

NATURE CONSERVATION RESERVES IN THE

Kimberley

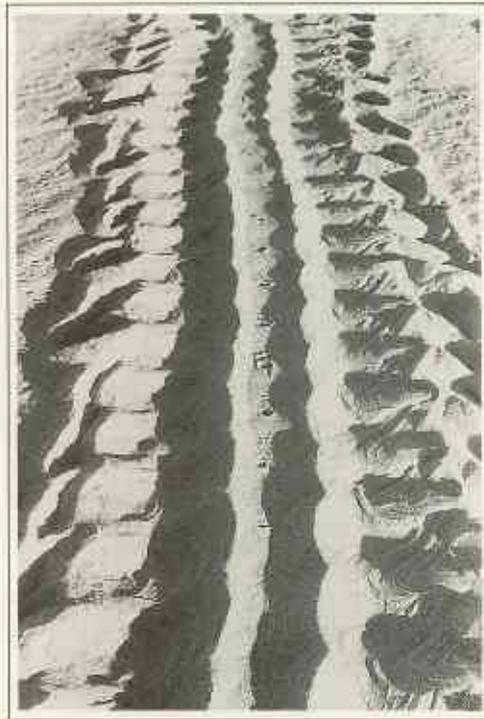


WESTERN AUSTRALIA



Department of Conservation and Land Management

NATURE
CONSERVATION
RESERVES



IN THE
KIMBERLEY
WESTERN AUSTRALIA

by
Andrew A. Burbidge
N.L. McKenzie
and
Kevin F. Kenneally

1991

Department of Conservation and Land Management, Western Australia

Gulingi Nangka



PREFACE

This publication is the submission by the Department of Conservation and Land Management to the Kimberley Region Planning Study. The submission was compiled from information available early in 1987.

Considerable biogeographical research has been conducted in the Kimberley since the early 1970s. This report is based on that research. However, future studies will doubtless highlight additional nature conservation requirements. Our recommendations, although based on a comparatively good data base, should not be considered the final word on a reserve system that represents all of the region's biota and landscapes.

Some additional information has already become available. Two areas deserve special mention:

1. Munja Lagoon (16° 22'S, 124° 56'E) is one of the few large permanent fresh water swamps in the North Kimberley. It provides suitable habitat for north-west Kimberley populations of the Comb-crested Jacana and numerous other wetland birds through the dry season.
2. A proposed nature reserve near Derby, at 17° 20'S, 123° 24'E, comprising a small, sub-coastal area of black-soil plain and relict Pleistocene sand dunes, was overlooked in the submission.

Decisions about previous conservation recommendations have been taken by the Government since CALM's submission was written, e.g. concerning Walcott Inlet. However, this report has not been amended.

In this document we have not addressed the conservation of MANGROVE and RAINFOREST communities. These two vegetation types are of significant importance to nature conservation. Both are dominated by species that do not occur in any other habitat type in the State and their dense vegetations create microclimates on which a great number of other species are totally dependent. Both communities occur in relatively small patches scattered over great areas; this feature makes it particularly difficult to protect them via reservation.

Considering the great importance of these communities and their susceptibility to disturbances, nothing should be done to destroy any patch of either community without proper environmental impact assessment.

The EPA commented on mangroves as follows:

"Mangrove communities are a feature of the northern Western Australian coast, both as extensive low closed-forest on tidal flats and as narrow fringes on rocky shores. Because of their great biological and physical importance which has only recently been widely recognised, the Authority considers that mangrove communities should be retained and protected wherever practicable. Mangroves help stabilise the coastline by colonising newly created prograding shorelines. Because of their extensive and specialised root system, mangroves slow water movement sufficiently to cause some sediment to fall out of suspension. This attribute has allowed the mangrove communities to become a very rich food source to marine fauna. Commercial exploitation of fish and crustacea dependent on this source takes place throughout much of northern Australia."

"The Authority therefore RECOMMENDS that any proposed developments which would affect a significant area of mangroves on the Western Australian coast be referred to the Authority for assessment as to its biological or physical importance in that location before action is taken which could lead to their destruction."

Recommendations: We recommend that the Environmental Protection Authority ensure that all proposals that affect either mangrove or rainforest communities are referred for environmental impact assessment. We recommend that Munja Lagoon and the proposed nature reserve near Derby be declared Class A reserves for the conservation of flora and fauna and vested in the National Parks and Nature Conservation Authority.



ACKNOWLEDGEMENTS

This report is based on "Conservation Reserves in Western Australia, Report of the Conservation Through Reserves Committee on System 7 to the Environmental Protection Authority 1977" and we acknowledge our debt to the authors of that document.

At the time the System 7 report was produced the Conservation Through Reserves Committee comprised:

Mr J.F. Morgan (Chairman), *Surveyor General for Western Australia*
Dr B.E. Balme, *Reader in Geology, University of Western Australia*
Professor R.T. Appleyard, *Professor of Economic History, University of Western Australia*

The report was written mainly by the Technical Sub-committee which comprised:

R.T. Appleyard, M.A., Ph.D. F.A.S.S.A., *Professor of Economic History, University of Western Australia (Convenor)*
A.A. Burbidge, B.Sc.(Hons), Ph.D., *Senior Research Officer, Wildlife Research Branch, Department of Fisheries and Wildlife*
A.S. George, B.A., *Western Australian Herbarium, Department of Agriculture*
***J.H. Lord, B.Sc., F.G.S., M.Aus.I.M.M.**, *Director, Geological Survey Branch, Mines Department*
B.J. White, B.Sc. (For), *Forests Department*
Mr L. Goodridge, *Secretary*

* Mr Lord was represented at most meetings of the Subcommittee by Mr E. Biggs, a Geologist of the Geological Survey Branch, Mines Department.

The sections of the CTRC Report on the South-west Kimberley were contributed by N.L. McKenzie.

We also thank our colleagues who have contributed information to this publication: P.F. Berry, A. Chapman, C.C. Done, P.J. Fuller, S.A. Halse, P. Kimber, J.A.K. Lane, and R.E. Johnstone. The assistance of Ms Jill Pryde with word processing is gratefully acknowledged. The maps were prepared by CALM's Mapping Branch and we are particularly grateful to John Forster, Steve Rowlands, Mark Laming, Annette Turpin and Annette Jones. We also thank Wendy Searle and Allan Burbidge for their accurate proofreading. The assistance of Carolyn Thomson, Louise Burch, Stacey Strickland, Sandra Mitchell and Margaret Wilke of CALM's Public Affairs Branch is gratefully acknowledged.

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INTRODUCTION

In 1972, shortly after it was established by Act of Parliament, the Environmental Protection Authority (EPA) established the Conservation Through Reserves Committee (CTRC) to recommend a system of nature conservation reserves for Western Australia.

CTRC divided the State into 12 "systems" (Map 1) and its first report in 1974 made recommendations for reserves in 10 of these. System 7, the Kimberley, was the subject of a separate report, released in 1977.

The EPA, after considering public submissions on the recommendations for reserves in System 7, made recommendations to State Cabinet, which were published in 1980. Although Cabinet endorsed all the EPA recommendations in principle, it decided that implementation of each recommendation was to be on the basis of separate Cabinet decisions. Very few of the recommendations have been further considered by Cabinet, mainly because of delays while various enquiries were completed, and the failure of all relevant Government departments to agree.

In 1986 the Government set up a Kimberley Land Use Study, later called the Kimberley Region Planning Study (KRPS) to be carried out by the State Planning Commission and the Department of Regional Development and the North-West.

The aim of the study is "to prepare a long range planning strategy for the Kimberley Region having particular regard to economic, social and environmental issues and to devise such mechanisms as are necessary to effect the implementation of that strategy."

The primary objective relating to natural resources is "to identify areas and items of natural, cultural, historical or archaeological significance and to specify those strategies which will provide for the maintenance, conservation and where appropriate the development of the Region's natural attributes and resources" (KRPS 1987).

The Department of Conservation and Land Management decided that it would make a major submission to the KRPS, especially with respect to the need to declare additional national parks, nature reserves and conservation parks in the Kimberley. It was felt that the best way to do this would be to revise and update the CTRC System 7 Report.

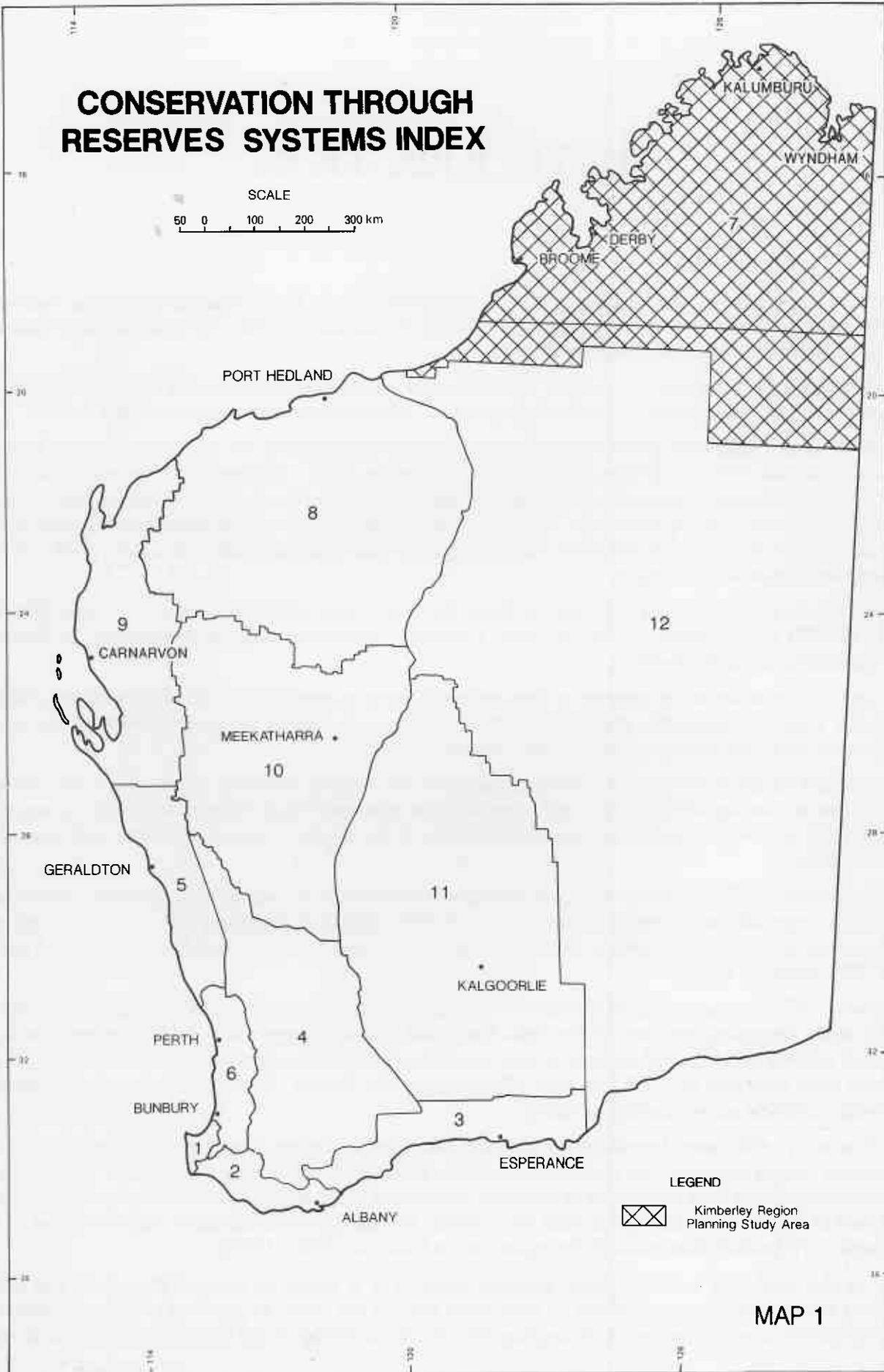
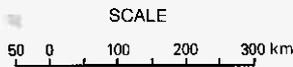
Because the KRPS is examining all the land in the four Kimberley Shires, its boundary is different from the CTRC study, extending into parts of the Great Sandy and Tanami Deserts (Map 1). In this report we have included existing and proposed reserves in those portions of the deserts relevant to the present study. Some of these were described by CTRC in their 1974 report under System 12; some have been recommended following biological surveys carried out since.

The Kimberley of Western Australia has a flora and fauna largely distinct from that of the rest of the State, but closely related to that of the northern parts of the Northern Territory and Queensland. Nevertheless, the Kimberley differs from other parts of northern Australia in many respects, and national parks elsewhere, such as Kakadu, do not remove the need for a proper, representative conservation reserve system in the Kimberley. A detailed description of the region can be found in CTRC (1977).

Most of the Kimberley is Crown land, although much of it is leased for pastoral purposes. The KRPS provides an opportunity, not available in most other parts of the State, to proclaim a truly representative series of nature conservation reserves in keeping with the World, National and State Conservation Strategies.



CONSERVATION THROUGH RESERVES SYSTEMS INDEX

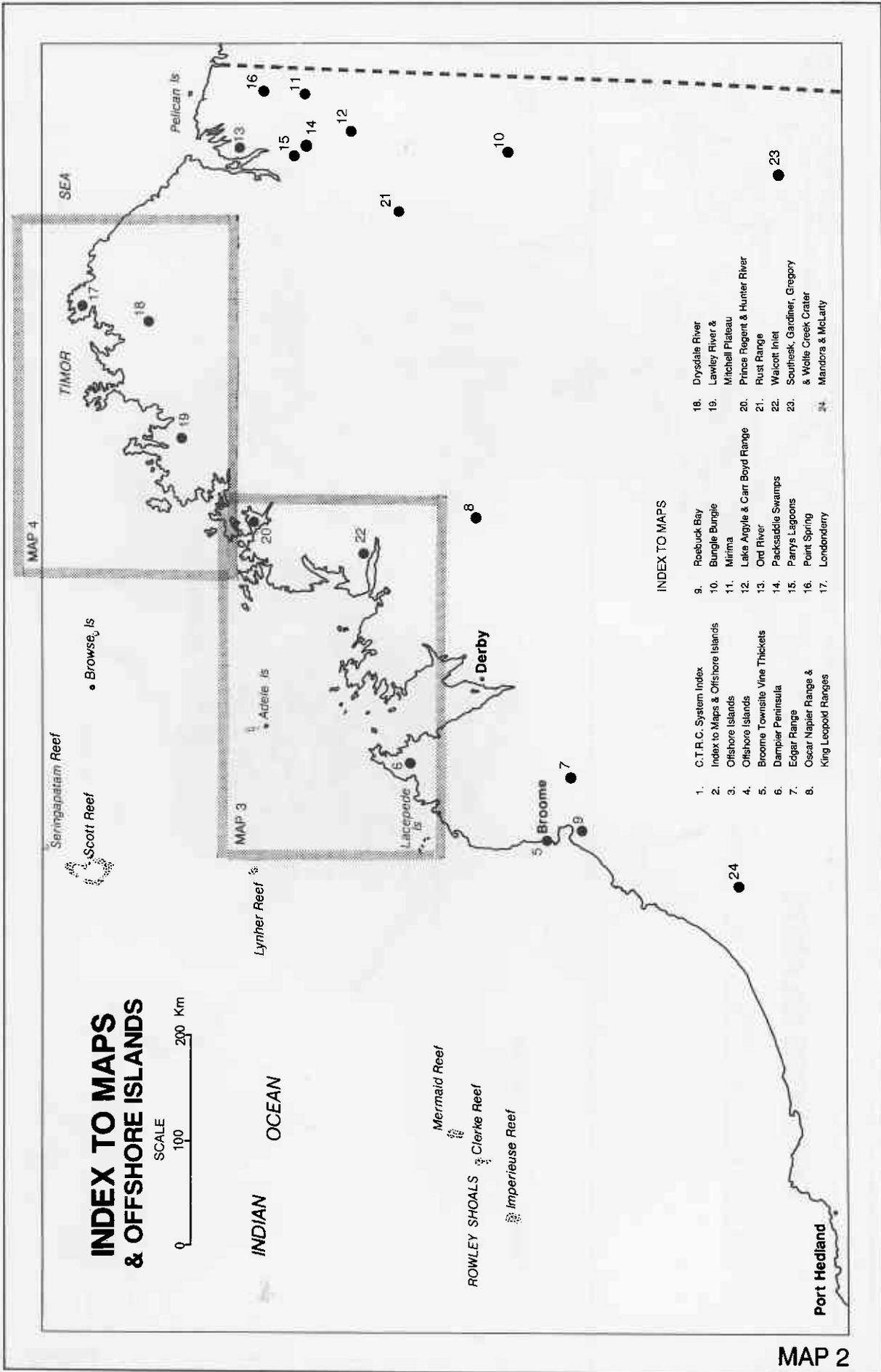


LEGEND



Kimberley Region
Planning Study Area

MAP 1



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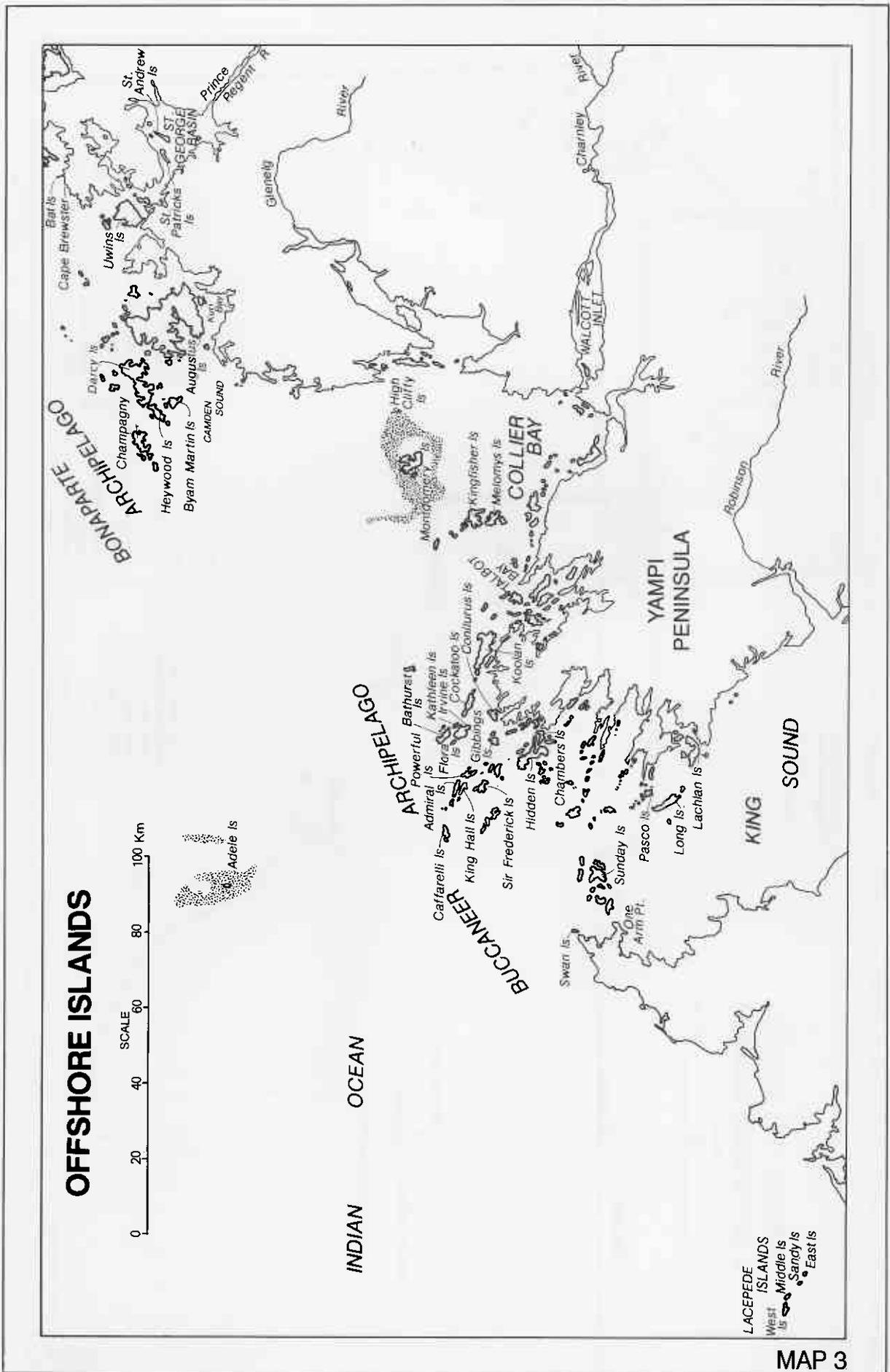
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INDIAN OCEAN

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MAP 2



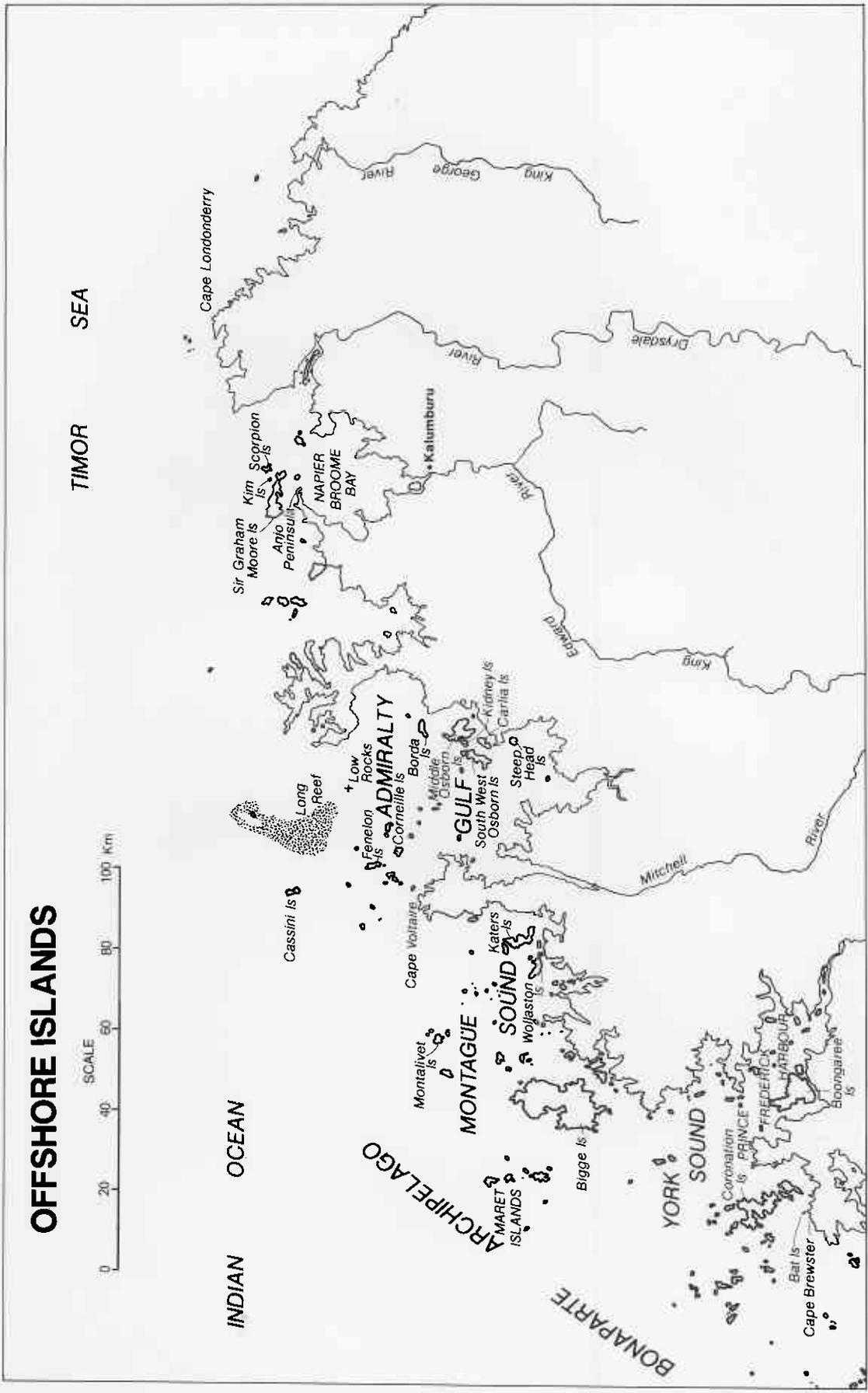
MAP 3

OFFSHORE ISLANDS

TIMOR SEA



INDIAN OCEAN



MAP 4



1

OCEANIC ISLANDS

The broad continental shelf off the Kimberley coast is dotted with reefs, banks, shoals and coral-fringed near-shore islands. Where the ocean floor is between about 100-200 metres deep, several submerged banks reach to within 30 m of the surface (well within the range of coral growth) and are reported to be coral banks. There are also several emergent reefs, and some have sand cays: Browse Island, Cartier Island, Ashmore Reef (with three sand cays), Hibernia Reef and, closer inshore, Adele Island.

A second series of emergent annular reefs rises from the Scott Reef/Rowley Shoals platform, between the 300 and 700 m contours. These are, from north-west to south-east, Seringapatam Reef, the two Scott Reefs and the three atolls of the Rowley Shoals (Imperieuse, Clerke and Mermaid Reefs). Unvegetated, supratidal sand cays are present on Imperieuse, Clerke and South Scott Reef, with intertidal sand cays on other reefs (Berry and Marsh 1986).

Some of the islands and surrounding reefs are within Western Australia, while others are Commonwealth Territory. The CTCRC Report discussed both classes of land but we have restricted our report to State land. Since the CTCRC Report was published, the Commonwealth Government has declared the Ashmore Reef and its islands to be a national nature reserve. Other areas owned by the Commonwealth and not discussed here are Cartier Island, Seringapatam Reef and Scott Reef.

Oceanic islands are important places for the nesting of seabirds and turtles. The surrounding coral reefs are rich in marine organisms and are of considerable scientific and conservation value. They are becoming well known and are now being visited by an increasing number of people wishing to view coral reef communities and/or conduct recreational

fishing. A series of conservation reserves are needed that represent the biological diversity of the fragile, rich marine ecosystems found on and around these isolated oceanic islands and shoals.

1.1 ADELE ISLAND

Location: Adele Island is situated about 100 km north-north-east of Cape Leveque at about 15° 31'S, 123° 09'E.

Map: 2, 3.

Current Status: Meda locations 10 and 13. Freehold land owned by the Commonwealth of Australia.

Geomorphology: Sand cay on limestone and coral reef. Extensive coral reefs surround the island; the structure is an unusual near-shore platform reef of great scientific interest.

Vegetation and Flora: A grassland of *Spinifex longifolius* on white sandy soils and *Sporobolus virginicus* on saline loamy soils. Nine plant species have been recorded (Anon. 1972).

Fauna: Seabird colonies are the most important wildlife feature. Species that breed there include the Lesser Frigate-bird (*Fregata ariel*) (2500 pairs in June 1972, 5700 pairs in July 1981), Brown Booby (*Sula leucogaster*) (1500 - 2000 pairs in June 1972, 7500 pairs in July 1981) and Masked Booby (*Sula dactylatra*) (100 pairs in June 1972, 320 pairs in July 1981) (Anon. 1972, Burbidge *et al.* 1987). The Polynesian Rat (*Rattus exulans*) occurs on the island, presumably having been introduced by Indonesian fishermen.

Nothing is known of the marine fauna of the platform reef, but it is certain to be rich in species and of exceptional conservation value.

Recreational use or potential: None.

Key Features: The seabird colonies and the surrounding reef.

CTRC Recommendation: "That the EPA ask the State Government to explore with the Commonwealth Government means of returning Adele Island to State control. Should this eventuate, the island be declared a Class B Reserve for the Conservation of Flora and Fauna vested in the W.A. Wildlife Authority. Leases be issued to protect the lighthouse, radio beacon and automatic weather station."

EPA Recommendation: "The EPA recommends that:

1. the State Government explore with the Commonwealth Government means of returning Adele Island to State control;
2. should such a transfer eventuate, Adele Island should be declared a Class B Reserve for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority;
3. leases be issued to protect the lighthouse, radio beacon and automatic weather station prior to reservation of the island."

Our Recommendation: We endorse the EPA recommendations, except that we see no reason why this important island should not be a Class A reserve. The reserve should be vested in the National Parks and Nature Conservation Authority. We recommend that the surrounding reef be declared a Class A marine nature reserve.

1.2 BROWSE ISLAND

Location: Browse Island is situated in the Timor Sea about 350 km north of Derby at 14°07'S, 123°33'E.

Map: 2.

Area: About 13 ha.

Current Status: Reserve No. 22697 for Minerals (Phosphatic Rock), not vested.

Geomorphology: A sand and limestone cay situated on a limestone and coral reef. The island once held large deposits of guano but these have been mined out, resulting in a disturbed surface.

Vegetation and Flora: Behind the beaches is a sparse vegetation consisting mainly of the creeper *Ipomoea pes-caprae* and a few scattered bushes of *Scaevola sericea*. On undisturbed coral sand the most common species are *Abutilon indicum* and an

unidentified *Sida*. The grasses *Eragrostis* sp. and *Cenchrus brownii* are also common. Disturbed areas have been colonised by *Ipomoea*, *Salsola kali* and *Sida* (Burbidge *et al.* 1978).

Fauna: No seabirds now breed on Browse Island, but it is one of the most important turtle nesting sites in Australia. A survey by the Department of Fisheries and Wildlife in June 1972 (Smith and Johnstone 1978) revealed thousands of turtle nests in the narrow strip of beach above high-water mark. The Green Turtle (*Chelonia mydas*) certainly breeds there and other species may also use it.

Recreational Use and Potential: None.

Key Features: The turtle rookeries.

CTRC Recommendation: "The Committee recommends that Reserve No. 22697 (Browse Island) be changed from Minerals (Phosphatic Rock) to Conservation of Fauna and Flora and that it be declared Class B and vested in the W.A. Wildlife Authority. The reserve should be extended to low water mark in order to ensure the protection of turtles."

EPA Recommendation: "The EPA recommends that:

1. the boundary of Reserve 22697 be extended to low water mark;
2. the classification and purpose of Reserve 22697 be amended to a Class B Reserve for the Conservation of Flora and Fauna and the Reserve be vested in the W.A. Wildlife Authority."

Our Recommendation: We endorse the EPA recommendation, except that the reserve should clearly be Class A. We recommend that the surrounding reef be declared a Class A marine nature reserve.

1.3 ROWLEY SHOALS

Location: The three separate atolls, Mermaid Reef (17° 07'S, 119° 20'E), Clerke Reef (17° 10'S, 119° 20'E) and Imperieuse Reef (17° 35'S, 118° 56'E) lie about 300 km (165 nautical miles) west of Broome.

Map: 2.

Area: Each atoll covers an area of around 80 to 90 km². Dimensions of the atolls are Mermaid: 14.5 x 7.6 km, Clerke and Imperieuse: 17.8 x 9.5 km.

Current Status: Imperieuse and Clerke Reefs are under State control and are vacant Crown land. Mermaid Reef is under Commonwealth jurisdiction.



The taking of corals, molluscs and some fish has been prohibited under the Fisheries Act.

Geomorphology: Regarded as the most perfect examples of shelf atolls in Australian waters. Each consists of a perimeter of coral reef (through which pass between one and three narrow passages) enclosing a central lagoon with prolific growth of patch reefs. Small islands occur on Imperieuse and Clerke Reefs - Cunningham and Bedwell Islands respectively. There is no permanent land above high tide mark on Mermaid Reef. All three atolls drop off extremely steeply to about 500 m.

Vegetation and Flora: The cays are not vegetated. One species of seagrass has been recorded.

Fauna: The marine fauna is typical of clear oceanic waters and contains a high proportion of taxa not found on the adjacent mainland. The Western Australian Museum has recorded a very wide variety of marine organisms: 184 species of corals in 52 genera (Vernon 1986), 273 species of molluscs (Wells and Slack-Smith 1986), 90 species of echinoderms (Marsh 1986) and 485 species of fishes (Allen and Russell 1986).

One species of seabird - the Red-tailed Tropic-bird - nests on Bedwell Island. Migrating birds, especially waders, rest on the sand cays.

Recreational Use and Potential: The Rowley Shoals offer spectacular diving conditions in a pristine environment. They have an unusual abundance of extremely large reef fish and sea snakes do not occur. These attributes are attracting increasing numbers of visitors both from Australia and overseas, using both charter and private vessels.

Key Features: Exceptional water clarity and prolific and spectacular underwater life, including large reef fish. The most accessible of the shelf-edge atolls for tourists (mainly from Broome). Fewer problems with Indonesian fishermen than other shelf-edge atolls.

CTRC Recommendation: None.

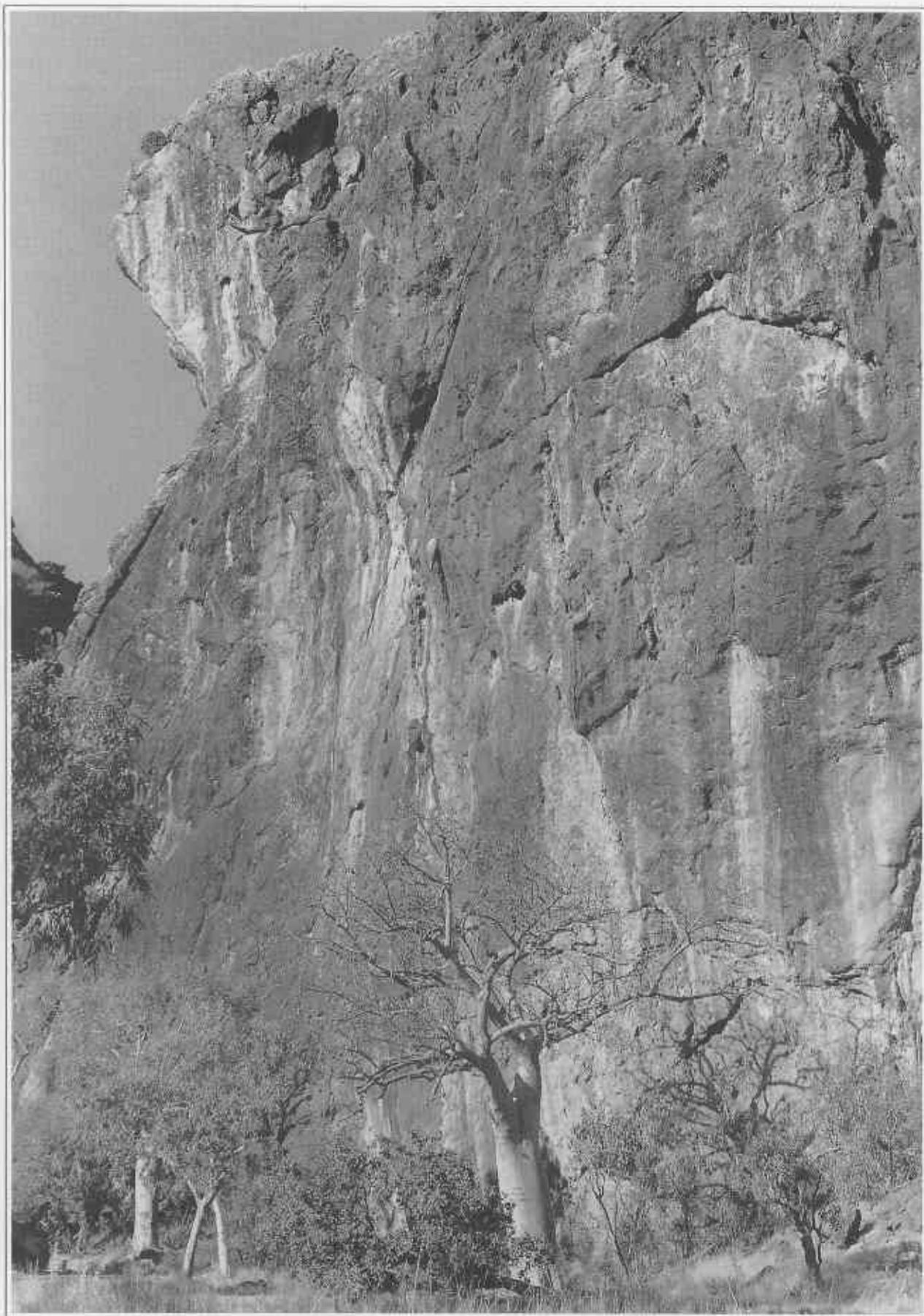
EPA Recommendation: None.

Our Recommendation: We recommend that Clerke and Imperieuse Reefs be declared Class A marine national parks vested in the National Parks and Nature Conservation Authority. A management plan is needed to control the activities of visiting vessels.

We also recommend that the State approach the Commonwealth with a view to Mermaid Reef being declared a marine national park under Commonwealth legislation.



Red-footed Booby nesting on Adele Island.



Limestone cliffs and baob trees are typical of the Oscar and Napier Ranges.



2

SOUTH-WEST KIMBERLEY

The Phanerozoic South-west Kimberley is the north-western corner of the Canning Basin, most of which is occupied by the reddish sand dunes and swales of the Great Sandy Desert. Compared with the rest of the Canning Basin, the South-west Kimberley district is well-watered, receiving an annual average rainfall of 400 to 800 mm during a predictable rainy season (McKenzie 1981c).

Well-watered tropical sandplain environments do not occur elsewhere in Western Australia. Their peculiar array of vegetation, known collectively as "pindan", is unique to the South-west Kimberley, although most of the component species are widespread across tropical Australia.

It is the dominance, continuity, and variety of these sandy plains that distinguish the Dampier Peninsula from other well-watered areas of the South-west Kimberley. Sand surfaces of the central South-west Kimberley are dissected by major river systems and include substantial areas of a variety of heavy alluvial soil surfaces. They are also interrupted by limestone and sedimentary ranges each mantled in and surrounded by areas of their derived soils. The Dampier Peninsula is basically a continuous, but heterogeneous, sandplain. Coastal environments and, rarely, rock outcrops provide only minor relief except in the Mount Jowlaenga area.

There are few offshore islands; the Lacepedes comprise the only significant group.

Apart from the Lacepede Islands, there are only four conservation reserves in the South-west Kimberley - each of these represents one or two relatively restricted environments rather than the widespread surface types of the district. The Coulomb Point Nature Reserve (28 300 ha) on the Dampier Peninsula comes closest to representing the "typical rather than the special" by including extensive areas of well-watered communities on

sandplains drained by incised watercourses and, to a lesser extent, light alluvial soils, as well as small areas of four different coastal environments; samphire and grasslands on supratidal mudflats, estuarine low forests of paperbarks, coastal sand dunes and vine thickets. However, as currently outlined, it includes neither tidal mudflats nor mangroves because the reserve does not extend to low water mark.

The other three conservation reserves (Tunnel Creek, Windjana Gorge and Geikie Gorge National Parks) have a total area of only 5 361 hectares and are restricted to small, scenic areas of the limestone Oscar and Napier Ranges on the inland northern edge of the district.

To improve the coverage of South-west Kimberley environments by conservation reserves, a large (807 000 ha) nature reserve has already been proposed in the vicinity of the Edgar Ranges, on the dry, southern, inland margin of the district (McKenzie 1981b). Dry country versions of communities on heavy alluvial soil surfaces and river frontage surfaces are included in the proposed Edgar Ranges Nature Reserve (McKenzie 1981b, p. 68), but only as relatively small areas. Unfortunately, it is not possible to propose reserves to represent the well-watered versions of communities growing on these surfaces (gilgai soils, black soils, etc) even though they are widespread in central and northern areas of the South-west Kimberley (Crowe, Towner and Gibson 1978); desirable as cattle pasture, they are entirely included within pastoral leases.

A different situation exists for the other main category of South-west Kimberley surface - sandplains and dunefields. Because communities of these sandy surfaces are less suitable for cattle grazing, large tracts along the drier southern edge of the district remain as vacant Crown land and are represented

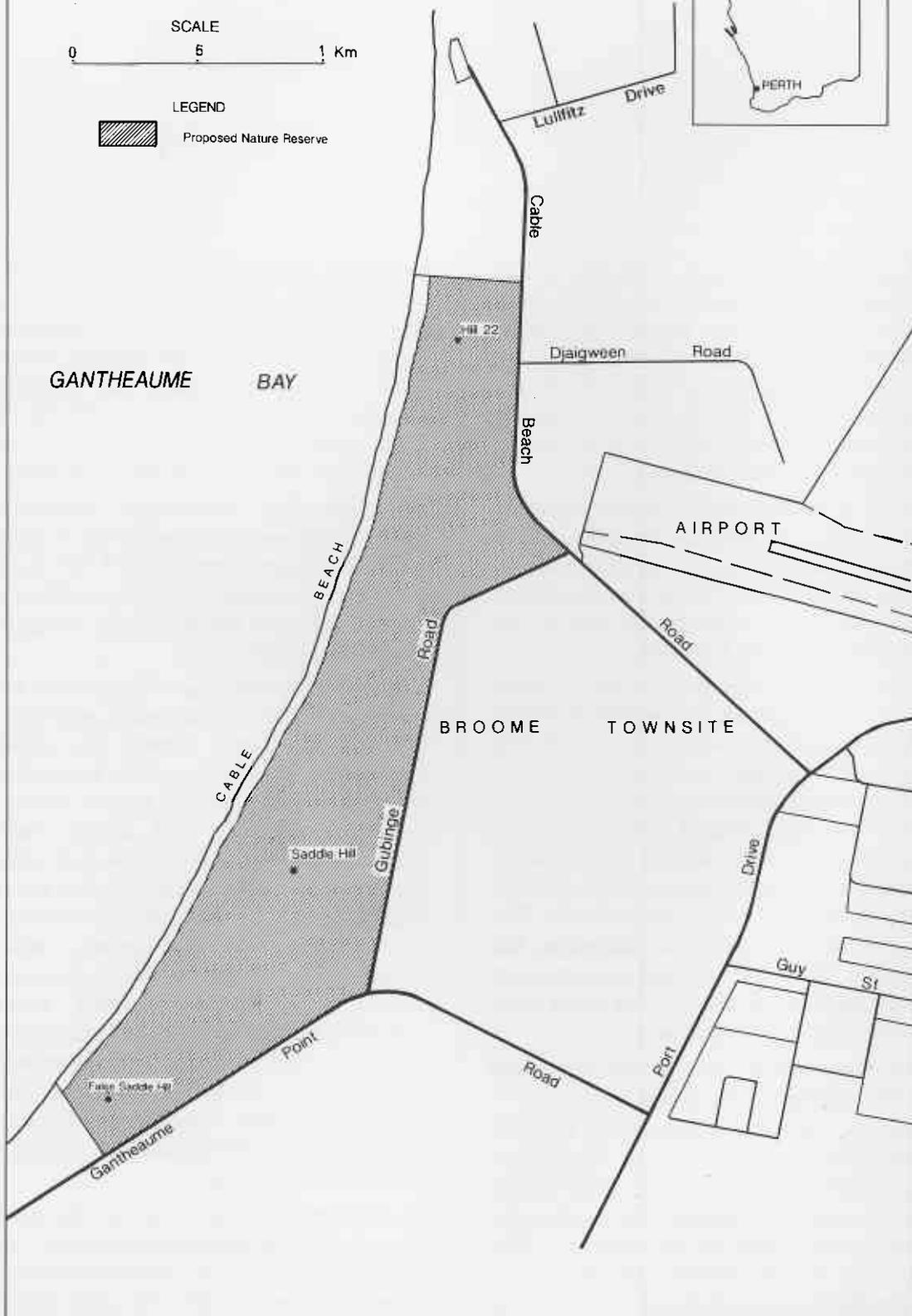


PROPOSED BROOME VINE THICKETS NATURE RESERVE

SCALE
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LEGEND
 Proposed Nature Reserve

LOCALITY MAP



MAP 5

in the proposed Edgar Ranges Nature Reserve. Although the well-watered versions of sandplain communities in central and northern areas of the South-west Kimberley are all held by pastoral stations, some areas still occur as vacant Crown land on the Dampier Peninsula. In fact, some of the most luxuriant forms of pindan occur in the vacant Crown land on the northern end of the Peninsula. Beard (1979) did not map these pindan areas, expressed as open-forests of *Eucalyptus miniata*, on the northern end of the Peninsula.

This pattern of land tenure also makes additional reserves on the Dampier Peninsula essential for the conservation of adequate areas of other communities typical of the South-west Kimberley. Examples include coastal communities such as vine thickets, grassed mudflats and mangroves.

Recommendation: We recommend that the Department of Conservation and Land Management identify possible areas of the Fitzroy River basin that could be reserved to protect representative areas of the communities that occur there and that these areas be examined for their biological values. Preferably, any reserve should be contiguous with the proposed Devonian Reef National Park (see Napier and Oscar Ranges, Area 2.5).

2.1 BROOME TOWNSITE VINE THICKETS

Location: Inland from Cable Beach, extending south to Gantheaume Point, Broome.

Map: 5.

Area: About 206 ha.

Current Status: Vacant Crown land.

Geomorphology: Coastal dunes and sandplains.

Vegetation and Flora: In the shelter of the dunes and west of Gubinge Road there is a major vine thicket. It is adjacent to the district's finest stands of Gubinge (*Terminalia ferdinandiana*). The vine thicket represents the southernmost stand of rainforest vegetation in the Kimberley. Representative species include the trees *Terminalia petiolaris*, *T. ferdinandiana*, *Pouteria sericea*, *Gyrocarpus americanus*, the shrubs *Pavetta brownii*, *Grewia breviflora*, *Mallotus nesophilus*, and the climbers *Caesalpinia major*, *Jacquemontia paniculata* and *Capparis lasiantha*.

The vine thickets contain a high proportion of plants with edible fruits, making them important

seasonal food resources for Aborigines.

Fauna: Not studied.

Recreational Use and Potential: Being in close proximity to a major tourist centre, the Broome Vine Thickets have considerable potential for educational use. If developed with nature trails and other interpretative features they could become a major tourist attraction.

Key Features: Southernmost rainforest vegetation in the Kimberley, immediately adjacent to major tourist centre.

CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: The Broome Botanical Society has campaigned for some years to preserve these vine thickets. Submissions have been made to Government but no final decision has yet been taken. We recommend that the Broome Vine Thickets be declared a Class A conservation park vested in the National Parks and Nature Conservation Authority.

2.2 DAMPIER PENINSULA

The Dampier Peninsula is one of the highest rainfall areas in the district. This is reflected in the greater proportion of sub-humid tropical species in its flora and fauna, and in the generally more subdued topography of the sandy surfaces that dominate its landscape (McKenzie and Kenneally 1983). Generally wetter conditions during the Holocene are thought to have eroded the dunefields, leaving extensive red sandplains and, especially in northern parts of the Peninsula, allowed organification and a degree of soil development. The Peninsula contains many areas of historic importance relating to natural history collections. Broome, in particular, has been the focus for many of these studies.

Location: Between Broome and Cape Leveque.

Map: 6.

Area:

Coulomb Point Nature Reserve: 28 300 ha

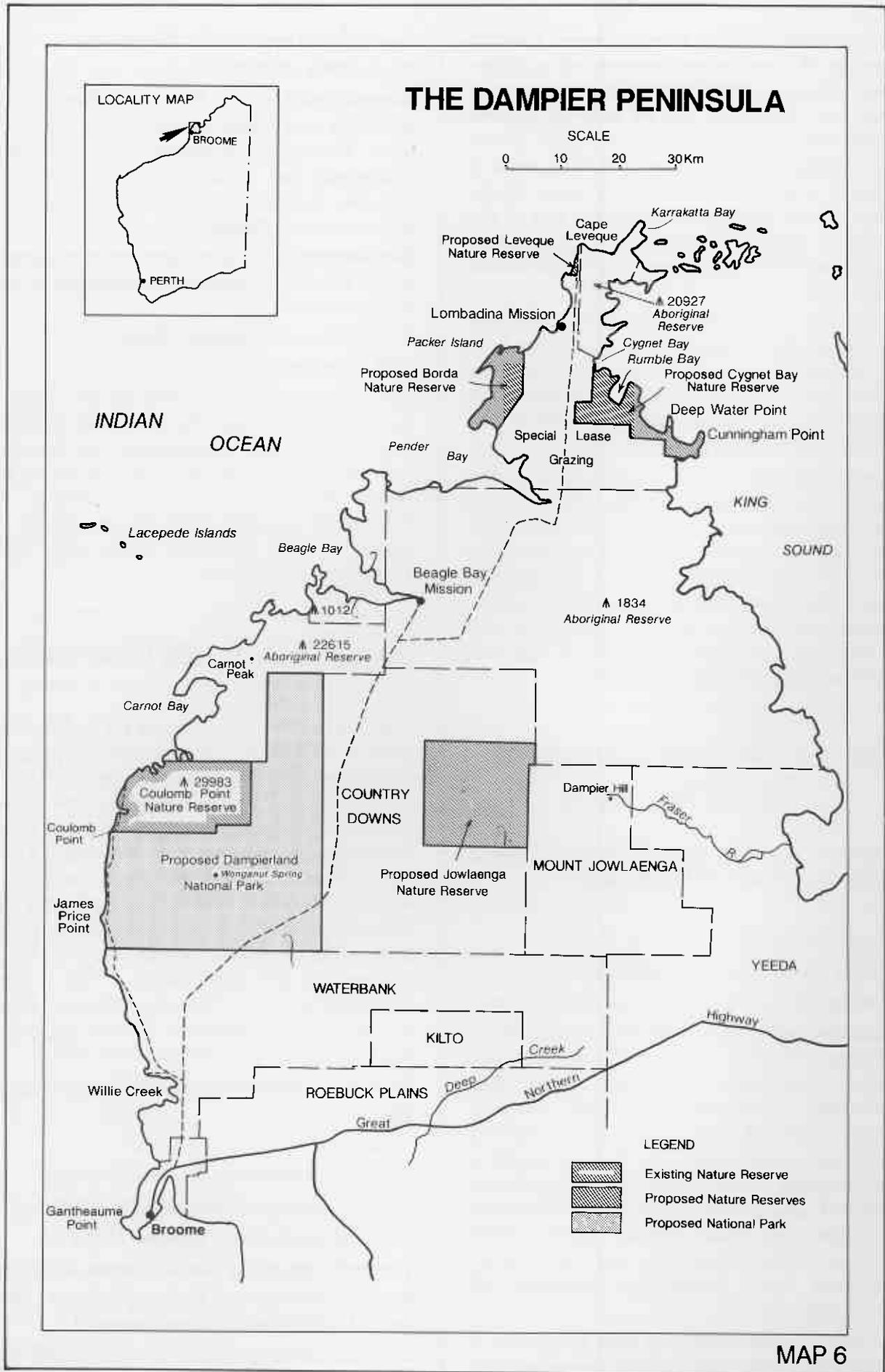
Proposed Leveque Nature Reserve: 1 010 ha

Proposed Borda Nature Reserve: 15 800 ha

Proposed Cygnet Bay Nature Reserve: 12 300 ha

Proposed Dampierland National Park: 112 800 ha (including Coulomb Nature Reserve)

Proposed Jowlaenga Nature Reserve: 35 040 ha



MAP 6

Current Status: Most is held as pastoral leases. Three small areas in the northern parts of the Peninsula are vacant Crown land proposed as nature reserves; the rest is pastoral lease, is reserved for the "Use and Benefit of Aborigines" (Reserve Nos 1834, 20927, 22615) or is nature reserve (Point Coulomb Nature Reserve, Reserve No. A29983, for the Conservation of Flora and Fauna).

Geomorphology: The Dampier Peninsula is underlain by Jurassic marine sediments (sandstone and mudstone). Occasional outcrops of Early Cretaceous sandstone occur in the Carnot Peak, Cygnet Bay and Mount Jowlaenga areas. Cainozoic rocks are restricted to relatively small exposures: calcrete in coastal situations on Waterbank Station and Packer Island; laterites on uplands in the Mount Jowlaenga area (Gibson 1983).

Most of the Dampier Peninsula is mantled by reddish-grey Quaternary sandplains of mixed alluvial and aeolian origin, which grade into yellowish-grey sandplains towards the northern end of the Peninsula where rainfall is higher. Areas of red aeolian sand as weak dunes occur throughout the Peninsula and are understood to be remnants of the previous era of aridity and homologous with the Quaternary dunes of the Great Sandy Desert. Beaches and beach dunes of quartzose shelly sand and saline mudflats, either supratidal or tidal (including mangroves), also occur coastally. A seasonally active coastal drainage system and scattered seasonal fresh water swamps are present, although poorly developed. In east-west section, the Dampier Peninsula is gently convex. Sheet flooding is the most widespread pattern of drainage because few abrupt rises interrupt the gentle gradients of the plains country that forms the broad spine of the Peninsula. The southern half of the Peninsula has a peripheral system of creeks and small rivers, best developed near the coast in the Coulomb Point Nature Reserve, at Roebuck Bay and east of Dampier Hill.

The northern end of the Peninsula is too small and narrow for development of substantial watercourses although steeper gradients are encountered on its eastern and western aspects. Broad sub-coastal drainage valleys, with seasonally swampy areas, occur behind most of the larger bays - especially Beagle Bay and Pender Bay.

The surfaces important on the Dampier Peninsula are: coastal saline mudflats; beaches and beach dunes with some derived limestone outcrops; Permian and Mesozoic outcrop country of south-eastern areas and the northern coastline; widespread reddish-

grey sandplains of southern areas; yellowish-grey sandy plains of northern areas; watercourses and seasonal fresh water swamps.

There are a number of permanent fresh water springs in the western portion of the Peninsula. These are located at Wonganut, Beagle Bay and Waterbank.

Vegetation and Flora: The sandy soil plains that dominate the landscape of the Peninsula support a repetitive mosaic of woodland vegetations, although two trends in this "pindan" vegetation can be distinguished (McKenzie & Kenneally 1983).

One is a gradual change from *Acacia*-dominated low open woodlands in the south to *Eucalyptus*-dominated open forests in the north. It corresponds to rainfall and rainfall-caused soil trends. From Beagle Bay southwards, the vegetation is a low open-woodland dominated by *Eucalyptus papuana*, *E. polycarpa*, *E. setosa*, *E. tectifera*, *E. dampieri* and *E. zygophylla* with *Erythrophleum chlorostachys*, *Gyrocarpus americanus* and *Lysiphyllum cunninghamii* also common. The understorey consists of several species of *Acacia* which reach canopy height and include *A. tumida*, *A. eriopoda* and *A. monticola*. Shrub species commonly found in the pindan include *Acacia holosericea*, *Dolichandrone heterophylla*, *Gardenia pyriformis*, *Grevillea refracta*, *G. heliosperma*, *Hakea arborescens*, *Petalostigma pubescens*, *Planchonia careya* and *Terminalia canescens*. The grass layer is mainly *Chrysopogon pallidus*, *Cymbopogon ambiguus*, *Heteropogon contortus* and *Sorghum stipoides*. The vegetation of Wonganut sandy plains surfaces only becomes distinguishable from the Yeeda surfaces at the lowest levels in the landscape. On the Coulomb Point Nature Reserve, for instance, Wonganut plains support a low open woodland of *Acacia tumida* with occasional patches of *Melaleuca nervosa*, *Gyrocarpus americanus* and small pockets of vine thicket elements (*Canarium australianum* and *Pouteria sericea*). A mixed grassland of *Cymbopogon* and *Eragrostis* is present.

Proceeding north from Broome a gradual change in the vegetation becomes noticeable after the first 30 kilometres. The tree layer of the Yeeda surface begins to increase in height and density. *Eucalyptus miniata* appears among *E. dampieri*, *E. papuana* (broad-leaved form), *Acacia eriopoda* and *A. tumida*. Other components of the shrub and ground layers do not change appreciably. A patch of *Eucalyptus jensenii* and *E. setosa* occurs on the Cape Leveque road 51 km north of Broome; the soil consists of red sand becoming clayey with depth. Associated vegetation includes *Acacia eriopoda*, *A. hippuroides*,



A. platycarpa, *A. tumida*, *Brachychiton diversifolius*, *Erythrophleum chlorostachys* and *Grevillea refracta*.

The other is a trend from sandplains, with uncoordinated drainage, found high in the landscape to the more alluvial sandplains with co-ordinated through-going drainage found in more coastal areas. This trend is most noticeable north of Pender Bay, where the higher surfaces support *Eucalyptus miniata* open-forest with *E. papuana*, *E. tectifera*, *E. dampieri* and an understorey of *Acacia tumida*, *Brachychiton diversifolius*, *Gardenia pyriformis*, *Lysiphyllum cunninghamii*, *Persoonia falcata* and *Planchonia careya*. On the medium level contours, and on patches of softer, more sandy soils, woodlands of *Eucalyptus dampieri* and *E. tectifera* replace the *E. miniata* although scattered shrubs and low trees (mainly *Acacia tumida* and *A. eriopoda*) over bunch grasses are the ubiquitous under-strata throughout. An area just south of Deep Water Point, which, at the time of the 1978 survey, had not been burnt for many years, carried an open scrub of *Acacia monticola* (to 7 m, 60%) with an understorey of *Distichostemon hispidulus*, *Calytrix exstipulata* and *Myrtella phebalioides* (0.5 to 2 m, 30%). The lower, more coastal surfaces support a woodland of *Eucalyptus polycarpa*, *E. papuana* and *Melaleuca viridiflora* over *Pandanus spiralis*, *Acacia pellita*, *Grevillea pyramidalis* and *Planchonia careya*. The fern *Platyzoma microphyllum*, and the herbs *Drosera petiolaris* and a species of *Xyris*, are frequent but localised. Occasional areas of dark, cracking clay are also present.

Sub-coastal vine thickets and closed vine forests occur immediately behind coastal dune systems. These include a variety of plants with Indo-Malesian affinities and are best developed towards the northern end of the Peninsula. The principal upper storey tree species of the closed vine forest (to 15 m) include *Melaleuca cajuputi*, *M. dealbata*, *M. viridiflora*, *Terminalia petiolaris*, *Cassine melanocarpa*, *Celtis philippinensis*, *Diospyros ferrea* var. *humilis*, *Ficus virens*, *Mimusops elengi*, *Pittosporum moluccanum* and *Pouteria sericea*. The understorey comprises shrub species such as *Dodonaea platyptera*, *Exocarpos latifolius*, *Plumbago zeylanica*, *Santalum lanceolatum*, *Flueggea virosa*, *Pandanus spiralis* and *Croton tomentellus*. Vine species including *Adenia heterophylla*, *Abrus precatorius*, *Caesalpinia major*, *Gymnanthera nitida*, *Jacquemontia paniculata*, *Passiflora foetida*, *Marsdenia cinerascens* and *Tinospora smilacina* are common climbers extending into the canopies of the trees. The semi-parasite *Cassytha filiformis* forms dense tangled patches in the canopies of the *Melaleuca* species.

Coastal dunes and beaches support the grass *Cenchrus biflorus*, while the shrubs *Crotalaria cunninghamii*, *Euphorbia coghlanii* and *Fimbristylis sericea* are common on the fore-dunes. Isolated clumps of *Pandanus spiralis* var. *convexus* (to 3 m) occur in the interdunal swales and sometimes in the strand community behind beaches. The leeward side of the dunes is characterised by dense shrub thickets of *Acacia ampliceps* and *Crotalaria cunninghamii* (to 2.5 m, 20-70% and patches of the grasses *Cymbopogon ambiguus* (to 1.5 m, 60%) and *Spinifex longifolius*.

Riverine communities are best developed in the Coulomb Point Nature Reserve and comprise *Melaleuca acacioides* low closed forests in estuarine situations, and fringing woodlands of *Eucalyptus camaldulensis*, *Syzygium eucalyptoides* and *Melaleuca viridiflora* over *Pandanus spiralis* var. *convexus* and *P. darwinensis* along fresh water creeks.

Where coastal dunes truncate drainage lines, fresh water swamps occur. They support a low woodland of *Lophostemon grandiflorus* with a fringe of *Melaleuca viridiflora* and *M. acacioides*. When water is present, following summer rain, the surface of these sub-coastal swamps is often covered with a dense bloom of *Lemna aequinoctialis*. As the water level recedes, the damp areas support numerous ephemeral species such as *Byblis liniflora*, *Drosera indica*, *D. petiolaris*, *Goodenia sepalosa* and *Oldenlandia galioides*. The grasses *Aristida hygrometrica*, *Digitaria bicornis*, *Echinochloa colona* and *Pseudoraphis spinescens* are common, as are the sedges *Cyperus bifax*, *C. pulchellus* and *Fimbristylis caespitosa*. The climbers *Protasparagus racemosus*, *Capparis lasiantha* and *Gymnanthera nitida* occur amongst the *Lophostemon*.

Small semi-permanent lakes and seasonal swamps on Yeeda surfaces are generally further inland and support a fringing low woodland of *Melaleuca acacioides* and either *M. viridiflora* or *M. nervosa*, often with *Eucalyptus papuana* and *Pandanus spiralis*, over numerous grasses.

Areas of permanent fresh water are rare on the Peninsula, and where they occur they support large groves of *Melaleuca cajuputi* and *M. viridiflora*. They are the only places on the Peninsula where aquatics such as the Blue Waterlily (*Nymphaea violacea*) and the fringed waterlilies *Nymphoides indica* and *N. beaglesensis* occur. The latter is endemic to the Beagle Bay area.

At one locality near Carnot Bay a fresh water spring known as "Fern Island" supports a closed stand of *Melaleuca cajuputi* over a dense ground cover of the fern *Cyclosorus interruptus*. The climbing Maidenhair Fern forms dense, trailing columns into the canopy.

Mangroves are widespread in coastal areas. In seaward and/or creek-fringing situations, *Camptostemon schultzei* (up to 12 m, 40% dense) and *Aegiceras corniculatum* (to 5 m, scattered) were recorded in the stands at Packer Island, Willie Creek and on the Coulomb Point Nature Reserve.

Avicennia marina and *Rhizophora stylosa* (to 14 m, 60-100%) always form the central zone of the stands with *Avicennia marina* (to 5 m, 40-80%) and/or *Ceriops tagal* (to 3.5 m, 80-100%) forming the landward zone, depending on substrate characteristics. The hemiparasite *Amyema thalassium* is common on *Avicennia marina*; the lichen *Ramalina ecklonii* is frequently found on the branches of *Ceriops tagal*. Less common species in the landward zone include *Aegialitis annulata*, *Excoecaria agallocha*, *Bruguiera exaristata* and *Osbornia octodonta*. Shrublands on supra-tidal mudflats are dominated by samphires *Halosarcia halocnemoides* subsp. *halocnemoides* and *H. halocnemoides* subsp. *tenuis* and/or the grass *Sporobolus virginicus* and the halophytes *Sesuvium portulacastrum* and *Neobassia astrocarpa* (0.25 m, 40-70%). Other sub-shrubs, such as *Hemichroa diandra*, *Muellerolimon salicorniaceum* and *Suaeda arbusculoides*, and the grass *Xerochloa imberbis* may occur on the landward perimeter of the mudflat.

The landward edge of the mudflat is frequently delimited by a fringing stand, up to 10 m wide, of paperbark trees (*Melaleuca acacioides*) to 7 m high or, on sandy ridges, strand shrubs such as *Hibiscus panduriformis*, *Thespesia populneoides* and *Abutilon indicum*.

Broome Sandstone is exposed along the coast as mud-stone and red, eroding claystone. In the James Price Point area it supports a wind-pruned thicket of *Acacia tumida* in which *Gyrocarpus americanus* and *Ficus opposita* are also common.

Extensive outcrops of Melligo Sandstone occur in the Mt Jowlaenga/Dampier Hill area in the south-eastern sector of the Peninsula. The vegetation of Dampier Hill is a low woodland to low open-woodland of *Eucalyptus papuana* and *E. confertiflora*, over a high shrubland comprising *Acacia stigmatophylla*, *A. holosericea*, *A. monticola*, *Atalaya hemiglauca*, *Calytrix exstipulata*, *Pterocaulon glandulosum* and *Triumfetta* aff. *denticulata*. The understorey is a tussock grassland of *Cymbopogon ambiguus*. Outcrops of Broome Sandstone in this area were not sampled. Surrounding the hills is a white clay drainage area which supports an open-woodland of *Eucalyptus tectifica*, with scattered *Lysiphyllum cunninghamii* over a grassland of *Sorghum*

stipoides. Termite mounds are very common.

Melligo Sandstone exposures around Cygnet Bay, near Deep Water Point and Karrakatta Bay, support a typical North Kimberley sandstone element which includes *Acacia monticola*, *Canarium australianum*, *Exocarpos latifolius*, *Cochlospermum fraseri*, *Ficus opposita* var. *indecora*, *F. playpoda*, *Grevillea wickhamii*, *Pouteria sericea*, *Templetonia hookeri* and *Trachymene glaucifolia* (1 to 2 m, 20-40%). The hummock grass *Triodia pungens* (0.5 m, 30%) is very common. The scramblers *Abrus precatorius*, *Flagellaria indica*, *Passiflora foetida*, *Sarcostemma australe*, *Tinospora smilacina* and *Mukia maderaspatana* are also present.

The 311 species of plant (including 283 flowering plants) (Kenneally 1983) recorded on the Peninsula include both Torresian (sub-humid Kimberley) and desert species, many of which are either near the southern or at the northern limits of their known ranges in Western Australia. In this context the Torresian species *Pavetta brownii*, *Mimusops elengi*, *Diospyros ferrea* var. *humilis* and *Gyrocarpus americanus* and the arid zone species *Codonocarpus cotinifolius* and *Gyrostemon tepperi* are relevant. The flora of the Dampier Peninsula has a much greater proportion of Torresian species than that of the proposed Edgar Ranges Nature Reserve. Of particular biogeographical significance in this context are the semi-deciduous vine thicket to vine forest communities. These outlying communities belong to the continuum of monsoon forest that stretches across the humid north of Australia. They are depauperate in Indo-Malesian species, even when compared with their North-west Kimberley counterparts.

The Point Coulomb Nature Reserve does not represent the diversity of the Dampier Peninsula; it includes sandplains with coordinated drainage that support the shrubland and open woodland versions of "pindan" typical of near coastal areas at the southern end of the Peninsula. While the fringing vegetations found along creeks are also well represented, outcrop surfaces, coastal communities, fresh water swamps and vine forests are hardly represented at all.

Following biological surveys between 1977 and 1981 (McKenzie and Kenneally 1983), three nature reserves were proposed that would represent the vegetations of the northern half of the Peninsula. Together, the three proposed reserves include extensive areas of vine-forest, coastal dune vegetations, fresh water swamps, limestone and sandstone outcrop vegetations, samphire and Ribbon Grass plains, mangrove communities and open forest

versions of pindan. They are situated in a large area of vacant Crown land between the Beagle Bay Aboriginal Reserve (No. 1834) and the Aboriginal Reserve to the east and south of Cape Leveque (No. 20927). Lombadina Mission is located on the north-west portion of this vacant Crown land and cattle from the settlement graze throughout the area.

In the context of conservation of South-west Kimberley environments, the ideal reserve on the north end of the Peninsula would occupy the entire area of vacant Crown land. However, to avoid prejudicing the pastoral pursuits of the Lombadina community, three smaller areas were selected to exclude tracks, bores and the major part of the pasture yet, at the same time, to represent the biological richness of the northern end of the Peninsula as far as possible.

Fauna: The fauna is also mainly Torresian in its affinities, with a small proportion of desert species. More than 33 species of native mammals have been recorded on the Peninsula since European settlement (McKenzie 1983a), but many species are now extinct there including the Golden Bandicoot (*Isodon auratus*), Golden-backed Tree-rat (*Mesembriomys macrurus*) and Boodie (*Bettongia lesueur*). Persisting mammals include the Northern Nail-tailed Wallaby (*Onychogalea unguifera*), Dalgyte (*Macrotis lagotis*), Northern Planigale (*Planigale maculatus*) as well as the common Sandy Wallaby (*Macropus agilis*). A rich bat fauna has been recorded including *Pteropus scapulatus*, *Taphozous flaviventris*, *Mormopterus loriae*, *Pipistrellus westralis* and *Nyctophilus bifax*.

Birds are plentiful and over 214 species have been recorded (Johnstone 1983). This richness is mainly due to the diversity of habitats, especially those on or near the coast. Some species, including the Broad-billed and Brown-tailed Flycatchers, Rose-crowned Fruit-Pigeon, Little Bronze-Cuckoo, Red-collared Lorikeet and Olive-backed Oriole, are at the extreme south-western edge of their ranges. Sixty-nine species of reptile have been recorded (Storr & Johnstone 1983) of which three are endemic (the snake *Vermicella minima* and two lizards, *Lerista apoda* and *L. separanda*). A rich amphibian fauna (nine species) is also known.

Colless (1983) collected 440 insect species during a 13-day visit in April 1977. Considering how poorly the insect fauna of the Kimberley is known, it is not surprising that many of these species are considered rare in collections and are new records for Western Australia. Several species of camaenid land snails, including *Quistrachia leptogramma* and

several *Rhagada* spp., are endemic to the Peninsula (Alan Solem, pers. comm.).

Frequent burning and the presence of wild cattle and donkeys are causing widespread damage throughout the Peninsula. Feral cats are also common.

Much of the faunistic richness of the Peninsula is found in the coastal and near-coastal environments so poorly represented in the Point Coulomb Nature Reserve. In addition many of the Peninsula's Torresian species only occur in the more luxuriant and species-rich communities in the far north of the Peninsula. Examples include the Rose-crowned Fruit-Pigeon, Green Tree-Snake and Northern Blossom-bat.

Recreational Use and Potential: The whole Peninsula is networked with tracks, and frequently visited by tourists. The coastal scenery is attractive and there is good fishing from the sandy beaches and in the mangrove creeks. The Aboriginal communities are establishing a tourist resort at Cape Leveque with guided tours of the area. The large tourist industry centred on Broome is growing rapidly, and more intensive tourist-use of the Peninsula is expected.

Key Features: The *Acacia*-dominated woodlands known as "pindan". A visibly rich bird fauna. Tropical sandy beaches and other coastal features that are readily accessible.

CTRC Recommendation: "The Point Coulomb Nature Reserve originated as part of a proposed reserve in Dampier Land recommended in the National Parks and Nature Reserve Report, 1962 (Australian Academy of Science 1962, 1965). This recommendation was for an area south and east of the present reserve totalling some 125 000 ha, to preserve an area of pindan and its characteristic fauna. The report also recommended that an area to the north of Point Coulomb, then occupied by Carnot Station, be added to the proposed reserve if it became vacant. This is the area now reserved and the area originally proposed is now part of Waterbank Station.

It appears that the existing Point Coulomb Nature Reserve contains only a small area of pindan and correspondingly small populations of both the Nail-tail Wallaby and Dalgyte (Butler 1971). The Dalgyte is known to occur on parts of Waterbank Station to the east of the reserve but this type of country is highly susceptible to damage by cattle. The Committee believes that it is important to protect an adequate area of pindan. It also sees a need to protect adequate areas of other features typical of

Dampier Land such as coastal sand dunes, mangroves, *Melaleuca* thickets, and swamps. It sees two possible ways of achieving this :

1. resuming part of Waterbank Station to enlarge the existing reserve; or
2. finding vacant land elsewhere which would serve the purpose.

The Committee favours the latter alternative and believes that resumption of part of a pastoral lease should be recommended only as a last resort.

The Committee endorses the status, purpose and vesting of the Point Coulomb Nature Reserve. It recommends that, after compilation of the data collected during the biological surveys coordinated by the Department of Fisheries and Wildlife in conjunction with the W.A. Museum, the W.A. Herbarium and C.S.I.R.O. Division of Entomology on:

- (i) the Point Coulomb Nature Reserve;
- (ii) the vacant Crown land between Aboriginal Reserve Nos. 1834 and 20927; and
- (iii) the vacant Crown land between Roebuck Plains and Thangoo Stations on the north and west and Dampier Downs and Ardjorie Stations on the east;

the EPA decide whether the Point Coulomb Reserve should be extended or whether the other two areas should be reserved. If the vacant Crown land in south-east Dampier Land is reserved, then the area formerly occupied by Ardjorie Station should be included within the proposed reserve, subject to agreement by the Pastoral Appraisal Board”.

EPA Recommendation: “Point Coulomb Nature Reserve is Class A Reserve 29983 for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority. While the reserve originated to preserve an area of pindan and its characteristic fauna, the area appears to contain only a small area of pindan and associated fauna. To alleviate this lack of representation, the CTCRC suggested two further areas for evaluation. Reports have been received following biological surveys of both areas, and the EPA recommendations take account of them.

1. The EPA endorses the present classification, purpose and vesting of Reserve 29983 - Point Coulomb Nature Reserve.

The EPA recommends that:

2. the area of Deep Water Point not within the existing pearl culture lease and as shown in Fig. 7.3(i) be set aside as a Class B Reserve for the

purpose of recreation. Should the pearl culture lease over the northern portion of the point be no longer required, that area should be added to the recreation reserve;

3. the areas of vacant Crown land delineated in Fig. 7.3(i) be declared Class A Reserves for the conservation of Flora and Fauna and vested in the W.A. Wildlife Authority. A suitable access into Deep Water Point should be excluded at the time of reservation;
4. the area shown in Fig. 7.3(ii) be set aside as a Class B Reserve for the purpose of Conservation of Flora and Fauna and Water and vested in the W.A. Wildlife Authority. This reserve should include the area formerly occupied by Ardjorie Station subject to the agreement of the Pastoral Appraisal Board.”

Our Recommendation: We endorse the EPA recommendations except that the reserves should be Class A and the former Ardjorie station should be added to the proposed Edgar Range Reserve whether or not the Pastoral Appraisal Board agrees; it is an essential addition to the region’s conservation reserve system.

The three proposed reserves on the northern end of the Peninsula represent its diversity of mesic pindan and coastal communities. These areas are the richest in species and include a greater proportion of Torresian elements than areas further south on the Peninsula.

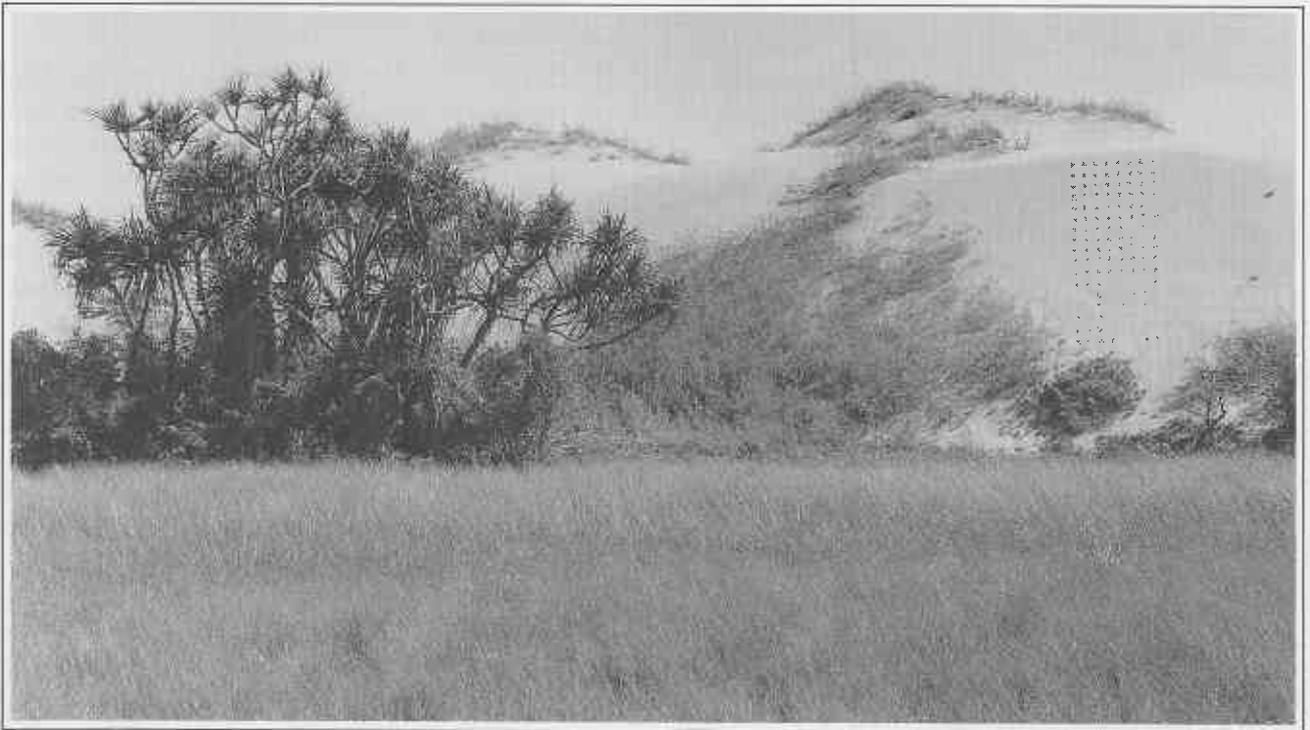
Coulomb Point Nature Reserve is clearly too small to represent the sandplain environments that dominate the Peninsula. The proposed Borda, Leveque and Cygnet Bay Nature Reserves represent an extreme form of these environments; they are also small areas. The original Australian Academy of Science recommendation (1962) was for a larger area now occupied by the northern half of Waterbank Station. Should the Government acquire Waterbank Station we recommend that the area shown on Map 6 be added to Coulomb Point Nature Reserve and the larger reserve be declared a national park in recognition of the major usage of its coastal environments. The park should be named the “Dampierland National Park”.

This new national park would also protect a greater number of the ephemeral lakes and fresh water springs (e.g Wonganut Spring) on the Peninsula, increase the representation of the Peninsula’s coastal and riverine environments, and of low-level pindan on through-drained soils.

A smaller area to the east of the proposed national park represents pindan in areas of uncoordinated



Highly dissected arid country typical of the Edgar Ranges.



*Dampier Peninsula: coastal dunes and clumps of screw pine (*Pandanus spiralis*) in interdunal swales.*



drainage high in the landscape of the Peninsula. It may also become available (see Map 6). We recommend that this area be declared a Class A nature reserve vested in the National Parks and Nature Conservation Authority. We recommend that it be named Jowlaenga Nature Reserve.

2.3 EDGAR RANGES AREA

The area includes parts of the Edgar Ranges, an interesting topographic feature drained by Geegully Creek, a tributary of the Fitzroy River. The Ranges have great historical interest to naturalists, since it was the site of collections made by J.P. Rogers in the early 1900s and the Swedish Mojberg Expedition in 1910-1913 (Soderburg 1918).

Location: About 120 km south-east of Broome.

Map: 7.

Area: 807 000 ha.

Current Status: Vacant Crown land.

Geomorphology: The Edgar Ranges area includes three relatively dry inland environments of the South-west Kimberley, as well as a comparatively well-watered version of a landscape belonging to the Great Sandy Desert (McKenzie 1981b). The Ranges comprise a picturesque scarp, with outlying mesas and buttes, formed by the headwaters of Geegully Creek eroding the plateau of Jurassic sandstone and mudstone strata underlying the Great Sandy Desert. The caprock is a resistant sandstone which affords some protection to the softer siltstones beneath. The difference in height between the two plains is about 150 m (Speck *et al.* 1964). The ranges contain gorges, caves and permanent water and support a variety of vegetation and animals. Heavier alluvial soils occur as outwash plains beneath the scarp. Quaternary sands cover both the plateau and the erosion plain beneath the scarp, as extensive tracts of sandplain and dunefields.

Vegetation and Flora: Sandplains dominate the western and north-western section of the Edgar Ranges area and extend further inland, as a wide band adjacent to the rim of the scarp, to latitude 18° 45' south (McKenzie and Kenneally 1983). They support dry-country versions of the pindan vegetation endemic to the district - low woodlands to low open-woodlands structurally controlled by species of *Eucalyptus zygophylla*, *Acacia eriopoda*, *Grevillea refracta*, *G. wickhamii* over mixed hummock and tussock grasslands. Nearer the Ranges are high

open-shrublands of *Acacia retivenia*, *A. hilliana*, *A. ancistrocarpa*, *A. stipuligera* and *A. monticola* over tussock grasses and spinifex. Occasional emergent bloodwoods such as *Eucalyptus zygophylla* occur. Patches of *Eucalyptus odontocarpa* (Sturt's Creek Mallee) and *Jacksonia* sp. form open scrubs in places near the scarp of the ranges. Torresian species are common in these formations (e.g. *Ehretia saligna*, *Lysiphyllum cunninghamii*, *Acacia holosericea* and *Dolichandrone heterophylla*). Sandplains of the Yeeda Land System are an important component of the South-west Kimberley, occupying about 25% of its land surface. The pindan vegetation they support varies across the district. Sandplains in the Edgar Ranges area, and similarly dry inland sandplains elsewhere in the district, support a vegetation distinct from their better-watered equivalents on the Dampier Peninsula and near Derby.

Isolated fig trees (*Ficus platypoda*) cling to the sheer sandstone cliffs. The most important occurrence of a plant in this habitat is a solitary colony of a new variety of the Screw Pine (*Pandanus spiralis* var. *flammeus*) at Logues Spring. Similar sedimentary ranges occur as isolated outcrops elsewhere in the South-west Kimberley, and occupy approximately 4% of its land surface. They support a variety of fairly sparse plant formations - open woodlands of River Gums, *Eucalyptus brevifolia* and *E. confertiflora* fringe the water-courses, and hummock grasslands with scattered *Acacia* thickets dominate gravel soils and scree slopes.

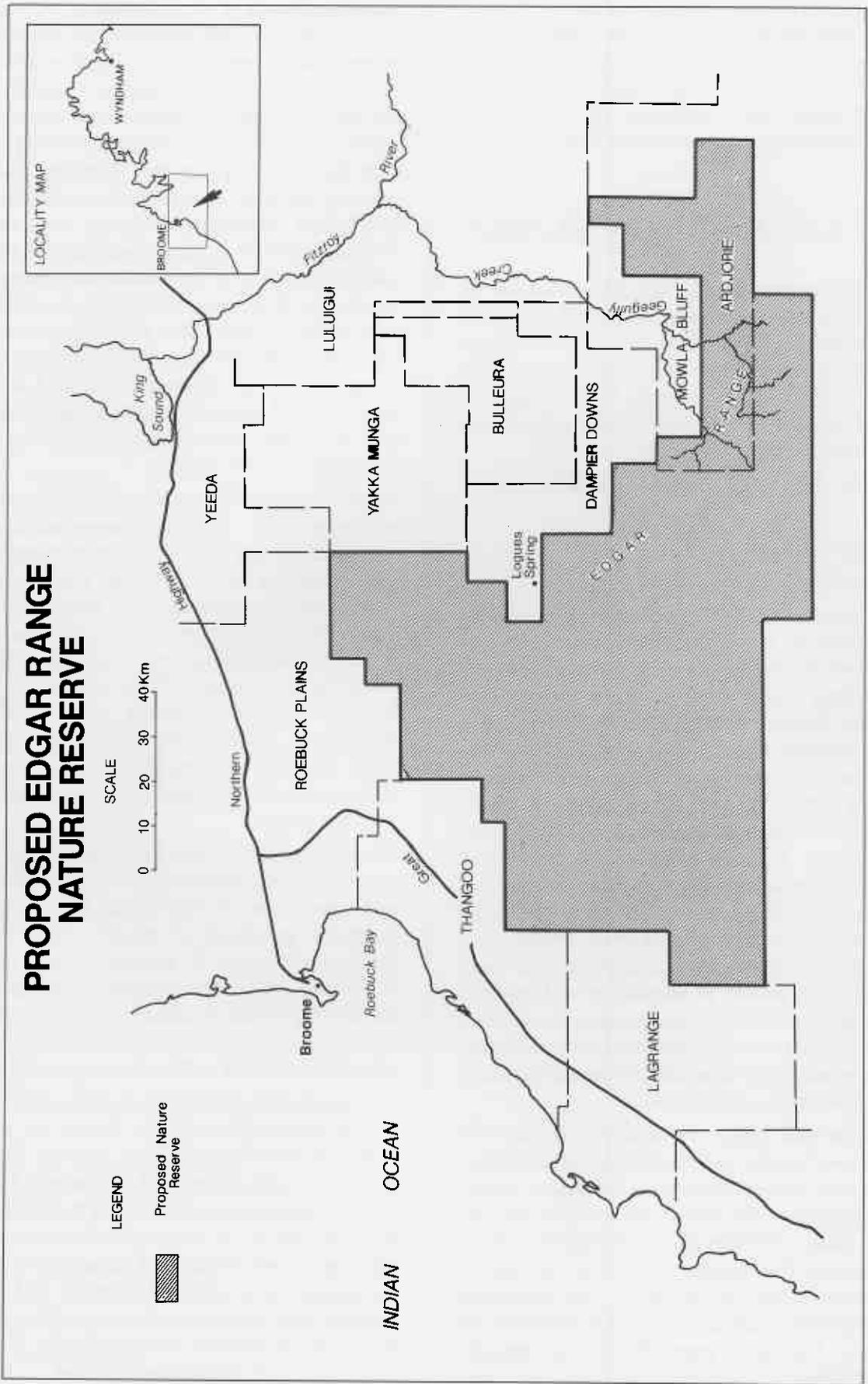
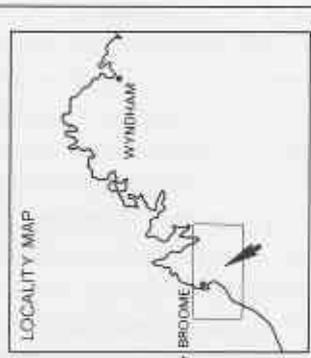
The sedimentary surfaces of the Edgar Ranges support a variety of fairly sparse vegetations. Gravel surfaces and scree slopes of the ranges support an open-hummock grassland of spinifex with emergent *Eucalyptus brevifolia*, *E. papuana*, *Acacia monticola*, *A. hilliana*, and *Solanum beaugleholei*. Fringing woodlands of *Eucalyptus camaldulensis*, *E. confertiflora* and *E. setosa* over *Acacia* species and spinifex line water-courses and narrow valleys running into the scarp.

Dunes and swale plains typical of the north-western margin of the Great Sandy Desert are extensive south of the Ranges. They support shrub and grassland communities with occasional low trees: *Gardenia pyriformis* and *Eucalyptus zygophylla*. Shrub and grass species on the swale plains are a stunted and depauperate selection of plants from the pindan community (e.g. *Acacia holosericea* and *Grevillea refracta*), with a greater percentage of desert species such as *Acacia anaticeps*, *A. ancistrocarpa*, *Newcastelia cladotricha* and *Plectrachne schinzii*. Although dunefields such as these dominate the landscape of

PROPOSED EDGAR RANGE NATURE RESERVE

LEGEND
 Proposed Nature Reserve

SCALE
 0 10 20 30 40 Km



MAP 7

the entire north-western sector of the Great Sandy Desert, small patches of eroded dunes are not infrequent in sandplain areas of central and southern parts of the South-west Kimberley. Available data suggests that, as a biological unit, this surface grades in a north-south axis from Kimberley to desert affinities.

Shrubs of the dunes include *Cyanostegia cyanocalyx*, *Cassia* sp., *Calytrix* sp., *Acacia drepanocarpa* and *A. eriopoda*. The Edgar Ranges area includes a few of the alluvial sand, earth, clay and loam surfaces associated with the drainage valleys of the Fitzroy and Lennard Rivers. These occur in the headwaters of Geegully Creek, on the now abandoned Ardjorie Station section of the Edgar Ranges area. Fringing formations of River Gums (*Eucalyptus camaldulensis* and *E. microtheca*) along Geegully Creek act as biogeographic corridors connecting the much more mesic communities of the North Kimberley to the relatively arid and outlying scarp of the Edgar Ranges.

The 213 species of plants recorded in the Edgar Ranges area (Kenneally 1981) include a mixture of Torresian (sub-humid Kimberley) and desert species; many are near either the southern or northern limits of their known ranges in Western Australia. Of particular interest in this context are the Torresian *Drosera petiolaris* and *Biblis liniflora* and the desert species *Cyanostegia cyanocalyx* and *Pityrodia chorisepala*.

Fauna: The fauna of the Edgar Ranges area is a mixture of Torresian (sub-humid Kimberley) and desert species. Twenty-four species of mammal have been recorded (Youngson, Henry & McKenzie 1981). A taxonomically unique population of the Rock Wallaby (*Petrogale lateralis*) occurs in the Range. Populations of the Dalgyte (*Macrotis lagotis*), Sandy Inland Mouse (*Pseudomys hermannsburgensis*), Forrest's Mouse (*Pseudomys forresti*) and Lesser Hairy-footed Dunnart (*Sminthopsis youngsoni*) are important for conservation and biogeographic reasons. The Edgar Ranges area is the "type locality" of *S. youngsoni*.

One hundred and twenty-one species of birds have been recorded (Johnstone, Smith & Fuller 1981), including three of special significance to conservation - Princess Parrot, Peregrine Falcon and Major Mitchell's Cockatoo. Resident populations of the last two were recorded in the area during the 1976 survey. Recorded in 1910, the rare and nomadic Princess Parrot is probably only an intermittent visitor. Among the Torresian species recorded were the Red-collared and Varied

Lorikeets, Rufous-throated Honeyeater and Pictorella Finch. Geomorphological changes make the presence of such species further south into the desert unlikely, even in the wet season. A larger component of arid zone birds has been recorded, including the Princess Parrot, White-fronted Honeyeater, Desert Warbler (*Gerygone fusca mungi*), Spinifex Bird and Black Honeyeater. A race of the Plumed Pigeon (*Geophaps plumifera mungi*) is endemic to the Edgar Ranges; many are desert species on the north-western limits of their ranges.

Storr and Smith (1981) recorded five species of amphibians and 40 species of reptiles in the Edgar Ranges area. Again, the fauna is a mixture of Kimberley and desert species; the presence of the dragon lizard *Diporiphora pindan* and the skink *Ctenotus inornatus* as well as their arid zone counterparts *D. winneckei* and *C. saxatilis* respectively, highlights this biogeographical characteristic of the Edgar Ranges area's fauna. Because the area is in relatively dry country, it is richer in desert rather than Kimberley birds and reptiles.

The insect collection from the Edgar Ranges area (Common 1981) contains 949 species (8 Orders); the additional 31 species collected at Logues Spring almost certainly occur at pools elsewhere in the ranges. A wet season collection would vastly increase the list. Ian Common concentrated on the Order Lepidoptera (moths and butterflies), collecting 514 species. Considering how poorly the Kimberley insect fauna is known (nearly 50 per cent of the micro-Lepidoptera collected in the Edgar Ranges area are undescribed), it is not surprising that many of these records have extended the known range of species.

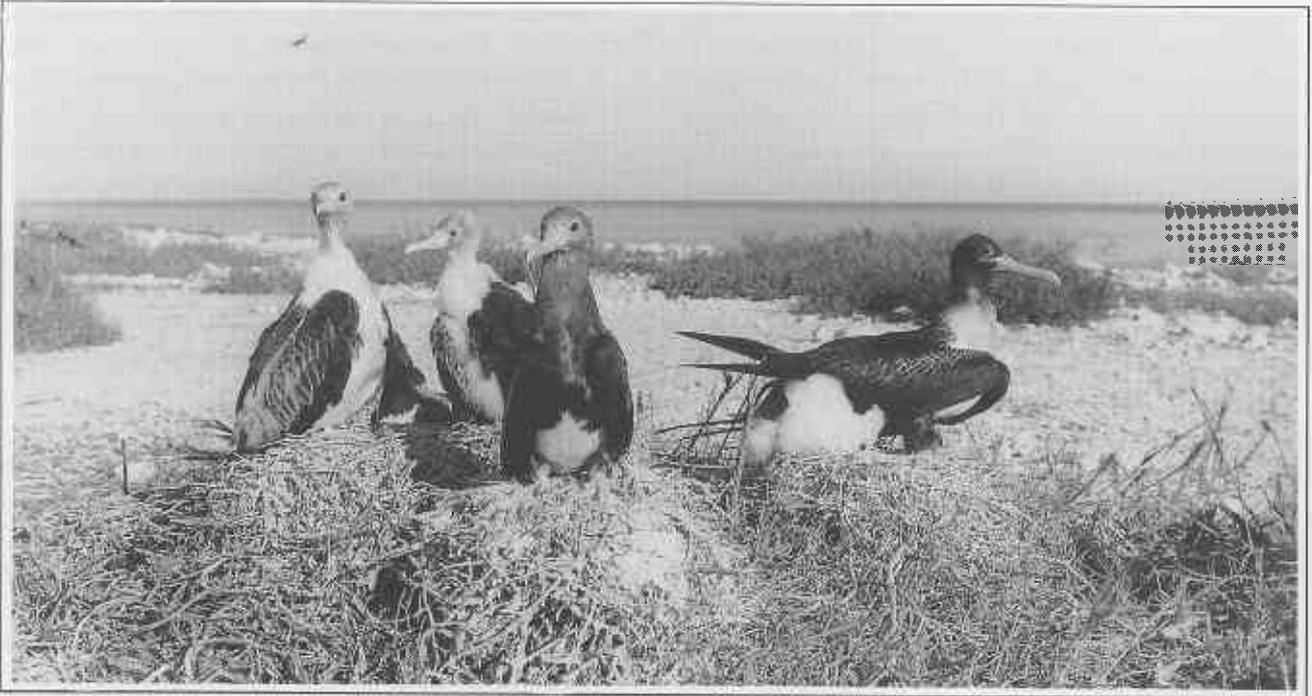
Recreational Use and Potential: No current use known. Unlikely to have major use in the foreseeable future because the area is accessible only via pastoral lease tracks, many of which are sandy. The exposed strata of the scarp are colourful, and the abrupt rock walls of the incised valleys are spectacular.

Key Features: Arid "pindan", Dalgytes and Rock-wallabies, northern edge of Great Sandy Desert.

CTRC Recommendation: See above under Dampier Peninsula (Area 2.2).

EPA Recommendation: See above under Dampier Peninsula. (Area 2.2).

Our Recommendation: See above under Dampier Peninsula. (Area 2.2).



Lesser Frigate-bird and chicks - Lacedpede Islands.



Brown Boobies nesting - Lacedpede Islands.



2.4 LACEPEDE ISLANDS

Location: The Lacepede Islands lie some 20 km off the coast, 150 km north of Broome.

Map: 2, 3.

Area: West Island: 106.6 ha, Middle Island: 53.6 ha, East Island: about 32 ha, Sandy Island: 8.2 ha.

Current Status: West and Middle Islands comprise Class C Reserve No. 7279 for the Conservation of Flora and Fauna, vested in the National Parks and Nature Conservation Authority. East Island is leased to the Commonwealth of Australia for a lighthouse site. Sandy Island is vacant Crown land.

Geomorphology: Sand cays on limestone and coral reef.

Vegetation and Flora: The Islands are sparsely vegetated with Beach Spinifex (*Spinifex longifolius*), *Amaranthus pallidiflorus*, *Cleome viscosa* and *Canavalia rosea*. A lagoon at the northern end of West Island is fringed with *Halosarcia indica* subsp. *julacea*, *Neobassia astrocarpa*, *Sesuvium portulacastrum* and *Sporobolus virginicus*. A few shrubs of the White Mangrove (*Avicennia marina*) have been recorded growing in the lagoon.

Fauna: The main conservation value of the islands is the significant seabird nesting colonies. The main species and the number of pairs counted in July 1981 are Brown Booby (*Sula leucogaster*) 17 670 pairs and Lesser Frigate-bird (*Fregata ariel*) 2 700 pairs (Burbidge *et al.* 1987). Other species include Australian Pelican (*Pelecanus conspicillatus*) about 70 pairs (P.J. Fuller and J.A.K. Lane pers. comm.), Common Noddy (*Anous stolidus*) and Fairy Tern (*Sterna nereis*). The Lacepede Islands colonies of Brown Booby are the largest in the world and the Lesser Frigatebird colonies are the largest in the Indian Ocean.

The Black Rat (*Rattus rattus*) was present, sometimes in plague numbers, on West, Middle and Sandy Islands. Rats inhibit or prevent breeding by the smaller species of seabirds and, in 1986, the Department of Conservation and Land Management (CALM) commenced an eradication campaign.

The islands possess major turtle nesting rookeries. Large numbers of Green Turtles (*Chelonia mydas*) nest there and CALM is currently tagging nesting turtles to elucidate migration patterns.

Two species of lizards, the gecko *Gehyra punctata* and the dragon *Gemmatophora gilberti* are known from West and Middle Islands, respectively.

Recreational Use and Potential: The islands are visited by fishermen and naturalists and by tourists viewing Kimberley features. There is no potential for intensive use by people because of the desolate nature of the islands and the lack of fresh water.

Key Features: The seabird colonies and turtle rookeries.

CTRC Recommendation: "The Committee Recommends that Reserve No. 7279 comprising the West and Middle Islands of the Lacepede Islands be reclassified to Class B. Should East Island become available for reservation, it should be added to the reserve. The reserve should be extended to low water mark in order to ensure the protection of turtles."

EPA Recommendation: "The EPA recommends that:

1. the boundary of Reserve 7279 be extended to low water mark;
2. the classification of Reserve 7279 be amended to Class B;
3. should East Island become available for reservation, it be added to Reserve 7279."

Our Recommendation: We endorse the EPA recommendations except that the status of the reserve should be Class A. Sandy Island should be added to the Nature Reserve.

2.5 OSCAR AND NAPIER RANGES

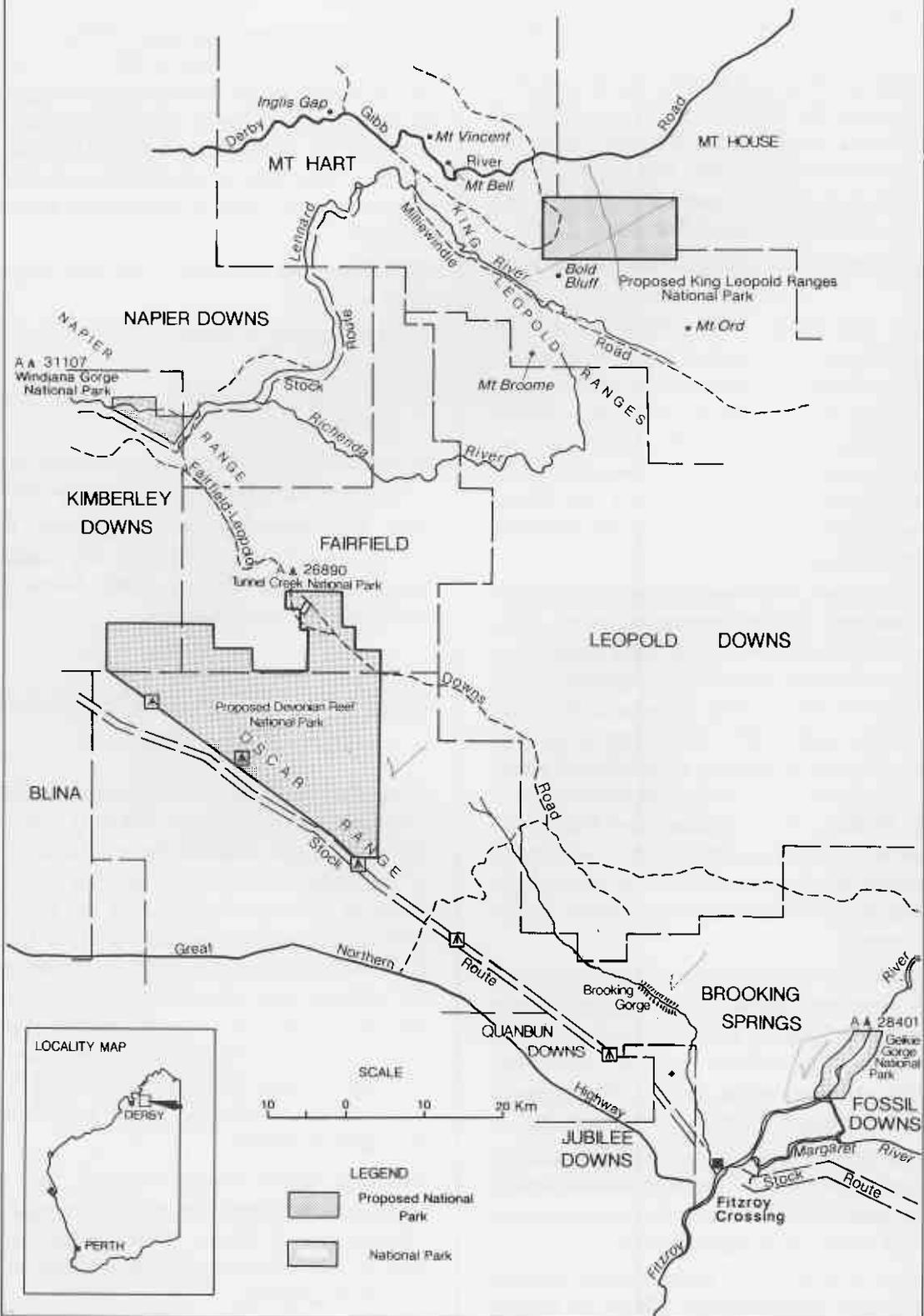
Australian Academy of Science (1962, 1965) gave considerable attention to this area. It expressed the opinion that because the ranges "include some of the most beautiful and striking scenery to be found in Western Australia", it was desirable that parts be set aside as a national park (Australian Academy of Science 1965, p. 208). It also expressed the opinion that selected gorges and ranges in the area be set aside as Class A reserves and that an expert committee be asked to survey the area and recommend parts for public recreation, Aboriginal and archaeological sites, fauna and flora and for geological purposes.

Location: Geikie Gorge National Park is 15 km north-east of Fitzroy Crossing; Windjana Gorge is 130 km east of Derby; Tunnel Creek is 165 km east of Derby; Brooking Gorge is about 16 km west of Fitzroy Crossing.

The Oscar Range extends from about 140 km east-



PROPOSED NAPIER & OSCAR RANGES AND KING LEOPOLD RANGES NATIONAL PARKS



MAP 8



south-east of Derby to north-west of Fitzroy Crossing. The Napier Range extends from about 25 km east of Derby 90 km to the east-south-east.

Map: 8.

Area: Geikie Gorge National Park: 3 136 ha; Windjana Gorge National Park: 2 134 ha; Tunnel Creek National Park: 91 ha.

Current Status: Since the publication of the National Parks Report, Geikie Gorge, Windjana Gorge and Tunnel Creek have been declared national parks and are now vested in the National Parks and Nature Conservation Authority.

Geikie Gorge is Class A Reserve No. 28401. Windjana Gorge National Park is Class A Reserve No. 31107. Tunnel Creek National Park is Class C Reserve No. 26890.

Brooking Gorge lies within Brooking Springs Station.

The Oscar Range lies within the pastoral leases of Brooking Springs, Fairfield and Leopold Downs. The Napier Range lies within the pastoral leases of Napier Downs, Kimberley Downs and Fairfield.

Geomorphology: The Napier and Oscar Ranges are the limestone remnants of a Devonian barrier reef. They are two of a series of low, elongate ridges that rise abruptly from grassy alluvial plains to the north of the Fitzroy River. The ranges are composed of a central west-north-west trending ridge of Precambrian schist and gneiss that is flanked to the north and south by narrow belts of Devonian limestone. The topography, particularly in the limestone belts, is rugged, with canyons, karst features and impressive cliffs rising above the plains. The numerous springs in the limestone terrain are lined with *Pandanus* and vines and covered with water lilies; they are peaceful enclaves in an otherwise harsh environment. Caves are abundant and contain Aboriginal paintings.

Geikie Gorge is formed where the Fitzroy River cuts through the limestone at the junction between the Oscar and Geikie Ranges. Permanent deep water occurs in the Gorge.

Windjana Gorge is a picturesque narrow canyon, cut through the limestone of the Napier Range by the Lennard River. As described in the National Parks Report, the gorge is about 5 km long, walled by vertical cliffs of weathered limestone from 30 to 100 m high. Though the Lennard River runs through the Gorge only in wet weather, it contains pools surrounded by trees and shrubbery during the dry season.

Tunnel Creek flows through the Napier Range, in

a large natural tunnel eroded through the limestone by the stream itself. Apart from its tourist appeal, this unusual physiographic feature is of interest to geomorphologists and geologists.

Brooking Gorge is regarded by some people as being even more beautiful than Geikie Gorge. A long narrow limestone gorge which has been eroded by Brooking Creek, it contains permanent pools of fresh water.

Vegetation and Flora: The forest fringing the river in Geikie Gorge is dominated by two species of cadjeput, *Melaleuca leucadendra* and *M. argentea*. There are also River Gums (*Eucalyptus camaldulensis*), Freshwater Mangroves (*Barringtonia acutangula*), figs (*Ficus racemosa*, *F. coronulata* and *F. hispida*) and screw pines (*Pandanus*). The Tropical Reed (*Phragmites karka*) forms dense stands on the banks, while Native Passionfruit (*Passiflora foetida*) scrambles over trees and shrubs.

In Windjana Gorge, River Gums (*Eucalyptus camaldulensis*) and cadjeputs (*Melaleuca leucadendra*) fringe the alluvial banks of the Lennard River, together with *Ficus coronulata*, *F. hispida*, *F. racemosa* and *Nauclea orientalis*. White Cedar (*Melia azedarach*), Boabs (*Adansonia gregorii*), *Gyrocarpus americanus* and *Atalaya hemiglauca* occur on the slopes of the Gorge.

Pools in Brooking Gorge are bordered by a dense growth of *Ficus racemosa*, *Nauclea orientalis*, *Melaleuca leucadendra*, *Pandanus aquaticus* and other trees.

Fauna: Geikie Gorge harbours a large population of Freshwater Crocodiles (*Crocodylus johnstoni*) as well as Leichardt's Sawfish (*Pristiopsis leichhardti*) and Coach-whip Stingray (*Himantura amak*), species normally marine. Barramundi (*Lates calceferus*) are also found there. The Short-eared Rock-wallaby (*Petrogale brachyotis*) and Orange Horseshoe Bat (*Rhinonicteris auranteus*) are notable mammals.

A wide variety of water birds have been recorded at Geikie Gorge, including the Darter, Great Egret and Little Pied Cormorant. Two species not often found so far from the sea are the White-breasted Sea-Eagle and Brahminy Kite. In the thick vegetation fringing the gorge, the rare and endangered Purple-crowned Fairy-wren breeds, and the Clamorous Reed-Warbler, Brush Cuckoo and Restless Flycatcher occur, while along the cliffs the Great Bower-Bird and Sandstone Shrike-Thrush are found.

Windjana Gorge is also rich in fauna, including Sandy Wallaby (*Macropus agilis*), Yellow-lipped Bat (*Eptesicus douglasi*) and Freshwater Crocodile (*Crocodylus johnstoni*). Water birds include Great

Egret, Black-fronted Dotterel, Darter, Little Pied Cormorant, White-faced Heron, Black Bittern and Rufous Night-Heron. The Peregrine Falcon and the Sandstone Shrike-Thrush are found on the cliffs. Other birds include the Barking Owl and Blue-winged Kookaburra. The pools contain four species of fresh water fish - an undescribed Rainbow Fish (*Nematocentris* sp.), Bony Bream (*Nematalos erebi*), Spangled Perch (*Terapon unicolor*) and an undescribed Archer Fish (*Toxotes* sp.).

Tunnel Creek contains five species of bats: the Ghost Bat (*Macroderma gigas*), Bent-wing Bat (*Miniopterus schreibersii*), Little Bat (*Eptesicus pumilus caurinus*), Orange Horseshoe Bat (*Rhinonictis aurantius*) and Yellow-lipped Bat (*Eptesicus douglasi*). The creek contains four species of fish: an undescribed Rainbow Fish (*Nematocentrus* sp.), the Bony Bream (*Nemataloserebi*), Spangled Perch (*Terapon unicolor*) and Fork-tailed Catfish (*Neosilurus glencoensis*).

Birds recorded in Brooking Gorge include the Black Duck, Restless Flycatcher, Bar-shouldered Dove, Peaceful Dove and Great Bower-bird.

There have been no detailed examinations of the fauna of the Oscar or Napier Ranges as a whole. However, the rare Rock Ringtail (*Pseudocheirus dahli*) is known to occur in the Napier Range. Some measure of the biological importance of the ranges can be gauged from the fact that they support a large number of endemic land snails and cave-dwelling invertebrates. Twenty-one species of camaenid land snails are endemic to the ranges (Solem 1979, 1981, 1984, 1985). These belong to the genera *Amplirhagada*, *Westraltrachia*, *Rhagada*, *Kimboraga*, *Kendrickia*, *Mouldinigia* and *Quistrachia*. There is also one species of pupillid land snail endemic to the ranges (*Gyliotrachela napierana*).

Recreational Use and Potential: Geikie Gorge is without doubt an important tourist attraction in the region. As it is close to Fitzroy Crossing and the main highway through the Kimberley, Geikie Gorge National Park has become a popular tourist resort. More than 13 000 people entered it between April 1974 and October 1975 and there were 27 000 visitors during the 1986 dry season. Rangers conduct boat tours through the Park, and the fees charged contribute to the cost of maintaining the service. The rapidly increasing number of tourists will create management problems in the future.

Windjana Gorge is popular with tourists because of its attractive scenery, and its Aboriginal and historical interest. The large cave near the eastern entrance is decorated by numerous paintings of men

and animals, the main figure being an impressive Wandjina. It is also the site of an Aboriginal uprising led by the Bunaba tribesman Pigeon (Jundumurra). Pigeon's first victim, Constable Richardson, was murdered in October 1894 at Lillimilura Police Station, just 215 metres east of the Gorge. The remains of the police station still stand. Shortly after this, Pigeon killed the stockmen Burke and Gibbs at the entrance to the Gorge.

Like Geikie Gorge, Windjana Gorge, and other sites in these limestone ranges, Tunnel Creek is on a route used increasingly by tourists. Its unusual formation and historical associations with the Aboriginal Pigeon (who hid from his pursuers in the tunnel), have attracted many visitors. The immediate problem at Tunnel Creek is to protect it from "improvements" and from damage by visitors. For instance, provision of lights to illuminate the tunnel would disturb the colonies of bats; the Ghost Bat requires a totally dark diurnal refuge.

As Brooking Gorge is accessible by a good track and close to Geikie Gorge, the number of visitors may be expected to increase greatly in the future. At present, tourists only visit it occasionally. The lessee of Brooking Springs Station does not generally allow tourists and is understandably apprehensive about the effects that increasing numbers of visitors will have on his lease. Brooking Gorge is fenced, but cattle are allowed to enter when other surface waters dry up.

Public access to the Oscar Range is currently limited to a road which cuts across the eastern part of the range between Leopold Downs and Fitzroy Crossing. Efforts to create a reserve for recreational purposes could be counter to the principal aims of conserving springs and cave paintings, unless the area received adequate management.

The main conservation requirements for the Oscar Range are the preservation of the springs and the Aboriginal paintings. This may be best achieved by designation of small reserves around springs, with fencing to limit access by stock, and by construction of barriers to control access to caves. Springs in the Oscar Range are important water resources for the pastoral industry. Provision would need to be made so that water be provided, preferably via bores, to the plains below. However, the range country itself has low grazing potential and is difficult to muster cattle from. The range also provides a refuge for vermin such as donkeys.

Key Features: A Devonian barrier reef known world-wide, with spectacular scenery, rare wildlife, caves, sub-fossil deposits and increasing tourist use.



CTRC Recommendation: "While CTRC believes in principle that a larger area of the Napier and Oscar Ranges should be set aside as National Park, it also recognises the difficulty of obtaining suitable land for such a purpose. Unlike the North Kimberley, there are no large tracts of vacant Crown Land in the region, and any proposal for a major park in the area would involve the acquisition of land held under pastoral lease.

The Committee endorses the status, purpose and vesting of the Geikie Gorge National Park. It recommends that in view of the expected large number of future visitors to the Gorge, the National Parks Authority:

- (i) reconsider the boundaries of the existing Park;
- (ii) consider whether the existing campsite and facilities are in the most desirable site.

The Committee endorses the status, purpose and vesting of the Windjana Gorge National Park.

The Committee endorses the status, purpose and vesting of the Tunnel Creek National Park.

The Committee recommends that negotiations be undertaken with the lessee of Brooking Springs Station, with a view to declaring Brooking Gorge as a Class B Reserve for the purpose of National Park, and vesting it in the National Parks Authority.

Concerning the Oscar Range, the Committee recommends that:

- a. The W.A. Museum be requested to make a survey of caves with the objective of proposing a conservation programme for important sites;
- b. A survey be made of springs with the objectives of:
 - (a) designating small reserves, and
 - (b) reconciling conservation requirements and pastoral usage."

EPA Recommendation:

"The EPA endorses the status, purpose and vesting of Geikie Gorge National Park. It recommends that the National Park Authority review the adequacy of the existing Park boundary.

"The EPA endorses the status, purpose and vesting of Reserve 31107 (Windjana Gorge National Park).

"The EPA endorses the status, purpose and vesting of Tunnel Creek National Park.

BROOKING GORGE

This gorge lies within Brooking Springs Station. During the visit by the EPA to Brooking Gorge, representations were made regarding the importance of the Gorge to the local community and to the

Station. Concern was expressed that reservation as a National Park would deny the local population the use of the Gorge for recreational purposes and would restrict the availability of water for stock purposes. In addition, the Gorge has a limited capacity to accommodate visitors.

The Authority considers that while Brooking Gorge is aesthetically attractive and has considerable scenic grandeur, the limited capacity for accommodating large numbers of visitors without costly management mitigates against its becoming a successful National Park at this time.

The EPA recommends that no action be taken to reserve Brooking Gorge at this time. However, should the public be denied reasonable access to the Gorge or if signs of significant deterioration of the Gorge become apparent, the question of reservation of Brooking Gorge be reconsidered by the Authority.

OSCAR RANGE

The EPA recommends that the W.A. Museum, in conjunction with the Australian Speleological Federation, make a survey of caves in the Oscar Range and report to the EPA on their consideration and anthropological value, with a view to reservation."

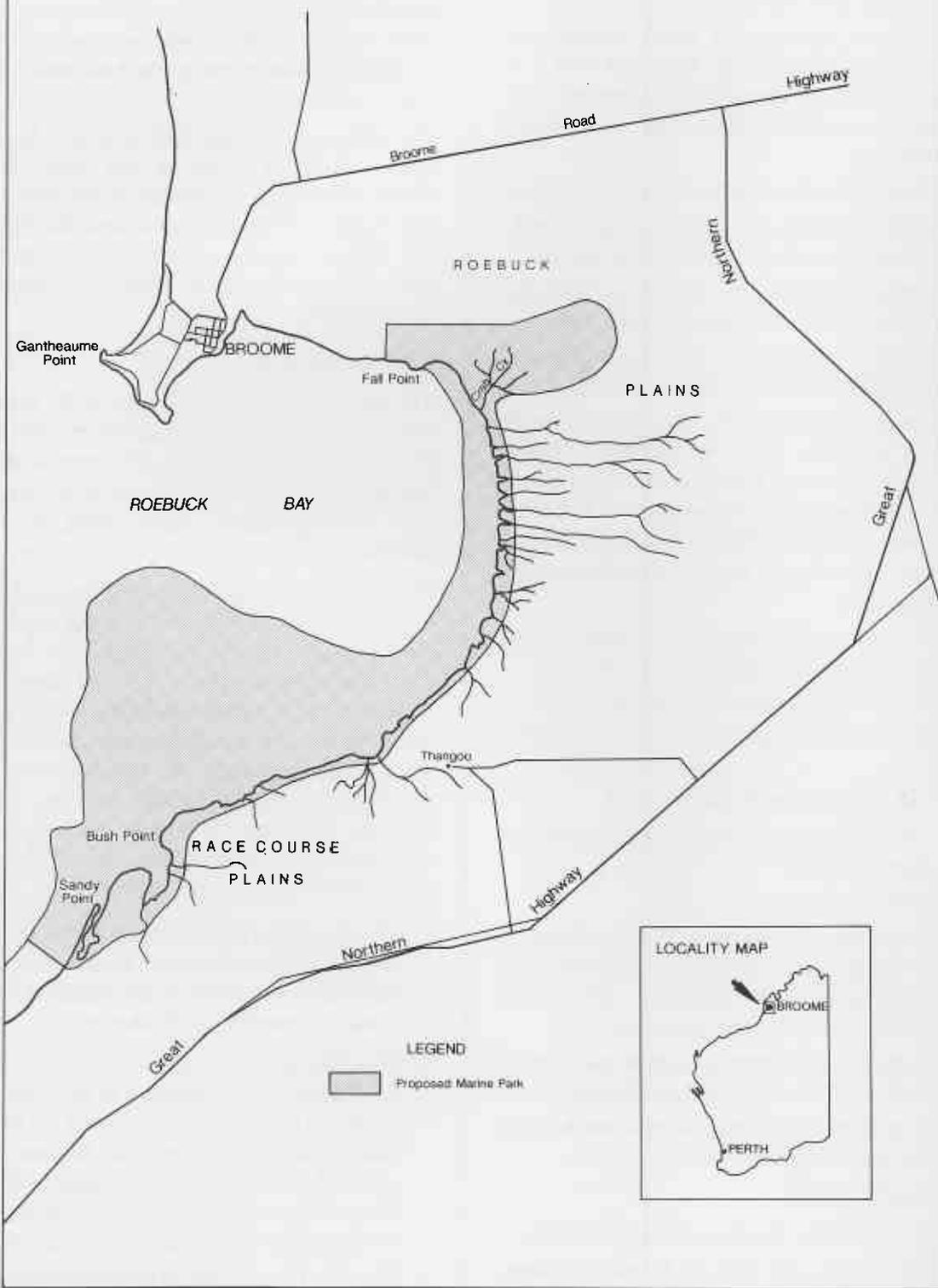
Our Recommendation: Our recommendations are based on the view that the existing small reserves in the Napier and Oscar Ranges are inadequate. They are not representative of the ranges, merely including small scenic localities, which are under considerable, and increasing, recreational pressure. To create a system of conservation reserves representing the structures, surfaces, biological diversity and major tourist attractions associated with the ranges and adjacent alluvial plains to the north and south we recommend:

1. That Brooking Gorge and environs (Map 8) be declared a Class A reserve for a conservation park and it be vested in the National Parks and Nature Conservation Authority.
2. That the reserve recommended by the Western Australian Sub-Committee of the Australian Academy of Sciences Committee on National Parks (1962, p. 92) (Map 8) be declared a Class A national park vested in the National Parks and Nature Conservation Authority. The park should be named the Devonian Reef National Park.
3. That the Department of Conservation and Land Management considers extending Windjana Gorge and Geikie Gorge National Parks to make



PROPOSED ROEBUCK BAY MARINE PARK

SCALE
5 0 5 10 km



MAP 9

them more representative of their districts and of the ranges as a whole. In particular, consideration should be given to connecting Windjana Gorge National Park with the proposed Devonian Reef National Park and to connecting the proposed Brooking Gorge Conservation Park with Geikie Gorge National Park.

2.6 ROEBUCK BAY AREA

Location: Immediately east and south-east of Broome.

Map: 9.

Area: Not known.

Current Status: Vacant Crown land and unreserved tidal flats. Includes a small part of Roebuck Plains Station.

Geomorphology: The coast consists of sandplains and low dunes underlain by weakly to moderately cemented alluvial conglomerate. Between the western edge and Fall Point there are steep sandy slopes or cliffs (2 - 5 m) adjacent to the beach. Elsewhere, muddy tidal flats occur along the shore and at low tide are dry for several hundred metres below high water mark. The tidal Crab Creek flows into the area just south of Fall Point.

Vegetation and Flora: In the northern part of the proposed reserve, the foredune zone is vegetated with *Spinifex longifolius* and *Canavalia rosea* close to the beach, and with *Plectrachne pungens* on the dune crests. On the sandplains behind is a typical pindan vegetation with low trees, tall shrubs (*Acacia eriopoda* is the dominant species) and tall grassland. Some plant species with rainforest affinity are found here. South of Fall Point, mangroves (*Avicennia marina*, *Rhizophora stylosa*, *Ceriops tagal* and *Bruguiera exaristata*) grow on the mudflats. Tidal portions of Crab Creek are vegetated with mangroves, and the Saltwater Couch (*Sporobolus virginicus*) grows on the floodplain of the creek.

Fauna: The intertidal flats and beaches are the landfall and feeding grounds of vast numbers of migratory wading birds that arrive in Australia from their breeding grounds in the arctic parts of east Asia in August-September and leave in March and April. Over 850 000 waders use Roebuck Bay and Eighty Mile Beach at migration time; large numbers spend the summer there and about 10 000 non-breeding birds use the area during the southern winter. At high tide, the wading birds concentrate at roosting areas on the beach around Fall Point and, to a lesser extent, Bush and Sandy Points. These areas are particularly important and are most

susceptible to disturbance. The birds also roost in the mangroves and on the mudflats behind the mangroves under some conditions.

The combined area of Roebuck Bay and Eighty Mile Beach is the seventh most significant place for wader concentrations in the world. Roebuck Bay contains a much greater density of birds than Eighty Mile Beach; over 170 000 birds have been counted there on a single occasion.

The bats of the mangrove community include an undescribed form of *Chalinolobus gouldii*. The bat community that forages in these mangrove stands is of considerable interest to ecologists (McKenzie and Rolfe 1986).

Recreational Use and Potential: The area is becoming a major attraction, being close to Broome and having pleasant coastal scenery. Amateur and a small amount of professional fishing takes place. The abundant bird life is becoming known internationally and is starting to attract overseas, as well as Australian, bird watchers. In conjunction with the other facilities and attractions of the Broome area, there is considerable potential for developing the area as an important international attraction.

The Royal Australasian Ornithologists Union has constructed and is staffing a Bird Observatory in the Roebuck Bay area. The Bird Observatory will attract increasing numbers of bird watchers to the area, and will provide a base from which to conduct research into bird movements, feeding and life cycles.

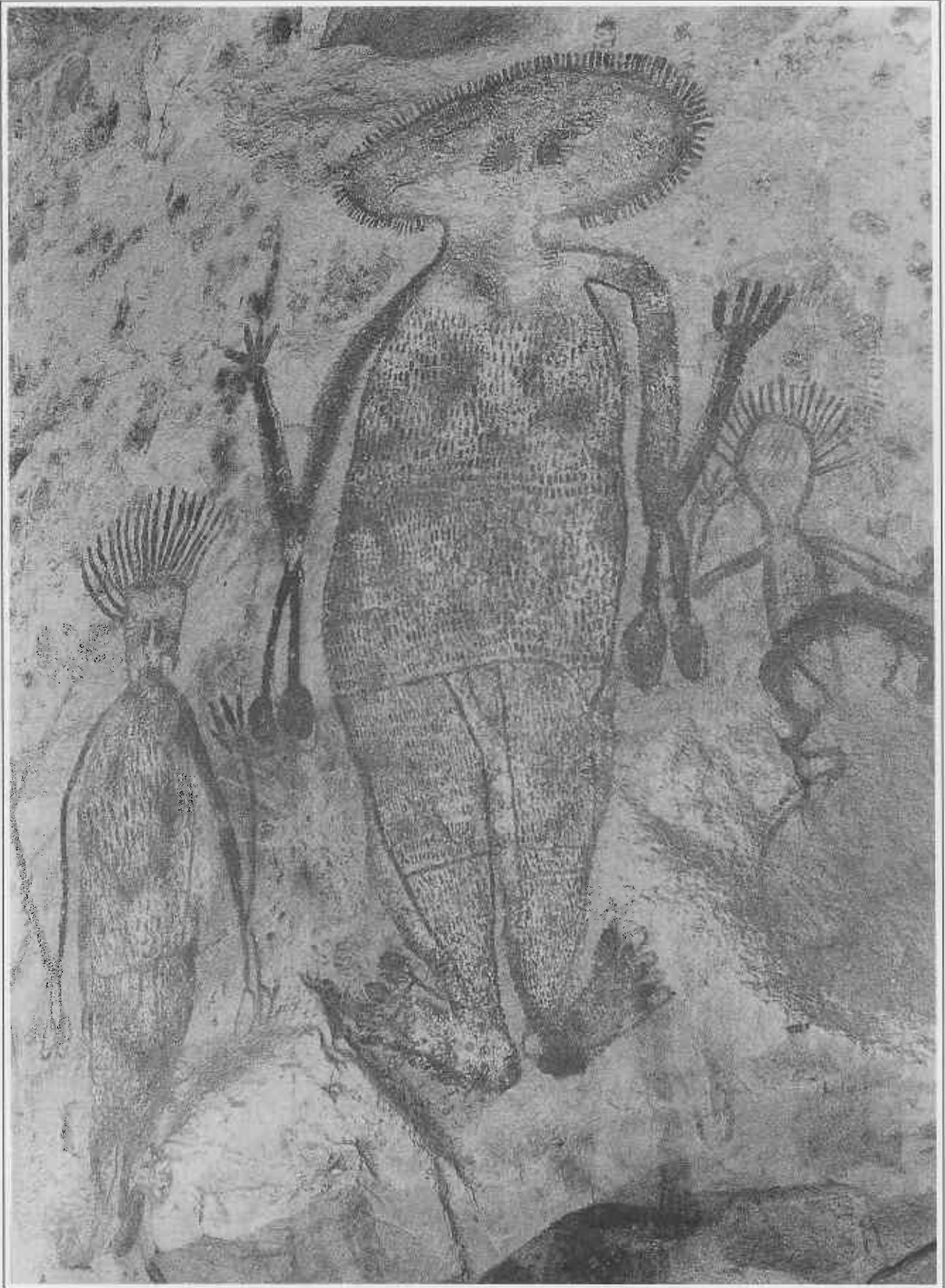
Key Features: The tidal flats and the migratory wading birds. The high tide roosting areas.

CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: Australia has signed three international treaties that protect migratory wading birds and their habitat. Reservation of the Roebuck Bay area would be a major step forward in meeting Australia's obligations under these treaties. Because both land and water is involved, the best form of reservation would be a marine park, that would allow zoning for recreational use of suitable areas.

We recommend that a Class A marine park be declared in the Roebuck Bay area, with the boundaries shown on the map. The reserve should be vested on the National Parks and Nature Conservation Authority.



Aboriginal Wandjina paintings are found on many of the sandstone cliff faces throughout the Kimberley.

3

EAST KIMBERLEY

For this discussion, the East Kimberley includes the Bonaparte Gulf Basin, the Ord Basin, the eastern side of the Halls Creek Mobile Zone and the northern part of the Victoria River Basin.

The two Phanerozoic basins (Bonaparte and Ord) are topographically and geologically distinct from the Precambrian rock types of the North Kimberley District. However, this is not true of the Halls Creek Mobile Zone and of the Victoria River Basin; we included these two areas in the East Kimberley because they fall within the drainage basin of the Ord River, the boundaries of which correspond to the Ordland Physiographic Division outlined by Beard (1979). Strictly then, the southern part of the Parys Lagoons Nature Reserve intrudes into the eastern edge of the North Kimberley (Kimberley Foothills Sub-Province).

We have not considered the south-western extension of the Hall Botanical District (see Beard 1979) in this account because it falls outside Ordland, there are no existing reserve recommendations in the area and there are few biogeographic data available.

Four distinct physiographic provinces are included in the Ordland Division (Paterson 1970, Stewart *et al.* 1970, Beard 1979):

1. The Cambridge Gulf Lowlands comprise low-lying erosional and alluvial plains that extend inland from the tidal mudflats of the northern coastline. These plains are mainly sandy, but include extensive areas of brown and grey alluvium (known as black soil), and do not exceed 100 m in altitude. Interspersed across the plains are remnants of Proterozoic sandstones (Pentecost, Cockburn and Hensman Sandstones, Pincombe Formation, and Wyndham Shale), Palaeozoic sandstones (Cockatoo and Skewthorpe

Formations, Hart Spring and Point Spring Sandstones) and limestones (Ningbing Limestone). These outcrop as structural plateaux, rocky mesas, hills and cuestas rising to 300 m altitude.

2. The Ord Plains Province was formed where the Ord River flows through a sequence of Lower Cambrian volcanics (Antrim Plateaux Volcanics), Middle Cambrian limestones (Headley and Linnekar Limestones) and shales (Panton Formation), and Devonian sandstone (Elder sandstone). The province comprises extensive low-lying plains and hilly tracts covered by residual and alluvial soils. Where associated with calcareous rocks, these are mainly "black soils"; where derived from the Elder sandstone, the soils are sandy; soils of the volcanics include lithosols on uplands and juvenile cracking clays on outwash plains. The volcanics have mostly been dissected to form mesas and buttes; limestones and shales form low cuestas; sandstones form cuestas and a structural bench surrounding a structural plateau (the Bungle Bungle massif). Altitudes range from 80 m in the north to 500 m on ridge crests in the south; the lowest parts of the plains were drowned by Lake Argyle.
3. The Sturt Plateau Province occurs along the southern margin of Ordland. It is a gently undulating, elevated, erosion plain, drained inland by Sturt and Wolfe Creeks, and separated from the dissected valley of the Ord River by steep breakaways. Much of the plateau is covered by cracking clay plains developed over Antrim Plateau Volcanics, though large areas are capped with thick laterite, which has partly been dissected to form mesas, and is mainly covered by extensive desert sandplains.

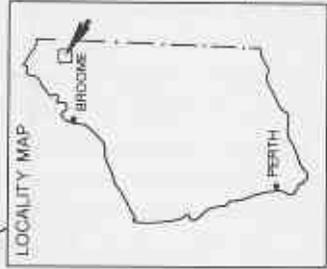
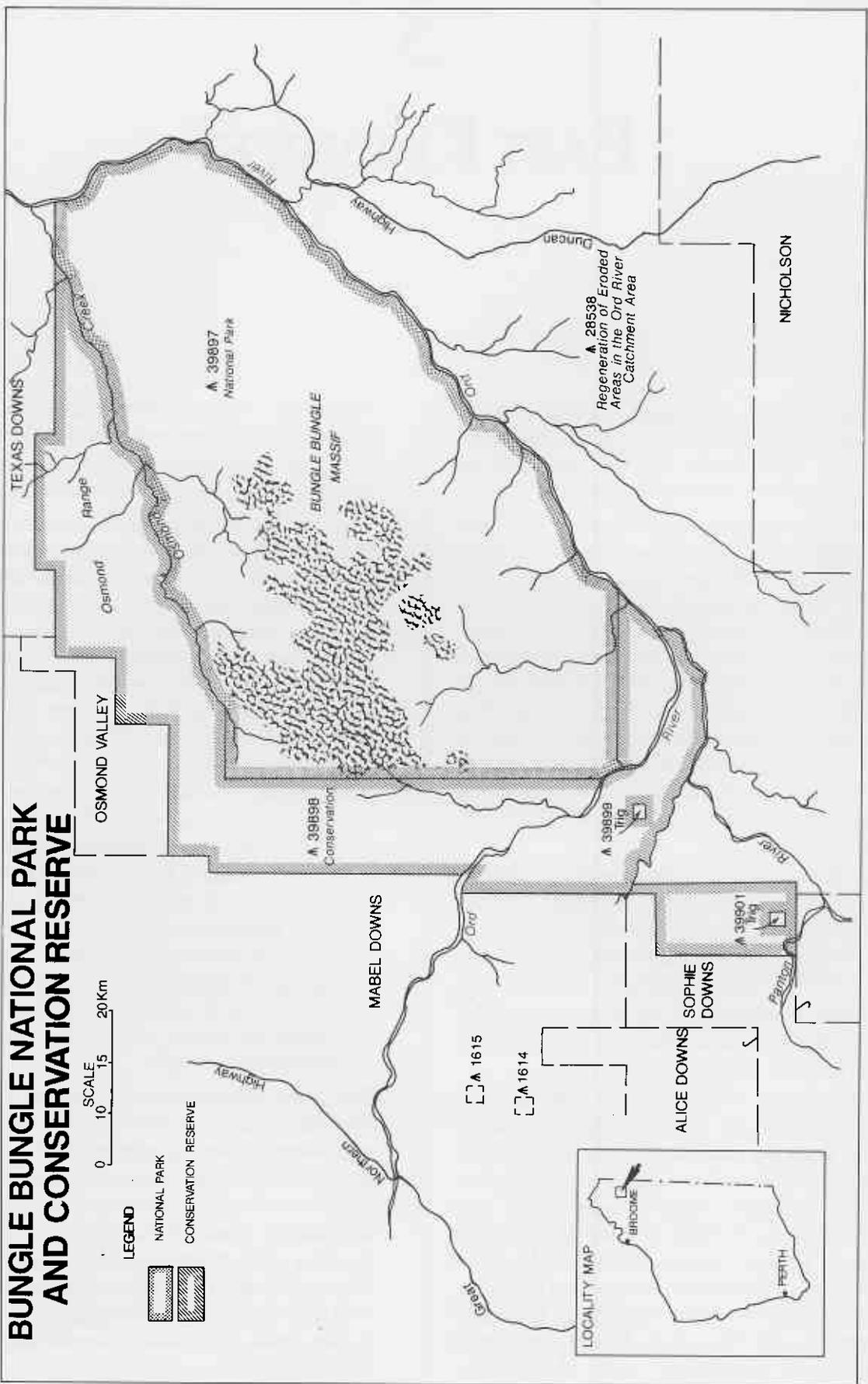


BUNGLE BUNGLE NATIONAL PARK AND CONSERVATION RESERVE

SCALE
0 10 15 20 Km

LEGEND

-  NATIONAL PARK
-  CONSERVATION RESERVE



MAP 10

4. The Lamboo Hills Province is an area of very rugged topography, comprised of a variety of Precambrian rock types that belong to the Halls Creek Mobile Zone:

Most of this Province is occupied by the Bow River Hills, an area of low, rounded, boulder-strewn hills and ridges consisting mainly of Bow River granite with intrusions of dolerite, porphyry and other rocks of the Lamboo complex. The soil cover is poor.

To the north is an area of rugged sandstone, siltstone and shale ranges, bounded by steep scarps, known as the Carr Boyd Ranges. Relief within the Ranges is up to 450 m. Loamy, duplex and sandy soils are present.

To the east, between the Bow River Hills and the Ord Basin, are the rugged, inaccessible sandstone, dolomite and siltstone terrains of the Osmond Range, and the Albert-Edward Range; the latter is characterised by northerly trending cuestas and hogbacks, and includes near-vertical scarps up to 125 m high, deep gorges and trellised drainage.

The Halls Creek ridges separate the Albert-Edward Range from the Bow River Hills; its Archean sub-grey wacke, shale, siltstone and basalt rocks have little soil cover, are tightly folded and have a rough, hilly relief of up to 100 m. Drainage is trellised and the steep slopes of the intervening ridges are deeply incised.

The East Kimberley District receives an annual average rainfall of between 500 mm (in the south) and 800 mm (in the north) during a predictable rainy season that lasts from late November to early April. The rest of the year is virtually a drought, during which fresh water is retained only in landscapes associated with the more ancient rock-types, as pools along the major river systems, and in man-made situations (such as dams on pastoral properties, and wetlands associated with Lake Argyle).

The East Kimberley includes parts of the Halls Creek and Wyndham-East Kimberley Shires. There are a number of existing and proposed conservation reserves in the district.

3.1 BUNGLE BUNGLE NATIONAL PARK AND CONSERVATION RESERVE

Location: About 120 km south of Kununurra and 120 km north-east of Halls Creek.

Map: 10.

Area: Reserve 39897, National Park : 208 723 ha, Reserve 39898, Conservation Reserve : 110 602 ha.

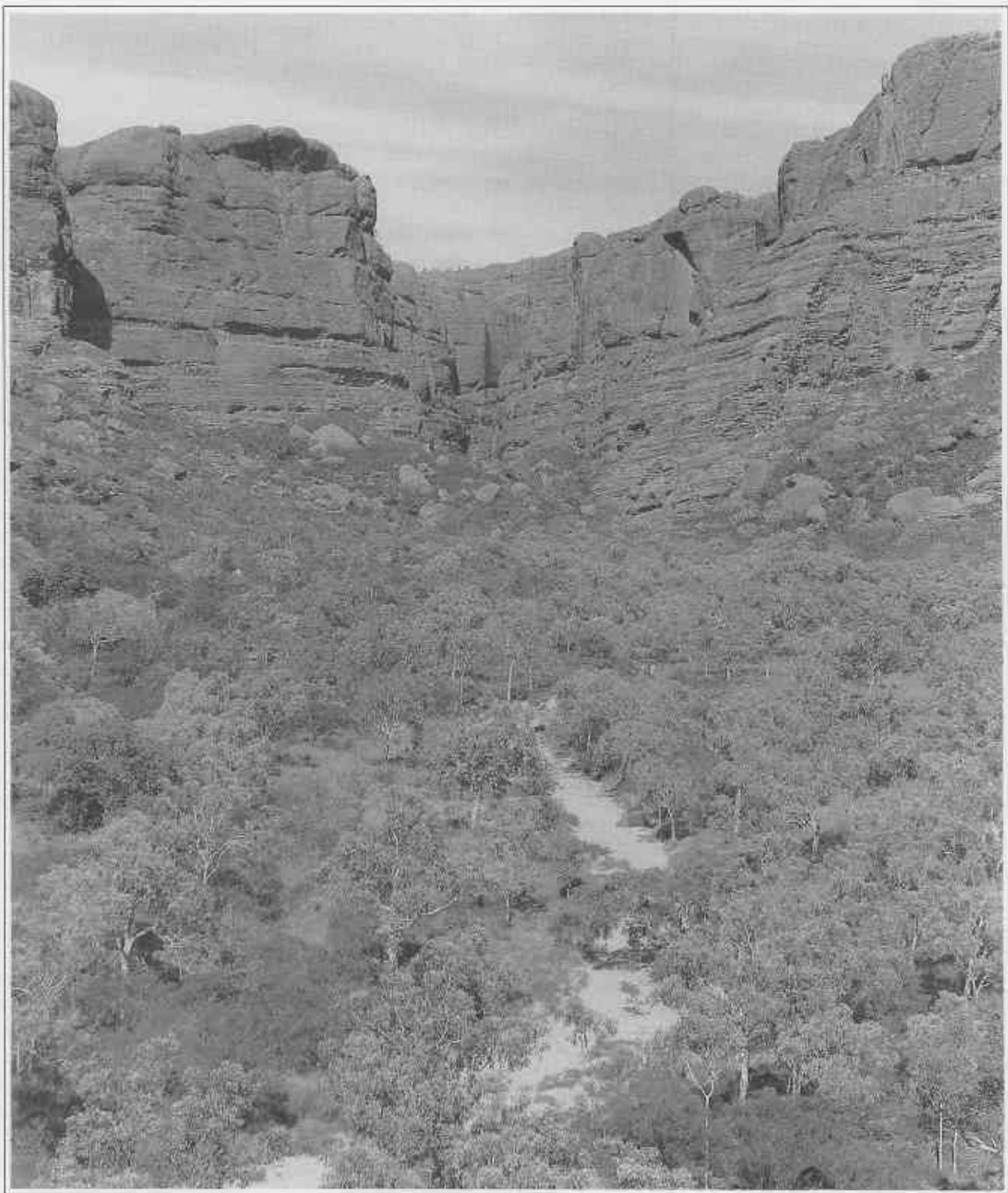
Current Status: During construction of the Ord Irrigation Scheme, large areas of the Ord Basin upstream from Lake Argyle were withdrawn from pastoral lease and reserved for the purpose of stabilising and regenerating vegetation on lands degraded by previous pastoral practices. The reserve was created following concern that the estimated 22 000 000 tonnes of sediment being washed off the Ord River catchment each year, from over-grazed pastoral leases, would occlude Lake Argyle. The Ord River Regeneration Reserve (No. 28538) is Class C, and is not vested. Management to achieve the stated purpose of reservation is in the hands of the Department of Agriculture.

Following media promotion of the spectacular Bungle Bungle massif during 1982 and 1983, the Environmental Protection Authority set up a working group to investigate and report on the status, vesting and purpose of Bungle Bungle and adjoining land. Following consideration of the working group's recommendations by State Cabinet, the north-western portion of the Ord River Regeneration Reserve was proclaimed partly a Reserve for Conservation and partly a National Park. Both were Class C and vested in the National Parks and Nature Conservation Authority. Cabinet proposed that the National Park be upgraded to Class A once its long-term boundaries were decided.

Geomorphology: The description below is drawn from the working group's final report to the Environmental Protection Authority (Bungle Bungle Working Group 1986).

The Bungle Bungle massif is a structural plateau of the Devonian Elder Sandstone, whose massive beds in places tower nearly 300 metres above the surrounding sandplain. The plateau is deeply incised and features numerous canyons with sheer sides, and arrays of dramatic silicified towers, on which orange and black bands are superimposed along the horizontal bedding planes. Substrates include exposed rock to sandy lithosols on the uplands and cuestas, with sandy to friable calcareous soils on the lower footslopes.

The bulk of the National Park, to the north, east and south of the massif, is occupied by a structural bench of extensive undulating sandplain, of deep red and yellow sands and earths, derived from the underlying Elder Sandstone. Rough stony hills of



Broad pebbly stream beds derived from conglomerates drain the Bungle Bungle massif.



Antrim Plateau Volcanics (mainly basalts), mantled with lithosols, and associated outwash plains of cracking clays, occur to the west and north of the Bungle Bungle massif.

To the south-west of the massif are complex fold-mountains and ridges of Archean sedimentary and metamorphic rocks with sparse gravelly lithosols. To the north and north-west of the massif are Proterozoic strata, including shale, siltstone, sandstone, conglomerate and dolomite rocks, as strike-ridges and cuestas with inaccessible terrain and intense drainage patterns; soils comprise stony lithosols between rock sheets, boulders and outcrops, duplex soils on mid and lower slopes and some areas of dark clay loams in major valley bottoms.

Relatively small areas of Headley Limestone, as cuestas and strike ridges, occur mainly to the south of the massif. Soils range from hard crystalline limestone pavements to stony calcareous lithosols and loams.

The main surfaces of the eastern and southern margins of the Park belong to the erosional plain of the Hardman Basin, which lies along both sides of the Ord River. The Cambrian rock-types consist of alternating layers of hard crystalline limestone and soft shale; four distinct geomorphic units occur:

1. cuestas, cuesta backslopes and low rises mantled in stable calcareous earths;
2. black soil plains, transitional to heavy cracking clays of river flood plains;
3. interfluvial upper and lower slopes with grey-brown calcareous desert loams and clays, often with a thin surface crust; and
4. unconsolidated micaceous sands, silts and loams associated with the Ord River floodplains.

Vegetation and Flora: The vegetation of the area has been described by Forbes and Kenneally (1986). The massif and the Proterozoic uplands to the west and north support low, open woodland. On the plateaux this comprises *Eucalyptus cliftoniana* and *E. collina*, with associated tall shrubs such as *Grevillea wickhamii*, *Acacia acradenia* and *A. eriopoda* over a spinifex understorey. Cambrian volcanic and Archean metamorphic and sedimentary ranges support low open-woodlands of species such as *Eucalyptus brevifolia*, *E. tectifera* and *E. dichromophloia* over spinifex. Lower slopes support *Eucalyptus* spp., *Terminalia* spp. and *Acacia* spp. over Ribbon Grass (*Chrysopogon fallax*).

Limestone surfaces support spinifex and low grass

with scattered trees, including *Eucalyptus terminalis*, Nutwood (*Terminalia arthrostrata*) and *Acacia farnesiana*.

Stream valleys associated with ranges feature narrow riparian woodlands of *Terminalia platyphylla*, or open forests of Cadjeput (*Melaleuca leucadendra*). Permanent swamps and streams in the Osmond Range include patches of dense riparian forest comprising *Syzygium angophoroides*, *Ficus coronulata*, *Nauclea orientalis* and *Carallia brachiata*, over a lush understorey of the fern *Cyclosorus interruptus* and Taro (*Colocasia esculenta*). The riverine habitats of this range include a rare tree, *Euodia elleryana*. Gorges in the Bungle Bungle massif feature the new species *Grevillea psilantha*, the first recorded occurrence in Western Australia of the fern *Taeniis pinnata*, the moss *Uleobryum peruvianum*, the vine *Stephania japonica*, the shrub *Comesperma secundum*, the tree *Leptospermum longifolium* and an undescribed *Livistonia* palm.

The sand and earth plains of the structural bench surrounding the massif support shrublands of *Acacia tumida* and *Grevillea wickhamii*, with extensive low open-woodlands of *Eucalyptus collina* and *E. breviflora* and grass understoreys of spinifex and Wiregrass (*Eriachne* sp.).

Black soil plains support grasslands dominated by Mitchell Grass (*Astrebla* spp.) or Feathertop (*Aristida* spp.) with scattered *Bauhinia* (*Lysiphyllum cunninghamii*) and Coolibah (*Eucalyptus microtheca*). The introduced Kapok Bush, Buffel Grass and Birdwood Grass have largely dominated loam and clay surfaces of the interfluvial. Major watercourses such as the Ord River support fringing woodlands of River Gum, Coolibah, Nutwood (*Terminalia arthrostrata*) and Cadjeput. The levees support low open-woodlands of *Lysiphyllum*, Ghost Gum (*Eucalyptus papuana*) and thickets of *Acacia farnesiana* over mixed perennial grasses.

Fauna: Knowledge of the fauna is largely restricted to birds and a comprehensive list is being drawn up.

Recreational Use and Potential: Though the existence of the Bungle Bungle massif was known locally, it was only recently discovered by the wider public and tourism interests after widespread media coverage in late 1982 and early 1983, initiated by the "Wonders of Western Australia" television series.

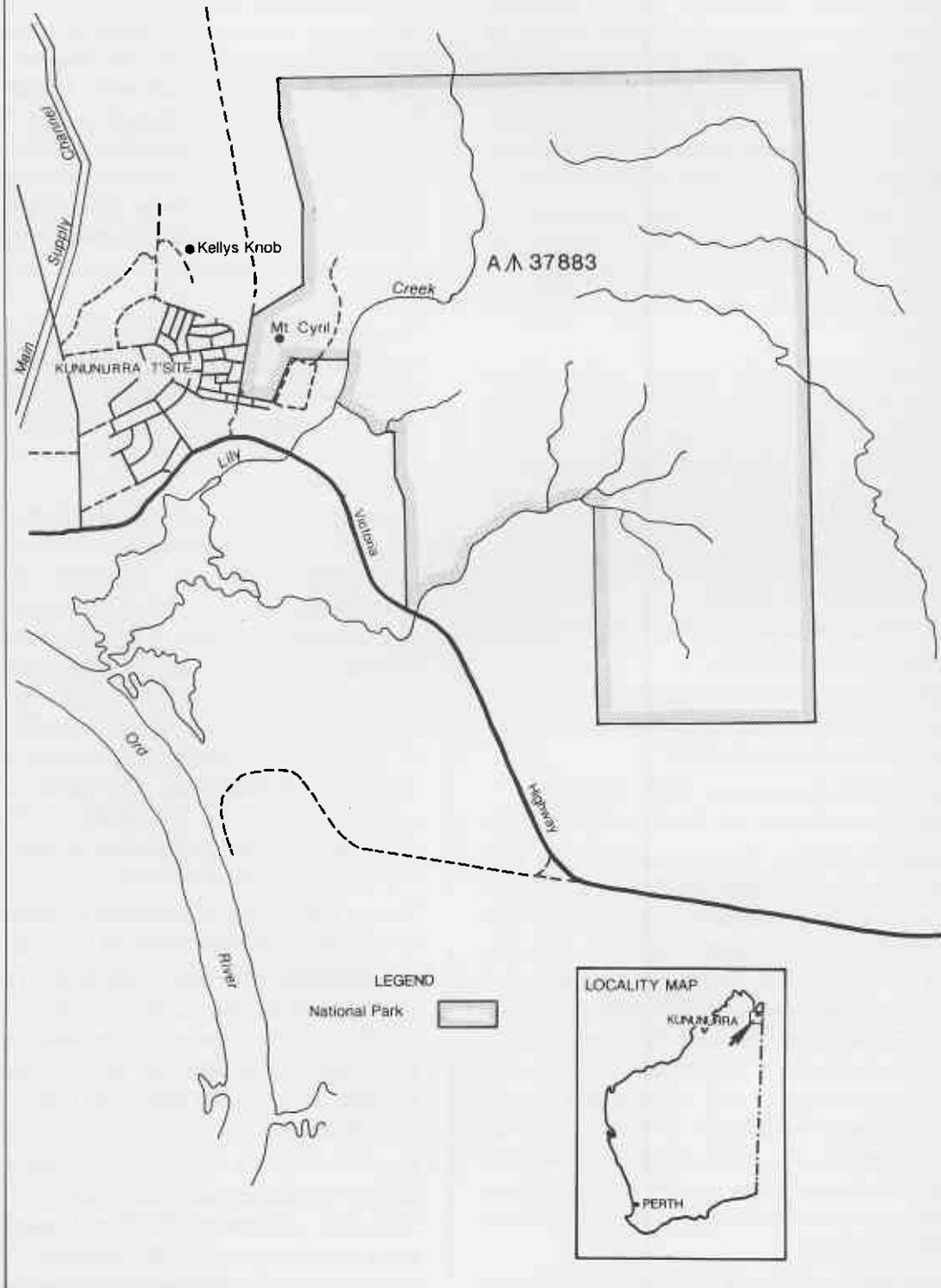
Despite relatively little official promotion of the area, it has already generated interest to the extent that most tourists to the East Kimberley region want to include it on their itinerary. This degree of interest may be attributed to several factors. Most



MIRIMA NATIONAL PARK

SCALE

1 0 1 2 Km



MAP 11



importantly, it is a feature that is certainly unusual, spectacular and highly distinctive. However, the exotic name, the relative remoteness and spectacular manner in which the area was first "discovered" by the television cameras and subsequent newspaper reports may also have contributed to the level of interest.

Access to the area by vehicle is difficult, particularly if the visitor's intention is to reach the areas which have been featured extensively in media coverage and have come to be regarded as the characteristic Bungle Bungle landscape. The rough pre-existing tracks which reach to within a few kilometres of the massif were constructed for mineral exploration purposes and were not intended to withstand continued use or to serve any lasting purposes. Accordingly, their routes were not surveyed to identify the most appropriate alignment with respect to ease of access or long term stability. Beyond the mining tracks, tourists and tour operators intending to reach the desired features have traversed fragile eroding lands and forced an access across country for a number of kilometres.

Key Features: One of the few large impact craters on the Earth's surface (the Piccaninny structure), remote inland occurrence of riverine rainforest (Osmond Ranges), spectacular scenery, cross-section of typical Ord Basin environments (none of which are included in conservation reserves elsewhere) and sites of Aboriginal importance.

CTRC Recommendation: None.

EPA Recommendation: At its meeting on 16 May 1985 the EPA considered and fully endorsed the report and recommendations of the Bungle Bungle Working Group (published in 1986).

Our Recommendation: We recommend that the National Park be upgraded to Class A and that the conservation reserve be added to the National Park as soon as circumstances permit.

3.2 MIRIMA NATIONAL PARK

Location: Immediately adjacent to Kununurra. Currently, officially known as Hidden Valley National Park, but a name change is proposed.

Map: 11.

Area: 1 817 ha.

Current Status: Class A Reserve 37883, vested

in the National Parks and Nature Conservation Authority.

Geomorphology: The dominant feature of the park is a rugged group of sandstone hills, which rise in places to almost 100 m above the surrounding alluvial red and yellow sandplains of the Ord River. The hills and enclosed valleys are part of the Kelly's Knob and Abrey Sandstone members and are of Devonian age.

Vegetation and Flora: The valley floors are dominated by Woollybutt (*Eucalyptus miniata*) and Long-fruited Bloodwood (*Eucalyptus polycarpa*) over shrubs such as *Cajanus reticulatus*, *Planchonia careya*, *Grevillea heliosperma*, *G. refracta* and *Pouteria sericea*. The rock walls support the Boab (*Adansonia gregorii*) and the figs *Ficus leucotricha* and *F. platypoda*, and Turkey Bush (*Calytrix exstipulata*). Undescribed species of *Lindernia* and *Platysace* are known from fissures in the gorge walls. Both appear to be endemic to the area. In the sandy areas subject to seasonal flooding the fern *Platyzoma microphyllum* is common, along with *Haemodorum parviflorum* and numerous ephemeral species such as *Stylidium*, *Utricularia*, *Byblis* and *Drosera*.

The park supports a mosaic of upland tall grass savannah and woodland; in particular the *Eucalyptus dichromophloia* sub-alliance in valleys and *Triodia pungens*, with low open eucalypt overstorey on the hills.

Eucalypts found in the area include Variable-barked Bloodwood (*E. dichromophloia*), Darwin Stringybark (*E. tetradonta*), Long-fruited Bloodwood (*E. polycarpa*), and Kalumburu White Gum (*E. herbertiana*). There is an impressive, almost pure stand of Woollybutt (*E. miniata*) growing on red sand in the north-west corner of the park.

Other tree species include the Boab (*Adansonia gregorii*), Wild Mango (*Buchanania obovata*), Emu Apple (*Owenia vernicosa*) and several species of *Terminalia*, including *T. latipes*. Wattles, such as *Acacia tumida* and *A. plectocarpa*, are common, as is the attractive shrub Kimberley Heather (*Calytrix exstipulata*). A geographically restricted plant, *Echinochloa macrandra*, has been recorded nearby and it is likely that it occurs within the park, along Lily Creek.

Fauna: No fauna surveys have been carried out. Known resident species include the Short-eared Rock-wallaby (*Petrogale brachyotis*) and the Echidna (*Tachyglossus aculeatus*). The park supports a diverse range of amphibian, reptilian and avian fauna.



Highly dissected sandstone is a dominant feature of Mirima National Park.



Water birds, including Pied Geese, congregate on Parrys Lagoons south of Wyndham.

Recreational Use and Potential: The park is a popular destination for townspeople, being well within walking distance of most houses in Kununurra. Local commercial tour operators and visiting coaches take groups of more than 100 tourists into the park each day during the dry season. Visitor numbers decline markedly in the wet.

Key Features: Striking scenery of sandstone ranges, cliffs and valleys. The area is often referred to as a "mini Bungle Bungle" because of similarities in rock formations.

CTRC Recommendation: Not included in CTRC's 1977 report, but recommended in a supplementary report to the EPA.

EPA Recommendation: "The EPA recommends that:

1. the area delineated in Fig. 7.18 be set apart as a Class A Reserve for National Park, vested in the National Parks Authority;
2. prior to this reservation, the Public Works Department, in consultation with the EPA, select an inconspicuous site for a water tank, and this site be reserved for Public Works;
3. the National Parks Authority consult with the traditional owners of Hidden Valley during the preparation of a management plan."

Our Recommendation: The National Park was declared in 1982. We endorse the class, purpose and vesting of the reserve. Because of its small size it does not warrant the status of national park and it should be designated a conservation park.

||||||| 3.3 LAKE ARGYLE AND CARR BOYD RANGE

Location: Fifty kilometres south of Kununurra.

Map: 12.

Area: About 125 000 ha.

Current Status: The W.A. Water Authority, as the dominant authority in all phases of the Ord Irrigation Scheme, exerts influence over all activity relating to the Lake. Potential erosion problems, mainly associated with stock use of the occasionally inundated black soil plains, have led to the vesting of Reserve 31165, of 182 885 ha, for "Government Requirements" on the east and south sides of the Lake, in the Minister for Water Resources. Some

vacant Crown land exists between Reserve 31165 and the low water marks, but seasonal inundation restricts its potential use for other than water protection purposes. In the vicinity of the dam and downstream to the irrigation area, particularly on the east side of the Ord River, the requirements of management suggest that the Water Authority should be involved in all land-use activities, including tourism.

Geomorphology: The Carr Boyd Ranges consist of rugged ridges, hogbacks, cuestas and structural plateaux of quartz sandstone, siltstone and shale (Paterson 1970). These structures are separated and dissected by narrow valleys and gullies, frequently steep-sided and rocky, which severely restrict access other than by foot. Small areas of basalt, granite and dolerite also occur. Drainage is structurally controlled. Fluvial plains of grey (or black) soil with heavy texture, and of red to yellow earths with coarse texture, occur in association with the deeply alluviated drainage valleys of the Ord and Dunham Rivers. Gradients of the fine-textured plains are very gentle except where cut by stream channels; the coarse-textured fluvial plains have a more irregular topography. The islands in Lake Argyle are outcrops of sandstone and/or siltstone.

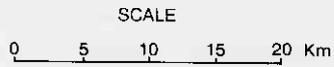
Vegetation and Flora: The Carr Boyd Ranges support an open woodland of *Eucalyptus miniata* and *E. tetradonta* or *E. dichromophloia* over annual *Sorghum* on deeper soils or *Plectrachne* on more stony areas with skeletal soils.

Fauna: The biology of the vacant Crown land west and north-west of Lake Argyle, comprising the Carr Boyd and other ranges that form the northern parts of the Lamboo Hills Province, has not been studied. A survey of areas now inundated or isolated as islands in Lake Argyle was undertaken by the Western Australian Museum prior to the completion of the main dam. Mammals recorded included the Euro (*Macropus robustus*), Short-eared Rock Wallaby (*Petrogale brachyotis*), an Antechinus (*Antechinus bilarni*), Ingram's Planigale (*Planigale ingrami*), the Dusky Horseshoe Bat (*Hipposideros gilberti*), and the Orange Horseshoe Bat (*Rhinonicteris aurantius*) (Kitchener 1978).

Later, studies by Peter Gowland for the Agriculture Department of Western Australia showed that the Lake Argyle wetland system, like the Ord River Irrigation Area, functions mainly as a dry season refuge to which vast numbers of birds (especially

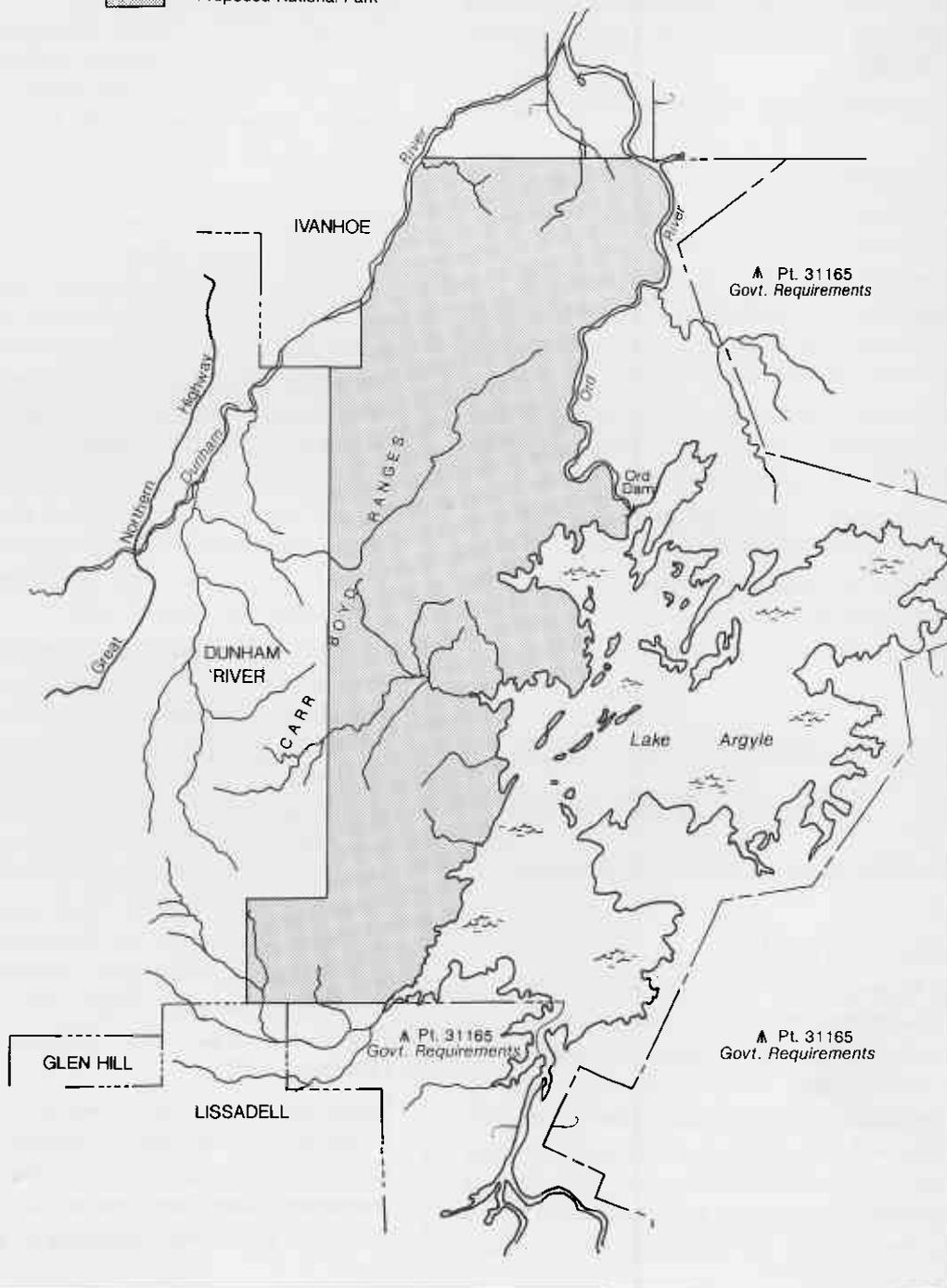


PROPOSED LAKE ARGYLE AND CARR BOYD RANGE NATIONAL PARK



LEGEND

 Proposed National Park



MAP 12

waterbirds) flock for its concentrated and convenient food source. Eurasian Coot, Black Duck, Grey Teal, Pink-eared Duck, Hardhead and Black-winged Stilt are some of the birds that favour the Lake rather than the Irrigation Area. The RAOU Remote Wetlands Expedition of 1986 reported 59 species of waterbirds totalling 181 400 individuals at Lake Argyle. Common species included Hardhead (51 400), Eurasian Coot (50 800), Grey Teal (17 200), Wandering Whistling-Duck (11 000) and Magpie Goose (10 500). Two species gazetted as "Rare" under the Wildlife Conservation Act were noted: Radjah Shelduck (657) and Comb-crested Jacana (296).

Freshwater Crocodiles (*Crocodylus johnstoni*) are abundant in the lake. Saltwater crocodiles are also present (C. Done, pers. comm.).

The islands created by the damming have biological importance as parts of a fragmented ecosystem that should not be overlooked. The ability of existing plants and animals to survive isolation and their capacity to adapt to a changed habitat are aspects that should be studied over a long period of time. The Short-eared Rock-wallaby and the Northern Nail-tailed Wallaby are both known to have been left on islands following "Operation Noah" which aimed to remove animals from areas destined for inundation. This situation would be expensive to create experimentally and ecologists should take advantage of it. Some form of reservation is desirable for this purpose although it may not be possible to use the reserve immediately.

Recreational Use and Potential: The decision to press ahead with the Ord Scheme signified the end of isolation for the lower Ord Valley. Planning, construction and operation of the scheme has meant more people and better access. Tourism has inevitably followed and has been increasing year by year. The need to protect significant features for the benefit of both local residents and visitors has therefore become a matter of urgency. The W.A. Water Authority has been active and responsible in this field, and in the provision of facilities to attract and handle the increasing tourist pressure. Pre-eminent among the attractions is the vast Lake Argyle itself. The islands created by the damming have obvious recreational potential and some are in use already.

The vacant Crown land west and north-west of Lake Argyle, comprising the Carr Boyd and other

ranges, has the attributes of a national park. The grandeur of the ranges, rising steeply from a large body of navigable water, gives them an obvious recreational value, particularly within a few kilometres of the water's edge.

Key Features: Spectacular scenery, man-made wetland with abundant wetland fauna, islands in Lake Argyle.

CTRC Recommendation: "The Committee recommends that the islands in Lake Argyle and the Carr Boyd Ranges to the west and north-west of Lake Argyle be declared a Class C Reserve for the purpose of National Park, and vested in the National Parks Authority of W.A.

Class C reservation as National Park is recommended until time and further work clarify the mineral potential of the area."

EPA Recommendation: "The EPA recommends that:

1. the area shown in Fig. 7.10, including the Carr Boyd Ranges and the islands in Lake Argyle, be declared a Class C Reserve for National Park and vested in the National Parks Authority;
2. the reserve should extend to high water mark."

Our Recommendation: We endorse the EPA recommendation.

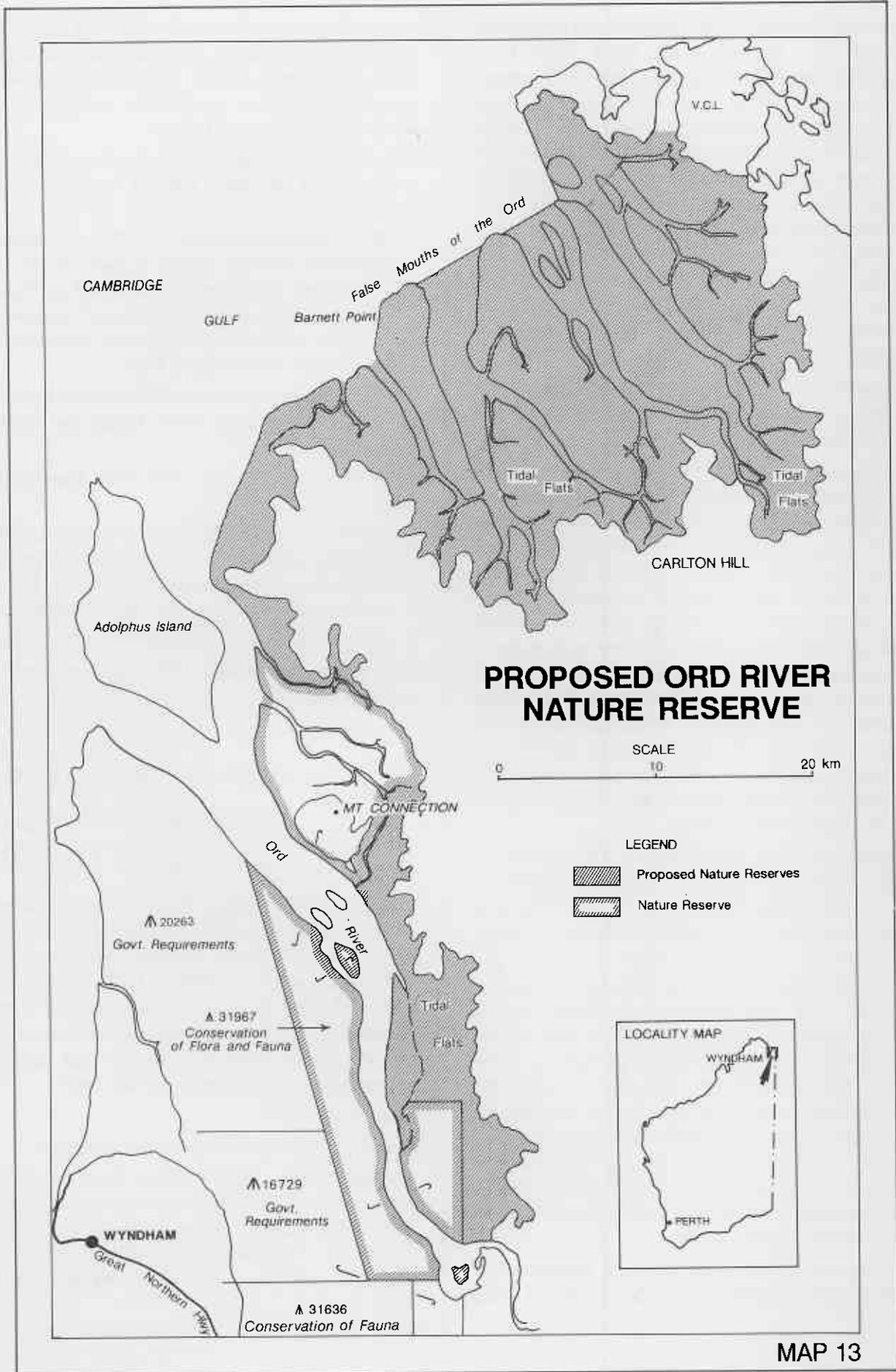
||||||| 3.4 ORD RIVER NATURE RESERVE AND FALSE MOUTHS OF THE ORD

Location: The Ord River Nature Reserve is situated on the tidal portion of the Ord River 25 kilometres north-east of Wyndham. It extends northward along the East Arm of Cambridge Gulf. CALM has requested that the reserve be extended further northwards to include the extensive tidal waterways, and enormous mangrove swamps and mudflats, known as the "False Mouths of the Ord".

Map: 13.

Area: 23 945 hectares is reserved at present.

Current Status: The Ord River Nature Reserve is Reserve No. 31967 for the Conservation of Flora and Fauna, Class C, vested in the W.A. Wildlife Authority. The mangle at the false mouths of the Ord and Adolphus Island are vacant Crown land.



MAP 13

Geomorphology: The reserve comprises coastal and estuarine deltaic plains of highly saline clays incised by dendritic tidal creeks. It includes an area of "coastal erosional plain" - deep sandy soils supporting woodland over tall grass - with several outcrops of Hart Spring Sandstone as abrupt hills. Mount Connection is one such outcrop (Plum and Perry 1971, Plum and Veevers 1971, Stewart et al. 1970, Beard 1979). The false mouths of the Ord is the most extensive mudflat and tidal waterway complex in Western Australia.

Vegetation and Flora: Mangroves line the estuary of the Ord River and the drainage creeks that incise the mudflats. They also cover mudflats where they are regularly inundated by the tides. Species of mangrove include *Camptostemon schultzei*, *Bruguiera parviflora*, *Excoecaria agallocha*, *Rhizophora stylosa*, *Xylocarpus australasicus*, *Aegiceras corniculatum*, *Aegialitis annulata*, *Ceriops tagal* and *Sonneratia alba*. Less frequently inundated areas of the mudflat support low shrublands of samphire and low grasslands of Saltwater Couch (*Sporobolus virginicus*). The scree-slopes of Mount Connection support a low open-woodland of eucalypts over spinifex hummock grassland.

Fauna: The reserve, which was declared primarily to protect the Saltwater Crocodile (*Crocodylus porosus*), resulted from a recommendation by Dr H.R. Bustard who was commissioned by the Department of Fisheries and Fauna to report on the status of crocodiles in Western Australia (Bustard 1969). Dr Bustard felt that this area was ideal for a crocodile reserve because it contained excellent habitat and still held a number of crocodiles which would repopulate the area if rigidly protected. Recent surveys of Saltwater Crocodile numbers (Messel et al. 1987) show that the Ord has an increasing crocodile population and is the major breeding river in Cambridge Gulf. However, the reserve does not include significant areas of breeding habitat.

The mammals and birds of the mangroves were sampled during a four-day visit in 1983. They support the only known Western Australian population of Black Butcherbird, as well as a population of flycatchers that is morphologically intermediate between the Lemon-breasted Flycatcher and the Brown-tailed Flycatcher. The rare Mangrove Kingfisher and other mangrove specialists, such as the Chestnut Rail, were also present.

Mammals recorded include the only known

population of Mozaic-tailed Rat (*Melomys*) from the East Kimberley and a rich bat fauna including Black Flying Fox (*Pteropus alecto*), Yellow-bellied Sheath-tail Bat (*Taphozous flaviventris*), Common Sheath-tail Bat (*T. georgianus*), Northern Mastiff Bat (*Chaerephon jobensis*), Common Bent-wing Bat (*Miniopterus schreibersii*), Hoary Bat (*Chalinolobus rogersi*), Little Broad-nosed Bat (*Scotorepens greyi*), *Pipistrellus westralis*, and Arnhem Land Long-eared Bat (*Nyctophilus arnhemensis*) (McKenzie and Rolfe 1986).

Recreational Use and Potential: It is readily accessible by boat from Wyndham, but has little recreational value except for naturalists and fisherpeople.

Key Features: Rare and scientifically important birds, extensive mangrove communities, Saltwater Crocodiles. Parts are scenically attractive.

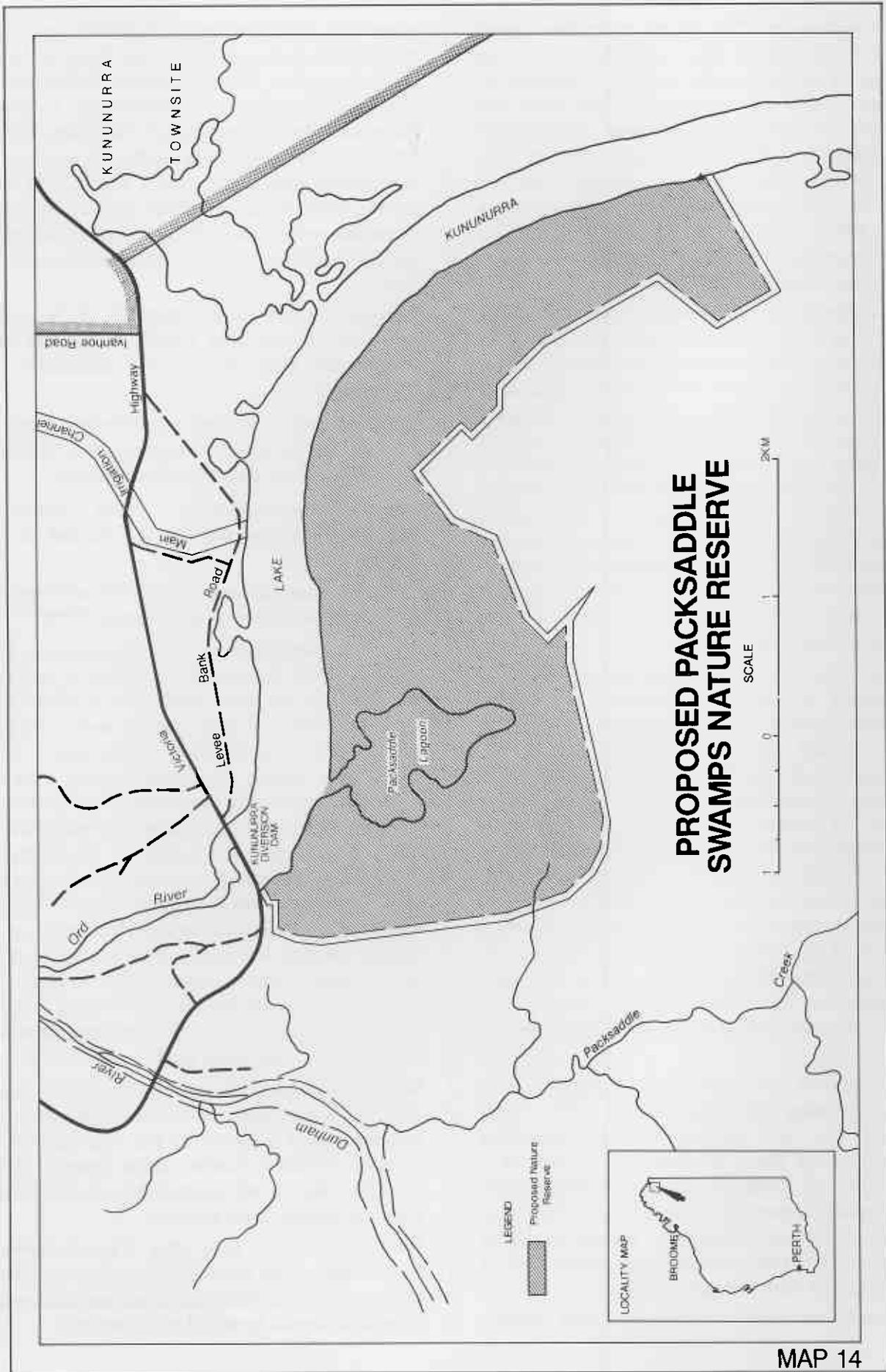
CTRC Recommendation: "The Committee endorses the status, purpose and vesting of this reserve."

EPA Recommendation: "The EPA endorses the status, purpose and vesting of Reserve 31967."

Our Recommendation: We recommend that Reserve 31967 be upgraded to Class A and that the area from low water mark to 40 m above high water mark adjacent to the reserve and at the false mouths of the Ord be added to the reserve (Map 13). This is because the current reserve is far too small to achieve its conservation objective of representing the estuarine and marine environments of the Cambridge Gulf Lowlands Physiographic Province. At present, some areas below high water mark adjacent to the Ord River Nature Reserve appear to be included in Carlton Hill Station, even though pastoral leases normally terminate 40 m above high water mark. To enact this recommendation the boundary of Carlton Hill will need to be readjusted to the usual legal boundary of 40 m above high water mark.

We also recommend that the lower reaches of the Ord, the waters adjacent to the existing reserve and the waters adjacent to the false mouths be declared a Class A marine nature reserve. Steps should be taken to add areas of Saltwater Crocodile breeding habitat to the reserve.

We recommend that the Department of Conservation and Land Management conduct a biological survey of Adolphus Island and recommend whether it should be added to the reserve.



MAP 14

3.5 PACKSADDLE SWAMPS

The persistence of the Packsaddle Swamps area of Lake Kununurra depends on structures associated with the Ord Irrigation Scheme; the swamps were formed when the Kununurra Diversion Dam was built across the Ord River so water levels in Lake Kununurra could be held constant throughout the year. The system is occasionally drained for maintenance for about two weeks at a time.

Location: On the western side of Lake Kununurra, immediately upstream of the Kununurra Diversion Dam, five kilometres west of Kununurra.

Map: 14.

Area: 860 ha.

Current Status: Vacant Crown land; it has been proposed as a reserve for irrigation, drainage and nature conservation, to be vested jointly in the W.A. Water Authority and the National Parks and Nature Conservation Authority.

Geomorphology: Inundated and exposed fluvial plains of black (cracking clay) and red soils (Plum and Perry 1971).

Four wetland areas, continuous with Lake Kununurra, are included, as well as seven kilometres of the edge of Lake Kununurra.

Vegetation and Flora: The Lake Kununurra waterway is fringed with a forest of *Melaleuca leucadendra*, *Eucalyptus microtheca*, *E. camaldulensis*, *Sesbania formosa*, *Nauclea orientalis* and *Lophostemon grandiflorus*. In the shallows along the waterway, and throughout the swamps, are stands of bullrushes (*Typha domingensis*) and *Eleocharis* spp. The aquatic vegetation of the swamps includes *Nymphoides indica*, *Nymphaea gigantea*, *Najas graminea*, *Hydrilla verticillata*, *Potamogeton tricaratus*, *Myriophyllum verrucosum*, *Vallisneria spiralis* and *Chara* spp. (S.A. Halse, pers. comm.).

Dry areas of red soil support an open low woodland of *Lysiphyllum cunninghamii*, *Eucalyptus pruinosus* and *E. tectifica* over perennial and annual grasses. *Eucalyptus microtheca* occurs on levee banks.

Fauna: The swamps are rich in bird life. More than 12 000 birds were recorded in the Kununurra wetlands in September/October 1978. Mike Osborne, Peter Gowland and Ron Johnstone have, at various times, made lists of the rich bird fauna found in the Packsaddle areas of the swamp. Typical birds include the Glossy Ibis, Star Finch, Crimson Finch, Clamorous Reed-warbler, Golden-headed

Fantail-warbler, Comb-crested Jacana (a declared rare species in W.A.), Great Egret, Horsfield's Bushlark, Eastern Swamphean, Magpie Goose, Restless Flycatcher and Jabiru.

Prodigious numbers of Freshwater Crocodiles occur in the swamps, along with the Water Rat, Black Flying Fox, Brown Flying Fox, Arnhem Land Long-eared Bat and Hoary Bat.

Recreational Use and Potential: National Highway One crosses the Ord River along the top of the Diversion Dam and provides an unmatched vantage point from which to view these picturesque swamps and their spectacular bird life. The swamps have become a major tourist attraction. The area is also a readily accessible study resource.

Key Features: Spectacular scenery, wetlands, wildlife.

CTRC Recommendation: Not discussed.

EPA Recommendation: Not considered.

Our Recommendation: We recommend that the proposed reserve for irrigation, drainage and nature conservation be created. Joint vesting in the W.A. Water Authority and the National Parks and Nature Conservation Authority is considered necessary because the former are responsible for controlling the water levels throughout the wetland system, part of the Ord Irrigation Scheme.

3.6 PARRYS LAGOONS NATURE RESERVE

Location: About 25 km south-east of Wyndham.

Map: 15.

Area: 18 742 ha.

Current Status: It is mostly contained within Class C Reserves Nos. 1058 (1 024 ha, Water and the Conservation of Fauna, vested in the Minister for Water Resources), 1059 (2 000 ha, Water and the Conservation of Fauna, vested in the Minister for Water Resources), 31636 (12 589 ha, Conservation of Fauna, vested in the National Parks and Nature Conservation Authority) and 30866 (2 129 ha, Protection of Flora and Fauna, vested in the National Parks and Nature Conservation Authority).

Geomorphology: These reserves include a number of wetlands (Parry Creek, Parrys Lagoons, Police Hole, Jogonalong Billabong, Palm Spring, Wild Goose Creek and Goose Hill Creek) and represent the

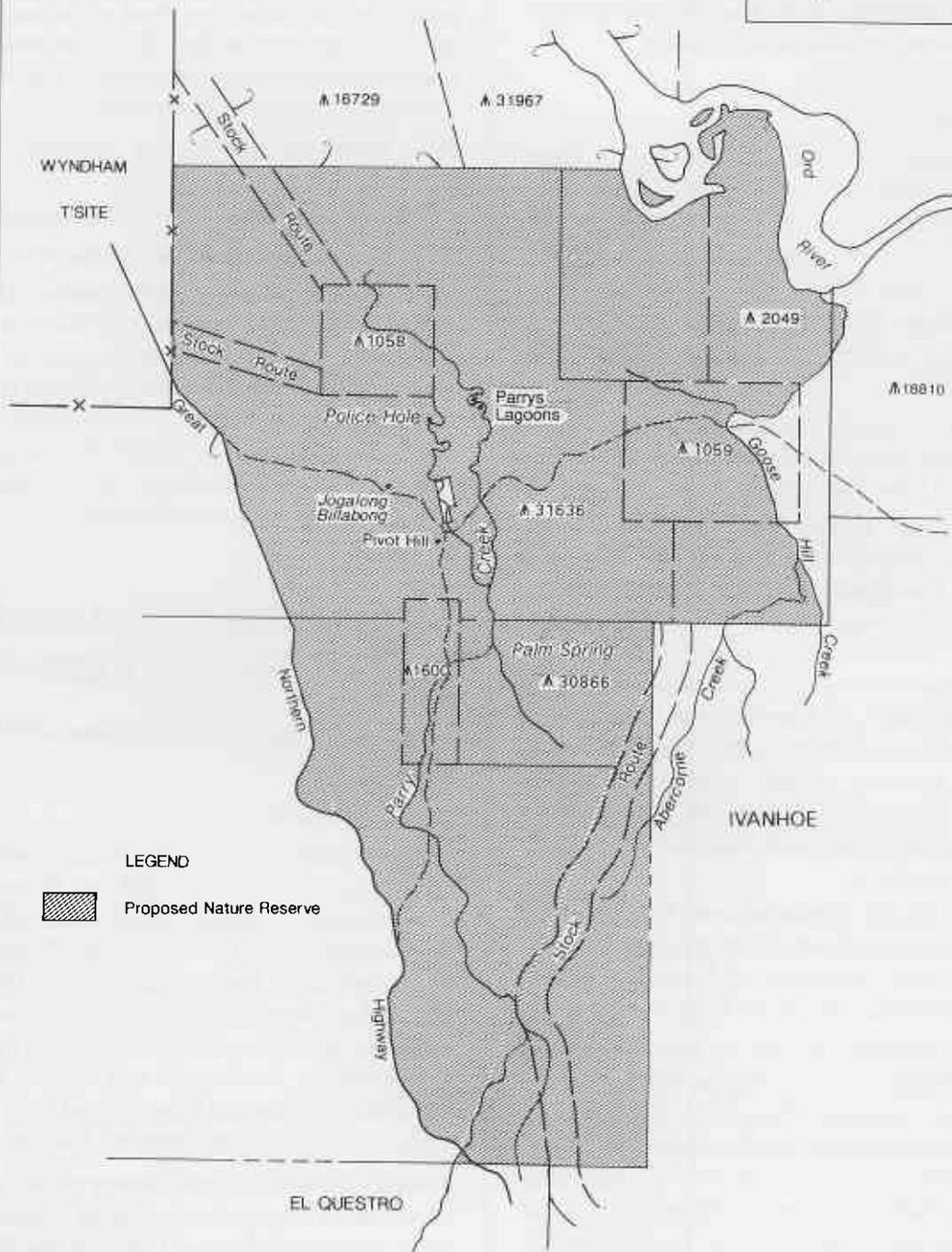


PROPOSED PARRYS LAGOONS NATURE RESERVE

LOCALITY MAP



SCALE



LEGEND

 Proposed Nature Reserve

MAP 15

non-marine ecosystems of the Cambridge Gulf Lowland Physiographic Province. Most of the land surface comprises nearly flat Quaternary alluvial plains with extensive areas of black soil (cracking clay) (Paterson 1970). The water table is at or near the surface during the dry season; the plains are flooded during the wet season. Drainage lines are poorly defined, widely spaced and sometimes end in fresh water swamps; an example is provided by Parry Creek which drains into Parrys Lagoons.

Structural plateaux, ridges and deep V-shaped valleys of Upper Pentecost Sandstone dominate the southern section of the area (Plum and Veevers 1971). These surfaces are rocky, and mantled with shallow skeletal soils. Small basalt outcrops occur as hills (e.g. Pivot Hill) near the western edge of the area.

Vegetation and Flora: The seasonal wetlands support a number of aquatic species such as *Nymphaea gigantea* and some stands of *Phragmites karka* and *Sesbania cannabina*. Trees fringing the wetlands include *Eucalyptus papuana*, *E. microtheca*, *E. camaldulensis*, *Melaleuca* sp., *Adansonia gregorii*, *Excoecaria parvifolia* and, especially around Palm Spring, areas of *Pandanus spiralis*. The grassland around the seasonal wetland includes cane grass (*Sorghum australiense*). The sandstone country supports open woodlands including *Eucalyptus tetradonta* and *E. dichromophloia* over spinifex and tussock grasses.

Fauna: The lagoons and billabongs attract thousands of water birds, especially during the dry season when fresh water in the region becomes scarce. S.A. Halse (pers. comm.) reported 27 000 water birds in May 1986, of which 18 400 were ducks. During that survey 54 species of waterbird were recorded on these wetlands. Common species included the Magpie Goose, Straw-necked Ibis, Sacred Ibis, Glossy Ibis, Black Duck, Wandering Whistling Duck, Australian Whistling Duck, Brolga, Jabiru, Australian Pelican, Little Curlew and Oriental Pratincole. The comparatively rare Radjah Shelduck can also be seen there. The Parrys Lagoons are probably the most important site in Australia for Wood Sandpipers and, in years when local rainfall is good, the lagoons and associated seasonal wetlands are one of the major breeding areas for waterbirds in the Kimberley.

The Red-backed Button-Quail occurs in grasslands around Parrys Lagoon. Finches are numerous in the area, species recorded including the Zebra,

Pictorella, Double-barred, Crimson and Longtailed. Mammals include the Northern Nail-tailed Wallaby, Sandy Wallaby and the Long-Haired Rat (*Rattus villosissimus*), which is known from only one other locality in Western Australia. Parry Creek, near Wyndham, is the "Type Locality" of Woodward's Rock-rat (*Zygomys woodwardii*), a species restricted to sandstone boulder country.

The reserves are at present being damaged by cattle and this should be controlled.

Recreational Use and Potential: The area is easily accessible as the Great Northern Highway runs along the western boundary and the old Wyndham-Kununurra Road runs through the area.

Key Features: Outstanding for its bird life.

CTRC Recommendation: "The Committee endorses the status, purpose and vesting of Reserves Nos. 1058, 1059, 30866 and 31636."

EPA Recommendation: "The EPA endorses the status purpose and vesting of Reserves 1058, 1059, 31636 and 30866."

Our Recommendation: Negotiations between the Department of Conservation and Land Management, the W.A. Water Authority and the Department of Agriculture have been held with the aim of consolidating and rationalising the boundaries of the Parrys Lagoons Nature Reserve. We recommend that a single reserve as shown on Map 15 be declared a Class A nature reserve vested in the National Parks and Nature Conservation Authority.

||||||| 3.7 PELICAN ISLAND NATURE RESERVE

Location: Pelican Island lies about 110 km north-east of Wyndham in Joseph Bonaparte Gulf.

Map: 2.

Area: About 8 ha.

Geomorphology: A low sand cay with some rocky areas.

Current Status: Class C Reserve 29541 for Wildlife Sanctuary, vested in the National Parks and Nature Conservation Authority.

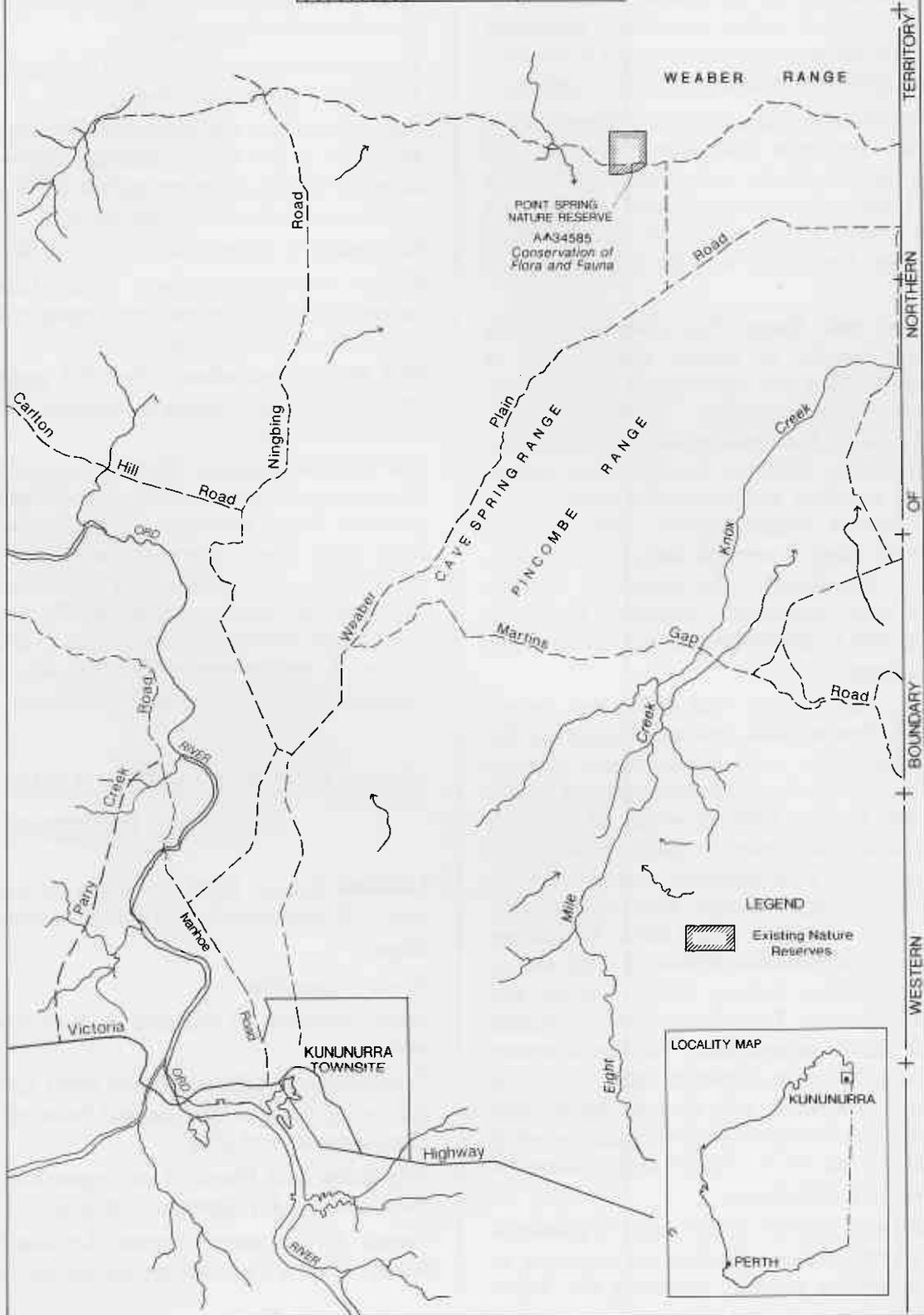
Vegetation and Flora: Low vegetation, mainly Saltwater Couch (*Sporobolus virginicus*).

Fauna: As the name suggests, the island's main feature is that it is a breeding place for the Australian



POINT SPRING NATURE RESERVE

SCALE



MAP 16

Pelican (*Pelecanus conspicillatus*). Pelicans breed on only five other offshore islands in W.A., although they occasionally breed on islands in major rivers and in estuaries in the South West of the State. Turtles also nest on Pelican Island.

Recreational Use and Potential: None.

Key Features: The pelican breeding colony.

CTRC Recommendation: "The Committee recommends that Reserve No. 29241 (Pelican Island, Joseph Bonaparte Gulf) be upgraded to a Class B Reserve."

EPA Recommendation: "The EPA endorses the purpose and vesting of Reserve 29241 but recommends that the classification be amended to Class B."

Our Recommendation: We recommend that the purpose of the reserve be amended to Conservation of Flora and Fauna and that it be upgraded to Class A.

||||||| 3.8 POINT SPRING NATURE RESERVE

Location: 40 km north-north-east of Kununurra.

Map: 16.

Area: 303 ha.

Current Status: Class A Reserve No. 34585 for the Conservation of Flora and Fauna, vested in the National Parks and Nature Conservation Authority. The reserve has been fenced to prevent damage by cattle from the surrounding pastoral lease.

Geomorphology: Point Spring is a permanent spring at the base of the Weaber Range, a low sandstone range rising from black soil plains. The reserve includes small areas of both the range and the plains. The spring feeds a small lake a short distance from the hills.

Vegetation and Flora: Around the spring there is a small patch of remnant rainforest. Tree species recorded include *Canarium australianum*, *Carallia brachiata*, *Euodia elleryana*, *Ficus racemosa*, *F. virens* and *Terminalia sericocarpa*. Patches of closed canopy rainforest are so rare in the lowland environments of the East Kimberley that a variety of species depend on Point Spring for their persistence in the district. Grasslands surround the lake, while there are open savannah woodlands elsewhere.

Fauna: A Flying Fox colony inhabits the rainforest patch along with populations of typical rainforest birds such as the Green-backed Gerygone. The lake provides a resting and feeding place for waterbirds, including brolgas, storks, egrets and herons.

Recreational Use and Potential: Because of its proximity to Kununurra the nature reserve is visited by people during the dry season. Wet season access is impossible because of the adjacent black soil plains.

Key Features: The spring and associated rainforest patch and wetland.

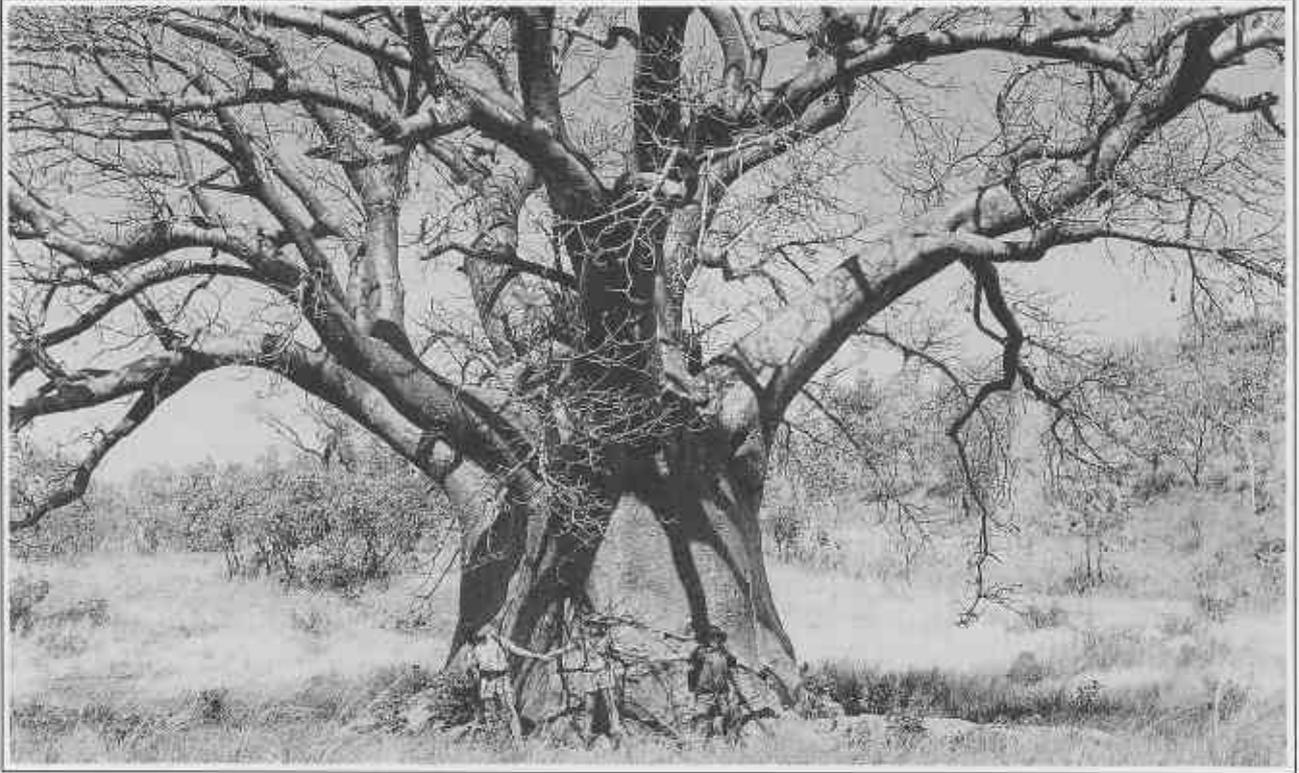
CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: We endorse the status, purpose and vesting of the Point Spring Nature Reserve.



Blue waterlily (*Nymphaeaceae*).



The Boab (Adansonia gregorii) is a gouty-stemmed tree common throughout much of the Kimberley. During the dry season it is leafless but adorned with large fruits containing edible pulp and seeds. The leaves and flowers appear in the wet season.



4

NORTH KIMBERLEY

The geology of the North Kimberley has been described by Thom (1975), so only an outline is presented here. The Kimberley Plateau Province occupies the major part of the district and has a broad, uplifted, dissected peneplain developed across the flat-lying sedimentary and volcanic rocks of the Kimberley Basin. The plateau has an altitude of 400 to 500 metres above sea level. Undulating sandstone benches many kilometres long, bounded by cliffs up to 75 metres high, are common features of the plateau landscape.

The plateau is flanked to the south-west by the King Leopold Mobile Zone and to the east by the Halls Creek Mobile Zone. Together, these zones are referred to as the Halls Creek Province and, though intensely folded and faulted, have a more subdued topography of igneous and metamorphic rocks. Open textured drainage and low, rounded bouldery hills are characteristic. The metamorphic rocks form sharp strike ridges, while smooth whale-back hills separated by narrow sandy flats are typical of the granite areas. Local maximum altitudes range from 300 to 600 metres, but relief seldom exceeds 200 metres.

Included in the Kimberley Basin, but lying between the Kimberley Plateau and the low country of the mobile zones, there is a topographically intermediate zone with a complex broken pattern of cuestas, hog-backs and minor escarpments. This zone has a relief of 200 to 400 metres.

The Precambrian rocks of the Kimberley Basin and its mobile zones were laid down between 1 900 and 1 650 million years ago, although the mobile zones have since undergone continual local renewals. Following rejuvenation of the drainage system in the late Tertiary or early Pleistocene, the Kimberley Plateau Province underwent a period of active dissection. Later, a Quaternary rise in sea level

resulted in the drowning of valleys, the formation of an indented shoreline and many offshore islands with a coastal configuration strongly controlled by the jointing in the King Leopold and Warton Sandstones. The islands are thought to have last been part of the mainland as recently as 8 000 to 10 000 years ago. A few islands, such as Boongaree, have possibly had a much more recent separation.

Thus, the stratigraphy of the islands is the same as that of the adjacent North Kimberley mainland, although even the largest islands usually include no more than two or three of the Precambrian rock types found on the mainland. The geomorphology of the North Kimberley, and all its adjacent islands, is controlled by sandstone or volcanic strata. In broad terms the Warton, King Leopold and Pentecost Sandstones are expressed as resistant, cliff-forming quartz sandstones, giving rise to a rugged, dissected terrain with joint-controlled gorges and drainage. The Carson Volcanics are expressed as rounded, usually soil covered, undulating country with gentle gradients and dendritic drainage. Hart Dolerite occurs as dark grey to black bouldery outcrops, and is generally found in valleys.

Shallow Cenozoic deposits of sandy soils, alluvium or (rarely) black soils, incompletely mantle the sandstones and volcanics. Away from the coast, and on uplands near the coast and on the islands where dissection is incomplete, the sandstone strata of the Kimberley Plateau are thinly mantled with Cenozoic soils of light, sandy texture. Superficial Tertiary deposits of laterite and bauxite cap the Precambrian strata in some areas (e.g. Mitchell Plateau).

Quaternary deposits also occur, though mainly in coastal situations and along the courses of major river systems such as the Drysdale, King Edward

and Carson Rivers. Quaternary soils are present on the coast as beach sands and grey mud. Shorelines are usually rocky, although small, sandy beaches are present between some headlands. Along sheltered shores a narrow strip of littoral mud occurs, and in sheltered bays there are often extensive littoral mudflats traversed by incised tidal creeks. Shallow rocky shoals and coral reefs are found around many of the islands.

The North Kimberley has a rich flora and fauna that includes many tropical species, with affinities to the Northern Territory and Queensland, that do not occur elsewhere in W.A. It also includes a number of endemic species and is the only district in Western Australia where there have been no documented extinctions of native species during the period of European settlement. The opportunity to protect these intact ecosystems is of international significance and should not be lost. Their proper management has some urgency - there is evidence that certain native mammal species have recently disappeared from south-eastern parts of the district (Harry Martin, pers. comm.).

The North Kimberley islands are particularly important nature conservation areas. They possess populations of a variety of plants and animals unaffected by European man or his introduced animals. Some islands further south in W.A. now contain the only populations of mammals once widespread on the mainland. While, fortunately, this is not the present situation in the Kimberley, similar massive extinctions can not be ruled out on the adjacent mainland in the future. Island populations of animals can be managed much more readily than mainland ones, because of their isolation from the many human-introduced disturbers that are found on large landmasses.

Islands are also important breeding sites for marine species such as seabirds and turtles. Kimberley islands provide important habitat for large Saltwater Crocodiles displaced from breeding habitat in nearby rivers.

There are only two major conservation reserves in the North Kimberley, though a number of others have been recommended.

4.1 ADMIRALTY GULF ISLANDS

Four distinct groups of islands can be recognised in Admiralty Gulf:

Institut, Montesquieu and Kingsmill Islands

Cassini Island

Osborn Islands

Low Rocks

For a general description see Burbidge and McKenzie (1978a).

4.1.1 INSTITUT, MONTESQUIEU AND KINGSMILL ISLANDS

Location: These are groups of small islands lying to the north of Cape Voltaire, about 410 km north-east of Derby.

Map: 4.

Current Status: Vacant Crown land.

Geomorphology: Fenelon and Corneille are the largest. They consist of laterite plateaux breaking away to steep dolerite slopes with sandy spits on parts of the shoreline.

Vegetation and Flora: On Fenelon the beach is fringed by a dense stand of *Spinifex longifolius*, which merges into woodland. A few strand species such as *Thespesia populneoides*, *Abutilon indicum*, *Mucuna diabolica* subsp. *kenneallyi* and *Sesuvium portulacastrum* have been recorded. Several trees of *Garuga floribunda* and the creepers *Abrus precatorius*, *Merremia quinata* and *Ipomoea tuba* grow directly behind the beach (Beard *et al.* 1984).

The plateau is reached by climbing a scree slope covered in laterite rubble. Scattered trees such as *Eucalyptus nesophila*, *E. papuana*, *E. polycarpa*, *Buchanania obovata*, *Dolichandrone heterophylla*, *Gyrocarpus americanus* and the shrubs *Acacia stigmatophylla*, *Cadaba capparoides*, *Carissa lanceolata*, *Distichostemon hispidulum*, *Ficus opposita*, *Strychnos lucida* and *Triumfetta plumigera* are common on the slopes and plateau. In the more open areas dense stands of the bunch grasses *Cenchrus elymoides*, *Eriachne ciliata*, *Heteropogon contortus* and the hummock grass *Plectrachne* sp. are encountered. Amongst the grasses, *Cassytha filiformis* and *Capparis spinosa* form impenetrable thickets.

The rim of the plateau supports *Alyxia spicata*, *Brachychiton* sp., *Celtis philippinensis*, *Ficus virens* var. *dasycarpa*, *Flagellaria indica*, *Mimusops elengi*, *Pouteria sericea* and *Turraea pubescens*.

The basalt slope below the plateau rim is covered in a dense patch of vine forest.

Eucalyptus nesophila forms an open forest on the perimeter of the vine thicket.

Fauna: No information available.

Recreational Use and Potential: No current use. Little potential; although picturesque, they are remote and there is no surface water.

Key Features: Insufficient information.

CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: We recommend that the Department of Conservation and Land Management carry out a biological survey of the Institut, Montesquieu and Kingsmill Islands, and report on their nature conservation value. Until a decision is made on their future, the Department of Land Administration should refer all proposals for their leasing or alienation to the EPA.

4.1.2 CASSINI ISLAND

Location: At 13° 57'S, 125° 38'E; approximately 30 km north of Cape Voltaire.

Map: 4.

Area: About 350 ha.

Current Status: Vacant Crown land.

Geomorphology: The island consists mostly of a laterite plateau about 12 - 15 m high, breaking away to cliffs undercut with shallow caves where they descend directly to the sea, or with narrow fringing beaches in sheltered areas.

Vegetation and Flora: The plateau vegetation is mostly a *Triodia* hummock grassland with emergent *Acacia* shrubs. There is a small area of *Eucalyptus* woodland at the eastern end of the plateau and remnant rainforest species occur along the cliffs (W.H. Butler pers. comm.).

Fauna: Cassini is an important nesting rookery for green turtles. Ospreys and sea-eagles nest on the island and there is a small population of Orange-footed Scrub-fowl (*Megapodius reinwardt*).

Recreational Use and Potential: None. There is no surface water.

Key Features: The turtle nesting rookeries.

CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: That Cassini Island be declared a Class A reserve for the conservation of flora and fauna, vested in the National Parks and Nature Conservation Authority.

4.1.3 OSBORN ISLANDS

Location: The Osborn Islands lie in the south-eastern part of Admiralty Gulf. There are five main islands: Middle Osborn, South-West Osborn, Carlia, Borda and Steep Head. The group provides a great variety of geology, flora and fauna, and is in many ways a microcosm of the region.

Map: 4.

Area: See under geomorphology.

Current Status: Vacant Crown land.

Geomorphology: Middle Osborn Island (2 300 ha) consists of weathered Carson Volcanic rocks. Unlike many basaltic areas it is steep and in places rugged, and the major peak resembles a volcanic plug. The undulating slopes are well-mantled with red volcanic soils. Kidney Island (approx. 230 ha) has a similar geology.

South-West Osborn (1 370 ha) consists of two central plateaux formed by Warton Sandstone, with sheer cliffs falling to basalt scree-slopes of Carson Volcanics. Deposits of alluvial soils occur on more gentle slopes near the coast. Carlia Island (480 ha) is somewhat similar, but the plateau is less conspicuous. The plateaux include shallow pockets of skeletal soils, while basic soils have developed in basalt areas with deeper alluvial deposits occurring in valleys. A small estuarine salt marsh occurs on the western coast of South-West Osborn. Steep Head Island (approx 290 ha) has a similar structure to South-West Osborn, but has smaller basaltic areas below the cliffs.

Borda Island (600 ha) contrasts sharply with the remainder of the group, as it is composed of rugged King Leopold Sandstones with deep, wide fissures. In places, there are extensive sandy flats at the base of the sandstone cliffs.

Vegetation and Flora:

Middle Osborn Island: The dominant vegetation is a low open-woodland of *Eucalyptus* with a grass and shrub understorey. Steep slopes support open and closed-shrublands of *Canarium australianum*, *Buchanania obovata* and *Mimusops elengi*. Low shrublands of *Cochlospermum fraseri* and *Brachychiton* occur on less steeply sloping areas. Small areas of an open-shrubland including *Acacia stigmatophylla*, *Trema aspera*, *Grevillea mimosoides*, *Celtis philippensis* and *Paramygnia trimera* are scattered in the shrublands of steep and gradual slope area. *Sorghum* sp. and *Heteropogon contortus* occur under these shrublands.

Littoral areas have narrow zones of mangroves with closed-shrublands of *Thespesia populneoides* and extensive flats of *Sporobolus virginicus* and *Spinifex longifolius*. Boab (*Adansonia gregorii*) occurs in the supra-littoral.

South-West Osborn Island: Scattered low open-shrublands, mostly in crevices, dominate the dissected sandstone on top of the mesas. *Pouteria sericea* is the most common shrub, with *Ficus platypoda*, *Exocarpos latifolius*, *Canarium australianum* and *Grevillea refracta*.

Sandstone scree slopes, at the foot of the sandstone cliffs of the mesas and adjacent areas of steeply sloping volcanic soils, support tall vine thickets of *Albizia lebeck*, *Aidia racemosa*, *Acacia hemignosta* with *Tinospora smilacina* and other lianes.

At lower levels, the volcanic soil slopes and areas of alluvium are characterized by *Adansonia gregorii* and extensive areas of *Themeda australis* and *Sorghum*. *Acacia dunnii*, *Zizyphus quadrilocularis* and *Hakea macrocarpa* also occur on the lower slopes as components of scattered low open shrublands.

Borda Island: Vegetation cover, mainly spinifex *Plectrachne* and *Triodia*, is sparse on the exposed sandstones. *Ficus platypoda*, *Gyrocarpus americanus* and *Calytrix exstipulata* occur in crevices. Deep wide fissures support a low open-shrubland of *Acacia retinervis* and *Plectrachne*.

A limited area of vine thicket, with *Tinospora* and a few large trees of *Albizia lebeck* occurs at the foot of a high sandstone cliff. Wet areas near this cliff support low open forests of *Melaleuca viridiflora*.

Extensive littoral areas of *Plectrachne* and *Spinifex longifolius*, with occasional *Pandanus*, occur on a coastal sandplain in the north-west portion of the island.

Carlia Island: The sandstone areas are sparsely vegetated except in crevices, where *Ficus*, *Pouteria sericea*, *Atalaya variifolia* and *Owenia vernicosa* frequently occur.

Both basic soils developed over volcanic rocks and alluvial soils in valleys support low open woodlands with a ground cover of grasses. There are no areas of fringing vine thicket, although a low forest was recorded at the base of a volcanic scree slope behind a beach on the western coast.

Extensive low closed forests of mangroves, including *Ceriops tagal* and *Avicennia marina* occur on the central eastern coast (Burbidge *et al.* 1978).

Steep Head Island: Steep Head Island has not been examined in detail. It has a structure and vegetation similar to that of South-West Osborn, and supports a major rainforest stand.

Fauna: The fauna of Middle Osborn includes Woodward's Rock-rat (*Zygomys woodwardii*) and the dingo (*Canis familiaris dingo*). The skink *Cryptoblepharus megastictus* has been recorded on only two islands - this and South-West Osborn.

On South-West Osborn, Woodward's Rock-Rat (*Zygomys woodwardii*) is the only mammal, but the island has an important bird fauna, especially that associated with the rainforest. Birds recorded include the Rose-crowned Pigeon (*Ptilinopus regina*), Torres Strait Pigeon (*Ducula spilorrhoa*), Green Winged Pigeon (*Chalcophys indica*), Scrub Fowl (*Megapodius reinwardt*), Rainbow Pitta (*Pitta iris*), Peregrine Falcon (*Falco peregrinus*) and Spangled Drongo (*Dicrurus bracteatus*).

The fauna of Carlia includes the Golden-backed Tree-Rat (*Mesembriomys macrurus*) and the dingo. The island was named after the skinks *Carlia johnstonei* and *C. triacantha*. Little Rock-wallabies (*Peradorcas concinna*) and Woodward's Rock-rats (*Zygomys woodwardii*) are common on Borda Island.

Recreational Use and Potential: No current use. There is some potential for human use when the Mitchell Plateau bauxite deposits are exploited.

Key Features: The group is in many ways a microcosm of the region as the four major geological surfaces of the north-west Kimberley are found here, as well as an array of beaches, mangrove bays and rocky shores. Of particular importance is the rainforest on South-West Osborn, the largest and most diverse rainforest on an island in W.A., and therefore the only large patch protected from degradation by feral animals.

CTRC Recommendation: "The Committee recommends...that the Osborn Islands, comprising Middle, South-West, Carlia, Kidney, Borda and Steep Head Islands be declared a Class B reserve for the conservation of flora and fauna and vested in the W.A. Wildlife Authority."

EPA Recommendation: "The EPA recommends that the Osborn Islands be declared a Class B Reserve for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority."

Our Recommendation: We endorse the EPA recommendation, except that the reserve should be Class A. The National Parks and Nature

Conservation Authority has replaced the W.A. Wildlife Authority.

4.1.4 LOW ROCKS

Location: Low Rocks are situated at 14° 04'S, 125° 52'E in the northern part of Admiralty Gulf.

Map: 4.

Current Status: Low Rocks comprise Class C Reserve No. 33832 for the Conservation of Fauna and Flora, vested in the W.A. National Parks and Nature Conservation Authority.

Geomorphology: A small outcrop of King Leopold Sandstones with little soil. They have an area of 4 ha.

Vegetation: Scattered grass.

Fauna: Low Rocks are important as a breeding site for the Pied Cormorant (*Phalacrocorax varius*), Bridled Tern (*Sterna anaethetus*) and Crested Tern (*Sterna bergii*).

Recreational Use and Potential: No current use. Visits should be permitted only under strict conditions to prevent disturbance of the seabird breeding colonies.

Key Features: The seabird colonies.

CTRC Recommendation: "The Committee recommends ...that Low Rocks, in Admiralty Gulf, be declared a Class B Reserve for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority."

EPA Recommendation: "The EPA endorses the purpose and vesting of Reserve 33832 - Low Rocks - but recommends that the classification be amended to Class B."

Our Recommendation: We endorse the purpose and vesting, but recommend that the classification be upgraded to Class A.



4.2 BONAPARTE ARCHIPELAGO

The Bonaparte Archipelago includes many inshore islands lying between Camden Sound and Cape Voltaire. It can be divided into three groups: Augustus, Prince Regent and Bigge. For general descriptions see Burbidge and McKenzie (1978).

4.2.1 AUGUSTUS GROUP

Location: The group lies 240 km north-north-east of Derby. Augustus Island is seaward of Kuri Bay. Further offshore are the Heywood Islands, Byam Martin Island, Champagny Island and several smaller islands.

Map: 3.

Area: See individual areas under 'Vegetation' below.

Current Status: Reserve 23079 for the use and benefit of Aborigines.

Geomorphology: The islands in this group represent a variety of coastal, aquatic and upland surface-types developed on Warton Sandstone strata, a dominant component of the adjacent mainland. The islands comprise massive scree slopes and rocky uplands with abrupt structural plateaux incised by narrow, joint-controlled valleys. Soils are mainly skeletal.

Vegetation and Flora: Augustus Island (17 952 ha) supports a variety of vegetation formations. Dense stands of mangroves belonging to a number of species (e.g. *Rhizophora stylosa*, *Sonneratia alba*, *Avicennia marina*) occur in the inlets. Most of the island is covered with a mosaic of hummock grassland, shrubland and low open woodland. Spinifex (*Plectrachne*) is the dominant grass. The trees include *Eucalyptus miniata*, *Terminalia canescens*, *Owenia vernicosa*, *Acacia* species and Boabs (*Adansonia gregorii*), screw pines (*Pandanus*) and cycads (*Cycas basaltica*) occur in some areas.

The island is criss-crossed by shallow valleys in which alluvial soils support an open forest of *Eucalyptus* species and *Erythrophleum chlorostachys*. A large fresh water creek runs southward through the centre of the island and, in its lower reaches, supports a fringing formation of massive cadjeputs (*Melaleuca leucadendra*, *M. viridiflora*), screw pines (*Pandanus*) and dense grass. Many swamp plants also grow along this creek. Cliffs and steep screes are often faced with rainforest patches.

The Heywood group includes two fairly large islands and a number of smaller ones. The largest is Darcy Island (4 800 ha) which is north-east of Heywood Island (760 ha) and is covered by a low open-forest of *Eucalyptus* (mostly *E. miniata*) with a variable, and often dense, shrub layer of *Acacia* spp. (including *A. delibrata*), *Grevillea* and *Dodonaea* over hummock grasslands. Like Augustus, the island is criss-crossed with shallow valleys in which the

density of these species is greater. At the mouth of a deeper gully is an area of massive cadjeputs (*Melaleuca* sp.), and in another, good stands of the cycad *Cycas basaltica* and Native Walnut (*Owenia vernicosa*) occur. Most of the coast consists of rugged unvegetated sandstone cliffs fringed by a narrow band of mangroves. In sheltered bays and inlets, the mangroves form low closed forests. Attractive sandy beaches, with *Spinifex longifolius* grasslands above the high tide line, occur in several inlets.

Heywood Island itself is much smaller and, although generally similar, has extensive open scrub of *Acacia* spp.

Champagny (1 330 ha) is covered mainly with an open scrub dominated by *Acacia plectocarpa* and *A. tumida* over lower shrubs such as *Santalum lanceolatum* and a dense ground cover of grasses. There is also hummock grassland dominated by *Plectrarchne*. This island has a lower profile than Augustus or the Heywood Islands. Sandy beaches, with areas of *Spinifex* grassland above the high tide line, are prominent along the coast, and areas of mangroves occur in sheltered situations.

On Byam Martin (760 ha) the dominant vegetation is a tall shrubland of *Acacia sericata* and *A. plectocarpa* over hummock grassland. Creeks are lined with *Pandanus* or *Melaleuca viridiflora* with *Terminalia* sp. and Boabs (*Adansonia gregorii*) away from the water. The creeper *Ipomoea pes-caprae* is common.

Fauna: Augustus Island has a rich mammal fauna. It includes the Little Rock-wallaby (*Peradorcas concinna*), Sugar Glider (*Petaurus breviceps*), Golden Bandicoot (*Isodon auratus*), Little Northern Native-Cat, (*Dasyurus hallucatus*), a species of Antechinus (*Pseudantechinus ningbing*), two species of Rock-rats (*Zyomys argurus* and *Z. woodwardii*), three species of bats and the dingo. The Golden Bandicoot is an endangered species that has declined drastically on the mainland. The only other island population is found on Barrow Island, and is considered to represent another subspecies.

The *Antechinus* is also known from Heywood Island and Woodward's Rock-rat occurs on both Heywood and Darcy Islands. A rock-wallaby (species unknown) is also found on the latter island.

A large number of birds and reptiles are known from the islands in the Augustus group. Notable birds include the Azure Kingfisher, Pheasant Coucal, Brown-tailed Flycatcher and Spangled Drongo. Populations of reptiles with restricted distributions

that are represented on these islands include *Gehyra xenopus*, *Ctenotus burbridgei* and *Lerista walkeri*.

Recreational Use or Potential: None.

Key Features: The Augustus group is particularly important because of the presence of the Golden Bandicoot. The group also protects areas typical of the adjacent mainland that have not been affected by the presence of feral animals.

CTRC Recommendation: "The Committee recommends that the EPA bring to the notice of the Aboriginal Lands Trust the conservation value of islands in the Augustus group, at the mouth of the Prince Regent River and in St George Basin. Should they at any time be no longer required as Aboriginal Reserves, they should be set aside as Nature Reserves."

EPA Recommendation: "The EPA recommends that ...should the islands of the Augustus group no longer be required as Aboriginal Reserve, they be set aside for the purpose of Conservation of Flora and Fauna."

Our Recommendation: We recommend that the Department of Conservation and Land Management negotiate with local Aboriginal communities and the Aboriginal Lands Trust with the view to working out arrangements for the management of the Augustus group of islands for nature conservation and the protection of Aboriginal heritage values.

4.2.2 PRINCE REGENT GROUP

Location: This group contains islands adjacent to the Prince Regent Nature Reserve: St Andrew and St Patrick Islands in St George Basin, Uwins Island at the mouth of the Basin, Bat Island off Cape Brewster, the Coronation Islands in York Sound and Boongaree Island in Prince Frederick Harbour. They are about 270 km north-north-east of Derby.

Maps: 3 and 4.

Area: See under Geomorphology.

Current Status: St Andrew, St Patrick and Uwins Islands are part of Reserve 23079 for the Use and Benefit of Aborigines. The Coronation Islands, Bat and Boongaree Islands are vacant Crown land.

Geomorphology: St Andrew (1 400 ha), St Patrick (440 ha) and Bat (30 ha) Islands each consist of a central plateau of Warton Sandstone, with steep cliffs falling away to the underlying Carson Volcanic slopes. Bat Island (about 5 ha) is a small, steep



sided island. Uwins Island (3 300 ha) consists of heavily jointed Warton Sandstone, with skeletal soils. Most of its shoreline is rocky and there are several muddy bays.

The Coronations are a group of low basaltic islands to the north of the Prince Regent Nature Reserve. Coronation Island (3 830 ha) is very irregular in outline and is mostly composed of gentle slopes and rounded hills of volcanic soils, with occasional rocky outcrops. There are many sandy beaches and rocky basaltic headlands with steep cliffs and scree slopes.

Boongaree Island (4 880 ha) lies near the coast in Prince Frederick Harbour. It consists mainly of King Leopold Sandstone, although a large dome of Hart Dolerite that occurs in the central part divides the sandstones into two discrete areas.

Vegetation and Flora: The vegetation of St Patrick and St Andrew Islands is generally similar to parts of the adjacent Prince Regent River Nature Reserve (Miles, Kenneally and George 1975). Small areas of rainforest occur on steep, moist basaltic soils and on screes below the sandstone cliffs, but much of the slopes is covered with open-woodlands of *Eucalyptus miniata* and *Terminalia ferdinandiana*.

Some of the plants collected by the botanist Allan Cunningham who visited Bat Island with P.P. King in 1820 were subsequently described as new species and the island is an important type locality.

The vegetation of Uwins Island is similar to that found on Warton Sandstones of the adjacent mainland in the Prince Regent River Nature Reserve (Miles, Kenneally and George 1975). It is mainly a woodland with *Eucalyptus ferruginea*, *E. miniata* and *E. perfoliata* predominating. Shrubs of *Acacia stipulosa* and *A. humifusa* are common, and the ground cover consists principally of hummock grasses and *Cenchrus elymoides*. The gullies support fan palms (*Livistona* sp.), screw pines (*Pandanus*), *Santalum* and *Choretrum*. Some of the inlets are lined with mangrove stands in which *Rhizophora* appears to predominate.

The main vegetation of Coronation Island is a mixed *Eucalyptus* low-woodland with a ground cover of tussock grasses. Patches of low woodland containing *Terminalia*, *Acacia*, *Pandanus*, *Hakea* and other genera are also found. There are a few areas of mangroves and extensive sandy beaches.

Vegetation on the sandstone areas of Boongaree Island is mainly an open-woodland of *Eucalyptus*

miniata and other eucalypts, with shrubs of *Acacia*, *Calytrix*, *Dodonaea* and *Grevillea*. Areas of deeper soil contain an open-scrub of *Acacia*. The doleritic slopes support grasslands with occasional Kapok Bush (*Cochlospermum fraseri*). There are extensive areas of mangroves. On the northern side of the island a stream in a steep sandstone valley provides habitat for dense banks of ferns.

Fauna: Mammals of St Andrew Island include the only known Kimberley island population of the Brindled Bandicoot (*Isodon macrourus*) and birds include the Rose-crowned Pigeon (*Ptilinopus regina ewingii*), which is restricted to rainforest patches. St Patrick Island has not been examined by biologists.

Northern Quolls (*Dasyurus hallucatus*) are plentiful on Uwins Island and the Golden-backed Tree-rat (*Mesembriomys macrurus*) also occurs there. The first European to visit Bat Island was P.P. King in 1820 (King 1827). He named the island after visiting a cave containing numerous bats. The island was investigated by scientists from the Department of Fisheries and Wildlife in 1973 and the cave proved to be a refuge for two species of bats - the Little Bat (*Eptesicus pumilis caurinus*) and the Common Sheath-tailed Bat (*Taphozous georgianus*).

The fauna of Coronation Island is less diverse than on sandstone islands and the only mammals known are the Common Rock-rat (*Zyromys argurus*) and the Black Flying Fox (*Pteropus alectro*). *Z. argurus* occurs here as an unusual form which may warrant taxonomic distinction. The beaches are an important turtle nesting site.

Boongaree Island has a rich fauna. The most important occurrence is the Scaly-tailed Possum (*Wyulda squamicaudata*). Other mammals include the Little Rock Wallaby (*Peradorcas concinna*), Northern Quoll (*Dasyurus hallucatus*), Tunney's Rat (*Rattus tunneyi*), Woodward's Rock-rat (*Zyromys woodwardii*) and three species of bat including the little-known Lesser Warty-nosed Horseshoe Bat (*Hipposideros stenotis*). Reptiles include the Superb Dragon (*Diporiphora superba*) and the large gecko *Pseudotothecadactylus cavaticus*.

Recreational Use or Potential: No current use. Coronation Island has some potential for tourism, since it possesses sandy beaches and has a comparatively smooth and attractive terrain.

Key Features: Unlike the Augustus group, the islands of the Prince Regent group also include

ecosystems on Hart Dolerite and Carson Volcanic surfaces. The islands complement the adjacent Prince Regent Nature Reserve and should be considered part of it. The presence of *Isoodon macrourus* on St Andrew Island and *Wyulda squamicaudata* on Boongaree Island is of considerable importance to the long-term survival of these species.

CTRC Recommendation: The Committee believes that data on selected islands are sufficient to warrant their immediate reservation. It does not wish to see all islands in this remote area reserved but is aware that future research may show that additional islands should be conserved.

"The Committee recommends: ...that Bat Island, the Coronation Islands and Boongaree Island be added to Reserve No. 27164 - the Prince Regent River Wildlife Sanctuary (see also Area 7.5) ...that the EPA bring to the notice of the Aboriginal Lands Trust the conservation value of islands in the Augustus group, at the mouth of the Prince Regent River and in St George Basin. Should they at any time be no longer required as Aboriginal Reserves, they should be set aside as Nature Reserves."

EPA Recommendation: "The EPA recommends that:

1. the attention of the Aboriginal Lands Trust be drawn to the conservation value of islands in ... St George Basin;
2. Bat Island, the Coronation Islands, Boongaree Island and the other islands within Prince Frederick Harbour be added to Reserve 27164 - Prince Regent River Wildlife Sanctuary."

Our Recommendation:

1. That CALM commence negotiations with local Aboriginal communities and the Aboriginal Lands Trust with the view to working out arrangements for the joint management of the islands at the mouth of the Prince Regent River and in St George Basin for nature conservation and the protection of Aboriginal heritage values.
2. Bat Island, the Coronation Islands, Boongaree Island and the other islands within Prince Frederick Harbour be added to Reserve 27164 - Prince Regent Nature Reserve.

4.2.3 BIGGE GROUP

Location: 330 km west-north-west of Wyndham.

Map: 4.

Area: See under geomorphology.

Current Status: Vacant Crown land.

Geomorphology: This group consists of three large islands and some smaller ones. The largest is Bigge Island, itself with an area of about 17 190 ha. Katers and Wollaston Islands, which lie near the mainland in Montague Sound, are also fairly large and geomorphologically similar to Bigge. They consist mainly of heavily dissected King Leopold Sandstone, expressed as exceedingly rugged scree, cliffs and undulating rock-pile country, with areas of dolerite and sandy soil. There are several smaller islands further offshore, including the volcanic Maret and Montalivet Islands, some of which are capped with laterite.

Vegetation and Flora: Most of Bigge Island consists of open, dissected sandstone with deep gullies, and occasional broad valleys. They support low open-woodlands and tall open-shrublands of *Acacia*, *Pandanus*, *Owenia*, *Eucalyptus* spp. *Ficus*, *Strychnos* and *Gardenia* with scattered hummock grasses (*Plectrachne*). Other shrubs include *Hibiscus*, *Santalum*, *Calytrix* and *Canthium*. Occasional creeks are fringed with cadjeputs (*Melaleuca leucadendra*) and screw pines (*Pandanus*), as well as the fern *Acrostichum speciosum*.

A wide central vale with basaltic soil contains a woodland of *Eucalyptus* species (including *E. miniata*), *Acacia* and *Terminalia*. Behind sandy shores there is a hummock grassland of *Spinifex longifolius* with scattered shrubs of *Morinda citrifolia* and *Scaevola sericea*. Muddy shores are fringed with mangroves, especially *Avicennia* and *Rhizophora*.

Katers Island has extensive areas of bare rock and areas of little soil with hummock grasslands. Fissures and cracks in the rocks support *Ficus* sp. and many small trees and shrubs such as *Ervatamia*, *Gardenia* and *Strychnos*. All open-shrublands of *Acacia retinervis* and *A. xylocarpa* with occasional *Eucalyptus* and *Erythrophleum* occur in larger fissures. A deep valley in the north-west part of the island has a narrow strip of vine thicket in which *Tinospora* and *Aristolochia* occur. There are some fringing sandy areas with *Spinifex longifolius*, Beach Morning Glory (*Ipomoea pes-caprae*) and a few mangrove formations.

Wollaston is a steep island with rock terraces. The main vegetation is a hummock grassland. *Gyrocarpus americanus*, *Alstonia* and *Ficus* are common trees in joint fractures in the sandstone. One deep valley contains a dense thicket of *Acacia* sp. and *Caesalpinia*



major with the creeper *Flagellaria indica* and, in seepage areas, the ferns *Lygodium microphyllum* and *Stenochlaena palustris*. Sandy flats by the sea are covered with *Sporobolus virginicus*.

East Montalivet Island, situated at the entrance of Montague Sound, is dominated by a laterite plateau supporting a hummock grassland of *Plectrachne* with some scattered shrubs of *Acacia* sp. The breakaway and scree slopes of the plateau support dense thickets of the same species as occur further down-slope although *Flagellaria indica* and *Abrus precatorius* are more common in this habitat.

The surrounding slopes of volcanic soil and rock outcrops are characterised by the low open-shrublands of *Brachychiton*, with scattered shrubs of *Mimusops elengi*, *Diospyros nitens*, *Aidia racemosa*, *Terminalia* sp. and *Buchanania obovata*. An extensive sandy littoral area dominated by *Spinifex longifolius* and *Salsola kali* occurs on the south side of the island.

South Maret Island, which lies 18 km seaward of Bigge Island, resembles East Montalivet.

Most of the island is a laterite capped plateau supporting a low open-shrubland to an open hummock grassland of spinifex. *Acacia retinervis*, *Eucalyptus* sp., *Grevillea pyramidalis* and *Diospyros nitens* are the common shrubs and trees. A medium dense or open grass understorey of *Plectrachne* and *Heteropogon contortus* occurs on the more weathered laterite. Open areas of laterite support *Crinum angustifolium*, *Cadaba capparoides* and *Gomphrena* sp. The steep scree slopes over volcanic rocks are generally covered by thickets of low shrubs such as *Pouteria sericea* and *Aidia* with *Flagellaria indica* and *Abrus precatorius*. *Pandanus* trees occur in deeper valleys.

Littoral vegetation is limited to narrow zones of *Spinifex longifolius* on the western and eastern shores.

Fauna: The most important fauna species of this group are the Warabi (*Petrogale burbidgei*), which is abundant on Bigge and Katers, and the Scaly-tailed Possum (*Wyulda squamicaudata*) which occurs on Bigge. Both species are north-west Kimberley endemics and the islands are most important to their long-term conservation. A small rock-wallaby, species unknown, also occurs on Wollaston. Bigge is rich in mammals, also having populations of the Echidna (*Tachyglossus aculeatus*), Northern Quoll (*Dasyurus hallucatus*), Woodward's Rock-rat (*Zyromys woodwardi*), Delicate Mouse (*Pseudomys delicatulus*)

and the Dingo. The Golden-backed Tree-rat (*Mesembriomys macrurus*) is found on Wollaston Island.

All islands in the group have rich bird and reptile faunas. Populations of the White-lined Honeyeater (*Meliphaga albilineata*), a bearded dragon (*Pogona microlepidota*) and the Blind Snake (*Typhlina polygrammica*) have been found on Bigge; the first also occurs on Wollaston. In Western Australia, these species are restricted to the high rainfall parts of the North Kimberley. Three species of frog have been found during dry-season surveys on Bigge Island, reflecting their size and representation in mainland situations.

Recreational Use and Potential: No current use. No potential for tourist development because of their rugged surfaces and remoteness. Potential for wilderness activities and nature study.

Key Features: These islands represent a variety of King Leopold Sandstone surfaces and their associated plant and animal communities. King Leopold Sandstone is the dominant surface of the north-west Kimberley. Bigge is one of the two largest Kimberley islands and the other, Augustus, is reserved for the use and benefit of Aborigines. The islands have a very rich flora and fauna.

CTRC Recommendation: "The Committee recommends ... that Bigge, Katers and Wollaston Islands, the Maret Islands, and the Montalivet Islands be declared a Class B Reserve for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority."

EPA Recommendation: "The EPA recommends that: ...Bigge, Katers, Wollaston, the Maret and the Montalivet Islands be declared a Class B Reserve for the Conservation of Flora and Fauna and vested in the W.A. Wildlife Authority."

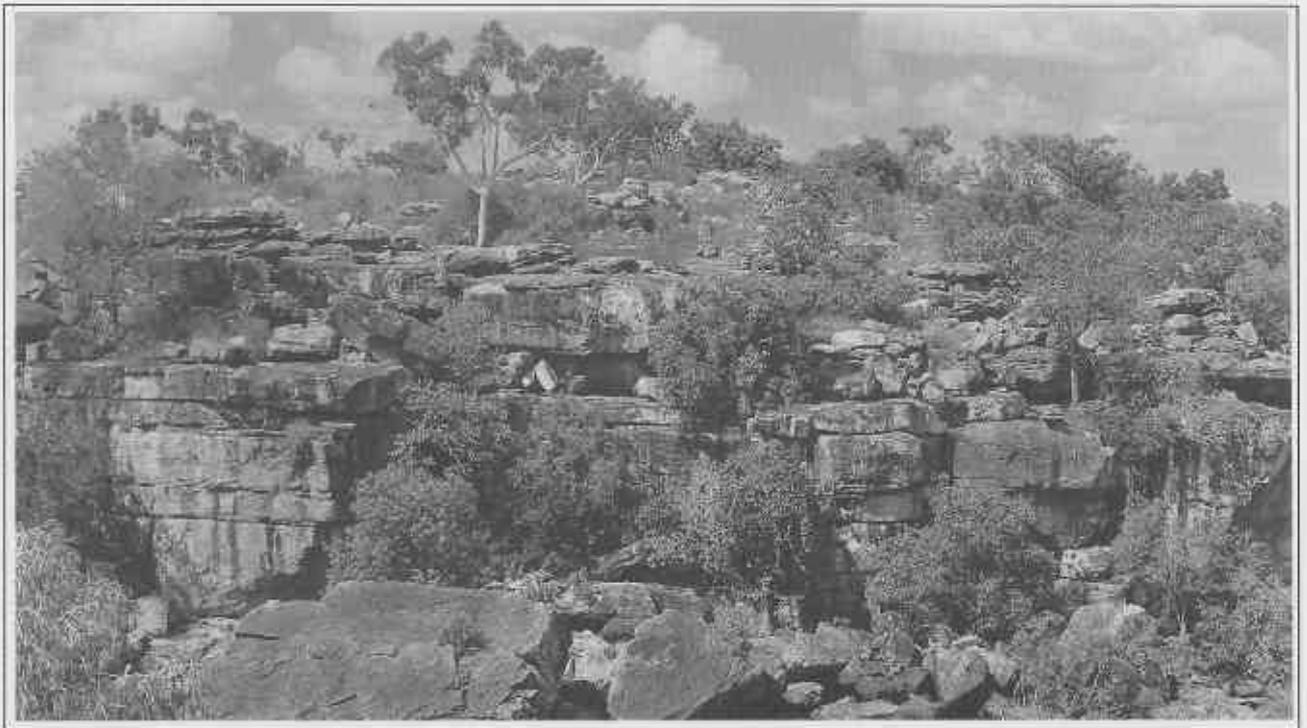
Our Recommendation: We endorse the EPA recommendation, except that the reserve should be Class A. The National Parks and Nature Conservation Authority has replaced the W.A. Wildlife Authority.

4.3 BUCCANEER ARCHIPELAGO

Location: At the northern end of King Sound, north of Derby.



Hidden Island in the Buccaneer Archipelago illustrates the rugged sandstone shoreline and sandy embayments which are typical features of the Kimberley coast.



Above the Mitchell River Falls, the surrounding country is characterised by rugged, highly dissected sandstone.

Map: 3.

Area: Not surveyed. Islands range from a few hectares to about 2 400 ha.

Current Status: Most islands are vacant Crown land. Sunday Island is a reserve for the use and benefit of Aborigines, and Swan Island is Reserve no. 34257 for the conservation of flora and fauna, vested in the National Parks and Nature Conservation Authority. Koolan and Cockatoo Islands are developed as iron-ore mines, with associated residential and port facilities, though ore is no longer mined on Cockatoo Island and the facilities are being developed as a tourist resort.

Geomorphology: The numerous islands conform to the strike of the geological structures of the Yampi Peninsula, and were formed when the coastline was flooded just prior to the Holocene. The islands are characterised by rugged Proterozoic sandstone topography, with abrupt structural plateaux and strike ridges, incised by narrow, joint controlled valleys and surrounded by steep scree slopes. Abrupt coastal cliffs and promontories overlook the narrow tidal channels that separate the islands from each other and from the mainland. Geological surfaces (Gellatly and Sofoulis 1973) exposed on the islands include King Leopold Sandstone (Hidden, Sunday, Lachlan, Long, Pasco, King Hall, Sir Frederick, Cafferelli), Elgee Siltstone (Gibbings, Koolan), Pentecost Sandstone (Irvine, Bathurst), Yampi Member including hematitic quartz sandstone (Koolan, Cockatoo), Hart Dolerite (Lachlan), and Wotjulum Porphyry (Conilurus). These surfaces are partially mantled by shallow skeletal to clayey soils.

The marine environment is diverse, with rocky island shores, coral reefs, algal reef flats and shallow sandy banks with extensive seagrass beds. Sandy beaches are sparse and confined to small sheltered bays, though tidal mudflats border most embayments. Tidal channels contain coarse-grained sands that often form cross-bedded tidal megaripples (e.g. Sunday Island). Small areas of alluvium are found on a few islands (e.g. Gibbings) where beach dunes have truncated outwash valleys. An intra-tidal lagoon, cut off from the sea by a sand-bar, occurs on MacLeay Island.

Vegetation and Flora: Each of the geological surfaces supports a different plant community. The characteristic vegetation of the islands is found in shallow sandy soils over sandstone. It consists of a

low open forest of *Eucalyptus confertiflora*, *E. miniata* and *Buchanania obovata*, over a closed heath of *Calytrix exstipulata*, *Acacia stigmatophylla*, *A. translucens* and *A. tumida*. *Grevillea pyramidalis* and *Acacia hippuroides* are occasional. Under the trees and shrubs is a closed hummock grassland of *Plectrachne*. *Eucalyptus brachyandra* occurs in fissures of the rugged outcropping sandstone.

Scree slopes of sandstone, having skeletal coarse sandy soils, typically support a low open shrubland of *Buchanania obovata* and *Calytrix exstipulata* with some *Grevillea pyramidalis*, over scattered *Plectrachne* sp. *Ficus platypoda* is restricted to scree slopes and cliff faces where it grows out of fissures.

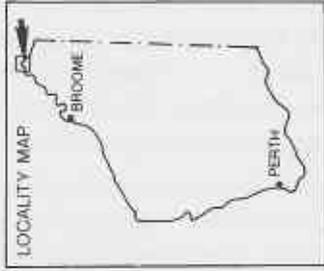
Dry creek valleys are marked by fine alluvial soil amongst rocky sandstone. They support a low open woodland of predominantly *Eucalyptus polycarpa*, *Buchanania obovata* and *Pouteria sericea*. The trees *Canarium australianum*, *Terminalia* sp. and *Brachychiton* sp. are also present and, though much less common, identify the creek valley habitat by being more or less restricted to valleys and gorges. Under the trees there is a shrubland of predominantly *Acacia stigmatophylla* and *Templetonia hookeri* and less commonly *Acacia tumida*, *Distichostemon hispidulus* and *Grevillea wickhamii*, over closed hummock grassland of *Plectrachne* sp. Very common in patches are *Cassytha* sp. and *Flagellaria indica*.

A low open forest of *Terminalia* sp., *Buchanania obovata*, *Pandanus* sp. and *Grevillea pyramidalis* occur on the moist alluvial and often colluvial soils of a gorge. Often, the soil is relatively deep (approximately 5 cm), having much organic matter and a thin leaf litter. Also present is *Ficus opposita* and in a moist fresh water seepage area tall individuals of *Eucalyptus zygomorpha* and *Owenia* sp. are found. Under the trees is a low open shrubland of *Acacia tumida*, *A. multisiliqua*, and *Bridelia* sp., and less commonly *Templetonia hookeri*, *Calytrix exstipulata* and *Atylosia* sp. and, in moist shady spots, *Gonocarpus* sp. In shallow soil over sandstone, a closed hummock grassland of *Plectrachne* occurs under the trees and shrubs, but in deeper soil a closed grassland of *Cymbopogon* sp. occurs.

Dry shelly beach sand of the coastal dunes often supports a closed grassland of *Spinifex longifolius*, with the creeper *Ipomoea pes-caprae* common amongst it. In lower adjacent areas flooded only by high spring tides, moist shelly beach sand supports a low woodland of *Lumnitzera racemosa* and *Thespesia*



PROPOSED CAPE LONDONDERRY NATIONAL PARK



LEGEND
Proposed National Park



Stewards Island

Cape Londonderry

Sandy Island

Cape Talbot

INDIAN OCEAN

Governor Island

NAPIER

BROOME

BAY

Curren Point

Beauty Point

Gallery Point

Drysdale River Mission

Drysdale River

CARSON RIVER

▲ 13873

Use And Benefit Of Aborigines

MAP 17

populneoides. *Avicennia marina* is also present and the creeper *Sesuvium portulacastrum* forms the only ground cover.

Sheltered bays and tidal creeks support the mangrove species *Osbornia octodonta*, *Rhizophora stylosa*, *Ceriops tagal*, *Camptostemon schultzei*, *Avicennia marina* and *Sonneratia alba* and, at the seaward edge of the mangroves, *Lumnitzera racemosa*.

Fauna: Nineteen species of native mammals are known from the archipelago. Of particular biogeographic and conservation interest are populations of the Little Rock-wallaby (*Peradorcas concinna*), Golden-backed Tree-rat (*Mesembriomys macrurus*), Grassland Melomys (*Melomys burtoni*), Ghost Bat (*Macroderma gigas*) and Lesser Warty-nosed Horseshoe Bat (*Hipposideros stenotis*). Ninety-six species of birds have been recorded including the Mangrove Kingfisher (*Halcyon chloris*) and Brown-tailed Flycatcher (*Microeca tormenti*). Twenty-five species of reptiles are known from the islands.

Dugongs (*Dugong dugon*) and turtles are abundant in surrounding seas, especially on seagrass beds and reefs.

Recreational Use and Potential: Some islands, which have picturesque beaches, are visited by people from Koolan and Cockatoo Islands and from One Arm Point. Some of the islands have high cultural values for the local Aboriginal people.

Key Features: The Archipelago protects an array of flora and fauna characteristic of the adjacent mainland. Island communities are less vulnerable to damage by exotic species and can be more easily protected from too frequent fires. The archipelago also has cultural value to the Aboriginal people and has some recreational potential.

CTRC Recommendation: "The Committee considers that data are insufficient to justify recommending the creation of specific reserves at present. It recommends that the Environmental Protection Authority commission a biological survey, to enable a firm decision to be reached."

EPA Recommendation: "The EPA recommends that the Department of Fisheries and Wildlife, Western Australian Museum and Western Australian Herbarium make a biological survey of the Buccaneer Archipelago with a view to recommending to the EPA the creation of specific reserves."

Our Recommendation: The biological survey was

carried out in June 1982 but the results have not been published. Following completion of the survey the Department and Fisheries and Wildlife made the following recommendations to the EPA and to the Department of Lands and Surveys:

1. That the following islands, to low water mark, be declared Class A reserves for the conservation of flora and fauna and be vested in the Western Australian Wildlife Authority: Hidden, Long, Irvine, Conilurus, Gibbings, Chambers, Pascoe, Flora, Kathleen and the group from King Hall to Cafferelli.
2. That the following islands be declared Class B reserves for the conservation of flora and fauna, be vested in the Western Australian Wildlife Authority and extended to the low tide line: Admiral, Powerful, Bruin, Sir Frederick, Lachlan.

The Department noted that reservation of the islands in "1" will protect populations of 14 of the 16 species of mammals and 21 of the 26 species of reptiles known from the archipelago (excluding Koolan and Cockatoo Islands). In addition, 81 of the 96 species of birds were recorded on these islands. The Department also recommended that a biological survey be made of the islands in Talbot Bay before their status is changed.

The Aboriginal Lands Trust, on behalf of the Bardi people, also applied for some of the islands to be declared reserves for the Use and Benefit of Aborigines.

Negotiations have been conducted between the Department of Conservation and Land Management and the Bardi people at One Arm Point with a view to agreeing on control and management. These negotiations are continuing.

We recommend that the Department of Conservation and Land Management continue negotiations with the local Aboriginal people with the aim of having the whole of the Buccaneer Archipelago and surrounding waters declared a marine park, zoned for multiple use according to a management plan developed by the two organisations.

4.4 CAPE LONDONDERRY AREA

Location: The northernmost point of Western Australia.

Map: 17.

Area: The land component has an area of about 70 862 ha.

Current Status: Vacant Crown land.

Geomorphology: Cape Londonderry lies at the apex of a broad peninsula whose coast is indented with deep bays. The estuary of the Drysdale River lies at the south-west corner of the area, and a number of small rivers, flowing only in the wet season, rise on the plateau which forms the core of the peninsula.

The coastline is extremely varied and colourful. Lateritic and sandstone cliffs up to approximately 50 m high are interspersed with low rocky shores, sandy tracts and alluvial tidal flats. Two small rivers enter the sea over 50 m cliffs, in an inlet on the east coast, and must be an impressive sight in the wet season.

The plateau consists of a core of Carpentarian Carson Volcanics, flanked on the east by Warton Sandstone and on the west by King Leopold Sandstone and Tertiary laterite. The undissected uplands, superficially mantled by sandy plains, are topographically quite different from the strongly dissected surfaces of existing and proposed conservation reserves further south in the district. Extensive sandy soils cover the north-west of the area, and deposits of Quaternary sand and silt occur in small pockets along the coast.

Vegetation and Flora: The vegetation of the plateau is mostly low open-forest and low woodland with areas of tall shrubland. Eucalypts are the predominant trees, especially Messmate (*E. tetradonta*), *E. latifolia*, Woollybutt (*E. miniata*) and several bloodwoods. Other trees include species of *Terminalia*, *Buchanania*, *Melaleuca*, *Grevillea*, *Persoonia*, *Brachychiton*, *Owenia*, *Xanthostemon* and *Pandanus*. Fan Palms (*Livistona loriphylla*) occur in the south-west of the area. Lateritic and some sandstone soils, especially in tall shrubland, support a mixture of shrubs such as *Grevillea cunninghamii*, *Acacia ?retinervis*, *Cassia oligoclada* and *Ficus* species, while after fires short-lived perennials appear, e.g. *Scaevola ovalifolia*, *Trachymene hemicarpa*, *Stemodia lythrifolia* and *Triumfetta* sp.

Rocky areas, especially near the east coast, support vine thickets which contain a wide range of species such as *Pouteria sericea*, *Gyrocarpus americanus*, *Ficus virens*, *Bridelia tomentosa*, *Celtis philippensis*, *Cassine melanocarpa* and lianes including *Flagellaria indica*,

Capparis sp., and *Malaisia scandens*. Areas of deep sand on the coast carry a hummock grassland of *Spinifex longifolius* and *Triodia* sp., sometimes with scattered shrubs of *Grevillea viscidula*, *G. refracta* and *Phyllanthus baccatus*.

Mangroves occur as both narrow and broad stands on tidal silt flats and include *Lumnitzera racemosa*, *Bruguiera exaristata* and *Scyphiphora hydrophyllacea*, the last being known in this State only from this area. The estuary of the Drysdale River is lined with extensive stands of mangroves. The coastal waters adjacent include extensive shallows with seagrasses.

Fauna: The fauna of the area has not been studied in detail, but the Spangled Drongo (*Dicrurus bracteatus*) is known to occur in small vine thickets on the east coast. Other birds recorded include the Brolga (*Grus rubicunda*), Jabiru (*Xenorhynchus asiaticus*) and Great Bower-bird (*Chlamydera nuchalis*). The seagrass banks are important habitat for dugongs (*Dugong dugon*).

Recreational Use and Potential: No known use at present. The reservation of land extremities is traditional because of the romantic appeal that they hold for most people. As examples, Cape Leeuwin and Wilsons Promontory in Australia and Lands End and John O'Groats in England may be cited.

Key Features: The northernmost point of the State lateritic surfaces and rainforest patches. Undissected sandstone uplands, superficially mantled by sandy plains.

CTRC Recommendation: "The Committee considers the area worthy of National Park status, on the basis of its geographical position, and its varied scenery, geology, flora and fauna. Although currently almost inaccessible except from the sea or by helicopter, it has potential for recreation in the future. CTRC has already recommended conservation reserves at West Cape Howe (Area 2.9) and West Point on Dirk Hartog Island (Area 9.1) the southern and western extremities of the State. The area is at present vacant Crown land and covers about 70 862 ha."

Recommendation. "The Committee recommends that the area as shown in Fig. 7.8 be declared a Class A Reserve for the purpose of National Park and vested in the National Parks Authority of W.A. The reserve should extend to low water mark to ensure preservation of mangroves and should include the adjacent islands. It should also include the islands of mangroves in the estuary of the Drysdale

River, down to low water mark."

EPA Recommendation: "The EPA recommends that:

1. the area shown in Fig. 7.8 including the adjacent islands, be declared a Class A Reserve for National Park and vested in the National Parks Authority;
2. this reserve include the islands of mangroves in the estuary of the Drysdale River;
3. the boundary be extended to low water mark."

Our Recommendation: We endorse the EPA recommendations. The National Parks and Nature Conservation Authority has replaced the National Parks Authority. We also recommend that the waters contiguous with the national park, including the seagrass banks, be declared a Class A Marine National Park.

4.5 DRYSDALE RIVER NATIONAL PARK

Location: The Park lies astride the Drysdale and Carson Rivers about 150 km west of Wyndham and 100 km south of Kalumburu.

For a description see Kabay and Burbidge (1977).

Map: 18.

Area: 435 906 ha.

Current Status: The Drysdale River National Park is Class B Reserve No. 32853 for the purpose of National Park and is vested in the National Parks and Nature Conservation Authority.

Geomorphology: The reserve embraces a cross-section of the country and includes sandstones, basalts and siltstones of the Late Precambrian Kimberley and Bastion Groups together with soils derived from them. Scenically it varies from extensive, rather monotonous open-woodlands to the broad waters of the Drysdale River, attractive pools in creeks, and rugged cliffs along the Carson Escarpment, along Johnson Creek and in Worriga Gorge. Major waterfalls occur at Morgan Falls and on the Drysdale River and there are numerous small falls elsewhere (Kabay, George and Kenneally 1977).

Biologically, the Park contains biota intermediate between those of the sub-humid north-west Kimberley and the semi-arid East Kimberley.

Vegetation and Flora: The vegetation is predominantly open-forest or woodland, low open-

forest and low woodland (Kabay, George and Kenneally 1977). Fringing formations occur along the major rivers and creeks and pockets of vine thicket and vine forest occur along the Carson Escarpment and in some gorges. There are small areas of open-shrubland and closed-grassland.

The woodlands and forests are mostly dominated by *Eucalyptus*. On sandstone *Eucalyptus miniata*, *E. tetradonta*, *E. latifolia* and *E. leucophloia* predominate and on basalt *E. tectifica* and *E. foelscheana* are the common species. Associated with these are species of *Gardenia*, *Owenia*, *Erythrophleum*, *Callitris*, *Acacia* and *Brachychiton*. Many shrubs, grasses and herbs make up the understorey, more densely in sand or loam than in rocky areas. Most plants are typical of the region, but some species of special interest include uncommon plants such as *Homalocalyx ericaeus*, *Myrtella phebaloides*, *Colocasia esculenta*, *Bombax ceiba* and *Ptilostigma malabaricum*.

Fringing formations along rivers and creeks are dominated by cadjeputs, especially *Melaleuca leucadendra*, *M. argentea* and *M. viridiflora*. Other trees include *Sesbania*, *Ficus*, *Nauclea*, *Syzygium*, *Terminalia* and *Pandanus*.

The vine thickets and forests are mostly poorer in species than those of the Mitchell Plateau and lower Prince Regent River, but are a valuable sample of rainforest which occurs only in small areas of the Kimberley. An important occurrence is in Worriga Gorge, where over 12 tree species are found and robust lianes occur. The epiphytic orchid, *Dendrobium affine* is common in wetter parts of the Drysdale vine thickets.

The Drysdale and Carson Rivers contain permanent pools, while some smaller streams are perennial. In and around the water are many aquatic and swamp plants. About 30 aquatics have been recorded for the Park, including rare or unusual species such as *Nymphoides minima*, *Blyxa echinosperma*, *Myriophyllum dicoccum*, *Triglochin procera* var. *dubia*, and *Limnophila* sp. nov. (George and Kenneally 1977). The swamp plants include a number of bladderworts (*Utricularia*), trigger plants (*Strylidium*), *Mitrasacme*, *Xyris*, etc.

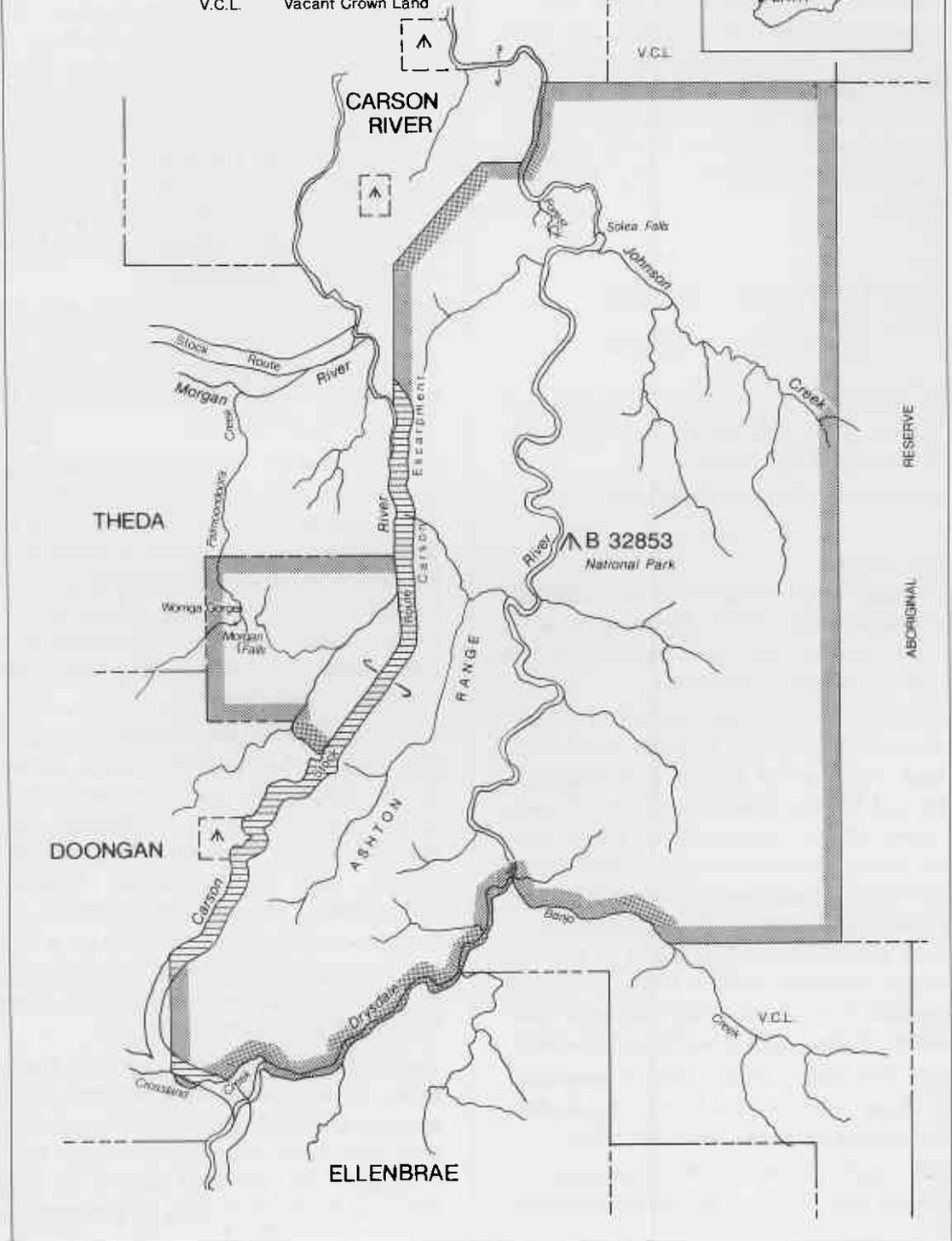
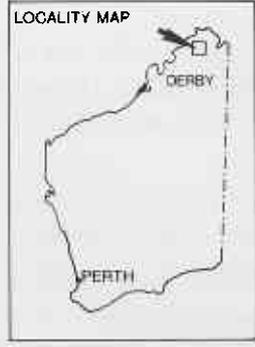
Twenty-five species of ferns occur in the Park. Of these, 13 are known from Worriga Gorge alone and two (*Christella dentata* and *Doryopteris concolor*) have not been recorded elsewhere in Western Australia. The recorded flora of the Park totals 594 species, of which only 39 per cent occur also



DRYSDALE RIVER NATIONAL PARK



- LEGEND
-  Existing National Park
 -  Proposed National Park
 - V.C.L. Vacant Crown Land



MAP 18

in the Prince Regent Nature Reserve.

Fauna: Twenty-six species of native mammals have been recorded in the Park (McKenzie *et al.* 1977). Thirteen of these are bats, including the poorly known *Myotis adversus*, *Tadarida loriae* and *Nyctophilus arnhemensis*. *N. walkeri*, a species previously known from only one specimen taken in the Northern Territory in 1892, was also collected. Terrestrial mammals include the Short-eared Rock Wallaby (*Petrogale brachyotis*), Sugar Glider (*Petaurus breviceps*), a Planigale (*Planigale maculata*), the Water Rat (*Hydromys chrysogaster*) and a recently described species of native mouse (*Pseudomys laborifex*).

Birds number 129 species (Johnstone *et al.* 1977). The avifauna includes sub-humid species at their eastern known limit of distribution, such as the Green-winged Pigeon (*Chalcophaps indica*) and Silver-backed Butcher-bird (*Cracticus torquatus latens*), as well as semi-arid species that do not extend further west, e.g. the Crested Pigeon (*Ocyphaps lophotes*), Brown Songlark (*Cinclorhamphus cruralis*) and Gouldian Finch (*Erythrura gouldiae*).

Frogs and reptiles were plentiful during the survey and 13 species of frogs and 47 reptiles were recorded (Storr and Smith 1977). A surprisingly high total of 26 species of fresh water fish was recorded (Hutchins 1977).

The land snail fauna in the park is indicative of drier conditions than those prevailing in the Prince Regent Nature Reserve and other north-west Kimberley coastal localities (Merrifield *et al.* 1977). The family Camaenidae is less diverse in the Drysdale River National Park, and operculate land snails (prosobranchs) are not represented. More arboreal snails were found in the Park, but these are mainly tiny species which may have been overlooked at the Prince Regent. They are found in dense vine thickets in the deeper, well-watered gorges. Their affinities appear to be mainly with Pacific and Indonesian snails, and they may be a relic fauna. Ground-living snails in the Park are found in a wide range of habitats wherever deep leaf litter accumulates. They belong mainly to groups endemic to northern Australia. Endemic land snails restricted to the Park include *Amplirhagada drysdaleana* and *Setobaudinia doongana*.

Some 2 415 species belonging to 15 insect orders were collected (Common and Upton 1977). They include 14 species of dragonflies (Odonata), 55 of grasshoppers (Orthoptera), 338 of bugs (Hemiptera), 403 of beetles (Coleoptera), 30 of butterflies

(Hesperiidae, Papilionidae, Pieridae, Nymphalidae and Lycaenidae), and 931 of moths (other Lepidoptera).

Recreational Use and Potential: At present, the National Park is not readily accessible to visitors, but it will become an important tourist attraction in the future.

Key Features: A major National Park representative of the drier interior of the North Kimberley.

CTRC Recommendation: "The Committee believes that the Reserve boundaries need slight modification such as the inclusion within the National Park of those portions of the existing Stock Route which is not required for that purpose. Its addition to the Park would rationalise the boundary and facilitate management, particularly in regard to the Carson Escarpment. It should be borne in mind that the original concept of the Stock Route was intended to preserve future public access as well as provide for passage of stock.

In its northern section the Park is at present confined to the east side of the Drysdale River. An area on the west side adjacent to the spectacular Solea Falls warrants inclusion in the Park. It consists partly of rugged sandstone hills on which there is a tall open-shrubland or low open-woodland with a spinifex (*Plectachne*) understorey. Fan Palms (*Livistona loriphylla*) are common here, as is Kalumburu Gum (*Eucalyptus herbertiana*). The outstanding feature of the area is a permanent stream now named Forest Creek entering the Drysdale some 10 km below the Falls. Along its lower course it is lined with a tall closed-forest of *Melaleuca leucadendra*, *Carallia brachiata*, *Syzygium eucalyptoides* and an unnamed species. This is the only known occurrence of this formation in the Kimberley. Upstream the creek forks and its two valleys contain dense vine thickets in which *Cassine*, *Pouteria*, *Stenocarpus*, *Ficus*, *Planchonella*, *Denhamia* and *Alstonia* occur. A small comb fern (*Schizaea digitata*) found here is not known elsewhere in Australia. There is also an undescribed species of *Ricinocarpos*.

The proposed addition is at present part of Carson River pastoral lease. It is rugged and has little pastoral value. It would add to the biological representation in the Park, and ensure the protection of Solea Falls on the Drysdale River. At present, only the eastern side of this Fall is within the Park."

Recommendation "The Committee endorses the purpose and vesting of Reserve No. 32853. It



Blechnum orientale is a common fern of seepage areas in rugged sandstone.

recommends that those adjacent portions of the existing Stock Route which are no longer required for that purpose be added to the National Park."

EPA Recommendation: "The EPA endorses the classification and vesting of Reserve 32853 and recommends that:

1. the purpose be amended to National Park and Water;
2. those adjacent portions of the existing Stock Route no longer required for that purpose be added to the National Park."

Our Recommendation: We agree that the adjacent portions of the Stock Route should be added to the Park, but see no reason to amend the purpose to include "water", since there is no foreseeable requirement to develop water supplies in this area.

The small adjacent portion of Carson River Station, which includes Solea Falls and the area of tall forest, has been added to the National Park.

4.6 HUNTER RIVER AREA

Location: 310 km north-east of Derby.

Map: 20.

Current Status: Partly vacant Crown land and partly portion of Reserve No. 30463 for the Use and Benefit of Aborigines.

Geomorphology: Along the northern side of Prince Frederick Harbour and on either side of the Hunter River are sheer, orange to red cliffs of Warton Sandstone, sometimes underlain by Carson Volcanic basalts. An unnamed tributary of the Hunter, which enters it from the north near its mouth, is especially scenic. Near this tributary is Mt Anderdon (484 m), which is only 2 km from tidal waters. Here the cliffs descend in great plunging steps towards the sea. In the mouth of the creek is an unnamed island of about 1 000 ha (herein referred to as Naturalist Island). It is geomorphologically similar to the adjacent mainland, with steep cliffs and small beaches in sheltered bays. On the other side of the creek is Manning Peak, 326 m high, which is only a kilometre from Prince Frederick Harbour. At the mouth of the Hunter are two enormous pinnacles of sandstone with overhanging cliffs. In 1820 these were named by P.P. King as "The Ninepin".

Enid Falls, and a deep gorge associated with Rufous

Creek, lies in the south of this area. The gorge is about 400 m wide, broadening southwards, and is bordered by a high rampart of quartz sandstone for most of its length.

Vegetation and Flora: Below the cliffs are areas of rainforest. One strip, that occurs either side of the north bank of the entrance to the Hunter, is one of the largest and best developed rainforest patches in Western Australia. This forest occurs in an almost unbroken line below the cliffs for many kilometres. The substantial patches of rainforest that occur on Naturalist Island are very similar in their species composition, but are isolated from feral animals (and many other sources of disturbance) that occur on the mainland; the island provides a reference point for measuring the effects of these disturbers on the rainforests of the nearby mainland. The botanical explorer Allan Cunningham, who visited this area with Philip King in the *H.M.C. Mermaid* in 1820, collected here. One species of tree, *Xanthostemon umbrosus*, has not been collected since. The vegetation of the sandstones has not been examined, but is likely to be similar to that of the Prince Regent River Nature Reserve. The vegetation of the Enid Falls area is described by Miles *et al.* (1975).

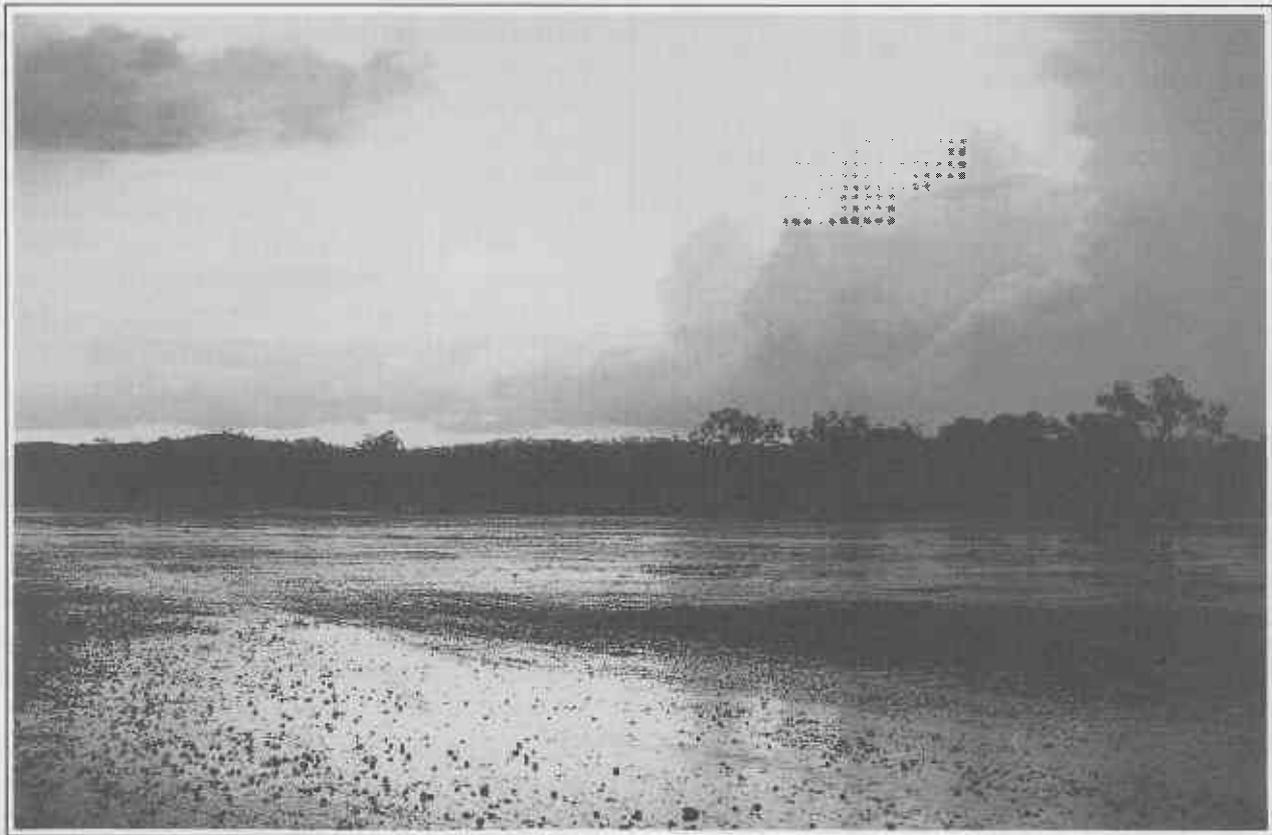
Fauna: A number of birds which are rare in Western Australia and restricted to rainforest patches are comparatively plentiful here. They include the Scrub Fowl (*Megapodius reinwardt*), Rose-crowned Pigeon (*Ptilinopus regina*) and Green-winged Pigeon (*Chalcophaps indica*). Other rainforest species recorded here include the Spangled Drongo (*Dicrurus bracteatus*), Yellow Oriole (*Oriolus flavocinctus*), Torres Strait Pigeon (*Ducula spilorrhoa*) and the Little Shrike-Thrush (*Colluricincla parvula*).

The rare Rufous Owl (*Ninox rufa*) and Black Grass-wren (*Amytornis housei*) have been recorded at Enid Falls. Details of these and other fauna of this area are given in Miles and Burbidge (1975). The Rock Ringtail Possum (*Pseudocheirus dahli*), an unusual and uncommon species, has been recorded feeding in the mangroves of the Hunter River and the Saltwater Crocodile (*Crocodylus porosus*) is found in the tidal portions of the Hunter and its tributaries (Messel *et al.* 1987).

Alan Solem (pers. comm.) considers that the Hunter River area is part of the generic centre of diversity for Kimberley land snails; a recent survey of



Naturalists' Beach on an unnamed island in the mouth of the Hunter River, with rainforest on the scree slopes.



Wet season storms over Mt Hart Station.

Kimberley rainforest patches found several new species of land snail in the area.

Recreational Use and Potential: There is little current use, although the area is being visited by an increasing number of people on charter boats or private cruises. The area has great potential for tourism because of its spectacular scenery, but the extremely rugged nature of the country indicates boat-based tourism rather than land-based facilities. There is no road access, and road construction and maintenance would be extremely expensive.

Key Features: The area contains the most spectacular scenery of the Western Australian, if not the Australian, coastline. The rainforests are outstanding and are among the best in the State.

CTRC Recommendation: "The Committee recommends that the area shown Fig. 7.6 be declared a Class B Reserve for the purpose of National Park and vested in the National Parks Authority of W.A. Negotiations should be undertaken with the Aboriginal Lands Trust to include the southern portion of Reserve No. 30643 within the proposed reserve."

EPA Recommendation: "The EPA recommends that ... the area of vacant Crown land north of the reserve (Prince Regent Nature Reserve) and as indicated in Fig 7.5, be added to the reserve."

Our Recommendation: The vacant Crown land provides a link between the Prince Regent Nature Reserve (proposed to be changed to a national park) and the proposed national park at Mitchell Falls. Thus the opportunity exists to create a single major national park, representative of much of the wetter parts of the north Kimberley. Part of Reserve 30463, for the Use and Benefit of Aborigines, is of great value for the protection of rainforests and has very high scenic value.

We recommend that the vacant Crown land in the Hunter River area, including Naturalist Island (125°21'E 15° 01'S), be added to the Prince Regent Nature Reserve and that the combined area be declared a Class A national park. We also recommend that the Department of Conservation and Land Management negotiate with relevant Aboriginal communities and the Aboriginal Lands Trust with a view to adding some of Reserve 30463, as outlined on Map 20, to the National Park.

4.7 KINGFISHER ISLANDS

Location: The Kingfisher Islands are situated in Collier Bay about 45 km east of Cockatoo Island and 140 km north-north-east of Derby.

A description is given in Burbidge and McKenzie (1978).

Map: 3.

Area: Kingfisher 1010 ha, Melomys 850 ha.

Current Status: Vacant Crown land.

Geomorphology: The group consists of two major islands, Kingfisher and Melomys, and some smaller ones. Until recently they were known as the Wood Islands. All are composed of the Yampi Member of the Pentecost Sandstone, and have a typical sandstone geomorphology of abrupt hills with steep screes, narrow valleys, stony beaches and abrupt coastal cliffs with littoral mud in sheltered embayments. The substrate on the sandstone comprises jumbled boulders with small patches of shallow, skeletal soils.

Vegetation and Flora: Both islands support extensive low open woodlands of *Eucalyptus* spp., especially *E. miniata*, with local development of low closed shrubland in drainage channels. *Terminalia canescens*, *Acacia hippuroides*, *Cassia oligocarpa* and *Celtis philippensis* are common shrubs, with an understorey of *Ptilotus exaltatus*, *Amaranthus leptostachyus*, *Phyllanthus* spp. and other small shrubs. Steep scree slopes occur near the coast and these are vegetated with hummock grasslands of *Plectrachne danthonioides* and other grasses, with emergent *Acacia tumida*. Rocky outcrops and coastal slopes support scattered small trees of *Ficus leucotricha*, *F. opposita*, *Calytrix exstipulata* and other small shrubs. Mangrove formations are limited to narrow strips in sheltered areas.

Fauna: A brief survey by the Department of Fisheries and Wildlife in 1973 revealed the presence of a Mosaic-tailed Rat (*Melomys* sp.) on Melomys Island and the Water Rat (*Hydromys chrysogaster*) on Kingfisher Island. The islands were named after the Mangrove Kingfisher (*Halcyon chloris*).

Recreational Use and Potential: Their close proximity to Derby, and Koolan and Cockatoo

Islands, has induced several proposals for the construction of tourist facilities, but none has reached fruition. The mining facilities on Cockatoo Island have now been developed for tourism.

Key Features: The presence of *Melomys* and the Water Rat.

CTRC Recommendation: "The Kingfisher Islands are vacant Crown land and the Committee makes no recommendation concerning them."

EPA Recommendation: The EPA makes no recommendation on the Kingfisher Islands.

Our Recommendation: We recommend that the Kingfisher Islands be declared a Class C reserve for the conservation of flora and fauna, vested in the National Parks and Nature Conservation Authority.

4.8 KING LEOPOLD RANGES

Location: The King Leopold Ranges extend for some 300 km from Walcott Inlet in the north-west Kimberley to Margaret River about 100 km west of Halls Creek.

Map: 8.

Area: Vacant Crown land: approximately 10 500 ha. Undefined additional area.

Current Status: The former Bell Creek Station is vacant Crown land. The remainder of the area is pastoral lease, being part of Mt Hart Station.

Geomorphology: The Ranges form a high marginal abutment to the Kimberley Plateau Province to the north and overlook lower ranges and the Fitzroy Plains to the south-west. Elevations are up to 950 m above sea level and relief is up to 300 m.

The Ranges consist mainly of white to pale brown crossbedded quartz sandstone, intruded by dark grey dolerite, which provides a marked visual contrast on steep hillsides. Both the sandstone and the dolerite have resisted erosion more than adjacent siltstones and feldspathic sandstones, and have given rise to a rugged terrain with a characteristic hogback topography. Sides of valleys are generally steep and have only thin soil cover supporting sparse vegetation, or are nearly vertical with precipitous bare rock cliffs. As a result, panoramic views of ranges, valleys and plains are obtained from many scarps.

Vegetation and Flora: The Ranges support a low open woodland with eucalypt species dominant, especially Woollybutt (*E. miniata*) and *E. tectifica*. Other trees include Boab (*Adansonia gregorii*) *Lysiphillum cunninghamii*, *Erythrophleum chlorostachys*, *Terminalia*, *Buchanania*, *Hakea arborescens*, *Grevillea mimosoides* etc. In sheltered or watered valleys and along creeks the open-forest vegetation becomes more diverse, including *Eucalyptus* sp., screw pines (*Pandanus* sp.) fan palms (*Livistona* sp.), *Albizia lebbek*, etc. Bold Bluff is the only known locality for the cycad *Cycas furfuracea* and is the type locality for two species of restricted distribution, viz. *Acacia gracillima* and *Solanum leopoldensis*. Mt Bell is the only known locality for *Pityrodia obliqua*. The declared rare plant *Eucalyptus mooreana* occurs in this area.

Fauna: The fauna of the area is diverse. Mammals include the rare Rock Ringtail (*Pseudocheirus dahli*), Sugar Glider (*Petaurus breviceps*), a rock-wallaby (*Petrogale* sp.), Antelope Kangaroo (*Macropus antilopinus*), Euro (*Macropus robustus*), Water Rat (*Hydromys chrysogaster*) and the Brindled Bandicoot (*Isodon macrourus*) (Bannister 1969).

Recreational Use and Potential: Because of their proximity to Derby, the King Leopold Ranges have considerable potential to become a major tourist attraction. Access to most of the Ranges at present is restricted by difficulties in building roads across the trend of the steep ridges. A graded gravel "beef road" from Derby towards Gibb River Station provides good access to the central King Leopold Ranges near Mount Broome and Mount Ord, and a road from Fitzroy Crossing to Lansdowne Station exploits the gap where the Leopold River cuts through the Ranges.

Key Features: Represents some of the major ecosystems of the Fitzgerald Phytogeographic District. Spectacular ranges, diverse flora and fauna, high recreational potential.

CTRC Recommendation: "The area formerly covered by Bell Creek Station, centred about 17° 14'S, 125° 26'E, is close to the "beef road" mentioned above and is now vacant Crown land. This block, of about 10 500 ha, would serve as a useful nucleus for a National Park encompassing some spectacular scenery in the mid-section of King Leopold Ranges. If adjacent land on Mt Hart Station to the west-north-west becomes available it should be

investigated with a view to possible acquisition and addition to the proposed Park so as to include Mts Bell and Vincent, perhaps as far as Inglis Gap. South-east of Mt Bell the road makes an abrupt turn beneath a cliff more than 50 m high in which intensely folded and overthrust beds of massive sandstone are exposed. These provide a spectacular example of the effects of mountain building movements and rock-deformation.

Immediately south of the former Bell Creek Station, a massive sandstone outcrop 844 m above sea level forms Bold Bluff, an impressive landmark within the Ranges and, if possible, this area should be included in the proposed Park."

Recommendations:

"The Committee recommends that :

- a. the vacant Crown land formerly leased as Bell Creek Station be declared a Class B Reserve for the purpose of National Park and vested in the National Parks Authority of W.A.,
- b. if a suitable opportunity occurs, land adjacent to the south and west-north-west be acquired and added to the proposed National Park."

EPA Recommendation: "The EPA recommends that:

1. the vacant Crown land formerly leased as Bell Creek Station be declared a Class B National Park and vested in the National Parks Authority of W.A.;
2. should suitable opportunities occur, the Department of Lands and Surveys negotiate to acquire those parts of Mt Hart Station that lie adjacent to the south and west-north-west of this reserve, and which include Bold Bluff, Mt Bell, Mt Vincent and Inglis Gap."

Our Recommendation: We endorse the EPA recommendation, except that the proposed national park should be a Class A reserve. This small area, on its own, does not represent the major landforms and biota of the King Leopold Ranges, nor is it large enough for national park status. We recommend that the Kimberley Region Planning Study identify areas of Mt Hart Station that are not needed for pastoral pursuits and that they be referred to the Department of Conservation and Land Management for evaluation for addition to the reserve.

4.9 MITCHELL PLATEAU

Location: On the west side of Admiralty Gulf, 350 km north-east of Derby and 270 km west-north-west of Wyndham.

For descriptions of this area see *Biological survey of Mitchell Plateau and Admiralty Gulf*, W.A. Museum (1981).

Map: 19 and 20

Current Status: Vacant Crown land, some of which is subject to mining lease.

Geomorphology: The Mitchell River flows northwards, draining part of the Kimberley Plateau into Admiralty Gulf via Walmsley Bay. It is actively eroding its bed through King Leopold Sandstone, giving rise to gorges and waterfalls, especially along the margins of the basaltic Mitchell Plateau. Two of the most noteworthy features of this erosion are Mitchell Falls (14° 49'S, 125° 42'E) and Surveyors Pool and Falls (14° 40'S, 125° 43'E), each with a deep gorge downstream. East of the Plateau, two small rivers and the larger Lawley River complete the drainage pattern of the area. These rivers flow into the bay towards Port Warrender through broad mangrove swamps.

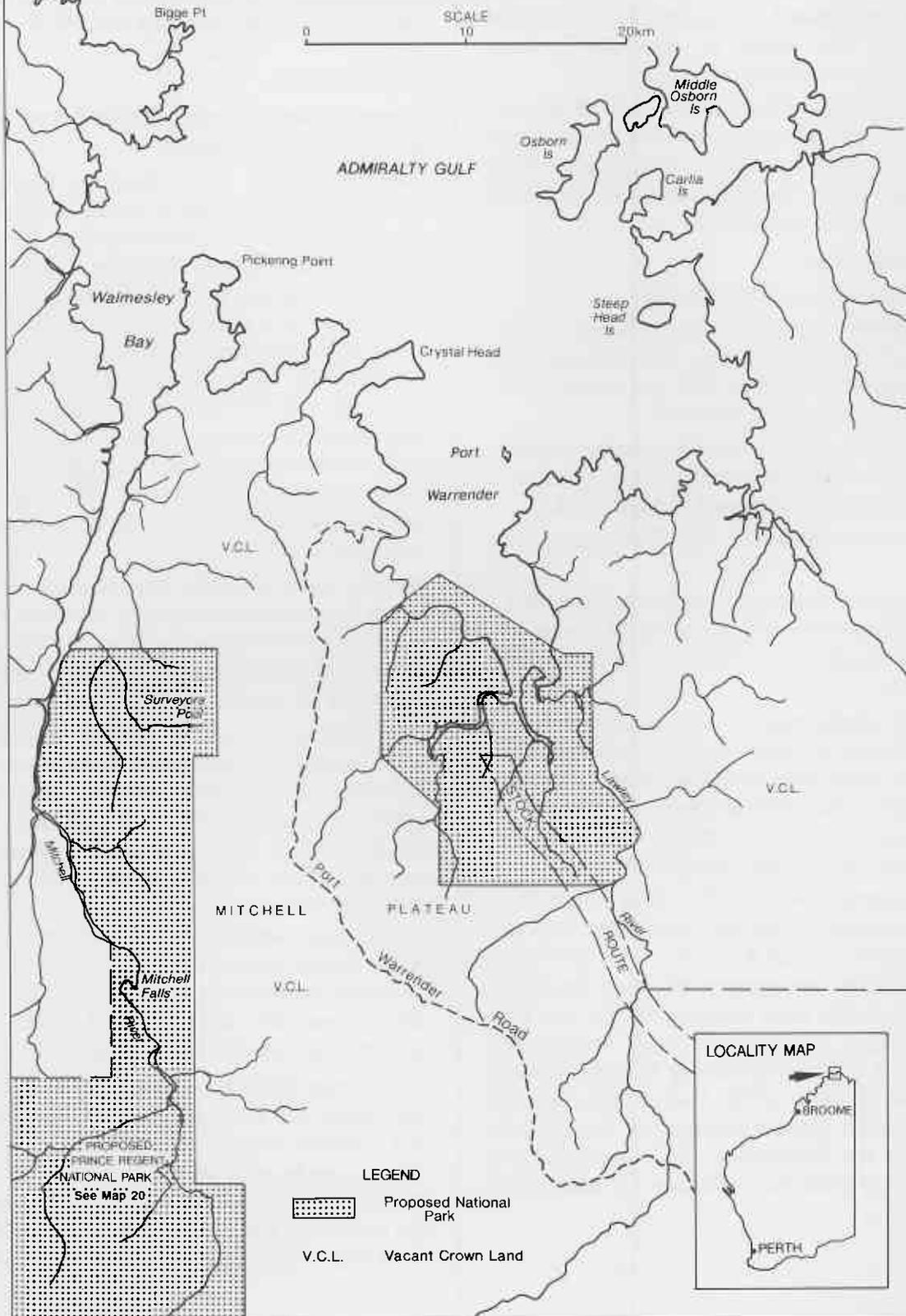
Near the watercourses the sandstone has weathered into a harsh blocky topography with sparse soil in joint cracks and narrow gullies. This in turn has restricted the height and distribution of vegetation, increasing the scenic impact of bare rock gorges.

The Mitchell Plateau is a dissected undulating upland underlain by dark basalt of Proterozoic Carson Volcanics (Wilson 1981). Leaching has produced a bauxitic laterite profile over large areas of the basalt, although only a few eroded remnants now remain. Much of this bauxitic laterite contains sufficient aluminium to make it a potentially valuable commercial source of that metal. The edge of the basaltic plateau is typically precipitous, with steep talus slopes beneath vertical cliff faces. These slopes, especially where shaded from westerly sunshine, are heavily vegetated with vine thickets.

The Carson Volcanic country has an undulating topography with generally gentle soil-mantled slopes and dendritic drainage. Near the coast, prominent terraces can be seen on the headlands. In places, volcanic scree occur below cliffs and terraces. To the east of the Mitchell Plateau, the Lawley River flows into a large estuary with extensive mudflats.



PROPOSED LAWLEY RIVER NATIONAL PARK



MAP 19

Vegetation and Flora: The vegetation of the area was described by Hnatiuk and Kenneally (1981).

The plateau itself is covered with an open-forest dominated by *Eucalyptus tetrodonta*, *E. miniata* and *E. nesophila*, with some *Erythrophleum chlorostachys* and *Terminalia canescens*. The fan-palm *Livistona eastonii* is very common in the understorey, and this is the only locality in the State where palms are such a dominant feature. Shrubs in the understorey include *Cochlospermum*, *Grevillea* spp., *Personia*, *Gossypium* and *Petalostigma*, and there is a ground layer of grasses such as *Sorghum*, *Heteropogon contortus* and *Chrysopogon latifolius* (Beard 1976).

Patches of rainforest occur on lateritic gravel and rocky basalt slopes around the edge of the plateau. Trees of many genera occur here, including *Albizia*, *Atalaya*, *Canarium*, *Micromelum*, *Vitex*, *Wrightia* and *Zizyphus*. There are lianes such as *Flagellaria*, *Operculina* and *Pisonia*. The floristic relationships of the formation are Indo-Malesian rather than Australian. Similar patches occur at lower levels below the plateau, but are somewhat different floristically, containing genera such as *Bauhinia*, *Terminalia*, *Cassine*, *Diospyros* and *Turraea*. Rainforest is of restricted occurrence in Western Australia and the areas at Mitchell Plateau are among the best available for reservation.

Below the plateau, on sandstone, the vegetation changes markedly. It is mostly a woodland or low woodland, with fringing formations along the perennial watercourses. Common trees in the woodland are *Eucalyptus*, *Terminalia*, *Gardenia*, *Planchonia*, *Grevillea*, *Hakea*, *Petalostigma* and *Acacia*. Very tall annual grasses are dense in places. Along and near the watercourses *Melaleuca viridiflora*, *Gardenia* species, *Xanthostemon paradoxus*, *Ficus platypoda*, and many small herbs such as *Strylidium* and *Utricularia* are found. On wet cliffs, as at Surveyors Falls, there are ferns, including *Nephrolepis*, *Ceratopteris* and *Lygodium*. At Mitchell Falls is a population of *Tristicha trifaria*, an unusual submerged aquatic plant which grows in fast-flowing water. *Ondinea purpurea*, a little-known aquatic, grows in sandy-bottomed creeks.

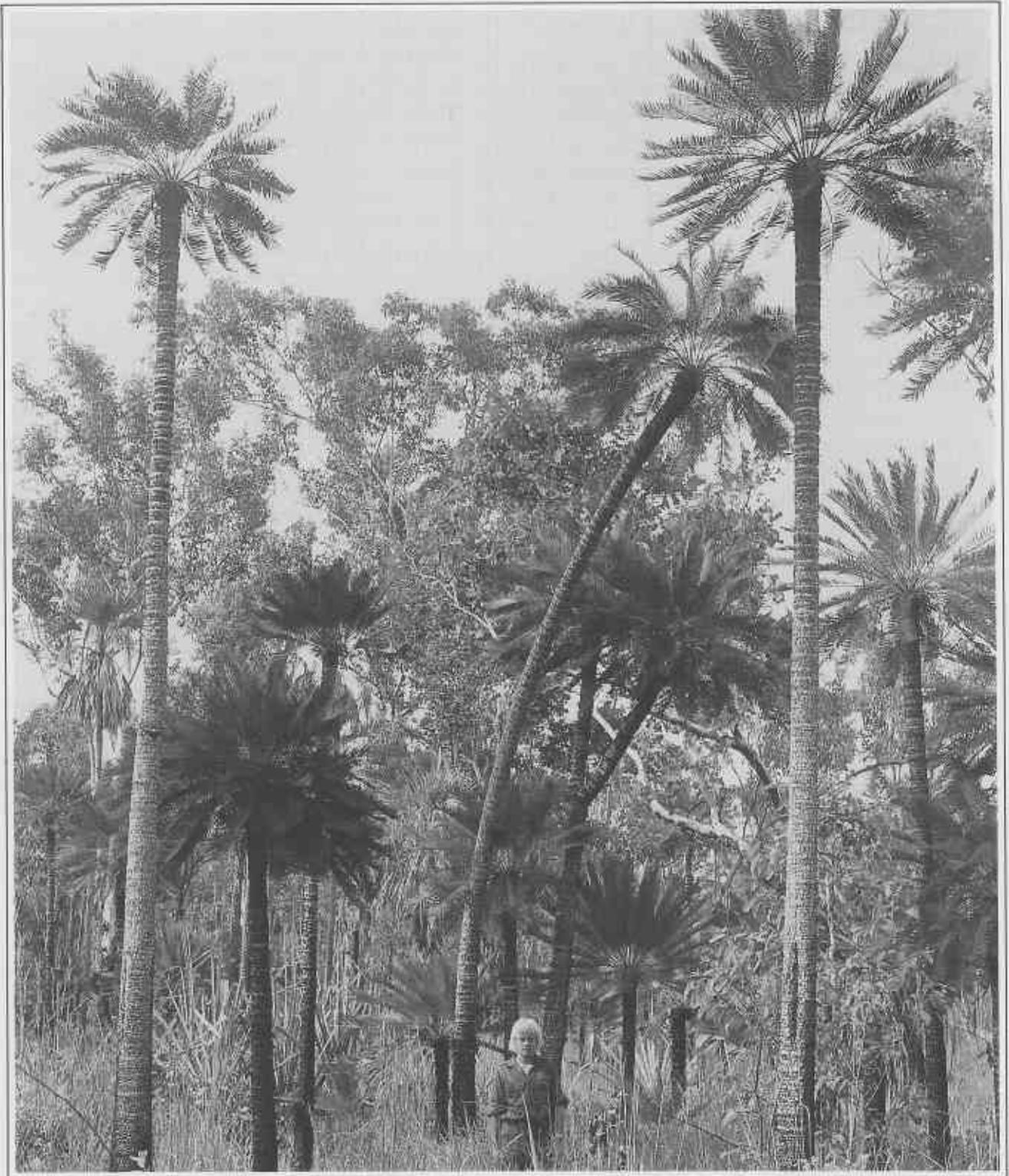
Extensive areas of mudbanks and mangroves are found in the Lawley River estuary. The dominant riverside community is a mixed low closed forest of *Avicennia marina* and *Rhizophora stylosa*. Thickets of *Ceriops tagal* var. *australis* form the more landward extension of the mangrove community. In two

tidal creeks adjacent to the main river is a mixed low closed forest of *Avicennia marina*, *Camptostemon schultzei* and *Rhizophora stylosa*. Pioneer communities of *Sonneratia alba* and the other more common species are located at the mouth of the creeks on extensive shelving mudbanks (Wells 1981).

Fauna: Following recent surveys, mainly by the W.A. Museum, the fauna of the area is comparatively well-known. Thirty-nine species of mammals have been recorded, the largest number known from any area of similar extent in Western Australia. Some species that are known from few other localities in the Kimberley include Warabi (*Petrogale burbidgei*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Red-cheeked Dunnart (*Sminthopsis virginiae*), Carpentarian Dunnart (*Sminthopsis butleri*), Scaly-tailed Possum (*Wyulda squamicaudata*), Brush-tailed Tree-rat (*Conilurus penicillata*), Black-footed Tree-rat (*Mesembriomys gouldii*), the mouse (*Pseudomys laborifex*), Orange Horseshoe Bat (*Rhinonicteris aurantius*) and Pygmy Long-eared Bat (*Nyctophilus walkeri*) (Kitchener et al. 1981). Recent work has shown that mangroves are an important mammal habitat, especially for bats and the Northern Brushtail Possum (*Trichosurus arnhemensis*).

Within a 20 km radius of Surveyors Pool, 92 non-passerine and 69 passerine species of birds have been recorded (Johnstone and Smith 1981). The vine forest is an important habitat for such species as the Rainbow Pitta (*Pitta iris*), Torres Strait Pigeon (*Ducula spilorrhoa*), Figbird (*Sphecotheres flaviventris*), Cicada Bird (*Coracina tenuirostris*) and Koel (*Eudynamis scolopacea*). In the mangroves around Port Warrender, 10 species of mangrove birds have been recorded, and 20 species of waders and terns were noted around mangroves and on mudflats. The rugged sandstone areas are inhabited by such species as the Black Grass Wren (*Amytornis housei*), White-quilled Rock Pigeon (*Petrophassa albipennis*) and Lavender-flanked Wren (*Malurus dulcis*). The plateau itself is a less important bird habitat, except for the Northern Rosella (*Platycercus venustus*), which is more common here than anywhere else on the Kimberley mainland.

The reptile and frog fauna is similar to that of the Prince Regent Nature Reserve, except for the occurrence at Mitchell Plateau of the tree frog (*Litoria microbelos*), the dragon lizard (*Diporiphora convergens*) and the Rough-scaled Python (*Morelia carinata*) (Smith and Johnstone 1981).



The cycad, Cycas armstrongii, grows on seasonally inundated areas near the Mitchell River.

A variety of endemic land snails belonging to the genera *Torresitrachia*, *Amplirhagada*, *Setobaudinia*, *Baudinella*, and *Rhagada* are restricted to the Mitchell Plateau (Solem 1979, 1981, 1985).

Recreational Use and Potential: The main scenic attraction of the area is the Mitchell River and its tributaries, deeply incised into sub-horizontal sandstone, with waterfalls and permanent pools. The sharp edge of the basaltic Mitchell Plateau forms an impressive backdrop to the east. The palm community of the Plateau is an unusual feature in Western Australia. The rainforest patches are also of interest.

This is the only place along the north-east Kimberley coast between Yampi Peninsula and Kalumburu where there is road access to the coast for the general public, at least in the dry season. The mining company's main track from the Mitchell Plateau runs through Mitchell River Station, to join the Kalumburu-Gibb River-Derby road to the east. A few rough tracks made during mineral exploration are the only routes from the Plateau to the hilly sandstone lowlands to the west. There are now regular "safari tours" to the area.

The area has enormous potential for national park development, including tourism.

Key Features: The importance of the proposed Lawley River national park is mainly the richness and diversity of its rainforests and mangroves. The proposed national park on the west side of the plateau represents sandstone environments, and it includes the spectacular Mitchell Falls. Both have extensive areas of volcanic country and include some of the laterite plateau. The Park boundaries were chosen to avoid areas with commercial bauxite deposits.

Mitchell Falls has the potential to become one of Australia's greatest tourist attractions.

CTRC Recommendation: "Both this (the Lawley River area) and the proposed Mitchell River National Park are so far from the bauxite occurrences that no conflict of interests is likely to arise. Port Warrender, the planned port for any mining operations, the probable railway, road and mining plant sites are outside the proposed reserves. Although bauxite occurs extensively on the plateau and adjacent isolated hills, variations in quality of the ore, difficulties of access and the small size of some deposits will ensure that some areas will remain unmined, so that tracts of the unusual palm forest

growing on the laterite will be preserved. These tracts, and the fragile vine thickets below the plateau edges, will need to be protected from the possibility of erosion arising in adjacent mining areas. The mining company is already considering rehabilitation processes for worked-out areas, including experimentation with regrowth of tree species, and should be encouraged and assisted where necessary.

As access will almost certainly have to be through Mitchell River Station and the probable future mining lease, it is essential that frequent liaison be maintained between the reserve authority and the mining company. It is recognised that some measure of control of tourists' activities may be necessary during certain phases of a mining operation".

Recommendations. "The Committee recommends that:

- a. the leaseholders of Mitchell River Station (who are also the company intending to mine the bauxite) be approached by the EPA with the request that they relinquish the portions of their pastoral lease and mineral tenement as indicated in Fig. 7.7;
- b. the land mentioned in a. and the vacant Crown land also indicated in Fig. 7.7 be declared a Class B Reserve for the purpose of National Park and vested in the National Parks Authority of W.A."

EPA Recommendation: "The EPA recommends that:

1. The Department of Lands and Surveys request the leaseholder of Mitchell River Station to relinquish those portions of the pastoral lease that fall within the boundary of the proposed reserve;
2. The areas of land contained within the boundaries outlined in Fig 7.7 be set aside as a Class B Reserve for the purposes of National Park and Water and be vested in the National Parks Authority. The boundary of the eastern area should extend to low water mark;
3. The mineral tenement holders be approached with the request to relinquish those tenements within the reserve area, and that their area be included within the reserve."

Our Recommendation: There have been recent negotiations between the Government and the company owning the mineral tenements and the pastoral lease. The mining company has agreed to



Fire in fan palm (Livistona eastonii) community, Mitchell Plateau.



Marine biologists collecting on Montgomery Reef at low tide.

forfeit areas from its tenements and pastoral lease to allow the creation of the national parks; however, the agreed boundaries differ slightly from the CTRC recommendation. The proposed new boundaries are shown in Map 19.

We recommend that the western area, along with the Hunter River area (Area 4.6), be added to the Prince Regent Nature Reserve and the whole area be declared a Class A national park vested in the National Parks and Nature Conservation Authority.

We recommend that the eastern area be declared a Class A national park vested in the National Parks and Nature Conservation Authority and that it be named the Lawley River National Park. We further recommend that the waters adjacent to this park be declared a Class A marine national park vested in the National Parks and Nature Conservation Authority.

4.10 MONTGOMERY ISLANDS AND REEF

Location: In Collier Bay, 60 km east-north-east of Koolan Island.

Map: 3.

Area: Not known.

Current Status: The Montgomery Islands and the adjacent High Clifty Islands are part of Reserve 23079 for the Use and Benefit of Aborigines. The surrounding reef is vacant Crown land.

Geomorphology: High Clifty Islands are composed of sandstone, probably Pentecost Sandstone and Siltstone, which contain one of the best examples in the State of Precambrian stromatalites, known as Conophyton. The Montgomery Islands are composed of Quaternary alluvium, with surrounding sandflats and coral reef.

Vegetation and Flora: The Montgomery Islands are vegetated with mangroves. They are surrounded by shallow sandy banks with seagrass. The vegetation of High Clifty Islands is a mixture of sandstone and vine thicket elements with some *Sorghum* and *Heteropogon contortus* grasslands on the flat sandstone pavements. Tree species include *Eucalyptus perfoliata*, *Adansonia gregorii*, *Terminalia petiolaris* and *Gyrocarpus americanus*. Scramblers such as *Flagellaria indica*, *Passiflora foetida*, *Xenostegia tridentata* and *Operculina brownii* are very common.

Fauna: The seagrass beds are an important feeding place for Dugongs (*Dugong dugon*) and support an excellent example of the rich invertebrate marine fauna distinctive of the Kimberley coast. The fauna of the coral reef has not been examined.

Recreational Use and Potential: The area is visited by people from Koolan and Cockatoo Islands and by charter boats.

Key Features: The seagrass beds, coral reef and associated marine fauna.

CTRC Recommendation: None.

EPA Recommendation: None.

Our Recommendation: We recommend that the waters surrounding the Montgomery Islands be declared a Class A marine park. We also recommend that negotiations take place between the Department of Conservation and Land Management, relevant Aboriginal communities and the Aboriginal Lands Trust, with the view to including the Montgomery Islands in the marine park.

4.11 PRINCE REGENT NATURE RESERVE

Location: About 250 km north-east of Derby and 300 km west of Wyndham.

Map: 20.

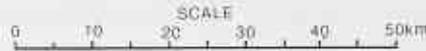
Area: About 635 000 ha.

Current Status: Class C Reserve 27164 for the Conservation of Flora and Fauna vested in the National Parks and Nature Conservation Authority.

Geomorphology: The Reserve lies largely within the Prince Regent Plateau, a sub-province of the Kimberley Plateau Province (Williams and Sofoulis 1971). The Plateau consists of Carpentarian King Leopold Sandstone, while to the west of St George Basin (the estuary of the Prince Regent River) is Warton Sandstone overlying Carson Volcanics. The Basin itself contains extensive tidal flats of Quaternary alluvium. Quaternary alluvial deposits also occur on erosional plains on the plateau. North-east of the Roe River is a hilly region of Carson Volcanics capped in places with Tertiary laterite. While much of the area has a relatively monotonous, low relief of sandstone and volcanic hills, there are spectacular features such as King Cascade, Pitta Gorge, Mt Trafalgar, Python Cliffs and the Prince Regent River itself, which runs straight for most of its length, often between rugged near-vertical cliffs.

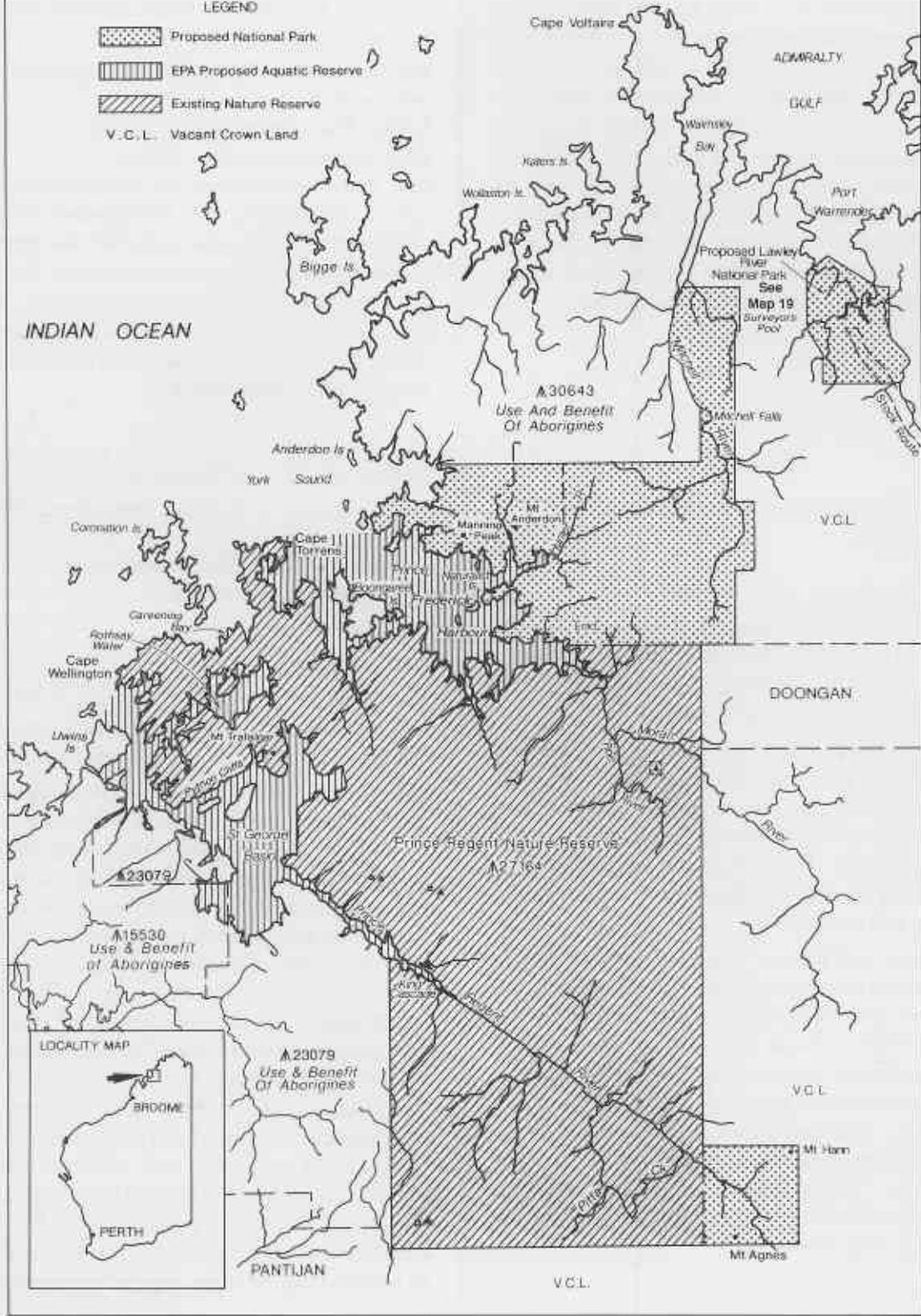


PROPOSED PRINCE REGENT NATIONAL PARK



LEGEND

-  Proposed National Park
-  EPA Proposed Aquatic Reserve
-  Existing Nature Reserve
- V.C.L. Vacant Crown Land



MAP 20

Vegetation and Flora: The vegetation consists mainly of closed forest, open forest, woodland, open woodland, tall shrubland and closed grassland (George and Kenneally 1975). *Eucalyptus* species are generally the dominant trees, often with a mixture of species of *Celtis philippensis*, *Canarium australianum*, *Buchanania obovata*, *Owenia vernicosa*, *Ficus* spp., *Erythrophleum chlorostachys*, *Gardenia* spp., *Planchonia careya* and others. In fringing formations along watercourses, *Melaleuca leucadendra*, *M. argentea*, *Pandanus spiralis* and *Eucalyptus* species are common. Grasses and sedges are dominant in the ground flora and, in some swamps, form the principal cover when trees and shrubs are absent. Several small but important pockets of rainforest, occurring as semi-deciduous vine thicket, grow on screes around St George Basin and Mt Trafalgar. Mangroves cover extensive areas on tidal flats, especially in St George Basin and Rothsay Water, these being the second largest blocks of mangle in the State.

Over 500 species of plants have been recorded from the reserve, including both common and rare species. Fan Palms (*Livistona loriphylla*) are common in restricted localities and several large populations of *Cycas basaltica* occur on stony slopes directly behind the beach at Careening Bay. Streams and swamps are rich in aquatic and swamp plants.

Fauna: Thirty-six species of native mammals are known from the reserve (McKenzie *et al.* 1975). This is nearly two-thirds of the total number of species recorded for the Kimberley and is particularly high for a single reserve. Macropods, bandicoots and rodents are well represented and there is a diverse assemblage of bats. The mammals include at least three species of rock-wallaby (*Petrogale brachyotis*, *P. burbidgei* and *Peradorcas concinna*), the Rock Ringtail Possum (*Pseudocheirus dahli*), the Scaly-tailed Possum (*Wyulda squamicaudata*), the native mouse *Pseudomys laborifex* as well as the mangrove bat *Pipistrellus westralis*.

One hundred-and-sixty species of birds, about half of the total known from the Kimberley, have been recorded in the reserve. Most represent the sub-humid avifauna of north-western Kimberley, which is also typical of the "Top End" of the Northern Territory, e.g. Scrub Fowl (*Megapodius reinwardt*) and Torres Strait Pigeon (*Ducula spilorrhoa spilorrhoa*) (Storr *et al.* 1975, Burbidge and Fuller 1979). Several dry-country birds are known from the inland sandstone plateau, e.g. the Diamond Dove (*Geopelia*

cuneata). The rare Black Grass-wren (*Amytornis housei*) occurs in various areas of the reserve, and one of only two records of the King Quail (*Coturnix chinensis lineata*) from Western Australia is from a locality in the Prince Regent Nature Reserve.

The frogs (13 species) and reptiles (54 species) are also typical of the north-west Kimberley and the north of the Northern Territory (Storr and Smith 1975). Torresian genera are well-represented, but Eremaean are not. Some taxonomic divergence from populations in the Northern Territory appears and *Diporiphora bilineata margaretae* and *Carlia johnstonei johnstonei*, for example, are both represented by other sub-species in the Northern Territory. The spectacular green lizard *Diporiphora supberba* occurs in the reserve and is restricted to the north-west Kimberley.

Recent work on the Saltwater Crocodile (*Crocodylus porosus*) in the Kimberley has shown that the Prince Regent Nature Reserve has an important role to play in the survival of this species (Messel *et al.* 1977, Burbidge and Messel 1979, Messel *et al.* 1987). Of the rivers surveyed, the best and fastest recovering populations were found in the Roe River, the Prince Regent River and St George Basin. These areas offer a much better chance for a build-up in crocodile numbers than do other areas in the State. *C. porosus* inhabits both fresh and salt water but, in Western Australia, is concentrated in the tidal portions of large rivers where mangroves are plentiful. It also occurs in bays and occasionally in the ocean, but most of the time crocodiles are sighted in shallow water. As it exists at present, the Prince Regent Nature Reserve does not protect all the habitat of Saltwater Crocodiles. Such protection could be afforded by declaring marine parks in Prince Frederick Harbour and St George Basin. This would also protect the habitat of other marine organisms occurring adjacent to the existing terrestrial Nature Reserve.

Fourteen species of fish have been recorded in fresh rivers and streams, and a further twenty-one species in the brackish inlet below King Cascade (Allen 1975). Most are widespread in tropical Australia, some extending to other countries. The Large-scale Grunter (*Leiopotherapon macrolepis*) is known only from the Reserve.

Non-marine molluscs are represented by 26 species of land snail, a freshwater snail and two species of fresh water mussels (Wilson and Smith 1975). The land snails are predominantly camaenids. More



Kings Cascade on the Prince Regent River.



*The cycad, *Cycas basaltica*, on stony slopes directly behind the beach at Careening Bay.*

recent studies by Alan Solem (1979, 1981, 1985, pers. comm.) indicate that the genera *Retroterra*, *Kimboraga*, *Hadra* and *Baudinella* have their centres of diversity in this area, and that restricted endemic species of the wide-ranging genera *Torresitrachia*, *Amplirhagada*, *Setobaudinia* and *Xanthomelon* are numerous. Almost no camaenid species are shared between the Mitchell Plateau area and the Prince Regent Nature Reserve.

There is a large insect fauna typical of the region but also containing little-known and undescribed species, e.g. of *Anax* (Odonata, dragonflies) and *Simulium* (Diptera, flies) (Bailey and Richards 1975).

Recreational Use and Potential: Some of the coastal scenery is very attractive and it is receiving increased attention from private and charter boats. The abundant Saltwater Crocodiles are an added feature. There has been some interest in bushwalking. There is no road access and construction and maintenance would be very costly. At present the Reserve is a Prohibited Area under the Wildlife Conservation Act and a permit is necessary to enter. CALM policy is to seek liaison with the Mowanjumb Aboriginal Community before issuing permits for other than coastal access because of the large number of sacred sites in the reserve. There is no management presence, but CALM is seeking money to construct a field station near Mt Waterloo.

We believe that future intensive recreational use should be directed to the proposed Mitchell Plateau National Park, where road access already exists and the scenery is comparable. Recreational use of the Prince Regent Nature Reserve should be restricted to the coast and to bushwalking under strict permit-only conditions.

Key Features: The Prince Regent Nature Reserve is representative of the sub-humid north-west Kimberley flora and fauna and contains most of the north-west Kimberley endemics. It is one of only two Biosphere Reserves in Western Australia. It contains populations of threatened mammals (e.g. Golden Bandicoot) and includes the only patches of rainforest currently within a conservation reserve. It has the best populations of Saltwater Crocodile in Western Australia and St George Basin includes the second largest areas of mangrove in the State.

An important historical site exists at Careening Bay. This is the "Mermaid Tree", a large Boab

carved by the crew of *H.M.C. Mermaid*, the vessel used by Phillip Parker King to carry out hydrographic surveys of the northern coasts of Australia from 1818 - 1820. King was accompanied by the botanist Allan Cunningham and the reserve is an important locality for botanists because of the large number of new species that were described from collections he made.

CTRC Recommendation: "The Committee considers that, although the Reserve is already large and representative of the region, it should be expanded to include several adjacent features. To the east, Mt Hann and Mt Agnes, two isolated mountains reaching over 820 m and 740 m in height respectively, lie in vacant Crown land. Between them, on an upper tributary of the Prince Regent River, is a deep gorge. The addition of this area would have these advantages:

1. it would protect the complete catchment of the Prince Regent River and greatly reduce the risk of pollution should adjacent areas be utilised. This is important in view of the extensive system of streams and rivers forming the river basin, and the dependence of so many plants and animals on them;
2. it would add an area of unique scenery to the reserve."

Several islands which supplement the Reserve biologically lie off the coast and in the St George Basin. St Andrew and St Patrick Islands in St George Basin, and Uwins and Greville Islands at the entrance to the Basin, are Aboriginal Reserves. However Bat, Boongaree and the Coronation Islands are vacant Crown land. They are described in Section 7.2. "Within the Nature Reserves are three other reserves (Numbers 8243, 8248 and 8252 of 405, 405 and 1215 ha respectively) which were declared prior to the creation of the Prince Regent Nature Reserve. All are Class C, their purpose being Water-Travellers and Stock. There seems to be no reason why they should not be included in the Reserve."

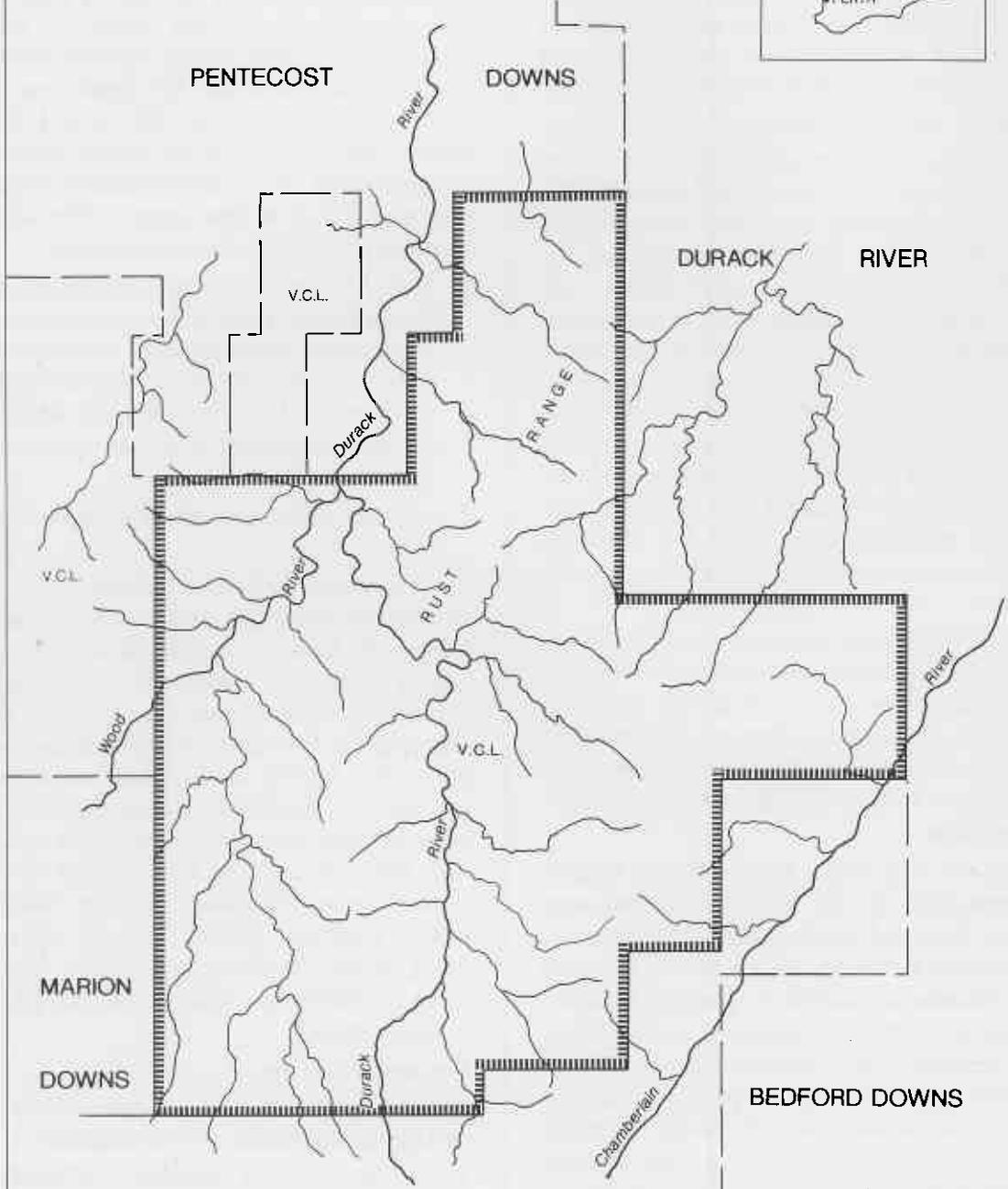
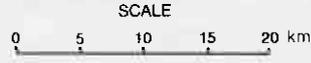
Recommendations.

"The Committee endorses the purpose and vesting of Reserve No. 27164. It recommends:

- a. that the reserve be upgraded to a Class B Reserve.
- b. that Aquatic Reserves be declared to include:
 - (a) Prince Frederick Harbour seaward to Cape Torrens and the unnamed cape south of the



RUST RANGE



LEGEND

- V.C.L. Vacant Crown Land
- Proposed Survey Area

MAP 21

- Anderdon Island; and
- (b) St George Basin seaward to Uwins Island and Cape Wellington, including Rothsay and Munster Waters;
- c. that the area around Mt Hann and Mt Agnes as designated in Fig. 7.5 be added to the reserve;
- d. that Coronation, Bat and Boongaree Islands be added to the reserve;
- e. that Reserves Nos. 8243, 8248 and 8252 be cancelled and their area added to Reserve No. 27164;
- f. that the W.A. Wildlife Authority, in consultation with the National Parks Authority, prepare a management plan for the reserve, taking into account increasing public interest in the area."

EPA Recommendation:

"The EPA recommends that:

1. the classification of Reserve 27164 be amended to Class B;
2. the purpose of the reserve be Conservation of Flora and Fauna and Water;
3. the area of vacant Crown land containing Mt Hann and Mt Agnes, as outlined in Fig 7.5, be added to the reserve;
4. the area of vacant Crown land to the north of the reserve and as indicated in Fig 7.5, be added to the reserve;
5. Reserves 8243, 8248 and 8252 be cancelled and their area added to Reserve 27164;
6. should the islands of the Augustus group and those within St George Basin no longer be required as Aboriginal Reserve, they be set aside for the purpose of Conservation of Flora and Fauna;
7. Bat Island, the Coronation Islands, Boongaree Island and the other islands within Prince Frederick Harbour be added to Reserve 27164 - Prince Regent River Wildlife Sanctuary;
8. Aquatic Reserves be declared to include:
 - (a) Prince Frederick Harbour seaward to Cape Torrens and the unnamed cape south of the Anderdon Islands, and
 - (b) St George Basin seaward to Uwins Island and Cape Wellington, including Rothsay and Munster Waters;
9. the aquatic reserves extend from high water mark;

10. the aquatic reserves be classified as Class A reserves and vested in the WA Wildlife Authority;
11. the WA Wildlife Authority, in consultation with the National Parks Authority, prepare a management plan for Reserve 27164, taking into account increasing public interest in the area.

Our Recommendation: We recommend that the reserve be amended to national park and that the vesting remain with the National Parks and Nature Conservation Authority. We endorse EPA recommendations b, c, d and e. We recommend that Recommendation a be changed, to the extent that the reserve should be Class A. The aquatic reserves recommended in b should be Class A marine national parks vested in the National Parks and Nature Conservation Authority.

||||||| 4.12 RUST RANGE

Location: About 200 km south-west of Kununurra. Formerly known as the Bluff Face Range.

Map: 21.

Area: About 323 000 ha.

Current Status: Vacant Crown land.

Geomorphology: The upper catchment of Durack River lies in a large area of vacant Crown land, surrounded by pastoral leases. Much of it is a gently undulating and monotonous plateau, but there are many seasonal streams and, along the larger watercourse, permanent pools. Most of the area is covered by the Late Precambrian Pentecost Sandstone, but there are small areas of sandy alluvium. In places, the streams have carved out picturesque gorges, and the southern end of the Rust Range lies across the area. Average annual rainfall is about 650 mm.

Vegetation and Flora: Low woodland with a grassy understorey occupies extensive tracts. *Eucalyptus tetradonta*, *E. phoenicia*, *E. dichromophloia* and *E. miniata* are the dominant trees, with *Plectrachne pungens* common as ground cover. Along drainage lines the vegetation often increases little in density, though the species composition changes. Orange Grevillea (*Grevillea pteridifolia*) and Boab (*Adansonia gregorii*) are characteristic species. An important occurrence is that of fan palms (*Livistona* sp.) in some gorges. Two species of *Livistona* occur in the area.



Fauna: The fauna of the area has not been studied.

Recreational Use and Potential: No current use known. Major use in the foreseeable future unlikely because the area is not scenically spectacular and is off the major tourist routes.

Key Features: Insufficient data to define. There are no reserves representing ecosystems of the driest southern interior of the Kimberley Basin.

CTRC Recommendation: At present there is no conservation reserve in the east-central Kimberley. The area in question lies midway between the wet north-west and the semi-arid south-east Kimberley. A reserve here would increase the conserved representation of Kimberley biota. Information is at present insufficient for a definite recommendation to be made, but no development of the area should be allowed until a biological survey has been carried out.

Recommendations: "The Committee recommends that:

- a. the Environmental Protection Authority arrange for a biological survey to be carried out in the area shown in Fig. 7.13 to determine its conservational value;
- b. the cooperation of the Department of Lands and Surveys be sought to ensure that the views of the Environmental Protection Authority be obtained prior to any land release, pending completion of the survey referred to in a above."

EPA Recommendation: "The EPA recommends that:

1. the Department of Fisheries and Wildlife, Western Australian Museum and Western Australian Herbarium make a biological survey of the Bluff Face Range area with a view to recommending to the EPA the creation of a reserve;
2. the Department of Lands and Surveys, pending the outcome of this biological survey, refer all applications for release of this land to the EPA."

Our Recommendation: We endorse the EPA recommendation. The biological survey should be coordinated by the Biological Surveys Committee. The Department of Land Administration has replaced the Department of Lands and Surveys.

4.13 SIR GRAHAM MOORE ISLANDS

Location: A group of islands located off Anjo Peninsula at the northern end of Napier Broome Bay about 40 km north of Kalumburu.

For a description see Burbidge and McKenzie (1978).

Map: 4.

Area: See under 'Geomorphology'.

Current Status: Vacant Crown land.

Geomorphology: The group comprises two small islands - Scorpion (approx. 350 ha) and Kim (approx. 15 ha) - as well as Sir Graham Moore Island itself (2 660 ha). Sir Graham Moore is a King Leopold Sandstone island. The western four-fifths has a low profile and is mostly covered with sandy soil. At the eastern end is a mesa, capped by laterite. The two sections are joined by a narrow sandy isthmus.

Vegetation and Flora: An open woodland of *Eucalyptus miniata*, *E. bleeseri* and *E. papuana* covers most of the island. Shrubs of *Pouteria sericea*, *Acacia stigmatophylla* and *Terminalia canescens* above *Plectrachne pungens*, *Heteropogon* and *Cymbopogon* form scattered areas of low open shrubland. Wide crevices, where sandstone is exposed, support *Pandanus* sp., *Eucalyptus* spp., *Owenia vernicosa* and *Ficus platypoda* over hummock grasslands. Extensive areas of swamp supporting a closed sedgeland of *Fuirena ciliaris* surrounded by low closed forests of *Melaleuca viridiflora* occur in the western portion of the island. *Xyris complanata* and *Styidium multiscapum* commonly occur in these wetlands.

Sandy areas at the eastern end of the island have a low open shrubland of *Pouteria sericea*, *Grevillea* sp., *Banksia dentata* and *Pandanus* with hummock grasslands.

The flat laterite plateau of the mesa is covered with an open *Eucalyptus* woodland over hummock grasses. *Acacia gonocarpa* and *Acacia translucens* occur as scattered low open shrublands. The laterite scree slopes of the mesa are covered with a low open or low closed shrubland, with some areas of *Pandanus* and *Adansonia gregorii*.

Fauna: The most interesting faunal element is the Mosaic-tailed Rat (*Melomys* sp.). Unfortunately, pigs have become established and are damaging the vegetation and soils, especially in swamps and creeks. Recently attempts to eradicate the pigs have been conducted by the Agriculture Protection Board as part of the brucellosis control campaign. Water Rats (*Hydromys chrysogaster*) also occur there. King Brown Snakes (*Pseudomys australis*) are common. The skink (*Ctenotus tantallis*) has been found on no other Kimberley island.

Recreational Use and Potential: None.

Key Features: Sir Graham Moore is a large island with a population of Mosaic-tailed Rats. It is by far the largest of very few islands in the Kimberley with lateritic surfaces.

CTRC Recommendation: "Sir Graham Moore Island is vacant Crown land but the Committee does not consider it worthy of reservation at this time."

EPA Recommendation: None.

Our Recommendation: We recommend that Sir Graham Moore Islands be declared a Class C Nature Reserve vested in the National Parks and Nature Conservation Authority.

4.14 WALCOTT INLET AREA

Location: Situated 150 kilometres north-east of Derby, the Walcott Inlet area includes the country south from the mouth of the Sale River to the King Leopold Range. It includes Walcott Inlet, which extends for about 30 km in an east-west direction from Collier Bay and is up to 11 km wide.

Map: 22.

Area: About 215 000 ha.

Current Status: At present, the entire Inlet is surrounded by vacant Crown land except at its eastern end, where Pantijan Station is leased by the Federal Government on behalf of the Aborigines of the Mowanjum community, and the land between the Isdell and the Charnley Rivers (eastward to 125° 00'E latitude), which is a pastoral lease.

Geomorphology: Walcott Inlet is the broad, shallowly drowned valley of a river that, in a previous era, followed a structural joint between Carson

Volcanic and King Leopold Sandstone strata. Thus there are contrasting landforms on either side of the Inlet.

To the north and north-east, there are undulating lowlands, with dendritic drainage off the gentle slopes of the isolated hills and ridges (typical volcanic country). These lowlands are overlooked by a sheer escarpment, the southern margin of a Warton Sandstone plateau stretching northward towards Doubtful Bay.

To the south of the Inlet are rugged, boulder-strewn valleys and ranges of King Leopold Sandstone.

Tidal mudflats, up to five kilometres wide, fringe the central and eastern parts of the Inlet and are variably inundated by the tides, which have an average effective rise and fall of 11 metres. Around the landward edge of the mudflat there are extensive alluvial plains, including areas of dark alluvial soils, occasional large fresh water lagoons and, where small streams flow out of the sandstone, small swampy areas of deep, sandy soil stained by organics.

Rock slopes rise steeply from the mangroves and rocky shores at the mouth of Walcott Inlet, terminating in a plateau which in places is bordered by cliffs. Here, the Warton and Pentecost Sandstones overlie the Carson Volcanics and produce a similar topography to that of King Leopold Sandstone. King Leopold Sandstone also forms the Artesian Range, between the Isdell and Charnley Rivers, east of Walcott Inlet. Dark grey Hart Dolerite intrudes all these rock types and produces a characteristic black bank on many hillsides where scree slopes have been produced by weathering. The sandstones, in particular, yield an angular, blocky scree when weathered, providing excellent shelter for many small animals.

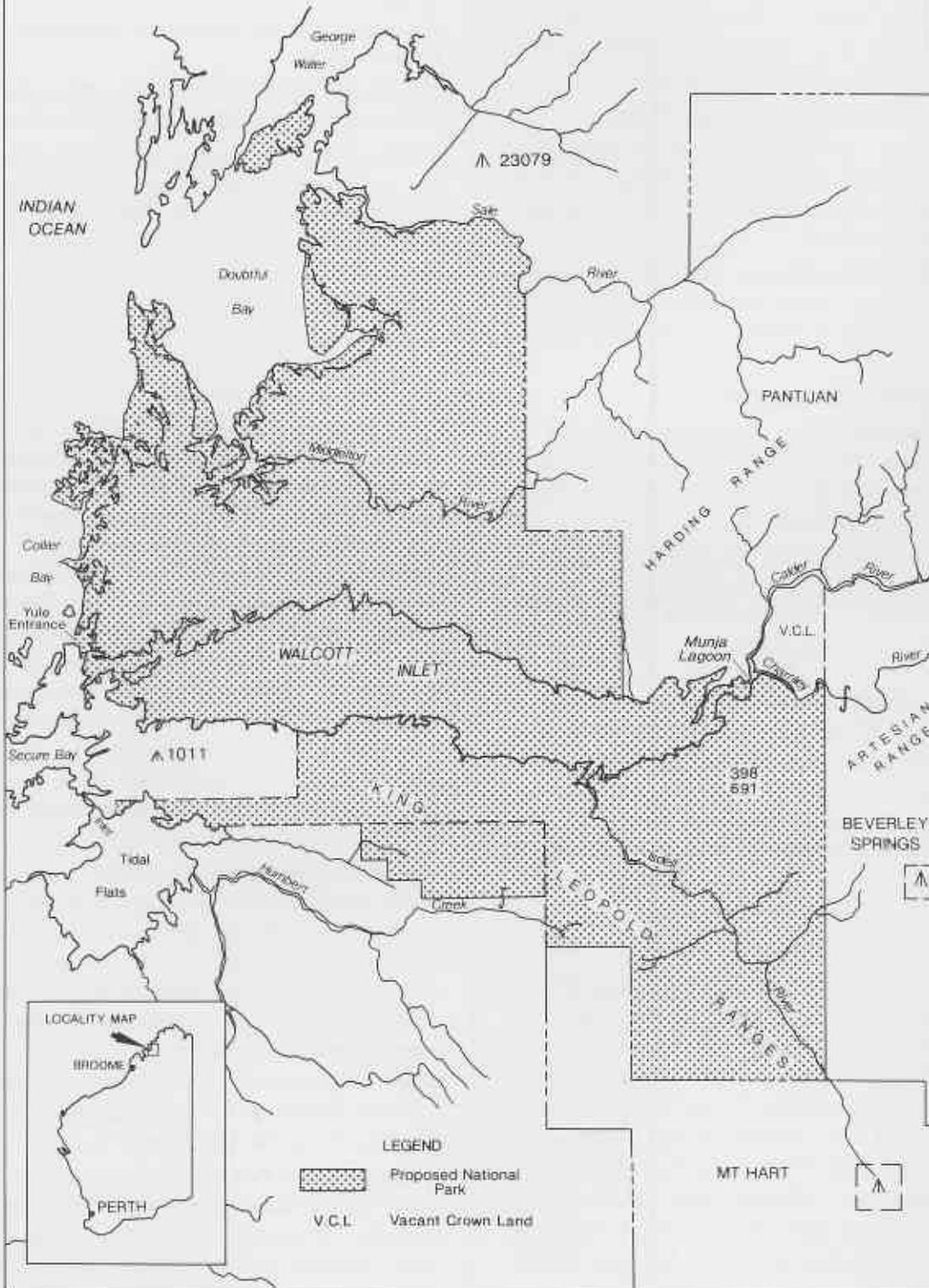
Watered by the Charnley, Calder, Isdell and Sale Rivers, these structurally controlled landscapes have a colourful and rugged grandeur. The Isdell River flows south-westerly from its headwaters then, deflected by the King Leopold Ranges, turns north-westerly to flow into Walcott Inlet. Spectacular gorges, found where the rivers cut through sandstone ridges, are particularly common in the southern Artesian Range, and on the northern margin of the area (along the Sale River).

Vegetation and Flora: The plant communities on the dominant surface types have not been surveyed, though observations made during aerial reconnaissance indicate a rich flora. However, detailed data are available from some localities.



PROPOSED WALCOTT INLET NATIONAL PARK

SCALE
0 5 10 15 20 25 Km



MAP 22



When the plants at six of the rainforest patches scattered through the area were surveyed in June 1987, more than 10 species new to Western Australia were recorded.

The Australian and New Zealand Scientific Exploring Society inventoried sites along the estuaries of the Charnley and Calder Rivers in 1983.

Extensive tidal alluvial flats support dense stands of mangroves. Alluvial plains support extensive grasslands dominated by woodland of *Eucalyptus tectifica* and *E. terminalis* with *Terminalia canescens*, *Gardenia pyriformis* and *Erythrophleum chlorostachys*. The ground layer is dominated by spear grass (*Heteropogon contortus*) and *Eriachne* sp.

Alluvial banks adjacent to rivers support *Eucalyptus papuana*, *Lysiphyllum cunninghamii*, White Cedar (*Melia azedarach*) and *Brachychiton diversifolius*.

Gallery forests extend along the banks of creeks and adjacent to the outcropping sandstone. Tree species include *Melaleuca leucadendra*, *Terminalia platyphylla*, *Ficus coronulata*, *Syzygium eucalyptoides* and *Carallia brachiata*. Dense groves of *Pandanus spiralis* occur over fern beds dominated by *Cyclosorus interruptus*.

Patches of rainforest occur on the steep slopes below the sandstone escarpments, in narrow gorges, in hollows on the upper slopes of some hills and in swampy areas behind tidal mudflats. Rainforest species include *Abrus precatorius*, *Aglaiia elaeagnoidea*, *Gyrocarpus americanus*, *Malaisia scandens*, *Brucea javanica*, *Melia azedarach*, *Mimusops elengi*, *Aidia racemosa*, *Bombax ceiba*, *Ficus virens*, *F. racemosa*, *Nauclea orientalis*, *Eucalyptus apodophylla*, and *Capparis sepiaria*.

A low or open woodland covers the sandstone slopes and plateaux, interspersed in places with tall shrubland and hummock grassland. Typical trees include Woollybutt (*Eucalyptus miniata*), Grey Box (*E. tectifica*), Bloodwoods (*E. polycarpa* and *E. dichromophloia*), *Terminalia* spp., Whitewood (*Atalaya hemiglauca*), *Bauhinia* (*Lysiphyllum cunninghamii*), Quinine Tree (*Petalostigma pubescens*), *Buchanania* sp., *Gardenia* spp., *Owenia vernicosa*, etc. Shrubs include *Acacia* spp., *Grevillea* spp., *Ficus* spp., *Cochlospermum fraseri*, *Dolichandrone*, etc. Hummock grass (*Plectrache pungens*), Spear Grasses (*Aristida* spp. and *Heteropogon contortus*), *Sorghum* sp., *Chrysopogon fallax* and Kangaroo Grass (*Themeda australis*) are common.

Rivers and creeks, flowing through sandstone, are fringed by stately Cadjeputs and River Gums over thickets of screw palm (*Pandanus*) and wattle. Pools in the watercourses are rich in aquatic plants such as water lilies; waterfalls are numerous even in the dry season, and decorated with fern banks and with fig trees that cling to the sheer rock walls.

Fauna: The area has a rich and apparently intact fauna. Mammals reported in the sandstone country by A. Chapman (pers. comm.) include the Scaly-tailed Possum (*Wyulda squamicaudata*), the rare and endangered Golden Bandicoot (*Isodon auratus*), the Sugar Glider (*Petaurus breviceps*), and a variety of native tree and rock rats. The Ghost Bat (*Macroderma gigas*) was recorded in riverine woodlands, along with the Blossom Bat (*Macroglossus minimus*). Swampy areas on the landward periphery of the mudflat support a variety of water birds such as the Green Pygmy Goose, Royal Spoonbill and Sacred Ibis, and provide breeding habitat for the Saltwater Crocodile. Forrest's Mouse (*Leggadina forresti*) was trapped in the grasslands on the alluvial plains.

The following mammals have been recorded in the rainforests: Short-eared Rock-wallaby (*Petrogale brachyotis*), *Dasyurus hallucatus*, *Isodon macrourus*, the Golden-backed Tree-rat (*Mesembriomys macrurus*), the rock-rats *Zyromys woodwardii* and *Z. argurus*, and Tunney's Rat (*Rattus tunneyi*). Birds recorded in the rainforests include the White-lined Honeyeater, Yellow Oriole, White-browed Robin, Rainbow Pitta, Spangled Drongo, Shining Flycatcher, Torres Strait Pigeon, Green-winged Pigeon and Figbird. Populations of the Olive Python, Green Tree Snake, and skinks such as *Carlia triacantha*, *Morethia ruficauda* and *Notoscincus wotjulum* are also present.

During a recent survey of rainforest patches, a number of endemic land snails were found to be restricted to this area (Alan Solem pers. comm.). The fauna of snails is, with few exceptions, different from the Prince Regent Nature Reserve in terms of species.

Recreational Use and Potential: Excellent; the scenic grandeur of this remote wilderness is accessible via the navigable waters of Walcott Inlet and the estuarine sections of the major rivers.

Key Features: Spectacular tidal currents and whirlpools, sandstone escarpments and gorges,



Climbing Swamp Fern (Stenochlaena palustris) is common in gallery forests fringing creeks draining into the Walcott Inlet.

floating fern banks, waterbird lagoons, rainforest patches, black soil plains.

CTRC Recommendation: "The Committee recommends that:

- a. all vacant Crown land surrounding the Inlet be declared a Class C Reserve for the purpose of National Park and vested in the National Parks Authority of W.A.;
- b. that once the reserve is gazetted, the National Parks Authority explore with the lessees of Pantijan Station the possibility of joint participation in management of the Park."

There have been proposals to build a tidal power station at Yule Entrance, in the mouth of Walcott Inlet. "Although the Committee's terms of reference do not include comment on the viability of these proposals, it believes that any recommendations for a National Park or Conservation Reserve in the area should not prejudice future decisions concerning a tidal power station."

EPA Recommendation: The EPA endorsed the CTRC recommendation to leave provision for a tidal power station.

"The EPA recommends that:

1. the vacant Crown land surrounding the Inlet be declared a Class C Reserve for the purpose of National Park and Water and vested in the National Parks Authority of W.A.;
2. once the reserve is gazetted, the National Parks Authority explore with the occupants of Pantijan Station the possibility of joint participation in management of the Park."

Our Recommendation: We endorse the EPA recommendation, except that the purpose of the reserve should not include "water" and the reserve should be Class A. The reserve should extend to low water mark.

Since the EPA recommendation was made, the land between the Isdell and Charnley Rivers has been leased for pastoral purposes.

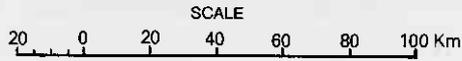
We further recommend that the waters of Walcott Inlet be declared a Class A marine national park vested in the National Parks and Nature Conservation Authority.



Backflow billabongs along the Walcott Inlet are rich in aquatic plants.

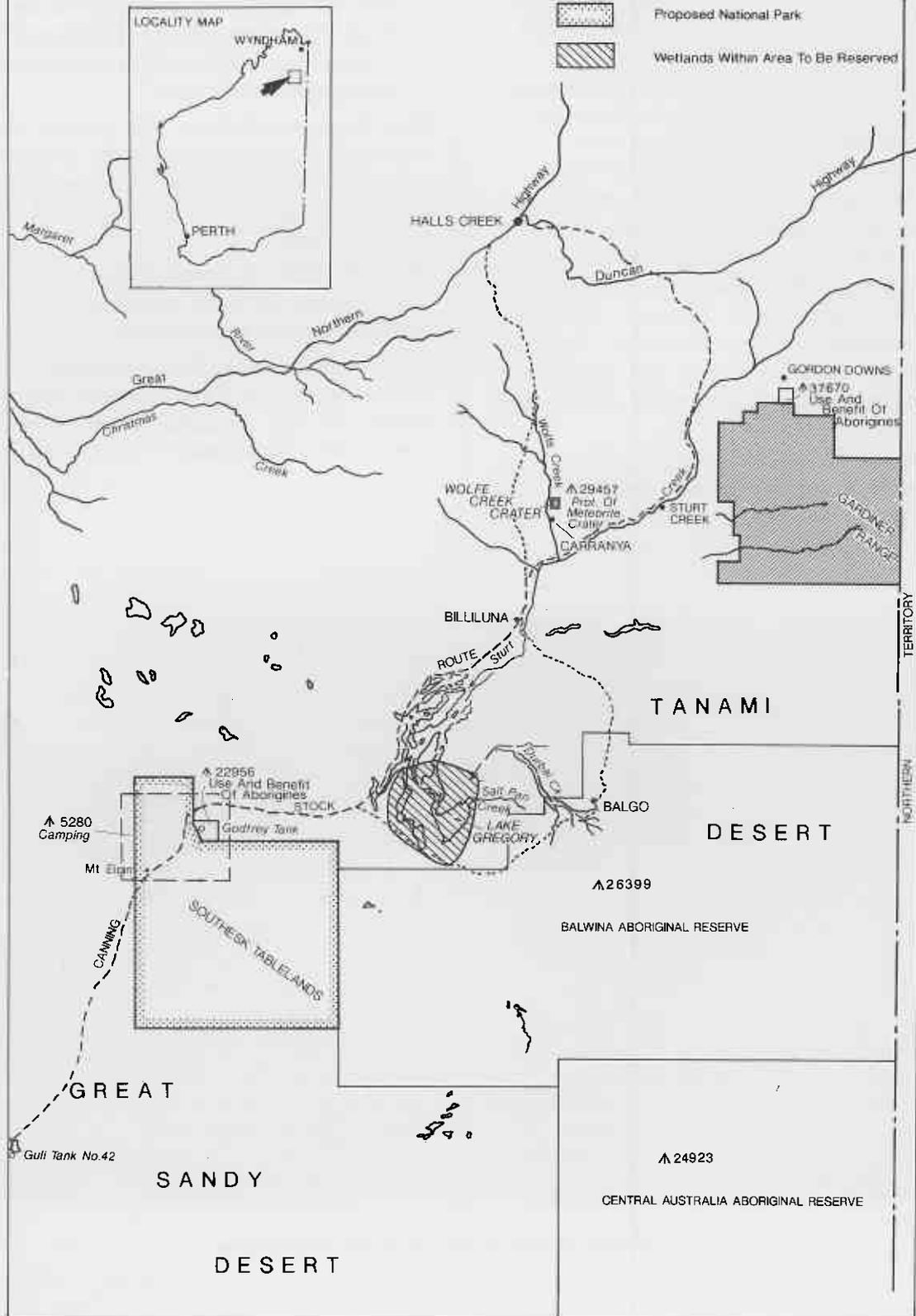


SOUTHESK TABLELANDS, GARDINER RANGE, GREGORY LAKE & WOLFE CREEK CRATER



LEGEND

-  Proposed Nature Reserves
-  Proposed National Park
-  Wetlands Within Area To Be Reserved



MAP 23

5

GREAT SANDY DESERT

The northern section of the Great Sandy Desert intrudes into the Broome, West Kimberley and Halls Creek Shires. The geology of this desert has been described by Towner *et al.* (1976), Towner and Gibson (1980) and Yeates *et al.* (1975). For a general description see Burbidge and McKenzie (1983).

Red sand surfaces dominate the landscape of the desert and are expressed mainly as longitudinal dunes (Crowe 1975), trending west to west-north-west, separated by inter-dune sandplains ranging from 0.5 km to several kilometres wide. The dunes vary from three to 20 metres in height. Extensive sandplains without dunes are also present in some places. Dune sand is red-brown and contains minor silt. In inter-dune plains it is firmer, sometimes with minor clay, and darker in colour.

The sand is thought to have originated *in situ* from "erosion and retreat of the sandstone breakaways and redistribution of soil originally present on top of the lateritic profile". (Towner and Gibson 1980) The iron-enriched lateritic crusts of the Great Sandy Desert are believed to have formed at the same time (mid-Miocene) as the relict, now blocked, drainage valleys (van de Graaf *et al.* 1977).

Today the Great Sandy Desert, like other deserts in Western Australia, has a disintegrated internal drainage characterised by ephemeral creeks and rivers that only flow after cyclones and discharge into salt lakes. Most of these lakes are arrayed in partly interconnected chains, or are elongate, and mark the courses of the ancient river valleys. One of these is the Mandora Palaeoriver, mapped by van de Graaf *et al.* (1977), that drained the northern half of the area encompassed today by the Great

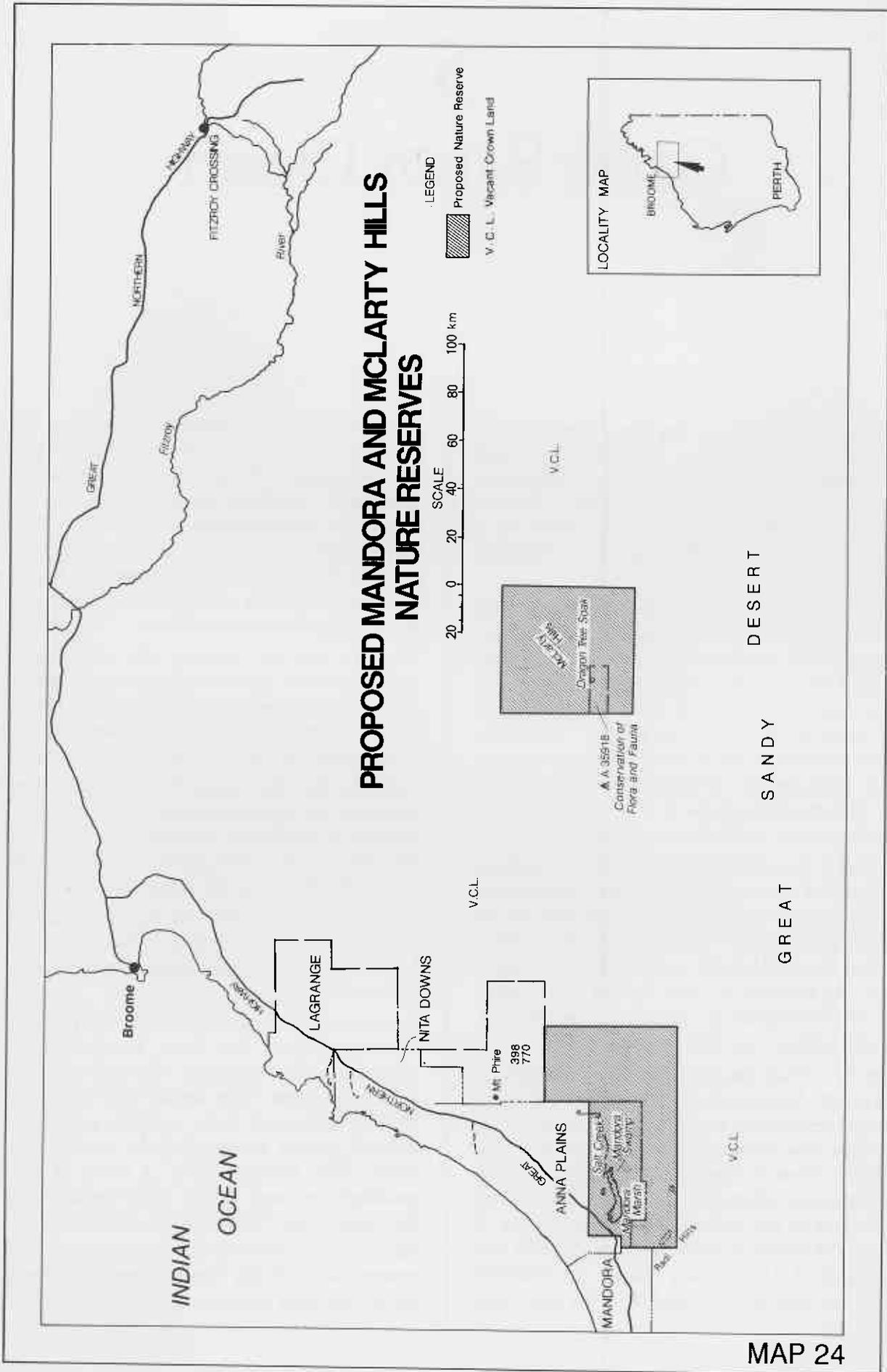
Sandy Desert. Its headwaters are in Sturt Creek, then its route can be traced westwards to the coast via Lake Gregory, Dragon Tree soak and Mandora Salt Marsh. Gradients are gentle along the axis of the major palaeodrainage valleys. Two distinct surface types are recognised in the valleys: calcrete and alluvial deposits of saline loam and clay. Non-saline loam and clay occur in the upper reaches of the drainage lines discussed later.

The lake deposits comprise clay, silt, fine sand, some superficial gypsum and occasional patches of gravel or rock fragments. They are salt encrusted where the water table is close to the surface (allowing evaporation) and usually crack as they dry out.

Laterally, the lakes grade into alluvial valley-fill sediments or, more commonly, deposits that are a mixture of windblown sand and alluvial clay/silt. The latter is often associated with calcrete and is gypsum-bearing along the margins of lakes.

Calcrete crops out extensively as pavements, mounds and rubble within the valleys. The topography of both sandy and alluvial surfaces overlying calcrete deposits is uneven.

Exposures of the Permian to Cretaceous sedimentary strata underlying the Great Sandy Desert are expressed as low sandstone, siltstone or mudstone ranges and mesas, often capped with iron-enriched laterite. In general, these outcrops are small and isolated, scacely interrupting the pattern of sand dunes. The McLarty Hills, a series of Jurassic sandstone outcrops in the north-western part of the Great Sandy Desert, provide a typical illustration. More extensive buttes and ranges occur in the north-eastern sector of the Desert; comprising Permian sandstones, these outcrops are mostly 15 to 30 metres



MAP 24

higher than the surrounding plains. The Southesk Tablelands near Godfreys Tank are 90 metres high in places.

Laterite is expressed as caps on many of the mesas and as intermittent gravelly rises and breakaways throughout the Great Sandy Desert. It represents the eroded remnants of the Miocene crust discussed earlier. Ferruginous gravelly sandplains often overlie the laterite.

Relatively small areas of clayey and silty soils, with only minor sand and gravel, are found in valleys and as outwash plains, where small creeks drain the Desert uplands (ranges, breakaway systems and gravel ridges). These non-saline alluvial surfaces are best developed in the Southesk Tablelands and near Lake Gregory. More typically, non-saline valley fill and outwash surfaces comprise a mixture of alluvial silt/clay and greater percentages of sand. Although these are still only a minor element, substantial areas occur in landscape depressions along the salt lake systems and adjacent to ranges and the less steep-sided uplands.

Burbidge and McKenzie (1983) recommended a series of reserves in the Great Sandy Desert, three of which are in its northern part.

5.1 MANDORA

Location: 220 km south-south-west of Broome.

Map: 24.

Status: Anna Plains pastoral lease includes almost all the features associated with the mouth of the palaeoriver. It also includes extensive areas of sandplains and desert dunes, and swales with scattered rock outcrops; the Radi Hills, in the vacant Crown land south of Mandora Marsh (salt), and Mount Phire, in the Nita Downs Pastoral Lease, are two of the more prominent. The adjacent vacant Crown land to the south and east (see map 24) comprises sandplains, dunes and isolated outcrops.

Geomorphology: Various Holocene coastal features and surfaces are associated with the mouth of the Mandora Palaeoriver. These include beach dunes of calcareous marine sands and saline lakes such as Mandora Marsh, with evaporite carbonate surfaces. Salt Creek is a deep channel several kilometres long that is permanently filled with salt water and discharges into the eastern side of Mandora Marsh. Extensive alluvial plains of greyish sandy silt and

clay surround the lakes. Where they are adjacent to the sand ridges of the desert, these plains are superficially mantled by red sand.

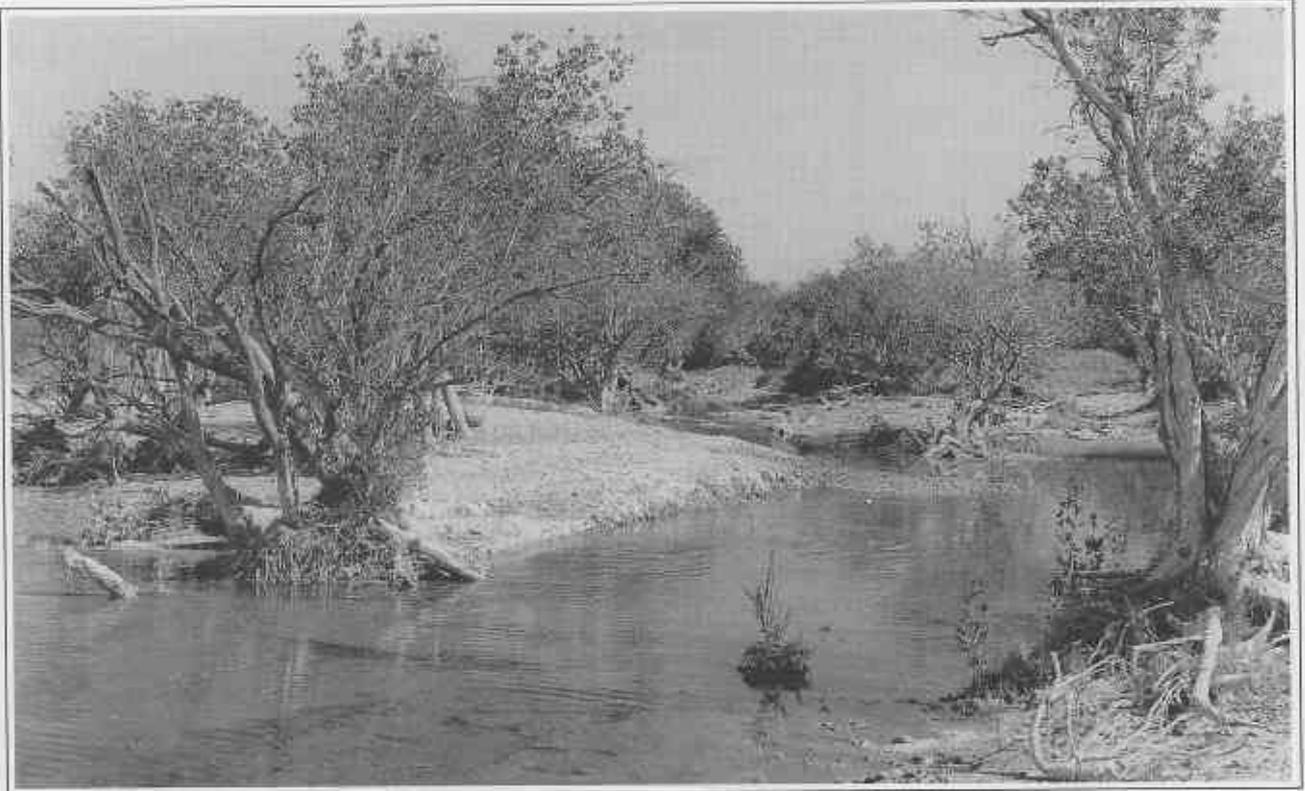
Mandora Swamp is one of a series of fresh water swamps scattered along the axis of the relict drainage valley to the east of the salt marsh (Wyrwoll *et al.* 1986). It is the only swamp in the area with a thick accumulation of organic sediment directly overlying a sand substrate. The organics at the other swamps are less than 40 cm thick and overlay a stiff plastic clay horizon. Mandora Swamp is also different because it takes the form of a 'raised bog', standing about two metres above the surrounding plain of organic rich mud, and is surrounded by a moat.

Undulating plains of ground-water calcretes occur. Most areas are superficially mantled by red sand, though the calcrete pavement is normally exposed on the tops of the rises.

Features typical of the north-western parts of the Great Sandy Desert include the extensive red sandplains, red sand dunes about 15 metres high and scattered Mesozoic mudstone and sandstone outcrops, often capped with laterite.

Vegetation and Flora: Nearest to the sea, where sand is still being thrown up and colonised, the dunes have a cover of *Spinifex longifolius*, almost pure at times, or with *Ipomoea pes-caprae*, *Euphorbia myrtoides* and *Ptilotus villosiflorus*. Further from the sea, usually after the first dune, the more consolidated sandhills are vegetated thickly with *Triodia pungens* and with some *Panicum* sp. Occasional woody plants include shrubs of *Acacia bivenosa*, *Santalum lanceolatum*, *Scaevola decipiens*, *Euphorbia coghlanii*, *Crotalaria cunninghamii* and *Aerva javanica*. Frequent burning of the dune vegetation appears to have reduced the abundance of woody growth, especially in the hollows, where *Acacia bivenosa* might tend to form thickets.

On the plain behind, scattered stands of *Eucalyptus* aff. *papuana* occur and *Triodia pungens* is lacking from the loam soils. Frequent burning characterises the grassland, which is a mixture of species and it would be difficult to say which is the most important. Species which do occur are *Eragrostis dielsii*, *E. lacunaria*, *Xerochloa barbata*, *Enneapogon planifolius*, *Sporobolus actinocladius*, *Triraphis mollis*, *Dichanthium affine*, *Chloris ruderalis*, *Panicum decompositum* var. *scaberrimum* and also *Sporobolus virginicus*, which has two growth forms. As Salt Grass it forms a coarse mat 0.2-0.3 m thick of erect culms, while as



*Salt Creek, permanently filled with salt water, supports an inland occurrence of the White Mangrove (*Avicennia marina*).*



Coastal Couch Grass it has long trailing culms, often more than 3 m in length. The two forms appear to be the result of a response to a slight alteration in soil mineral salt content. On what appear to be damper patches in the grassland, there are colonies of *Eulalia fulva* or *Bothriochloa decipiens* (both known as Bundle Bundle Grass) with *Panicum decompositum* as a subordinate form.

As a rule, the grass flats are treeless areas, but occasionally there are small groups of *Melaleuca nervosa*, *M. lasiandra* and *M. acacioides*. Here, most of the grasses are absent, though *Cenchrus ciliaris* may occur. These tree groups represent isolated patches of the *Melaleuca* shrublands that form a definite phase in the transitional zone between the coastal plain vegetation and that of the spinifex pindan. This border type appears on the junctions between loam and red sand and between grey and red sand.

The lakes are bare of vegetation, or support low open shrublands of samphires such as *Halosarcia indica*, *H. halocnemoides* and *Frankenia*. The banks of Salt Creek are lined by a relictual stand of the White Mangrove (*Avicennia marina*) first described by Beard (1967). The extensive alluvial plains surrounding the lakes support low woodlands or shrub thickets of *Acacia ampliceps* and *Melaleuca acacioides*, over low shrubs such as *Acacia monticola*, *Halosarcia auriculata* and the other samphires listed above. Grasslands of the native couch, *Sporobolus virginicus*, which cover extensive areas of these plains, occur as glades between the thickets and as an understorey where the thickets are more open.

The fresh water swamps support an open forest of the paperbark *Melaleuca argentea* 20 metres high with, in wet areas, scattered Dragon Flower Trees (*Sesbania formosa*), areas of the sedge *Schoenoplectus littoralis*, the bulrush *Typha domingensis* and clumps of the fern *Acrostichum speciosum*. The sedge *Fimbristylis ferruginea* forms a tussock grassland under the paperbark trees on the raised bog. The swamps are all severely trampled by cattle though, fortunately, the moat at Mandora Swamp was still (May 1986) providing partial protection for the raised bog.

Where red sand mantles the alluvial silt and clay plains, the vegetation comprises scattered low trees and tall shrubs such as *Lysiphyllum cunninghamii*, *Grevillea wickhamii*, *Terminalia cunninghamii* and *Acacia ampliceps*, low shrubs such as *Acacia translucens*, hummock grasses (including *Plectrachne*

schinzii), bunch grasses such as *Eragrostis* and a variety of herbs (*Stemodia* spp., *Minuria integerrima*, *Pluchea tetranthera*, and *Crotalaria crispata*)

The undulating calcrete plains, thinly mantled with red sand, support open shrublands of *Grevillea wickhamii* and *Acacia ampliceps* over *A. translucens* and the other understorey species described in the previous paragraph.

The red sand ridges of the desert support open shrublands of *Grevillea*, *Melaleuca*, *Crotalaria cunninghamii*, *Corchorus*, *Newcastelia cladotricha*, *Dampiera cinerea*, *Borreria* aff. *breviflora*, *Cyanostegia cyanocalyx* and *Acacia translucens*, over a hummock grassland of *Plectrachne schinzii* with scattered low trees (*Terminalia cunninghamii*).

The extensive red sandplains of the inter-dune swales support a selection of pindan and desert plants. Vegetation is a low open woodland of *Eucalyptus zygophylla* over an open shrubland of *Acacia ancistrocarpa*, *A. holosericea*, *A. monticola* and *A. translucens* over a dense hummock grassland of *Plectrachne schinzii*. In an area regenerating after fire, the 1981 survey recorded a low open woodland of *Lysiphyllum cunninghamii*, *Grevillea stenobotrya* and *Acacia holosericea* over an open shrubland of *Acacia translucens* and *Cassia curvistyla* mixed with scattered hummock (*Plectrachne schinzii*) and tussock grasses and the herbs *Calandrinia*, *Trianthema pilosum* and *Ptilotus calostachyus*.

No data on the vegetation of the outcrops in the area have been collected.

Fauna: A mixture of desert and Torresian species were recorded during the brief visit in August 1983. Mammals included the Red Kangaroo, Larapinta (*Sminthopsis macroura*), Lesser Hairy-footed Dunnart (*S. youngsoni*), Delicate Mouse (*Pseudomys delicatulus*), Yellow-bellied Sheath-tailed Bat (*Taphozous flaviventris*) and Northern Mastiff Bat (*Chaerephon jobensis*). Numerous birds were recorded; notably the Clamorous Reed-Warbler, Barking Owl, Little Corella, Black-tailed Native Hen, Brolga, Peaceful Dove, Straw-necked Ibis, White-plumed and Black Honeyeater, Wedge-tailed Eagle, numerous wading birds and water fowl. Reptiles included the dragons *Ctenophorus caudicinctus*, *Diporiphora pindan*, *D. winneckeii* and *Gemmatophora gilberti*, the skinks *Ctenotus grandis*, *Lerista ips*, *Sphenomorphus isolepis*, *Notoscincus ornatus* and the legless lizard *Delma tinctoria*. Several amphibians were recorded, including *Notaden nichollsi*.

When flooded, the Marsh is an important habitat for water birds.

All environments in the area are being severely degraded by cattle.

Recreational Use and Potential: Desert scenery traversed by national highway, bird watching.

Key Features: The peat pile at Mandora Swamp is of great scientific importance. Desert environments abutting the coast and estuarine environments truncated by beach dunes. Fresh water swamp plants and animals isolated by sandy desert environments. Wetlands important for the conservation of wading birds.

CTRC Recommendation: "Radi Hills and Samphire Marsh (= Mandora Marsh) - Further investigation is recommended."

EPA Recommendation: "The EPA recommends to the Department of Fisheries and Wildlife that when resources are available it should carry out a biological survey of the Radi Hills and Samphire Marsh with particular attention to the inland population of the mangroves."

Our Recommendation: Investigations of the biological resources of the area have proceeded far enough to enable a reserve to be delineated. We recommend that a Class A nature reserve, vested in the National Parks and Nature Conservation Authority, be declared with the following boundaries: 20° 00'S 121° 07'E east to 122° 00', north to 19° 30', east to the Anna Plains lease boundary, south to 19° 40', west to 121° 10', south to the Anna Plains lease boundary, west to 121° 07', south to the starting point (see Map 24). The most significant part of this proposed reserve includes the features associated with the mouth of the Mandora palaeoriver which are within Anna Plains Station. We recommend that the reserve be named the Mandora Nature Reserve.

5.2 McLARTY HILLS

Location: 225 km south-east of Broome.

Map: 24.

Current Status: This proposed reserve comprises 290 000 hectares, most of which is vacant Crown land. It includes the 14 182 hectare Dragon Tree Soak Nature Reserve (A35918).

Geomorphology: Most of the area is covered by sand dune country typical of the north-western

part of the Great Sandy Desert (McKenzie *et al.* 1983). It straddles the Mandora Palaeoriver, including alluvial flats, numerous small salt lakes and the peat swamp at Dragon Tree Soak (Wyrwoll *et al.* 1986). The proposed reserve also includes the McLarty Hills, a series of low Jurassic sandstone plateaux and mesas that scarcely disrupt the longitudinal pattern of the sand ridges.

Vegetation and Flora: A detailed description was provided in McKenzie *et al.* (1983) and additional plant species were listed in George and Mitchell (1983).

The screes of the McLarty Hills consist of shaly pebbles and small boulders, often cemented together by a fragile crust of clay-like soil. The vegetation is mostly open hummock grass with a few herbs and occasional shrubs of *Grevillea*. Some areas are almost bare. The spinifexes are *Triodia intermedia* and *T. pungens*. Herbs include *Abutilon lepidum*, *Dampiera candidans*, *Gomphrena cunninghamii*, *Ptilopus calostachyus*, *P. exaltatus*, *P. incanus*, *Trichodesma zeylanicum* and *Triumfetta micrantha*. Two other grasses collected here were *Eriachne ciliata* and *E. mucronata*.

Among large boulders around the breakaway edge *Grevillea pyramidalis* and *Ficus platypoda* occur as isolated plants. Herbaceous species are *Cyperus cunninghamii*, *Mukia maderaspatana*, *Nicotiana benthamiana*, *Solanum petrophilum*, *Stemodia lythrifolia* and, by sheltered overhangs, *Tinospora smilacina*.

The smaller plateau areas carry open hummock grass with scattered shrubs. *Triodia pungens* is the common spinifex. Shrubs include *Calytrix longiflorus*, *Grevillea pyramidalis* and *G. wickhamii*. In small gullies there are thickets of *Acacia acradenia*, *A. monticola* and *Grevillea refracta*.

In the larger valleys, where sandy loam has accumulated, open scrub occurs along creek lines. This is dominated by *Acacia*, especially *A. holosericea* and *A. monticola*, with a few *Clerodendrum floribundum*, *Gardenia pyriformis*, *Grevillea refracta*, *Hibiscus leptocladus* and *Eucalyptus papuana*. There is a bunch grass to cane grass understorey, often dense, of *Eragrostis eriopoda*, *Aristida browniana*, *A. inaequiglumis*, *Sorghum plumosum* and the hummock grass *Triodia pungens*, together with the sedge *Fimbristylis dichotoma*. There are herbs such as *Buchnera* (ASG 14735), *Crotalaria crispata*, *Drosera petiolaris*, *Pluchea tetranthera* and *Zornia* sp. Away from the drainage lines, *Triodia pungens* and



T. intermedia predominate, often with *Leptosema anomala*.

The plains and swales are sand or sandy loam, with vegetation varying from open hummock grass to scrub. The spinifex is *Triodia pungens*, which in some areas is stoloniferous. At the time of the investigation, other grasses present were long past flowering, the ephemeral species mostly being dead. The only species that could be determined was *Panicum australiense*. Shrubs are generally scattered, the species being *Acacia coriacea*, *A. translucens*, *Grevillea pyramidalis*, *G. wickhamii*, *Hakea* sp. aff. *suberea* (ASG 14706), *Persoonia falcata*, *Pimelea ammocharis* and *Stylobasium*. In some areas there are thickets, usually of *Acacia* (e.g. *A. monticola*, *A. orthocarpa*, *A. stipuligera*) but sometimes of *Grevillea refracta*. Herbs include *Bonamia* sp. (ASG 14727), *Cassia notabilis*, *Corchorus sidoides*, *Goodenia azurea*, *Heliotropium tenuifolium*, *Keraudrenia ?integrifolia*, *Phyllanthus maderaspatensis*, *Psoralea pustulata* and *Ptilotus fusiformis*.

The sand dunes carry the richest flora, with a varied association of shrubs, herbs and grasses, and occasional trees. The only spinifex on the dunes is *Plectrachne schinzii*. Shrubs are *Acacia tumida*, *Burtonia simplicifolia*, *Calytrix longiflora*, *Comesperma pallidum*, *Crotalaria cunninghamii*, *Cyanostegia cyanocalyx*, *Gyrostemon tepperi*, *Dodonaea peduncularis*, *Duboisia hopwoodii*, *Grevillea* aff. *eriostachya* (ASG 14703), *G. stenobotrya*, *Jacksonia aculeata*, *Newcastelia cladotricha*, *Psoralea* sp. (ASG 14645), *Solanum diversiflorum* and *Templetonia incana*. The perennial herbs include *Aenictophyton reconditum*, *Cassia pumila*, *Dampiera cinerea*, *Goodenia armitiana*, *Halgania solanacea*, *Ptilotus arthrolasius*, *Scaevola parvifolia*, *Sida* spp. (ASG 14701), *Trichodesma zeylanicum*, *Velleia panduriformis* and *Zornia* sp. (ASG 14646). Ephemeral herbs recorded are *Borreria auriculata*, *Setaria apiculata* and *Trianthema pilosa*. The trees are *Gardenia pyriformis* and *Owenia reticulata*. *Erythrophleum chlorostachys*, which is usually arborescent, occurs as a shrub.

The most notable feature of the section of palaeo-drainage valley included in the area is Dragon Tree Soak. The centre of Dragon Tree Soak is dominated by an almost pure stand of *Baumea articulata* growing on wet, black mud. At the southern and northern ends are small areas of *Sesbania formosa* growing as a low forest. Scattered *Sesbania formosa* also grows among the *Baumea*. Bulrush, *Typha domingensis*, occurs under the *Sesbania*, with occasional clumps

among the *Baumea*. Around the edge of the soak in damp mud is a sward of *Paspalum*. Scattered plants of *Fimbristylis ferruginea* occur in this sward. On the slightly higher (and dryer) grey loam flat surrounding the *Paspalum* sward is a zone in which *Sporobolus virginicus* forms a ground cover and *Acacia ampliceps* occurs as scattered or grouped tall shrubs.

Further away from the soak, loam flats and claypans carry dense low heath to dwarf scrub; hummock grass covers occasional sandy rises. More clayey areas are dominated by samphires, especially *Halosarcia indica* subsp. *leiostachya* and *H. halocnemoides*. More widespread is *Trianthema turgidifolia*, its succulent leaves mostly dark red. A number of grasses and herbs occur among the *Trianthema* e.g. *Cyperus bulbosus*, *Eragrostis pergracilis*, *Flaveria australasica*, *Lawrencina* sp., *L. glomerata*, *Neobassia astrocarpa*, *Pluchea tetranthera*, *Pterocaulon sphacelatum*, *Salsola kali*, *Sesbania cannabina*, *Sporobolus australasicus*, *Trianthema triquetra* and *Xerochloa barbata*.

Thickets also occur on the loam flats, mostly dominated by *Acacia ampliceps*, some by *Melaleuca glomerata* and *M. lasiandra*, a few by *Myoporum acuminatum*. In one area, about 0.5 km south of the soak, the perennial sedge *Schoenus falcatus* forms a tussock layer beneath *Acacia* and *Melaleuca*. Just west of the Soak is a solitary tree of *Eucalyptus microtheca*. Several *Hakea suberea* also occur on the flats.

Hummock grass that mantles the sandy rises scattered across the flats is dominated by *Plectrachne pungens*, a stoloniferous soft spinifex. Less common is *Triodia pungens*.

Dunes and swales associated with the palaeo-drainage valley carried a low scrub of *Melaleuca lasiandra* mixed with *Plectrachne schinzii*. The Desert Walnut, *Owenia reticulata*, occurs either as open stands or scattered trees. On dunes and swales throughout most of the proposed reserve, the *Melaleuca* is replaced by other shrubs such as *Acacia amaticeps*, *A. translucens*, *Duboisia hopwoodii*, *Grevillea stenobotrya* and *G. wickhamii*. Occasional shrubs are *Crotalaria cunninghamii*, *Cyanostegia cyanocalyx*, *Dodonaea peduncularis* and *Dolichandrone heterophylla*. A number of perennial herbs are found on the dunes, e.g. *Aenictophyton reconditum*, *Cassia pumila*, *Corchorus sidoides*, *Corynotheca micrantha*, *Dampiera cinerea*, *Heliotropium* sp. (ASG 14806), *Newcastelia cladotricha*, *Solanum diversiflorum* and *Tephrosia* sp.

(ASG 14796). A few ephemerals were found, viz. *Aristida browniana*, *Borreria auriculata*, *Euphorbia* sp., *Dactyloctenium radulans*, and *Trianthema pilosa*. Two species of mistletoe, *Amyema gibberula* on *Grevillea wickhamii* and *Amyema preissii* on *Acacia ampliceps*, were collected.

Fauna: The area supports a typical suite of desert vertebrates, though the population of Clamorous Reed-Warblers, and records of the White-striped Mastiff-Bat, and Pheasant Coucal, at Dragon Tree Soak are of interest. Desert species recorded in the area include the Marsupial Mole (*Notoryctes typhlops*), a small goanna (*Varanus gilleni*), the geckos *Diplodactylus conspicillatus* and *D. taeniatus*, the skinks *Lerista ips* and *Ctenotus brooksi brooksi*, Major Mitchell Cockatoo and White-plumed Honeyeater (Burbidge 1983, Start and Fuller 1983, McKenzie and Youngson 1983).

Recreational Use and Potential: Wilderness area.

Key Features: Represents ecosystems and landscapes of the northern interior of the Great Sandy Desert, including an oasis. The scenery (Young 1981) and palaeo-climatic implications of Dragon Tree Soak (Wyrwoll *et al.* 1986) are also important.

CTRC Recommendation: None.

EPA Recommendation: That a biological survey be completed of the Great Sandy Desert.

Our Recommendation: The biological survey was carried out between 1977 and 1980 (Burbidge and McKenzie 1983). Following the survey, recommendations were made to the EPA that several reserves, including this one, be declared (Burbidge, McKenzie and Start 1983). We endorse the recommendation that the McLarty Hills area be declared a Class A nature reserve with the following boundaries: 19° 20' to 19° 50' S and 123° 15' to 123° 45' E. The nature reserve should be vested in the National Parks and Nature Conservation Authority.

5.3 SOUTHESK TABLELANDS

A general description was given by Burbidge and McKenzie (1983).

Location: 300 kilometres south-south-west of Halls Creek on the Canning Stock Route.

Map: 23.

Status: Vacant Crown land.

Geomorphology: The Permian sandstone ranges,

mesas and buttes that occur in the north-east of the Great Sandy Desert include some of the most prominent and topographically rugged landscapes in the deserts of Western Australia. These outcrops are mostly 15 to 30 metres higher than the surrounding plains, although the Southesk Tablelands near Godfreys Tank are 90 metres high in places. Extensive areas of alluvial surfaces are present, both as valley floors and outwash plains, in and around the Tablelands. Extensive sandplains and dune fields surround the hills (McKenzie *et al.* 1983).

Vegetation and Flora: The mesas, buttes and screes are vegetated with hummock grass, mainly *Triodia pungens*, and scattered shrubs, while there are occasional figs (*Ficus platypoda*) at the edge of breakaways and in fissures. Around rockholes at the head of valleys are ferns (*Cheilanthes tenuifolia*) and herbs such as *Elytrophorus spicatus*, *Glossostigma diandra*, *Lipocarpa microcephala*, *Marsilea* sp. and *Oldenlandia galioides*.

The deep gullies below the rockholes carry the thickest vegetation. As well as occasional trees (*Erythrina vespertilio* and *Eucalyptus aspera*), there are thickets of shrubs, including *Acacia holosericea*, *A. monticola*, *Grevillea wickhamii* and *Santalum lanceolatum*. Beneath the shrubs is a dense growth of grass and herbs. Dense, tall grassland occurs elsewhere in the valleys.

Two plant species are known only from this area - *Ptilotus marduguru* and *Pseudochaetochloa* sp. Both occur on the dry, rocky slopes of the mesas (McKenzie *et al.* 1983, George and Mitchell 1983).

Fauna: Among the small mammals, the occurrence of both the Western Chestnut Mouse (*Pseudomys nanus*) and the Desert Mouse (*P. desertor*) is of interest, since these have been considered to be the same species by some zoologists. The uncommon Short-tailed Mouse (*Leggadina forrestii*) also occurs in the valleys. Euros (*Macropus robustus*) live in the hills (McKenzie and Youngson 1983). The ranges, with their water and relatively lush vegetation, support some birds that are uncommon in the deserts, e.g. Fairy Martin, Brown Honeyeater and Painted Finch (Start and Fuller 1983). Twenty seven species of reptiles have been recorded (Burbidge 1983).

Recreational Use and Potential: Wilderness; the area receives little tourist use at present but, because of its scenery and location on the Canning Stock Route, it could become a major tourist attraction

in the future.

Key Features: Permian ranges, landscapes and ecosystems of north-eastern Great Sandy Desert, endemic plants, rock pools, historical interest associated with early exploration and the Canning Stock Route.

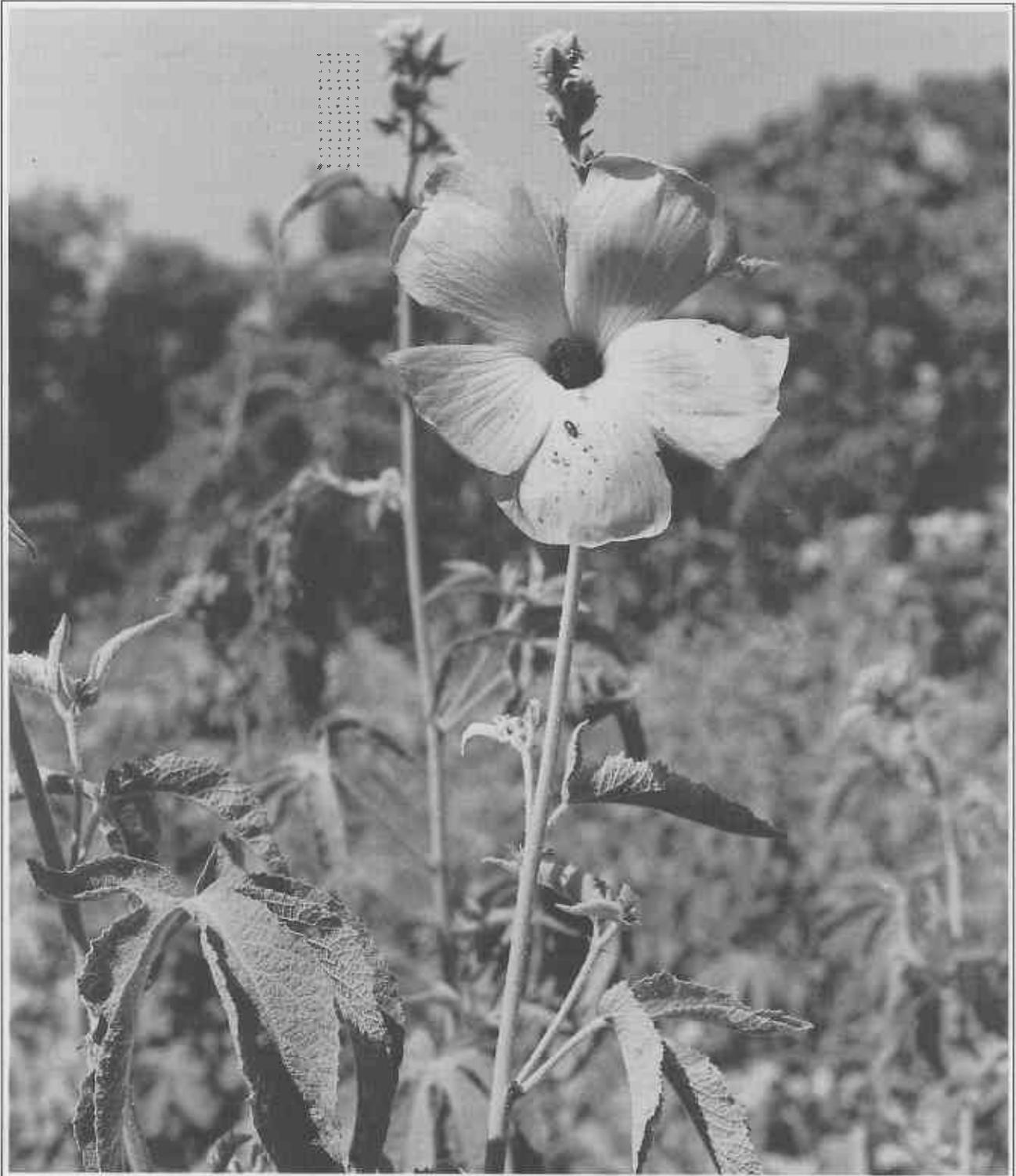
CTRC Recommendation: None.

EPA Recommendation: EPA made a general recommendation for a biological survey of the Great Sandy Desert.

Our Recommendation: The biological survey was carried out between 1977 and 1980 (Burbidge and McKenzie 1983). Following the survey, recommendations were made to the EPA that several reserves, including this one, be declared (Burbidge,

McKenzie and Start 1983).

We endorse the recommendation that an area of approximately 570 000 hectares be declared a national park with the following boundaries. 20° 05'S 126° 20'E thence east to 126° 33'E, south to the north-west corner of Reserve No. 22956 (Use and Benefit of Aborigines), south along the western boundary to the south-west corner of Reserve No. 22956, east to the western boundary of the Billiluna Pastoral Lease (approx. 127° 03'30"E), south to latitude 20° 55'S, west to 126° 20'E, north to starting point. The proposed national park includes much of Reserve 5280 for "Camping". The national park should be vested in the National Parks and Nature Conservation Authority.



Hibiscus superbus with its showy pink flowers is one of 14 species of *Hibiscus* recorded from the Kimberley.

6

TANAMI DESERT

The north-western portion of the Tanami Desert is included within the Halls Creek Shire.

Geologically, the northern portion of the Tanami Desert in Western Australia comprises parts of the Victoria River Basin, Arunta Block and, further south, the Lake MacKay Basin. Their geology is described by Trendall and Cope (1975) and detailed in Crowe and Muhling (1977) and Blake, Passmore and Muhling (1977). The main exposed rock types are unmetamorphosed Proterozoic sandstones such as the Gardiner Beds and Permian sandstones and siltstones of the Liveringa Group, Godfrey Beds and Noonkanbah Formation.

Most of the area comprises gently undulating, red sandy plains of Quaternary age, that are interrupted by occasional outcrops of Proterozoic rocks as low rocky ranges. In the southern part, these plains are dominated by parallel sand dunes. Laterite crusted uplands occur on the Permian outcrops near Lake Gregory. The north-west corner is traversed by Sturt, Wolfe, Durbai and Salt Pan Creeks, all of which drain inland to Lake Gregory.

The north-western Tanami Desert receives an annual average rainfall of between 350 mm (in the north) and 250 mm, received during a predictable rainy season that lasts from early December to early April (Beard 1979). The rest of the year is virtually a drought, during which fresh water is retained only in rock holes associated with outcrops, in Lake Gregory, and as pools along Sturt Creek.

There are a number of existing and proposed conservation reserves in the district.

6.1 GARDINER RANGE AREA

Location: About 400 km south of Kununurra and 180 km south-east of Halls Creek.

Map: 23.

Area: 349 000 ha.

Current Status: Vacant Crown land (formerly the Coronado pastoral lease).

Geomorphology: Most of the ranges are composed of the Proterozoic Gardiner Range sandstone with small areas of the Talbot Well formation, a stromalitic chert with siltstone and limestone. The range is surrounded by sandplains (Blake *et al.* 1977).

Vegetation and Flora: The Gardiner Range is a series of low hills covered by a hummock grassland (*Triodia*) with scattered *Grevillea*, *Hakea* and *Acacia* shrubs. The flats around the hills carry grasses and sporadic eucalypts. A small area of mulga is the northernmost locality for this formation in Western Australia. The Gardiner Range is in a transition zone between Kimberley and desert flora, the former mainly occupying moister and sheltered habitats, but with progressively fewer representations as the rainfall decreases.

Fauna: The area was examined in June 1975 by W.H. Butler, while under contract to the W.A. Museum (G.M. Storr and W.H. Butler, pers. comm.). Sixty-nine species of birds were recorded, including the Port Lincoln Parrot (*Barnardius zonarius*), this being its northernmost record in W.A. Most birds observed were Eyrean (arid zone) species, with the Torresian (Kimberley) element in the minority. Mammals observed included the Northern

Nailtail Wallaby (*Onychogalea unguifera*) and the Dalgite (*Macrotis lagotis*). Seven species of reptiles and a frog were collected.

Recreational Use and Potential: None.

Key Features: A zone of transition between the Kimberley and Tanami Desert flora and fauna, the former mainly occupying the moister and sheltered habitats, but with progressively fewer representatives as the rainfall decreases. The only area representative of the Tanami Desert available for reservation for nature conservation in Western Australia.

CTRC Recommendation: "all of the land concerned is held under pastoral lease, but provision should be made to ensure the creation of an appropriate reserve should any of the existing leases be determined.

At present there is no significant conservation reserve in the East Kimberley. The proposed National Park in the Carr Boyd Ranges adjacent to Lake Argyle (Area 7.10) would provide some representation of East Kimberley ecosystems, but on its own it would not adequately represent the region. Most of the east Kimberley is under pastoral lease and cannot be considered for reservation without good supporting data; such data are not available. In the absence of other reserves, the Gardiner Range area will provide additional representation of the region as well as being of value in its own right, being in an area of biological transition between two floras and faunas."

Recommendation: "The Committee recommends that the Department of Lands and Surveys be requested to give consideration to the creation of an appropriate reserve in the Gardiner Range area, should any of the existing pastoral leases be determined."

EPA Recommendation: "The EPA recommends that the Department of Lands and Surveys reserve a suitable area of land in the vicinity of the Gardiner Range should any of the existing pastoral leases be determined."

Our Recommendation: The pastoral lease has been surrendered and the land is now vacant. There has been a request that part of the area be set aside as an Aboriginal living area, and that a new pastoral lease be issued. The Pastoral Board believes that pastoral pursuits in this area would not be viable.

We recommend that the former Coronado pastoral lease, apart from a 200 ha area for an Aboriginal living area, be reserved for the conservation of flora

and fauna, declared Class A and vested in the National Parks and Nature Conservation Authority.

6.2 GREGORY LAKE

For a general description see Burbidge and McKenzie (1983).

Location: North-eastern edge of Great Sandy Desert, 50 km west of Balgo.

Map: 23.

Current status: The proposed reserve is within the Lake Gregory Pastoral Lease owned by the Mulan Aboriginal Corporation.

Geomorphology: Gregory Lake lies in sandplain with low east-west dunes and is the terminal drainage area for Sturt Creek, which arises in the South-west Kimberley and flows south. The sandplain consists of aeolian red and yellow sand. Moving closer to the lake, the soil changes from alluvial sand, silt and clay through to alluvial clay in drainage channels and salt lakes and then to gypsiferous and saline sand, silt and clay in the main lake bed. Sandstone underlies the whole area.

Although often referred to as Gregory Salt Lake, the Lake is fresh when water levels are high (0.5 ppt TDS in May 1980, 0.6-1.9 ppt in September 1986).

Vegetation and Flora: The vegetation around the lake is greatly affected by water level: at times of flood much of the surrounding vegetation is inundated and dies. At moderate water levels the lake is surrounded by a belt of samphire containing *Halosarcia halocnemoides*, *H. indica*, *Eragrostis dielsii*, *Cressa cretica*, *Morgania floribunda*, *Sida rohlenae* and *Swainsona* sp. Around this is a belt of trees, the main species are an undescribed *Acacia*, *Eucalyptus microtheca* and *Hakea suberea*. Beyond the trees, sand dunes occur, covered by spinifexes (*Plectrachne schinzii* and *Triodia pungens*) and grasses (*Aristida* sp., *Eragrostis eriopoda* and *Eriachne aristida*) (McKenzie et al. 1983).

Fauna: Gregory Lake supports spectacular numbers of water birds when water levels are high: in September 1986, 57 species and 240 000 individuals were recorded. Notable occurrences include: Australian Pelican (5 000 in November 1979) (Start and Fuller 1983); Little Black Cormorant (60 000 in September 1986); Plumed Whistling Duck (13 000 in September 1986); Black Swan (6 000



in September 1986); Freckled Duck (900 in September 1986); Grey Teal (25 000 in August 1985); Pink-eared Duck (34 000 in September 1986); Hardhead (16 000 in September 1986); Eurasian Coot (74 000 in September 1986); Brolga (3 500 in September 1986); Whiskered Tern (2 000 in September 1986); Caspian Tern (1 500 in September 1986) (R. Jaensch pers. comm.). The Freckled Duck is a declared threatened species, and the large flocks on Lake Gregory show that it has great significance in the conservation of this species.

Recreational Use and Potential: No current use. Limited potential as tourist site, especially for keen ornithologists.

Key Features: Unique arid zone lake with an enormous diversity and number of water birds.

CTRC Recommendation: "At present, Gregory Lake is within Billiluna pastoral lease. In view of its importance the Committee recommends that a biological survey of the lake be carried out, coordinated by the Department of Fisheries and Fauna, and recommendations drawn up for a conservation reserve there."

EPA Recommendation: "The EPA, noting that Gregory Lake is within the Billiluna pastoral lease, recommends to the Department of Fisheries and Wildlife, the National Parks Board and the W.A. Museum respectively that, when resources become available, features of Gregory Lake within their individual framework of interests be investigated with a view to appropriately advising the EPA as to whether a conservation reserve should be created within the region."

Our Recommendation: Gregory Lake has been proposed as a wetland of international importance. Reservation and protection of the wetland vegetation would be a major step towards meeting Australia's obligation for proper management of the wetland as well as ensuring the future of one of the most important sites for water birds in Western Australia.

The Lake is now in the Lake Gregory pastoral lease. At present, cattle from Lake Gregory Station are seriously damaging the fringing vegetation.

We recommend that the Department of Conservation and Land Management commence negotiations with the Aboriginal community with the view to reserving the wetlands for conservation and developing appropriate management of Gregory Lake and associated wetlands, plus the lower reaches

of Sturt Creek, so as to minimise cattle damage to the lake and its surrounds.

6.3 WOLFE CREEK CRATER

Location: 100 km south of Halls Creek.

Map: 23.

Area: 1 460 ha.

Current Status: Class A Reserve 29457 for Protection of Meteorite Crater, vested in the National Parks and Nature Conservation Authority.

Geomorphology: The feature of the reserve is the Wolfe Creek Crater, a near circular depression about 900 m in diameter with the floor about 60 m below the rim. The crater was formed by an enormous explosion and was probably about 180 to 200 m deep before it was filled by blown sand and gypsum. It is thought to have been formed in the Miocene, although some authors believe that it formed more recently - either in the Pliocene or early Pleistocene. The origin of the crater is not certain. Two hypotheses have been put forward: an impact explosion from an enormous meteorite weighing several thousand tonnes, or an explosion of endogenous cryptovolcanic origin. The former seems more likely, but does not entirely fit all the geological evidence (McCall 1965).

The crater is surrounded by sandplains and low dunes. Wolfe Creek itself is situated three kilometres to the west.

Vegetation and Flora: The crater rim supports a *Triodia intermedia* hummock grassland with scattered shrubs and small trees of *Eucalyptus brevifolia*, *Grevillea pyramidalis*, *G. refracta*, *G. wickhamii* and *Hakea lorea*. The vegetation of the crater floor is a low open woodland of *Acacia ampliceps* with a few bloodwood eucalypts. The herb layer consists mainly of grasses.

The surrounding red sands support a *Triodia pungens* hummock grassland with emergent shrubs and trees. The shrubs include *Acacia hemimosta*, *Dolichandrone heterophylla*, *Hakea arborescens* and *Melaleuca lasiantha* (A.S. George pers. comm.).

Fauna: A brief survey in 1979 provides the only available data. Species recorded included the Northern Mastiff-bat (*Chaerephon jobensis*), the Little Broad-nosed Bat (*Scotorepens greyii*), and a number



of birds and reptiles. A rare dragon lizard (*Tympanocryptis aurita*) was located a short distance to the west of the reserve.

Recreational Use and Potential: The meteorite crater is a major tourist attraction and, despite its remoteness, is visited by an increasing number of people, including organised bus tours.

Key Features: The meteorite crater, which has world significance. Only three other similar craters exist - in Arizona, Canada and Algeria.

CTRC Recommendation: "The Committee recommends that the classification be upgraded to A Class, and that the vesting remain unaltered."

EPA Recommendation: "The EPA recommends to the Department of Lands and Surveys that Wolfe Creek Crater reserve 29457, a geological site of world significance, vested in the National Parks Board, be upgraded to Class A."

Our Recommendation: The reserve is now Class A. We endorse the current purpose, status and vesting.

7

AREAS REQUIRING ADDITIONAL INVESTIGATION

Many important features of the Kimberley are not included in either existing or proposed reserves. We have insufficient information to make definite recommendations concerning some areas that have potential for reservation as national parks or nature reserves. These areas are discussed briefly below.

7.1 BURT RANGE - MOUNT ZIMMERMAN

Situated 25 km east of Kununurra, the Burt Range and Mt Zimmerman lie adjacent to the Keep River National Park in the Northern Territory. The conservation values of the Keep River National Park would be complemented by the creation of a corresponding national park in Western Australia.

Features of the area include rugged and dissected sandstone terrain, Aboriginal art sites, interesting fauna, including the Short-eared Rock-wallaby (*Petrogale brachyotis*), White-quilled Rock-pigeon (*Petrophassa albipennis*), Sandstone Strike-thrush (*Coluhricinch woodwardi*) and a variety of flora (including an undescribed fan palm, *Livistona*).

The area fronts the Duncan Highway at the border, and is strategically placed to intercept visitors. An information centre/quarantine facility could be incorporated in this area. The area is currently within Ivanhoe Station. Approximately 225 km² is proposed for investigation.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the Burt Range area and make recommendations concerning its future status. Discussions should be held with the Conservation Commission of the Northern Territory to ensure that mutually compatible boundaries are selected.

7.2 CAPE BOUGAINVILLE PENINSULA

Cape Bougainville Peninsula lies between Admiralty Gulf and Vansittart Bay. It consists of a plateau of bauxitic laterite overlying Carson Volcanic slopes.

The laterites support a different plant community from that at Mitchell Plateau, being mainly a *Eucalyptus* savannah woodland. Extensive rainforests, some of the largest and best developed in the State, are found below the edges of the lateritic plateau. Feral cattle have not yet entered this area, although populations exist nearby. The volcanics support a savannah woodland with tussock grasses.

The laterites have commercial potential for alumina production and are held as mineral tenements.

Recommendation: We recommend that when an Environmental Review and Management Plan is produced for the development of the bauxite, it include recommendations for the reservation and management of the rainforests.

7.3 CHEDDA CLIFFS, NAPIER RANGE

The 80 m high Chedda Cliffs extend for 56 kilometres to the north-west of Windjana Gorge National Park, forming the most westerly exposure of the Devonian fossil reef system. Parts of the range are scenically attractive, and parts are highly significant to the traditional Aboriginal owners of the area.

In this area, the range contains hanging valleys that form waterfalls at the cliff face with plunge pools below, cliff-foot caves and an "in-out" cave

near Barnet Spring. Also near Barnet Spring, a narrow, but very deep, vertical-walled gorge penetrates through the cliff into the range. Above the Old Napier Downs Cave lies the largest enclosed depression in the limestone ranges, and it exhibits interesting karst features such as pinnacles, corridor valleys and sink holes. Old Napier Downs Cave appears to be the outflow cave for the depression, and is situated in the outer wall of the Napier Range. It is horizontally developed and, while short, the cave is very big in cross-section (W.A. National Parks and Reserves Association, unpublished report to the EPA, 1978).

The range and its cliffs are situated on Kimberley Downs and Napier Downs Stations.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the conservation and recreation values of the Chedda Cliffs sector of the fossil reef and, after consultation with local Aboriginal people and the pastoral lease owners, make recommendations concerning its future status (see also Area 2.5).

7.4 COCKBURN RANGE

The Cockburn Range is an isolated mesa-form range at the head of Cambridge Gulf. It rises to 600 m, well above the local level of the Kimberley Plateau, and is bounded by scarps 300 m high. It has a capping of sandstone over shale.

Spectacular gorges and massive scree slopes are a feature of this precipitous sandstone range. Isolated rainforest patches are rich in species such as *Cryptocarya cunninghamii*, *Alstonia spectabilis* and the ferns *Lygodium microphyllum* and *Blechnum orientale*.

The range lies within El Questro Station.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the conservation and recreation values of the Cockburn Range and surrounds and make recommendations as to its future status.

7.5 ISLANDS IN TALBOT BAY

Talbot Bay, situated just to the south of Koolan Island, contains several fairly large islands. The islands are vacant Crown land. As discussed

previously, islands have major nature conservation values. These particular islands have not been examined by biologists.

Geologically the islands are part of Yampi Peninsula and would have been cut off from the Peninsula by rising sea levels about 8 000 years ago. Most islands are composed of the Yampi member of the Pentecost Sandstone. There are extensive adjacent mudflats and mangrove swamps.

Recommendation: We recommend that the Department of Conservation and Land Management conduct a biological survey of the islands in Talbot Bay. Until this is completed, any proposals for developing the islands should be referred by the Department of Land Administration to the EPA.

7.6 JOSEPH BONAPARTE GULF COASTAL LAND

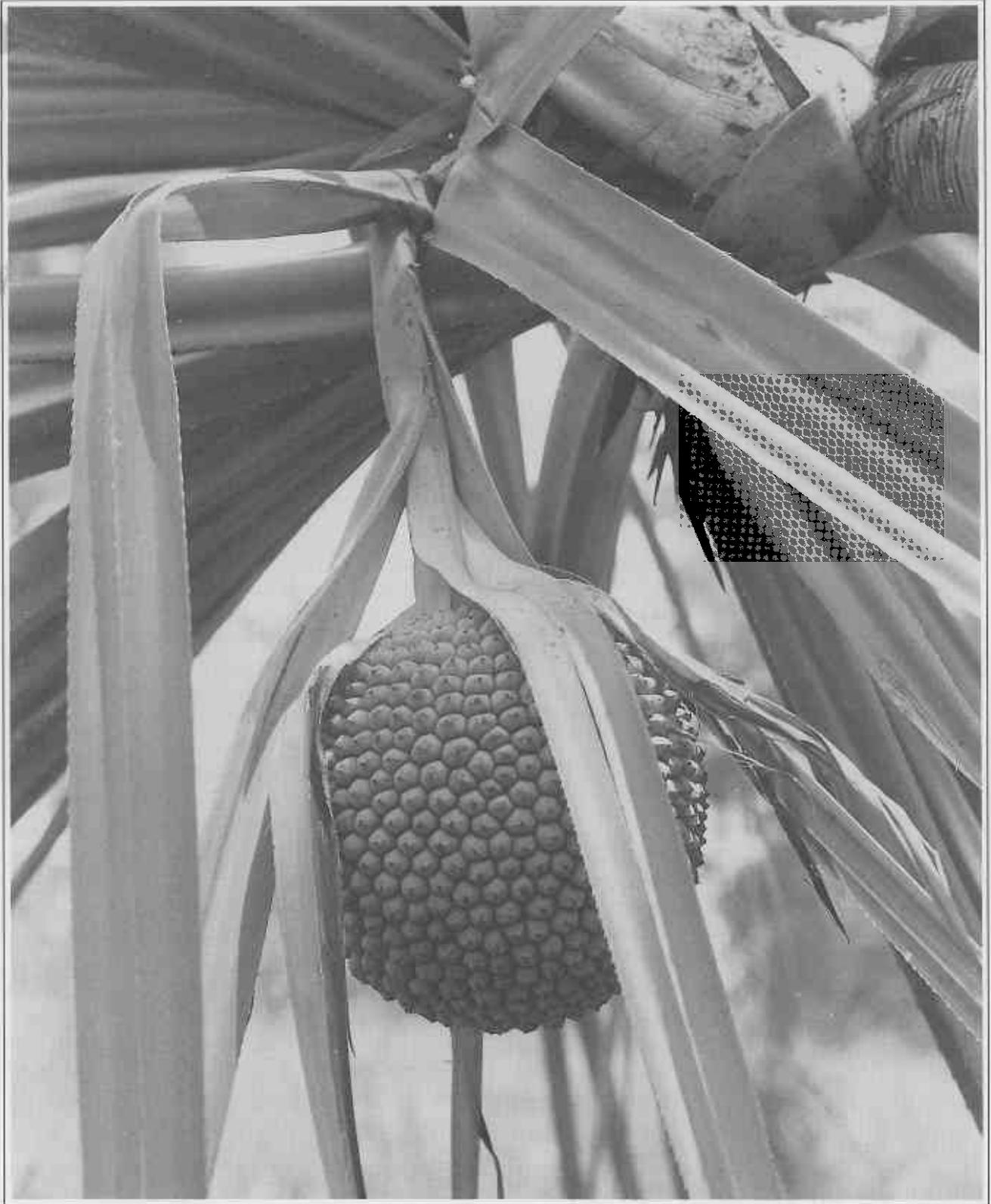
One hundred kilometres north of Kununurra lies a strip of coastal vacant Crown land, ranging in width from 2 to 8 km, which runs from the WA-NT border (129°E) to the mouth of Cambridge Gulf. Features include Shakespeare Hill and the Needles, extensive tidal mudflats and some *Eucalyptus tetradonta* woodland. There has been no biological survey work done in the area.

To the west, this land adjoins that proposed for reservation around the false mouths of the Ord (Area 3.4). The Ningbing Range (Area 7.9), part of the Denovian Reef System, also adjoins this area.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the area to determine its conservation potential and make recommendations concerning its future status. A marine/terrestrial reserve system should be considered, including the area from Lacrosse Island to Rocky Island and Pelican Island (Area 3.7).

7.7 KING LEOPOLD AND DURACK RANGES

The inland margin of the Kimberley Basin is delineated by the King Leopold Ranges in the south and the Durack Ranges in the east.



The River Screw Pine (Pandanus aquaticus) is found along the banks of permanent creeks and rivers.

Both ranges are belts of narrow, parallel, steep-sided flat-topped ridges, mainly of sandstone intruded by Hart Dolerite. Deeply incised valleys have formed in relatively erodible basalts and dolerites.

Parts of the ranges are scenically outstanding. Areas of very high landscape quality include:

- the Elgee Cliffs and Chamberlain River Valley;
- the passage of the Fitzroy River through the King Leopold Range, and adjacent escarpments, extending for 50 kilometres to the south-east;
- the highlands centred on Mounts Ord, Broome, Herbert, and Bell (125° 11'E to 125° 38'E, and 17° 3'S to 17° 30'S) (see also Area 4.8).

All three areas are presently leased for pastoral purposes.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the conservation and recreation values of the three areas and make recommendations concerning their future status.

7.8 LAWFORD RANGE

The Lawford Range is situated about 70 km south-east of Fitzroy Crossing. The range is composed of limestone - part of the Kimberley fossil barrier reef. It is scenically attractive and is adjacent to the Great Northern Highway. It is located on Gogo Station.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the conservation and recreation values of the Lawford Range and surrounds and make recommendations as to its future status.

7.9 NINGBING RANGE

Ningbing Range is situated 90 km north of Kununurra. It is composed of Upper Devonian quartz sandstone and limestone and is part of the Kimberley Devonian limestone reef complex that is better known in the Napier and Oscar Ranges.

The Ningbing Range is immediately adjacent to the proposed nature reserve including the false mouths of the Ord River (Area 3.4). It is within Carlton Hill Station.

Recommendation: We recommend that the Department of Conservation and Land Management

investigate the conservation values of the Ningbing Range and surrounding area and make recommendations as to its future status.

7.10 NORTH KIMBERLEY COAST, EAST OF CAPE LONDONDERRY

The coastline (and up to five to 10 kilometres inland) from Elsie Island (127° 43'E, 14° 15'S) to Cape Dussejour (128° 13'E, 14° 44'S) is scenic and diverse, comprising coastal cliffs, gorges, mangrove-lined bays, enormous sand dunes, and shallow sandplanes on horizontally-bedded sandstone strata.

At King George Falls, the King George River plunges spectacularly over a sandstone cliff into tidal waters. The base of the 100 m falls is accessible by boat from the Timor Sea, and is visited by an increasing number of tourists. Similar falls occur on Casuarina Creek, a tributary of the Berkeley River.

The majority of the area is Aboriginal Reserve, and the south-eastern sector is vacant Crown land.

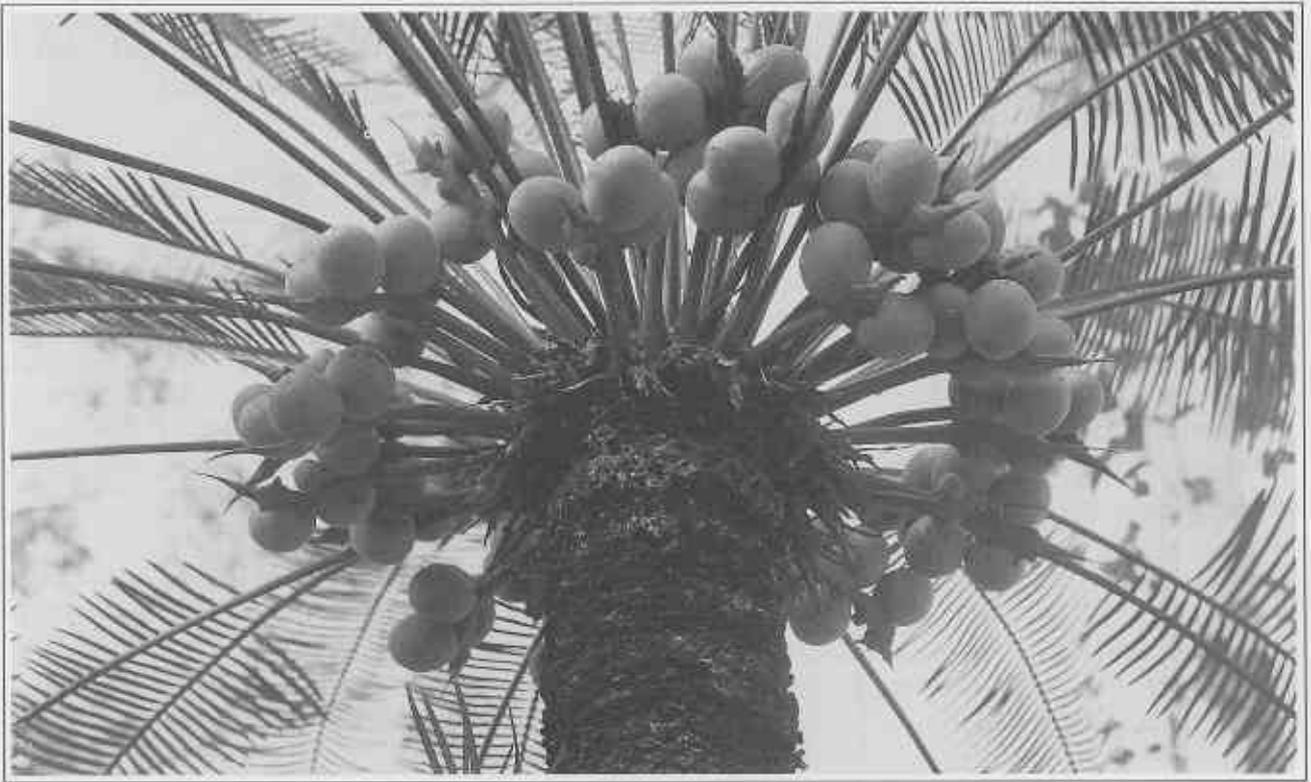
Recommendation: We recommend that the Department of Conservation and Land Management consult with Aboriginal people concerning the possibility of managing some of the area for conservation and recreation.

7.11 PENTECOST AND DURACK RIVER GORGES

The Durack and Pentecost Rivers and their tributaries in their descent to Cambridge Gulf have formed deep incisions through the sandstones of the Kimberley Basin. The extensive system of deep, steep-sided valleys and gorges that has resulted is spectacular, and has great recreational potential because it is located within 120 km of Kununurra.

Land tenure comprises Aboriginal Reserve, Home Valley and El Questro Stations.

Recommendation: We recommend that the Department of Conservation and Land Management determine suitable boundaries for these areas and institute negotiations for their reservation as national parks.



Cycads are widespread in northern Australia. This female plant of Cycas basaltica shows the palm-like fronds and modified leaves bearing large seeds.

||||||| 7.12 PHILLIPS RANGE

The Phillips Range straddles the Gibb River Road between Mt House and Mt Barnett Stations. Most of the Range is in a tongue of vacant Crown land lying between the two pastoral leases. Within and adjacent to the vacant Crown land are several scenic gorges: Manning, Adcock, Galvans, Isdell and Barnett Gorges.

The range and surrounding country are composed mainly of rugged King Leopold Sandstones.

The area is receiving increasing tourist use. During 1986, about 8 000 people in over 3 000 vehicles visited Mt Barnett, and most of these people visited Manning Gorge, which is only two kilometres from the station homestead. The increasing tourist pressure is starting to lead to environmental degradation around camping areas and water holes.

Local people have proposed that the Phillips Range area be declared a national park, and that areas of adjacent pastoral leases be added to the park so it includes the scenic gorges.

Recommendation: We recommend that the Department of Conservation and Land Management investigate the proposal to declare a Phillips Range National Park and report on boundaries and management costs.

||||||| 7.13 SAINT GEORGE RANGE

The St George Range is situated about 75 km south-west of Fitzroy Crossing, partly within Noonkanbah Station and partly within Cherrabun Station.

The area is scenically attractive and is near the boundary of Kimberley vegetation types and the Great Sandy Desert. The ranges are composed of heavily-faulted Permian sandstones and shales surrounded by Quaternary sandplains. It has not been examined by biologists.

Rock-wallabies have been reported there. If proven, this may be of considerable significance. The population of rock-wallabies in the Edgar Range (Area 2.3), not far to the west, is taxonomically distinct, and is extremely rare and possibly threatened with extinction. St George Range rock-wallabies may be the same taxon.

Recommendation: We recommend that the

Department of Conservation and Land Management conduct a biological survey of the St George Range and report on its nature conservation values.

||||||| 7.14 WEST CAMBRIDGE GULF

A strip of country approximately 15 km wide along the western side of Cambridge Gulf, between the Milligan Ranges and Cape Dussejour, is vacant Crown land.

It comprises the eastern edge of the Kimberley Basin, and includes massive outcrops of Pentecost and Warton Sandstones, as well as smaller areas of Elgee Siltstone, tidal mudflats and creek systems. The precipitous nature of the rock strata makes the area scenically attractive. There are extensive areas of mangrove and populations of the Saltwater Crocodile; otherwise, almost nothing is known of the area's flora and fauna.

There are no conservation reserves representing the coastal environments along the north-eastern edge of the Kimberley Basin. In fact, the entire north-eastern part of the Kimberley Basin is devoid of reserves for conservation.

Recommendation: We recommend that the Department of Conservation and Land Management conduct a biological survey of the western side of Cambridge Gulf and report on its nature conservation values.

||||||| 7.15 YAMPI PENINSULA

Much of the coastline, promontories and inlets of Yampi Peninsula comprise landscapes of great beauty and diversity. The large tidal range and narrow channels and entrances to inlets combine to produce tidal waterfalls in some locations.

Proterozoic rock formations comprising sandstone, siltstone and basalt give rise to the rugged ridges of the Peninsula. Doleritic intrusions are common.

The northern part of the Peninsula is Aboriginal Reserve, and the southern part Defence Reserve.

Recommendation: We recommend that any changes in land tenure in the area take into account the desirability that the coastal parts of the Peninsula become a national park.



NOTES

APPENDIX I

Comparison Between EPA and CALM Recommendations

KEY

NR	Nature Reserve
NP	National Park
MNR	Marine Nature Reserve
MNP	Marine National Park
MP	Marine Park
S	Recommended for biological survey or other investigations
A	Recommended negotiations with Aboriginal people concerning participation in management
*1_	EPA made a general recommendation for a biological survey of the Great Sandy Desert
*2_	EPA recommended a reserve, purpose not stipulated
++	Additions recommended

CALM No.	EPA No.	Locality	EPA Proposal	CALM Proposal
1.1	7.1.2	Adele Island	NR	NR, MNR
1.2	7.1.3	Browse Island	NR	NR, MNR
1.3	-	Rowley Shoals	-	MNP
2.1	-	Broome vine thickets	-	NR
2.2	7.3	Dampier Peninsula	NR(4)	NR(4), NP
2.3	7.3	Edgar Range	NR	NR
2.4	7.1.1	Lacepede Islands	NR	NR
2.5	7.15	Oscar & Napier Ranges	NP(3)	NP(4)++
2.6	-	Roebuck Bay	-	MP
3.1	-	Bungle Bungle	-	NP
3.2	7.18	Mirima (Hidden Valley)	NP	NP
3.3	7.10	Lake Argyle, Carr Boyd R	NP	NP
3.4	7.12	Ord River	NR	NR++
3.5	-	Packsaddle Swamps	-	NR
3.6	7.11	Parrys Lagoons	NR	NR++
3.7	7.2.6	Pelican Island	NR	NR
3.8	-	Point Spring	-	NR
4.1	7.2.4	Admiralty Gulf Islands	NR	NR
4.2	7.2.3	Bonaparte Archipelago	NR, A	NR, NP, A
4.3	7.2.3	Buccaneer Archipelago	S	MP, A
4.4	7.8	Cape Londonderry	NP	NP, MNP
4.5	7.9	Drysdale River	NP++	NP++
4.6	7.5	Hunter River	NR	NP++, A
4.7	7.2.2	Kingfisher Islands	-	NR
4.8	7.16	King Leopold Ranges	NP	NP
4.9	7.7	Mitchell Plateau	NP(2)	NP(2)
4.10	-	Montgomery Is & Reef	-	MP
4.11	7.5	Prince Regent	NR++	NP++ MNP(2)
4.12	7.13	Rust Range	S	S



CALM No.	EPA No.	Locality	EPA Proposal	CALM Proposal
4.13	7.2.5	Sir Graham Moore Islands	-	NR
4.14	7.4	Walcott Inlet	NP	NP, MNP
5.1	12.2	Mandora	S	NR
5.2	*1	McLarty Hills	S	NR
5.3	*1	Southesk Tablelands	S	NP
6.1	7.14	Gardiner Range	*2	NR
6.2	12.4	Lake Gregory	S	A
6.3	12.5	Wolfe Creek	NP	NP
7.1	-	Burt Range - Mt Zimmerman	-	S
7.2	-	Cape Bougainville Pen.	-	see text
7.3	-	Chedda Cliffs	-	S
7.4	-	Cockburn Range	-	S
7.5	-	Islands of Talbot Bay	-	S
7.6	-	Joseph Bonaparte Gulf Coastal Land	-	S
7.7	-	King Leopold & Durack Ranges	-	S
7.8	-	Lawford Range	-	S
7.9	-	Ningbing Range	-	S
7.10	-	Coast east of Cape Londonderry	-	S,A
7.11	-	Pentecost & Durack River Gorges	-	S
7.12	-	Phillips Range	-	S
7.13	-	St George Range	-	S
7.14	-	West Cambridge Gulf	-	S
7.15	-	Yampi Peninsula	-	NP



REFERENCES

- Allen, G.R. (1975). A preliminary checklist of the fresh water fishes of the Prince Regent River Reserve, North West Kimberley, Western Australia. In: Miles, J.M. & Burbidge, A.A. (Eds.). *A Biological Survey of the Prince Regent River Reserve, North-West Kimberley, Western Australia in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Anon. (1972). Adele Island report. SWANS. 3, 38-39. Australian Academy of Science (1962). Report of the Western Australian Sub-committee of the Australian Academy of Science Committee on National Parks. Cyclostyled.
- Australian Academy of Science (1965). *National parks and nature reserves in Western Australia*. (Australian Academy of Science and National Parks Board of Western Australia.)
- Bailey, W.J. & Richards, K.T. (1975). Insect fauna. In: Miles, J.M. & Burbidge, A.A. (Eds.). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Bannister, J.S. (1969). *A list of the species of mammals collected by W.H. Butler for the Archbold Collections of the American Museum of Natural History and the Western Australia Museum, 1963-1966*. Western Australian Museum Annual Report, pp 61-76.
- Beard, J.S. (1967). An inland occurrence of mangrove. *West. Aust. Nat.* 10, 112-115.
- Beard, J.S. (1969). Endemism in the Western Australian flora at the species level. *J. Roy. Soc. W. Austral.* 52, 18-20.
- Beard, J.S. (1976). The monsoon forests of the Admiralty Gulf, Western Australia. *Vegetatio* 31, 177-192.
- Beard, J.S. (1979). *The vegetation of the Kimberley area. Explanatory notes to map sheet 1 of Vegetation Survey of Western Australia: Kimberley*. (Univ. West. Aust. Press: Nedlands.)
- Beard, J.S., Clayton-Green, K.A. & Kenneally, K.F. (1984). Notes on the vegetation of the Bougainville Peninsula, Osborn and Institut Islands, North Kimberley District, Western Australia. *Vegetatio* 57, 3-13.
- Berry, P.F. & Marsh, L. (1986). History of investigation and description of the physical environment. In: Berry, P.F. (Ed.). *Faunal surveys of the Rowley Shoals, Scott Reef and Seringpatam Reef, north-western Australia*. Rec. West. Mus. Suppl. No. 25.
- Blake, D.H., Passmore, V.L. & Muhling, P.C. (1977). Billiluna 1:250 000. Geological Series. Bur. Miner. Res. Aust. Explanatory Notes. SE/52-14.
- Bungle Bungle Working Group (1986). *Final report to the Environmental Protection Authority*. (Dept. Cons. Env.: Perth.)
- Burbidge, A.A. (1975a). History of the Prince Regent River Reserve. In: Miles, J.M. & Burbidge, A.A. (Eds.). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. (1975b). Conclusions and recommendations. In: Miles, J.M. & Burbidge, A.A. (Eds.). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. (1977a). The history of the Drysdale River National Park. In: Kabay, E.D. & Burbidge A.A. (Eds) *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. (1977b). Conclusions and recommendations. In: Kabay, E.D. & Burbidge A.A. (Eds) *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)

- Burbidge, A.A. (1983). Amphibians and reptiles. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. (1987). Crocodile management in Western Australia. In: Webb, G.J.W., Manolis, S.C. & Whitehead, P.J. (Eds) *Wildlife management: crocodiles and alligators*. (Surrey Beatty and Sons: Sydney.)
- Burbidge, A.A., Marchant, N.G., McKenzie, N.L. & Wilson, P.G. (1978). Environment. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *The islands of the north-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 7. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. & McKenzie, N.L. (Eds) (1978a). *The islands of the north-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 7. (Dept. Fish. Wildl.: Perth.)
- Burbidge A.A. & McKenzie, N.L. (1978b) Introduction. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *The islands of the north-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 7. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. & McKenzie, N.L. (1978c) Conclusions and recommendations. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *The islands of the north-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 7. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. & Messel, H. (1979). *The status of the Salt-water Crocodile in the Glenelg, Prince Regent and Ord River systems, Kimberley, Western Australia*. Dept. Fish. Wildl. West. Aust. Rept. No. 34. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A. & McKenzie, N.L. (Eds) (1983). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A., McKenzie, N.L. & Start, A.N. (1983). Conclusions and recommendations. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- Burbidge, A.A., Fuller, P.J., Lane J.A.K. & Moore, S.A. (1987). Counts of nesting boobies and Lesser Frigatebirds on Western Australian islands. *Emu* 87, 128-9.
- Burbidge, N.T. (1960). The phytogeography of the Australian Region. *Aust. J. Bot.* 8, 75-211.
- Bustard, H.R. (1969). *The current status of crocodiles in Western Australia with recommendations for conservation and managed exploitation*. Report IV. Department of Fisheries and Fauna, Western Australia.
- Butler, W.H. (1971). Report on a survey of the vertebrate fauna of the Point Coulomb Flora and Fauna Reserve, Dampier Land, W.A. Unpublished report. Dept. Fish. Wildl. West. Aust.
- Butler, W.H. (1973). Extension of range of some Kimberley birds. *West. Aust. Nat.* 12, 166-167.
- Colless, D.H. (1983). Insects. In: McKenzie, N.L. (Ed.) *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- Common, I.F.B. (1981). Insects. In: McKenzie, N.L. (Ed.) (1981c). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- Common, I.F.B. & Upton, M.S. (1977). Insects. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Conservation Through Reserves Committee (1975). *Conservation reserves in Western Australia. Systems one to five, eight to twelve*. (Department of Conservation and Environment: Perth.)
- Conservation Through Reserves Committee (1977). *Conservation reserves in Western Australia. System seven*. (Department of Conservation and Environment: Perth.)
- Crowe, R.W.A. (1975). *The classification, genesis and evolution of sand dunes in the Great Sandy Desert*. Geol. Surv. of Western Australia Annual Report 1975.
- Crowe, R.W.A. & Muhling, P.C. (1977). Lucas 1:250 000. Geological Series. Bur. Miner. Res. Aust. Explanatory Notes. SF/52-2.
- Crowe, R.W.A., Towner, R.R. & Gibson, D.L. (1978). *Permian and Mesozoic geology of the Derby and Mt Anderson 1:250 000 sheet areas, Western Australia*. Record 1978/8 (Bur. Min. Res. Geol. Geophys.: Canberra) (unpubl.).
- Environmental Protection Authority (1975). *Conservation reserves for Western Australia. Systems 4, 8, 9, 10, 11, 12*. (Department of Conservation and Environment: Perth.)
- Environmental Protection Authority (1980). *Conservation reserves for Western Australia. System 7*. (Department of Conservation and Environment: Perth.)
- Forbes, S.J. & Kenneally, K.F. (1986). A botanical survey of Bungle Bungle and Osmond Range, south-eastern Kimberley, Western Australia. *West. Aust. Nat.* 16 (5-7), 93-170.
- Fuller, P.J. & Burbidge A.A. (1978). Additions to the avifauna of the Prince Regent River Nature Reserve. *West. Aust. Nat.* 14, 42-43.
- Gardner, C.A. (1944). *The vegetation of Western Australia*. Presidential Address, 1942. *J. Roy. Soc. W. Austral.* 28, IX - CXXXVII.

- Gellatly, D.C. & Sofoulis, J. (1973). 1:250 000 *Geological Series - Explanatory Notes*. Yampi, W.A. (Bur. Min. Res. Geol. Geophys.: Canberra.)
- George, A.S. & Kenneally, K.F. (1975). Flora. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- George, A.S. & Kenneally, K.F. (1977). Flora. In: Kabay, E.D. and Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- George, A.S. & Mitchell, A.S. (1983). Flora. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- Gibson, D.L. (1983). Geology. In: McKenzie, N.L. (Ed.) *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- Hnatiuk, R.J. & Kenneally, K.F. (1981). In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia*. (West. Aust. Mus.: Perth.)
- Hutchins, J.B. (1977). Freshwater fishes. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Johnstone, R.E. (1983). Birds. In: McKenzie, N.L. (Ed.) *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- Johnstone, R.E. & Smith, L.A. (1981). Birds of Mitchell Plateau and adjacent coast and lowlands, Kimberley, Western Australia. In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia*. (West. Aust. Mus.: Perth.)
- Johnstone, R.E., Smith, L.A. & Fuller, P.J. (1981). Birds. In: McKenzie, N.L. (Ed.). *Wildlife of the Edgar Ranges Area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- Kabay, E.D. & Burbidge A.A. (Eds) (1977). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Kabay, E.D., George, A.S. & Kenneally, K.F. (1977). The Drysdale River National Park environment. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Kenneally K.F. (1981). Flora. In: McKenzie, N.L. (Ed.) *Wildlife of the Edgar Ranges Area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- Kenneally, K.F. (1983). Flora. In: McKenzie, N.L. (Ed.) *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- Kerr, A. (1975). *Australia's North-West*. (University of West. Aust. Press, Nedlands), 2nd Ed.
- Kimberley Region Planning Study (1987). *Information bulletin no. 2*. (State Planning Commission: Perth.)
- King, P.P. (1827). *Narrative of a survey of the intertropical and western coasts of Australia, performed between the years 1818 and 1822*. (John Murray, London.)
- Kitchener, D.J. (1978). Mammals of the Ord River area, Kimberley, Western Australia. *Rec. West. Aust. Mus.* 6 (2), 189-219.
- Kitchener, D., Keller, L.E., Chapman, A., McKenzie, N.L., Start, A.N. & Kenneally, K.F. (1981). Observations on mammals of the Mitchell Plateau area, Kimberley, Western Australia. In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia*. (West. Aust. Mus.: Perth.)
- McCall, G.J.H. (1965). Possible meteorite craters - Wolf Creek, Australia and analogs. *Annals of the New York Academy of Sciences* 123, 970-998.
- McKenzie, N.L. (Ed.) (1981a). *Wildlife of the Edgar Ranges Area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. (1981b). Conclusions and recommendations. In: McKenzie, N.L. (Ed.). (1981c). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. (1981c). Mammals of the Phanerozoic South-west Kimberley - biogeography and recent changes. *J. Biogeog.* 8, 263-280.
- McKenzie, N.L. (1983a). Mammals. In: McKenzie, N.L. (Ed.). *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. (1983b). Conclusions and recommendations. In: McKenzie, N.L. (Ed.). *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L., Chapman, A. & Youngson, W.K. (1975). Mammals. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish.

- Wildl.: Perth.)
- McKenzie, N.L., Chapman, A., Youngson, W.K. & Burbidge, A.A. (1977). The mammals of the Drysdale River National Park, north Kimberley, Western Australia. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L., Burbidge, A.A., Chapman, A. & Youngson, W.K. (1978). Mammals. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *The islands of the north-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 7. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. & Kenneally, K.F. (1981). Background. In: McKenzie, N.L. (Ed.). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. & Kenneally, K.F. (1983). Background and Environment. In: McKenzie, N.L. (Ed.). *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia*. Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L., Burbidge, A.A., George, A.S. & Mitchell, A.S. (1983). Environment. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. & Youngson, W.K. (1983). Mammals. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia*. Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- McKenzie, N.L. & Rolfe, J.K. (1986). Structure of bat guilds in the Kimberley mangroves, Australia. *J. Anim. Ecol.* 55, 401-420.
- McKenzie, N.L. & Start, A.N. (1989). Structure of bat guilds in mangroves: environmental disturbance and determinism. In: Morris, D.W., Abramsky, Z., Fox, B.J. & Willig, M.R. (Eds). *Patterns in the structure of mammalian communities*. (Texas Tech. Univ.: Lubbock.)
- Merrifield, H.E., Slack-Smith, S.M. & Wilson, B.R. (1977). Mollusc fauna. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975*. Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Messel, H., Burbidge, A.A., Wells, A.G. & Green, W.G. (1977). *The status of the Saltwater Crocodile in some river systems of the north-west Kimberley, Western Australia*. Dept. Fish. Wildl. West. Aust. Rept. No 24. (Dept. Fish. Wildl.: Perth.)
- Messel, H., Burbidge, A.A., Vorlicek, G.C., Wells, A.G., Green, W.J., Onley, I.C. & Fuller, P.J. (1987). *Surveys of tidal river systems in the Northern Territory and their crocodile populations*. Monograph 20. Tidal waterways of the Kimberley surveyed during 1977, 1978 and 1986. (Pergamon Press: Sydney.)
- Miles, J.M. & Burbidge, A.A. (Eds) (1975). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Miles, J.M., Kenneally, K.F. & George, A.S. (1975). Environment. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974*. Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Morgan, J.S. (1955). *Report on the Central North Kimberley Region. North Kimberley Survey and Mapping Expedition, 1954*. Department of Lands and Surveys, Perth.
- Paterson, S.J. (1970). *Geomorphology of the Ord - Victoria area*. CSIRO Land Research Series No. 28. (CSIRO: Melbourne.)
- Plum, K.A. & Perry, W.J. (1971). *1:250 000 Geological Series - Explanatory Notes*. Medusa Banks, W.A. (Bur. Min. Res. Geol. Geophys.: Canberra.)
- Plum, K.A. & Veevers, J.J. (1971). *1:250 000 Geological Series - Explanatory Notes*. Cambridge Gulf, W.A. (Bur. Min. Res. Geol. Geophys.: Canberra.)
- Serventy, D.L. (1952). Bird Islands of the Sahul Shelf. *Emu* 52, 33-39.
- Smith, L.A. & Johnstone, R.E. (1981). Amphibians and reptiles of Mitchell Plateau and adjacent coast and lowlands, Kimberley, Western Australia. In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia*. (West. Aust. Mus.: Perth.)
- Soderburg, R. (1918). Results of Dr. E. Mojberg's Swedish scientific expeditions to Australia, 1910-1913. XVIII. Studies of the birds in North-West Australia. *Kungl. Svenska Vet. Akademiens Handlingar* 52. No. 17.
- Solem, A. (1979). Camaenid land snails from western and central Australia (Mollusca: Pulmonata: Camaenidae). I. Taxa with trans-Australian distributions. *Rec. West. Aust. Mus. Suppl.*, 10, 1-142.
- Solem, A. (1981). Camaenid land snails from western and central Australia (Mollusca: Pulmonata: Camaenidae). II. Taxa from the Kimberley, Amphirhagada Iredale, 1933. *Rec. West. Aust. Mus. Suppl.*, 11, 147-320.
- Solem, A. (1984). Camaenid land snails from western and central Australia (Mollusca: Pulmonata: Camaenidae). IV. Taxa from the Kimberley, Westraltrachia Iredale, 1933 and related genera. *Rec. West. Aust. Mus. Suppl.* 17, 427-705.

- Solem, A. (1985). Camaenid land snails from western and central Australia (Mollusca: Pulmonata: Camaenidae). V. Remaining Kimberley taxa and addenda to the Kimberley. *Rec. West. Aust. Mus. Suppl.* 20, 707-981.
- Speck, N.H., Wright, R.L., & Rutherford, G.K. (1964). *General Report on Lands of the West Kimberley Area, W.A.* CSIRO Aust. Land Res. Ser. No. 9.
- Start, A.N. & Fuller, P.J. (1983). Birds. In: Burbidge, A.A. & McKenzie, N.L. (Eds). *Wildlife of the Great Sandy Desert, Western Australia.* Wildl. Res. Bull. West. Aust. No. 12. (Dept. Fish. Wildl.: Perth.)
- Stewart, G.A., Perry, R.A., Paterson, S.J., Sleeman, J.R. & Traves, D.M. (1970). *Land systems of the Ord - Victoria area.* Land Research Series No. 28. (CSIRO: Melbourne.)
- Storr, G.M. & Smith, L.A. (1975). Amphibians and reptiles. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974.* Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Storr, G.M., Johnstone, R.E., Dell, J. & Smith, L.A. (1975). Birds. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974.* Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Storr, G.M. & Smith, L.A. (1977). Amphibians and reptiles. In: Kabay, E.D. & Burbidge A.A. (Eds). *A biological survey of the Drysdale River National Park, north Kimberley, Western Australia, in August 1975.* Wildl. Res. Bull. West. Aust. No. 6. (Dept. Fish. Wildl.: Perth.)
- Storr, G.M. & Johnstone, R.E. (1981). Amphibians and reptiles. In: McKenzie, N.L. (Ed.). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia.* Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)
- Storr G.M. & Johnstone, R.E. (1983). Amphibians and reptiles. In: McKenzie, N.L. (Ed.). *Wildlife of the Dampier Peninsula, South-west Kimberley, Western Australia.* Wildl. Res. Bull. West. Aust. No. 11. (Dept. Fish. Wildl.: Perth.)
- Teichert, C. & Fairbridge, R.W. (1948). Some coral reefs of the Sahul Shelf. *Geog. Rev.* 38, 222-249.
- Thom, J.H. (1975). Kimberley region. In: *Geology of Western Australia.* West. Australia Geol. Survey Mem. 2, pp. 160-193.
- Towner, R.R., Crowe, R.W.A. & Yeates, A.N. (1976). *Notes on the geology of the southern part of the Canning Basin.* Record 1976/95. (Bur. Min. Res. Geol. Geophys.: Canberra.) (Unpublished)
- Towner, R.R. & Gibson, D.L. (1980). *Geology of late carboniferous and younger rocks of the onshore western Canning Basin, Western Australia.* Record 1980/30. (Bur. Min. Res. Geol. Geophys.: Canberra.) (Unpublished)
- Trendall, A.F. & Cope, R.N. (1975). Areas between the Kimberley region and the Musgrave Block. In: *Geology of Western Australia.* West. Australia Geol. Survey, Mem. 2, pp. 205-16.
- van der Graaf, W.J.E., Crowe, R.W.A., Bunting, J.A. & Jackson, M.J. (1977). Relict early Cainozoic drainages in arid Western Australia. *Z. Geomorph. N. F.* 21(4), 379-400.
- Wells, A.G. (1981). A survey of riverside mangrove vegetation fringing tidal river systems of Kimberley, Western Australia. In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia.* (West. Aust. Mus.: Perth.)
- Western Australian Museum (1981). *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia.* (West. Aust. Mus.: Perth.)
- Williams, I.R. & Sofoulis, J. (1971). *Prince Regent and Camden Sound, W.A.* 1:250 000 Geological Series. Bur. Miner. Res. Aust. Explanatory Notes. SD. 5/1 - 15.
- Wilson, B.R. (1981). General introduction. In: Western Australian Museum. *Biological survey of Mitchell Plateau and Admiralty Gulf, Western Australia.* (West. Aust. Mus.: Perth.)
- Wilson, B.R. & Smith, P.R. (1975). Mollusc fauna. In: Miles, J.M. & Burbidge, A.A. (Eds). *A biological survey of the Prince Regent River Reserve, north-west Kimberley, Western Australia, in August 1974.* Wildl. Res. Bull. West. Aust. No. 3. (Dept. Fish. Wildl.: Perth.)
- Wyrwoll, K.-H., McKenzie, N.L., Pederson, B.J. & Tapley, I.J. (1986). The Great Sandy Desert of north Western Australia: the last 7 000 years. *Search* 117(7-9), 208-210.
- Yeates, A.N., Crowe, R.W.A., Towner, R.R., Wyborn, L.A.I. & Passmore, V.L. (1975). *Notes on the geology of the Gregory Sub-Basin and adjacent areas of the Canning Basin, Western Australia.* Record 1975/77. (Bur. Min. Res. Geol. Geophys.: Canberra.) (Unpublished)
- Young, C. (1981). Dragon Tree Soak - an oasis in the Great Sandy Desert. *Swans* 11, 17-20.
- Youngson, W.K., Henry, J. & McKenzie, N.L. (1981). Mammals. In: McKenzie, N.L. (Ed.). *Wildlife of the Edgar Ranges area, South-west Kimberley, Western Australia.* Wildl. Res. Bull. West. Aust. No. 10. (Dept. Fish. Wildl.: Perth.)