be more common than the Dusky Moorhen. Forty-four nests of this species were recorded on Middlesex Dams (D. & M. Brown, personal communication*), and it also occurs on small lakes and swamps in forested areas.

Eurasian Coot *(Fulica atra)*

This species is common throughout the State in suitable habitats, and was the most frequently observed of the birds in this family. It was sighted on fresh water swamps at Yeagarup and Dombakup, as well as on saline water in the Perup and Frankland Rivers, and Broke Inlet.

On one small seasonal swamp amongst the pines at Balingup, a total of ten nests, with up to six eggs each, was observed.

The species most often occurs in pairs or small flocks on dams, small lakes and rivers. On the estuaries along the south-west coast, large flocks of several dozen birds often congregate during summer and autumn.

Order Charadriiformes

Family Charadriidae

Banded Lapwing *(Vanellus tricolor)*

Recorded on only the Woolbales and Perup surveys, this species is nevertheless quite common on pasture and sports fields throughout the survey area. Most often seen in pairs, the Banded Lapwing has been recorded several times nesting on the Manjimup football oval and hockey fields.

Red-capped Plover *(Charadrius ruficapillus)*

This coastal species was observed on only three surveys: Lake Yeagarup, Woolbales, and Shannon. It has also been observed at Wilson's Inlet on the south coast.

Black-fronted Plover *(Charadrius melanops)*

An uncommon species in the survey area, the Black-fronted Plover was recorded only on the Perup survey, on Twin Lakes to the west of Perup. It is usually seen in pairs, and has been sighted at times on small dams outside the forested area.

Family Scolopacidae

Curlew Sandpiper *(Calidris ferruginea)*

A numerous, migratory species, which arrives from the northern hemisphere in summer, the Curlew Sandpiper was recorded only on Broke Inlet during the Shannon survey.

Family Laridae

Silver Gull *(Larus novaehollandiae)*

Common along the south coast, this species was recorded on the Boranup and Woolbales surveys and upon Broke Inlet on the Shannon survey. It has also been sighted on Lake Muir.

Pacific Gull *(Larus pacificus)*

This species is common along the south coast, but was sighted only on the Shannon survey at Broke Inlet.

Caspian Tern *(Hydroprogne caspia)*

The Caspian Tern is common along the coast, but was recorded on only two surveys, at Broke Inlet and on the coast at Boranup. It is essentially a sea bird, which rarely ventures far inland.

Crested Tern *(Sterna bergii)*

This species is common along the coast, and was recorded on two surveys, Boranup and Shannon, at Broke Inlet. The Crested Tern has also been recorded on Lake Muir.

Order Columbiformes

Family Columbidae

Common Bronzewing *(Phaps chalcoptera)*

This species is generally distributed and common throughout the survey area. It was recorded on seven surveys but appears to be uncommon in the extreme south. The Common Bronzewing is frequently sighted in farmland and townships. It is often seen feeding on the seeds of introduced *Acacias* in forestry settlements.

Brush Bronzewing *(Phaps elegans)*

The Brush Bronzewing is widespread and common throughout the survey area. It was recorded on all surveys, and is locally common in the north-eastern

*See p.32.

Perup where it feeds on the seeds of the heartleaf poison bush *(Gastrolobium bilobum)*.

Order Psittaciformes

Family Cacatuidae

Red-tailed Black-Cockatoo
(Calyptorhynchus magnificus)

The Red-tailed Black-Cockatoo is locally common and widespread throughout the survey area; it was recorded on nine surveys. This species generally occurs in small flocks of up to a dozen birds, and is most often seen feeding in marri trees.

We recorded it breeding near Nyamup, 16 km east of Manjimup, and we saw young birds on the Giants survey. Saunders (1977) demonstrated a discontinuous distribution of the species in the south-west. He cites a northern occurrence of the species, south of the Murchison River inland through the northern wheatbelt, and a southern distribution restricted to the forested area.

White-tailed Black-Cockatoo
(Calyptorhynchus baudinii)

The White-tailed Black-Cockatoo is common throughout the survey area, and flocks of a dozen or more birds may often be observed feeding in marri trees.

There are two different forms of this species, the short-billed form *(C. baudinii latirostris)* and the long-billed form *(C. baudinii baudinii)*, which Saunders (1979) considers to be a separate species. The long-billed form is found in areas with an annual rainfall of 750 mm or more, whereas the short-billed form occurs where there is 300-750 mm (Saunders, 1974).

As it is difficult to differentiate the two from observations, and no attempt was made to distinguish them on surveys, it is assumed that most of the records were of *C. baudinii baudinii* because the survey area receives an annual rainfall that exceeds 750mm. The very large flocks observed in the Blackwood Valley pine plantations were possibly the short-billed form, because pine seed is known to be a major part of the diet of *C. baudinii latirostris* (Saunders, 1974).

Long-billed Corella *(Cacatua tenuirostris)*

A south-west species, the Long-billed Corella is not a forest bird and was not observed on surveys. However, a population of the species is known to exist within the survey area at Lake Muir, where they feed on cleared farmland. These birds appeared to have spread northwards along cleared farmland near the Tone River.

A flock of this species was also observed in 1975 flying over land cleared for pine planting in the Donnybrook Sunkland west of Nannup.

Galah *(Cacatua roseicapilla)*

This species is rare and restricted in the survey area, and was not sighted on any of the surveys. However, a small flock of eight or nine birds, believed to have escaped from aviaries, has been resident within the Manjimup township for some years.

A species from the north of Western Australia, the Galah has spread extensively south since European colonization. It is now common in wheatbelt areas, but avoids the heavier forested country (Serventy and Whittell, 1976).

Family Loriidae

Purple-crowned Lorikeet
(Glossopsitta porphyrocephala)

Though common throughout the survey area, this species was only recorded on some surveys. The birds follow the flowering of eucalypts and other species, feeding on pollen and nectar (Churchill & Christensen, 1970). The Purple-crowned Lorikeet is most plentiful when karri is flowering, but was recorded in most other vegetation types as well. The distinctive call of this species in the tree tops is a certain sign that flowering is taking place.

Family Platycercidae

Red-capped Parrot *(Purpureicephalus spurius)*

Common throughout much of the survey area, this species was recorded on most surveys. It is plentiful in the north-eastern open forests and woodland areas, and in karri areas where it is often a pest in the apple orchards.

Western Rosella *(Platycercus icterotis)*

The Western Rosella is common throughout the survey area, and was recorded on all surveys. It is found in all the vegetation types, especially in the karri/marri forests where it is the commonest parrot species. The Western Rosella spends much of its time foraging on the ground and in the lower tree and understorey strata. It is frequently observed on farms in the Manjimup district; 299 birds were banded between 1976 and 1980 (D. and M. Brown, personal communication*).

Port Lincoln Ringneck *(Barnardius zonarius)*

Common throughout the survey area in all major vegetation types, the Port Lincoln Ringneck was recorded on all surveys. The species is more inclined to inhabit the tree tops than is the Western Rosella, and it is frequently found where marri trees are a major part of the forest. It also occurs in agricultural areas and is a pest in orchards.

Elegant Parrot *(Neophema elegans)*

The Elegant Parrot is locally common in pasture areas to the east of Manjimup, and does not seem to occur in the heavier forest types. It was recorded on five surveys, almost always associated with cleared land. However, flocks of this species were sighted in open woodland, at Perup and on the Hay River. This bird

*See p.32.

is not a forest species, but in recent years it has been extending its range (Serventy and Whittell, 1976).

Rock Parrot *(Neophema petrophila)*

This species is locally common along the coast, and was recorded on three surveys: the Boranup, Yeagarup and Woolbales. The birds were sighted flying over estuaries in sand dune country.

Fairly large flocks of this species (30 to 40 birds) have been sighted at Peaceful Bay to the east of Walpole. It is also common in Wilson's Inlet at Denmark.

Order Cuculiformes

Family Cuculidae

Pallid Cuckoo *(Cuculus pallidus)*

This species is common throughout the survey area, and it was recorded on almost all surveys, in all forest types.

The Pallid Cuckoo usually migrates into the survey area during late September or early October. However, resident birds have been recorded by D. and M. Brown (personal communication*).

Fan-tailed Cuckoo *(Cuculus pyrrhophanus)*

The Fan-tailed Cuckoo is the most common of the cuckoos in the survey area. It does not appear to be a migrant species, and occurs throughout the year in all vegetation types.

Horsefield's Bronze-Cuckoo *(Chrysococcyx basalis)*

This species migrates to the survey area in early spring and leaves in autumn, and is the most widespread of the Bronze-Cuckoos recorded during the surveys. It appears to favour the more open jarrah forest and woodland areas where it is most often sighted perching on the outer dead branches in the crowns of jarrah or marri trees.

Shining Bronze-Cuckoo *(Chrysococcyx lucidus)*

This is another migrant species, which arrives in spring and leaves in early autumn. Although it was not recorded as frequently as Horsefield's Bronze-cuckoo, this species is common throughout the survey area and occurs in most forest types from the dense karri to the open jarrah/wandoo woodlands.

Order Strigiformes

Family Strigidae

Southern Boobook *(Ninox novaeseelandiae)*

This species is widespread throughout the survey area, and it was the most common owl recorded in the survey area. It was frequently heard at night, and occasionally sighted on spotlight surveys.

Family Tytonidae

Barn Owl *(Tyto alba)*

Recorded on only three surveys, this species appears to be uncommon in the survey area. However, several birds were seen on spotlight surveys in the pines along the Blackwood River, where the species appears to be locally common. We have several other non-survey records of Barn Owls in similar farmland-forest areas, and, therefore, consider that the species may be abundant in this habitat. It is also occasionally seen during the daytime, resting in garden trees in the Manjimup township.

*See p.32.

Masked Owl *(Tyto novaehollandiae)*

Only one Masked Owl was sighted, in *Casuarina* woodland on the Soho survey. A road kill specimen was also found near Pemberton in 1972. This species would appear to be uncommon in the survey area.

Order Caprimulgiformes

Family Podargidae

Tawny Frogmouth *(Podargus strigoides)*

The Tawny Frogmouth (Plate 25) is the most common nocturnal bird in the survey area and was recorded in all vegetation types. It appears to favour the more open jarrah forest, in which 13 birds were recorded on one spotlight survey over a distance of only 16 km.

Family Aegothelidae

Australian Owlet-nightjar *(Aegotheles cristatus)*

This species is common throughout most of the survey area especially in the woodlands to the north and the east. It was recorded on nine surveys in all major vegetation types, often being seen and heard at night.

Family Caprimulgidae

Spotted Nightjar *(Caprimulgus guttatus)*

Compared with the other nocturnal birds, this species appears to be rare in the survey area. It has not been sighted on any of the numerous spotlight surveys undertaken throughout the survey area, or on any of the ecological studies carried out during the last 12 years. The only record from the area is a road killed specimen found on Thompson Road to the north of Walpole, where the road passes through the heathland and low open banksia woodland.

Order Coraciiformes

Family Alcedinidae

Laughing Kookaburra *(Dacelo novaeguineae)*

Introduced from Victoria in 1897 (Serventy & Whittell, 1976), this species has become firmly established in the forested areas of the south-west. It was recorded on all surveys, and is common in major vegetation communities throughout the survey area. Kookaburra nests have been recorded in hollow spouts of trees some 5 to 60 m above the ground.

Sacred Kingfisher *(Halcyon sancta)*

Widespread throughout the survey area, but nowhere common, this species was recorded on nine surveys. The birds were usually sighted on branches overhanging water, and were often seen sitting on telephone lines

also. The Sacred Kingfisher may be largely a migrant in the south-west (Serventy & Whittell, 1976), but many birds are sighted throughout the year. D. and M. Brown (personal communication*) also record the species as a breeding resident in the Middlesex valley.

Family Meropidae

Rainbow Bee-eater *(Merops ornatus)*

This species is uncommon in the survey area, with only a few records from the north. A flock of about 40 Rainbow Bee-eaters were seen on the Pines survey and several pairs were observed on the railway telegraph lines in the Sunklands survey. A pair was also sighted at Lake Muckipoo to the north of Manjimup in 1981.

The species appears to occur in small numbers in the north western portion of the survey area (the Sunklands and the Blackwood Valley), but is either absent or uncommon further south.

Order Passeriformes

Family Hirundinidae

Welcome Swallow *(Hirundo neoxena)*

Recorded on six surveys, this species is locally common in settled areas, particularly in towns in the northern and eastern sector of the survey area; it is rare in the heavily forested areas. The largest flock, fifteen birds, was recorded on the Mitchell River survey. Several nests with eggs were found under a bridge at Lewana on the Pines survey in 1978.

Tree Martin *(Cecropis nigricans)*

The Tree Martin is the commonest swallow of the south-west. It is very common in the survey area, and was recorded on almost all surveys. Nests have been recorded in many trees with a suitable hollow; several pairs used the same tree when enough hollows occurred. Large flocks are frequently observed hawking or sitting on telephone lines.

Family Motacillidae

Richard's Pipit *(Anthus novaeseelandiae)*

This species is common throughout the survey area wherever there is open country, and was recorded on all but one survey. It occurs wherever land has been cleared for agriculture, and may also colonize and breed on areas of clear felled forest during the first year or two before regeneration. Richard's Pipit also occurs naturally along coastal dune country and on the southern flats and open sedgeland, especially following recent fires when the vegetation is short and open. It may also be found in some of the eastern woodland areas and in granite outcrops.

Family Campephagidae

Black-faced Cuckoo-shrike
(Coracina novaehollandiae)

Common throughout the survey area, this species was recorded on all surveys. It favours open areas, farmland, clearings and openings in the forest.

Serventy & Whittell (1976) state that there have been no migratory movements of the Black-faced Cuckoo-shrike detected in this State; however, in the survey area the highest numbers of birds were observed in spring and summer and very few were sighted during winter.

White-winged Triller *(Lalage sueurii)*

Recorded only on the Perup survey, this species is rare in forested areas. However, it occurs where clearing has taken place and it has been sighted breeding on farmland area near Manjimup, (D. and M. Brown, personal communication*).

In forested areas the White-winged Triller appears to invade open jarrah forest and woodland following severe wildfires, which scorch and defoliate the tree canopy. Several pairs were recorded in the Perup in spring 1981 following a severe wildfire in the area during the previous summer.

Family Muscicapidae

Scarlet Robin *(Petroica multicolor)*

Recorded on all surveys, this species is common throughout the survey area, but less frequently sighted in denser understorey of the southern high rainfall areas. It does occasionally occur in these forest types, but only where the forest is less dense, or where small openings or clearings have been created. Scarlet Robin nests have been found 3 to 15 m above the ground, mainly in the jarrah forest.

The Scarlet Robin also invades forest areas following burning. Thus, they may be observed in the true karri forest for a year or two following a fire, until the understorey regenerates and becomes too dense for them.

Red-capped Robin *(Petroica goodenovii)*

This species is rare in the survey area. It was only recorded on the Sunkland survey when one bird was seen in the Nannup townsite. D. and M. Brown (personal communication*) also banded one individual at Middlesex in 1977/78. The species has been recorded on other F.D. surveys in the northern jarrah forest areas where it is much more common.

Hooded Robin *(Melanodryas cucullata)*

The Hooded Robin was not recorded on the surveys, and is considered very rare in the survey area. However, in 1974, the Fisheries and Wildlife Department recorded its presence in the Kent River area. In 1976, it was reported in the Whicher Range by the Naturalist Club (Hussey, 1977) and D. and M. Brown (personal communication*) also reported it at Wilgarup.

White-breasted Robin *(Eopsaltria georgiana)*

This species is common throughout most of the survey area, and was recorded on all surveys. It does not occur

*See p.32.

in all forest types, and is confined to areas of fairly tall dense understorey. It is widespread and common throughout the southern high rainfall area, especially in karri forest. In jarrah forest and more open jarrah/wandoo woodlands in the northern and north-eastern section of the survey area, it is confined to dense vegetation along creeks and drainage lines.

Western Yellow Robin *(Eopsaltria griseogularis)*

This species is common and widespread in the more open forest types in the north and north-east of the survey area. Further south it is rare and restricted.

Within the survey area, the range of this species overlaps with that of the closely related White-breasted Robin. In the jarrah forest the Western Yellow Robin inhabits the ridges that have a low open understorey, avoiding the dense gully vegetation favoured by the White-breasted Robin. Further south, where the understorey is uniformly dense, the Western Yellow Robin is replaced by the White-breasted Robin.

The Western Yellow Robin may invade the karri forest for a short period when the understorey is opened after fire.

Crested Shrike-tit *(Falcunculus frontatus)*

Uncommon, but apparently fairly widespread in the survey area, this species was recorded on three surveys: in the jarrah-wandoo woodland on the Perup survey; in karri forest near Crystal Springs on the Woolbales survey; and near Pemberton on the karri survey. On occasions other than surveys, the Crested Shrike-tit has been recorded amongst epicormic branches on karri in a clear-felled area near Northcliffe, and in regrowth jarrah/marri forest at West Manjimup. Wherever it has been recorded, this species was seen in the forest mid-storey.

Although uncommon, the species appears to be resident in the survey area as it has been recorded breeding at Middlesex by D. and M. Brown (personal communication*).

The Crested Shrike-tit inhabits the lighter timber country further to the east (Serventy & Whittell, 1976), but like many other species it appears to have extended its range into the heavier forested areas following clearing for farms, and the opening of forest after felling operations.

Golden Whistler *(Pachycephala pectoralis)*

The Golden Whistler (Plate 28) is common throughout the survey area, in almost all the major vegetation types, and was recorded on all the surveys. It is very common in both the open and high open forest. Essentially a mid-storey species of the jarrah forest, it tends to favour the understorey tree level in the karri forest. This species is not greatly affected by burning, but it may be temporarily displaced by clear felling operations.

*See p.32.

Rufous Whistler *(Pachycephala rufiventris)*

This species is locally common, but not widespread in the survey area. It was recorded on four surveys; all sightings were in open forest or open woodland regions in the north and eastern parts of the survey area. It does not appear to be present in the heavier forests of the south.

The Rufous Whistler has also benefited from clearing, and is frequently seen on farmland and in townships. It may also be a seasonal migrant as it first appears in Manjimup during autumn and early winter and disappears sometime in spring or early summer.

Grey Shrike-thrush *(Colluricincla harmonica)*

Common throughout the survey area, this species was recorded on all but the Boranup and Shannon surveys. It was sighted in almost all major forest types, more frequently in the open and high open forest and less frequently in the low open woodland and sedgelands.

Restless Flycatcher *(Myiagra inquieta)*

This species was recorded on eight surveys, but is uncommon throughout much of the survey area. It was often seen in the more open jarrah forest and woodland in the northern parts of the area, but it also occurs in the karri forest. It was very common along the Balingup Brook and Blackwood River where several pairs were observed nesting in *Eucalyptus rudis* branches overhanging water.

Grey Fantail *(Rhipidura fuliginosa)*

Widespread and common, this species is the most common flycatcher in the south-west. It was recorded on all surveys and was seen in all major vegetation types, being one of the most frequently and easily observed birds.

Willie Wagtail *(Rhipidura leucophrys)*

The Willie Wagtail is locally common in the survey area, and was recorded on eight surveys. It is unlikely that this species occurred in the survey area prior to clearing for agriculture. It only occurs on farms and in townships, where it is frequently seen in gardens.

Family Timaliidae

White-browed Babbler *(Pomatostomus superciliosus)*

This species is common but not widespread in the survey area. It was recorded on eight of the surveys, mostly those south of Manjimup, but is also present in the Sunklands area.

Serventy & Whittell (1976) note that a few isolated colonies exist at Busselton, Pemberton, Irwin Inlet and Denmark. The species is, in fact, common over much of the karri and high open forest area, especially in the southern areas where there is a tall dense understorey of karri wattle *(Acacia pentadenia)* present. The White-browed Babbler invariably occurs in groups of between 6 and 12 individuals.

Family Sylviidae

Clamorous Reed-Warbler *(Acrocephalus stentoreus)*

The Clamorous Reed-Warbler, like the Little Grassbird, does not appear to be common in the forested areas, probably also because of the scarcity of a suitable habitat. It was recorded only on the Yeagarup swamp, but may be locally common and appears to adapt well to suitable man-made habitats. D. and M. Brown (personal communication*) have recorded many pairs breeding on Middlesex dam.

Little Grassbird *(Megalurus gramineus)*

This species was recorded on only two surveys, in freshwater reed swamps at Yeagarup and Dombakup. It has also been recorded breeding at Middlesex, by D. and M. Brown (personal communication*). It does not appear to be common in the forested areas, possibly because of the scarcity of a suitable habitat.

Family Maluridae

Splendid Fairy-wren *(Malurus splendens)*

The Splendid Fairy-wren (Plate 27) is common throughout the survey area wherever suitable habitats occur. It inhabits low dense scrub and is very common in the coastal scrub communities. It is also found in the open jarrah forest and woodlands along densely vegetated drainage lines, and is present in the karri forest. It is frequently found in agricultural areas where dense cover has been left along the road verges.

In the karri forest, the Splendid Fairy-wren often occurs with the Red-winged Fairy-wren *(Malurus elegans)*, the latter tending to be more abundant in this habitat. The two species may also occur together in the jarrah forest, woodlands and coastal scrub, where the Splendid Fairy-wren is more abundant.

*See p.32.

Red-winged Fairy-wren *(Malurus elegans)*

This species is widespread and common throughout most of the survey area, especially in the south, wherever suitable habitat occurs. It is very common in the high open forests of karri and tingle, especially in areas of dense sword grass *(Lepidosperma effusum)*, and is common in some vegetated drainage lines on farms. However, the species is less common in the more open forests of the northern and eastern parts of the survey area.

Southern Emu-wren *(Stipiturus malachurus)*

Recorded on seven surveys, this species has a restricted distribution, but may be locally common in the survey area. It usually occurs in coastal thickets, and is rarer further inland in the main forest area. It was recorded well inland from the coast at Granite Peaks and on the Sunklands survey. A further two populations have been recorded on non-survey research, one near Donnelly Mill and the other near Lake Muckipoo to the north of Manjimup.

Of these inland populations, three occur in dense gully vegetation dominated by *Agonis parviceps* that is heavily parasitized by *Cuscuta* sp. The Lake Muckipoo population occurs in clumped thickets in a paperbark *(Melaleuca preissiana)* swamp. Although the Southern Emu-wren is very secretive and difficult to observe, its call is quite distinctive and it responds readily to a bird caller.

Plate 28▲ Golden Whistler *(Pachycephala pectoralis)*.

Family Acanthizidae

White-browed Scrub-wren *(Sericornis frontalis)*

Recorded on all surveys, this is one of the common species in the denser scrub areas in the south of the survey area. It is very common in the high open forest and dense areas of coastal heath, but also occurs along densely vegetated drainage lines throughout the more open jarrah forest and woodland areas.

Weebill *(Smicrornis brevirostris)*

The Weebill is uncommon in the survey area, and was recorded only on four surveys: Sunklands, Milyeannup, Perup and Soho. On each survey only one or two individuals were sighted. Serventy & Whittell (1976) state that the species is absent to the south of a line joining Cape Naturaliste, Granite Peak and Albany. The record at Milyeannup is just to the south of this line, whilst the Sunklands recording is virtually on it. It seems likely that the species may be present in the Donnybrook Sunkland area, but only in low numbers. The record on the Soho survey is interesting as it is outside the range suggested by Serventy & Whittell, and in an area where the bird might not be expected to occur. The Soho record was of a single bird sighted in extensive *Casuarina* woodlands, which may be similar to the birds' drier habitat in the north.

Western Gerygone *(Gerygone fusca)*

This species is widespread in the survey area, but only locally common. It was recorded on all but four of the surveys and occurs in most vegetation types from the coastal woodlands to the karri forest. It is common in the more open jarrah forests in the northern parts of the survey area, but also occurs in the karri where it appears to frequent the mid-storey tree layer.

Inland Thornbill *(Acanthiza apicalis)*

This species is widespread and common throughout the survey area, occurring in all major vegetation types. It is very common in the southern portion of the survey area and common in the jarrah forests of the northern sector. In the latter habitat it is replaced, to some extent, by the Western Thornbill. This trend increases northwards, such that the Western Thornbill is more common than the Inland Thornbill in the jarrah forests to the north of the survey area. The Inland Thornbill occurs predominantly in densely vegetated gullies.

Western Thornbill *(Acanthiza inornata)*

The Western Thornbill is common in the jarrah forests in the northern portion of the survey area, and uncommon in most of the southern forests. It is rare in the high open karri forest, and becomes increasingly common further to the north in the more open jarrah forests. Here it frequents the ridges, feeding amongst the foliage of saplings and tree canopy.

Yellow-rumped Thornbill *(Acanthiza chrysorrhoa)*

Widespread, but only locally common in the survey area, this species was recorded on most surveys. It is absent from the high open forests and other forest types with a dense understorey. It frequents the coastal scrub and the open woodlands in the north-eastern part of the survey area, and is common wherever the forest has been cleared.

Family Neosittidae

Varied Sittella *(Daphoenositta chrysoptera)*

Widespread throughout the survey area, this species was recorded on all but one of the surveys. The birds are usually seen in small flocks (four to ten birds), and are locally common in the jarrah forest and woodlands in the northern and eastern portions of the area. It is uncommon in the high open karri forest or southern communities, but may be found wherever jarrah and marri are present.

Family Climacteridae

Rufous Treecreeper *(Climacteris rufa)*

The Rufous Treecreeper is widespread and locally common throughout the survey area. It is common in the open and high open jarrah and marri forest and uncommon in the pure karri stands. However, several pairs were observed feeding upon flaking bark on young karri trees following a wildfire in Pemberton in 1971. This species appears to be more common in the forests on the Darling Range further to the north.

Family Meliphagidae

Red Wattlebird *(Anthochaera carunculata)*

This species is widespread and common throughout the survey area, and may be found in all major vegetation types. Like many of the honeyeaters, these birds tend to be concentrated around such species as eucalypts and banksias when they are flowering. The Red Wattlebird is a canopy species, feeding predominantly in the upper and lower canopy, but seldom in the scrub. It is a frequent garden visitor, particularly in summer when there is a scarcity of flowers in the bush.

Little Wattlebird *(Anthochaera chrysoptera)*

Locally common, this species favours areas of woodland and open woodland, particularly when *Banksia* spp. are present. It is not as common or widespread as the Red Wattlebird, and is rarely seen in the high open and open jarrah forest areas.

White-naped Honeyeater *(Melithreptus lunatus)*

A common and widespread species in the survey area, the White-naped Honeyeater was recorded on all surveys. It was most frequently observed in the high open karri forest where it is very common. It feeds mainly in the lower and upper tree canopy.

Brown Honeyeater *(Lichmera indistincta)*

Locally common in the survey area, the Brown Honeyeater was only sighted on surveys in low open woodlands with *Banksia* spp. present and where the forest has been cleared for agriculture. It is common in townships throughout the area.

New Holland Honeyeater *(Phylidonyris novaehollandiae)*

This species is the most common honeyeater in the survey area. It is common and widespread in all major vegetation types from the coastal heath to the high open karri forest. It is very common in areas where the kangaroo paw *(Anigosanthus flavida)* and *chorilaena quercifolia* are in flower. The New Holland Honeyeater also frequents gardens and remnant forest on farmland.

White-cheeked Honeyeater *(Phylidonyris nigra)*

Rare and restricted in the survey area, this species was recorded on the Woolbales and Yeagarup surveys. In both cases the single birds were seen in coastal open woodland and heath communities.

Tawny-crowned Honeyeater *(Phylidonyris melanops)*

This species is locally common in the coastal heaths around the southern fringe of the survey area. Inland colonies exist in some places where open heath vegetation or low open woodlands occur. The Tawny-crowned Honeyeater was also recorded in the Blackwood Valley near Nannup.

Western Spinebill *(Acanthorhynchus superciliosus)*

This species is common throughout the survey area, but locally common in low open woodland, especially where banksias are present. It has been recorded in all major vegetation types, and in the karri forest it is most often associated with the kangaroo paw.

Family Pardalotidae

Spotted Pardalote *(Pardolotus punctatus)*

The Spotted Pardalote is common throughout the survey area, and was recorded on most of the surveys. It is common in the jarrah forests in the northern and eastern parts of the survey area, and was also sighted in most of the forest and woodland association. It has been recorded nesting in both jarrah and karri forest, and in both instances burrows were excavated in soil heaps along the edge of forest tracks.

Striated Pardalote *(Pardalotus striatus)*

This species is common throughout much of the survey area, and was most frequently recorded in the northern jarrah forests. Nests of this species, at least 50 m above the ground, have been recorded in jarrah, marri and karri trees.

Family Zosteropidae

Silvereye *(Zosterops lateralis)*

The Silvereye is common throughout the survey area in all major forest types. This species is very common in agricultural areas and along the coast.

Family Ploceidae

Red-eared Firetail *(Emblema oculata)*

Common over most of the survey area, this species (Plate 26) was recorded on 13 surveys. It occurs wherever there is suitable habitat, being common in coastal thickets and along densely vegetated watercourses in the high open karri forest. It is not confined to native forests, and is common in the Blackwood Valley pine plantations wherever there is suitable understorey cover. D. and M. Brown (personal communication*) have trapped and banded 105 birds in and around the farming areas of the Middlesex Valley.

The Red-eared Firetail is listed on the "rare or otherwise in need of special protection" list (Government Gazette W.A., April 8th 1983).

Family Grallinidae

Australian Magpie-lark *(Grallina cyanoleuca)*

The Australian Magpie-lark is not a forest bird, but is locally common throughout much of the survey area, wherever there has been clearing for agriculture. Recorded on eight surveys, this species was sighted mainly in wet or moist pastures. It appears to be seasonal, arriving sometime in summer and being absent for most of winter. D. and M. Brown (personal communication*), however, record them as residents at Middlesex.

Family Artamidae

Dusky Woodswallow *(Artamus cyanopterus)*

This species is common throughout the survey area in all vegetation types. The birds are often seen hawking for insects high above the forest canopy, and over open pasture and clearings in the forest.

Family Cracticidae

Grey Butcherbird *(Cracticus torquatus)*

The Grey Butcherbird is rare and restricted, with only one pair being recorded, on the Woolbales survey. Serventy and Whittell (1976) state that this species does not occur south of a line passing through Augusta, Nannup, Kirup, Cranbrook and Albany. The Woolbales recording may be an incidental sighting.

Australian Magpie *(Gymnorhina tibicen)*

The Australian Magpie is locally common throughout the survey area, wherever the forest has been cleared for agriculture. It prefers open country, is present in some woodlands and open forest types, but is entirely absent from the high open forest.

Grey Currawong *(Strepera versicolor)*

This species was common throughout the survey area, and was recorded on all surveys in all major vegetation types. It is most frequently observed in the open jarrah forest, and increases in number following fire.

Family Corvidae

Australian Raven *(Corvus coronoides)*

The Australian Raven is common throughout the survey area, but prefers the more open forest types, clearings and farmland areas. It is most often seen in pairs or small groups of three or four birds.

*See p.32.

(C) REPTILES

DISCUSSION OF FINDINGS

This vertebrate group is poorly represented in the survey area, with a total of only 32 species collected on all surveys. The region's prolonged winter, with its consistently low temperatures and high annual rainfall, appears to be the major cause for the small number of reptiles collected. Further to the north, in the smaller area encompassed by the Northern Swan coastal plain, which has a much drier and warmer climate, a total of 57 species of reptiles were recorded (Storr, *et al.*, 1978). The Geckos *(Gekkonidae),* legless lizards *(Pygopodidae)* and, to a lesser extent, the elapid snakes *(Elapidae)* are particularly scarce in the southern forests, compared with the larger populations found in the Northern Swan coastal plain. The dragon lizards *(Agamidae)* appear not to be represented at all in the survey area.

The greatest variety in species and numbers of reptiles was consistently recorded on surveys in coastal and sub-coastal areas, and those in the northern and eastern extremities of the survey area. In the coastal and sub-coastal areas, open woodland, low open woodland, scrubland and heathland formations are common on sandy soils. The northern and eastern extremities of the survey area receive less rainfall, and open woodlands predominate. Sandy soils and a high percentage of bare ground appear to favour reptiles in the southern forests.

Although specimens of most reptile species collected on the surveys were sent to and recorded by the Western Australian Museum, the specimens were not always kept, and there is no Museum number for many of the collections.

Geckos, Legless Lizards and Dragons

Geckos, legless lizards and dragons are the least recorded group of reptiles in the survey area; only one species each of tortoise and gecko, three legless lizards, and no dragons were noted.

The Oblong Turtle *(Chelodina oblonga)* is common throughout the survey area, as is the gecko *(Phyllodactylus marmoratus).* The three species of legless lizard are all rare, and restricted to the northern and west coastal areas.

An examination of the distribution of geckos in Western Australia suggests that a few other species may be present in the northern parts of the survey area. Amongst these are three widespread species, *Phyllurus millii, Diplodactylus vittatus,* and *D. pulcher.* The former was recorded on the Northern Swan coastal plain by Storr *et al.* (1978), and the latter species recorded at Kelmscott by us in 1975. In addition, *D. polyopthalmus, D. spinigerus* and *D. alboguttatus,* all recorded by Storr *et al.* (1978), might also occur in the survey area.

Species of legless lizards which may occur in the northern parts of the survey area include *Lialis burtonii, Aprasia repens,* and *Aclys concinna* all collected by Storr *et al.* (1978) on the Northern Swan coastal plain. *Lialis burtonii* was also collected by us east of Dwellingup in 1979. The south coast species *Aprasia striolata glauerti,* which has been recorded to the east of Albany (Hopper, 1981), may extend further west into the survey area.

Although no dragons were recorded, there are several species that are known to occur just north of the survey area. Amongst these are, *Amphibolurus minor minor, A. minimus* and *A. ornatus,* all located at Kelmscott by us in 1975, and *A. adelaidensis,* recorded on the Northern Swan coastal plain by Storr *et al.* (1978). *Moloch horridus* was recorded at Dryandra and *A. maculatus maculatus* and *A. cristatus,* have been recorded further east on the south coast. Some or all of these dragon species could occur within the survey area.

Skinks

Skinks are well represented in the survey area. We have collected nineteen species. However, only five of these species may be regarded as common and widespread in the area: Smith's Skink *(Egernia napoleonis)* and the Red-Legged Skink *(Ctenotus labillardieri)* (Plate 29), which were collected on all surveys; the Burrowing Skink *(Hemiergis peronii peronii);* and the Bobtail *(Tiliqua rugosa)* and King's Skink *(Egernia kingii)* which were collected on 14, 12 and 10 surveys respectively. Two species, Mourning Skink *(Egernia luctuosa)* (Plate 30) and *E. pulchra pulchra,* are common in the survey area, and were collected on seven and nine surveys respectively. The remaining 12 species were all collected on six surveys or less, with one other species, *Lerista elegans,* being found on only one survey.

Of the five common and widespread species, *E. napoleonis, H. peronii peronii* and *C. labillardieri* appear to be predominantly southern forest species, and *T. rugosa* and *E. kingii* occur further north (Storr *et al.*, 1978 and 1981).

Two true southern forest species, *E. luctuosa* and *E. pulchra pulchra,* are common in the survey area, whilst four other essentially south-west species, *L. microtis microtis, L. trilineatum, Sphenomorphus australis* (Plate 31) and *C. catenifer,* are uncommon.

The remaining eight species, *C. impar, H. initialis*

Plate 29▲
Red-legged Skink *(Ctenotus labillardieri).*

Plate 32▲
Little Brown Snake *(Elapognathus minor).*

Plate 30▲
Mourning Skink *(Egernia luctuosa).*

Plate 31▲
Sphenomorphus australis.

Plate 33▲
Mueller's Snake *(Rhinoplocephalus bicolor).*

initialis, Cryptoblepharus plagiocephalus, Morethia lineoocellata, M. obscura, L. elegans, Mentia greyii and *L. distinguenda,* are all from drier areas further to the north and east of the survey area. These were recorded only in the north-western portion of the survey areas on the Boranup, Sunkland, the Pines and Yeagarup surveys. *Mentia greyii* and *L. distinguenda* were also recorded on the Frankland survey in the eastern part of the survey area.

One skink species which was not collected and which could occur in the Boranup area is *C. lesueurri.* There are also a number of other species which might occur in the northern part of the survey area; such as *H. quadrilineata,* a coastal species which we collected in the tuart forest at Ludlow, north of Busselton, and *Ctenotus gemmula* which was collected at Rocky Gully (Storr, 1973).

Two west coast species, *L. praepedita* and *L. lineopunctulata,* might occur in the survey area. It is also possible that the range of two south coastal species, *Egernia multiscutata bos* and *Cryptoblepharus virgatus clarus* (Storr, 1968 and 1976 a and b) may extend westwards into the survey area.

Snakes

A total of nine snakes — one species of *Typhlopidae,* one of *Boidae* and seven of *Elapidae* — have been recorded in the survey area in recent years. In addition, a Yellow-Bellied Sea Snake *(Pelamis platurus)* was picked up by Mr B. Voutier on the Warren Beach west of Pemberton in 1975.

Four species — the Carpet Python *(Morelia spilota variegata),* the Bardick *(Echiopsis curta),* the Black-Headed Snake *(Unechis gouldii)* and the Blind Snake *(Ramphotyphlops australis)* — are relatively widespread throughout the State, and the survey area represents the southern and western limits of their natural range. The survey area also forms the major part of the range of the Dugite *(Pseudonaja affinis affinis),* the Black Tiger Snake *(Notechis ater occidentalis),* the Crowned Snake *(Drysdalia coronata),* the Little Brown Snake *(Elapognathus minor)* (Plate 32) and Mueller's Snake *(Rhinoplocephalus bicolor)* (Plate 33). The Little Brown Snake appears to be a generally rare and restricted species.

The small snakes in the survey area have quite distinctive distribution patterns. The Black-Headed Snake is confined to the Perup and Milyeannup area. The Crowned Snake occurs primarily on the west and south coast, being replaced further inland with Mueller's Snake and the Little Brown Snake, which appears to be confined to southern portions of the survey area. The Bardick also appears to have a coastal distribution, but too few specimens were collected to be certain.

It is possible that other species of snakes may occur within the survey area, such as *Ramphotyphlops bituberculatus,* the Desert Banded Snake *(Simoselaps betholdi),* the Half-girdled Snake *(Simoselpas semifasciatus semifasciata),* the Western Black-naped Snake *(Neelaps bimaculatus),* the Western Black-striped Snake *(N. calonotos)* and the Common Death Adder *(Acanthophis antarcticus).* There have been reports of the Common Death Adder being seen on the rocks at Windy Harbour. However, it seems likely that the species is being confused with the Bardick.

It is also conceivable that the Mulga Snake *(Pseudechis australis)* and Children's Python *(Liasis childreni)* may be present in the survey area. The former has been recorded at Bridgetown (Glauert, 1967) and the distribution of the latter may extend down the coast.

LIST OF SPECIES

Order Testudines

Family Cheloniidae

Aquatic Tortoises *(Chelidae)*

Although recorded on only seven of the surveys, the long-necked tortoise (*Chelodina* spp.) is known to be widespread and common throughout the survey area. It occurs in all major river systems, and is present in most permanent or seasonal fresh water swamps and lakes. The species appears to be tolerant of high salt concentrations, as a nest with eggs was recorded on the estuarine section of the Hay River.

Order Squamata

Family Gekkonidae

The Marbled Gecko *(Phyllodactylus marmoratus)*

This species was collected on all except the Milyeannup, the Karri and the Giants surveys. It is common throughout most of the survey area, and was collected from all major vegetation types. It was most frequently found under loose dead bark of marri *(Eucalyptus calophylla), Banksia* spp. and *Casuarina* spp., and slabs of rock on granite outcrops.

Museum specimens include Soho M51437, M51449, M51452-53, M51465.

Family Pygopodidae

The Pretty Worm-Lizard *(Aprasia pulchella)*

A rare and restricted species in the survey area, specimens were collected only on the Sunklands survey in low open woodland. It is distributed widely in the south-west, from Geraldton southwards, but is absent from the Goldfields (Glauert, 1961).

Museum records include: R45746, Sunklands (1975).

Frazer's Scale-footed Lizard *(Delma fraseri)*

This species is also rare and restricted in the survey area. Only one specimen was collected in open coastal heathland, on sand on the Yeagarup survey, and two specimens were collected from wandoo woodland on the Perup survey.

This is a very widely distributed species in W.A.; its range extends from the Kimberleys to the south coast (Glauert, 1961).

No specimens were kept by the Museum.

The Common Scaly-foot *(Pygopus lepidopodus)*

Another species that is rare and restricted in the survey area. Only one specimen was collected in open coastal heath, on grey sand at Boranup, and another in low open scrub on the edge of *Banksia attenuata* woodland on the Shannon survey. This last record was the southernmost record of any legless lizard collected on surveys. However, two specimens were recorded at Williams Bay on the south coast (Western Australian Nat. News, May 1982).

The Common Scaly-foot is a widely distributed species throughout the southern half of the State, from Yalgoo and Northampton in the north, inland to Norseman and Kalgoorlie, and along the south coast to Eucla (Glauert, 1961). The specimens collected on surveys were from well within the species' known range.

No specimens were kept by the Museum.

Family Scincidae

Bobtail *(Tiliqua rugosa)*

The Bobtail is common throughout the survey area, and was recorded on 12 surveys. It occurs in almost all habitats, but is uncommon in the wetter areas. This species appears to have declined in numbers since the increase in the Fox population in 1973/74. Fox scat analysis has shown the Bobtail to be a frequent item in its diet. No specimens were sent to the Museum.

The species is widely distributed in Western Australia south of the tropics (Glauert, 1961; and Storr *et al.* 1981).

Mourning Skink *(Egernia luctuosa)*

This species (Plate 30) was recorded on seven of the surveys. It is common throughout most of the survey area, but restricted to moist sites, including reedbeds and other dense vegetation in low lying wet and damp places. It is locally common in the high rainfall southern portion of the survey area, but occurs wherever there is suitable habitat. One skink was observed catching a Slender Tree Frog *(Hyla adelaidensis)* on the Soho/Mitchell survey.

The Mourning Skink is not widely distributed, being confined to the south-west, the vicinity of Perth and the extreme south (Glauert, 1961; Storr *et al.*, 1981). The survey area probably represents the main or central area of this species' distribution.

Museum specimens include: R45752, Sunklands (1974); R51440, R51454, R51457, Soho (1975); R57424, R57434, Soho (1977).

Smith's Skink *(Egernia napoleonis)*

Perhaps the most common skink in the survey area, Smith's Skink was collected on all surveys, most frequently from inside dead blackboys, in old logs or under slabs of stone on granite outcrops. It seems to prefer areas where there is a substantial amount of ground cover. There is a very wide variation in the colouration of this skink.

This is another south-west species; Glauert (1961) and Storr *et al.* (1981) list it as occurring in the vicinity of Perth and in the extreme south of the State.

The Museum also lists this species under the name *E. nitida.* Numbers include: R47378-84, Sunklands (1974); R51436, R51447-48, R51459, Soho (1975); R57408, R57436-53, R57462-65, Soho (1977); R78305-06, Giants (1981).

King's Skink *(Egernia kingii)*

Widespread throughout the survey area, though nowhere common, this species was collected on eleven surveys. It is found in most of the drier habitats, and seems to prefer fairly dense cover. It is also frequently found near water along the coast, where it occurs amongst rocks on the beach.

This species is distributed along the west and south coast, from Dirk Hartog Island to the Recherche archipelago, and inland to the Great Southern Railway (Glauert, 1961, and Storr *et al.*, 1981.)

Museum specimens include: R45755, Ludlow (1972); R45753-54, R45756, Pines (1974); R51444, Soho (1975); R57399-404, Soho (1977).

Fry's Skink *(Egernia pulchra pulchra)*

Fry's Skink was collected on nine surveys, Soho, Milyeannup, Sunklands, Yeagarup, Dombakup and Mitchell River. It appears to be confined to coastal and sub-coastal habitats within the survey area. It occurs in low open woodland, heathland and herbland communities, usually on sandy soils, and is found under rocks, in dead blackboys and hollow logs.

Not a widely distributed species, it is confined to the humid south-west corner of W.A., north to Dwellingup, south to Eclipse Island and east to the Stirling Range and Cheyne Beach (Storr *et al.* 1981). These survey records are from well within the species' known range.

Red-legged Skink *(Ctenotus labillardieri)*

The Red-Legged Skink (Plate 29) is very common (second only to *E. napoleonis)* in the survey area. It is common in almost all forest types, and was collected on all surveys. It is particularly common on granite outcrops in the survey area, frequently being found under loose slabs of stone. It prefers more open areas of forest, particularly woodland areas on sandy soils.

The species' distribution is along the humid coast and near-coastal ranges of the south-west and Eucla Division, north to the Swan River, east to Thomas River, and inland to Mt. Helena, Boddington, Rocky Gully and the Stirlings (Storr, 1973) and Storr *et al.* (1981). This is not a widely distributed species, and the survey area is well within its range.

Museum records include: R47390-92, Sunklands (1974); R51451, Soho (1975); R51464, Soho (1975).

Ctenotus catenifer

This is an uncommon species, collected on only four surveys: Sunklands, Soho, Mitchell River and Frankland. It was mostly captured in pit traps with drift fences, and may thus have been missed on some of the earlier surveys before the introduction of pit traps. It is also possible that it may at times have been confused with *C. labillardieri* which it superficially resembles. It was most frequently collected in woodland sites on sandy soils.

This is a south coastal species whose range extends from West Cape Howe to Cheyne Beach, and inland to Chorkerup (Storr, 1973; and Storr *et al.,* 1981). The records on this survey considerably extend its range westwards.

Museum records include: R473931, Sunklands (1974); R51462, Soho (1975); R51468, Soho (1975).

Ctenotus impar

This species is uncommon in the survey area, being collected only on the Boranup and Sunklands surveys in the north-west section. All specimens were collected on sandy soils in low open woodland of jarrah and banksia, or on the edge of open heathland.

The species occurs in the southern half of the South-west Division, north to the Gingin district, but is absent from the far south-west (south of Busselton and west of the Fitzgerald) (Storr, 1973; and Storr *et al.,* 1981).

It is not a widely distributed species in the southern forests, and the survey records extend its known range southwards.

Museum specimens include: R45749, R47389, Sunklands (1974).

Hemiergis initialis initialis

This is an uncommon skink in the survey area, collected only on the Sunkland and Yeagarup surveys, in jarrah/marri forest.

The species has a limited distribution in the south-west, extending from the Darling Range north to the Avon, south to Collie and east to Boddington (Storr, 1975).

The collection from Yeagarup represents the species' most southerly occurrence on the coast.

No Museum specimens were kept.

Burrowing Skink *(Hemiergis peronii peronii)*

A very common skink in the southern forests, the Burrowing Skink was collected on all but the Yeagarup survey. It is commonly found under logs, stones, litter and in old Stick Ants' nests, frequently buried in litter or soil. It occurs in most vegetation types with a deep litter layer, and it is also common in suburban gardens and on farmland areas.

It is a south-west species occurring along the lower west coast, east to the Nullarbor and north to Busselton, Collie, Bridgetown and Rocky Gully (Storr, 1975; and Storr *et al.,* 1981). Collections from these surveys are all within the known range of this species.

Museum records include: R45744-45, R45750, R47399, R47402-03, Sunklands (1974); R51445, R51466, Soho (1975); R57413, R57443, R57455, Soho (1977); R78307-09, Giants (1981).

Lerista microtis microtis

An uncommon skink in the survey area, this species was found on six surveys: the Milyeannup, Perup, Soho, Shannon, Mitchell and Giants.

This species has restricted distribution, and is not often collected. It occurs in the lower south-west, north to Dwellingup and east to Israelite Bay (Storr, 1971 & 1976a), Storr *et al.* (1981).

Museum specimens include: R57415, Soho (1977); R78317, Giants (1981).

Lerista distinguenda

This species is uncommon in the survey area, being found only on the two most north-western surveys (Sunklands and Boranup) and the Frankland survey to the east. Specimens were collected in jarrah forest and

on coastal heath, often in sandy soils. The species appears to be more common in the northern jarrah forests outside the survey area; it has been collected east of Dwellingup (R68124) and Kelmscott (R51421-22).

It is a fairly widespread south-west species, its distribution extending from Geraldton in the north to the Great Australian Bight and inland to Northam (Storr *et al.*, 1981). It does not appear to be a southern forest species; the records from the surveys fall within the limits of its range.

The only Museum specimen from this survey is R47401, Sunklands (1974).

Lerista elegans

This species is uncommon in the survey area and was found only on one of the most northern surveys, the Pines. No specimens were kept by the Museum.

This is a fairly widely distributed species occurring along the west coast from the Murchison River south to Perth and inland to Lockwood Springs and the Darling Range (Storr *et al.*, 1981). It also occurs on the offshore islands from Barrow Island south to Rottnest (Storr *et al.*, 1981).

A north coastal species, the record from the Pines survey extends its range southwards.

Museum records include: R62402, Dryandra (1978).

Sphenormophus australis

An uncommon skink (Plate 31) in the survey area, this species was located on only four surveys: the Dombakup, Shannon, Soho and Mitchell. It appears typical of the southern coastal and sub-coastal high rainfall area.

This species occurs from Collie in the north to Cheyne Beach in the south (Storr, 1967) and Storr, *et al.* (1981).

It is relatively scarce even within the areas where it was collected, although the survey area would appear to be its centre of distribution.

Museum specimens include: R57422, R57440-42, Soho (1977).

New Holland Skink *(Leiolopisma trilineatum)*

The New Holland Skink is fairly widespread, but nowhere common; it was found on six surveys. It appears to prefer the drier woodland habitats, and may be more common in the jarrah forest to the north of the survey area.

It is not a widely distributed species, occurring only in the vicinity of Perth, south to Margaret River, Bridgetown, Manjimup, Pemberton and Albany (Glauert, 1961) and Storr *et al.* (1981). The survey records are from well within its known range.

The only Museum specimen from the surveys is R47397, Sunklands (1974).

Wood Skink *(Cryptoblepharus plagiocephalus)*

This species is uncommon in the survey area except in the north-west, where it was found in jarrah forest on both the Sunklands and Boranup surveys.

It is very widely distributed throughout the State, except south of the line from Busselton to Gnowangerup (Storr, 1976b) and Storr *et al.* (1981).

The Wood Skink is not a southern forest species and the specimens collected were from the southern extremity of its known range.

The only Museum specimen from the survey is R45748, Sunklands (1974).

Sandhill Skink *(Morethia lineoocellata)*

The Sandhill Skink is an uncommon species found only in the north-west of the survey area; it was found on three surveys: Yeagarup, Pines and Sunklands. It appears to favour the drier, more open habitats.

The species occurs along the mid-west and lower west coast of the State, from just north of Perth south to Cape Leeuwin, and inland to the Canning Dam. It also occurs at Rocky Gully and on Rottnest and Garden Islands (Storr, 1972; and Storr *et al.*, 1981).

It appears to be a mid-west coastal species, and the record from Yeagarup extends its coastal distribution further southwards.

No Museum specimens were kept.

Morethia obscura

This species is uncommon, and was found only in the north-west of the survey area on the Sunklands, Pine, and Yeagarup surveys, and in the north eastern portion of the Frankland survey. It prefers the drier jarrah/marri forest and woodland habitats.

The species occurs in southern W.A. along the west coast, north to Shark Bay, and south-east to Eucla. It also occurs on some of the offshore islands such as Garden Island, but is absent from the lower south-west, south of a line from Bunbury to Albany (Storr, 1972; and Storr *et al.*, 1981).

The specimens collected on these surveys extend its known range into the lower south-west.

Museum specimens include: R45747, Pines (1974); R47394, R47396, R47398, R47400, Sunklands (1974).

Grey's Skink *(Menetia greyii)*

Grey's Skink is common in the north of the survey area, and it was collected on the Boranup, Sunklands, Pines and Frankland surveys.

The species occurs over the greater part of W.A., but is absent south of a line from Nannup, through Rocky Gully to Albany (Storr, 1976; Storr *et al.*, 1981). The records from these surveys appear to be from the edge of its known range.

Museum specimens include: R45743, Pines (1974); R47399, Sunklands (1974).

Family Typhlopidae

Blind Snake *(Ramphotyphlops australis)*

Uncommon in the survey area, this species was collected on five surveys: the Sunklands, Milyeannup, Pines, Perup and Frankland. Its distribution is restricted to the jarrah and wandoo forests in the north of the area.

Only a few specimens have been collected, usually from underneath old logs or timber. We collected one specimen, a road casualty, in jarrah forest between Bridgetown and Donnelly Mill in 1972.

The Blind Snake is more common to the north of the survey area. It was widely collected by Storr *et al.* (1978), on the Swan Coastal Plain, and by us, east of Dwellingup in 1979.

Family Boidae

Carpet Python *(Morelia spilota variegata)*

The Carpet Python is very rare in the survey area, and none were collected on surveys. Only two specimens, one collected from jarrah forest west of Manjimup in 1972, and the other sighted at Lewana near Nannup in the early 1950s, have been recorded.

This species is widely distributed throughout the State (Glauert, 1967).

Family Elapidae

Black Tiger Snake *(Notechis ater occidentalis)*

The species is common and widespread throughout the survey area. It was recorded on all surveys except Boranup and Milyeannup, but it is certainly present in these areas as well. It may be found in almost all habitats, including farmland, and is most commonly found in densely vegetated areas along watercourses, streams, lakes and swamps.

Some specimens have been found to contain frogs, tadpoles and *Mus musculus* in their stomachs. This species also invariably contains huge numbers of parasitic stomach worms *(Nematoda)*.

The Black Tiger Snake is confined to "the south-west, south of the Moore River, inland to the Great Southern Railway and the Stirling Range" (Glauert, 1967). The survey area encompasses the main distribution of this species.

Museum No: R51443, Walpole (1975).

Dugite *(Pseudonaja affinis affinis)*

Common and widespread throughout the survey area, the Dugite was recorded on all surveys. It is very common in southern sub-coastal areas amongst heath and herbland communities, along the west and south coast in woodland and heath, and to the east of the Frankland River. It is common in the jarrah forests in the north of the survey area, but only locally common in the wetter karri forests, occurring mainly on granite outcrops.

The species is also frequently found in the farmlands and townships of the south-west. Specimens were often collected with smaller animals, particularly Bobtail Lizards *(Tiliqua rugosa)*, in their stomachs. One specimen from Northcliffe contained two young Bandicoots *(Isoodon obesulus)*.

The survey area lies within the main distribution range of this species, that is, "the coastal plain west of the Darling Range, the country around Albany and the lower Great Southern" (Glauert, 1968).

Dugite specimens were not always sent to the Museum.

Museum records include: R54150, Walpole (1975); R57484, Soho (1976); R68164, Walpole (1979).

The Black-headed Snake *(Unechis gouldii)*

Uncommon in the survey area, this species was recorded only on two of the most northerly surveys: the Perup and Milyeannup.

The species appears to be restricted to open jarrah and wandoo forest in the northern part of the survey area. It is frequently collected on our surveys in jarrah forests north of the survey area. It does not appear to occur in coastal areas south of Busselton. However, it is common along the coast further north (Storr *et al.*, 1978).

One unusual record is from Brittain's Rock, a granite monadnock in karri forest 16km to the south of the old Shannon River townsite. This specimen appears to be well outside the species' normal range.

Glauert (1967) gives little detail on the distribution of the Black-headed Snake, stating merely that it is common in the south-west, north of Geraldton and inland to the Murchison, Kalgoorlie and Norseman.

Crowned Snake *(Drysdalia coronata)*

This is a common species in the survey area, and it is certainly the most abundant of the small snakes. It was found on ten of the surveys, but was not collected on the Karri, Pines, Perup, Sunklands and Yeagarup. It appears to be a coastal and sub-coastal species occurring on sandy soils in woodland, heathland and herbland communities.

One record which is slightly out of keeping with the otherwise coastal and sub-coastal distribution of the Crowned Snake comes from a sighting in a patch of jarrah/blackbutt woodland and heath, on grey sand near Quininup on the South-west Highway. The species is also found in woodland communities to the east of the Frankland River, as far north as Lake Muir. It would seem then that the coastal and sub-coastal distribution may be due to the species avoiding the open and high open forests of jarrah and karri.

Glauert (1967) lists this species as occurring in "South-western Australia, south of Gingin, inland to the lower Great Southern and coastwise to Esperance and Israelite Bay". It is scarce on the Northern Swan coastal plain (Storr *et al.,* 1978).

Its main occurrence within the survey area is the coastal areas and south coastal vegetation communities.

Museum records include: R51472-73, Soho (1975).

Little Brown Snake *(Elapognathus minor)*

Although this species (Plate 32) is listed as being confined to the lower south-west (Glauert, 1967) it is rare in the survey area. One was collected on the Shannon survey, from an ants' nest in a woodland community on grey sand, and another was found in a pit trap in a moist gully on the Frankland survey.

Four other specimens have been recorded or collected during recent years. The first specimen (1974) was from open jarrah woodland, with a dense *Agonis parviceps* understorey, on grey sand to the north of Walpole. The second specimen (1975) was from Walpole, collected in a low open woodland near the lower reaches of the Shannon River. The third specimen was collected in 1977 from a recently burnt ants' nest, south of Lake Yeagarup. It was found in a moist sandy gully under a stand of *Banksia littoralis* with an understorey of *Lepidospermum effusum.* The fourth specimen (1982) was collected in Irwin Inlet, approximately 100m from the shore. A further specimen was also collected just outside the survey area, approximately 75km east of Albany.

Although the Little Brown Snake is probably one of the rarest snakes in Western Australia, it is surprisingly not included on the list of "Fauna which is rare, or otherwise in need of special protection" (Government Gazette, 8th April 1983).

Mueller's Snake *(Rhinoplocephalus bicolor)*

Mueller's Snake (Plate 33) is locally common in the survey area, being recorded on nine surveys. It was not recorded on the Karri, Dombakup, Pines, Boranup or Perup, and appears to be absent from the north of the survey area and the karri forest.

It is common amongst the consolidated sand dunes in the south of the survey area, where almost all specimens were collected from sandy soils on the edge of woodland communities. Most of the known specimens have been collected on these surveys.

Glauert (1969) lists Mueller's Snake as, "probably confined to the lower south-west".

Museum records include: R51438, Walpole (1975); R51456, Walpole (1975); R51471, Soho (1975); R68169, Sunklands (1978).

Bardick *(Echiopsis curta)*

This species appears uncommon in the survey area, being recorded only on the Mitchell River block some months prior to the official survey. Three other specimens have been recorded by us in recent years: one was found on the coastal plains at Peaceful Bay, east of Walpole; another was a road casualty on the South-west Highway in a sandy herbland near Shannon airfield; and the last was caught at West Cape Howe on recently burnt coastal heathland, close to a small seasonal creek near Lake William. The third specimen contained a frog, *Heleioporus* sp. in its stomach, and the specimen from Peaceful Bay also contained the remains of several small frogs.

Glauert (1967) records the Bardick species as being "widely distributed in southern Western Australia". The Museum specimens are from around Perth south to Busselton, and the Great Southern and Albany districts. Inland specimens were obtained from Lake Monger, Kalgoorlie and Borden.

No Museum specimens were kept.

(D) AMPHIBIANS

DISCUSSION OF FINDINGS

All species of frogs collected are endemic to the south-west. The known range of most of these species falls largely within State Forest, many being restricted to the survey area.

A total of fifteen species of frogs from the survey area has been identified by the Museum.

The number of frogs found on each survey varied considerably. Nine species were collected on both the Frankland and Mitchell surveys, three were collected on the Boranup and four on the Milyeannup survey. The season in which each survey was carried out affected the number of species that were recorded.

The species most frequently caught was *Heleioporus eyrei,* the Moaning Frog. Other frogs found on the majority of surveys included the Slender Tree Frog *(Litoria adelaidensis),* the Green and Gold Tree Frog *(Litoria moorei)* (Plate 34), the Western Banjo Frog *(Limnodynastes dorsalis)* and *Crinia georgiana.*

Species that were less frequently found included *Pseudophryne nichollsi* (on three surveys), *Heleioporus psammophilus* (on two surveys), and *Geocrinia rosea, G. lutea (Plate 35)* and *Neobatrachus pelobatoides* (on one survey each).

The *Ranidella insignifera* group is extremely difficult to identify unless studied within their natural habitat, where biological differences can be determined. It is almost certain that *R. pseudinsignifera* has been recorded on the surveys, and probably *R. sub-insignifera* as well. The presence of *R. pseudinsignifera* has also been confirmed in the Manjimup township.

Other species of frogs collected in the survey area were *Heleioporus inornatus, Crinia leai, Crinia glauerti* and *Pseudophryne guentheri.*

Many of the frog species in the survey area appear to be tolerant of major changes in their natural environment. Consequently, *Litoria moorei, L. adelaidensis, Geocrinia georgiana, G. glauerti, Helioporous inornatus* and *H. eyrei* are all common in farmland areas and even in gardens. *Limnodynastes dorsalis* is found in most farm dams.

It is probable that other species of frogs occur in the survey area which were not caught on surveys. *Heleioporus albopunctatus* and *Myobatrachus gouldii* could occur in the woodlands in the north-east of the survey area, though they are more common in the "drier part of the reliable winter rainfall region of southern Western Australia" (Main, 1965). *Myobatrachus gouldii,* in particular, may also occur further south on the coastal sands. *Heleioporus barycragus,* a Darling Range species may occur in the northern part of the survey area, as might *H. cyclorhynchus,* a south coastal species occurring to the east of Albany (Main, 1965).

LIST OF SPECIES

Order Salienta

Family Hylidae

Genus Litoria

Slender Tree Frog *(Litoria adelaidensis)*

This species is common and widespread throughout the survey area, and was collected on all surveys except the Sunklands, Milyeannup and Boranup. It favours the margins of streams, lakes and swamps, especially where there is reedy growth. It was most often observed on the stems of reeds and rushes.

It is present in all major vegetation types wherever suitable habitat occurs.

The Slender Tree Frog is a south-west species occurring in the area of winter rainfall (Main, 1965).

Museum numbers include: R1474, Soho (1975), R57472-76.

Green and Gold Tree Frog *(Litoria moorei)*

This species was found on all but five of the surveys, and is common and widespread within the survey area (Plate 34).

It was found in all major vegetation types, usually occurring in the vicinity of swamps, lakes and vegetated stream edges. It also readily adapts to changes in its habitat, and has been found in wet pastures and along drains, in garden trees or shrubs, taking advantage of any cover provided, such as wood heaps and cement blocks. It can be heard calling throughout the warm evenings of spring and early summer.

This is a south-west species which occurs in "the area of winter rainfall extending to the goldfields along the water supply pipeline" (Main, 1965).

Museum specimens retained were: R47405-06, Nannup (1974).

Plate 34 ▲ Green and Gold Tree Frog *(Litoria moorei)*.

Plate 35 ▲ *Geocrinia lutea*.

Family Myobatrachidae

Genus Limnodynastes

Western Banjo Frog *(Limnodynastes dorsalis)*

This large frog, sometimes called the Pobble Bonk, was collected on ten of the surveys, in most of the major vegetation types where suitable habitat occurred. It was always collected in the vicinity of permanent water, and favours swamps and stream banks. It was also found in old wells and water tanks, and very often in farm dams throughout the survey area.

On spotlight surveys, the Banjo Frog was often seen along roads and tracks, just after rain.

It is a south-west species occurring from Northampton to Israelite Bay (Main, 1965).

No Museum specimens were retained.

Genus Neobatrachus

Humming Frog *(Neobatrachus pelobatoides)*

This species was found only on the Mitchell survey. It is a burrowing frog, usually found after the first autumn rains. It has a very extensive range in the south-western part of W.A., although there are no Museum records for the extreme south-west corner

(Main, 1965). It has also been recorded in the Perup area (Main A.R., personal communication*).

No Museum specimens were retained.

Genus Heleioporus

Burrowing Frog *(Heleioporus inornatus)*

This species is common in the survey area, and was recorded on eight surveys, in most major vegetation types. It was very common in the sandy soils of the southern woodland areas and south coast flats, and was most often caught in pit traps, particularly where these were combined with a drift fence.

The Burrowing Frog is another south-west species whose range extends "south along the Darling Scarp then east along the south coast to east of Albany" (Main, 1965).

Museum records include: R47404, Nannup (1974); R51482, Soho (1975).

Moaning Frog *(Heleioporus eyrei)*

This is the most common frog in the survey area, and was found on all but two surveys. It is very common in sandy soils, particularly along the coast and south of the high open forest. On several occasions dozens of specimens were caught in pit traps following early autumn rains.

The Moaning Frog's predators include Tiger Snakes and Foxes. One Moaning Frog was found in the stomach of a snake killed near Jarrahwood, and nine frogs were found in a fox shot on the Dombakup survey.

This is a south-west species which occurs in the Darling Scarp, Swan coastal plain and along the south coast to Esperance (Main, 1965).

Museum specimens include: R47419, Busselton (1974); R45757, Cane Break Road (1974).

Heleioporus psammophilus

This is a rarely collected species, with only two specimens being recorded, one from the Shannon survey, the other from Dombakup. No detailed records are available, but both species appear to have been collected from areas of sandy soils, probably with low open woodland or heath vegetation.

Another south-west species, its distribution extends from Dongara, south along the scarp and east along the coast to Albany (Main, 1965).

Specimens were not retained by the Museum.

*Main A.R., Department of Zoology, University of Western Australia

Genus Pseudophryne

Gunther's Toadlet *(Pseudophryne guentheri)*

Gunther's Toadlet is uncommon but widely distributed in the survey area. It was found on seven of the surveys, in a variety of vegetation types, most often under rocks on granite outcrops and under bark and litter in moist locales.

Another south-west species, it occurs in the region of reliable winter rainfall (Main, 1965).

Museum records include: R47407-08, R47417-18, R47423, R47428, Busselton (1974).

Nicholl's Toadlet *(Pseudophryne nichollsi)*

This is an uncommon frog species in the survey area, being recorded on only four surveys. Three specimens were collected from deep litter in the karri forest, one in Dombakup block, one in Strickland block during a fire, and the third in eight-year-old karri regeneration in Gray block. Two specimens were obtained from Giants block, one in karri forest the other in jarrah forest. The remaining two records were from a dry creek bed in the Sunklands and from under a piece of bark on a track on Granite Peaks.

The species is said to occur most frequently in the wet karri forest (Main, 1965). Three of the seven specimens recorded by the F.D. survey team, however, are from jarrah forest.

Nicholl's Toadlet has a restricted distribution, and "the central part of its range appears to be the wet karri forest from Pemberton to Nornalup. Specimens have been collected at Augusta and an isolated population occurs on the Stirling Range" (Main, 1965).

This species is also listed as *Metacrinia nichollsi*. Numbers include: R47422, Busselton (1974); R78302-03, Giants (1981).

Genus Geocrinia

Geocrinia rosea

This is another frog species with restricted distribution, but it is locally common within the survey area. Recorded on only the Karri survey, it was present in many creeks in the Donnelly and Warren River catchments. Several specimens have been trapped in pit traps during studies on clear felling at Crowea block.

This species is very common in dense reed beds of *Lepidosperma tetraquetrum* growing along small permanent creeks or soaks. Pit trapping at Crowea indicates that the species can survive clear felling and regeneration burning, as its moist habitat protects it from fire.

Its distribution is given by Main (1965) as within the valley of the Warren River.

No Museum specimens were kept.

Geocrinia lutea

This species (Plate 35) has a very restricted distribution, and was not collected on any survey.

Until recently, the species was known from only nine specimens (Main, 1963 and 1965) found on the Deep River near Crystal Springs. However, since then it has been found in many of the small creeks on the lower reaches of the Deep, Walpole and Frankland Rivers. It occurs in shallow gullies with dense vegetation, chiefly *Agonis linearifolia, Loxocarya flexuosa, Lepidosperma tetraquetrum, L. longitudinale* and *L. effusum.* Although its range is within the tingle forest, it is found mainly in gullies containing jarrah.

The species appears to be geographically isolated from *G. rosea* by the open heath and sedgelands of the Pingerup plains.

It has recently been synonomized with *G. rosea* by the Western Australian Museum.

Its distribution is given by Main (1965), as, "Deep River at Nornalup". Nornalup seems to be a 'misprint' since Main found his specimens in a small soak just off the South Coast Highway on the Deep River at Crystal Springs. (Main, personal communication*).

Museum records include: R73772, Walpole (1981).

Geocrinia leai

This is a common and widespread species which was found on six surveys, mostly in the southern part of the survey area. Common in small streams and moist areas, it was frequently collected in streams and swamps.

Main (1965) gives its distribution as the Darling Scarp from Mundaring in the north to the south coast and east to Albany.

Museum specimens: R51483, R51486, Soho (1975).

Genus Crinia

Crinia georgiana

This common and widespread species was collected on most surveys. It occurs in all vegetation types, in moist sites, and is often found under rocks, in old logs, deep litter and holes in stream banks.

*Main, see p.57.

The species is also found on farms and may be observed on roads at night during the first rains in autumn.

It is a south-west species whose distribution extends from Gingin in the north-western part of the Darling Scarp, east along the coast to the vicinity of Esperance (Main, 1965).

Museum records include: R47409-16, Nannup (1974); R47424-25, R47427, Busselton (1974); R51475, R51481, Soho (1975); R78300-1, Soho (1981).

Genus Ranidella

Ranidella glauerti

This common and widespread species was found on most of the surveys. It occurs in all major vegetation types, in permanently wet situations such as small streams, swamps and marshy areas. It is also common in wet pastures and in farm dams in many areas.

Another south-west species, its range is similar to that of *Crinia georgiana,* but it does not extend beyond about 65km east of Albany (Main, 1965).

Museum records include: R51486, R51523, Soho (1973); R78295-99, R78310-16, Soho (1981).

Ranidella insignifera complex

Ranidella subinsignifera were reported from Dombakup survey and from the Karri survey near Pemberton, while *R. insignifera* was reported on the Mitchell survey and *R. pseudinisignifera* on the Frankland survery. The first two reports were not identified positively by the Museum.

In appearance, *R. insignifera, R. subinsignifera* and *R. pseudinisignifera* are almost indistinguishable, although the latter has minor colour variations. Their main differences are biological, such as breeding times and calls.

Ranidella insignifera inhabits the Swan coastal plain south of the Moore River and west of the Darling Scarp. *Ranidella subinsignifera* ranges from just north of Manjimup, south-east to Mt. Barker and as far as the south coast from Torbay Head to Cheyne Beach. *Ranidella pseudinsignifera* inhabits the Darling Plateau.

It is almost certain, therefore, that the specimen recorded in Yeagarup was in fact *R. pseudinsignifera,* and those in Dombakup and Crowea block (Karri survey) could be either *R. subinsignifera* or *R. pseudinsignifera.* One confirmed record (Main A.R., personal communication*) is of *R. pseudinsignifera* on the Perup in 1982.

Museum records include: R57445-46, Soho (1977).

(E) FRESHWATER FISH

DISCUSSION OF FINDINGS

Fish were not always collected on surveys, and only those that have been identified by the museum are listed here. A large portion of the survey area was covered by a special 'fish survey' in 1978-79 (Christensen, 1982) and records from this are also discussed.

Twelve native species of fish and five introduced species have been collected in the survey area. With the exception of the Mullet *(Mugil cephalus)* and the Pouched Lamprey *(Geotria australis),* all the native species are endemic to the south-west region. There is also one endemic monotypic family, *Lepidogalaxiidae* and two endemic genera, *Nannatherina* and *Bostockia.*

With the exception of the Black-Stripe Minnow *(Galaxiella nigrostriata),* the Swan River Goby *(Pseudogobius olorum)* and the Western Minnow *(Galaxias occidentalis),* the endemic fish species occur largely in forest streams. Several of these: the Salamander Fish *(Lepidogalaxias salamandroides)* (Plate 36), the Mud Minnow *(Galaxiella munda),* the Night Fish *(Bostockia porosa)* (Plate 37) and Balston's Pygmy Perch *(Nannatherina balstoni)* have a very restricted range.

The Minnows *(Galaxiidae),* are well represented in the survey area, and, of the five known south-west species, only *Galaxias truttaceus* was not collected. This species is known to occur just east of the survey area in the vicinity of Albany (McDowall and Frankenburg, 1981) and its range very likely extends into the survey area. The Bigmouth Goby *(Favonigobius suppositus),* which should occur in the survey area, was not collected. This species is not common in freshwater, however, as it spends a significant proportion of its life cycle in estuaries and the sea (Coy, 1979). It is also possible that several species of Hardyhead *(Atherinosoma* spp.) may occur in the survey area, though only one species, not positively identified, was collected. Three other fish species are known to occur in south-west rivers, the Swan River Hardyhead *(A. edelensis),* the Rockingham Hardyhead *(A. rockinghamensis)* and *A. elongata.* The exact distribution of the first two species is somewhat obscure, and the latter is mainly restricted to estuaries (Coy, 1979).

The fish within the survey area show a higher degree of endemism than any of the other vertebrate groups.

LIST OF SPECIES

(i) INDIGENOUS SPECIES

Family Galaxiidae

Western Minnow *(Galaxias occidentalis)*

Collected on ten surveys, this species is widespread and common throughout the survey area. It prefers the larger streams, deeper shaded pools and small lakes. It is seldom seen during the day, especially in hot weather, and prefers deeper water. It is most active near the surface at night, and often occurs in fast flowing streams.

The survey is well within the Western Minnow's known range. The species is endemic to the south-west, occurring between the Albany district and the Arrowsmith River.

Museum specimens: P24341-42, Milyeannup (1974); P25085-002, Sunklands (1974); P25731-002, Milyeannup (1974).

Black-Stripe Minnow *(Galaxiella nigrostriatus)*

The Black-Stripe Minnow appears to be uncommon in the survey area. Specimens were collected in 1979 from two small creeks adjacent to the South-West Highway, 10km from Walpole (Christensen, 1982). Fish identified as *Brachygalaxias pucillus nigrostriata* (synonymous with *G. nigrostriata)* by the Museum (P25731-003) were also collected in 1976 on the Milyeannup survey. However, since this collection was not mentioned by McDowall (1978) in his review of the species, or by McDowall and Frankenburg (1981) in their review of the galaxiids, there may be some doubt about this identification. If it is confirmed that the specimens collected are *B.p. nigrostriata* it would greatly extend the known range, given by McDowall and Frankenburg (1981), of the species.

Mud Minnow *(Galaxiella munda)*

Although common and widespread in the southern portion of the survey area (Christensen, 1982), the Mud Minnow was only collected on the Soho and Frankland surveys. The Soho collection is described by McDowall (1978). The species is found in small freshwater streams and pools, both permanent and seasonal, throughout the southern high rainfall portion of the survey area. It is often found in association with other fish species.

The species is endemic to the south-west, distributed between Albany on the south coast and Margaret River in the north. An isolated population occurs at Gingin, north of Perth (McDowall, 1978; and McDowall and Frankenburg, 1981).

Family Lepidogalaxiidae

Salamander Fish *(Lepidogalaxias salamandroides)*

This species (Plate 36) was collected on five surveys: the Woolbales, Dombakup, Soho, Giants and Frankland, and at many other locations within the survey area (Christensen, 1982). The Salamander Fish is common in the southern portion of the survey area, and is often found in either permanent or seasonal shaded pools, slow flowing streams or roadside drains. It is associated with 'peaty waters' arising in herblands and sedgelands in areas of grey peaty sand. These waters are most often of low pH and have a high chemical O_2 demand (Christensen, 1982). The species may aestivate in the mud if the pool dries up during summer (Pusey, 1981).

The species' distribution is given by Coy (1979) and Christensen (1982) as between Lake Powell, east of Albany and some small eastern tributaries of the Blackwood River. Consequently, the species is almost entirely restricted to the survey area.

The family *Lepidogalaxiidae,* including the single Salamander Fish species, is endemic to the south-west.

Family Percichthyidae

Nightfish *(Bostockia porosa)*

Collected on eleven surveys, the Nightfish (Plate 37) is one of the most common and widespread species in the survey area. It is often found in association with other small fishes, and frequents slow moving streams and seasonal and permanent ponds. It also appears tolerant of salinity, as it was collected in a small creek which had almost 5 000 ppm total dissolved salts (T.D.S.) (Christensen, 1982).

Coy (1979) gives the distribution of this species as extending from the Albany district to Gingin Brook north of Perth. The survey area would appear to be its main sronghold.

Museum specimens include: P25731-002, Milyeannup (1976).

Family Kuhliidae

Western Pygmy Perch *(Edelia vittata)*

This species was collected on ten surveys, and is one of the most common species in the survey area. It

Plate 36 ▲
Salamanderfish *(Lepidogalaxias salamandroides).*

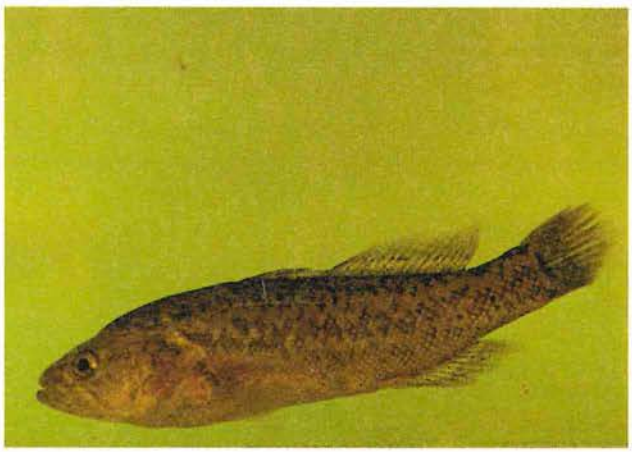

Plate 37 ▲
Nightfish *(Bostockia porosa).*

appears to occur with about the same frequency as, and in equal numbers to, the Nightfish (Christensen, 1982). Specimens were taken from both still and running waters, including rivers, lakes, small creeks, ponds and roadside drains. It was frequently found in association with other fish species and often occurred amongst water weeds.

The species appears to be particularly hardy, and was collected at one point on the Frankland River with a T.D.S. of 5 672 ppm (Christensen, 1982).

Coy (1979) gives this species' distribution as extending from Moore River, north of Perth, to the Phillips River, near Hopetoun on the south coast.

Museum specimens: P25084-001, P25085-001, Sunklands (1974); P25731-001, Milyeannup (1976).

Balston's Pygmy Perch *(Nannatherina balstoni)*

Collected only on the Karri survey in the Shannon River, Balston's Pygmy Perch does not appear to be common in small streams in the survey area. This is confirmed by Christensen (1982).

This species was often found in association with other fish species. Specimens were collected from creeks and rivers at four separate localities (Christensen, 1982). At two of these localities it was common, with 20 specimens being collected at each site. It may be a large stream or river species, and more common than the surveys would suggest. It was also collected in the Abba River just north of the survey area.

Coy (1979) gives its distribution as the south coastal streams and ponds between Two People's Bay and the Blackwood River. The collections from the Abba River at Ludlow extends the species' range further northwards.

Museum specimens were not kept.

Family Plotosidae

Freshwater Cobbler *(Tandanus bostocki)*

No Cobblers were collected on any of the surveys, probably because a scoop net was used to collect fish. However, they are known to occur in several of the larger rivers, including the Blackwood and the Warren.

Coy (1979) gives the species' distribution as the coastal streams and ponds from the Moore River to the Frankland River.

Family Geotriidae

Pouched Lamprey *(Geotria australis)*

This species was not collected on any surveys, but it has been observed or collected by us in the Donnelly and Warren Rivers. The species is widely distributed in Australia, New Zealand and southern South America.

Family Atherinidae

Swan River Hardyheads *(Atherinosoma edelensis)*

Identified by the Museum as *Atherinosoma* sp., these Hardyheads were collected in brackish water on the Pines survey, from the Blackwood River between Nannup and Balingup. They were observed swimming in schools close to the edge of the river.

Coy (1979) describes *Atherinosoma* sp. as common in estuaries, although its exact range remains somewhat obscure.

Family Mugilidae

Mangrove Mullet *(Mugil cephalus)*

The Mangrove Mullet was collected in brackish water from the lower section of the Shannon River.

This species is widespread throughout tropical and warm waters, including the entire coastline of the State (Coy, 1979).

Family Gobiidae

Swan River Goby *(Pseudogobius olorum [Lizagobius olorum])*

This species was collected in brackish water from the Hay River on the Mitchell survey.

The species is distributed in streams along the south coast of Australia and north to the Murchison River.

Museum specimens were not kept.

(ii) INTRODUCED SPECIES

Family Poecilidae

Mosquito Fish *(Gambusia affinis)*

This species was collected on four surveys: Soho, Grants, Frankland and Pines. In the latter three surveys, specimens were obtained from the Frankland and Blackwood Rivers, respectively. It was also collected from the Abba River to the north of the survey area, where it was found in asociation with several species of native fish including *B. porosa, E. vittata, N. balstoni, P. olorum* and *Atherinosoma* sp.

The Mosquito Fish was very common at all sites where it was collected, but it did not appear to have invaded the streams and rivers between the Blackwood and the Frankland Rivers. This is confirmed by Christensen (1982) and Coy (1979), who comments that the species is not common in many south coastal streams. There is one further record from the Warren River (Mees, 1977).

Family Cyprinidae

Carp spp. *(Carassuis* spp.)

A fish identified by the Museum as *Carassius* spp. was collected from the Blackwood River on the Pines survey.

Family Percidae

Redfin Perch *(Perca fluviatilis)*

This species was collected on only the Giants survey, in the lower Frankland River. In 1973,a specimen taken from the Manjimup Wildlife Sanctuary was identified as a Redfin Perch. The species also occurs in the upper reaches of the Warren, Tone and Perup Rivers.

Family Salmonidae

Brown Trout *(Salmo trutta)* and Rainbow Trout *(Salmo gairdneri)*

Neither species was collected on the surveys, but specimens of both have been taken from several of the larger rivers and streams, including the Donnelly and Warren Rivers, and the Lefroy, Four Mile and Smith's Brooks.

Fingerling trout were also captured in a small tributary of the Warren River in 1979 (Christensen, 1982).

GENERAL DISCUSSION

Species of scientific interest have been discussed in the general text and in the discussion sections at the beginning of each chapter. This discussion concentrates on broader issues, and highlights areas with an outstanding value for fauna or flora, and vegetation associations which are unique to the survey area. The fauna data are also examined for trends in distribution, and the concept of faunal zones in the south-west is discussed.

The Flora

The survey area contains the only substantial area of high open or wet sclerophyll forest, the karri and tingle forest formations, in Western Australia. Surprisingly perhaps, few species of plants apart from the dominant trees themselves — karri, yellow tingle, and red tingle — are entirely restricted to these forests. Nevertheless, these eucalypts create unique formations.

The Donnybrook Sunklands is of special botanical interest because of the gazetted rare plants that occur in this area, *Lambertia rariflora, Adenanthos detmoldii* and *Franklandia triaristata.* The former is of scientific importance because of its primitive floral characteristics which represent definite intermediate changes in the evolutionary pathway of the proteaceous flower (Melville, 1973 and 1975).

Dasypogon hookerii, which is common throughout the Sunklands, and *Grevillea brachystylis,* which occurs only in the Whicher Range, are both restricted to this area. Also in the Whicher Range there is an unnamed species of pink-flowered *Darwinia* and there are populations of two other species, *Eucalyptus haematoxylon* and *Crowea angustifolia,* which are separated from other occurrences of these species.

Another plant of botanical interest in this area is the small *Dampiera linearis,* recognised as a single taxonomic species, but which includes at least two biological species, the primitive diploids and the derived polyploids (Bousfield and James, 1976). The diploid population only occurs in the Whicher Range and near Albany, the polyploids are more widespread. This euploid complex is of great interest to students of genetic systems and evolution.

The south-eastern sector of the survey area, on the Hay and Mitchell Rivers, is another botanically rich region. This area forms the largest block of comparatively undisturbed vegetation near the junction of the three botanical districts of Gardner and Bennetts (1956): the Darling, Stirling and Warren. It contains representatives of species from all three of these botanical districts. There are, for example, 16 species of eucalypt, which is a high number for any area in the forested south-west. *Eucalyptus diversicolor, E. megacarpa, E. marginata* and *E. calophylla* are all typical forest trees of the Warren and Darling districts; *E. wandoo, E. decipiens, E. occidentalis* are typical of the Darling district; and *E. decurva, E. doratoxylon, E. falcata, E. anceps* and *E. staerii* are more typical of the Stirling district. More widespread species such as *E. rudis* and *E. cornuta* are also present. The banksias, of which there are nine species, exhibit a similar diversity.

The granite monadnocks, particularly numerous in the southern part of the area, have a distinctive flora and are also of considerable botanical interest. Many interesting and unusual plants grow in these isolated and specialized habitats. The rock fern *Cheilanthes tenuifolia* is common on the rocks, a species of *Isoetes* is found in seasonal pools of water in some rocks, the resurrection plant *Borya nitida* is widespread and *Acacia triptycha* and *A. sulcata* are common species restricted to this habitat. One species, *Chamalaucium forrestii* is entirely confined to one monadnock, Granite Peaks; and *Grevillia fistulosa* on Mt. Lindesay, near Denmark, is the most westerly known occurrence of this species. Populations of the gazetted rare plant *Grevillia drummondii* occur on granite outcrops near the Shannon townsite on the South-west Highway.

These areas all deserve further study as there are undoubtedly more species of interest to be discovered.

The Fauna

Two areas are noteworthy for their vertebrate fauna: the low open woodland, heathland and sedgeland complex to the south of the main forest block; and the Perup/Tone River forest. The former region encompasses the main occurrences of the two rare snakes: *Elapognathus minor,* and *Rhinophlocephalus bicolor;* the skink *Sphenomorphus australis,* the frog *Geocrinia rosea var. lutea,* and the small fish *Lepidogalaxias salamandroides.* The distribution of these species is entirely restricted to the lower south-west area.

The Perup/Tone River area contains five mammal species that are listed as rare and in need of special protection (Wildlife Conservation Act, 1950): *Bettongia penicillata* (Plate 38), *Macropus eugenii, Myrmecobius fasciatus* (Plate 39), *Dasyurus geofroii,* and *Pseudocheirus peregrinus.*

Plate 38▲
Brush-tailed Bettong or Woylie *(Bettongia penicillata).*

These two areas are, therefore, of exceptional scientific interest, the former for the number of restricted species, and the latter for the populations of rare and endangered animals in the area.

A feature of interest is the comparatively poor vertebrate fauna of the high open karri and tingle forests. It might be expected that these unique forests would have a distinct fauna, such as that of similar high open forests in the Eastern States of Australia. The latter forests are optimum habitat for several mammal species which are also considered to be dependent residents viz. *Phascolarctos cinereus, Acrobates pygmaeus, Gymnobelideus leadbeateri, Petaurus breviceps, P. australis, Schoinobates volans* and *Trichosurus caninus* (Tyndale-Biscoe and Calaby, 1975). Why are similar species absent from the karri forests?

One possible explanation might be the fire frequency in this habitat. Fire is believed to be a comparatively frequent event in the karri forests (Underwood, 1978). Frequent fire encourages species of animals suited to an unstable environment: r-selective species, which display short life span, early sexual maturity, and high fecundity. Such animals, which are adapted to a wide range of habitats, are precisely the sorts of species found in the karri forests.

Plate 39▼
Numbat *(Myrmecobius fasciatus).*

The karri, however, is unsuitable for many species which inhabit the more mesic high open forests of the eastern States, where fire is a less frequent event. The dependent species of these forests display k-selective traits: longevity, late sexual maturity and low fecundity (Tyndale-Biscoe and Calaby, 1975) — adaptations that are suited to a more stable environment. Another possible reason for lack of diversity is that the karri and tingle forests of the south-west occupy too small an area for dependent residents to have evolved in them.

ANALYSIS OF TRENDS IN THE DISTRIBUTION OF FAUNA

The unique assemblage of restricted species inhabiting the southern flats, and the distinctive mammalian fauna of the Perup area suggested that there might be distinctive faunal zones within the survey area.

Several schemes for phytogeographic regions or districts have been proposed for W.A. (Beard, 1981); a few authors have also attempted to establish zoogeographic regions or zones (Littlejohn, 1981). Partitioning in all cases has been based on combinations of physiography, geology, soils, climate, rainfall and vegetation.

Botanists generally acknowledge the existence of phytogeographic regions or zones, though they may dispute the exact location of boundaries. Many zoologists on the other hand do not accept the concept of zoogeographic regions, and the subject seems to have fallen out of favour in recent times. Littlejohn (1981) does, however, consider that the south-west area of Australia justifies recognition as a faunal sub-region for *Anura* (frogs and toads).

The data collected on these surveys provides an opportunity to examine the concept of faunal districts or zones, albeit at a regional level. To broaden the data base we included information from another eight biological surveys which have been carried out to the north of the area treated in this publication. These surveys include: The Northern Swan Coastal Plain (W.A. Museum, 1978), Dryandra (Butler, 1964; and Burbridge, 1977), Sampson (Nichols, O., personal communication*), Harris River, Kelmscott, Jarrahdale, Tuart and Julimar (F.D., unpublished data).

The fauna data collected on all of these surveys were analysed by means of reciprocal averaging, using the programme RECAV (Hill, 1973; and Morton, n.d.), which gives ordination of individuals and attributes at the same time. By this means the relationship of the surveys to one another was examined using species present data in separate ordinations of each of the major animal groups — mammals, birds, snakes, skinks, amphibia and fish.

*Dr O. Nichols. Alcoa of Australia Ltd. Pinjarra.

Ordination of the data, in particular the mammal, reptile and all species' data, indicates fairly consistent clumping of the surveys in to four groups (Figs. 14a, 14b, 14c). The surveys were allotted to four zones based on the results of their ordinations (Table 3).

Zone I includes all the south coastal surveys to the south of the main karri belt centred in the area around Walpole. This is the coolest and moistest part of the south, the only area that receives any significant summer precipitation. Zone II surveys include a larger area but they are mostly within what is generally referred to as the southern forests, the area to the south of the Blackwood River; a region with a cool mild climate. The surveys in the Sunklands, which have a very similar climate, also fall into this zone.

Zone III surveys all occur within the region generally referred to as the northern jarrah forests, including the wandoo area to the east, a much drier region with longer and hotter summers. Zone IV surveys are all within the dry woodland areas to the north of Perth.

There is a broad relationship between these four zones and the phytogeographic scheme proposed by Gardner and Bennetts (1956) — districts and sub-divisions related to rainfall, climate, soils and vegetation. The two northern groups of surveys, Zones III and IV, and the two southern groups, Zones I and II, fit the Darling and the Warren districts respectively, of Gardner and Bennetts. How do these zones compare with regard to fauna?

Inspection of the fauna data by the survey grouping or zones reveals several distinct differences between the four zones. Zone IV, the north coastal area, has the richest fauna in terms of total species numbers (Table 4). This is because of the high number of bird and reptile species recorded on the surveys within that zone. The two forest zones, II and III, contain the highest numbers of mammalian species. Most of these occur in the two eastern woodland areas of the Perup and Dryandra forests. The wetter south coastal zone and the southern forests, Zones I and II, contain the highest numbers of fish and amphibian species.

TABLE 3
Surveys Allotted to Faunal Zones

ZONE I South Coastal	ZONE II Southern Forest	ZONE III Northern Jarrah	ZONE IV North Coastal
Woolbales	Yeagarup	Kelmscott	Northern Swan Coastal Plain
Dombakup	Boranup	Dryandra	
Soho	Sunklands	Sampson	Julimar
Mitchell	Pines	Harris River	
Shannon	Milyeannup	Jarrahdale	
Giants	Perup		
	Karri		
	Mitchell River		
	Tuart		
	Frankland		

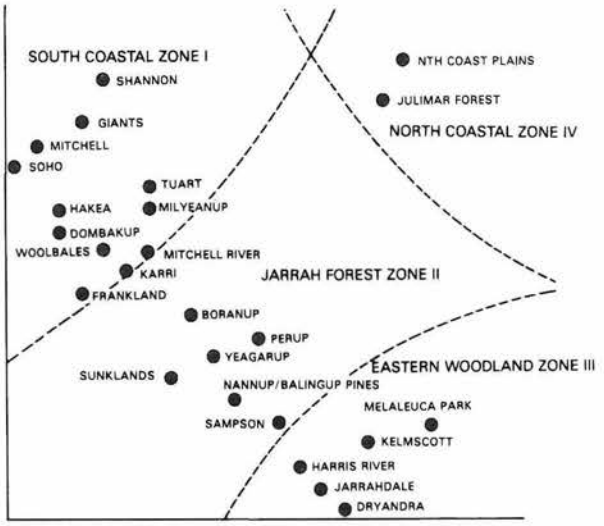

Figure 14a: Diagrammatic representation of the results of ordination of 25 surveys, based on data for all vertebrate species.

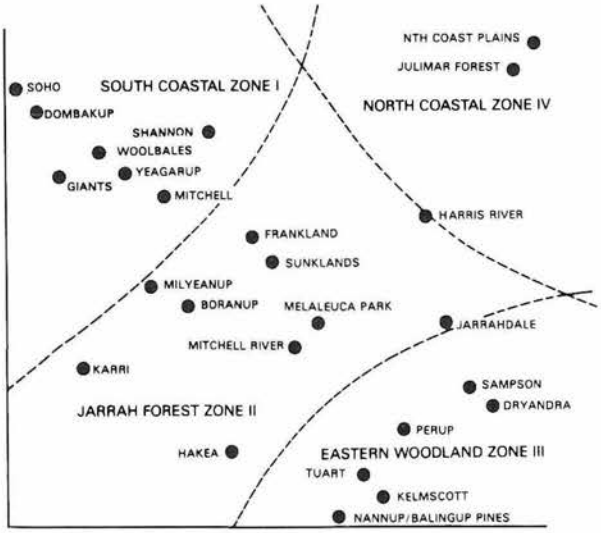

Figure 14b: Diagrammatic representation of the results of ordination of 25 surveys, based on mammal data.

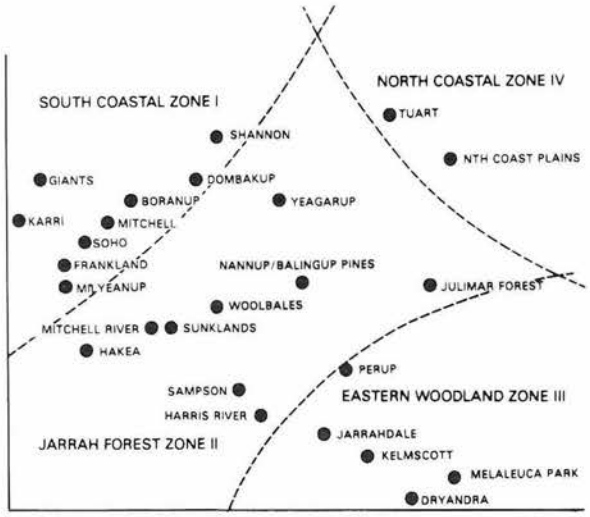

Figure 14c: Diagrammatic representation of the results of ordination of 25 surveys, based on reptile data.

There is a considerable degree of overlap between the four zones in terms of species' composition. However, the number of species in common in any of the major taxa between any zones rarely exceeds 50 per cent (Table 5). The numbers of reptiles in common between any of the four zones is particularly low, never exceeding 35 per cent of the total number of species. The lowest numbers occur between the two zones which are furthest apart from each other: Zone I on the south coast, and Zone IV to the north of Perth.

Each zone contains a number of species of animals that are restricted to that group of surveys (Table 6). Inspection of the list of restricted species (Appendix V) suggests some anomalies, however. These are due to the fact that only survey data were used in the analysis, and some species are inevitably missed on any survey. Museum records were not included because of the bias they would introduce into the analysis. For example, some of the mammals on older records are no longer extant, and collections of other groups have been opportunistic. Records are also heavily biased in areas close to the Metropolitan region and other populated areas.

Because of this, the species list in Appendix V should be treated with some caution. For example, the Brush-Tailed Phascogale *(Phascogale tapoatafa)* occurs throughout the region and is not restricted to Group I as indicated in Appendix V. Similarly, the Red-Tailed Phascogale *(P. calura)* probably occurs in Zone IV as well as Zone III.

In spite of the relationships between survey grouping and the botanical districts of Gardner and Bennetts, it would be difficult to argue the case for distinct and separate faunae in any part of the south-west land division.

The results of the analysis of these surveys suggests a continuum of fauna distributed along a temperature/moisture gradient, which is particularly strong north/south and weaker in an east/west direction. The more zeric adapted groups, such as the reptiles, are more frequent in the warmer, drier northern forest areas. The mesic fauna, such as amphibia and fish, reach a peak of development in the cooler, moister south.

On a smaller scale, information provided in the general text suggests that secondary factors affecting distribution include vegetation and soils, which appear to influence faunal distribution at a more local level. For example, sandy areas appear to have more abundant and diverse reptile fauna.

Some species may be related to certain vegetation associations; however, no known species of vertebrate, for example, is restricted to any one single site-vegetation type. Even species with a very restricted distribution, such as the Little Brown Snake

TABLE 4
Comparison between Faunal Zones: Total Species Numbers

Vertebrate Group	Faunal Zones: South Coastal I	Southern Forest II	Northern Jarrah III	North Coast IV	Total
Native Mammals	14 (50)	23 (82)	23 (82)	16 (57)	28
Exotic Mammals	7 (64)	11 (100)	8 (73)	10 (91)	11
Birds	115 (63)	120 (66)	110 (60)	152 (83)	183
Snakes	5 (25)	8 (40)	6 (30)	18 (90)	20
Skinks, Lizards and Turtles	13 (27)	24 (50)	23 (48)	33 (69)	48
Frogs	15 (75)	13 (65)	12 (60)	12 (60)	20
Native Fish	8 (67)	10 (83)	2 (17)	6 (50)	12
Exotic Fish	2 (40)	4 (80)	1 (20)	1 (20)	5
TOTALS	179 (55)	213 (65)	185 (57)	248 (57)	327

( ) = percentage of total

TABLE 5
Comparison between Faunal Zones: Species in Common

Vertebrate Group	Faunal Zones: I & II	I & III	I & IV	II & III	II & IV	III & IV
Native Mammals	14 (50)	12 (43)	8 (29)	20 (71)	12 (43)	13 (46)
Exotic Mammals	7 (64)	6 (55)	7 (64)	8 (73)	8 (91)	8 (73)
Birds	100 (55)	84 (46)	95 (52)	88 (48)	102 (56)	90 (46)
Snakes	5 (25)	2 (10)	3 (15)	4 (20)	6 (30)	6 (30)
Skinks, Lizards and Turtles	13 (27)	7 (15)	10 (21)	15 (31)	14 (29)	17 (35)
Frogs	11 (55)	9 (45)	9 (45)	10 (50)	8 (40)	8 (40)
Native Fish	7 (58)	2 (17)	3 (25)	2 (17)	5 (42)	2 (17)
Exotic Fish	1 (20)	1 (20)	1 (20)	0	1 (20)	0
TOTALS	158 (48)	123 (38)	136 (42)	147 (45)	156 (48)	144 (44)

( ) = percentage of total

TABLE 6
Comparison between Faunal Zones: Numbers of Restricted Species

Vertebrate Group	Faunal Zones: South Coastal I	Southern Forest II	Northern Jarrah III	North Coast IV
Native Mammals	—	1 (4)	1 (4)	2 (7)
Exotic Mammals	—	1 (9)	—	—
Birds	4 (2)	1 (1)	8 (4)	31 (17)
Snakes	—	2 (4)	1 (2)	12 (25)
Skinks, Lizards and Turtles	—	—	—	10 (50)
Frogs	2 (10)	1 (5)	1 (5)	1 (5)
Native Fish	1 (8)	1 (8)	—	1 (8)
Exotic Fish	—	3 (60)	—	—
TOTALS	7 (2)	10 (3)	11 (3)	57 (17)

Restricted species = species recorded only in that zone on the 23 surveys included in the analysis.

(Elapognathus minor) and the Salamander Fish *(Lepidogalaxias salamandroides),* occur on several site-vegetation types. The small frog *Crinia rosea var. lutea,* perhaps the most site specific species, occurs in several distinct site-vegetation types.

In summary, the vertebrate fauna of the forested south-west occur in a faunal continuum with a strong north-south, and lesser east-west influence. This appears to be related to climatic factors. On a smaller scale, individual species' distribution may be influenced by vegetation and soil factors, but all species located on these surveys occur across vegetation and soil gradients. The results of this analysis, therefore, provide little support for zoning of south-west forest faunae.

Acknowledgements

Many people have contributed to this survey over the years. Members of the public, farmers, school children and persons from all walks of life have brought or sent us specimens of animals or plants, or have telephoned or written in with reports of sightings. Some of the fauna specimens have been live, some dead, and a few long dead and decomposed, but all have added to our knowledge and all reasonable specimens have been forwarded to the W.A. Museum for their records. To all these people, too numerous to mention by name, we extend our thanks for their interest and the effort they have made to assist our work.

We would also like to thank the W.A. Museum and W.A. Herbarium for identification of specimens, Harry Butler for his assistance on the original surveys, and Jim Wilson for photographs of reptiles.

We extend our thanks to those members of the Forests Department who from time to time have put a lot of time and effort, often at very inconvenient hours, into the surveys. In particular the technical staff of the Manjimup Research Station, many of whom have accompanied us on some of the surveys.

Last, but not least, our thanks go to Fiona Styles and Alene Lim for typing and assistance with drafting, to Jenny Liddelow and Liz Bartuccio for valuable laboratory work, and Cefn Ridout and Liana Christensen for endless editing.

References

ALLEN, G.R. (1982). *Inland fishes of Western Australia.* Western Australian Museum, Perth.

APLIN, T.E.H. (n.d.). Poison Plants of Western Australia. *Bulletin 3772.* Western Australian Department of Agriculture.

BEARD, J.S. (ed.) (1970). *A descriptive catalogue of West Australian plants,* 2nd edn. Society for Growing Australian Plants, Perth.

BEARD, J.S. (1981). The history of the Phytogeographic region concept in Australia: *in* Keast, A. ed. *Ecological Biogeography of Australia.* V1. JUNK, THE HAGUE

BOUSFIELD, L.R. and JAMES, S.H. (1976). The Behaviour and Possible Cytoevolutionary Significance of B Chromosomes in Dampiera linearis (Angiospermae: Goodeniaceae) *Chrosoma (Berl.)* 55, 309-323 (1976).

BRUNNER, H. and COMAN, B.J. (1974). *The identification of Mammalian Hair.* Inkata Press, Melbourne.

BUTLER, W.H. (1964). Report of a survey of the vertebrate fauna of Contine Forestry Reserve, South-west of Western Australia. *Unpublished report.* Department of Fisheries and Wildlife, Western Australia.

BURBIDGE, A.A. (1977). The management of Dryandra forest for Wildlife Conservation. *Unpublished Report.* Department of Fisheries and Wildlife, Western Australia.

CALABY, J. (1960). Observations on the banded ant-eater *Myrmecobius F. fasciatus* Waterhouse (Marsupialia), with particular reference to its food habits. *Proceedings of the Zoological Society of London,* 135, 2, 183-207.

CHIPPENDALE, G.M. and WOLF, L. (1981). The natural distribution of *Eucalyptus* in Australia. *Special publication No. 6,* Australian National Parks and Wildlife Service.

CHRISTENSEN, P. (1973). Some ecological aspects of jarrah dieback. *Forest Focus No. 10,* 11-15, Forests Department of Western Australia.

CHRISTENSEN, P. (1978). The introduced European Red Fox *(Vulpes vulpes):* A serious threat to native mammals of the south-west. *Unpublished Report,* Forests Department of Western Australia.

CHRISTENSEN, P. (1980a). A sad day for native fauna. *Forest Focus No. 23,* 3-12. Forests Department of Western Australia.

CHRISTENSEN, P. (1980b). The biology of *Bettongia penicillata* Gray 1837 and *Macropus eugenii* (Desmarest, 1817) in relation to fire. *Bulletin 91,* Forests Department of Western Australia.

CHRISTENSEN, P. (1982). The distribution of *(Lepidogalaxias salamandroides)* and other small fresh-water fishes in the lower south-west of Western Australia. *Journal of the Royal Society of Western Australia;* 65, 4, 131-141.

CHRISTENSEN, P. & LEFTWICH, T. (1980). Observations on the nest-building habits of the brush-tailed rat kangaroo or woylie *(Bettongia penicillata). Journal of the Royal Society of Western Australia,* 63, 2, 33-38.

CHRISTENSEN, P., MAISEY, K. & PERRY, D.H. (1984). Radiotracking the Numbat, *Myrmecobius fasciatus,* in the Perup Forest of Western Australia. *Australian Wildlife Research,* 11, 275-88.

CHRISTENSEN,P., RECHER, H. and HOARE, J. (1981). Responses of open forest to fire regimes. In A.M. Gill, R.H. Groves, and I.R. Noble, *Fire and the Australian Biota.* Australian Academy of Science, Canberra.

CHURCHILL, D.M. & CHRISTENSEN, P. (1970). Observations on pollen harvesting by brush-tongued lorikeets. *Australian Journal of Zoology,* 18, 427-37.

COGGER, H.G. (1975). *Reptiles and Amphibians of Australia.* Rev. ed. 1983. A.H. & A.W. Reed Pty. Ltd., Sydney.

COY, N.J. (1979). *Freshwater fishing in south-west Australia.* Jabiru Books, Perth.

FISHERIES and WILDLIFE, DEPARTMENT OF. (1980). Have poisonous plants helped save some of our native wildlife from extinction? *SWANS* 10, 1, Department of Fisheries and Wildlife, Perth, Western Australia.

GARDNER, C.A. and BENNETTS, H.W. (1956). *The Toxic Plants of Western Australia.* W.A. Newspapers Ltd., Perth.

GEOLOGICAL SURVEY OF W.A. (1975). *Geology of Western Australia: Western Australian Geological Survey, Memoir 2.* Government Print, Perth, Western Australia.

GILES, R. (ed.), (1971). *Wildlife Management Techniques.* 3rd edn. The Wildlife Society, Washington D.C.

GLAUERT, L. (1948). Development of our knowledge of the marsupials of Western Australia. *Journal of the Royal Society of Western Australia,* 34, 115-134.

GLAUERT, L. (1961). *A handbook of the lizards of Western Australia.* Handbook No. 6, W.A. Naturalists Club, Perth.

GLAUERT, L. (1967). *A handbook of the snakes of Western Australia.* Handbook No. 1, W.A. Naturalists Club, Perth.

HALL, L.S. & RICHARDS, G.C. (1979). *Bats of Eastern Australia.* Queensland Museum booklet No. 12.

HILL, M.O. (1973). Reciprocal averaging: an Eingenvector method of ordination. *Journal of Ecology,* 61, 1, 237-49.

HINDMARSH, R. (1976). The effects of prescribed burning in the forests of south-west Western Australia on the invertebrate fauna, and its possible relation to the delayed recovery in the population of *Antechinus Flavipes. W.A.I.T. Student Biology Project No. 302.* 85 pages.

HOPPER, S.D. (1981). A pit-trap survey of small mammals, lizards and frogs on the Two People's Bay Nature Reserve. *Report 43,* Department of Fisheries and Wildlife, W.A.

HOSKINGS, J.S. & BURVILLE, G.H. (1938). A soil survey of part of the Denmark Estate, Western Australia. *Bulletin 115,* Council for Scientific and Industrial Research of Australia.

HUSSEY, B.M.J. (1977). Excursion — Whicher Range-Donnybrook Sunklands. *Western Australian Naturalist,* 13, 8, 211-216.

KABAY, E.D. and START, A.N. (1975/76). Results of the search for the Potoroo in the south-west and South coast of Western Australia. *Unpublished Report,* Department of Fisheries and Wildlife, Western Australia.

KING, D.R., OLIVER, A.J. & R.J. MEAD (1978). The adaptation of some Western Australian mammals to food plants containing fluoroacetate. *Australian Journal of Zoology,* 26, 4, 699-712.

KING, D.R., OLIVER, A.J. & MEAD, R.J. (1981). Bettongia and Fluoroacetate: A role for 1080 in fauna management. *Australian Wildlife Research* 8, 3, 529-36.

KITCHENER, D.J. (1982). Predictors of vertebrate species richness in nature reserves in the Western Australian Wheatbelt. *Australian Wildlife Research,* 9, 1, 1-7.

KITCHENER, D.J., CHAPMAN, A., and BARRON, G. (1978). Mammals of the Northern Swan Coastal Plain. In *Faunal Studies of the Northern Swan Coastal Plain: A consideration of past and future changes,* Western Australian Museum for the Department of Conservation and the Environment, Perth, Western Australia.

KITCHENER, D.J., CHAPMAN, A., DELL, J., MUIR, B.G & PALMER, M. (1980a). Lizard assemblage and reserve size and structure in the Western Australian Wheatbelt — some implications for conservation. *Biological Conservation,* 17, 1, 25-62.

KITCHENER, D.J., CHAPMAN, A., MUIR, B.G. & PALMER, M. (1980b). The conservation value for mammals of reserves in the Western Australian Wheatbelt. *Biological Conservation,* 18, 3, 179-207.

KITCHENER, D.J., DELL, J., MUIR, B.G. & PALMER, M. (1982). Birds in Western Australian Wheatbelt reserves — implications for conservation. *Biological Conservation,* 22, 2, 127-163.

KITCHENER, D.J. & VICKER, E. (1981). *Catalogue of modern mammals in the Western Australian Museum 1895-1981.* Western Australian Museum, Perth.

LITTLEJOHN, M.J. (1981). The Amphibia of Mesic Southern Australia: A Zoogeographic Perspective *in* Keast, A. Ed. *Ecological Biography of Australia.* V2. JUNK, THE HAGUE.

LONG, J.L. (n.d.). Introduced birds and mammals in Western Australia. *Technical Series No. 1* Agriculture Protection Board of Western Australia.

MAIN, A.R. (1963). A new species of *Crinia (Anura; Leptodactylidae),* from national park, Nornalup. *Western Australian Naturalist,* 8, 6, 143-144.

MAIN, A.R. (1965). *Frogs of Southern Western Australia.* Handbook No. 8, Western Australia Naturalists Club, Perth.

MASTERS, K.B. (1979). Feral pigs in the south-west of Western Australia — Final report to the Feral Pig Committee. *Unpublished Report.*

MCARTHUR, W.M. & CLIFTON, A.L. (1975). Forestry and agriculture in relation to soils in the Pemberton area of Western Australia. *Soils and Land Use Series No. 54.* Division of Soils, C.S.I.R.O., Australia.

MCDOWALL, R.M. (1978). A new genus and species of Galaxiid fish from Australia (Salmoniformes: Galaxiidae). *Journal of the Royal Society of New Zealand,* 8, (1), 115-124.

MCDOWALL, R.M. & FRANKENBURG, R.S. (1981). The Galaxiid fishes of Australia. *Records of the Australian Museum,* 33, (10).

MEAD, R.J., OLIVER, A.J. & KING, D.R. (1979). Metabolism and defluorination of Fluoroacetate in the Brush-tailed Possum *(Trichosurus vulpecula), Australian Journal of Biological Sciences,* 32, 1, 15-26.

MEES, G.F. (1977). The status of *Gambusia affinis* (Baird & Girard) in South-Western Australia. *Records of the Western Australian Museum,* 6, 1, 27-31.

MELVILLE, R. (1973). Relict plants in the Australian flora and their conservation. In A.B. Costin and R.H. Groves, *Native Conservation in the Pacific,* 83-90. Australian National University Press, Canberra.

MELVILLE, R. (1975). The distribution of Australian relict plants and its bearing on angiosperm evolution. *Botanical Journal of the Linnean Society,* 71, 67-88.

METEOROLOGY, BUREAU OF (n.d.). *Climatic survey, Region 11 — Great Southern Western Australia, Meteorological Summary.* Bureau of Meteorology, Melbourne.

METEOROLOGY, BUREAU OF (1962). *Climatological survey, Region 12 Albany Western Australia, Meteorological Summary.* Bureau of Meteorology, Melbourne.

METEOROLOGY, BUREAU OF (1965). *Climatic survey, Region 16 — South-west Western Australia, Meteorological Summary.* Bureau of Meteorology, Melbourne.

MORTON, A.J. (N.d.). *Programme RECAV.* Botany Department, Imperial College, London.

NORTHCOTE, K.H. (1971). *A factual key for the recognition of Australian soils.* Rellim Technical Publishers, Adelaide.

OLIVER, A.J., KING, D.R. & MEAD, R.J. (1979). Fluoroacetate Tolerance, a Genetic marker in some Australian Mammals. *Australian Journal of Zoology,* 27, 3, 363-72.

PEACOCK, W.J. (1963). Chromosome numbers and cytoevolution in the Goodeniaceae. Proceedings of the Linnean Society of N.S.W., 88, 8-27.

PERRY, D.H. (1973). Some notes on the Decline and subsequent Recovery of Mammal Populations in the South-West. *Western Australian Naturalist,* 12, 6, 128-130.

PUBLIC WORKS DEPARTMENT (1979). Clearing and stream salinity in the South-West of Western Australia. *Document No. MDS 1/79.* Public Works Department of Western Australia.

PUSEY, B.U.J. (1981). The life history of the Shannon mud minnow *Lepidogalaxias salamandroides (Mees)* with special reference to aestivation. *Honours thesis.* Department of Zoology, University of Western Australia.

RIDE, W.D.L. (1970). *A guide to the native mammals of Australia.* Oxford University Press, Melbourne.

ROYAL AUSTRALIAN ORNITHOLOGISTS UNION (1978). Recommended English names for Australian birds. *EMU Vol. 77,* Supplement May 1978, 245-313.

RYE, B.L. and HOPPER, S.D. (1981). A Guide to the Gazetted Rare Flora of Western Australia. *Report No. 42,* Department of Fisheries and Wildlife, Western Australia.

SAUNDERS, D.A. (1974). Subspeciation in the White-tailed Black Cockatoo, *Calyptorhynchus baudinii.* in Western Australia. *Australian Wildlife Research,* 1, 1, 55-69.

SAUNDERS, D.A. (1977). Red-tailed Black Cockatoo breeding twice a year in the south-west of Western Australia. *Emu,* 77, 3, 107-110.

SAUNDERS, D.A. (1979). Distribution and taxonomy of the White-tailed and Yellow-tailed Black Cockatoos *Calyptorhynchus* spp. *Emu* 79, 4, 215-227.

SAWLE, M. (1979). Habitat components of *Antechnius flavipes* (Waterhouse, 1838) in the karri *(Eucalyptus diversicolor)* forest south-west of Western Australia. *Honours thesis, Department of Environment and Life Sciences,* Murdoch University, Western Australia.

SERVENTY, D.L. (1954). The recent increase in the rarer native mammals. *Western Australian Naturalist,* 4, 6, 128-41.

SERVENTY, D.L. (1979). History of Zoology in Western Australia. *Journal of the Royal Society of Western Australia,* 62, 1-4, 33-43.

SERVENTY, D.L. and WHITTELL, H.M. (1976). *Birds of Western Australia.* 5th edition. University of Western Australia Press, Perth.

SHEA, S.R. (1979). Forest Management and *Phytophthora cinnamomi* in Australia. In Old K.M., *Phytophthora and Forest Management in Australia.* C.S.I.R.O., Canberra.

SHEA, S.R. and KITT, R.J. (1976). The capacity of jarrah forest native legumes to fix nitrogen. *Research Paper No. 21,* Forests Department of Western Australia.

SHORTRIDGE, G.C. (1909). An account of the geographical distribution of marsupials and monotremes of south-west Australia, having special reference to the specimens collected during the Balston Expedition of 1904-1907. *Proceedings of the Zoological Society,* 55, 803-48. (London).

SMITH, F.G. (1972). *Vegetation survey of Western Australia.* Western Australian Department of Agriculture.

SMITH, R. (1951a). Soils of Margaret and Lower Blackwood Rivers, W.A. *Bulletin 262.* C.S.I.R.O., Melbourne.

SMITH, R. (1951b). Pedogenisis in the Frankland River Valley, Western Australia. *Bulletin 165.* C.S.I.R.O., Melbourne.

STRAHAN, R. ED. (1983). *The Australian Museum Complete Book of Australian Mammals.* Angus & Robertson, Sydney.

STORR, G.M. (1967). The genus Sphenomorphus *(Lacertilia, Scincidae)* in Western Australia and the Northern Territory. *Journal of the Royal Society of Western Australia,* 50, 1, 10-20.

STORR, G.M. (1968). Revision of the Egernia-Whitei species group *(Lacertilia, Scincidae). Journal of the Royal Society of Western Australia,* 51, 2, 51-62.

STORR, G.M. (1971). The genus Lerista *(Lacertilia, Scincidae)* in Western Australia. *Journal of the Royal Society of Western Australia,* 54, 3, 59-75.

STORR, G.M. (1972). The genus Morethia *(Lacertilia, Scincidae)* in Western Australia. *Journal of the Royal Society of Western Australia,* 55, 3, 73-79.

STORR, G.M. (1973). The genus Ctenotus *(Lacertilia, Scincidae)* in the South-west and Eucla Division of Western Australia. *Journal of the Royal Society of Western Australia,* 56, 3, 86-93.

STORR, G.M. (1975). The genus Hemiergis *(Lacertilia, Scincidae)* in Western Australia. *Records of the Western Australian Museum* 3, 4, 251-260.

STORR, G.M. (1976a) Revisionary notes on the Lerista *(Lacertilia, Scincidae)* of Western Australia. *Records of the Western Australian Museum,* 4, 3, 241-246.

STORR, G.M. (1976b). The genus Cryptoblepharus *(Lacertilia, Scincidae)* in Western Australia. *Records of the Western Australian Museum,* 4, 1, 53-63.

STORR, G.M. (1976c). The genus Menetia *(Lacertilia, Scincidae)* in Western Australia. *Records of the Western Australian Museum,* 4, 2, 189-200.

STORR, G.M., HAROLD, G. and BARRON, G. (1978). The amphibians and reptiles of the Northern Swan Coastal Plain. *In Faunal Studies of the Northern Swan Coastal Plain: A consideration of past and future changes.* Western Australian Museum for the Department of Conservation and Environment, Perth, Western Australia.

STORR, G.M., SMITH, L.A. and JOHNSTONE, R.E. (1981). *Lizards of Western Australia: No. 1, Skinks.* University of Western Australia Press, Perth.

TIEDEMANN, C.R. and WOODSIDE, D.P. (1978). A collapsible bat-trap and a comparison of results obtained with the trap and with mist-nets. *Australian Wildlife Research,* 5, 3, 355-62.

TYNDALE-BISCOE, C.H. and CALABY, J.H. (1975). Eucalyp forests as refuge for wildlife. *Australian Forestry,* 38, 117-133.

UNDERWOOD, R.J. (1978). Natural fire periodicity in the karri *(Eucalyptus diversicolor* F. Muell.) forest. *Research Paper No. 41,* Forests Department of Western Australia.

VALENTEE, A. and WOOLLEY, P.A. (1982). Hair structure of some Western Australian Mammals. *Journal of the Royal Society of Western Australia,* 64, 4, 101-132.

WESTERN AUSTRALIAN MUSEUM (1978): *Faunal studies of the Northern Swan Coastal Plain: A consideration of past and future changes.* Western Australian Museum, for the Department of Conservation and the Environment, Perth.

WHITE, S.R. (1952). The occurrence of the quokka in the south-west. *Western Australian Naturalist,* 3(5), 101-3.

WOOLLER, R.D., RENFREE, M.B., RUSSELL, E.M., DUNNING, A., GREEN, S.W. and DUNCAN, P. (1981). Seasonal changes in a population of the nectar-feeding marsupial *Tarsipes spencerae (Marsupialia: Tarsipedidae), Journal of Zoology, London,* 195, 267-279.

APPENDIX I

Results from Fauna Surveys 1972-1982

TABLE A.I. (a)

Number of trap nights* for all trap types in each area surveyed

	Number of trap nights per trap type						
Survey Area	*Mixed Traps†*	*Box*	*Elliott*	*Snap Traps*	*Pit*	*Pit with Drift Fence*	*Totals*
Yeagerup		80	208	162	—		450
Woolbales		76	400	400	67		943
Dombakup		—	320	200	—		520
Perup		15	200	200	—		415
Boranup		31	324	328	—		683
Sunklands	638	—	—	—	—		638
Pines	630	252	—	630	—		1512‡
Milyeannup	—	60	—	1032	352		1444
Soho	1696	—	—	—	—		1696
Mitchell Block		—	148	1496	1232		2876
Shannon		88	—	351	354		793
Karri		179	748	2482	3708		7117§
Mitchell River		114	—	489	820	110	1533
Giants		141	40	286	499	51	1017
Frankland		300	—	540	540	102	1482
Total	2964	1336	2338	8596	7572	263	23119

* A trap night is defined as one trap set for one night, thus 30 traps set for one night equals 30 trap nights.

† Mixed traps consist of some or all of the 4 main types. No breakdown available.

‡ Includes 3 separate surveys in this area.

§ Includes several surveys in different areas of karri forest.

TABLE A.I. (b)

Fauna type and capture rate per trap type

	*Fauna type and capture rate (%)**			
Trap Type	*Mammals*	*Reptiles*	*Amphibians*	*Total*
Box	2.10	0.15	nil	2.25
Elliott	7.66	0.42	0.18	8.26
Snap trap†	8.47	2.15	0.07	10.69
Pit trap	0.15	1.04	1.80	2.99
Pit trap with drift fence‡	7.22	12.93	34.98	55.13

* Numbers of animals caught per 100 trap nights

i.e. % capture rate = $\frac{\text{No. animals x 100}}{\text{No. trap nights 1}}$

† Includes breakback and conibear types. Use and proportions of different trap types have varied from survey to survey. See Appendix II, Table A.II. (a).

‡ Pit traps with drift fences were only used on 263 trap nights. All others were used on 1000 + trap nights. See Table A.I. (a).

TABLE A.I. (c)

Time spent on types of survey work

	Survey Method		
Area	*Searching (hours)*	*Spotlighting (hours)*	*Bird Counting (hours)*
Yeagarup	63	8	15
Woolbales	72	4	16
Dombakup	56	8	15
Perup	45	10	10
Boranup	42	16	16
Sunklands	105	35	32
Pines	156	40	40
Milyeannup	47	11	16
Soho	80	16	16
Mitchell Block	96	12	16
Shannon	92	9	16
Karri	49	14	72
Mitchell River	95	9	26
Giants	62	8	16
Frankland	78	8	16
TOTALS	1138	208	338

APPENDIX II

Results from Other Research Studies within the Survey Area, 1970-1982

TABLE A.II. (a)

Number of trap nights* for all trap types in each study

	Trap nights per trap type				
Study and Area	*Box*	*Elliott*	*Snap Traps*	*Pen*	*Other*
Perup Woylie study (1974-1976)	18953			2412	9
Perup Woylie study (1977-1982)	4401			1290	
Bush Rat study (Warren Block)		15900			
Quokka study (Dombakup Block)				538	
Mardo Study (Big Brook)		7055	500		
Phascogale trapping (West Manjimup)	170				
Miscellaneous Trapping	1183	55	60	126	
TOTAL	24707	23010	560	4366	9

* A trap night is defined as one trap set for one night

TABLE A.II. (b)

Number of captures for each fauna type, and the total capture rate for all studies

	No. of Captures per Fauna Type		
Study and Area	*Mammal*	*Reptile*	*Capture Rate** *%*
Perup Woylie study (1974-1976)	2581	2	12.08
Perup Woylie study (1977-1982)	1493	—	26.23
Bush Rat study (Warren Block)	2448	96	16.00
Quokka study (Dombakup Block)	39	—	7.25
Mardo Study (Big Brook)	595	188	10.36
Phascogale trapping (West Manjimup)	—	—	0
Miscellaneous trapping	75	6	11.25
TOTAL	7231	292	14.92

* Number of animals caught per 100 trap nights

i.e. % capture rate = $\frac{\text{No. animals x 100}}{\text{No. trap nights xI}}$

TABLE A.II. (c)

Spotlight survey results from other research studies in the survey area, 1970-1982

	No. of Animals Sighted										
Area	*Hours Spent*	*Brushtail Possum*	*Ringtail Possum*	*Grey Kangaroo*	*Brush Wallaby*	*Woylie*	*Tammar*	*Native Cat*	*Bandicoot*	*Birds*	*Other**
North Perup — Possum Study	32	180	142	60	22	22	—	1	—	8	1
General Surveys†	91	376	354	304	53	112	18	3	4	18	38
TOTALS	123	556	496	364	75	134	18	4	4	26	39

* Includes animals seen but not positively identified, and exotic species.

† Includes school tours, and surveys done for film teams etc.

TABLE A.II. (d)

Results of evening vehicle transects from other research studies in the survey area, 1970-1982

	Number of Animals Sighted						
Area	*Hours Spent*	*Kangaroos*	*Brush Wallaby*	*Emu*	*Brumby*	*Other Native Species**	*Exotic Species*
Poorginup (Lake Muir)	86	924	87	26	10	4	6
Perup	72	1617	474	179		4	
General Forest Survey (1970)	44	270	44	19		1	6
TOTALS	202	2811	605	224	10	9	12

* Numbat, woylie, tammar, brushtail possum.

TABLE A.II. (e)

Time spent on bird counts in the survey area, 1971-1982

	Year and Hours Spent												
Area	*1971*	*1972*	*1973*	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*Total*
1. Warren Block (karri forest)	23	15	38	23									99
2. Crowea (karri forest)						9	—	5	8	8	16		46
3. Iffley Block (jarrah forest)						32	32	32	32	32	32	18	210
4. Perup (jarrah forest)									30	30	30		90
5. West Manjimup Nursery (jarrah forest)			12										12
TOTAL	23	15	50	23	—	41	32	37	70	70	78	18	457

APPENDIX III

Plant Species Collected in the Survey Area Since 1968

Plants listed include all those collected on surveys, together with species collected in the area during the course of other work. All species have been identified by the W.A. Herbarium.

Plants are listed under families following the system used in Blackall and Grieve (1954). Species names are as identified by the W.A. Herbarium at the time of collection. For each species we indicate the vegetation types in which it has been found. For plants collected on surveys we indicate the surveys on which they were collected. This information is given in the form of a numerical and letter code as indicated below.

Coding used for plant species occurrence:

LEGEND

Surveys

a. Yeagarup
b. Woolbales
c. Dombakup
d. Perup
e. Boranup
f. Sunklands
g. Pines
h. Milyeannup
i. Soho
j. Mitchell
k. Shannon
l. Karri
m. Mitchell River
n. Giants
o. Frankland

Vegetation Types

1. High Open Forest
2. Open Forest
3. Woodland
4. Low Woodland
5. Closed Scrub
6. Open Scrub
7. Sedgelands
8. Granite
9. Waterways and Wetlands
10. Pines

Plant Family and Species	Surveys	Vegetation Types
POLYPODIACEAE		
Adiantum aethiopicum L.	gijlo	129
Asplenium adiantoides Lam.	l	12
Asplenium flabellifolium Cav.	i	12
Cheilanthes tenuifolia Swartz.	dghijklo	12348
Lindsaya linearis Swartz.	dfghijklmno	123
Pteridium esculentum Nakai.	abcdefghijklmno	1234 10
Lastreopsis sp.	l	129
SCHIZAEACEAE		
Schizaea fistulosa	—	7
LYCOPODIACEAE		
Lycopodium serpentinum	—	7
IOSETACEAE		
Isoetes sp.	l	18
CYCADACEAE		
Macrozamia riedlei C.A.Gardn.	abcdefghijklmno	234
PODOCARPACEAE		
Podocarpus drouyniana F.Muell.	defghijklmno	1234
CUPRESSACEAE		
Actinostrobus pyramidalis Miq.	—	46
TYPHACEAE		
Typha angustifolia Linn.	ghil	9
NAIADACEAE		
Naias marina Linn.	—	9
SCHEUCHZERIACEAE		
Triglochin procera R.Br.	egijklmn	9
GRAMINAE		
Alopercurus geniculatus	e	—
Amphipogon amphipogonoides (Steud) VicKery	e	12
Amphipogon sp.	mo	2
Danthonia caespitosa	lm	12
Danthonia pilosa R.Br.	d	2
Danthonia semiannularis	ij	3

Plant Family and Species	Surveys	Vegetation Types
Danthonia setacea R.Br.	—	23
Echinopogon ovatus	f	12
Microlaena stipoides	l	—
Neurachne alopecuroides	d	23
Poa caespitosa	h	3
Poa maxwelli	l	1
Poa nodosa	l	—
Poa poaeformis	l	1
Stipa parbata	l	1
Stipa campylachne	g	2
Stipa compressa	—	6
Stipa scabra Lindl.	—	3
Stipa semibarbata	e	2
Tetrarrhaena laevis	gl	12
Vulpia bromoides	d	2
CYPERACEAE		
Cladium articulatum	k	49
Cyathochaete azvenacea	kdijklmno	2347
Evandra aristata R.Br.	ijkmo	47
Evandra pauciflora	i	3
Gahnia preisssii Nees.	f	—
Gahnia trifida Labill.	dkjklmno	1247
Juncellus laevigatus (Rottb) C.B. Clarke	f	2
Lepidosperma angustatum R.Br.	dfgijlno	1253
Lepidosperma brunoniquum Nees.	dij	23
Lepidosperma effusum Benth.	gijklmno	1792
Lepidosperma gracile	l	1
Lepidosperma leptostachyum Benth.	gijl	123 10
Lepidosperma longitudindale	dm	2457
Lepidosperma tenue	l	12
Lepidosperma tetraquetrum	fghijkilmno	12679
Mesomelaena uncinata	dijkm	5
Mesomelaena tetragona R.Br. F. Muell.	dfiljkmo	23467
Reedia spathaceae F.Muell.	jk	579
Schoenus grandiflorus	gl	—
Schoenus sp.	f	2
Scirpus sp.	—	2
Tetrariopsis octandra	fl	—
Tricostularia neesii Lehm.	—	8
RESTIONACEAE		
Anarthria gracilis R.Br.	—	567
Anarthria laevis R.Br.	—	3
Anarthria prolifera R.Br.	fij	4
Anarthria scabra R.Br.	fijlmo	467
Ecdeiocolea monostachya F.Muell.	l	—
Hypolaena exsulca R.Br.	f	6
Leptocarpus canus Nees.	ij	67
Leptocarpus scariosus R.Br.	fl	12
Leptocarpus tenax (Labill.) R.Br.	f	2
Leptocarpus sp.	—	—
Loxocarya fasciculata (R.Br.) Benth.	dlo	2
Loxocarya flexuosa (R.Br.) Benth.	fklmo	2367
Lyginia tenax (Labill.) C.A.Gardn.	f	6
Restio leptocarpoides Benth.	—	3
Restio sp.	i	247
Restio tremulus	m	6
XYRIDAECAE		
Xyris gracillima F.Muell.	l	679
Xyris sp.	fijk	679
Xyris lanata R.Br.	—	79
PHILYDRADEAE		
Pritzelia pygmara (R.Br.) F.Muell.	df	34

Plant Family and Species	Surveys	Vegetation Types
JUNCACEAE		
Juncus caespititius E.Mey.	l	19
Juncus capitatus	l	—
Juncus holoschoenus R.Br.	l	19
Juncus pallidus R.Br.	dgijlm	—
LILIACEAE		
Agrostocrinum scabrum (R.Br.) Bail.	djm	238
Borya nitida Labill.	dijlo	48
Burchardia multiflora Lindl.	fhl	123
Burchardia sp.	dg	2
Caesia parviflora R.Br.	fl	2
Calectasia cyanea R.Br.	d	23
Chamaescilla corymbosa (R.Br.) F.Muell.	d	2
Johnsonia lupulina R.Br.	dhijklmno	23467
Lasemannia minor	l	—
Stypandra impricata R.Br.	dgijklmn	123
Sowerbaea laxiflora Lindl.	dgijn	23
Dianella revolutos R.Br.	d	23
Thysanotus dichotomus R.Br.	l	12
Thysanotus isantherus R.Br.	l	—
Thysanotus myltiflorus R.Br.	l	—
Thysanotus patersoni R.Br.	l	12
Thysanotus pauciflorus R.Br.	l	—
Thysanotus thyrsoides Baker.	fg	2
Thysanotus triandrus R.Br.	l	—
Thysanotus tuberosus	d	3
Tricoryne humilis Endl.	d	2
XANTHORRHOEACEAE		
Dasypogon bromeliaefolius R.Br.	dfijklmo	2347
Dasypogon hookeri Drummond.	fh	234
Kingia australis R.Br.	fhijklmn	23467
Lomandra endlicheri F.Muell.	dijl	1234
Lomandra odora (F.Muell.) Ewart.	k	7
Lomandra ordii (F.Muell.) Ewart.	—	—
Lomandra sp.	dfhijk	234
Lomandra sonderi Baker.	—	3
Xanthorrhoea gracilis Endl.	dfhijklmo	23467
Xanthorrhoea preissii Endl.	defghijklmno	23467
HAEMODORACEAE		
Anigozanthos bicolor Endl.	dij	23479
Anigozanthos flavida Red & D.C.	defghijklmno	1234679
Anigozanthos manglesii D.Don.	dfh	2346
Anigozanthos preissii Endl.	i	234
Conostylis aculeata R.Br.	j	23467
Conostylis cynosa	—	2
Conostylis serrulata R.Br.	—	3
Conostylis setosa Lindl.	hij	23467
Conostylis setigera R.Br.	dfhijl	23467
Conostylis sp.	gk	9
Haemodorum sparsiflorum F.Muell.	—	8
Haemodorum spicatum R.Br.	im	23
Hypoxis glabella R.Br.	l	—
Hypoxis occidentalis Benth.	d	2
Phlebocarya ciliata R.Br.	f	23
Tribonanthes australis Endl.	d	23
Tribonanthes uniflora Lindl.	fgl	23
XRIDACEAE		
Orthrosanthus laxus Endl.	fgl	1239
Orthrosanthus multiflorus Sweet.	l	123
Orthrosanthus polystachyus Benth.	l	123
Patersonia occidentalis R.Br.	dfl	123
Patersonia drummondii (F.Muell.) Benth.	l	1
Patersonia juncea Endl.	—	2

Plant Family and Species	Surveys	Vegetation Types
Patersonia pygmaea Lindl.	d	3
Patersonia umbrosa Endl.	fl	23
Patersonia xanthina F.Muell.	fghjl	234
ORCHIDACEAE		
Acianthus reniformis (R.Br.) Schlechter	dl	123
Acianthus reniformis var. huegelii (Endl. A.S. George)	d	23
Caladenia aphylla Benth.	ijklmo	23
Caladenia barbarossae Reichb.	d	2
Caladenia cairnsiana F.Muell.	—	2
Caladenia coryhrephora A.S.George	jl	1
Caladenia deformis R.Br.	dfl	123
Caladenia dilatata R.Br.	l	23
Caladenia dilatata var. falcata W.Nicholls	f	23
Caladenia discoidea Lindl.	f	23
Caladenia filamentosa R.Br.	f	23
Caladenia flava R.Br.	dfhjlo	23
Caladenia gemmata Lindl.	dfhij	23
Caladenia hirta Lindl.	l	123
Caladenia huegelii Klotsch.	df	23
Caladenia latifolia R.Br.	dfijl	23
Caladenia longiclavata Coleman.	ijk	23
Caladenia macrostylis R.Fitzg.	dg	239
Caladenia maryinata Lindl.	—	2
Caladenia menziesii R.Br.	dl	23
Caladenia nana Endl.	f	23
Caladenia patersonii R.Br.	dfhl	23
Caladenia sericea Lindl.	l	123
Caleana nigrita Lindl.	dl	23
Calochilus roberstonii Benth.	l	6
Cryptostylis ovata R.Br.	ijlo	128
Diuris laxiflora Lindl.	dj	23
Diuris longifolia R.Br.	l	—
Diuris purdiei Diels.	f	23
Diuris emarginata R.Br.	d	23
Drakea elastica Lindl.	—	234
Drakea glyptodon Fitz.	d	234
Corybas dilatatus Rhipp. et Nicholls.	dijl	123
Elythranthera brunnonis (Endl.) A.S.George	dfj	23
Elythranthera emarginata (Lindl.) A.S.George	df	23
Eriochilus dilatatus Lindl.	dkl	123
Eriochilus scaber Lindl.	l	—
Gastrodia sesamoides R.Br.	l	128
Lyperanthus serratus Lindl.	df	23
Lyperanthus nigricans R.Br.	df	23
Microtis alba R.Br.	dl	23
Microtis unifolia (Forst.) Reichb.	l	—
Microtis sp.	hi	—
Prasophyllum australe R.Br.	l	12
Prasophyllum brownii Reichb.	l	—
Prasophyllum fimbria Reichb.	dl	—
Prasophyllum gibbosum R.Br.	l	4
Prasophyllum parviflorum Lindl.	d	4
Prasophyllum regium R.S.Rogers.	l	12
Pterostylis barbata Lindl.	l	12
Pterostylis nana R.Br.	dfhijln	23
Pterostylis recurva Benth.	dfhij	23
Pterostylis vittata Lindl.	flo	123
Thelymitra antennifera (Lindl.) Hook.	f	23
Thelymitra aristata Lindl.	—	23
Thelymitra campunalata Lindl.	—	23
Thelymitra crinita Lindl.	dfl	23
Thelymitra flexuosa Endl.	l	12
Thelymitra fuscolutea R.Br.	d	23
Thelymitra nuda R.Br.	l	12
Thelymitra pauciflora R.Br.	d	23
Thelymitra villosa Lindl.	d	23

Plant Family and Species	Surveys	Vegetation Types
CASUARINACEAE		
Casuarina decussata Benth.	ijklmno	123
Casuarina drummondiana Miq.	f	—
Casuarina fraseriana Miq.	fhijkm	23
Casuarina humilus Ptto. et Dietr.	dfmo	234
Casuarina hugelii	d	4
Casuarina thuyoids Miq.	—	2
PROTEACEAE		
Adenanthos barbigera Lindl.	fh	2346
Adenanthos cuneata Labill.	jm	346
Adenanthos detmoldii F.Muell.	—	7
Adenanthos meissneri Lehm.	fh	346
Adenanthos obovata Labill.	dfhijklmno	23467
Banksia attenuata R.Br.	efhijkm	4
Banksia grandis Willd.	defghijkilmno	2346
Banksia ilicifolia R.Br.	fhijkmno	2347
Banksia littoralis R.Br.	abdefghijklmno	124679
Banksia meissneri Lehm.	—	3
Banksia occidentalis R.Br.	m	6
Banksia prostrata R.Br.	m	34
Banksia quercifolia R.Br.	fijkmo	34567
Banksia sphaerocarpa R.Br.	dfhmo	2347
Banksia verticillata R.Br.	b	4
Conospermum caeruleum R.Br.	dfhij	23
Conospermum capitatum R.Br.	f	6
Conospermum acerosum Lindl.	f	—
Conospermum flexuosum R.Br.	df	234
Conospermum teretifolium R.Br.	f	—
Dryandra armata R.Br.	dj	23
Dryandra bipinnatafida R.Br.	df	23
Dryandra carduacea Lindl.	fhm	23
Dryandra formosa R.Br.	fijmo	12347
Dryandra nivea R.Br.	dfgijkmo	23
Dryandra serra R.Br.	o	2
Dryandra sessilis (R.Br.) Druce.	def	236
Dryandra stupposa Lindl.	f	23
Dryandra subpinnatifida	d	23
Franklandia fucifolia R.Br.	fmo	2347
Franklandia triarista Benth.	f	34
Grevillea bipinnatifida R.Br.	g	2
Grevillea brachystylis Meissn.	f	23
Grevillea brevicuspis Meissn.	flo	23
Grevillea brownii Meissn.	m	2
Grevillea drummondii Meissn.	l	12
Grevillea fistulosa A.S.George	m	347
Grevillea leptobotrya	f	—
Grevillea manglesioides Meissn.	fh	23
Grevillea occidentalis R.Br.	fjm	23
Grevillea ornithopida Meissn.	f	—
Grevillea pilulifera (Lindl.) C.A.Gardn.	d	4
Grevillea pulchella Meissnj.	dfl	23
Grevillea quercifolia R.Br.	dfjlo	123
Grevillea trifida (R.Br.) Meissn.	h	23
Grevillea umbellulata Meissn.	f	—
Hakea amplexicaulis R.Br.	dfghijklmno	1234
Hakea ambigua Meissn.	fhj	234
Hakea ceratophylla (Sm.) R.Br.	fhijmno	23467
Hakea cyclocarpa Lindl.	fh	23
Hakea florida R.Br.	ijo	23467
Hakea incrassata R.Br.	d	23
Hakea lasiantha R.Br.	fijklno	123
Hakea linearis R.Br.	fhijk	234
Hakea lissocarpa R.Br.	dfghijmo	2346
Hakea marginata R.Br.	f	—
Hakea oleifolia (Sm.) R.Br.	dlmo	123

Plant Family and Species	Surveys	Vegetation Types
Hakea prostrata R.Br.	dem	234
Hakea ruscifolia Labill.	defhijmno	23467
Hakea sulcata R.Br.	d	3
Hakea trifurcata (Sm.) R.Br.	d	23
Hakea undulata R.Br.	dmo	234
Hakea varia R.Br.	dfijmo	23
Isopogon attenuatus R.Br.	dfh	23
Isopogon axillaris R.Br.	fk	67
Isopogon formosus R.Br.	fijo	23
Isopogon sphaerocephalus Lindl.	fj	23
Isopogon teretifolius R.Br.	d	23
Lambertia multiflora Lindl.	f	34
Lambertia rariflora Meissn.	f	34
Persoonia elliptica R.Br.	fhijmo	23
Persoonia longifolia R.Br.	dfghijklmno	123
Persoonia microcarpa R.Br.	ijkm	56
Persoonia saccata R.Br.	f	—
Petrophile diversifolia R.Br.	fhijklmno	12347
Petrophile longifolia R.Br.	dijm	67
Petrophile linearis R.Br.	f	—
Petrophile serruriae R.Br.	df	23
Petrophile squamata R.Br.	f	—
Petrophile striata R.Br.	f	—
Strangea stenocarpoides (F.Muell. ex Benth. C.A.Gardn.)	fgh	23
Synaphea favosa R.Br.	dfg	234
Synaphea petiolaris R.Br.	dfh	234
Synaphea polymorpha R.Br.	m	23
Synaphea preissii Meissn.	df	—
Synaphea reticulata (Sm.) C.A.Gardn.	dfh	—
Synaphea sp.	fmo	—
Stirlingia latifolias (R.Br.) Stead.	f	346
Stirlingia simplex Lindl.	dfh	234
Stirlingia teretifolia	f	—
Xylomelum occidentale R.Br.	fhl	234
SANTALACEAE		
Choretrum laterifolium R.Br.	l	12
Exocarpos sparteus R.Br.	l	12
Leptomeria cunninghamii Miq.	dfijlmo	123
Leptomeria spinosa (Lehm.) D.C.	—	3
Leptomeria squarrulosa R.Br.	—	23
Santalum spicatum (R.Br.) D.C.	dm	23
LORANTHACEAE		
Loranthus miquelii Lehm.	—	2
Nuytsia floribunda (Labill.) R.Br.	fhijkmno	3467
OLACACEAE		
Olax benthamii Miq.	d	—
Olax phyllanthi (Labill.) R.Br.	lkmo	—
POLYGONACEAE		
Rhagodia radiata Nees.	—	6
AMARANTACEAE		
Trichinum manglesii Lindl.	d	234
PHYTOLACCACEAE		
Gyrostemon sheathii W.V.Fitz.	—	6
AIZOACEAE		
Carpobrotus aequilateralis (Haw.) N.E.Br.	id	28
PORTULACACEAE		
Calandrinia calyptrata Hook	i	2

Plant Family and Species	Surveys	Vegetation Types
RANUNCULACEAE		
Clematis pubescens Hueg.	dfghijl	123
Ranunculus colonorum Sm.	dgl	12359
Ranunculus muricatus L.	f	2
LAURACEAE		
Cassytha racemosa Nees.	l	—
CRUCIFERAE		
Cardamine hirsuta L.	l	—
DROSERACEAE		
Drosera bulbosa Hook.	di	67
Drosera gigantea Lindl.	dfl	36
Drosera huegelii Endl.	—	2
Drosera leucoblasta	l	12
Drosera macrantha Lindl.	i	67
Drosera menziesii R.Br.	i	67
Drosera modesta Diels.	—	23
Drosera pallida Lindl.	ijl	67
Drosera platypoda Trucz.	—	3
Drosera platystigma	d	3
Drosera stolonifera Endl.	d	5
Drosera sulphurea Lehm.	d	6
Drosera sp.	fgh	—
CEPHALOTACEAE		
Cephalotus follicularis Labill.	ijkl	567
ROSACEAE		
Acaena ovina A.Cunn.	l	12
PITTOSPORACEAE		
Billardiera candidus Hueg.	ef	23
Billardiera coerulea-punctatus Klotzsch.	l	1
Billardiera drummondiana (Putterl.) Benth.	l	12
Billardiera floribunda (Putterl.) Muell.	dfl	123
Billardiera latifolia (Turza.) Druce.	i	23
Billardiera parviflora D.C.	ld	2
Billardiera variifolia Trucz.	dfl	123
Billardiera sp.	fgm	2
Sollya fusiformis (Labill.) Briq.	dgl	2
MIMOSACEAE		
Acacia alata R.Br.	efghl	12 10
Acacia browniana	fghijklmno	123
Acacia cochlearis Labill.	—	5
Acacia chrysocephala	d	3
Acacia decipiens R.Br.	ef	45
Acacia dentifera Benth.	g	23
Acacia divergens Benth.	fhijlmno	125
Acacia drummondii Lindl.	dfhm	23
Acacia cyclopis A.Cunn.	—	6
Acacia extensa Lindl.	dfhijlmno	23
Acacia gilbertii Meissn.	fjl	23
Acacia hastulata Smith.	il	123
Acacia horridula Meissn.	—	67
Acacia incurva Benth.	d	23
Acacia insoliata E. Pritzel.	d	23
Acacia latipes Benth.	d	23
Acacia microbotrya Benth.	d	23
Acacia pilosa Benth.	m	3
Acacia mooreana W.V.Fitzg.	f	3
Acacia myrtifolia Wild.	abcdefhijklmno	1236
Acacia nervosa D.C.	dfh	23
Acacia obovata Benth.	f	—
Acacia pentadenia Lindl.	dijklmn	12
Acacia preissiana (Meissn.) B.R. Maslin	f	—

Plant Family and Species	Surveys	Vegetation Types
Acacia pulchella R.Br.	defghijklmno	123468 10
Acacia saligna Wendl.	dg	2356
Acacia scalpelliformis Meissn.	jl	12
Acacia stenoptera Benth.	dj	23
Acacia sulcata R.Br.	j	23
Acacia triptycha (F.Muell.) Benth.	ijm	23
Acacia urophylla Benth.	dfghijkln	123
Acacia wildenowniana	dfh	23
Albizzia lopantha (Vent.) McBoide.	ijklmn	1289
CAESALPINIACEAE		
Labichea punctata Benth.	dfh	23
PAPILIONACEAE		
Aotus ericocoides	h	23
Aotus genistoides Turcz.	—	4
Aotus passerinoides Meissn.	l	5
Aotus tietkensii F.Muell.	l	4
Aotus villosa Sm.	f	23
Bossiaea aquifolia Benth.	g	2
Bossiaea disticha Lindl.	ei	46
Bossiaea eriocarpa Benth.	d	3
Bossiaea laidlawiana Tovey & Morris.	ijkln	123
Bossiaea linophylla R.Br.	defghijklmno	123
Bossiaea ornata (Lindl.) Benth.	dfghijklmno	234
Bossiaea pulchella Meissn.	f	—
Bossiaea rufa R.Br.	c	23
Bossiaea webbii F.Muell.	ij	12
Brachysema praemorsum Meissn.	dfm	23
Brachysema sericeum (Sm.) Domin.	do	23
Burtonia conferta D.C.	f	3
Burtonia scabra R.Br.	fh	2
Burtonia villosa Meissn.	fij	23
Chorizema aciculare (D.C.) C.A.Gardn.	d	23
Chorizema cordatum Lindl.	j	—
Chorizema diversifolium D.C.	fijln	12
Chorizema clycinifolium (Sm.) Druce.	fd	23
Chorizema ilicifolium Labill.	ijln	12
Chorizema rhombeum R.Br.	dijl	23
Daviesia alternifolia Endl.	fm	23
Daviesia brevifolia Lindl.	—	3
Daviesia cordata S. Moore.	dfghijlno	23
Daviesia divaricata Benth.	fijl	23
Daviesia horrida Meissn.	ijo	238
Daviesia incrassata Sm.	dfijo	23
Daviesia pectinata Lindl.	fij	234
Daviesia polyphylla Benth.	f	23
Daviesia preissii Meissn.	df	23
Daviesia quadrilatera Benth.	f	23
Daviesia rhombifolia Meissn.	d	3
Dillwynia cinerascens R.Br.	f	23
Dillwynia uncinata (Turcz.) C.A.Gardn.	fi	34
Euchilopsis Linearis	—	3
Eutaxia densifolia Turcz.	ij	234
Eutaxia epacridioides Meissn.	fh	234
Eutaxia obovata (Labill.) C.A.Gardn.	fijl	23
Eutaxia virgata Benth.	i	234
Gastrolobium bennettsianum C.A.Gardn.	—	67
Gastrolobium bilobum R.Br.	dflmo	1235
Gastrolobium brownii Meissn.	m	3
Gastrolobium forrestii Ewart.	jm	23
Gastrolobium ovalifolium Henfr.	d	3
Gastrolobium spinosum Benth.	dfg	23
Gastrolobium villosum Benth.	d	23
Gompholobium amplexicaule Meissn.	—	46
Gompholobium aristatum Benth.	f	34
Gompholobium burtonioides Meissn.q	df	46

Plant Family and Species	Surveys	Vegetation Types
Gompholobium capitatum A.Cunn.q	f	23
Gompholobium knightianum Lindl.	df	23
Gompholobium marginatum R.Br.	d	23
Gompholobium ovatum Meissn.	dfijl	23
Gompholobium polymorphum R.Br.	fl	12
Gompholobium tomentosum Labill.	f	23
Gompholobium venustum R.Br.	fm	23
Goodia latifolia Salisb.	d	23
Hardenbergia comptoniana Benth.	defl	123
Hovea chorizemifolia (Sweet) D.C.	dfhjkmlo	123
Hovea elliptica (Smith) D.C.	dfghijklno	123
Hovea trisperma Benth.	dfhl	23
Isotropis cuneifolia (Sm.) Domin.	dfhijl	23
Jacksonia alata Benth.	d	3
Jacksonia furcellata (Bonpl.) D.C.	dijk	23
Jacksonia horrida D.C.	f	6
Jacksonia sp.	gmo	23
Kennedya carinata (Benth.) Domin.	l	123
Kennedya coccinea Vent.	dfghl	123
Kennedya prostrata R.Br.	dl	123
Kennedya stirlingii Lindl.	f	23
Latrobea diosmifolia Benth.	—	4
Latrobea genistoides Meissn.	—	46
Latrobea tenella Meissn.	—	46
Mirbelia dilatata R.Br.	fghijkl	123
Mirbelia scabra R.Br.	dj	—
Oxylobium capitatum	fl	234
Oxylobium lanceolatum	abcfghklo	1258
Oxylobium linearfolium (Don.) Domin.	dl	238
Oxylobium spathulatum	fl	12
Phyllota barbata Benth.	—	5
Pultenaea andrewsi	f	—
Pultenaea barbata C.R.Andrews	i	67
Pultenaea drummondii Meissn.	f	23
Pultenaea ericifolia Benth.	d	3
Pultenaea ochreata Meissn.	d	3
Pultenaea reticulata (Sm.) Benth.)	abcfhijklm	345
Pultenaea skinneri F.Muell.	f	23
Pultenaea strobilifera Meissn.	f	23
Sphaerolobium alatum Benth.	i	23
Sphaerolobium medium R.Br.	dfijlo	23
Sphaerolobium macranthum Meissn.	fl	123
Sphaerolobium grandiflorum (R.Br.) Ber.	l	23
Sphaerolobium racemulosum Benth.	g	—
Sphaerolobium scabriusculum Meissn.	f	23
Sphaerolobium vimineum Smith.	fl	123
Sphaerolobium sp.	dfghij	23
Templetonia retusa (Vent.) R.Br.	e	12
Viminaria juncea Sm.	defhijklm	6
OXALIDACEAE		
Oxalis corniculata L.	dgl	12 10
GERANIACEAE		
Erodium cygnorum (Nees.) Carol.	g	10
Geranium retrorsum L.Hex. ex. D.C.	fijk	—
Geranium solandri Carol.	d	3
Pelargonium australe Willd.	dfl	123
Pelargonium havlasae Domin.	l	123
Pelargonium inodorum Willd.	—	2
Pelargonium littorale Hueg.	—	2
Pelargonium rodneyanum Lindl.	l	123
RUTACEAE		
Boronia alata Sm.	el	6
Boronia crenulata Sm.	defhijl	36
Boronia defoliata F.Muell	f	23

Plant Family and Species	Surveys	Vegetation Types
Boronia denticulata Sm.	ijl	12
Boronia languinosa Endl.	klo	67
Boronia fastigata Benth.	fhl	123
Boronia gracilipes F.Muell.	fhijkln	12
Boronia heterophylla F.Muell.	f	5
Boronia juncea Bartl.	fijk	6
Boronia megastigma Nees.	flm	23
Boronia molloyae Drumm.	fijl	12
Boronia nematophylla F.Muell.	dij	4
Boronia spathulata Lindl.	dfijlo	234
Boronia stricta Benth.	—	6
Boronia ternata Endl.	fij	—
Chorilaena quercifolia Endl.	ekl	12
Crowea angustifolia Turcz.	f	2
Crowea dentata (R.Br.) Benth.	ijklo	12
Diplolaena dampieri Desf.	e	5
Diplolaena microcephala	l	12
Eriostemon nodiflorus Lindl.	df	34
Eriostemon spicatus A.Rich.	f	34
Phebalium argenteum Sm.	l	12
Urocarpus pallidus (Benth.) P.G.Wilson	fh	2
Urocarpus squamuligera (Hook.) P.G.Wilson	f	23
TREMANDRACEAE		
Platytheca verticillata (Hueg.) Baill.	dfhlmo	23
Tetratheca affinis Endl.	dglo	23 10
Tetratheca setigera Endl.	fhijlo	23
Tetratheca viminea Lindl.	f	23
Tremandra diffusa R.Br.	gl	123
Tremandra stelligera R.Br.	gijklmo	123
POLYGALACEAE		
Comesperma calymega Labill.	l	12
Comesperma confertum Labill.	dfml	2
Comesperma flavum D.C.	fgij	6
Comesperma scoparium Steetz.	f	—
Comesperma virgatum Labill.	fl	12
Comesperma volubile Labill.	dfijl	12
EUPHORBIACEAE		
Beyeria sp.	d	34
Phyllanthus calycinus Labill.	dfgl	23
Poranthera huegelii Klotzsch.	dfhijl	23
Pseudoanthus virgatus (Klotzsch.) Muell.-Arg.	—	3
Ricinocarpus cyanescens Muell.-Arg.	f	23
Ricinocarpus glaucus Endl.	dfhjl	123
Ricinocarpus tuberculatus Muell.-Arg.	f	23
Monotaxis lurida (Muell.-Arg.) Benth.	—	l
LINACEAE		
Linum marginale A.Cunn. ex Planch.	d	2
RHAMNACEAE		
Cryptandra pungens Steud.	d	34
Spyridium globulosum (Labill.) Benth.	e	5
Trymalium ledifolium Fenzl.	dfhijmo	234
Trymalium spathulatum (Labill.) Ostf.	defghijklmno	12
MALVACEAE		
Sida hookeriana Miq.	l	12
STACKHOUSIACEAE		
Stackhousia brunonis Benth.	dfh	23
Stackhousia huegelii Endl.	dfgl	123
SAPINDACEAE		
Dodonea attenuata A. Cunn.	gijkmo	9
Dodonea aptera Miq.	l	23
Dodonea ceratocarpa Endl.	dlk	3

Plant Family and Species	Surveys	Vegetation Types
STERCULIACEAE		
Lasiopetalum cordifolium Endl.	—	23
Lasiopetalum floribundum Benth.	ijkl	12
Ruelingia corylifolia Grah.	ijklm	12
Ruelingia cygnorum (Steud.) C.A.Gardn.	kl	128
Sterculia undescribed sp.	i	23
Thomasia foliosa J. Gay.	d	2
Thomasia grandiflora Lindl.	fd	23
Thomasia laxiflora Benth.	f	23
Thomasia pauciflora Lindl.	ijkl	23
Thomasia purpurea (Ait.) J. Gay.	d	23
Thomasia quercifolia (Andr.) J.Gay.	ijkln	123
Thomasia triloba Turcz.	lm	123
Thomasia triphylla (Labill.) J.Gay.	l	23
Thomasia sp.	hk	123
DILLENIACEAE		
Hibbertia amplexicaulis Steud.	dfghlmo	123 10
Hibbertia aurea Steud.	f	23
Hibbertia commutata Steud.	ij	123
Hibbertia cuneiformis Labill.	abcdel	123
Hibbertia cunninghamii Benth.	il	123
Hibbertia furfuracea (R.Br.) Benth.	l	12
Hibbertia glaberrima (Steud.) Gilg.	fo	23
Hibbertia glomerata	fo	23
Hibbertia grossulariaefolia	el	12
Hibbertia huegelii (Endl.) F.Muell.	f	23
Hibbertia hypericoides (D.C.) Benth.	fg	23
Hibbertia inconspicua Ostf.	lo	12
Hibbertia lasiopus Benth.	f	23
Hibbertia pachyrrhiza Steud.	fh	23
Hibbertia perfoliata Endl.	fl	39
Hibbertia pulchra Ostf.	d	23
Hibbertia quadricolor Domin.	dfh	234
Hibbertia racemosa (Endl.) Gilg.	f	23
Hibbertia rhadinopoda F.Muell.	df	23
Hibbertia serrata Hotchk.	l	12
Hibbertia stellaris Endl.	dfij	467
Hibbertia sylvestris Diels.	l	1
Hibbertia tetrandra Lindl. Gilg.	l	12
Hibbertia vaginata (Benth.) F.Muell.	f	23
VIOLACEAE		
Hybanthus calycinus (Steud.) F.Muell.	l	12
Hybanthus debilissimus F.Muell.	fjl	123
Hybanthus floribundus (Walp.) F.Muell.	df	23
THYMELAEACEAE		
Pimelea angustifolia R.Br.	fl	123
Pimelea clavata Labill.	gjkl	12 10
Pimelea ferruginea Labill.	e	6
Pimelea imbricata R.Br.	ijl	34
Pimelea longifolia R.Br.	fhl	234
Pimelea lehmanniana Meissn.	l	—
Pimelea microcephala R.Br.	—	6
Pimelea nervosa (Walp.) Meissn.	d	23
Pimelea rosea R.Br.	dfhl	123
Pimelea spectabilis (Fisch. & Mey.)	fgl	23
Pimelea suaveolens (Endl.) Meissn.	dfhl	123
Pimelea sylvestris R.Br.	de	34
Pimelea sp.	m	—
MYRTACEAE		
Actinodium cunninghamii Schau.	djo	679
Agonis ciliatum	lm	12
Agonis flexuosa (Spreng.) Schau.	abcefghijkln	129
Agonis hypericifolia Schau.	kl	4579

Plant Family and Species	Surveys	Vegetation Types
Agonis juniperina Schau.	abcfhijkln	129
Agonis linearifolia (D.C.) Schau.	abcdfghijklmno	129
Agonis marginata (Labill.) Schau.	m	129
Agonis parviceps Schau.	abcdfghijklmno	2346
Agonis undulata Benth.	im	2
Astartea fascicularis (Labill.) D.C.	dfkm	346
Baeckea camphorosmae Endl.	fg	23
Beaufortia andisandra Schau.	m	34
Beaufortia decussata R.Br.	ijm	34
Beaufortia micrantha Schau.	—	3
Beaufortia sparsa R.Br.	bfhijkmno	3467
Beaufortia squarrosa Schau.	f	346
Callistemon speciosus (Sims.) D.C.	bfhijkmno	3479
Calothamus gracilis R.Br.	f	—
Calothamus lateralis Lindl.	djk	367
Calothamus sanguineus Labill.	df	23
Calothamus sp.	mo	67
Calythrix sp.	—	2
Calythrix asperula Schau.	m	3
Calythrix brachyphylla Turcz.	df	23
Calythrix flavescens A.Cunn.	dfm	23
Calythrix leschenaultii Schau.	—	2
Calythrix variabilis Lindl.	f	3
Chamaelaucium forrestii	j	68
Darwinia citriodora (Endl.) Benth.	fgm	468
Darwinia oederoides (Turcz.) Benth.	—	46
Darwinia vestita (Endl.) Benth.	dfh	346
Darwinia sp.	—	—
Eremea pauciflora (Endl.) Druce.	df	23
Eucalyptus anceps (R.Br. ex Maiden.)	m	34
Eucalyptus angulosa Schau.	m	4
Eucalyptus calcicola Brooke.	e	45
Eucalyptus calophylla R.Br.	defghijklmno	1234
Eucalyptus cornuta Labill.	dem	238
Eucalyptus brevistylis Brook.	i	12
Eucalyptus decipiens Endl.	dmo	4
Eucalyptus decurva F.Muell.	m	34
Eucalyptus diversicolor F.Muell.	eijklmn	12
Eucalyptus doratoxylon F.Muell.	m	34
Eucalyptus falcata Turcz.	m	34
Eucalyptus ficifolia F.Muell.	i	34
Eucalyptus guilfoylei Maiden.	ij	12
Eucalyptus haematoxylon Maiden.	f	34
Eucalyptus jacksonii Maiden.	n	12
Eucalyptus marginata Sm.	abcdefghijklmno	1234
Eucalyptus megacarpa F.Muell.	fhijklmno	234
Eucalyptus occidentalis Endl.	m	23
Eucalyptus patens Benth.	dfghijklmno	1234
Eucalyptus rudis Endl.	abcdfgijklmno	2389 10
Eucalyptus staeri Maiden.	ijmo	34
Eucalyptus wandoo Blakely.	dmo	234
Hypocalymma angustifolium Endl.	dfgh	34
Hypocalymma cordifolium (Lehm.) Schau.	fghijlno	1237
Hypocalymma ericifolium Benth.	k	4
Hypocalymma puniceum C.A.Gardn.	i	456
Hypocalymma robustum Endl.	fh	34
Hypocalymma strictum Schau.	fijkmo	3467
Kunzea micrantha Schau.	d	3
Kunzea micromera Schau.	il	34
Kunzea recurva Schau.	defijmo	34
Kunzea vestita Schau.	ijmn	459
Leptospermum crassipes Lehm.	fijmo	67
Leptospermum ellipticum Endl.	df	23
Leptospermum erubescens Schau.	d	3
Leptospermum firmum (Schau.) Benth.	fijlmn	59
Lhotzkya acutifolia Lindl.	l	12

Plant Family and Species	Surveys	Vegetation Types
Melaleuca acerosa Schau.	de	5
Melaleuca cuticularis Labill.	jkmo	56
Melaleuca densa R.Br.	f	56
Melaleuca aff. globifera R.Br.	—	3
Melaleuca hamulosa Turcz.	—	—
Melaleuca huegelii Endl.	ef	—
Melaleuca incana R.Br.	d	5
Melaleuca lanceolata Otto.	—	5
Melaleuca lateritia Otto.	dm	59
Melaleuca micromera Schau.	d	3
Melaleuca microphylla Sm.	l	129
Melaleuca parviflora Lindl.	dfijk	56
Melaleuca polygaloides Schau.	dfl	56
Melaleuca pubescens Schau.	mo	—
Melaleuca rhaphiophylla Schau.	do	79
Melaleuca scabra R.Br.	df	23
Melaleuca spathulatum Schau.	—	3
Melaleuca striata Labill.	m	34
Melaleuca thymoides Labill.	dfhmo	23
Melaleuca viminea Lindl.	dlo	—
Verticordia densiflora Lindl.	fd	—
Verticordia habrantha Schau.	do	236
Verticordia lindleyi Schau.	d	2
Verticordia pennigera Endl.	d	34
Verticordia plumosa (Desf.) Druce.	jkl	8
Verticordia sp.	—	23
HALORRHAGACEAE		
Glischrocaryon aureum (Lindl.) Orch.	f	23
Glischrocaryon sp.	d	—
Haloragodendron racemosum (Labill.) Orch.	n	9
Halorrhagis diffusa Diels.	l	—
Halorrhagis racemosa Labill.	l	—
Halorrhagis rotundifolia Benth.	ijl	12
Myriophyllum propinquum A.Cunn.	l	9
APIACEAE		
Actinotus omnifertilis (F.Muell.) Benth.	i	6
Daucus glochidiatus Sieb.	dl	3
Eryngium pinnatifidum Bunge.	em	45
Hydrocotyle diantha D.C.	e	3
Hydrocotyle hirta R.Br.	l	12
Hydrocotyle plebeia R.Br.	l	12
Pentapeltis silvatica (Diels.) Domin.	dflmo	123
Platysace compressa (Labill.) Norman.	dl	2
Platysace tenuissima (Benth.) Norman.	dfl	23
Trachymene anisocarpa (Turcz.) B.L. Burtt.	l	12
Trachymene caerulea (Reichb.) Grah.	j	2
Trachymene compressa Labill.	l	12
Trachymene cyanopetala (F.Muell.) Benth.	l	36
Trachymene pilosa Sm.	def	36
Trachymene sp.	l	12
Xanthosia atkinsoniana F.Muell.	df	23
Xanthosia candida (Benth.) Steud. ex Bung	dflo	23
Xanthosia peduncularis Benth.	e	—
Xanthosia rotundifolia D.C.	ijlmo	23
Xanthosia silvatica Diels.	fl	23
Xanthosia huegelii (Benth.) Steud.	lo	123
Xanthosia pilosa	l	12
EPACRIDACEAE		
Acrotriche cordata (Labill.) R.Br.	—	6
Andersonia caerulea R.Br.	dfklij	234
Andersonia involucrata Sond.	—	23
Andersonia longifolia (Benth.) L. Watson	fm	—
Andersonia sprengelioides R.Br.	ijk	238
Andersonia sp.	mo	23

Plant Family and Species	Surveys	Vegetation Types
Astroloma ciliatum (Lindl.) Druce.	dijo	23
Astroloma drummondii Sond.	m	2
Astroloma epacridis (D.C.) Druce.	f	23
Astroloma pallidum R.Br.	dfho	234
Astroloma sp.	m	—
Bachyloma preissii Sond.	d	23
Conostephium pendulum Benth.	fh	34
Cosmelia rubra R.Br.	ijmok	57
Leucopogon australis R.Br.	dfhijklmno	123479
Leucopogon capitellatus D.C.	dfghijklno	23
Leucopogon concinnus Benth.	jml	23
Leucopogon corifolius Endl.	f	23
Leucopogon distans R.Br.	—	67
Leucopogon gibbosus Stschegl.	d	2
Leucopogon gilbertii Stschegl.	fj	45
Leucopogon glabellus R.Br.	fijml	3456
Leucopogon hirsutus Sond.	l	—
Leucopogon ovalifolius Sond.	dm	3
Leucopogon oxycedrus Sond.	m	23
Leucopogon parviflorus (Andr.) Lindl.	f	6
Leucopogon pendulus R.Br.	dfl	23
Leucopogon affin ovalifolius Sond.	m	23
Leucopogon polymorphus Sond.	f	23
Leucopogon propinquus R.Br.	dgijlo	123
Leucopogon pulchellus Sond.	d	23
Leucopogon racemulosus D.C.	fij	23
Leucopogon reflexus R.Br.	ij	23
Leucopogon revolutus R.Br.	l	123
Leucopogon striatus R.Br.	f	23
Leucopogon tenuis D.C.	—	—
Leucopogon verticillatus R.Br.	dfghij	123
Lysinema ciliatum R.Br.	fijkmo	67
Lysinema conspicuum R.Br.	—	7
Needhamia pumilio R.Br.	—	2
Sphenotoma capitatum (R.Br.) Lindl.	fh	3
Sphenotoma gracile (R.Br.) Sweet	—	67
Sphenotoma squarrosum (R.Br.) G.Donn.	j	46
Styphelia tenuiflora Lindl.	df	234
LOGANIACEAE		
Logania buxifolia F.Muell.	—	6
Logania serpyllifolia R.Br.	dghlo	123
Logania vaginalis (Labill.) F.Muell.	efhl	12
Mitrasacme paradoxa R.Br.	l	12
GENTIANACEAE		
Centaurium australe (R.Br.) Ostf.	dgikl	123
Villarsia albiflora F.Muell.	fl	9
Villarsia lasiosperma F.Muell.	eikl	79
Villarsia parnassifolia (Labill.) R.Br.	i	—
Villarsia latifolia Benth.	l	—
Villarsia sp.	ijl	—
VERBENACEAE		
Pityrodia bartlingii (Lehm.) Benth.	f	34
LAMIACEA		
Hemiandra pungens R.Br.	df	34
Hemiandra rubriflora O.H.Sargent.	a	6
Hemigenia canescens (Bartl.) Benth.	il	12
Hemigenia drummondii Benth.	n	2
Hemigenia incana (Lindl.) Benth.	dfgjl	23
Hemigenia rigida Benth.	flm	23
Hemigenia sericea	g	2
Westringia dampieri R.Br.	—	6

Plant Family and Species	Surveys	Vegetation Types
SCROPHULARIACEAE		
Gratiola peruviana Linn.	l	12
Veronica plebeia R.Br.	d	2
OROBANCHACEAE		
Orobanche australiana F.Muell.	g	10
LENTIBULARIACEAE		
Polypompholyx multifida (R.Br.) F.Muell.	fhijl	7
Utricularia sp.	j	7
MYOPORACEAE		
Myoporum oppositifolium R.Br.	l	12
Myoporum serratum R.Br.	e	2
Myoporum tetrandrum	l	2
RUBIACEAE		
Opercularia hispidula Endl.	gjl	12 10
Opercularia volubilis (R.Br.) Benth.	l	12
Opercularia sp.	—	23
CAMPANULACEAE		
Wahlenbergia communis Carolin.	—	—
LOBELIACEAE		
Isotoma hypocrateriformis (R.Br.) Druce.	fijlm	23
Lobelia alata Labill.	l	12
Lobelia anceps Thumb.	—	—
Lobelia gibbosa Labill.	—	4
Lobelia heterophylla Labill.	—	2
Lobelia rhombifolia De Vriese.	dlo	46
Lobelia tenuior R.Br.	d	2
GOODENIACEAE		
Anthotium humile R.Br.	—	4
Dampiera cuneata R.Br.	—	23
Dampiera hederacea R.Br.	—	12
Dampiera linearis R.Br.	—	123
Dampiera sacculata (F.Muell.) Benth.	—	23
Dampiera sericantha (F.Muell.) Benth.	—	23
Dampiera sp.	—	23
Diaspis filifolia R.Br.	—	6
Goodenia eatoniana F.Muell.	o	12
Goodenia claytoniaceae Poole.	—	18
Goodenia filiformis R.Br.	—	23
Leschenaultia biloba Lindl.	—	23
Leschenaultia expansa R.Br.	—	236
Leschenaultia formosa R.Br.	d	2
Scaevola globulifera Labill.	—	6
Scaevola humifusa De Vriese	—	12
Scaevola longifolia De Vriese	d	3
Scaevola microphylla Benth.	—	6
Scaevola nitida R.Br.	—	6
Scaevola striata R.Br.	dfklo	123
Vellia macrophylla (Lindl.) Benth.	—	9
Vellia pilosella	l	12
Vellia trinervis Labill.	cdfghklno	9
STYLIDIACEAE		
Levenhookia preissii	—	2
Levenhookia pusilla R.Br.	dfl	123
Stylidium adnatum R.Br.	delo	467
Stylidium assimile R.Br.	—	23
Stylidium amoenum R.Br.	lo	1236
Stylidium barleei F.Muell.	f	2
Stylidium breviscapum R.Br.	—	123
Stylidium brunonianum Benth.	d	23
Stylidium calcaratum R.Br.	cdijkl	23

Plant Family and Species	Surveys	Vegetation Types
Stylidium caespitosum R.Br.	d	46
Stylidium caricifolium Lindl.	d	—
Stylidium carnosum Benth.	f	23
Stylidium ciliatum Lindl.	fd	23
Stylidium emarginatum Sond.	d	—
Stylidium fasciculatum R.Br.	el	12
Stylidium falcatum R.Br.	l	12
Stylidium guttatum R.Br.	—	2
Stylidium imbricatum Benth.q	k	23
Stylidium junceum R.Br.	efl	2367
Stylidium laciniatum C.A.Gardn.	l	12
Stylidium piliferum R.Br.	—	23
Stylidium pilosum Labill.	—	—
Stylidium pritzelianum Mildbr.	l	12
Stylidium rehens R.Br.	dlk	23
Stylidium rhyncocarpum Sond.	l	2
Stylidium scandens R.Br.	cfhijkln	123
Stylidium schoenoides D.C.	fd	23
Stylidium sp.	d	23
Stylidium sp.	i	23
Stylidium sp.	im	23
Stylidium squamellosum	d	23
ASTERACEAE		
Athrixia pulverulenta (Lindl.) Druce.	—	23
Brachycome iberidifolia Benth.	dfl	23
Cotula coronopifolia L.	o	24
Craspedia glauca (Labill.) Spreng.	dfhkmo	234
Gnaphalodes condensatum A.Grav.	—	2
Gnaphalium gymnocephalum D.C.	—	3
Gnaphalium indicum L.	—	3
Gnaphalium luteo-album Linn.	dlo	12
Gnaphalium sphaericum Willd.	f	234
Gnephosis pygmea (A.Gray) Benth.	l	12
Helichrysum bracteatum (Vent.) Andr.	df	23
Helichrysum cordatum D.C.	—	—
Helichrysum ramosum D.C.	dlo	12
Helipterum cotula (Benth.) D.C.	o	23
Ixiolaena viscosa Benth.	l	12
Lagenophora huegelii Benth.	dl	23
Lagenophora stipitata (Labill.) Druce	f	23
Milatia mysotidifolia (Benth.) Steetz.	—	456
Olearia axillaris (D.C.) F.Muell.	—	6
Olearia cassiniae F.Muell.	dg	69
Olearia paucidentata (Steetz.) F.Muell.	el	1236
Olearia pimelioides (D.C.) Benth.	l	12
Olearia strigosa Benth.	l	12
Pithocarpa corymbulosa Lindl.	—	67
Podolepis gracilis R.Grah.	e	6
Podolepis lessonii (Cass.) Benth.	d	3
Senecio gilbertii Turcz.	—	23
Senecio lautus Soland.	e	236
Senecio minimus Poir.	d	23
Senecio var. pieridoides (Turcz.) Belther.	m	23
Senecio quadridentatus Labill.	l	12
Senecio ramosissimus D.C.	l	12
Senecio sp.	l	12
Trichocline spathulata (A.Cunn.)	glm	123
Waitzia citrina (Benth.) Steetz.	dl	123

APPENDIX IV

LIST OF VERTEBRATES RECORDED ON SURVEYS

Species in each of the major taxa are listed according to the authority whose nomenclature we have followed (see introduction). The presence or absence of a species in each of the survey areas is indicated.

LEGEND

Surveys

1 Yeagarup
2 Woolbales
3 Dombakup
4 Perup
5 Boranup
6 Sunklands
7 Pines
8 Milyeannup
9 Soho
10 Mitchell
11 Shannon
12 Karri
13 Mitchell River
14 Giants
15 Frankland

APPENDIX IV(A) (Mammals)

SURVEY AND OCCURRENCE

SPECIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Western Grey kangaroo *(Macropus fuliginosus)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Western Brush Wallaby *(Macropus irma)*				X	X	X	X	X		X			X		X
Tammar Wallaby *(Macropus eugenii)*				X											
Quokka *(Setonix brachyurus)*	X	X	X		X	X			X	X		X		X	
Brush-tailed Bettong or Woylie *(Bettongia penicillata)*				X											
Common Brushtail Possum *(Trichosurus vulpecula)*				X	X	X	X					X	X		X
Common Ringtail Possum *(Pseudocheirus peregrinus)*				X			X					X	X		
Western Pygmy possum *(Cercartetus concinnus)*	X	X	X	X		X		X				X	X		
Honey-possum *(Tarsipes rostratus)*						X		X	X	X	X		X	X	X
Southern Brown Bandicoot *(Isoodon obesulus)*	X	X	X	X	X	X			X	X	X	X	X	X	X
Western Quoll or Chuditch *(Dasyurus geoffroii)*				X		X									
Brush-tailed Phascogale *(Phascogale tapoatafa)*												X			
Yellow-footed Antechinus or Mardo *(Antechinus flavipes)*		X		X				X		X		X		X	X
Common Dunnart *(Sminthopsis murina)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Numbat *(Myrmecobius fasciatus)*				X											
Bush Rat *(Rattus fuscipes)*	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Water-rat *(Hydromys chrysogaster)*	X	X	X	X					X	X		X			X
Greater Long-eared Bat *(Nyctophilus timoriensis)*	X									X					
Lesser Long-eared Bat *(Nyctophilus geoffroyi)*	X			X									X		
Gould's Wattled Bat *(Chalinolobus gouldii)*				X	X	X							X		X
Chocolate Wattled Bat *(Chalinolobus morio)*				X						X	X				
King River Eptesicus *(Eptesicus regulus)*	X	X		X	X	X				X	X		X		X
Great Pipistrelle *(Pipistrellus tasmaniensis)*	X	X		X	X	X				X			X	X	
Echidna *(Tachyglossus aculeatus)*				X											

	SURVEY AND OCCURRENCE														
SPECIES	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Cat *(Felus catus)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dingo *(Canis familiaris dingo)*	X	X	X	X		X				X					X
Goat *(Capra hircus)*												X			
Horse *(Equus caballus)*						X									X
House Mouse *(Mus musculus)*	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Black Rat *(Rattus rattus)*	X	X	X		X	X	X	X	X	X	X	X	X		X
Rabbit *(Oryctolagus cuniculus)*	X	X	X	X	X	X	X					X	X	X	X
Fox *(Vulpes vulpes)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pig *(Sus scrofa)*							X								
APPENDIX IV(B) (Birds)															
Emu *(Dromaius novaehollandiae)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Hoary-headed Grebe *(Poliocephalus poliocephalus)*											X				
Australasian Grebe *(Tachybaptus novaehollandiae)*	X		X	X		X	X			X					
Hutton's Shearwater *(Puffinus huttoni)*		X													
Australian pelican *(Pelicanus conspicillatus)*											X			X	
Darter *(Anhinga melanogaster)*	X	X		X		X	X							X	X
Great Cormorant *(Phalacrocorax carbo)*											X			X	X
Pied Cormorant *(Phalacrocorax varius)*					X						X				
Little Black Cormorant *(Phalacrocorax sulcirostris)*				X		X				X					
Little Pied Cormorant *(Phalacrocorax melanoleucos)*	X		X	X		X	X			X	X		X	X	
Pacific Heron *(Ardea pacifica)*				X					X	X	X		X	X	
White-faced Heron *(Ardea novaehollandiae)*	X	X	X	X		X	X		X	X	X	X	X	X	X
Great Egret *(Egretta alba)*		X				X									
Rufous Night Heron *(Nycticorax caladonicus)*	X			X					X						
Black Bittern *(Dupetor flavicollis)*				X						X					X
Australasian Bittern *(Botaurus poiciloptilus)*	X					X									
Sacred Ibis *(Threskiornis aethiopica)*	X														
Straw-necked Ibis *(Threskiornis spinicollis)*	X			X	X		X								
Black Swan *(Cygnus atratus)*				X			X				X				
Freckled Duck *(Strictonetta naevosa)*	X														
Australian Shelduck *(Tadorna tadornoides)*				X		X	X			X	X				
Pacific Black Duck *(Anas superciliosa)*	X	X	X	X	X	X	X	X	X		X		X	X	X
Grey Teal *(Anas gibberifrons)*			X	X							X				
Australasian Shoveller *(Anas rhynchotis)*			X												

SPECIES	SURVEY AND OCCURRENCE														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Maned Duck *(Chenonetta jubata)*				X		X	X		X					X	X
Blue-billed Duck *(Oxyura australis)*	X														
Musk Duck *(Biziura lobata)*	X		X	X		X	X		X		X				X
Osprey *(Pandion haliaetus)*											X				
Black-shouldered Kite *(Elanus notatus)*														X	
Square-tailed Kite *(Lophoictinia isura)*			X												
Whistling Kite *(Heliastur sphenurus)*	X	X		X	X	X	X		X			X	X		
Brown Goshawk *(Accipter fasciatus)*	X	X		X		X	X		X	X			X		X
Collared Sparrowhawk *(Accipiter cirrhocephalus)*							X	X				X			
White-bellied Sea Eagle *(Haliaeetus leucogaster)*			X								X				
Wedge-tailed Eagle *(Aquila audax)*	X	X	X	X		X	X		X	X	X	X	X	X	X
Little Eagle *(Hieraaetus morphnoides)*				X		X			X	X					
Spotted Harrier *(Circus assimilis)*		X													
Marsh Harrier *(Circus aeruginosus)*											X			X	X
Peregrine Falcon *(Falco peregrinus)*		X							X						
Australian Hobby *(Falco longipennis)*		X	X	X			X								
Brown Falcon *(Falco berigora)*		X	X	X	X	X	X	X	X	X	X		X	X	
Australian Kestrel *(Falco cenchroides)*		X	X	X	X		X		X				X	X	X
Malleefowl *(Leipoa ocellata)*									X						
Stubble Quail *(Coturnix novaezelandiae)*										X	X		X		
Brown Quail *(Coturnix australis)*															X
Painted Button-quail *(Turnix varia)*				X									X		
Spotless Crake *(Porzana tabuensis)*	X		X			X		X				X			
Dusky Moorhen *(Gallinula tenebrosa)*							X								
Purple Swamphen *(Porphyrio porphyrio)*	X		X				X				X	X			
Eurasian Coot *(Fulica atra)*	X		X	X			X				X				X
Banded Lapwing *(Vanellus tricolor)*		X		X											
Red-capped Plover *(Charadrius ruficapillus)*	X	X									X				
Black-fronted Plover *(Charadrius melanops)*				X											
Curlew Sandpiper *(Calidris feriuginea)*											X				
Silver Gull *(Larus novaehollandiae)*		X			X						X				
Pacific Gull *(Larus pacificus)*											X				
Caspian Tern *(Hydroprogne caspia)*					X						X				
Crested Tern *(Sterna bergic)*					X						X				

SPECIES	SURVEY AND OCCURRENCE														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Common Bronzewing *(Phaps chalcoptera)*	X	X	X	X	X	X	X								
Brush Bronzewing *(Phaps elegans)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-tailed Black-Cockatoo *(Calyptorhynchus magnificus)*	X	X	X	X		X			X	X			X		X
White-tailed Black-Cockatoo *(Calyptorhynchus baudinii)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Purple-crowned Lorikeet *(Glossopsitta porphyrocephala)*		X	X	X					X	X	X	X	X	X	X
Red-capped Parrot *(Purpureicephalus spurius)*	X	X	X	X		X	X	X	X	X	X	X	X		X
Western Rosella *(Platycercus icterotis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Port Lincoln Ringneck *(Barnardius zonarius)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Elegant Parrot *(Neophema elegans)*		X	X	X		X							X		
Rock Parrot *(Neophema petrophila)*	X	X			X										
Pallid Cuckoo *(Cuculus pallidus)*	X	X	X	X		X	X	X	X		X	X	X	X	
Fan-tailed Cuckoo *(Cuculus pyrrhophanus)*	X	X	X	X	X			X	X	X	X	X		X	X
Horsefield's Bronze-Cuckoo *(Chrysococcyx basalis)*	X	X	X		X			X	X						X
Shining Bronze-Cuckoo *(Chrysococcyx lucidus)*				X		X	X	X	X		X	X		X	
Southern Boobook *(Ninox novaeseelandiae)*	X	X		X	X	X			X	X		X			
Barn Owl *(Tyto alba)*				X	X		X								
Masked Owl *(Tyto novaehollandiae)*									X						
Tawny Frogmouth *(Podargus strigoides)*	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Australian Owlet-nightjar *(Aegotheles cristatus)*	X			X		X	X			X	X	X	X		X
Spotted Nightjar *(Caprimulgus guttatus)*									X						
Laughing Kookaburra *(Dacelo novaeguineae)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sacred Kingfisher *(Halcyon sancta)*			X	X	X	X	X		X		X	X		X	
Rainbow Bee-eater *(Merops ornatus)*						X	X								
Welcome Swallow *(Hirundo neoxena)*	X			X		X	X				X		X		
Tree Martin *(Cecropis nigricans)*	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Richard's Pipit *(Anthus novaeseelandiae)*	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Black-faced Cuckoo-shrike *(Coracina novaehollandiae)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-winged Triller *(Lalage Sueurii)*				X											
Scarlet Robin *(Petroica multicolor)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-capped Robin *(Petroica goodenovii)*							X								
White-breasted Robin *(Eopsaltria georgiana)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Western Yellow Robin *(Eopsaltria griseogularis)*	X	X	X	X		X	X	X				X	X		X
Crested Shrike-tit *(Falcunculus frontalus)*		X		X								X			
Golden Whistler *(Pachycephala pectoralis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

SPECIES	SURVEY AND OCCURRENCE														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Rufous Whistler *(Pachycephala rufiventris)*				X	X		X						X		
Grey Shrike-thrush *(Colluricincla harmonica)*	X	X	X	X		X	X	X	X	X		X	X	X	X
Restless Flycatcher *(Myiagra inquieta)*		X		X	X		X		X	X			X		X
Grey Fantail *(Rhipidura fuliginosa)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Willie Wagtail *(Rhipidura leucophrys)*	X	X	X	X	X	X	X						X		
White-browed Babbler *(Pomatostomus superciliosus)*	X	X				X			X	X	X	X		X	
Clamorous Reed-Warbler *(Acrocephalus stentoreus)*	X														
Little Grassbird *(Megalurus gramineus)*	X		X												
Splendid Fairy-wren *(Malurus splendens)*	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Red-winged Fairy-wren *(Malurus elegans)*	X		X	X	X	X	X	X	X	X		X			
Southern Emu-wren *(Stipiturus malachurus)*	X	X			X	X		X		X				X	
White-browed Scrub-wren *(Sericornis frontalis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Weebill *(Sinicrornis brevirostris)*				X		X		X	X						
Western Gerygone *(Gerygone fusca)*	X	X	X	X		X		X	X	X		X		X	X
Inland Thornbill *(Acanthiza apicalis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Western Thornbill *(Acanthiza inornata)*		X	X	X		X	X	X	X	X	X		X	X	X
Yellow-rumped Thornbill *(Acanthiza chrysorrhoa)*	X	X	X	X		X	X		X	X			X		X
Varied Sitella *(Daphoenositta chrysoptera)*	X	X	X	X	X	X	X	X	X		X	X	X	X	X
Rufous Treecreeper *(Climacteris rufa)*	X	X	X	X		X	X		X	X	X	X	X	X	
Red Wattlebird *(Anthochaera carunculata)*	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Little Wattlebird *(Anthochaera chrysoptera)*	X	X	X	X		X	X	X	X		X				
Yellow-throated Minor *(Manorina flavigula)*		X													
White-naped Honeyeater *(Melithreptus lunatus)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Brown Honeyeater *(Lichmera indistincta)*	X	X	X	X			X	X	X				X		
New Holland Honeyeater *(Phylidonyris novaehollandiae)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
White-cheeked Honeyeater *Phylidonyris nigra)*	X	X													
Tawny-crowned Honeyeater *(Phylidonyris melanops)*		X	X				X	X	X	X	X				
Western Spinebill *(Acanthorhynchus superciliosus)*	X	X	X	X		X	X	X	X	X	X		X	X	X
Spotted Pardalote *(Pardalote punctatus)*	X	X	X	X	X	X		X	X	X	X	X	X		X
Striated Pardalote *(Pardalotus striatus)*	X	X		X	X	X	X	X	X	X		X		X	X
Silvereye *(Zosterops lateralis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-eared Firetail *(Emblema oculata)*	X	X	X		X	X	X		X	X	X	X	X	X	X
Australian Magpie-lark *(Grallina cyanoleuca)*		X	X	X	X	X	X						X	X	
Dusky Woodswallow *(Artamus cyanopterus)*		X	X	X	X	X	X		X	X	X	X	X	X	X

SPECIES	SURVEY AND OCCURRENCE														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Grey Butcherbird *(Cracticus torquatus)*		X													
Australian Magpie *(Gymnorhina tibicen)*	X	X	X	X	X	X	X	X	X			X	X	X	X
Grey Currawong *(Strepera versicolor)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Australian Raven *(Corvus coronoides)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
APPENDIX IV(C) (Reptiles)															
Blind Snake *(Ramphotyphlops australis)*				X		X	X	X							
Dugite *(Pseudonaja affinis affinis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black Tiger Snake *(Notechis ater occidentalis)*	X	X	X	X		X	X		X	X	X	X	X	X	X
The Black-headed Snake *(Unechis gouldii)*				X				X							
Crowned Snake *(Drysdalia coronata)*		X	X		X			X	X	X	X		X	X	X
Little Brown Snake *(Elapognathus minor)*											X				X
Mueller's Snake *(Rhinoplocephalus bicolor)*	X	X				X		X	X	X	X		X		X
Bardick *(Echiopsis curta)*													X		
Marbled Gecko *(Phyllodactylus marmoratus)*	X	X	X	X	X	X	X		X	X	X		X		X
The Common Scaly-Foot *(Pygopus lepidopodus)*					X						X				
Fraser's Scale-footed Lizard *(Delma fraseri)*	X			X											
Pretty Worm-lizard *(Aprasia pulchella)*								X							
Mourning Skink *(Egernia luctuosa)*	X					X		X	X	X		X	X		
Bobtail *(Tiliqua rugosa)*	X	X	X	X	X	X	X		X	X		X	X		X
Smith's Skink *(Egernia napoleonis)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
King's Skink *(Egernia kingii)*	X	X		X		X	X	X	X	X		X	X	X	
Fry's Skink *(Egernia pulchra pulchra)*	X		X			X		X	X	X			X	X	X
Red-legged Skink *(Ctenotus labillardieri)*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ctenotus catenifer						X			X				X		X
Ctenotus impar					X	X									
Hemiergis initialis initialis	X					X									
Slippery Skink *(Lerista microtis microtis)*				X				X	X	X	X			X	
Sphenomorphus australis			X						X	X	X				
Burrowing Skink *(Hemiergis peronii peronii)*		X	X	X	X	X	X	X	X	X	X	X	X	X	X
New Holland Skink *(Leiolopisma trilineatum)*	X			X		X	X						X		X
Wood Skink *(Cryptoblepharus plagiocephalus)*					X	X									
Sandhill Skink *(Morethia lineoocellata)*	X					X	X								
Morethia obscura	X					X	X								X
Lerista elegans							X								
Lerista distinguenda					X	X									X
Grey's Skink *(Menetia greyii)*					X	X	X								X
Bungarra *(Varanus gouldii)*	X		X	X	X	X	X					X	X		X

SPECIES	SURVEY AND OCCURRENCE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Long-necked Tortoise *(Chelodina oblonga)*	X			X							X	X	X	X	X
APPENDIX IV(D) (Amphibians)															
Slender Tree Frog *(Litoria adelaidensis)*	X	X	X	X			X		X	X	X	X	X	X	X
Green and Gold Tree Frog *(Litoria moorei)*	X	X	X	X	X		X		X			X	X		
Western Banjo Frog *(Limnodynastes dorsalis)*	X	X			X	X	X				X	X	X	X	X
Burrowing Frog *(Heleioporus inornatus)*				X		X	X		X	X	X		X		X
Moaning Frog *(Heleioporus eyeri)*	X	X	X	X	X	X	X	X		X	X	X	X		X
Heleioporus psammophilus			X								X				
Humming Frog *(Neobatrachus pelobatoides)*										X					
Pseudophryne nicholsi						X				X		X		X	
Gunther's Toadlet *(Pseudophrne guntheri)*	X	X	X			X		X					X		X
Crinia georgiana			X	X		X	X	X	X	X		X	X	X	X
Ranidella glauerti				X		X			X	X	X	X		X	X
Ranidella insignifera										X					
Ranidella subinsignifera			X									X			
Ranidella pseudinsignifera															X
Geocrinia leai								X	X		X	X	X		X
Geocrinia lutea		X													
Geocrinia rosea												X			
APPENDIX IV(E) (Freshwater Fish)															
Western Minnow *(Galaxias occidentalis)*	X	X	X			X	X		X			X	X	X	X
Black-Striped Minnow *(Galaxiella nigrostriatas)*														X	
Mud Minnow *(Galaxialla munda)*									X						X
Salamander Fish *(Lepidogalaxis salamandroides)*		X	X						X					X	X
Night Fish *(Bostockia porosa)*	X	X	X			X	X	X	X			X	X	X	X
Western Pygmy Perch *(Edelia vittata)*	X	X	X			X	X	X	X			X			X
Balston's Pygmy Perch *(Nannatherina balstoni)*			X									X			
Pouched Lamprey *(Geotria australis)*												X			
Hardyhead *(Atherinosoma edelensis)*							X								
Mangrove Mullet *(Mugil cephalus)*											X				
Swan River Goby *(Pseudogobius olorum)*													X		
Mosquito Fish *(Gambusia affinis)*							X		X					X	X
Carp *(Carassius carassius)*							X								
Redfin Perch *(Perca fluviatilis)*												X		X	
Brown Trout *(Salmo trutta)*												X			
Rainbow Trout *(Salmo gairdneri)*												X			

APPENDIX V

Vertebrates recorded in each of the Faunal Zones

Ordination analysis resulted in the surveys being grouped into four faunal zones. Zone I South coastal, Zone II Southern forests, Zone III Northern jarrah, Zone IV North Coastal (Table 3). Each species of animal recorded on the surveys is listed here according to the zones in which it may be found.

To facilitate comparison by zones, species have been listed according to their geographic location, rather than in the usual manner. Thus the species near the top of the list are southern species (Zones I and II) and those near the bottom are northern species, (Zones III and IV).

Asterisks denote introduced species.

APPENDIX V(A) (Mammals)

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Brush-tailed Phascogale *(Phascogale tapoatafa)*	X			
Goat* *(Capra hircus)*	X			
The Yellow-footed Antechinus or Mardo *(Antechinus flavipes)*	X	X	X	
Common Dunnart *(Sminthopsis murina)*	X	X	X	
Common Ringtail Possum *(Pseudocheirus peregrinus)*	X	X	X	
Quokka *(Setonix brachyurus)*	X	X	X	
Great pipistrelle *(Pipistrellus tasmaniensis)*	X	X	X	
Long-eared Bats *(Nyctophilus species)*	X	X	X	
Bush Rat *(Rattus fuscipes)*	X	X	X	
Southern Brown Bandicoot *(Isoodon obesulus)*	X	X	X	X
Common Brushtail Possum *(Trichosurus vulpecular)*	X	X	X	X
Western Pygmy-possum *(Cercartetus concinnus)*	X	X	X	X
Honey-possum *(Tarsipes rostratus)*	X	X	X	X
Western Grey Kangaroo *(Macropus fuliginosus)*	X	X	X	X
Western Brush Wallaby *(Macropus irma)*	X	X	X	X
King River Eptesicus *(Eptesicus regulus)*	X	X	X	X
Gould's Wattled Bat *(Chalinolobus gouldii)*	X	X	X	X
Chocolate Wattled Bat *(Chalinolobus morio)*	X	X	X	X
Water-Rat *(Hydromys chrysogaster)*	X	X	X	X
Cat* *(Felis catus)*	X	X	X	X
Dingo* *(Canis familiaris)*	X	X	X	X
Cow* *(Bos taurus)*	X	X	X	X
Mouse* *(Mus musculus)*	X	X	X	X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Black Rat* *(Rattus rattus)*	X	X	X	X
Rabbit* *(Oryctolagus cuniculus)*	X	X	X	X
Fox* *(Vulpes vulpes)*	X	X	X	X
Horse* *(Equus caballus)*	X	X		X
Ferret* *(Mustela putoris)*	X			X
Short-beaked Echidna *(Tachyglossus aculeatus)*		X	X	X
Western Quoll or Chuditch *(Dasyurus geoffroii)*		X	X	X
White-striped Mastiff-bat *(Tadarida australis)*		X	X	X
Little Mastiff-bat *(Mormopterus planiceps)*		X	X	X
Feral Pig* *(Sus scrofa)*		X	X	X
Red-tailed Phascogale *(Phascogale calura)*			X	
Numbat *(Myrmecobius fasciatus)*			X	
Tammar Wallaby *(Macropus eugenii)*			X	
Brush-tailed Bettong *(Bettongia penicillata)*			X	
Fat-tailed Dunnart *(Sminthopsis crassicaudata)*				X
Ash-grey Mouse *(Pseudomys albocinereus)*				X

APPENDIX V(B) (Birds)

Hutton's Shearwater *(Puffinus huttoni)*	X			
Curlew Sandpiper *(Calidris feruginea)*	X			
Pacific Gull *(Larus pacificus)*	X			
Spotted Nightjar *(Caprimulgus guttatus)*	X			
Southern Emu-wren *(Stipiturus malachurus)*	X	X		
Brown Quail *(Coturnix australis)*	X	X	X	
Australian Owlet-Nightjar *(Aegotheles cristatus)*	X	X	X	
Red-tailed Black-Cockatoo *(Calyptorhynchus magnificus)*	X	X	X	
Red-eared Firetail *(Emblema oculata)*	X	X	X	
White-browed Babbler *(Pomatostomus superciliosus)*	X	X	X	
Emu *(Dromaius novaehollandiae)*	X	X	X	X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Australasian Grebe *(Tachybaptus novaehollandiae)*	X	X	X	X
Darter *(Anhinga melanogaster)*	X	X	X	X
Pied Cormorant *(Phalacrocorax varius)*	X	X	X	X
Little Black Cormorant *(Phalacrocorax sulcirostris)*	X	X	X	X
Little Pied Cormorant *(Phalacrocorax melanoleucos)*	X	X	X	X
Pacific Heron *(Ardea pacifica)*	X	X	X	X
White-faced Heron *(Ardea novaehollandiae)*	X	X	X	X
Rufous Night Heron *(Nycticorax caladonicus)*	X	X	X	X
Black Swan *(Cygnus atratus)*	X	X	X	X
Australian Shelduck *(Tadorna tadornoides)*	X	X	X	X
Pacific Black Duck *(Anas superciliosa)*	X	X	X	X
Maned Duck *(Chenonetta jubata)*	X	X	X	X
Musk Duck *(Biziura lobata)*	X	X	X	X
Black-shouldered Kite *(Elanus notatus)*	X	X	X	X
Square-tailed Kite *(Lophoictinia isura)*	X	X	X	X
Whistling Kite *(Haliastur sphenurus)*	X	X	X	X
Brown Goshawk *(Accipiter fasciatus)*	X	X	X	X
Collared Sparrowhawk *(Accipiter cirrhocephalus)*	X	X	X	X
Wedge-tailed Eagle *(Aquila audax)*	X	X	X	X
Little Eagle *(Hieraaetus morphnoides)*	X	X	X	X
Australian Hobby *(Falco longipennis)*	X	X	X	X
Brown Falcon *(Falco berigora)*	X	X	X	X
Australian Kestrel *(Falco cenchroides)*	X	X	X	X
Eurasian Coot *(Fulica atra)*	X	X	X	X
Common Bronzewing *(Phaps chalcoptera)*	X	X	X	X
Brush Bronzewing *(Phaps elegans)*	X	X	X	X
White-tailed Black-Cockatoo *(Calyptorhynchus baudinii)*	X	X	X	X
Purple-crowned Lorikeet *(Glossopsitta porphyrocephala)*	X	X	X	X
Red-capped Parrot *(Purpureicephalus spurius)*	X	X	X	X
Western Rosella *(Platycercus icterotis)*	X	X	X	X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Port Lincoln Ringneck *(Barnardius zonarius)*	X	X	X	X
Elegant Parrot *(Neophema elegans)*	X	X	X	X
Pallid Cuckoo *(Cuculus pallidus)*	X	X	X	X
Fan-tailed Cuckoo *(Cuculus pyrrhophanus)*	X	X	X	X
Horsefield's Bronze-Cuckoo *(Chrysococcyx basalis)*	X	X	X	X
Shining Bronze-Cuckoo *(Chrysococcyx lucidus)*	X	X	X	X
Southern Boobook *(Ninox novaeseelandiae)*	X	X	X	X
Tawny Frogmouth *(Podargus strigoides)*	X	X	X	X
Laughing Kookaburra *(Dacelo novaeguineae)*	X	X	X	X
Sacred Kingfisher *(Halcyon sancta)*	X	X	X	X
Welcome Swallow *(Hirundo neoxena)*	X	X	X	X
Tree Martin *(Cecropis nigricans)*	X	X	X	X
Richard's Pipit *(Anthus novaeseelandiae)*	X	X	X	X
Black-faced Cuckoo-shrike *(Coracina novaehollandiae)*	X	X	X	X
Scarlet Robin *(Petroica multicolor)*	X	X	X	X
White-breasted Robin *(Eopsaltria georgiana)*	X	X	X	X
Western Yellow Robin *(Eopsaltria griseogularis)*	X	X	X	X
Golden Whistler *(Pachycephala pectoralis)*	X	X	X	X
Grey Shrike-thrush *(Colluricincla harmonica)*	X	X	X	X
Restless Flycatcher *(Myiagra inquieta)*	X	X	X	X
Grey Fantail *(Rhipidura fuliginosa)*	X	X	X	X
Willie Wagtail *(Rhipidura leucophrys)*	X	X	X	X
Splendid Fairy-wren *(Malurus splendens)*	X	X	X	X
Red-winged Fairy-wren *(Malurus elegans)*	X	X	X	X
White-browed Scrub-wren *(Sericornis frontalis)*	X	X	X	X
Weebill *(Sinicrornis brevirostris)*	X	X	X	X
Western Gerygone *(Gerygone fusca)*	X	X	X	X
Inland Thornbill *(Acanthiza apicalis)*	X	X	X	X
Western Thornbill *(Acanthiza inornata)*	X	X	X	X
Yellow-rumped Thornbill *(Acanthiza chrysorrhoa)*	X	X	X	X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Varied Sitella *(Daphoenositta chrysoptera)*	X	X	X	X
Rufous Treecreeper *(Climacteris rufa)*	X	X	X	X
Red Wattlebird *(Anthochaera carunculata)*	X	X	X	X
Little Wattlebird *(Anthochaera chrysoptera)*	X	X	X	X
White-naped Honeyeater *(Melithreptus lunatus)*	X	X	X	X
Brown Honeyeater *(Lichmere indistincta)*	X	X	X	X
New Holland Honeyeater *(Phylidonyris novaehollandiae)*	X	X	X	X
White-cheeked Honeyeater *(Phylidonyris nigra)*	X	X	X	X
Tawny-crowned Honeyeater *(Phylidonyris melanops)*	X	X	X	X
Western Spinebill *(Acanthorhynchus superciliosus)*	X	X	X	X
Spotted Pardalote *(Pardalotus punctatus)*	X	X	X	X
Striated Pardalote *(Pardalotus striatus)*	X	X	X	X
Silvereye *(Zosterops lateralis)*	X	X	X	X
Australian Magpie-lark *(Grallina cyanoleuca)*	X	X	X	X
Dusky Woodswallow *(Artamus cyanopterus)*	X	X	X	X
Grey Butcherbird *(Cracticus torquatus)*	X	X	X	X
Australian Magpie *(Gymnohina tibicen)*	X	X	X	X
Grey Currawong *(Strepera versicolor)*	X	X	X	X
Australian Raven *(Corvus coronoides)*	X	X	X	X
Great Egret *(Egretta alba)*	X	X		X
Marsh Harrier *(Hircus aeruginosus)*	X	X		X
Spotless Crake *(Porzana tabuensis)*	X	X		X
Purple Swamphen *(Porphyrio porphyrio)*	X	X		X
Red-capped Plover *(Charadrius ruficapillus)*	X	X		X
Silver Gull *(Larus novaehollandiae)*	X	X		X
Caspian Tern *(Hydroprogne caspia)*	X	X		X
Crested Tern *(Sterna bergii)*	X	X		X
Rock Parrot *(Neophema petrophila)*	X	X		X
Little Grassbird *(Megalurus gramineus)*	X	X		X
Hoary-headed Grebe *(Poliocephalus poliocephalus)*	X		X	

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Grey Teal *(Anas superciliosa)*	X		X	X
Peregrine Falcon *(Falco peregrinus)*	X		X	X
Banded Lapwing *(Vanellus tricolor)*	X		X	X
Yellow-throated Miner *(Manorina flavigula)*	X		X	X
Black Bittern *(Dupetor flavicollis)*	X		X	
Malleefowl *(Leipoa ocellata)*	X		X	
Crested Shrike-tit *(Falcunculus frontalus)*	X		X	
Australian Pelican *(Pelicanus conspicillatus)*	X			X
Great cormorant *(Phalacrocorax carbo)*	X			X
Chestnut Teal *(Anas castanea)*	X			X
Australian Shoveller *(Anas rhynchotis)*	X			X
Osprey *(Pandion haliaetus)*	X			X
White-bellied Sea-Eagle *(Haliaeetus leucogaster)*	X			X
Spotted Harrier *(Circus assimilis)*	X			X
Masked Owl *(Tyto novaehollandiae)*	X			X
Straw-necked Ibis *(Threskiornis spinicollis)*		X	X	X
Barn Owl *(Tyto alba)*		X	X	X
Rainbow Bee-eater *(Merops ornatus)*		X	X	X
White-winged triller *(Lalage sueurii)*		X	X	X
Red-capped Robin *(Petroica goodenovii)*		X	X	X
Rufous Whistler *(Pachycephala rufiventris)*		X	X	X
Painted Button-quail *(Turnix varia)*		X	X	
Australasian Bittern *(Botaurus poiciloptilus)*		X		X
Sacred Ibis *(Threskiornis aethipica)*		X		X
Freckled Duck *(Stictonetta naevosa)*		X		X
Blue-billed Duck *(Oxyura australis)*		X		X
Dusky Moorhen *(Gallinula tenebrosa)*		X		X
Clamorous Reed-warbler *(Aerocephalus stentoreux)*		X		X
Black-fronted Plover *(Charadrius melanops)*			X	X
Feral Pigeon *(Columba livia)*			X	X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Spotted Turtle-dove *(Streptopelia chinensis)*			X	X
Laughing Turtle-dove *(Streptopelia senegalensis)*			X	X
Crested Pigeon *(Ocyphaps lophotes)*			X	X
Galah *(Cacatua roseicapilla)*			X	X
Little Corella *(Cacatua sanguinea)*			X	X
Regent Parrot *(Polytelis anthopeplus)*			X	X
Budgerigar *(Melopsittacus undulatus)*			X	X
Fork-tailed Swift *(Apus pacificus)*			X	X
Fairy Martin *(Cecropis ariel)*			X	X
Hooded Robin *(Melanodryas cucullata)*			X	X
Crested Bellbird *(Oreoica gutturalis)*			X	X
Rufous Songlark *(Cinclorhamphus mathewsi)*			X	X
Brown Songlark *(Cinclorhamphus cruralis)*			X	X
Singing Honeyeater *(Lichenostomus virescens)*			X	X
Yellow-plumed Honeyeater *(Lichenostomus ornatus)*			X	X
White-fronted Chat *(Ephthianura albifrons)*			X	X
Mistletoebird *(Dicaeum hirundinaceum)*			X	X
Black-faced Woodswallow *(Artamus cinereus)*			X	X
Little Crow *(Corvus bennetti)*			X	X
Little Button-quail *(Turnix Velox)*			X	
Bush Thick-knee *(Burhinus magnirostris)*			X	
Chestnut Quail-thrush *(Cinclosoma castanotum)*			X	
Blue-breasted Fairy-wren *(Malurus pulcherrimus)*			X	
White-eared Honeyeater *(Lichenostomus leucotis)*			X	
Brown-headed Honeyeater *(Melithreptus brevirostris)*			X	
White-fronted Honeyeater *(Phylidonyris albifrons)*			X	
Great Crested Grebe *(Podiceps cristatus)*				X
Little Bittern *(Ixobrychus minutus)*				X
Glossy Ibis *(Plegadis falcinellus)*				X
Yellow-billed Spoonbill *(Platalea flavipes)*				X

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Magpie Goose *(Anseranas semipalmata)*				X
Garganey *(Anas querquedula)*				X
Pink-eared Duck *(Malacorhynchus membranaceus)*				X
Hardhead *(Aythya australis)*				X
Buff-banded Rail *(Rallus philippensis)*				X
Black-tailed Native-hen *(Gallinula ventralis)*				X
Australian Bustard *(Ardeotis australis)*				X
Red-kneed Dotterel *(Erythrogonys cinctus)*				X
Black-winged Stilt *(Himantopus himantopus)*				X
Red-necked Avocet *(Recurvirostra novaehollandiae)*				X
Greenshank *(Tringa nebularia)*				X
Sharp-tailed Sandpiper *(Calidris acuminata)*				X
Whiskered Tern *(Chlidonias hybrida)*				X
White-winged Tern *(Chlidonias leucoptera)*				X
Sulphur-crested Cockatoo *(Cacatua galerita)*				X
White-backed Swallow *(Cheramoeca leucosternum)*				X
Variegated Fairy-wren *(Malurus lamberti)*				X
White-winged Fairy-wren *(Malurus leucopterus)*				X
Calamanthus *(Sericornis fuliginosus)*				X

APPENDIX V(C) (Reptiles)

Little Brown Snake *(Elapognathus minor)*	X			
Mueller's Snake *(Rhinoplocephalus bicolor)*	X	X		
Blind Snake *(Ramphotyphlops australis)*	X	X	X	X
Dugite *(Pseudonaja affinis affinis)*	X	X	X	X
Black Tiger Snake *(Notechis ater occidentalis)*	X	X	X	X
Crowned Snake *(Drysdalia coronata)*	X	X		X
The Black-headed Snake *(Unechis gouldii)*		X	X	X
Bardick *(Echiopsis curta)*		X		X
Carpet Python *(Morelia spilota variegata)*			X	X

SPECIES	Faunal Zone I	Faunal Zone II	Faunal Zone III	Faunal Zone IV
Half-Girdled Snake *(Simoselaps semifasciatus semifasciatus)*			X	X
Desert Banded Snake *(Simoselaps bertholdi)*			X	X
Black-naped Snake *(Neelaps bimaculatus)*			X	X
Western Black-striped Snake *(Neelaps calanotos)*			X	X
Common Death Adder *(Acanthophis antarcticus)*				X
Children's Python *(Liasis childreni)*				X
Mulga Snake *(Pseudechis australis)*				X
Narrow Banded Snake *(Rhynchoelaps fasciolatus)*				X
Whip Snake *(Demansia psammophis reticulata)*				X
Gwadar *(Pseudonaja nuchalis)*				X
Ramphotyphlops bituberculata				X
Fry's Skink *(Egernia pulchra pulchra)*	X	X		
Ctenotus caternifer	X	X		
Grey's Skink *(Menetia greyii)*	X	X	X	
Mourning Skink *(Egernia luctuosa)*	X	X		X
Slippery Skink *(Lerista microtis microtis)*	X		X	X
Sphenomorphus australe	X			X
Marbled Gecko *(Phyllodactylus marmoratus)*	X	X	X	X
Scale-footed Lizard *(Pygopus lepidopodus)*	X	X	X	X
Pretty Worm Lizard *(Aprasia pulchella)*	X	X	X	X
Bobtail *(Tiliqua rugosa)*	X	X	X	X
Smith's Skink *(Egernia napoleonis)*	X	X	X	X
King's Skink *(Egernia kingii)*	X	X	X	X
Red-legged Skink *(Ctenotus labillardieri)*	X	X	X	X
Burrowing Skink *(Hemiergis peronii peronii)*	X	X	X	X
New Holland Skink *(Leiolopisma trilineatum)*	X	X	X	X
Bungarra *(Varanus gouldii)*	X	X	X	X
Salmon-bellied Skink *(Egernia nitida)*		X		
Hemiergis initialis initialis		X	X	
Morethia obscura		X	X	
Lerista distinguenda		X	X	
Festooned Gecko *(Diplodactylus vittatus)*		X	X	X

SPECIES	Faunal Zone I	Faunal Zone II	Faunal Zone III	Faunal Zone IV
Fraser's Scale-footed Lizard *(Delma fraseri)*		X	X	X
Ornate Dragon *(amphibolurus ornatus)*		X	X	X
Sandhill Skink *(Morethia lineocellata)*		X	X	X
Wood Skink *(Cryptoblepharus plagiocephalus)*			X	
Ctenotus fallens			X	
Ctenotus gemmula			X	
Ctenotus lesueurri			X	
Lerista praepedita			X	
Beautiful Gecko *(Diplodactylus pulcher)*			X	X
Common Snake Lizard *(Lialis burtonii)*			X	X
Western Jew Lizard *(Amphibolurus barbatus minor)*			X	X
Mountain Devil *(Moloch horridus)*			X	X
Sandhill Dragon *(Morethia lineocellata)*			X	X
Blue Tongue *(Tiliqua occipitalis)*			X	X
Soft Spined Gecko *(Diplodactylus spinigerus)*				X
Hemiergis peronii quadrilineata				X
Netted Dragon *(Amphibolurus reticulatus)*				X
Gunther's Skink *(Tiliqua branchialis)*				X
Slender Snake Lizard *(Pletholax gracilis)*				X
Dtella *(Peropus variegatus variegatus)*				X
Black Goanna *(Varanus tristis)*				X
Large Spiny-tailed Skink *(Egernia stokesii)*				X
White's Skink *(Egernia whitii)*				X
Keeled Skink *(Sphenomorphus monotropis)*				X
Metallic Skink *(Leiolepisma metallicum)*				X
Long-necked Tortoise *(Chelodina oblonga)*	X	X	X	X
Short-necked Tortoise *(Pseudemydura umbrina)*				X

APPENDIX V(D) (Amphibians)

Geocrinia rosea	X			
Geocrinia lutea	X			
Ranidella subinsignifera	X			
Melacrinia nicholli	X	X		
Helioporus inornatus	X	X	X	
Pseudophyrne guentheri	X	X	X	
Crinia leai	X	X	X	

SPECIES	*Faunal Zone I*	*Faunal Zone II*	*Faunal Zone III*	*Faunal Zone IV*
Slender Tree Frog *(Hyla adelaidensis)*	X	X	X	X
Green and Gold Tree Frog *(Hyla mooreei)*	X	X	X	X
Western Banjo Frog *(Limnodynastes dorsalis)*	X	X	X	X
Moaning Frog *(Heleioporus eyrei)*	X	X	X	X
Crinia georgiana	X	X	X	X
Crinia glauertia	X	X	X	X
Crinia insignifera	X	X	X	X
Crinia pseudinsignifera	X		X	X
Heleioporus psammophilus	X			X
Neobatrachus pelobatoides	X			X
Heleioporus albopunctatus			X	X
Heleioporus barycragus		X	X	
Myobatrachus gouldii				X

APPENDIX V(E) (Freshwater Fish)

Pouched Lamprey *(Geotria australis)*	X			
Mud Minnow *(Galaxiella munda)*	X			
Salamander Fish *(Lepidogalaxias salamandroides)*	X			
Mangrove Mullet *(Mugil cephalus)*	X			
Black-Striped Minnow *(Galaxiella nigrostriatus)*	X			
Brown Trout* *(Salmo trutta)*	X			
Rainbow Trout* *(Salmo gairdneri)*	X	X		
Redfin Perch* *(Perca fluviatilis)*	X	X		
Western Minnow *(Galaxias occidentalis)*	X	X	X	X
Nightfish *(Bostockia porosa)*	X	X		X
Western Pygmy Perch *(Edelia vittata)*	X	X		X
Mosquito Fish* *(Gambusia affinis)*	X	X		X
Balston's Pygmy Perch *(Nannatherina balstoni)*	X			X
Swan River Goby *(Pseudogobius olorum)*		X		X
Swan River Hardyhead *(Atherinosoma edelensis)*		X		X
Carp* *(Carassius carassius)*		X		
Freshwater Cobbler *(Tandanus bostocki)*				X