



DEPARTMENT OF
FISHERIES AND WILDLIFE
WESTERN AUSTRALIA

REPORT No 16 DEPARTMENT OF
FISHERIES & WILDLIFE
LIBRARY
WESTERN AUSTRALIA

Published by the Director of Fisheries and Wildlife, Perth,
under the authority of the Hon. Minister for Fisheries and Wildlife

Notes on the Wildlife of a
Proposed Nature Reserve
around Lake Grace
and Lake Chinokup,
Western Australia

BY

N. L. MCKENZIE

AND

W. K. YOUNGSON

PERTH
WESTERN AUSTRALIA

1975

055193

Department of Fisheries and Wildlife

108 Adelaide Terrace

PERTH

DEPARTMENT OF
FISHERIES & WILDLIFE
LIBRARY
WESTERN AUSTRALIA

29 SEP 1975

R E P O R T

No. 16

NOTES ON THE WILDLIFE OF A PROPOSED NATURE
RESERVE AROUND LAKE GRACE AND LAKE CHINOKUP,
WESTERN AUSTRALIA

BY

N.L. MCKENZIE AND W.K. YOUNGSON

1975

CONTENTS

			Page
	ABSTRACT	... ..	7
I	INTRODUCTION	... ..	7
II	FLORA	... ..	9
	Low Open-shrubland and Low Shrubland	... ..	9
	Low Open-shrubland and Open-heath	... ..	10
	Tall Shrubland of <i>Melaleuca</i> spp.	... ..	10
	Low Open-shrubland, Tall Shrubland and Open-scrub of Mallee Species	... ..	10
	Low Forest, Woodland and Open-woodlands	... ..	11
	Low Shrubland, Open-heath and Tall Open-shrubland	... ..	11
III	FAUNA	... ..	12
	A. Mammals	... ..	13
	B. Birds	... ..	16
	C. Reptiles and Amphibians	... ..	19
IV	DISCUSSION	... ..	21
V	ACKNOWLEDGEMENTS	... ..	22
VI	REFERENCES	... ..	22

FIGURES

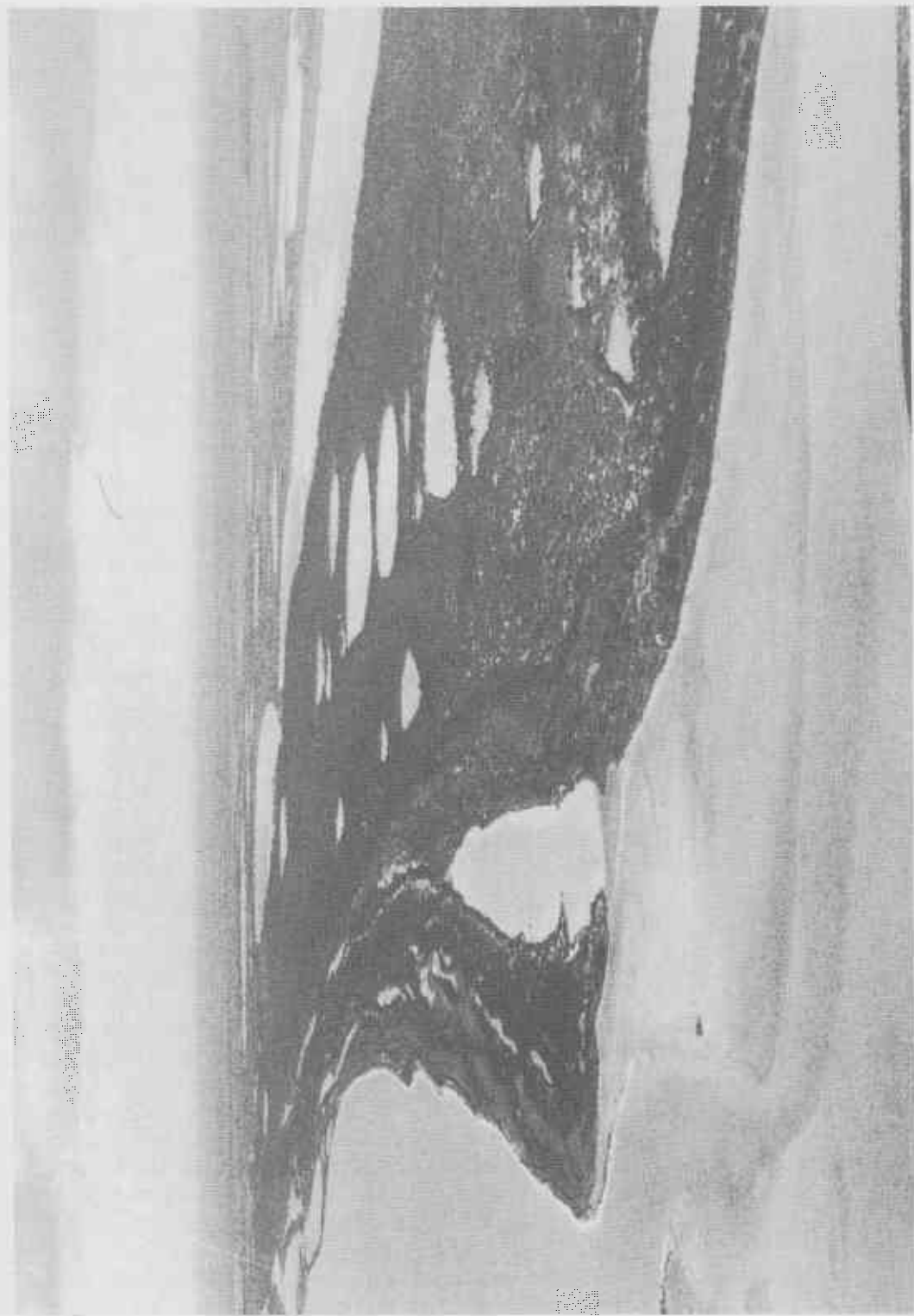
1.	Lake Grace, Lake Chinokup and Environs 	24
2.	Key to Vegetation Maps 	25
3.	The Vegetation Around Lake Chinokup 	26
4.	The Vegetation of the Central Portion of the Proposed Reserve 	27
5.	The Vegetation Between Lake Grace North and Lake Grace South 	28

PLATES

	Front Plate - Aerial view, Lake Grace 	5
1.	Low open-shrubland of <i>Arthrocnemum</i> spp. 	29
2.	Aerial view of low-shrubland and low open-shrubland of <i>Melaleuca</i> spp. and <i>Arthrocnemum</i> spp. respectively 	29

PLATES (Cont.)

- | | | | | |
|----|--|-----|-----|----|
| 3. | Low shrubland to open-scrub
of <i>Melaleuca</i> spp. | ... | ... | 30 |
| 4. | Mixed tall shrubland of mallee species
and open-heath to tall shrubland of
<i>Melaleuca</i> spp. | ... | ... | 30 |
| 5. | Tall shrubland of mallee species
fringing a small lake | ... | ... | 31 |
| 6. | Woodland | ... | ... | 31 |
| 7. | Low shrubland (<i>Leptospermum</i>) | ... | ... | 32 |
| 8. | Tall open-shrubland (Proteaceae) | ... | ... | 32 |



Looking NNE from the southern end of Lake Grace (South Lake). The main water body of Lake Grace (South Lake) is shown on the mid-left.

NOTES ON THE WILDLIFE OF A PROPOSED NATURE RESERVE AROUND LAKE GRACE AND LAKE CHINOKUP, WESTERN AUSTRALIA

N. L. McKenzie and W.K. Youngson.
Western Australian Wildlife Research Centre,
P.O. Box 51, Wanneroo, Western Australia, 6065.

ABSTRACT

During 1972 and 1973 plants and vertebrate animals were collected and recorded from a proposed 22 000 ha nature reserve centred on a chain of salt lakes in south-western Western Australia ($33^{\circ} 10' S - 33^{\circ} 35' S$ and $118^{\circ} 19' E - 118^{\circ} 29' E$).

The dominant plant species were collected, the structural formations described and a vegetation map produced. Seven species of native terrestrial mammal and three species of bat were recorded.

Three of the terrestrial species are endemic to south-western Western Australia, and two of these - Pseudomys occidentalis and Sminthopsis granulipes - are regarded as rare species. An inland population of Pseudomys albocinereus was recorded. Fifty-six bird, twenty-two reptile and two amphibian species were recorded. Many waterbirds use the lakes.

The area only includes habitats found at low level in the regional landscape.

I INTRODUCTION

Lake Grace North, Lake Grace South and Lake Chinokup are part of the salt lake system found east of the Meckering Line - a physiographic line in South Western Australia which, in the words of Mulcahy (1973) "marks a striking change in the drainage pattern". Sheet 5 of the Atlas of Australian Soils (Northcote, Bettenay, Churchwood and McArthur, 1967) clearly shows the pattern of drainage provided by the system.

The Grace-Chinokup lakes lie along the floor of a broad shallow valley with a north-south trend. Further north,

near Jilakin Lake, the lake chain coalesces with three similar chains originating near Lake Bryde, Lake Magenta and Lake Pallarup respectively. The resulting system gradually turns westward until, after collecting several other chains from further east and further north, it becomes, near Beverley, part of the headwaters of the Avon River (Beard, 1972).

The drainage system only functions as a river in exceptionally wet years. Normally, the lakes act as sumps in which water and salts accumulate. Evaporation, acting on the impeded drainage system, rapidly removes any exposed water leaving broad expanses of crystalline salt.

Like the other lakes in the system Lake Grace and Lake Chinokup are shallow and have flat bottoms. Soils in the salt lakes and saline channels are mainly undeveloped saline loams on riverine wash (Northcote *et al.*, 1967). Fringing the lakes are various resalinized duplex soils with yellow clayey "B" horizons. These areas, subject to periodic inundation, commonly support patches of low samphire (*Arthrocnemum* spp.) vegetation with *Melaleuca* shrubs on the slightly drier rises. The predominantly down-wind (eastern and south-eastern) edges of the lakes are generally surrounded by sand dunes or lunettes not more than 10 m high. The valley in which the lakes occur is broad and shallow and gradients are slight. Two isolated outcrops of granitic country rock occur on the western side of Lake Grace South.

The relevant climatic survey data has been published by The Bureau of Meteorology (Anon., 1964). Some generalizations have been extracted for this report.

Lake Grace and Lake Chinokup have a seasonal climate with cool wet winters and hot dry summers. There are three rainfall stations along these lakes. The oldest commenced recording in 1910, another in 1914 and the third in 1920. At all three, more than 50% of the rain falls between May and August (inclusive). Annual average rainfall at Edithdale Farm, *ca* 2 km west of the south end of L. Chinokup, is 36.5 cm. At L. Pingrup, at the north end of L. Chinokup, average rainfall is 35.0 cm, while at Lake Grace Townsite, *ca* 9 km north of the proposed nature reserve, it is 35.9 cm. Figures from Lake Grace and Lake Pingrup indicate that average rainfall exceeds effective rainfall for between 4.5 and 5 months each year. This is the approximate length of the plant growing season.

Temperature figures are available only from the Lake Grace Townsite. Over 8 years, the hottest month - January - had a mean maximum temperature of 32.1°C and the coldest month - July - a mean minimum temperature of 5.3°C. The highest temperature recorded was 44.5°C and the lowest - 1.7°C. In January the prevailing winds are from the north-west and in July from the south-east.

Although most of the surrounding country has been cleared, two extensive Flora Reserves (Nos. 26802 and 28395), and one smaller block of Crown land known as the Chinocup Townsite, still support native vegetation (Fig.1). A large proportion of Lake Grace North is covered by mining claims (for gypsum). The proposed reserve boundary recommended in McKenzie (1973) is shown in Fig. 1. These mining claims have since been relinquished and a series of new claims pegged. Although the new claims extend further northward than those illustrated in Fig. 1., the area under claim at the south end has been reduced. There is no good reason why the northern reserve boundary originally recommended should be changed. A narrow buffer strip of vacant Crown land such as the one separating the present mining claims from the proposed wildlife sanctuary is likely to be an advantage.

II FLORA

The lakes are in the Stirling District of the South-Western Botanical Province. Structurally important species, collected during the surveys, were used to construct a vegetation map based on the density, height and crown cover system described by Specht (1970).

The vegetation map (Figs. 2, 3, 4 and 5) was the result of aerial photo-interpretation of data collected by both field traverses on the ground and an aerial reconnaissance. Notes relating to the vegetation map are included below.

LOW OPEN-SHRUBLAND AND LOW SHRUBLAND.

Principally occur as decumbent mats of Chenopodiaceae (*Arthrocnemum* spp.) which fringe the lakes and fringe or cover the drainage channels and depressions in low-lying country around the lakes. These formations are extensive along the eastern and south-eastern borders of the large lakes.

LOW OPEN-SHRUBLAND AND OPEN-HEATH.

Found on the generally low lying, undulating, swampy country immediately west of the large lakes and in the regularly inundated country containing the drainage channels between the lakes, are slight sandy rises separated by saline depressions. In the depressions, as already mentioned, are areas of *Arthrocnemum* spp. while on the small isolated rises is an open-heath formation dominated by *Melaleuca* spp. (*M. thyoides* Turcz. etc.).

As the country becomes less swampy the patches of *Arthrocnemum* spp. disappear and *Melaleuca uncinata* R.Br. and *M. lateriflora* Benth. become more common in the open-heath. Small isolated patches of *Eucalyptus spathulata* Hook., *Melaleuca uncinata* R.Br. and *Bossiaea walkeri* F. Muell., forming a tall shrubland, occur on occasional slight rises.

TALL SHRUBLAND OF *Melaleuca* spp.

On higher ground, 2 m to 3 m above the level of the lakes, the sandy soils support a tall shrubland of *Melaleuca lateriflora* Benth., *M. affin. scabra* R.Br., *M. eleuthrostachya* F. Muell. and other *Melaleuca* spp. This formation is found as a narrow band around the edge of lakes where the shores rise abruptly from the salt-pan and, in broader expanses, well away from the lakes. A tall shrubland dominated by mallee species occurs as small isolated stands on slight rises in this formation. Species include *Eucalyptus leptocalyx* Blakely and *E. foecunda* Schau. over *Bossiaea walkeri* F. Muell. and *Melaleuca* sp.

LOW OPEN-SHRUBLAND, TALL SHRUBLAND AND OPEN-SCRUB OF MALLEE SPECIES.

Expanses of low open-shrubland, mainly *Eucalyptus angustissima* F. Muell. over *Isopogon burxifolius* R.Br., occur on the well drained and very gently sloping sandy soils found in areas south and south-west of Lake Chinokup and, to a limited extent, east of Lake Grace South. Further away from L. Chinokup, *Eucalyptus redunca* Schau., *E. leptocalyx* Blakely and scattered *Santalum* sp. form a tall shrubland over *Melaleuca uncinata* R.Br. and *Isopogon burxifolius* R.Br.

On the more clayey soils near the Chinokup Townsite Reserve the tall shrubland is replaced by an open-scrub formation of *Eucalyptus redunca* Schau. and *E. anceps* R.Br. (3-4 m) over an almost homogeneous understorey of *Melaleuca uncinata* R.Br. (1 m).

LOW FOREST, WOODLAND AND OPEN-WOODLANDS.

Open-woodland occurs in isolated patches throughout the lake system. The trees, *Eucalyptus kondininensis* Maiden et Blakely, are 10 to 20 m high. Occasional shrubs and thickets of *Melaleuca uncinata* R.Br., *Atriplex vesicaria* Benth. and *Acacia nysophylla* F. Muell. form the understorey although most of the ground under the trees is bare or covered with leaf litter.

In the south-eastern corner of reserve No. 26802 *Eucalyptus loxophleba* Benth. and *E. kondininensis* Maiden et Blakely, form a woodland formation. Sparse *Chamaelaucium ciliatum* Desf. and leaf litter cover the ground.

An open-woodland of *Eucalyptus salmonophloia* F. Muell., over *Eucalyptus annulata* Benth., *Melaleuca cuticularis* Labill. and *M. acuminata* F. Muell., is found as an isolated stand west of L. Chinokup. Nearby is a low forest of *Eucalyptus platypus* Hook. over *Melaleuca uncinata* R.Br. and *M. lateriflora* Benth. In places the *Eucalyptus platypus* Hook. becomes an understorey element of the open-woodland. Much of the exposed ground in both these formations is covered by thick deposits of leaf litter.

LOW SHRUBLAND, OPEN-HEATH AND TALL OPEN-SHRUBLANDS.

These formations occur on the deep sandy soils of the dune systems found east and south-east of the lakes.

Low shrubland often covers the narrow sandy dunes found close to the edge of the lakes. *Leptospermum podanthum* (F. Muell.) Diels. and *Regelia inops* Schau. are the structurally important species.

Further from, but still associated with the lakes, are extensive dune systems often forming broad, relatively flat sandplains about 10 m above the level of the lakes. These sandplains support an open-heath which includes a number of species in various combinations. *Eremaea pauciflora* (Endl.) Druce., *Regelia inops* Schau., *Leptospermum ? erubescens* Schau., *Banksia baueri* R.Br., *Adenanthos cuneata* Labill., *Hakea corymbosa* R.Br., *Stephelia tenuiflora* Lindl., *Petrophile ericifolia* R.Br., *Hakea prostrata* R.Br., *Lachnostachys albicans* Hook., *Casuarina acuaria* F. Muell., *Bossiaea walkeri* F. Muell., *Grevillea* sp., and *Isopogon buxifolius* R.Br. are common species.

On the rises in the sandplains and on the broad dunes along the south-eastern and eastern sides of the major lakes, elements of the previous formation become the understorey of a tall open-shrubland dominated by *Banksia prionotes* Lindl. and, to a lesser extent, *B. attenuata* R.Br. In some places there is no understorey and in other places *Leptospermum podanthum* (F. Muell.) Diels. is important. These dunes, to the east of the major lakes, also support broad areas of tall open-shrubland in which the understorey is the open-heath of mainly Proteaceous species described earlier but the upperstorey is a mallee (*Eucalyptus ? redunca* Schau.). *Banksia prionotes* Lindl. is often also present.

Restricted areas of other formations also occur in these sandplain systems. On the open-heathland between North and South Lake Grace are a series of claypans in which the vegetation is mainly an as yet undescribed species of *Arthrocnemum*. Fringing the claypans is a tussock grassland of *Gahnia trifida* Labill. and Pigface (*Carpobrotus ? modestus* T.S.Blake). Two species of mallee, *Eucalyptus loxophleba* Benth. (glaucous form) and *E. foecunda* Schau., form a narrow band around the pans. South of Lake Chinokup, in a similar situation, a low shrubland of *Eucalyptus foecunda* Schau. occurs. The understorey is a tussock grassland of *Gahnia polyphylla* Benth. and *Melaleuca* sp. *Eucalyptus leptocalyx* Blakely is sometimes present in the larger hollows.

III FAUNA

The first collection (Butler, 1972) was made in February 1972 when Mr. W.H. Butler, under contract to the Department of Fisheries and Wildlife, visited the area while undertaking a biological survey of the Chinokup Reserve (No. 18803). His capture of *Pseudomys occidentalis* prompted a closer examination of the potential value of the lake system to wildlife conservation.

Subsequent surveys by officers of the Department of Fisheries and Wildlife were undertaken late in March 1972 (vegetation only), in early and late February 1973, in mid-March 1973 and in late August 1973. Each visit lasted five to six days.

Trapping effort, involving Cage, Pit, small Elliott and Break-back Traps, was approximately 900 trap-nights on reserve No. 28395 and 2200 trap-nights on reserve No. 26802.

The bird list was compiled from sight records although certain species were collected to confirm their identification. Reptiles and amphibians were collected opportunistically.

All the collected animal specimens have been lodged with the Western Australian Museum.

A. MAMMALS

Macropus fuliginosus (Desmarest)

Grey Kangaroos were seen throughout the system both during the day and during spotlighting runs at night.

Macropus irma (Jourdan)

Western Brush Wallabies were seen during the day and during night-time spotlighting runs in both reserves, especially in the open-heathland of the sandplains.

Sminthopsis granulipes Troughton

Two female White-tailed Dunnarts were trapped (15 and 16 March 1973) in tall open-shrubland, with both *Banksia prionotes* and *B. attenuata* in the upper-storey, on reserve No. 26802.

This species has been recorded on only two Flora and Fauna Reserves; an 800 ha reserve near Nippering and from the 5 000 ha Bending Wildlife Sanctuary west of Kondinin (Kitchener *et al.*, in press).

Pseudomys occidentalis Tate

One male Western Mouse was trapped by W.H. Butler on 15 February 1972. It came from reserve No. 28395 - south of Lake Chinokup.

The species has recently been collected on the Dragon Rocks Proposed Reserve near Hyden (McKenzie *et al.*, 1973) and on the Bending Wildlife Sanctuary (Kitchener *et al.*, in press).

Pseudomys albocinereus (Gould)

Two male Ashy-grey Mice were trapped on reserve No. 26802 on 16 and 20 March 1973. One came from tussock grassland (*Gahnia trifida*) fringing a claypan and the other from an area of regenerating tall open-shrubland (*Banksia prionotes*) only a short distance away.

This record is further inland than any previous capture in Western Australia although the species is known from inland localities in New South Wales, Victoria and South Australia (Ride, 1970). Thomas (1907, cited in Ride, Mees, Douglas, Royce and Tyndale-Biscoe, 1962) includes a record of this species from "open sandplains around Beverley, Brookton and Pingelly" - Western Wheatbelt Shires in Western Australia.

Notomys mitchellii (Ogilby)

Two male Mitchell's Hopping-mice were captured on reserve No. 28395 on 6 and 8 February 1973. One was trapped on the edge of tall shrubland (*Melaleuca* spp.) near a small patch of mallee growing on sandy soil and the other came from low shrubland (*Leptospermum podanthum*) growing on a narrow dune.

Nyctophilus geoffroyi Leach

Two female Lesser Long-eared Bats were collected on reserve No. 26802. One was under the bark of a dead *Banksia attenuata* (ca 3 m from the ground) and the other was shot at dusk in *Eucalyptus kondininensis* open-woodland.

Chalinolobus gouldii (Gray)

Ten (9 females and 1 male) Gould's Wattled Bats were collected on reserve No. 26802. Seven were shot at dusk; five in *Eucalyptus kondininensis* open-woodland and two (including the male) over low-shrubland (*Leptospermum podanthum*) on sand dunes fringing a soak. Three were shot at night in tall open-shrubland (mallee) on the sandplain system east of Lake Grace.

Eptesicus pumilis (Gray)

Two adult female Little Bats were shot at dusk over a claypan adjacent to an open-woodland of *Eucalyptus kondininensis* in February 1973 on reserve No. 28395.

Tachyglossus aculeatus (Shaw)

One adult Echidna was collected and subsequently released in August 1973 in *Eucalyptus kondininensis* open-woodland on reserve No. 26802. Diggings and scats were recorded on meat-ant nests in both reserves.

Vulpes vulpes (Linnaeus)

Tracks, thought to be made by foxes, were noted on sandy areas in both the Flora reserves.

Mus musculus (Linnaeus)

Twelve (11 male and 1 female) House Mice were collected from open-heath (on sandplain) during the 1973 visits. W.H. Butler collected 2 males and 1 female during his visit to reserve No. 28395 in February 1972. Owl pellet material from reserve No. 26802 yielded only *Mus musculus* bone material.

Oryctolagus cuniculus (Linnaeus)

Rabbit warrens were common in sandy soils fringing cleared farming land.

The ten species of native mammal includes only one small marsupial. Other small marsupials such as *Tarsipes spencerae*, *Cercartetus concinnus*, *Phascogale calura*, *Sminthopsis murina*, *Sminthopsis crassicaudata* and *Dasyurus geoffroii* occur in the district (McKenzie *et al.*, 1973; Kitchener *et al.*, in press).

The list includes two species of small mammal which are endemic to the South-Western Botanical Province of Western Australia. These species, *Sminthopsis granulipes* and *Pseudomys occidentalis*, have been declared "rare and likely to become extinct" under the W.A.

Fauna Conservation Act. Since 1970, populations of both species have been found on at least two reserves in the South-West of W.A. From the point of view of their long-term survival, a series of reserves throughout their range and covering the diversity of their known habitats is desirable.

B. BIRDS.

<i>Dromaius novaehollandiae</i>	Emu
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant
<i>Ardea novaehollandiae</i>	White-faced Heron
<i>Tadorna tadornoides</i>	Mountain Duck
<i>Anas superciliosa</i>	Black Duck
<i>Aquila audax</i>	Wedge-tailed Eagle
<i>Falco berigora</i>	Brown Hawk
<i>Falco cenchroides</i>	Nankeen Kestrel
<i>Vanellus tricolor</i>	Banded Plover
<i>Charadrius cucullatus</i>	Hooded Dotterel
<i>Charadrius alexandrinus</i>	Red-capped Dotterel
<i>Recurvirostra novaehollandiae</i>	Avocet
<i>Phaps chalcoptera</i>	Common Bronzewing
<i>Neophema elegans</i>	Elegant Parrot
<i>Barnardius zonarius</i>	Port Lincoln Parrot
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet
<i>Ninox novaeseelandiae</i>	Boobook Owl
<i>Podargus strigoides</i>	Tawny Frogmouth
<i>Aegotheles cristatus</i>	Owlet Nightjar
<i>Merops ornatus</i>	Rainbow Bee-eater
<i>Hirundo neoxena</i>	Welcome Swallow
<i>Artamus cinereus</i>	Black-faced Wood-Swallow
<i>Artamus cyanopterus</i>	Dusky Wood-Swallow
<i>Anthus novaeseelandiae</i>	Australian Pipit
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-Shrike
<i>Drymodes brunneopygia</i>	Southern Scrub-Robin
<i>Pomatostomus superciliosus</i>	White-browed Babbler
<i>Smicrornis brevirostris</i>	Weebill
<i>Hylacola cauta</i>	Heath Wren
<i>Acanthiza apicalis</i>	Broad-tailed Thornbill
<i>Pyrrhuloemus brunneus</i>	Redthroat
<i>Malurus pulcherrimus</i>	Blue-breasted Wren
<i>Petroica goodenovii</i>	Red-capped Robin
<i>Petroica multicolor</i>	Scarlet Robin
<i>Microeca leucophaea</i>	Brown Flycatcher
<i>Seisura inquieta</i>	Restless Flycatcher

<i>Rhipidura leucophrys</i>	Willie Wagtail
<i>Rhipidura fuliginosa</i>	Grey Fantail
<i>Pachycephala pectoralis</i>	Golden Whistler
<i>Colluricincla rufiventris</i>	Western Shrike-Thrush
<i>Oreoica gutturalis</i>	Crested Bellbird
<i>Neositta pileata</i>	Black-capped Sitella
<i>Pardalotus substriatus</i>	Striated Pardalote
<i>Zosterops gouldi</i>	Western Silvereye
<i>Meliphaga cratitia</i>	Purple-gaped Honeyeater
<i>Meliphaga leucotis</i>	White-eared Honeyeater
<i>Meliphaga ornata</i>	Yellow-plumed Honeyeater
<i>Phylidonyris niger</i>	White-cheeked Honeyeater
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater
<i>Lichmera indistincta</i>	Brown Honeyeater
<i>Anthochaera carunculata</i>	Red Wattlebird
<i>Anthochaera chrysoptera</i>	Little Wattlebird
<i>Strepera versicolor</i>	Grey Currawong
<i>Gymnorhina dorsalis</i>	Western Magpie
<i>Cracticus torquatus</i>	Grey Butcherbird
<i>Corvus coronoides</i>	Australian Raven

The fifty-six birds identified are those normally associated with the salt lake and sandplain systems of the south-eastern parts of the "Wheatbelt" of the South-Western Botanical Province.

Storr (pers. comm.) examined the list and commented that "the Purple-gaped Honeyeater (*Meliphaga cratitia*) in Western Australia is confined to the Wheat Belt. Its continued existence therefore depends on mallee country reserved from agriculture. It not only requires substantial stands for breeding in but also for maintaining itself during its seasonal movements throughout the southern half of the Wheat Belt".

Riggert (1973), in his submission on waterfowl to the Conservation Through Reserves Committee, stated that the Lake Grace wetland system is of major importance to waterfowl. In the years when they contain water the large lakes of the system are used for breeding and the small lakes, some of which are fresh-water lakes, for feeding and drinking. As the water evaporates from the large lakes the waterfowl move to the more permanent smaller lakes.

In Riggert's opinion disturbance of the waterfowl while they are breeding on the large lakes is unlikely because

of the huge areas of inundation involved. Strip mining however, or other widespread disturbance of the lake surfaces, might disrupt the natural flow of water through the lakes, or alter the water's physical and chemical properties, and thereby affect the breeding of ducks on these lakes. Such mining operations are becoming quite common in eastern Australia; the Gypsum claims which cover a large part of North Lake Grace have already been mentioned.

The following waterfowl have been recorded from the lake system by Riggert (pers. comm.):

1. Black Swan (*Cygnis atratus*) and Mountain Duck (*Tadorna tadornoides*) - common on all wetlands throughout the system.
2. Grey Teal (*Anas gibberifrons*) and Chestnut Teal (*Anas castanea*) - normally seen in the brackish conditions around the edges of the large lakes, and in many of the small lakes, in winter.
3. Wood Duck (*Chenonetta jubata*), Black Duck (*Anas superciliosa*), Pink-eared Duck (*Malacorhynchus membranaceus*) and Blue-winged Shoveler (*Anas rhynchotis*) - normally associated with small fresh-water lakes although in years of heavy rainfall, when all the lakes are flushed and the waters are relatively fresh, these species can be seen throughout the entire system.

The list of birds is by no means complete. Carnaby (1933) listed many other species in the Lake Grace district including several additional species of wading birds and waterfowl. Hoary-headed Grebe, Red-kneed Dotterel, Australian Dotterel, Black-fronted Dotterel, White-headed Stilt, Banded Stilt, Sanderling and Musk Duck are included in his list. Serventy (1958) recorded Greenshank, Little Grebe and Silver Gull, among other species, from the causeway across North Lake Grace. He also recorded Gull-billed Terns at Lake Grace. Pelicans, White-fronted Heron and White Egret are also known to visit the system (Riggert, pers. comm.). It is clear from these records that a further visit, in spring after a wet winter, would be needed to provide a more comprehensive list of the waterfowl and wading birds.

Two Wedge-tailed Eagle nests were located and a search of the ground beneath the nests revealed that they had been feeding mostly on rabbits. Skeletal fragments of

a juvenile Grey Kangaroo (*Macropus fuliginosus*), two reptiles (*Tiliqua rugosa* and *Varanus gouldii*), and two birds (Raven, *Corvus coronoides*, and Port Lincoln Parrot, *Barnardius zonarius*) were also found on the ground under the nests.

A Brown Hawk was collected and its gut contents included two reptiles species (*Denisonia gouldii* and *Amphibolurus maculatus griseus*) and several grasshoppers and beetles.

C. REPTILES AND AMPHIBIANS

LEPTODACTYLIDAE

Heleioporus albopunctatus
Neobatrachus pelobatoides

TYPHLOPIDAE

Ramphotyphlops bituberculatus

ELAPIDAE

Denisonia gouldii
Demansia affinis
Vermicella bertholdi

PYGOPODIDAE

Pygopus lepidopodus

GECKONIDAE

Oedura reticulata
Gehyra variegata
Diplodactylus maini
Phyllodactylus marmoratus

AGAMIDAE

Amphibolurus maculatus griseus
Amphibolurus salinarum
Amphibolurus minor

SCINCIDAE

Hemiergus initialis
Tiliqua rugosa
Tiliqua occipitalis
Cryptoblepharus plagiocephalus
Morethia obscura
Menetia greyii
Egernia multiscutata bos
Ctenotus impar
Lerista distinguenda

VARANIDAE

Varanus gouldii rosenbergi

The twenty-two reptile species listed all belong to the south-eastern Wheatbelt reptile fauna which includes at least forty species. The only family of reptiles not collected is that of the Pythons which, in the area being discussed, has only one known representative - *Python spilotes*. Certain other families are poorly represented in the collection and many relatively common south-eastern Wheatbelt reptiles were not recorded, possibly because the area only had representatives of habitats found in low level landscapes. *Amphibolurus salinarum* is near the western limits of its range.

The amphibians are only represented by two species although *Crinia pseudinsignifera* was collected, and *Limnodynastes dorsalis* was heard calling, in a fresh water soak ca 100 m outside the eastern boundary of the proposed sanctuary. The failure to record these, and certain other species known to occur in this district, is probably connected with the apparent absence of permanent fresh water habitats

in the survey area. *Litoria cyclorhynchus* for instance, which is found in swamps and permanent fresh water (Main, 1965), was recorded from the nearby Chinocup Reserve (No. 18803) by Butler (1972). He collected the specimens in a large permanent fresh water dam.

Further work, especially after periods of heavy rain, might uncover *Pseudophryne guentheri* and *Myobatrachus gouldii* on the proposed nature reserve.

IV DISCUSSION

The recommendations to change the purposes of the Crown land around Lake Grace and Lake Chinocup to include Conservation of Flora and Fauna, to vest it in the Western Australian Wild Life Authority, and to declare the area of "A Class" status, have already been made in McKenzie (1973). The proposed sanctuary boundaries were also discussed in that publication. Recent changes in the area covered by mining claims on North Lake Grace have already been discussed in the introduction to this paper where a recommendation was made that the proposed boundary be left unchanged.

Although the area covered by the proposal totals 22 000 ha (ca 12 500 ha is salt lake), it does not include a cross-section of the landscape found in the region. In fact, the vegetation map (Figs. 2-5) and results of the survey of Kent Shire (McKenzie, 1973) indicate that while habitats of low-level landscape units are well-represented on the proposal no high-level, and few medium-level, habitats could be found. Throughout this report the absence of such habitats has been suggested as a reason why so many apparently common south-eastern Wheatbelt animals were not recorded. Naturally, in areas surrounded by cleared farmland, other influences might tend to reduce the species diversity; furthermore the collecting effort was extensive but by no means exhaustive.

The lists of animals are not presented as complete lists of the vertebrate species which use the system. It is hoped that they will provide a background for further work in the area, provide additional information which can be used in studies of faunal diversity in relatively isolated Wheatbelt reserves, and supply sufficient comparative information to assist in the assessment of other proposed Wheatbelt reserves.

If the mining claims on North Lake Grace are to be developed in the future, a monitoring program should be undertaken. It should be designed to record any effects on the drainage pattern through the system, any alteration in the physical properties of the water, and to document usage by waterfowl and wading birds.

V ACKNOWLEDGEMENTS

We would like to thank the Western Australian Museum and the Western Australian Herbarium for their assistance in identifying the collections of animals and plants.

The authors would especially like to express their appreciation to Dr. T.L. Riggert for his comments on the waterfowl and to Dr. G. Storr for his comments on the bird list.

Mr. F. Riffey, Mr. K. Morris and Mr. E. Ride assisted with the field work and Dr. A.A. Burbidge examined the manuscript.

VI REFERENCES

Anon. (ca 1964). Climatic Survey. Region 2 - Great Southern, Western Australia. Issued by the Director of Meteorology, Melbourne.

Beard, J.S. (1972). The Vegetation of the Newdegate and Bremer Bay Areas, Western Australia. (Vegmap Publications: Sydney).

826/69 *Butler, W.H. (1972). A preliminary survey of Chinocup reserves, Lake Bryde Wildlife Sanctuaries, and Lake Cairlocup Wildlife Sanctuary. Unpublished Report Prepared for the Department of Fisheries and Wildlife, Western Australia. -121/71

Carnaby, J.C. (1933). The Birds of the Lake Grace district, W.A. *Emu* 33, 103-109. -281/66

- Kitchener, D.J., Chapman A. and Dell, J., (In press).
 In Kitchener *et al.* Biological Surveys of the
 Western Australian Wheatbelt. Part IV - Bending
 Reserve. *Supp. Rec. West. Aust. Mus.*
- Main, A.R. (1965). "Frogs of southern Western Australia"
 Handbook No. 8. Western Australian Naturalists Club:
 Perth.
- * McKenzie, N.L. (1973). Results of a biological survey
 of the shire of Kent, Western Australia. Report
 No. 13. Department of Fisheries and Wildlife.
- McKenzie, N.L., Burbidge, A.A. and Marchant, N.G. (1973).
 Results of a biological survey of a proposed wildlife
 sanctuary at Dragon Rocks near Hyden, W.A. Report
 No. 12. Department of Fisheries and Wildlife, W.A.
- Northcote, K.H., Bettenay, E., Churchwood, H.M. and
 McArthur, W.M. (1967). Atlas of Australian Soils
 Sheet 5. (C.S.I.R.O. - Melbourne University Press:
 Melbourne).
- Mulcahy, M.J. (1973). Landforms and soils of south-
 western Australia. *J. Roy. Soc. W.A.* 56, 16-22.
- Ride, W.D.L. (1970). "A guide to the native mammals
 of Australia". (Oxford University Press : Melbourne).
- Ride, W.D.L. and Tyndale-Biscoe, C.H. (1962). Mammals.
 In 'Results of an Expedition to Bernier and Dorre
 Islands, Shark Bay, Western Australia in July 1959'.
 Ed. A.J. Fraser. Fauna Bulletin No. 2, Fisheries
 Department, Perth.
- Riggert, T.L. (1973). Submission to the Conservation
 Through Reserves Committee, W.A. (Unpublished).
- Serventy, V. (1958). Bird notes from the Dumbleyung
 camp-out, 1956. *Emu* 58, 5-20.
- Specht, R.L. (1970). Vegetation. In "The Australian
 Environment". 4th Ed. (Ed. G.W. Leeper). pp 44-67
 (C.S.I.R.O. - Melbourne University Press : Melbourne).

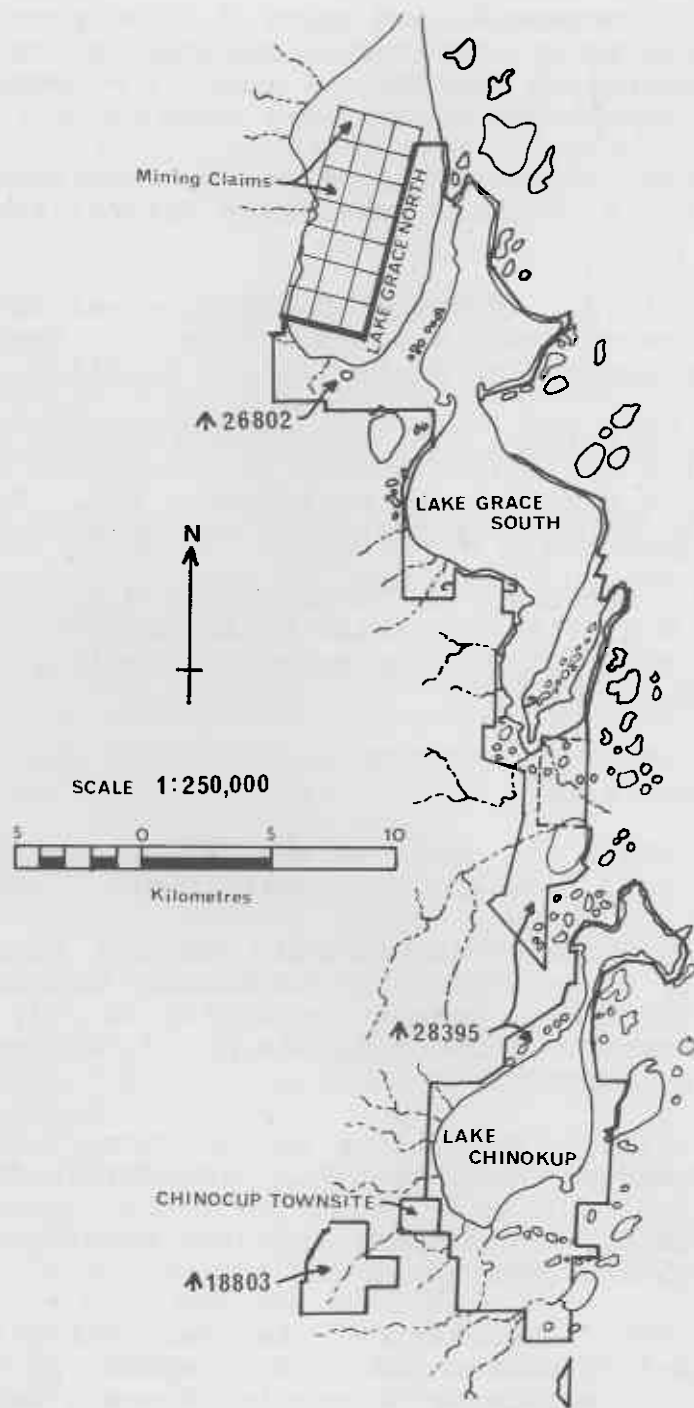


FIGURE 1. LAKE GRACE, LAKE CHINOKUP AND ENVIRONS.

KEY TO FLORA MAPS

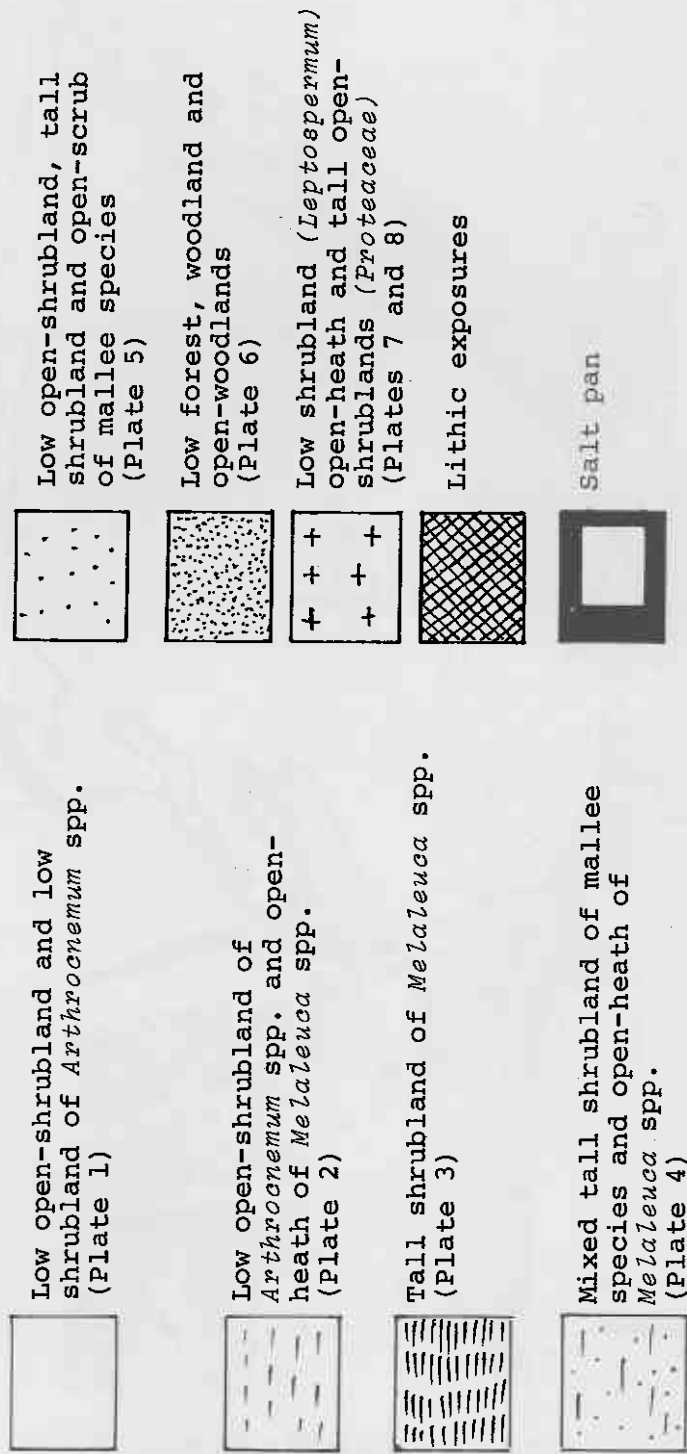


FIGURE 2. KEY TO VEGETATION MAPS.

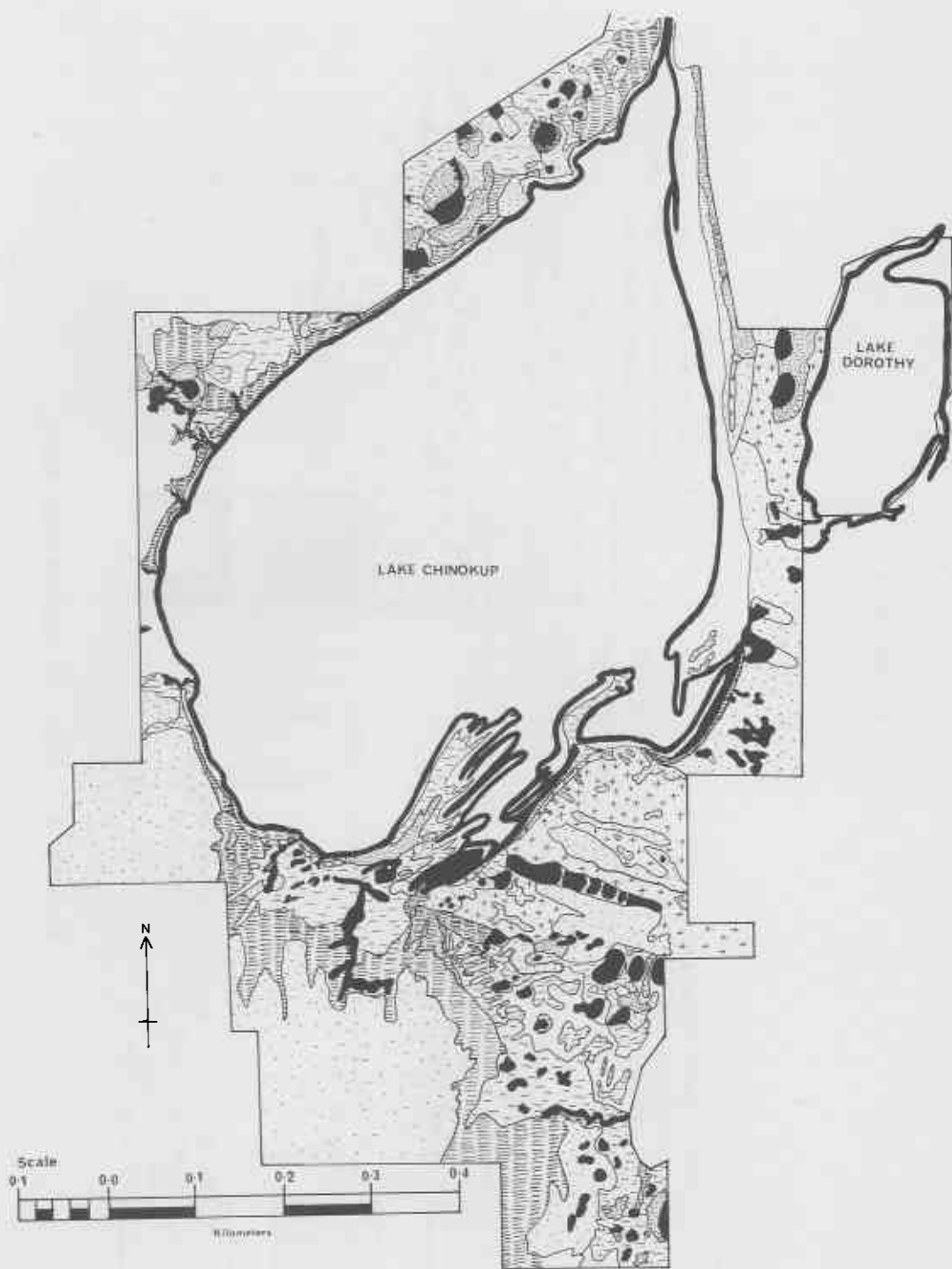


FIGURE 3. THE VEGETATION AROUND LAKE CHINOKUP.



FIGURE 4. THE VEGETATION OF THE CENTRAL PORTION OF THE PROPOSED RESERVE

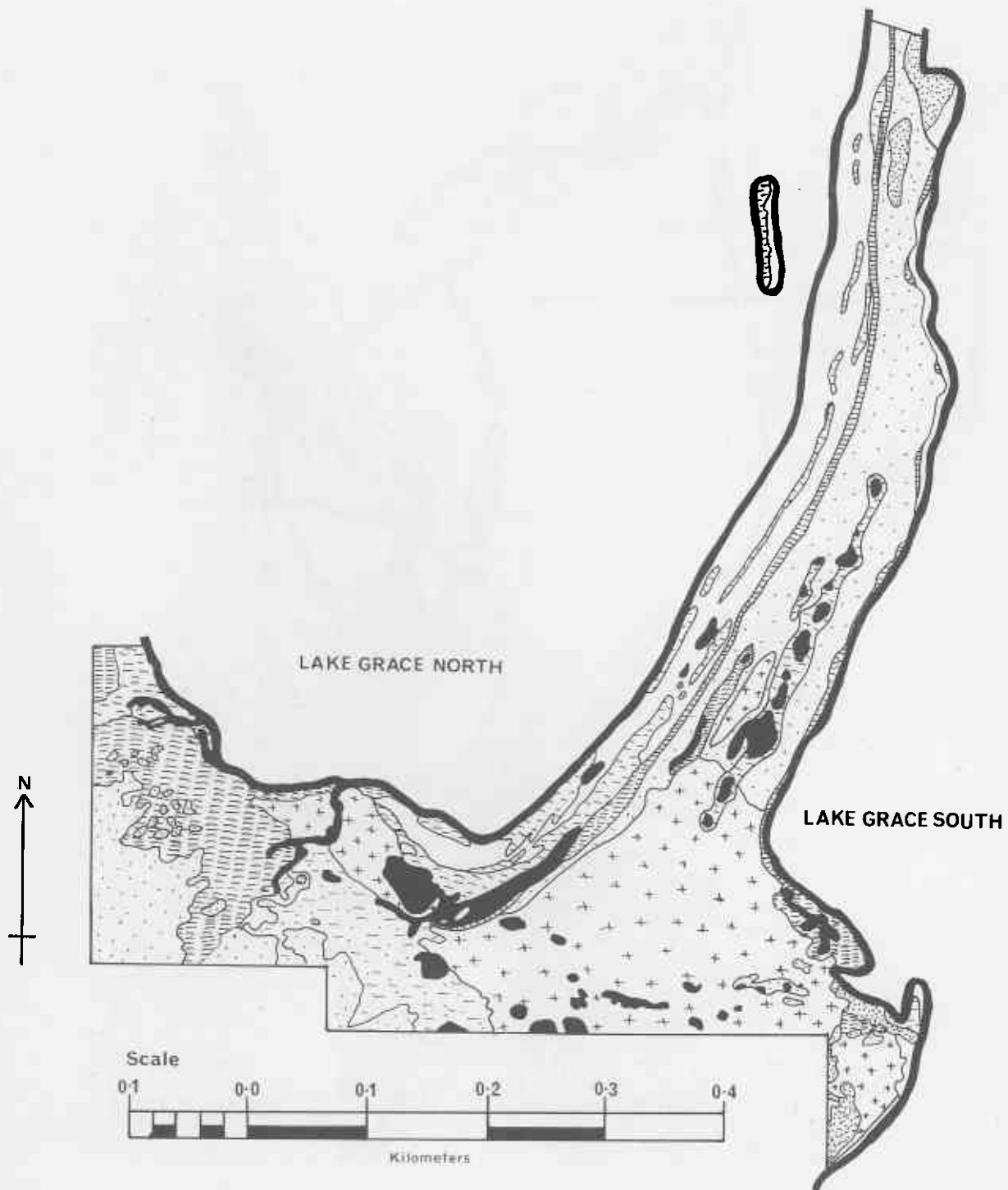


FIGURE 5. THE VEGETATION BETWEEN LAKE GRACE NORTH AND LAKE GRACE SOUTH



Plate 1. Low open-shrubland of *Arthrocnemum* spp.



Plate 2. Aerial view of low-shrubland and low open-shrubland of *Melaleuca* spp. and *Arthrocnemum* spp. respectively



Plate 3. Low shrubland to open-scrub of *Melaleuca* spp.



Plate 4. Mixed tall shrubland of mallee species and open-heath to tall shrubland of *Melaleuca* spp.



Plate 5. Tall shrubland of mallee species fringing
a small lake



Plate 6. Woodland



Plate 7. Low shrubland (*Leptospermum*)



Plate 8. Tall open-shrubland (Proteaceae)