ROEBUCK BAY

BACKGROUND INFORMATION FOR THE CONSERVATION OF A WETLAND OF INTERNATIONAL IMPORTANCE

A Report to the

Western Australian Department of Conservation and Land Management

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January 1993

Cover Photo: Transequatorial migratory waders; Roebuck Bay, March 1992;
A.G. Wells, FRPS EFIAP AAP.

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ACCOMPANYING DOCUMENTS

This report has drawn from numerous State and Local Government planning studies and from other documents concerning the conservation values of the Bay, marine parks in Western Australia and potentially threatening activities. For reference, two sets of these documents have been lodged with this report - one in the Library of the WA Department of Conservation and Land Management, the other with the Australian National Parks and Wildlife Service, Canberra.

1. BACKGROUND

In February 1990, the high conservation value of Roebuck Bay was formally recognised by the Western Australian Government when it nominated the area to the Commonwealth Government for listing under the (Ramsar) "Convention on Wetlands of International Importance, Especially as Waterfowl Habitat" (Department of Conservation and Land Management 1990). The two principal conservation values recognised for the area were its importance to migratory shorebirds and its significance as a tropical marine embayment.

Research conducted by the Royal Australasian Ornithologists Union has shown that Roebuck Bay is internationally important for 18 species of shorebirds and nationally important for an additional two species (Watkins in press). Up to 170 900 shorebirds have been counted in Roebuck Bay at one time (Lane 1987).

In addition to the Ramsar Convention, Australia is a party to three other international conservation agreements that relate to shorebird conservation. These are the Japan-Australia Migratory Bird Agreement, the China-Australia Migratory Bird Agreement and the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention). These treaties commit the Australian Government to protect migratory birds and their habitat.

To protect Roebuck Bay, the Department of Conservation and Land Management has proposed that it be declared a marine park (Burbidge et al. 1987). This is one of several marine park proposals being considered by a working group, appointed by the Minister for the Environment, which will report on establishing a system of marine conservation reserves in Western Australia.

To assist in the development of protection measures for Roebuck Bay, this report was commissioned by the Department of Conservation and Land Management with funding from the Australian National Parks and Wildlife Service.

The brief for the work was to develop a database, on the Roebuck Bay area, which encompasses the following areas of interest:

"(a) tenure and status of land and water,
(b) landform and vegetation types (habitats) and factors affecting viability,
(c) key habitats for different animal species or groups (i.e. feeding and resting areas for waders, breeding habitats, etc.),
(d) seasonal requirements for different groups or species,
(e) floristic associations in need of special protection,
(f) potential conflicts arising from existing adjacent land use or proposed use,
(g) parameters required for total catchment protection and management of key wetlands and other habitats of priority value,
(h) key seasonal periods when protection of fauna from disturbance is critical,
(i) definition of management objectives and strategies to ensure protection of habitats (in particular wetlands),
(j) identification of sites suitable for development as observation points for observing waders".

As this work is aimed at assisting in the development of strategies for the conservation of Roebuck Bay, additional material has been included and the report has been presented in a landuse planning format.

In addition to this study of Roebuck Bay, a scientific working group is to report on the selection of Marine Parks and Reserves in Western Australia. Proposals for Roebuck Bay presented in this report will need to be viewed in the light of the recommendations of the State-wide review.

2. ROEBUCK BAY STUDY AREA

The study area covers the coast from Gantheaume Point south to Cape Villaret. These are the coastal extremities of the Bay. Above the high water mark, the study area extends inland to include the supratidal flats and adjacent pindan. The area includes the waters of Roebuck Bay and extends out to the edge of the State Territorial Sea (Figure 1).

This report does not deal in detail with the section of coast from Gantheaume Point to the Port as this relatively small area at the north-western extremity of the Bay has been addressed in three previous studies (Chalmers and Woods 1987, Department of Planning and Urban Development 1990, Broome Task Force 1992).

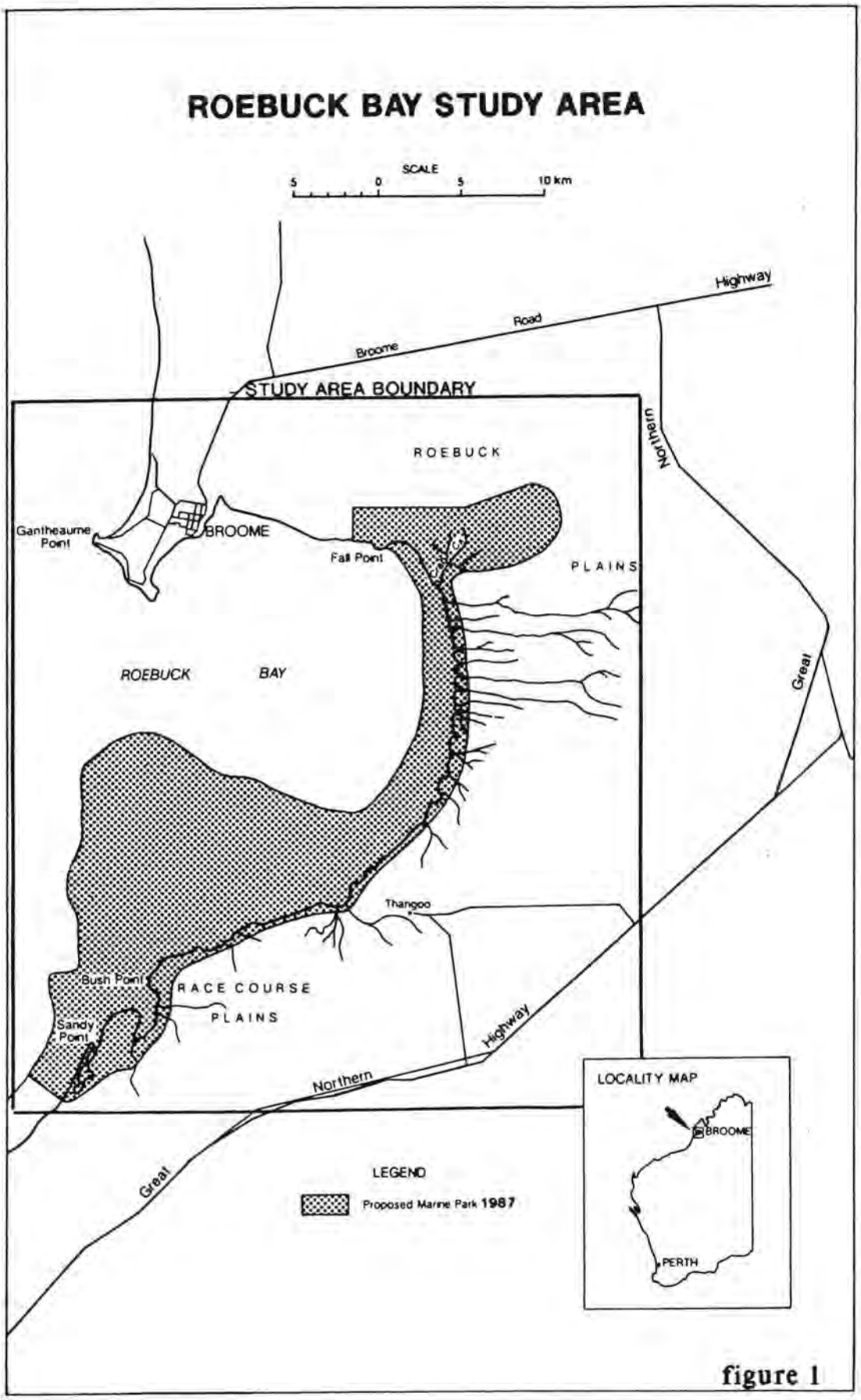

ROEBUCK BAY STUDY AREA
SCALE
5 0 5 10 km
Broome
Road
Highway
STUDY AREA BOUNDARY
ROEBUCK
Northern
Gantheaume Point
BROOME
Fall Point
PLAINS
ROEBUCK
BAY
Great
Thangoo
Bush Point
RACE COURSE
PLAINS
Sandy Point
Highway
Northern
Great
LEGEND
Proposed Marine Park 1987
LOCALITY MAP
BROOME
PERTH

figure 1

3. THE ECOLOGY OF ROEBUCK BAY

The ecology of the Roebuck Bay area is greatly influenced by soil characteristics, climate, landform and coastal processes. These are important factors in determining the vegetation which in turn influences the fauna.

3.1 PHYSICAL PROCESS

3.1.1 Geology

Roebuck Bay is situated in an area geologically termed the northern Canning Basin. The geology of the area has been mapped at a scale of 1:250 000 scale (Gibson 1983a, 1983b) and has been reviewed in a number of publications on the Broome area (Lohn 1984, Chalmers and Woods 1987, Department of Planning and Urban Development 1990, Broome Planning Taskforce 1992). The review given in the "Broome Coastal Management Plan" (Chalmers and Woods 1987) is recommended as the most applicable to understanding the ecology of the Bay.

Seven geological structures can be observed around Roebuck Bay. Five of these are superficial deposits of sand, silt, clay and some gravel formed during the Quaternary period.

The most dominant structure is the fine to medium red sand, called pindan, which is characteristic of the town, Broome Road and much of the Northern Highway. This sand is wind-borne (aeolian) from the dunes in the Great Sandy Desert. The pindan is between two to six metres in depth.

The second most extensive feature is the grey clay, silt and sand of the supratidal mud flats. This can be seen on the grass plains behind Dampier Creek and on Roebuck Plains.

A similar structure, but with a higher clay and organic content, occurs under the mangrove stands of Dampier Creek and from Crab Creek south around the Bay to Sandy Point.

Near the Port an area of white calcareous sand occurs that has been blown up into high dunes. These are called the Roebuck Dunes.

There are also some small areas of water-borne (alluvial) and estuarine (lacustrine) sand, silt and clay near Thangoo Station homestead.

These five superficial deposits overlay a thin lateritic layer called the Bossut Formation which is on top of the Broome Sandstone. The Bossut Formation and the top of the Broome Sandstone can be seen along the shoreline from Gantheaume Point to the Port and around Fall Point. The Broome Sandstone is of considerable interest because it contains plant fossils, microfossils and dinosaur footprints.

The Broome Sandstone is estimated to be 240 m thick (Gibson 1983a). Beneath this there are several other layers before meeting the Precambrian igneous, metamorphic and sedimentary rocks that form the basement of the Canning Basin.

3.1.2 Landform

Sea level changes have been a major factor in the development of the soils and the formation of the modern day landforms in the Roebuck Bay area.

The Broome Sandstone, that underlies most of the area, is considered to have formed from the deposition of sand and mud in a shallow sea about 130 million years ago (Gibson 1983a).

This was followed by many changes in sea level. During the drier and lower sea level period of the late Tertiary, the pindan sands were blown into the area. About 1 million years ago the low areas around the bay were flooded and the sediments of the tidal flats were deposited as the pindan sands were reworked. The substrate of the mud flats near Crab Creek is described as very soft and muddy with silt content ranging from 40% to 73% (mean = 52.2%, SD=12.5%, n=7) (Tulp and de Goeij in prep).

A sea level drop to minus 100 m occurred about 30 000 years ago during the last ice age. During this period, the deep gorge of the Roebuck Deep and the Inner Anchorage were formed by water running off Roebuck Plains (Chalmers and Woods 1987).

The sea level rose again to its present level about 6 000 years ago. In areas where the sea has come against the pindan dunes these have been eroded to form cliffs. This is characteristic of the coast between Dampier Creek and Crab Creek. The shoreline in these areas continues to erode at a rate of 300 mm per year, although during a cyclone in February 1985 the rate was measured at 600 - 1 500 mm per day (Chalmers and Woods 1987).

3.1.3 Climate

Broome has a tropical monsoon climate, with a mean annual rainfall of 512 mm. The dry season occurs from May to October when the rainfall is generally less then 25 mm. During the wet season from November to April the rainfall increases to about 500 mm.

Mean monthly maximum temperatures range between 20 ^{o}C and 34 ^{o}C, while minimums range between 14 ^{o}C and 29 ^{o}C. The hottest months are March and April while the coolest are June and July.

Broome is subject to cyclones. With winds over 160 km/h and intense rainfall, these can cause massive erosion and damage to vegetation. In the past 70 years, 11 cyclones have passed within 50 km of Broome and a further 29 have passed within 150 km (Department of Planning and Urban Development 1990).

3.1.4 Coastal Processes

A massive tidal range is a dominant feature of Roebuck Bay. Spring tides may exceed 9 m while neaps fall to 0.5 m. The area of mudflat exposed during neap tides is 10% of that exposed during spring tides. The tide moves at 0.2 m/s at during spring tides, measured at 20 m from the tide line (Tulp and de Goeij in press).

The rough seas and heavy swells associated with cyclones have been suggested as the dominant process in shaping the coastline around Broome (Chalmers and Wood 1987).

3.2 BIOLOGICAL PROCESSES

3.2.1 Vegetation

The vegetation of the Kimberley has been studied and mapped at a scale of 1:1 000 000 (Beard 1979). This work divided the Kimberley into four botanical districts with the area around Broome falling within the Dampier Botanical District. More detail descriptions of the flora and vegetation of the area have been given in a biological survey of the Dampier Peninsula (McKenzie 1983) and the Broome Coastal Management Plan (Chalmers and Woods 1987).

Hydrology, soils and landform are the dominant factors in determining the distribution of vegetation in the area.

3.2.1.1 Seagrass Beds

Extensive seagrass beds occur in Roebuck Bay (Prince 1986). The two major species are *Halophila ovalis* and *Halodule uninervis*. The most vigorous stands grow in areas that are only exposed for less then two hours at low tide.

No information is available on the vegetation of the deeper water areas in Roebuck Bay or on the rocky substrate.

3.2.1.2 Mangroves

The term mangal is used generally to describe the mangrove plant community (Macnae 1968). Mangals occur around the coast of Western Australia north of Shark Bay, with an isolated stand at Bunbury. The distribution of mangal in Western Australia has been divided into four biogeographic regions (Semeniuk et al. 1978). Broome is situated in the middle of the tropical semi-arid (Semeniuk et al. 1978) or south-west Kimberley region (Johnston 1990). This region runs from Cape Leveque, near the northern tip of the Dampier Peninsula, south to Whistle Creek at the northern end of Eighty Mile Beach (Johnston 1990).

Within Roebuck Bay, Johnston (1990) divides the mangal into a northern and southern section. The Broome section is estimated to cover 640 ha and consists of a low open to closed forest of *Avicennia marina*, *Aegiceras corniculatum*, *Camptostemon schultzii* and *Rhizophora stylosa* with some adjacent patches of *Aegialitis annulata* shrubland. The common species on the landward and seaward edge of the mangroves is *Avicennia marina*. Scattered shrubs and trees of *Excoecaria agallocha* occur on the outer fringe.

The 200 ha Thangoo section is described as a mixed woodland (to 5m) of *Avicennia marina, Bruguiera exaristata, Osbornia octodonta and Camptostemon schultzii. Ceriops tagal* occurs as closed thickets on the landward zone with some *Excoecaria agallocha* (Johnston 1990).

The mangal has its highest diversity and tallest trees in Dampier and Crab Creek and in the inlet between Bush and Sandy Point. In these areas there is distinct zonation of the mangal. Factors that determine this are: frequency of flooding by tidal waters, soil type, soil salinity, drainage, plant interactions and animal interactions (Semeniuk et al. 1978). The typical sequence of species moving landward is *Avicennia*, *Rhizophora*, *Ceriops* and samphire or salt flats (Chalmers and Woods 1987).

Landward of the mangroves are areas of bare flats which are inundated on high spring tides. The hypersalinity of the soil in these areas inhibits the establishment of vegetation.

Several of the mangrove species provide important food sources for honeyeaters and bats during flowering and fruiting.

3.2.1.3 Samphire Flats

Samphire flats extend from the landward edge of the mangroves and the bare flats. The dominant species in this community are: *Halosarcia halocnemoides, Neobassia astrocarpa, Sueda ardusculoides, Sesuvium portulacastrum, Hemichroa diandra* and *Limonium salicorniaceum* (Chalmers and Woods 1987). These flats may be inundated by some high tides.

3.2.1.4 Saline Grasslands

The saline grassplains are slightly higher in elevation than the samphire flats and the soil has a lower salinity. The dominant species is *Sporobolus virginicus* (Salt Water Couch) which forms a dense grassland 15-20 cm tall. Other species are *Dicanthium fecundum*, *Eragrostis falcata* and *Salsola kali*.

Towards the edge of the grassplains are thickets of *Melaleuca acacioides* which grow to 10 m in height.

3.2.1.5 Pindan

The dominant vegetation type on inland areas around Broome is called pindan. This vegetation type is very common in the south-western Kimberley covering 55 000 km^2 or 65% of the Damperland region (Beard 1984).

Pindan occurs adjacent to Roebuck Bay inland from the low cliffs between Fishermans Bend and Crab Creek. Here the pindan has scattered trees over a dense layer of *Acacia* to 4 m in height. *Acacia eriopoda* is the characteristic species.

The main tree species are: *Eucalyptus* aff. *papuana*, *Eucalyptus* aff. *terminalis*, *Gyrocarpus americanus*, *Terminalia petiolaris*, *Lysiphyllum cunninghamii*, *Ventilago viminalis*, *Canthium attenuatum*, *Premna acuminata*, *Hakea macrocarpa*, *Persoonia falcata*, *Atalaya hemiglauca*, and *Gardenia pyriformis*.

The main shrub species are: *Acacia eriopoda*, *Acacia holosericea*, *Acacia adoxa*, *Pavetta brownii*, *Carissa lanceolata*, *Distichostemon hispidulus*, *Ehretia saligna* and *Santalum lancolatum*.

Other species include: mistletoes - *Amyeira bethamii* and *Lysiana spathulata*, climbers - *Jasminium didymum* and *Jacquemontia paniculata*, and grasses - *Plectrachne pungens*, *Heteropogon contortus* and *Chrysopogon fallax*.

Fire has a major influence on the structure of the pindan. Beard (1967) has described this as:

> *"... fire destroys the ground layer and the middle Acacia layer leaving the trees intact. The grasses regenerate from seed or rhizomes, the Acacia from seed. The grasses quickly re-establish and for the first season or two after fire the pindan has the aspect ... of a tree savanna. Gradually the Acacia shrubs regenerate, grow taller and become dominant, suppressing the grasses forbs and small woody plants. After a certain number of years the aspect is three-layed, with scattered trees, a shrub thicket and a sparse ground layer. Later still the Acacia individuals reach the height of the trees, which disappear from view giving the aspect of a tall thicket or a low forest of Acacia".*

3.2.2 Fauna

3.2.2.1 Terrestrial Mammals

A zoogeographical study of the terrestrial mammal fauna of the South-west Kimberley found it to be an interzone between the fauna of the North Kimberley and the Great Sandy Desert. It shared 60% similarity with the North Kimberley and 32% similarity with the Great Sandy Desert (McKenzie 1981).

Two extensive mammal surveys have been conducted in the south-western Kimberley. These were of the Edgar Ranges area (McKenzie 1981) and the Dampier Peninsula (McKenzie 1983). While data collection was limited in areas adjacent to Roebuck Bay, the surveys did include similar vegetation types.

The Edgar Ranges area was studied by the then Department of Fisheries and Wildlife in the late 1970's (McKenzie 1981). The study area was adjacent to the inland boundaries of Roebuck Plains and Thangoo Stations. Data were collected from nine major study sites, two of which had pindan vegetation. The survey recorded 24 native species of which 16 were present in the pindan vegetation (Table 1).

The second major survey, also conducted by the then Department of Fisheries and Wildlife, was of the wildlife of the Dampier Peninsula (McKenzie 1983). The survey covered seven habitat types in the Coulomb area and eight in the Borda and Cygnet Bay areas. The report documented the occurrence of 33 species of native mammals on the Dampier Peninsula in the past 200 years (Table 1).

Five of these species have not been confirmed on the Peninsula this century; Boodie, Sugar Glider, Golden Bandicoot, Brush-tailed Phascogale and Golden-backed Tree-Rat. There is however, one unconfirmed record of a Sugar Glider in 1970 and of a Golden-backed Tree-Rat in 1971 (McKenzie 1983). The Boodie and Golden Bandicoot are both on the list of declared rare fauna under the Western Australian Wildlife Conservation Act.

Some data have also been collected on mammals by Broome Bird Observatory (Table 1). This list is valuable in that it refers to the areas directly adjacent to the northern end of Roebuck Bay.

The insectivorous bats of the mangroves at Crab Creek have been studied as part of a larger study of the bat guilds in the Kimberley mangroves (McKenzie and Rolf 1986). The species recorded were: *Taphozous flaviventris*, *Chaerephon jobensis*, *Mormopterus loriae*, *Chalinolobus gouldii*, *Nycticeius greyi*, *Pipistrellus tenuis* and *Nyctophilus arnhemenis*.

Two species of flying foxes (*Pteropus alecto* and *Pteropus scapulatus*) and one blossom bat (*Macroglossus lagochilus*) also occur at Broome. Flying foxes are known to form large camps in the mangroves at Dampier Creek and can be observed dispersing from this area at dusk. Some damage is caused to local horticultural crops by the flying foxes.

Table 1 Mammals known from the Dampier Peninsula and west of the Edgar Ranges (excluding species that occur in rocky habitats).

Species	Scientific Name	Study Area 1	2	3
Native				
Red Kangaroo	*Megaleia rufa*	X	X	
Agile Wallaby	*Macropus agilis*		X	X
Northern Nail-tailed Wallaby	*Onychogalea unguifera*		X	
Boodie	*Bettongia lesueur*		X	
Scaly-tailed Possum	*Wyulda squamicaudata*		?	
Northern Brush Possum	*Trichosurus arnhemensis*		X	
Sugar Glider	*Petaurus breviceps*		X	
Dalgyte	*Macrotis lagotis*	X	X	
Golden Bandicoot	*Isoodon auratus*		X	
Brush-tailed Phascogale	*Phascogale tapoatafa*		X	
Common Planigale	*Planigale maculata*	X	X	
Water Rat	*Hydromys chrysogaster*		X	
Golden-backed Tree-Rat	*Mesembriomys macrurus*		X	
? Dunnart	*Sminthopis youngsonii*	X		
Western Chestnut Mouse	*Pseudomys nanus*	X	X	X
Delicate Mouse	*Pseudomys delicatulus*	X	X	
Little Red Flying Fox	*Pteropus scapulatus*	X	X	
Black Flying Fox	*Pteropus alecto*	X	X	
Northern Blossum Bat	*Macroglossus lagochilus*		X	
Yellow-bellied Sheath-tail Bat	*Taphozous flaviventris*	X	X	
Common Sheath-tail Bat	*Taphozous georgianus*	X		
Northern Mastiff-bat	*Chaerephon jobensis*	X	X	
Little Northern Scurrying Bat	*Mormopterus loriae*		X	X
North Queensland Long-eared Bat	*Nyctophilus bifax*		X	
Arnhem Land Long-eared Bat	*Nyctophilus arnhemensis*	X	X	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		X	
Common Bent-wing Bat	*Miniopterus schreibersii*		X	
Gould's Wattled Bat	*Chalinolobus gouldii*	X	X	
Hoary Bat	*Chalinolobus nigrogriseus*		X	
Timor Pipistrelle	*Pipistrellus tenuis*		X	
Little Broad-nosed Bat	*Nycticeius greyi*		X	
Western Broad-nosed Bat	*Nycticeius balstoni*		X	X
Echidna	*Tachyglossus aculeatus*		X	
Dingo	*Canis familiaris*	X	X	
Introduced				
Black Rat	*Rattus rattus*		X	
House Mouse	*Mus musculus*		X	X
Domestic Cattle	*Bos taurus*	X	X	
Donkey	*Equus asinus*	X	X	
Red Fox	*Vulpes vulpes*			X
Feral Cat	*Felis cattus*		X	X

Note: Study Area 1 - Pindan vegetation, west of the Edgar Ranges (McKenzie 1981).
Study Area 2 - Dampier Peninsula (McKenzie 1983).
Study Area 3 - Environs of Broome Bird Observatory (Bamford unpub. data).

3.2.2.2 Marine Mammals

Dugong and dolphins occur in Roebuck Bay.

Dugong occur around the northern coast of Australia from Shark Bay in Western Australia to Moreton Bay in Queensland. The species is listed as vulnerable to extinction in the IUCN Red Data Book (Thornback and Jenkins 1982). In Western Australia it is gazetted as a species in need of special protection.

Dugong occur in highest densities in sheltered waters less then 5 m in depth. The distribution has been correlated with the extent of seagrass beds on which Dugong feed (Bayliss and Freeland 1989).

In tropical waters, Dugong are thought to be sedentary, with local movements in the order of 10 km (Marsh 1988). The minimum pre-reproductive age is 10 years and individuals have been estimated to be up to 73 years in age (Marsh 1988). Dugong have a low rate of natural increase and mortality levels must be low for populations to be sustainable (Marsh 1986).

A survey of Dugongs in the Kimberley, conducted by the Department of Conservation and Land Management in 1984 (Prince 1986), estimated the population in Roebuck Bay at 50 - 100 individuals.

In Western Australia, as in the Northern Territory and Queensland, aborigines may take Dugongs for food. There is considerable concern that, in some parts of northern Australia, the numbers of Dugong being hunted by aboriginals exceed natural recruitment (Marsh 1988).

In the mid-1980's, it was estimated that up to 30 dugong per annum were being killed in Roebuck Bay and concern was expressed that this rate of killing was not sustainable (Prince 1986).

The Department of Conservation and Land Management is proposing to conduct a social study with aboriginal communities on the Dugong in the West Kimberley (Peter Trembath pers. comm.).

The hunting of Dugong is a major conservation and social issue for Roebuck Bay. Resolution of this issue may have to be conducted on a State-wide basis.

Dolphins occur through the Bay. Prince (1986) counted 37 during an aerial survey of the Dugong population. No information is available on which species use the Bay.

3.2.2.3 Birds

Regional distributional studies on birds have been published for the Kimberley by the Western Australian Museum (Storr 1980) and the Royal Australasian Ornithologists Union (Blakers et al. 1984).

In a study and review of the avifauna of the Dampier Peninsula, Johnston (1983) recorded 214 species. The major habitats and the number of species using each were described as: pindan - 56; melaleuca woodlands, thickets and scrubs - 29; samphire flats and open grasslands - 21; mangal - 20; and inshore seas, tidal mudflats, beaches and coastal cliffs - 59.

The most detailed studies in the Broome area have been conducted by members of the Royal Australasian Ornithologists Union (RAOU). The first research work on shorebirds was commenced in September 1981 (Lane 1987). The importance of Roebuck Bay, along with Eighty Mile Beach and the Port Hedland Saltworks, encouraged the RAOU to develop a

regular shorebird research program in the area. In March 1988, the RAOU opened a Bird Observatory at Broome. This has an ongoing biological research program.

To date, 252 species have been recorded in the Crab Creek to Broome area. This includes seven species not recorded on the Dampier Peninsula list of Johnston (1983). This takes the Dampier Peninsula list to 268 species.

Research on shorebirds has found that Roebuck Bay may support up to 850 000 birds of 44 species. Most of the these species breed in northern China, Mongolia, Siberia and Alaska during the May to July period (Lane 1987). Each year these birds complete two trans-equatorial flights between their breeding and non-breeding areas. This migration route is called the East Asian - Australasian Flyway (Parish 1987).

Recent analysis of shorebird counts in Australia has found Roebuck Bay to be of international importance for 19 species and nationally important for an additional 2 species (Watkins in press). Roebuck Bay has the highest numbers recorded in Australia for the Bar-tailed Godwit, Ruddy Turnstone and Sanderling. It has the second-highest count of Curlew Sandpiper and the third highest for Red Knot, Oriental Plover, Black-tailed Godwit, Eastern Curlew, Grey Plover and Whimbrel (Table 2).

Table 2 Species for which Roebuck Bay is Internationally and Nationally Important

Species	Max Count	Rank	Imp.	Reference
Bar-tailed Godwit	65 000	1	I	Lane 1987
Ruddy Turnstone	2 060	1	I	Lane 1987
Sanderling	1 510	1	I	Lane 1987
Large Sand Plover	26 900	2	I	Lane et al. 1983
Red Knot	11 200	3	I	Lane 1987
Oriental Plover	8 700	3	I	Lane 1987
Black-tailed Godwit	7 374	3	I	S-DB / s90
Eastern Curlew	2 160	3	I	Lane et al. 1983
Grey Plover	1 300	3	I	Lane 1987
Whimbrel	1 020	3	I	Lane 1987
Great Knot	22 600	4	I	Lane 1987
Grey-tailed Tattler	3 180	4	I	Lane 1987
Terek Sandpiper	1 000	4	I	Minton 1987
Red-capped Plover	3 300	6	I	Lane 1987
Red-necked Stint	19 800	7	I	Lane 1987
Mongolian Plover	1 057	7	I	S-DB / s90
Greenshank	560	7	I	Lane 1987
Curlew Sandpiper	6 000	10	I	Lane 1987
Pied Oystercatcher	190	18	I	Lane 1987
Broad-billed Sandpiper	110	4	N	Lane 1987
Common Sandpiper	40	6	N	Lane et al. 1983

Note: Rank = rank of maximum count in Australia.
Imp. I = International Importance. Imp. N = National Importance

Roebuck Bay is considered to be one of the three most important areas of shorebirds in the East Asian - Australasian Flyway (Lane 1987). The other two areas are Eighty Mile Beach in Western Australia and the Gulf of Carpentaria in Queensland. In recognition of this importance, Roebuck Bay is now listed under the Ramsar Convention.

Shorebird numbers in Roebuck Bay start to increase in September of each year with the arrival of adult birds after breeding. Numbers continue to rise until November as juvenile birds arrive. In March, numbers decline as adults return to breed in the Northern Hemisphere. First year birds and some adults remain in Australia during the breeding season and numbers in Roebuck Bay are approximately 10% of the non-breeding season population.

Banding, colour marking and radar studies have shown Roebuck Bay to be of particular importance as a migration staging area for birds spending the non-breeding season in southern Australia. Twelve Red-necked Stints colour marked in the north-west of Western Australia have been resighted within weeks in Victoria (Minton 1983). Similar movements have been recorded for Curlew Sandpipers (Lane et al. 1983, Minton 1983).

Banding returns link Roebuck Bay with Hong Kong, China, Taiwan, Japan and Russia (Pook 1992).

Studies have commenced on the feeding ecology of shorebirds in Roebuck Bay (Tulp and de Geoij in press). These have found that most shorebirds follow the tide edge. Visual observations and scat analysis indicate that Great Knot and Red Knot feed mainly on bivalves. Visual observations of Whimbrels and Eastern Curlew show that they feed mostly on crabs. Bar-tailed Godwits were observed feeding on worms, crabs and bivalves; Pied Oystercatcher on *Anadara granosa*, and Terek Sandpipers on crabs.

At high tide shorebirds are pushed up into large flocks. The two known major roosting areas are Crab Creek - Fishermans Bend and Bush Point - Sandy Point.

On high neap tides birds are able to remain on the mudflats and in the northern area of the Bay shorebirds concentrate around Crab Creek.

On most high tides shorebirds are pushed up onto the sandy beaches to roost. The major roosts at the north end of the Bay are between Crab Creek and the Bird Observatory and at Quarry Beach. Between these two roosts there are a number of smaller roosts. The species composition of the roosts varies with roost site. The highest concentration of large shorebirds is found on the Crab Creek beaches, while Ruddy Turnstone, Terek Sandpiper and Grey-tailed Tattler prefer to roost on small beaches along the cliffs.

Some shorebirds roost on the beach between the Port and Mangrove Point and near Riddel Point.

On some high Spring tides shorebirds leave the Crab Creek and Quarry Beaches and fly to the bare mudflats on the landward side of the mangroves.

Considerable disturbance of roosting flocks is caused by recreation along the Fishermans Bend to Crab Creek coast. Crab Creek is a popular fishing and crabbing area and people often drive four wheel drive vehicles on the beach. Shorebird roosts are disturbed when approached in vehicles or on foot. In April/May 1991 up to 7 vehicles and 25 people were counted on the beach at one time (Tulp and de Goeij pers. comm.).

Commercial hovercraft operations have regularly operated in Roebuck Bay. This has involved landings at Quarry Beach.

Broome Bird Observatory operates half-day tours for people to observe the large roosting flocks near Crab Creek. These are carefully managed by Observatory staff to minimise impact on both birds and dunes.

While most of the shorebird activity is centred on the mudflats of Roebuck Bay, the small tidal creeks behind the mangal are important to some species such as Whimbrel.

Further inland, the grassplains provide important feeding areas for Little Curlew and Oriental Pratincole. Up to 50 000 Little Curlew (Minton 1987) and 50 000 Oriental Pratincole (Wells and Hooper 1989) have been recorded. This is the highest count of Oriental Pratincole and the second highest count of Little Curlew in Australia and qualifies Roebuck Plains as an area of international importance for shorebird conservation (Watkins in press).

Six of the bird species recorded in the area are restricted to the mangrove habitat (Schodde et al. 1982). The avifauna of the mangroves in the South West Kimberley contains 16 species (Johnston 1990). A further 22 species visit.

3.2.2.4 Reptiles and Amphibians

In a review of the herpetofauna of the Dampier Peninsula, Storr and Johnston (1983) recorded 72 reptile and nine amphibian species. The reptile species consisted of two turtles, nine geckoes, two legless lizards, seven dragons, 21 skinks, five monitors, two blind snakes, four pythons, two fangless and rear-fanged snakes, nine front-fanged snakes, eight sea snakes and one crocodile.

Dampier Peninsula is considered to be the southern limit of 17 species and sub-species and the northern limit for eight species. Three of the species recorded are considered to be endemic to the Peninsula and two have limited distributions outside the area. Five of the species were considered to be confined to the far north of the Peninsula (Storr and Johnston 1983).

Most of the nine species of frogs have been recorded from freshwater wetlands. This type of habitat is limited in occurrence close to the Bay.

Some additional surveys have been conducted close to Broome Bird Observatory (Bamford unpub. data). The surveys recorded species in the following groups: one frog, five geckos, one legless lizard, four dragons, two monitors, nine lizards, three pythons and two front-fanged snakes. This work extended the range of one of the skinks previously thought to be endemic to the northern Peninsula.

The two turtles that have been recorded in the Bay are the Loggerhead Turtle (*Caretta caretta*) and the Green Turtle (*Chelonia depressa*). Loggerhead Turtles use Roebuck Bay as a seasonal feeding area and as a transit area on migration. The recovery of banded Loggerhead Turtles indicated that some of the individuals nest on the sandy beaches near Exmouth. No turtle nesting is known from the beaches inside Roebuck Bay.

Estuarine Crocodiles are recorded on an infrequent basis near Broome.

3.2.2.5 Fishes

The inshore seas of north-western Australia are considered to have approximately 1 400 species of fishes (Allen and Swainston 1988). In general, these species tend to be widely distributed over the Indo-Pacific Region.

The mangroves around the Bay will be important nursery areas for larval and juvenile fishes.

Some limited surveys have been conducted by the Western Australian Museum.

3.2.2.6 Invertebrate Fauna

A variety of work has been conducted on invertebrates in the Broome area.

The Western Australian Museum has collected information on Fiddler Crabs (George and Jones 1982). Nine of the 17 species of Fiddler Crabs that occur in Australia have been recorded at Broome (Chalmers and Woods 1987). The scientific importance of the mangrove habitats and flats for the study of crabs has been noted in previous studies of the area (Chalmers and Woods 1987).

Broome is recognised world-wide for the variety of shellfish found on the rocky shores around Gantheaume Point and out from Fall Point. The most notable species is Ruby Murex (*Chicoreus rubiginosus*) which is endemic to the Broome area.

Studies have also commenced on the benthic fauna of the mudflats by researchers associated with the Bird Observatory and the Department of Conservation and Land Management.

The zoobenthic biomass near Crab Creek has been estimated to average 13.9 g ash free dry mass per m^2 (Tulp and de Goeij in press). The most abundant invertebrate species on the tidal flats are *Macoma* sp. and *Siliqua* cf. *winteriana*, *Anodontia omissa*, *Modiolus micropterus*, brittle star, seacucumber and tubeworms (Tulp and de Goeij in press).

3.3 MAINTAINING ECOLOGICAL PROCESSES

A fundamental issue to be addressed in the management of Roebuck Bay is the need to minimise changes to the natural physical, chemical and biological processes that maintain the ecosystem.

Examples of these processes are;

physical - hydrology, water and sediment flow and erosion,
chemical - pollution by heavy metals or nutrients,
biological - fishing, grazing, introduction of new species.

All uses of, and adjacent to, Roebuck Bay need to be assessed in terms of how they can be managed to minimise changes to these processes.

4. COMMERCIAL USE

The commercial use of the Roebuck Bay area can be divided into four major groups: pearling, fishing and shipping; tourism; pastoralism; mining and mineral and oil exploration.

4.1 PEARLING, FISHING AND SHIPPING

The pearling industry has a 130 year history at Broome. It is now focused on cultured pearls rather then shells. The value of annual production is estimated to be over $60 million (Department of Planning and Urban Development 1990). Most of the pearling areas are outside Roebuck Bay, however a culture area has been established in the middle of the Bay. The cultured pearl industry has campaigned actively to maintain the environmental condition of the Bay.

Fishing is a much smaller industry at Broome. In 1989-90, 209 tonnes of fish were caught around the Broome area. It has been suggested that this increased to around 500 tonnes in 1991-92 with an increase in fish trapping north of Broome (Fisheries Department pers. comm.). Of this total, 53 tonnes came from within and adjacent to Roebuck Bay (Fishing Block 1822). No commercial catches of crabs, prawns or molluscs were recorded for Broome during the two year period to July 1990 (Australian Bureau of Statistics 1991).

The Kimberley Regional Plan Study Report has recognised that fishing and recreational boating facilities at Broome are particularly inadequate (Department of the North West and the Department of Planning and Urban Development 1990).

Broome is one of three ports in the Kimberley. In 1990/91, 67 311 tonnes of produce, materials and equipment were imported through the port and 23 691 tonnes were exported. The major imports were: bulk fuel (55 146 tonnes), building materials (2 664 tonnes), ammonium nitrate (1 754 tonnes) and drilling equipment (174 tonnes). The major exports were: bulk oil (Blina) (19 988 tonnes), meat and by-products (2 722 tonnes), livestock (1 122 tonnes) and drilling equipment and material (191 tonnes) (Department of Marine and Harbours 1991).

Port visits for 1990/91 were: 54 ships, 236 fishing, 46 charter, 358 pearling, 30 naval and 7 other boats. Broome is listed as the survey location (in most cases the "home-port") for 60 commercial vessels (Department of Marine and Harbours 1991).

4.2 TOURISM

Broome has a large and growing tourism industry. During the 1980's a large amount of infrastructure was developed (eg. Club Cable Beach, Roebuck Bay Resort, redevelopment of Chinatown) to cater for the increasing demand.

A number of the tourist ventures have programs based on the biological features of the area. Examples of these are; Broome Bird Observatory, Hovercraft Tours, the Mangrove Walk, the Launjarrie Trail, fishing, and safari operations.

4.3 PASTORALISM

Roebuck Plains Station and Thangoo Station graze cattle on the grassplains and pindan vegetation around Roebuck Bay. Roebuck Plains Station lease covers 283 459 ha of Roebuck Plains and the adjacent pindan. A portion (5 334 ha) of land adjacent to the mangroves around Crab Creek was excised from the Station in the late 1980's when ownership of the lease

changed. The excision was to facilitate the protection of the environment. The excised land is presently Vacant Crown Land.

Roebuck Plains Station has recently undertaken an extensive refencing program in which environmentally sensitive areas such as mangroves and Lake Eda have been fenced to prevent grazing by cattle. The Kimberley Regional Plan Study Report (1990) expressed concern that large areas of the grassplains on Roebuck Plains were unsuitable for grazing.

Thangoo Station is to the south of Roebuck Plains Station. The lease covers 172 834 ha and extends to 40 m above the high tide mark. This "seaward" boundary is not fenced.

4.4 MINING, MINERAL AND OIL EXPLORATION

4.4.1 Petroleum Tenements

The Canning Basin has been extensively explored since the 1950's. Seismic surveys have been conducted in the study area and an exploratory well (WAPET Roebuck Bay 1) was sunk to 1 219 m on Thangoo Station (Gibson 1983b).

Most of the study area is presently covered by one exploration tenement (EP 114 R2 Part 1).

Roebuck Bay is currently zoned as a Special Protection Locality under the "Procedures for the Protection of the Western Australian Marine Environment from Oil Spills" (Jones et al. 1984). With the Ramsar Convention listing of the area it could be expected that the zoning will change to an Environmentally Sensitive Locality. With this zoning, an Environmental Review and Management Program would need to be prepared for any drilling proposals (Jones et al. 1984).

There are a number of exploration tenements on the edge of the North West Shelf 400 km north of Broome. These operations are often serviced out of Broome.

4.4.2 Mineral Exploration and Mining Tenements

There are four current mineral tenements in the study area (Department of Minerals and Energy TENDEX, 10 December 1992). Gravel is extracted from a small tenement near Fishermans Bend and small quantities of shell are taken near Crab Creek.

On the south end of Thangoo are two large tenements. One of these tenements, held by Salt Exporters (Australia) Pty Ltd (E 04/638), includes the mudflats and mangroves around Bush and Sandy Point. Immediately south and along the coast is a tenement held by Terrex Resources (E 04/645). These tenements expire on 1 April 1995 and 18 June 1997 respectively.

5. LAND/MARINE TENURE AND STATUS

5.1 TENURE UNDER THE LAND ACT

Land in the study area exists as four major categories; pastoral lease, freehold, Crown reserves and Vacant Crown Land.

5.1.1 Pastoral Leases

The two major leases are Roebuck Plains Station and Thangoo Station (Section 4.3). There are a few small leases between Fall Point and the Broome Road.

An area of 5 334 ha was removed from the Roebuck Plains Station lease when a change of lessees occurred in the late 1980's. It was intended that this land would become part of a conservation area to protect the mangroves from Crab Creek south to Thangoo Station. This land is presently Vacant Crown Land.

The Thangoo Station lease extends to 40 m above the high water mark.

5.1.2 Freehold

Freehold land adjacent to the Bay is limited to the Broome townsite. Most of this land is separated from the high water mark of the Bay by a foreshore reserve. Details of the various allotments are shown on the 1:2 000 cadastral maps (Department of Land Administration) of Broome.

5.1.3 Crown Reserves

There are a number of Crown reserves along the edge of the Bay between Fall Point and Gantheaume Point. These are shown in Table 1.

Table 3 Crown reserves around Roebuck Bay (excluding those between the Broome townsite and the Bay)

Reserve No.	Gazetted Purpose	Area (ha)	Vested In
41066	Bird Observatory	3	CALM
631	Common	844	(not vested)
35493	Gravel	38	Shire of Broome
30906	Use and Benefit of Aborigines	212	Aboriginal Lands Trust
35827	Recreation	4	Shire of Broome
28650	Harbour Purposes	108	Minister for Transport
35828	Recreation	24	Shire of Broome
22648	Recreation	66	Shire of Broome
19289	Recreation	6	Shire of Broome

5.1.4 Vacant Crown Land

There are five areas of Vacant Crown Land on the coast around Roebuck Bay.

The largest of these is the 5 334 ha area around Crab Creek that was excised from the Roebuck Plains Station lease. A small area exists between Crab Creek road and the Bay between Fishermans Bend and Fall Point. The third area is on the western side of Dampier Creek, extending out to the Broome Road.

The remaining two areas are between the townsite and the Port, and between Riddell Point and Gantheaume Point.

5.2 OTHER LAND/MARINE STATUS ISSUES

There are five other land/marine status issues that need to be considered in developing proposals to protect the conservation values of Roebuck Bay. These are aboriginal tenure aspirations, petroleum tenements, mineral tenements, the Broome Port limits and the pearl oyster farms.

5.2.1 Aboriginal Tenure Aspirations

The local aboriginal people have a strong interest in changes to the tenure of the area. Aboriginal people make extensive use the Roebuck Bay area to forage, fish and collect material for cultural artifacts. There are also a number of sacred and culturally significant sites in the area.

The aboriginal community is represented by the regional committee of the Aboriginal and Torres Strait Islander Council (Kularri Regional Council) and the Yawuru Aboriginal Corporation. There are also some individuals with special responsibilities for traditional law and custodianship.

The aboriginal community is presently evaluating the implications of the Mabo case on the tenure of the Roebuck Bay area.

5.2.2 Petroleum Tenements

Most of the study area is covered by one exploration tenement (EP 114 R2 Part 1). This is held by a consortium of 7 companies and operated by Bridge Oil. The lease is due to expire on 22 July 1994 (Department of Mines 1992).

The State Government has indicated that a "petroleum resource assessment" must be conducted before submission to Cabinet of a marine park proposal (Department of Mines 1992).

5.2.3 Mineral Tenements

There are four current mineral tenements in the study area (Department of Minerals and Energy TENDEX Report, 10 December 1992). The two tenements between Fishermans Bend and Crab Creek are quarried for gravel and small quantities of shell grit.

In 1990, Renison Ltd applied for a tenement to explore for mineral sands around Crab Creek and in Roebuck Bay. The company withdrew its application following submissions made to it by community groups on the conservation value of the area.

The State Government has indicated that a "mineral resource assessment" must be conducted before marine park proposals are submitted to Cabinet (Department of Mines 1992).

5.2.4 Broome Port Limits

Port limits have been defined by the Department of Marine and Harbours in order to administer the movement of ships.

The Broome Port limits cover the marine area from Fall Point, south for 8 km, then west for 19 km, then north for 15 km through Escape Rocks, then east to the Cable Beach shoreline in front of Station Hill (Approaches to Broome 1:50 000, Aus 50).

The Department of Marine and Harbours is currently finalising an oilspill contingency plan for the Port.

5.2.5 Pearl Oyster Farms

Two leases currently exist for pearl farms in the middle of Roebuck Bay. These 21 year leases have been issued under the Pearling Act, administered by the Fisheries Department. Applications may be made for additional leases at some time in the future.

5.2.6 Commercial and Recreational Fishing

Roebuck Bay is part of the Northern Gill Net and Barramundi Fisheries. Up to three commercial fishermen have operated concurrently in the Bay, however in 1992 there was only one. Much of the Bay is closed to commercial catching of mud crabs.

The Fisheries Department of Western Australia has regulations to manage recreational fishing in Western Australia. These cover methods of capture, seasons, bag limits and other related matters.

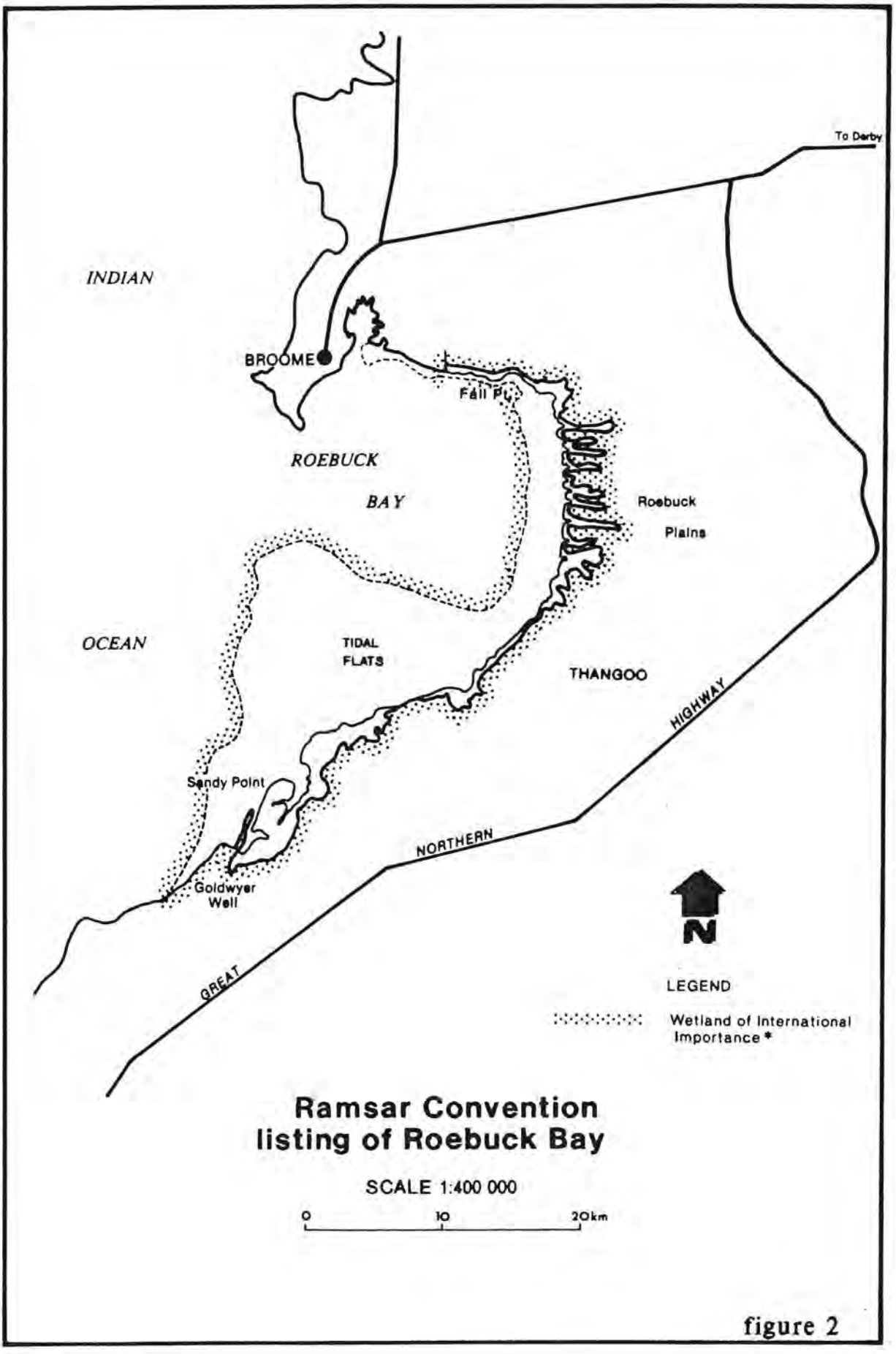
All recreational net fishing requires a Recreational Fishing Licence. Regulations limit the number, length and mesh size of nets and set bag limits and minimum legal sizes for netted fish.

The waters immediately in and around Dampier and Crab Creeks are closed to recreational net fishing. The waters between Dampier Creek and the Port are closed to set nets between 1 April and 30 September and the whole of the Bay is closed to net fishing between 1 December and 31 January (Fisheries Department 1992).

The Fisheries Department is currently reviewing regulations relating to shell collecting. The Fisheries Act has been used to close the area around Gantheaume Point to the collection of gastropods.

5.2.7 Listing as a Wetland of International Importance

Much of Roebuck Bay is listed under the Ramsar Convention (Figure 2). This commits the State and Commonwealth Governments to ensure that the area is conserved and wisely managed.


To Derby
INDIAN
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Fall Pt
ROEBUCK
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Roebuck
Plains
TIDAL
FLATS
THANGOO
HIGHWAY
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listing of Roebuck Bay
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figure 2

6. PREVIOUS PLANNING STUDIES

In considering the future management of Roebuck Bay, it is valuable to review existing planning provisions and policies for the Broome area. This enables conservation proposals to be developed within the context of existing planning considerations.

6.1 BROOME TOWN PLANNING SCHEME

Land use zones and developments in and around Broome are regulated by the Town Planning Scheme of the Shire of Broome. Town Planning Scheme No.2, gazetted in 1985, covers the townsite of Broome (Map 8, Broome Coastal Management Plan). Town Planning Scheme No.3 covers areas outside the townsite and extending to include Crab Creek, the 12 Mile and Coconut Well (Map 9, Broome Coastal Management Plan). These schemes are currently being reviewed.

6.2 BROOME COASTAL MANAGEMENT PLAN

In 1987, the Environmental Protection Authority prepared a coastal management plan for the Broome Shire covering the coastline from Willie Creek to Crab Creek (Chalmers and Woods 1987). The report is a comprehensive planning document that gives a detailed account of the physical environment, existing planning and management controls and recommends planning and management goals, objectives and policies.

The major management issues identified in the report were: mangroves, quarrying of sand and gravel, coastal processes, migratory shorebirds, culture and heritage and, in particular, aboriginal sites.

The two goals for coastal management recommended in the plan are:

> *"(a) Only uses that depend on a coastal location shall be permitted in the coastal zone;*
> *(b) The coastal environment will be protected and improved where possible".*

The Environmental Protection Authority recommended that the Broome Council achieve these goals by:

> *"maintaining existing terrestrial and marine systems, coastal processes, landscapes and cultural assets, protecting and maintaining groundwater resources and seawater quality, providing for a wide range of appropriate recreational use, preserving the Broome atmosphere, protecting Aboriginal sites, encouraging and catering for tourism, providing for appropriate commercial and industrial activities, developing a public education program".*

Detailed policy recommendations were given for off-road vehicles, launching facilities, developments, tourism, picnic areas, recreational use, landscape management, soil conservation, fire management, wildlife management and research, shellfish, waste and garbage disposal, effluent disposal, storm water drainage, conservation, public education, mangroves and Broome townsite and off-shore management.

The coast was divided into six management units and policies were outlined for each. Three of these management units are within Roebuck Bay and the remaining three units have direct relevance (Riddell Point, Gantheaume Point and Cable Beach).

The plan recommended a marine park to protect the reef around Gantheaume Point. It also recommended other marine conservation areas near the Port, from Mangrove Point to

Fishermans Bend and several locations between Fishermans Bend and Fall Point (Map 6, Broome Coastal Management Plan).

Most of the recommendations in the plan were proposed for implementation by the Broome Shire when considering amendments to the existing Town Planning Scheme and when the Scheme was next reviewed.

6.3 ROEBUCK BAY MARINE PARK PROPOSAL

As part of its submission to the Kimberley Regional Planning Study, the Department of Conservation and Land Management presented detailed proposals for the declaration of additional conservation areas in the Kimberley (Burbidge et al. 1987).

The submission presented a proposal for a marine park covering most of Roebuck Bay and a nature reserve to protect the vine thickets adjacent to Cable Beach. The marine park proposal included Vacant Crown Land, unreserved tidal flats and a small part of Roebuck Plains Station (Figure 2). The primary conservation value identified for the area was its importance to migratory shorebirds.

6.4 CABLE BEACH / RIDDELL POINT, DEVELOPMENT CONCEPT PLAN

In response to the rapid growth of Broome in the mid-1980's, the Department of Planning and Urban Development prepared a special development concept plan to guide development in the Cable Beach / Riddell Point area in Broome (Department of Planning and Urban Development 1990).

That document reviews the history, population, economic base, utility services, physical environment and community perceptions of Broome. It then presents a development concept plan and proposes mechanisms for its implementation.

While the study area for the concept plan was outside Roebuck Bay, it is important because it endorses the recommendations of the Broome Coastal Management Plan for a coastal park along the Cable Beach / Riddell Point coast. It recommends that the area be vested in the National Parks and Nature Conservation Authority as a Coastal Park to be managed by the Department of Conservation and Land Management. A Marine Park is also recommended to protect the coastal area around Gantheaume Point, this being an area valuable for its dinosaur footprints, fossils and shellfish.

6.5 BROOME TOWNSITE STRUCTURE PLAN

Concurrent with the Department of Planning and Urban Development study, the Department of Land Administration prepared a structure plan for the Broome townsite (Department of Land Administration 1990). The Plan did not examine the Cable Beach / Riddell Point area. The Structure Plan has important recommendations for a linear area of open space between the townsite and Roebuck Bay.

6.6 KIMBERLEY REGIONAL PLAN STUDY REPORT

During the late 1980's the Department of Regional Development and the North-west and the Department of Planning and Urban Development co-ordinated the preparation of a strategy for "growth and conservation" in the Kimberley. Recommendations given in the Plan of relevance to the development of conservation proposals for Roebuck Bay are discused below.

The Plan calls on Government and the community to:

"Ensure that the coordinating between Government Departments, local authorities, voluntary bodies and other agencies on environmental management matters is ongoing and comprehensive".

"Encourage local authorities to be involved in environmental issues such as joint management of reserves and provision of access".

In relation to management of mangroves and of pastoral leases the Plan recommends a number of strategies:

"Identify important mangrove stands and ensure that specific management guide-lines for mangroves be prepared."

"A detailed appraisal be prepared for Roebuck Plains Station and for areas abutting the coastline" (eg. Thangoo Station). The Plan shows large areas of the grassplains on Roebuck Plains Station as being unsuitable for pastoral use (Figure 6, data from the Western Australian Department of Agriculture).

"Following such an appraisal, ensure appropriate negotiation and consultation with a view to resolving any existing or potential land-use problems using the land-use planning mechanism."

"Determine the most effective, efficient and environmentally acceptable means of boundary adjustment to pastoral leases to divest unsuitable land from leases.".

The area of mangroves on Roebuck Plains Station have since been removed from the lease in line with these recommendations.

The potential for use of management agreements between lessees and the Department of Conservation and Land Management to manage land for conservation of wetlands and mangroves is noted in the report.

In relation to marine conservation reserves, the report noted that the Minister for the Environment had appointed a working group to report on the establishment of a system of marine reserves in Western Australia.

In relation to fishing, the Plan called for an examination of the existing demand for recreational and commercial boating facilities at Broome and for identification of any potential for greater use or development of those facilities. The Plan goes on to recommend the following strategies:

"Increase management and policing of recreational fishing, particularly netting in coastal and inland areas."

"Ensure that fish breeding grounds are protected through appropriate planning controls".

The Plan lists a large number of strategies for tourism in the Kimberley. Of particular relevance are:

"Provide appropriate planning and consultative mechanisms for Aboriginal people to determine their involvement in and use of their land for the tourist industry".

"Develop programs to increase "wet" season demand, promoting year round use of facilities and ensuring the public has year round access to information about the availability of tours and accessibility to places of interest".

"Assess and monitor the effect of tourists and recreational activity on the natural environment to identify and rectify any environmental deterioration and continue to promote environmental education".

"Develop measures to inform and educate holiday-makers and recreational users of the need to protect and conserve the Region's natural resources, in order to prevent over exploitation, pollution or destruction and increase safety awareness."

"Establish and expand the role of interpretative centres in order to improve visitor knowledge of the Region's attributes."

"Ensure tourist bodies, and recreational organisations promote environmental awareness by provision of interpretative information boards and pamphlets".

6.7 BROOME PLANNING STRATEGY

A planning task force is currently developing a further strategy for the Broome area. In April 1992, a draft report was released for public comment (Broome Planning Task Force 1992).

The aim given for the Strategy is to:

"provide opportunities for the future development of the tourist, recreational, residential, commercial and industrial potential of Broome as a service, residential and tourist destination, whilst enhancing and conserving the environment and cultural values of the town and its environs".

The Strategy lists the goal of planning and development as:

"To ensure the conservation of environmental quality through the creation of an adequate open space system, and the adoption of land use and management mechanisms that aim to achieve sympathetic utilisation of natural resources."

Actions recommended in the draft Broome Planning Strategy are to:

"Create a Coastal Park and management structure to facilitate conservation and recreation use of the western and south western coastlines. The Park would include Hidden Valley, the Cable Beach dunes and vine thickets, the environmentally sensitive flanks of Gantheaume Point and the Riddell Beach coastline."

"Protect the Roebuck Bay Coastal Dune system through vesting and management".

"Develop an environmental conservation management policy for the Townsite for inclusion in the Scheme Revision."

The Strategy gives specific strategies for the areas; Chinatown, Chinatown to Mangrove Point, and the Coastal Park (Section 6.8.2).

6.8 IMPLICATIONS FOR THE CONSERVATION OF ROEBUCK BAY

6.8.1 General Implications

The planning studies outlined above have identified the need for integrated management of the coastal areas around Broome. There is clear recognition of the need for:

(a) protection of coastal areas (especially mangroves),

(b) development of tourism and recreation opportunities compatible with nature conservation,
(c) development of environmental awareness and education programs,
(d) involvement of local communities (especially aboriginal) in planning and implementation of land management programs.

Previous planning studies also propose a number of area-specific recommendations that have implications for the development of a conservation proposal for Roebuck Bay. For the purposes of discussing these recommendations, it is convenient to divide the coast into two areas separated by the Port.

6.8.2 Area-Specific Recommendations

6.8.2.1 Cable Beach / Riddell Beach, Conservation Park

The coastal area to the north west of the Port has been proposed for vesting in the National Parks and Nature Conservation Authority as a Conservation Park (Chalmers and Woods 1987, Department of Planning and Urban Development 1990, Broome Planning Taskforce 1992), managed by the Department of Conservation and Land Mangement. The Broome Planning Taskforce has recommended an Advisory Committee be established, comprising representatives from the Shire, Department of Conservation and Land Management, the community and other interest groups.

This section of coast also includes the Marine Park proposed for the reef off Gantheaume Point (Environmental Protection Authority 1987, Department of Planning and Urban Development 1990, Broome Planning Taskforce 1992).

6.8.2.2 Port - Mangrove Point - Chinatown - Crab Creek Road

A strategy is being developed, by the Broome Planning Taskforce (1992), for the coastal area to the north-east of the Port, based on the recommendations of Environmental Protection Authority (Chalmers and Woods 1987). Proposals are for the protection of the Roebuck Bay Dunes, the foreshore between Mangrove Point and Chinatown and around Chinatown. This area of public open space is shown to extend north around Dampier Creek to Crab Creek Road in the Broome Structure Plan (Department of Land Administration 1990).

<u>Roebuck Bay Dunes</u>

The draft Broome Planning Strategy contains the following strategies for this area:

> *"Reserve the Roebuck Bay Dunes for Conservation, Recreation and Foreshore Management subject to detailed planning to establish boundaries generally in accordance with this Strategy".*
>
> *"Investigate the options available for the management of the Roebuck Bay coastal dunes. Management considerations will include the need to:*
>
> - *maintain and improve public access*
> - *monitor shoreline movement*
> - *incorporate Aboriginal interests*
> - *rehabilitate degraded areas*
> - *promote scenic opportunities."*

Mangrove Point to Chinatown

This area is identified as being an important landscape feature for both recreational and ecological reasons. The draft Broome Planning Strategy recommends:

> *"Support the Broome Heritage Trail plan which could be expanded to create a mangrove walk and heritage trail. A trail has already been partly developed with signs but needs to be continued as resources become available to construct sections of board-walk."*
>
> *"Acknowledge that the areas bounded by Guy Street, Robinson Street, Mangrove Point and the foreshore offers potential for a tourism development site including a low key marine for shallow draft boats off Mangrove Point and community and recreational areas. This would involve the rationalisation of Government land holdings and the maintenance of a foreshore reserve, public access and the existing mangroves, which could become a feature of the development".*

Chinatown

The strategies presented in the draft Broome Planning Strategy for this area are:

> *"Prepare a detailed management plan for the Chinatown foreshore area, with objectives of accommodating continued public access, managing the environment, and rationalising property Boundaries where appropriate ..."*
>
> *"Support the provision of public access to the foreshore reserve, linking it to the Mangrove Walk."*
>
> *"Support the formation of a "Foreshore Clean-up Group" as a community initiative to rid the shoreline environment of litter. Ideally this group could be initiated through the key Aboriginal Community Organisation in Broome in recognition of the recreational importance of the foreshore area of Chinatown to the Aboriginal people."*

Chinatown - Crab Creek Road

This foreshore area is proposed as open space in the Broome Structure Plan (Department of Land Administration 1990).

The Environmental Protection Authority has approved a proposal to develop a crocodile park between Broome Road, Crab Creek Road and Dampier Creek (Environmental Protection Authority 1992). The development has yet to gain approval from the Broome Shire and the Department of Planning and Urban Development.

7. CONSERVATION OF ROEBUCK BAY

7.1 CONSERVATION NEEDS

The listing of Roebuck Bay under the Ramsar Convention gives it formal recognition as a Wetland of International Importance. Australia is a signatory to a further three international conservation treaties relating to migratory shorebirds and their environments. Under these treaties the Commonwealth and State Governments are obliged to ensure that Roebuck Bay is managed wisely and that its conservation values are maintained.

At present, there is no coordinated management of Roebuck Bay and only limited monitoring programs are in place to record changes in the Bay environment. Broome Bird Observatory is conducting limited monitoring of bird populations.

Given the conservation importance of the Roebuck Bay, the international obligation for its wise management, the cultural importance of the area to the aboriginal community and the increasing pressure on the ecosystem from development and recreation, there is a clear need for an integrated management arrangement.

The arrangement that is needed is one that would:

(a) ensure the conservation of the native species, ecosystems, historic and cultural features,
(b) provide additional recreational opportunities that are consistant with environmental conservation,
(c) provide additional environmental awareness and education facilities and programs,
(d) provide for a high level of community involvement (especially aboriginal) in decisions on the management of the area,
(e) maintain the primary role of the Broome Shire Council in controlling development in the Broome Townsite,
(f) maintain the role of the Environmental Protection Authority in reviewing development proposals and issuing pollution licences,
(g) continue the high level of involvement of the Department of Fisheries in the management of commercial fishing, pearl oyster farming and recreational fishing,
(h) continue the role of the Department of Marine and Harbours in controlling the movement of shipping around the Port,
(i) minimise any impact on pastoral leases.

A marine park proposal for Roebuck Bay could meet the above-listed criteria.

It is suggested that the principal goals for the management of a marine park in Roebuck Bay should be similar to those given for Ningaloo Marine Park (May et al. 1989, pg.37):

> *"Conservation: Conserve marine species, marine ecosystems, historic and cultural features;*
>
> *Recreation: Facilitate public enjoyment of the Park to the extent compatible with conservation of the natural environment;*
>
> *Education: Create an awareness and understanding of the marine and coastal environment and the limitations on their use".*

The key to developing a successful management arrangement for Roebuck Bay will be to have local community ownership of the proposals. This will need to extend beyond "community involvement" and "communication" to be truly successful.

While the Broome Shire have supported proposals for a Marine Park, the Yawuru Community have indicated their opposition to initial proposals (Peter Hutchison pers. comm.).

7.2 DETERMINATION OF THE BOUNDARIES OF A CONSERVATION AREA

In determining the boundaries of a conservation area for Roebuck Bay, there are five important issues to be addressed:

(a) areas that need to be protected,
(b) processes that maintain these areas,
(c) existing planning policies,
(d) the impact of conservation proposals on other users of the area,
(e) community support.

The areas of primary importance for conservation are the shallow waters, tidal flats, mangroves, and the vegetation and landforms adjacent to the mangroves and foreshore. Information on the conservation importance of the deeper water areas is limited.

The ecological and physical processes that maintain these areas are complex and extend many kilometres inland and out to sea. The extent to which it is possible to extend the conservation area to include these areas is limited because of the impact this would have on other users of the area. Such extensions inland would be in conflict with existing planning policies and are likely to lack community support.

There have been a number of planning studies of Broome townsite that have implications for the development of conservation proposals for the Bay. These studies are presently being reviewed by the Broome Planning Taskforce. The draft report suggests that there will be two important outcomes for conservation; a coastal park in the Cable Beach / Riddell Point area and a Broome foreshore conservation area.

There are also a number of other area-specific issues that should be addressed.

7.2.1 Planning Considerations

Coastal Park in the Cable Beach / Riddell Point Area

The Broome Task Force proposes a Coastal Park in the Cable Beach -Riddell Point area. This is likely to include a small marine park between Gantheaume Point and Roebuck Deep. This proposal was first developed in the Broome Coastal Management Plan, reviewed and endorsed in the Cable Beach - Riddell Point Development Concept Plan, then updated in the draft Broome Planning Strategy.

Given the advanced development of this proposal, its location outside the Bay proper, and the different issues that are involved, it would seem most constructive to view this as separate to a conservation proposal for Roebuck Bay.

Broome Foreshore Conservation Area

The second important outcome from the Broome Planning Strategy is likely to be a foreshore conservation proposal between the Port and Chinatown. This follows the recommendations of the Broome Coastal Management Plan. It is likely that this area would be vested in the Shire of Broome.

No detailed proposals have been made for the land between Chinatown and Crab Creek Road, beyond the proposal for a crocodile farm and open space.

Given the proximity of the complete foreshore area to the townsite of Broome, and the levels of recreation and disturbance in the area, it is suggested that this area should remain outside the Marine Park.

7.2.2 Land/Marine Use Considerations

Broome Port

The location of Broome Port has a major influence on management proposals for Roebuck Bay. The most appropriate option may be to exclude Roebuck Deep and the waters within 3 km of the end of the jetty. A distance of 3 km would include most of the deeper water around the jetty. Exclusion of these waters from the Marine Park would ensure that the efficient management of shipping would not be hindered as is might be if an additional management agency were involved.

Roebuck Plains and Thangoo Stations

The supratidal flats (grasslands) behind the mangroves extend many kilometres inland and are largely within Roebuck Plains and Thangoo Stations. These grasslands are valuable feeding areas for cattle.

The flats are important to Roebuck Bay in terms of Bay hydrology and sediment flow. Following heavy rainfall during the Wet season, these flats may flood and at this time they are also valuable feeding and breeding areas for waterbirds.

The plant communities of Roebuck Plains and other coastal short-grassland plains have been identified as being "geographically restricted or potentially subject to endangering processes" (Department of Conservation and Land Management 1992, Government of Western Australia 1992). It has been suggested that this type of plant community may be endangered by overgrazing by cattle (Department of Conservation and Land Management 1992). This issue should be addressed in the review of the Roebuck Plains Station and Thangoo Station leases recommended in the Kimberley Regional Plan. Conservation proposals for the grassland plains proper should await this review.

The Roebuck Bay conservation area needs to include the mangroves as these are an integral part of the Roebuck Bay marine system. The conservation area should extend a sufficient distance inland to enable the mangroves and associated plant communities to be fenced and managed. This boundary will need to be established on both management and access considerations rather than landform or vegetation types.

This has already occurred on Roebuck Plains Station with the excision of 5 330 ha from the lease. In developing a conservation proposal for Roebuck Bay, this issue should be discussed with the holders of the Thangoo Station lease. If the lessees do not wish to have a similar area removed from their lease, then the possibility of a joint-management agreement between the lessees and the Department of Conservation and Land Management should be pursued.

7.2.3 A Roebuck Bay Conservation Area

The conservation area recommended in this report is shown in Figure 3. It has four major units:

(a) The waters of Roebuck Bay - from near East Rocks in an arc of 3 km radius around the Port to Mangrove Point, along the high water mark in front of the town site, around Dampier Creek, Fishermans Bend, Fall Point, Crab Creek then south around the coast past Bush and Sandy Points to Yardoogarra Well, then north to East Rocks.

(b) The Common around the east side of Dampier Creek and the Vacant Crown Land extending towards Fall Point. This would exclude Reserve 30906 (For the use and benefit of Aborigines) and Reserve 35493 (Gravel).
(c) The Vacant Crown Land already excised from Roebuck Plains Station for the specific purpose of conservation. This includes Reserve 41066 (Bird Observatory).
(d) An area of land along the seaward margin of Thangoo Station to ensure protection of the mangroves and adjacent vegetation.

There are no land tenure difficulties with incorporating the first three units into a marine park proposal, as this is all Crown land. If the lessee of Thangoo Station is unwilling to have the area excised from the lease then a joint-management agreement between the lessee and the Department of Conservation and Land Management should be pursued for this area.

The conservation area suggested above is more extensive than the original proposal made by the Department of Conservation and Land Management for the Roebuck Bay Marine Park (1987). Proposed extensions include: the important shorebird roosting areas between Fall Point and Fishermans Bend, the mangrove stands of Dampier Creek and additional marine areas in Roebuck Bay. A larger conservation area is also seen as a more comprehensive approach to natural resource management in the Broome area.

The report of the Marine Parks and Reserves Selection Working Group will also need to be considered in evaluating the boundary of the conservation area for Roebuck Bay proposed in this report.

7.3 MANAGEMENT OF THE CONSERVATION AREA

7.3.1 Management Objectives

If it is determined that the conservation area should be a Marine Park, then it is recommended that the objectives of management should be similar to those for Ningaloo Marine Park (May et al. 1989). The following are proposed:

1. Conserve native species, habitats and natural processes.

2. Promote an appreciation and understanding of the marine environment and sites of cultural significance in the Park, through information, interpretation and education.

3. Provide recreational opportunities and facilities which maximise the quality of experience sought by visitors.

4. Provide for tourism, to the extent consistent with maintenance of resources.

5. Manage recreational and commercial fishing without adversely affecting fish populations.

6. Provide for pearl oyster farming without adversely affecting the ecological character of the Park.

7. Integrate management and development of the Park with that of adjacent areas of land to achieve maximum effectiveness and optimum allocation of management resources.

8. Ensure that all development and activities are consistent with the maintenance of species, populations, habitats, natural features, and cultural and scenic values.

9. Conduct research programs aimed at understanding how impacts of use and natural processes affect the maintenance and management of the Park.

Marine parks in Western Australia are managed through the use of zones. The zonings are developed on a case by case basis in consultation with local communities and relevant interest groups. In Roebuck Bay, zonings could be developed, for example, to complement the present controls on recreational fishing.

7.3.2 Management Issues

Currently the areas most in need of management are those with the highest levels of recreation. These are below the foreshore reserve in the Broome townsite and the coast from Fishermans Bend to Crab Creek. General recommendations have already been developed to address many of the coastal management issues (Chalmers and Woods 1987). These recommendations relate to pedestrian and vehicle access, management of off-road vehicles, car-park, boat launching facilities, tourism, recreational use, landscape management, soil conservation, fire management, disturbance of shorebird roosting areas, shellfish collecting, waste and garbage disposal, effluent disposal, storm water drainage, and public education.

The Broome Coastal Management Plan has recommended a number of policies specifically for the Dampier Creek to Crab Creek coast. These include the need to:

(a) establish a conservation area,
(b) rationalise the gravel quarrying operations along the coast and rehabilitate the existing pits,
(c) realign Crab Creek Road to minimise erosion of the cliffs,
(d) prevent illegal camping and shack construction,
(e) control the movements of off-road vehicles,
(f) close all tracks around Dampier Creek tidal flats to ensure protection of the tidal flat and mangrove system,
(g) formalise car-parking areas,
(h) close tracks along the coast that provide access to important roosting areas for shorebirds.

The declaration of a Marine Park for Roebuck Bay should not impact on pearling or commercial fishing operations. These activities would continue to be managed by the Fisheries Department, in consultation with the Department of Conservation and Land Management.

7.4 THE IMPLICATIONS OF MANAGEMENT OF ADJACENT AREAS

The main implication of a Marine Park in Roebuck Bay for adjacent land users is that they need to review their activities and ensure that there is minimal impact on the Bay.

Specific attention should be given to waste water discharge, oil spill planning and erosion from road and pastoral areas.

The development of a Marine Park would offer increased opportunities for the tourist industry.

7.5 ADMINISTRATION

Careful attention would need to be given to the involvement of the local community and other government agencies in the future management of the Marine Park.

Along with the Department of Conservation and Land Management, the key Government agencies are the Department of Fisheries and the Department of Marine and Harbours. The Fisheries Department has responsibilities for pearling, commercial and recreational fishing

while the Department of Marine and Harbours is responsible for the operation of the Port and oil spill planning.

The nature and level of community involvement should be decided by the community in consultation with the Department of Conservation and Land Management during the development of a conservation proposal for the area.

Particular attention will need to be given to the aspirations of the aboriginal community.

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INDIAN

OCEAN

ROEBUCK

BAY

Cable Beach

BROOME

(b)

Gantheaume Point

Mangrove Point

Entrance Point

(a)

Crab Creek

ROEBUCK PLAINS

(c)

Territorial Sea

coastal base line

lowest astronomical tide

"Thangoo"

(d)

Bush Point

Racecourse Plains

Sandy Point

Highway

9697

Northern

Great

Cape Villaret

122° 10'

Proposed Boundary of Roebuck Bay Marine Park

LEGEND

Proposed Marine Park Boundary

(a) Marine Waters
(b) Crown Land with various current vestings
(c) Vacant Crown Land
(d) part Thangoo Pastoral Lease

SCALE

0 2 4 6 8 10

Kilometres

figure 3