

CONSERVATION RESERVES

IN WESTERN AUSTRALIA

*REPORT OF THE
CONSERVATION THROUGH
RESERVES COMMITTEE
TO THE
ENVIRONMENTAL PROTECTION
AUTHORITY 1974*

SECTION TWO

SYSTEMS EIGHT - TWELVE

SYSTEM 8 - THE PILBARAINTRODUCTIONArea and Physiography

System 8, which encompasses the Pilbara and Ashburton districts of Western Australia, covers an area of about 271,750 square kilometres (Fig 8.0). It can be divided into four main regions:

a) Rowley Shelf and Coastline

Rocks underlying the Rowley Shelf and coastline consist of marine and terrestrial sediments ranging in age from Silurian to Recent. The Lower Cretaceous Barrow Formation is a proven oil and gas producer, and recent offshore discoveries have demonstrated a commercial gas field in rocks ranging from Triassic to Lower Cretaceous. Surface exposures are almost exclusively of Pleistocene calcareous rocks. On this Shelf there are offshore islands, coral patch-reefs and shoals; the coast is comprised largely of vast tidal flats with numerous tidal channels and extensive mangrove thickets.

b) The Pilbara Block

The Pilbara Block is an area of outcropping Archaean rocks consisting generally of synclinal belts of metasedimentary and metavolcanic rocks ("greenstones") lying between and sinuously enclosing irregularly ovoid domes of granitic rock. These are overlain in places by Proterozoic sediments and volcanics.

The greenstones have been worked for gold, and alluvium derived from the granites has yielded tin.

It is the oldest crustal block in the Australian continent.

c) The Hamersley Iron Province

The Hamersley Iron Province is broadly an ovoid depositional basin some 100,000 km² in area, in which, in Lower Proterozoic time, dominantly iron-rich and silica-rich sedimentary rocks were laid down in remarkably quiescent conditions. Subsequent folding, exposure and weathering of interbedded softer rocks has resulted in a highly-dissected terrain noted for its scenery and rich and extensive iron deposits. The Hamersley Iron Province contains four distinct physiographic zones. From north to south these are:

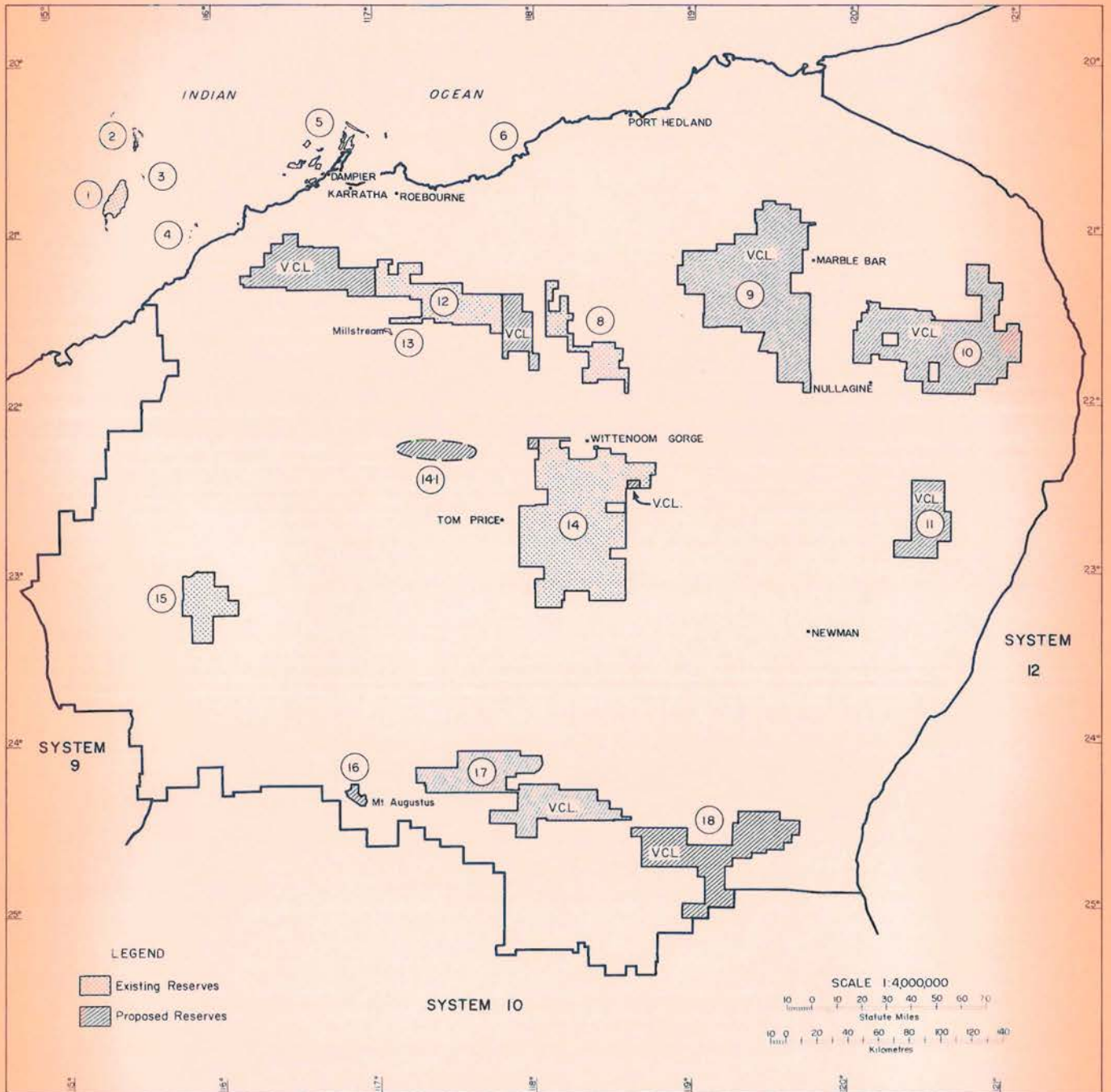


Figure 8.0 System map

1. The Chichester Range
2. The Fortescue Plain
3. The Hamersley Range
4. The Southern Watershed

d) The Ashburton

Rocks of the Ashburton region are a younger and southerly extension of those of the Hamersley Iron Province but have been deposited in more turbid conditions in Middle Proterozoic time. They are a generally monotonous sequence of arenaceous rocks that have undergone only mild folding and little metamorphism. Here the terrain is (with a few exceptional areas) only moderately dissected, largely the result of erosion by the Ashburton River system.

Biology

Biologically the system comprises elements of both desert and Kimberley floras and faunas. The northern influence is shown for example, by the presence of palms and Kimberley birds at Millstream and the presence of mammals such as the Northern Native Cat near Roebourne and the Northern Bush Possum on Barrow Island.

Population

At the time of the 1971 census, the population of the System was about 30,000 of whom 20% were rural and 80% urban. Due mainly to rapid development of the iron ore industry, urban population* in the Pilbara rose from 4,000 to 24,000 during the inter-censal period 1966-1971, an increase of 600%, compared with 25% for the Perth metropolitan region during the same period. With expected further developments in the mining industry, there is no doubt that population will continue to increase, the rate depending mainly upon policy decisions concerning industrialisation at coastal towns and further exploitation of ore deposits.

Land Usage

About 70% of land in System 8 is held under pastoral leases. A significant part of the remainder consists (under the Land Act) of vacant Crown land, including two large areas in the Pilbara Block; one west of Marble Bar and the other north-east of Nullagine. In addition, two-thirds of the Hamersley Iron Province comprises vacant Crown land or National Park (Chichester Range and Hamersley Range National Parks). Further large blocks of vacant Crown land in the upper Ashburton include the Teano and Collier Ranges.

* Defined as population within a centre of more than 1000 people (Western Australian Year Book, 1973)

Primary Industry

Although occupied land is used mainly for sheep grazing, the pastoral industry is second in economic importance to mining. Commercial fishing in coastal waters has recently assumed some importance, and investigations indicate that mackerel, tuna and other scale fish will provide the basis of future development. A prawning industry is now centred around the Nickol Bay area.

Mining and Industrial Development

Mining is the Pilbara's major industry. The discovery of extensive deposits of high-grade iron ore, and the subsequent establishment of mines and ports are well known. Other developments include production of solar salt at Dampier and Port Hedland, the production of crude oil on Barrow Island and the discovery of vast reserves of natural gas offshore. Although present industrialisation in the Pilbara is confined largely to pelletisation of iron ore, the State Government (through its Pilbara Development Concept) envisages a massive industrial complex costing more than \$6,000 million, including a major steelworks, aluminium smelter, uranium enrichment plant, the production of ferro-manganese and the synthesis of bulk chemicals for a plastics industry. These developments would, of course, require the establishment of a wide range of service industries.

While natural gas from the North West Shelf is seen as the basic energy source, another major requirement will be a large and reliable water supply. A number of rivers in the region have been examined as likely storage sites, to be supplemented with underground supplies. A dam on the Fortescue River at Gregory Gorge, in conjunction with underground water from the nearby Millstream aquifer, has been suggested as one possible supply for the proposed industrial complex, and additional supplies will also be required.

Although a deep-water port has been established at Dampier for the export of iron ore and salt, and another port established at Cape Lambert, the adoption of the Pilbara Development Concept would mean the extension of port facilities to other parts of the Dampier Archipelago, e.g. at Legendre Island where vessels of up to 300,000 tonnes could be accommodated.

Recreation and Tourism

The Pilbara holds many attractions for tourists: a spacious outback very different from the environment of most visitors, spectacular scenery in the ranges and gorge country of the Hamersley Iron Province, diverse coastal features, offshore islands with high potential for recreation and sport fishing, and interesting historical sites including abandoned settlements and mining towns. It also has gigantic iron-ore operations. In 1970, travel and tourism ranked as the region's third industry in value behind mining and grazing (Anon., 1971). It was estimated that about 32,000 visitors, spent \$3.5 million on accommodation, food, etc. an average of \$15 per visitor per day. If the 120,000 visitors estimated for 1975 enter the region

(Anon., 1971), tourism could replace grazing as the second most important industry. Also, the adoption of the Pilbara Development Concept would require a new town to house an additional 130,000 people, many of whom would use the National Parks and Reserves in the region.

A tourist survey undertaken in 1968/9 (Anon., 1969) revealed that wildflowers and scenery (especially the range and gorge country near Wittenoom) ranked first in visitor-appreciation, well above mining operations, and we see no reason why these will not continue to attract large numbers of visitors and local residents. In our view, more conservation reserves are required to preserve the natural features of the region.

CONSERVATION RESERVES

The Pilbara contains five major conservation reserves. While these form the basis of a viable reserve system, they do not, in the Committee's view, provide a biologically representative coverage of the Pilbara, nor do they include all its outstanding natural features, nor will they cater adequately for expected future demands of tourism and recreation.

In addition to examining the areas referred to in submissions, the Committee examined some large tracts of vacant Crown land. Some of the sites it has recommended as new reserves are, in terms of scenery, flora and fauna, among the most exceptional in the State, and the Committee strongly urges that early action be taken to safeguard them.

Although reluctant to rank its recommendations the Committee wishes to convey that while greatly impressed with existing reserves at Barrow Island and in the Hamersley Range, it was equally impressed with the Dampier Archipelago and Millstream; it recommends that these be reserved as soon as possible, and that adequate arrangements be made for their proper supervision and management. The Pilbara is basically a hot, arid region and local people and tourists are understandably attracted to water for their recreation. The Dampier Archipelago not only comprises many islands with sheltered bays and sandy beaches, but is close to a rapidly growing port and industrial centre. Millstream, some 110 km inland is literally an oasis of great scenic and biological interest. In the Committee's view, its recommendations for these areas should be acted upon as soon as possible to ensure that they continue to cater for human recreation without damage to their natural ecosystems.

The areas reported upon by the Committee are:

- a) Rowley Shelf and Coastline
 1. Barrow Island Wildlife Sanctuary
 2. Monte Bello Islands
 3. Lowendal Islands
 4. Coastal Islands - Mary Anne to Regnard
 5. Dampier Archipelago
 6. Coastal Islands - Dixon to Cape Keraudren
 7. Coastal Region - Mary Anne Islands to Cape Keraudren
- b) Pilbara Block
 8. Mungaroon Range Wildlife Sanctuary
 9. Marble Bar area
 10. Nullagine area
 11. Former Mt. Fraser Station
- c) Hamersley Iron Province
 12. Chichester Range National Park
 13. Millstream Wildlife Sanctuary
 14. Hamersley Range National Park
- d) Ashburton
 15. Barlee Range Wildlife Sanctuary
 16. Mt. Augustus
 17. Teano Range area
 18. Collier Range area

8.1 BARROW ISLAND WILDLIFE SANCTUARY

Barrow Island (Fig 8.1) was one of the first flora and fauna reserves declared in Western Australia and is well known for its outstanding wildlife. The mammals in particular are numerous and spectacular. These include the Barrow Island Euro (Macropus robustus isabellinus), the Brush-tailed Rock-wallaby (Petrogale penicillata), the Spectacled Hare-wallaby (Bettongia lesueur), the Northern Brush Possum (Trichosurus arnhemensis), the Barrow Island Bandicoot (Isoodon auratus barrowensis), two marsupial mice and two native rodents. Among the birds, the Black and White Wren (Malurus leucopterus) is restricted to Barrow and Dirk Hartogs Islands, and the Spinifex-bird (Eremiornis carteri) is more plentiful on Barrow than anywhere on the mainland. A full list of species known to exist on the island has been published by Butler (1971).

The vegetation of Barrow Island is dominated by spinifex, three species being present: Triodia wiseana on rocky areas, T. pungens on the slopes and T. angusta in the valleys. Shrubs occur, especially in the valleys, while only one tree species, Eucalyptus patellaris has been recorded

Surrounding the island are tidal flats and rocky reefs which support a wide variety of marine life. Beaches on the western side are used as nesting sites by turtles.

Barrow Island contains a producing oil field developed by West Australian Petroleum Pty. Ltd. A series of joint inspections by the Department of Fisheries and Fauna and the WA Wild Life Authority (Burbidge and Main, 1971 and unpublished) has confirmed that the oil field has had no



Figure 8.1. Barrow Island Wildlife Sanctuary, showing development within oilfield.



Figure 8.2. Cordia subcordata on Boodie Island - the only known locality for this species in Western Australia.

major detrimental effect on the native fauna. The Company has introduced a number of conservation measures, both on its own initiative and following recommendations made by the Department of Fisheries and Fauna. These have been most effective.

Barrow Island is at present a Class A reserve for the "Preservation of Flora and Fauna", but being not vested and under the Land Act is under the control of the Minister for Lands. It is a sanctuary within the meaning of the Fauna Conservation Act and the regulations concerning the management of sanctuaries apply to it but the WA Wild Life Authority does not have full control. This situation is liable to lead to administrative confusion. Recognising that Barrow Island is a wildlife sanctuary of worldwide significance, the Committee strongly recommends its vesting in the WA Wild Life Authority.

Adjacent to Barrow Island are a number of smaller islands, some of which are of conservational significance.

Boodie Island, about 8 km south of Barrow, is of interest because it harbours a small population of the Boodie (Bettongia lesueur), a rat-kangaroo which occurs also on Barrow, Bernier and Dorre Islands but which is extinct on the Australian mainland. One notable plant is Cordia subcordata (Fig 8.2) this being the only known occurrence of the species in Western Australia.

Middle Island, which lies between Barrow and Boodie Islands, is an important turtle nesting site. The Caspian Tern (Hydroprogne caspia) also nests there.

Double Island, lying off the north-eastern coast of Barrow, is the site of a breeding colony of the Wedge-tailed Shearwater (Puffinus pacificus). The Crested Tern (Sterna bergii) breeds on an islet immediately south of Double Island.

Recommendations

The Committee recommends that:

1. Barrow Island remain a Class A reserve for the Preservation of Flora and Fauna;
2. Barrow Island be vested in the WA Wild Life Authority;
3. the reserve be extended to low water mark to facilitate control of access and to protect the adjacent reefs and beaches;
4. Boodie, Middle and Double Islands, to low water mark, be included in the reserve.

8.2 MONTE BELLO ISLANDS

The Monte Bello Islands, which lie about 20 km north of Barrow Island and 90 km from the mainland, were used by the British Atomic Weapons Research Establishment as a site for testing nuclear weapons in 1952 and 1956. The natural history has been described by Burbidge (1971 b). They carry two main types of vegetation, spinifex steppe on red sand on Hermite Island, and a shrub savannah on islands which have white sand. The islands once contained two marsupials - the Spectacled Hare-wallaby and the Golden Bandicoot - but they are now extinct here, due most probably to the introduction of the domestic cat (Felis catus). The Water Rat (Hydromys chrysogaster) still occurs there as does a variety of birds and reptiles.

Marine life is varied; turtles, rays and fish abound and there are many interesting molluscs.

Hermite Island provides an ideal situation for the re-establishment of Hare-wallabies and Bandicoots from Barrow Island. Both species have forms restricted to Barrow, and a second population would be a safeguard against extinction. Only Hermite Island has the correct type of vegetation necessary for establishment, which would have to be preceded by a cat eradication programme.

Although somewhat isolated, the islands have great tourist appeal, and a number of proposals for tourist development have recently been made. The islands are at present vacant Crown land.

Recommendations

The Committee recommends that the area be reserved as follows:

1. Hermite Island be made an A Class reserve for the "Conservation of Flora and Fauna", vested in the WA Wild Life Authority, the reserve to extend to low water mark;
2. the remainder of the Monte Bello Islands be made an A Class reserve for the "Conservation of Flora and Fauna and Recreation" vested in the WA Wild Life Authority, with power to lease, the reserve to extend to low water mark.

8.3 LOWENDAL ISLANDS

The Lowendals are a group of small islands about 11 km north-east of Barrow Island. Composed of limestone and associated sand dunes they rise only a few metres above sea level. Biologically little is known of them but the islands are important as a breeding site for the Wedge-tailed Shearwater (Puffinus pacificus). A number of other birds as well as a few reptiles have been recorded (Serventy and Marshall, 1964).

Recommendation

The Committee recommends that conservation requirements in the Lowendal Islands be met as discussed in the Introduction.

8.4 COASTAL ISLANDS - MARY ANNE TO REGNARD

These islands are described under System 9.

Recommendation

The Committee recommends that conservation requirements for islands be met as discussed in the Introduction.

8.5 DAMPIER ARCHIPELAGO

The Dampier Archipelago (Fig 8.4) is a group of about 10 large and many small islands adjacent to the towns of Dampier and Karratha. The islands have long been of interest to scientists, fishermen and tourists, and a recommendation for their reservation was included in the 1962 report of the Australian Academy of Science Committee on National Parks.

The Archipelago is adjacent to an area of rapid development and increasing population. Legendre and Delambre Islands have both been investigated as port sites capable of handling much larger bulk carriers than can presently be accommodated in existing ports. There is also interest in mining the limestone on the islands and in developing tourist and recreational facilities.

The main conservational value of the area has been discussed by Burbidge and Prince (1972) and may be summarised as follows:

1. The islands contain unique animals e.g. the Dolphin Island Euro (Macropus robustus rubens), or animals which are rare and not protected elsewhere e.g. Rothschild's Rock-wallaby (Petrogale rothschildi).
2. The vegetation of the islands is typical of much of the North-West, but has not been affected, as has the mainland, by the grazing of such exotic animals as sheep, goats and cattle. It thus provides a valuable area for the comparison and measurement of grazing effects.

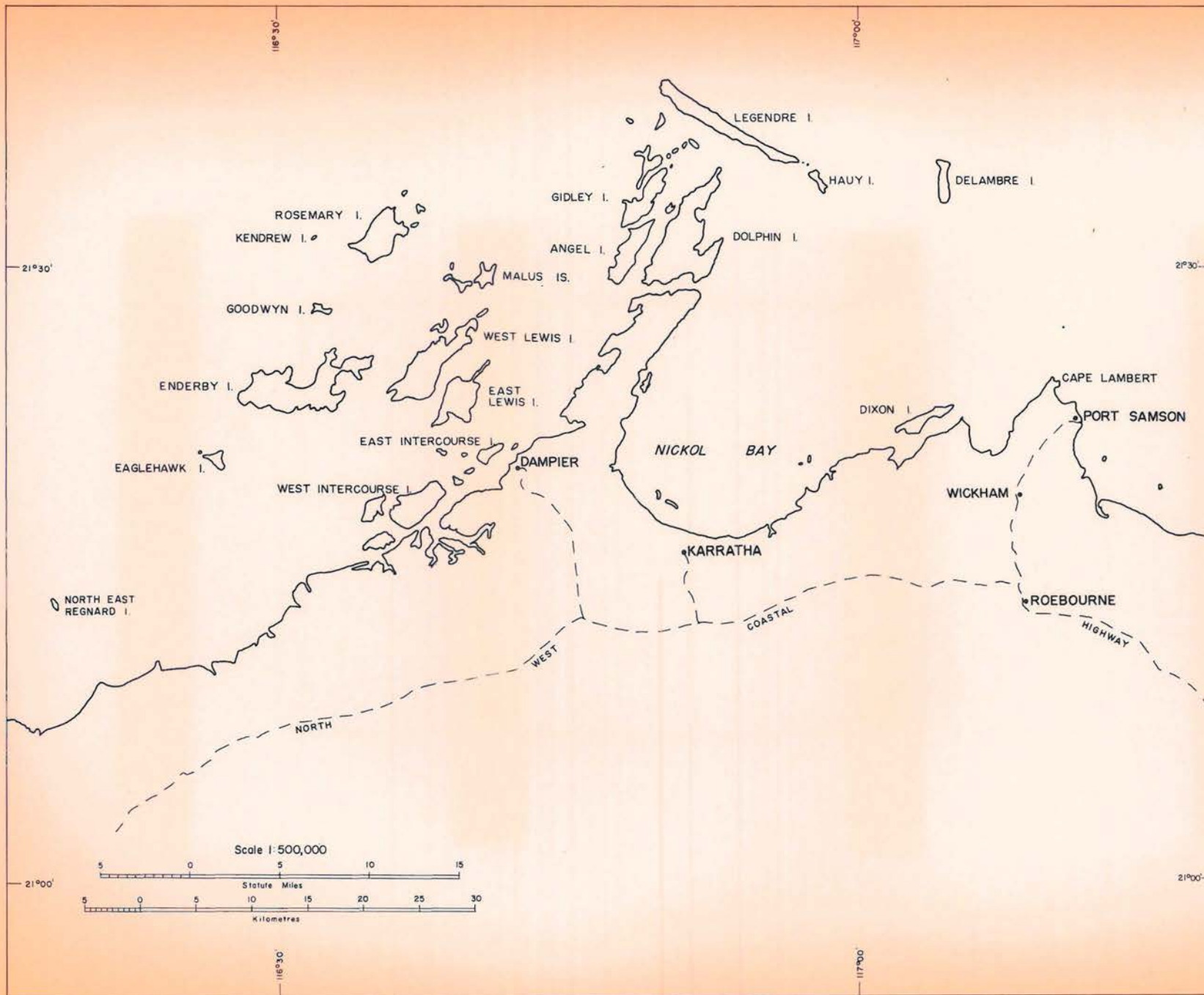


Figure 8.4 Area map of the Dampier Archipelago



Figure 8.3. Aboriginal engraving, Angel Island, Dampier Archipelago.

3. The islands contain large numbers of aboriginal rock engravings of outstanding scientific value and tourist appeal, (Fig 8.3).
4. The marine fauna of the adjacent sea is rich and diverse. Notable areas include the coral reef surrounding Delambre Island and the sand flats east of Rosemary Island. The Western Australian Museum is currently studying the crown-of-thorns starfish on reefs adjacent to Kendrew Island.

Because the Archipelago contains a number of islands it provides a clear case for multi-purpose usage, with islands being allocated different usages.

From a conservation viewpoint Rosemary and Dolphin Islands are the most important. Dolphin is the largest island, has the most diverse flora (over 100 species) and harbours Euros, rock-wallabies, native cats and rodents as well as a wide variety of birds and reptiles. Rosemary Island does not have the same variety of flora and fauna as Dolphin, but is complementary, containing many different species. Rock-wallabies are much more common and are possibly of a different species. The reptiles are especially diverse for such a small island (1132 ha) and include species not found elsewhere. There is also an insular population of the Sandy Inland Mouse (Pseudomys hermannsburgensis).

Though aboriginal engravings occur abundantly on almost all the islands, Angel and Dolphin appear to have the best.

Recreational pressures on the Archipelago are understandably heavy and increasing, because the islands provide sheltered water for boating and fishing, and contain the best sandy beaches in the region. The proximity of Dampier, Karratha, Wickham and Roebourne, and the expected rapid growth of these centres, especially if the Pilbara Development Concept is implemented, ensure increasing pressure being applied to open the islands for recreation.

The North West Game Fishing Club (Inc.) already has a lease of about seven hectares on Rosemary Island. A building and airstrip have been constructed and a well sunk for water. The Committee believes that Rosemary is too valuable biologically and too small to be used extensively as a holiday resort. Enderby Island, on the other hand is much larger (3000 ha, almost twice the size of Rottnest) and of less biological value. It has the same scenic attractions and contains many sheltered bays and beaches.

Recommendations

The Committee recommends that the Dampier Archipelago be divided into four areas:

1. Wildlife Sanctuary. To include all the following islands and all smaller islands in their vicinity: Hauy, Angel, Gidley, Keast, Rosemary, Malus, Mawby, Kendrew, Goodwyn, Eaglehawk, Egret, West Lewis and East Lewis. These islands to be declared a Class A reserve for the "Conservation of Flora and Fauna" vested in the WA Wild Life Authority.
2. Recreation Area. Enderby Island to be reserved for "Recreation and the Conservation of Flora and Fauna", vested in the Wild Life Authority with power to lease.
3. Port Sites and associated industrial activities. Legendre Island and Delambre Island. The Committee recommends the following controls:
 - i) that part of Legendre Island be left in its natural state;
 - ii) that the coral reef around Delambre Island be declared an A Class Aquatic Reserve vested in the Director of Fisheries and Fauna, if the island is used as a port, that effective measures be taken to protect and prevent pollution of the reef;
 - iii) that if Delambre is not used as a port site it be added to the Wildlife Sanctuary.
4. Causeway to Legendre. Dolphin Island to be left unreserved at this stage to allow for the construction of a causeway and road to Legendre Island. Should the causeway be constructed the Committee recommends that all of Dolphin except the road reserve set aside for the road to Legendre be declared an A Class reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

The Committee recommends the following controls;

- i) that before any disturbance takes place the cataloguing and mapping of aboriginal rock engravings be completed and the route of the causeway be aligned to meet requirements of the Aboriginal Heritage Act;
- ii) that the causeway contain effective barriers preventing the movement of animals between Dolphin, Legendre and the mainland;
- iii) that vehicular access from the road reserve to Dolphin Island be prohibited.

8.6 COASTAL ISLANDS - DIXON ISLAND TO CAPE KERAUDREN

Several important islands are included in this group. Depuch Island contains not only one of the finest aboriginal art galleries in Australia but also a population of rock-wallabies (Petrogale penicillata) (Ride et al., 1964). The Australian Pelican (Pelicanus conspicillatus) nests on North Turtle Island while Bedout Island is an outstanding sea-bird breeding site. Other islands may well be nesting sites for sea-birds and turtles but their importance can only be assessed following biological survey.

Further uses are possible for some islands in this region, e.g. Dixon Island in Nickol Bay has been suggested as a possible port site and recreation area.

Although Depuch Island is a reserve for the "Preservation of Native Art", vested in the WA Museum, and is also protected under the Aboriginal Heritage Act, the other islands are vacant Crown land.

Recommendations

The Committee endorses the reservation and vesting of Depuch Island. It recommends that:

- a. North Turtle and Bedout Islands be declared a Class A reserves for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority;
- b. conservation requirements for other islands be met as discussed in the Introduction.

8.7 COASTAL REGION - MARY ANNE ISLANDS TO CAPE KERAUDREN

The Pilbara coastline is characterised by wide tidal-supratidal flats. The channels and interchannels areas on the seaward margin of the flats are bordered by extensive mangrove thickets and terrains of algal mat. The Pilbara is arid and there is only intermittent run-off, thus only small amounts of nutrient enter the sea from the land.

It is probable that the mangrove - algal mat association is an important factor in the nutrient cycle for all organisms that inhabit the shelf zone. The extensive tidal channel system is the habitat for juvenile fish, prawns and other fauna.

The tidal-supratidal flats have been utilized for solar salt extraction and some destruction of mangroves has resulted.

Recommendation

The Committee recommends that biological and sedimentological surveys be carried out on tidal-supratidal flats in the coastal segment from southern Exmouth Gulf to Cape Keraudren (see also System 9), and that further development for solar salt production be limited to the supratidal zone, landward of the mangrove thickets. It also recommends that such development and any other project which might cause the destruction of mangroves be subject to approval by and under the supervision of the Environmental Protection Authority.

8.8 MUNGAROONA RANGE WILDLIFE SANCTUARY

This area is a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

It was declared in 1972 following representation from the Department of Fisheries and Fauna and an investigation by the Pastoral Branch of the Department of Lands and Surveys.

The area originally proposed for a sanctuary was representative of the region; rough country in the east containing deep gullies with isolated water holes; high rolling tableland to the west and north covered with grasses, and open flats dissected by creeks running north to the Yule River. Outstanding features are spectacular gullies and ravines in the Mungaroona Range and, to the north, the headwaters of the Sherlock and Peawah Rivers.

The Red Kangaroo, Euro and Echidna as well as the Dingo are indigenous to the area and bird life, which is diverse, includes Emu, Spinifex Pigeons and Finches while reptiles include the Perentie (Varanus giganteus) and Olive Python (Liasis olivaceus).

However, the area reserved was considerably smaller than the area proposed, mainly because most of the land considered suitable for pastoral use was included in surrounding stations or in reserves for the "Use and Benefit of Aborigines". The reserve has a most irregular shape and appears not to be fully representative of this part of the Pilbara.

Recommendation

The Committee recommends that the Department of Fisheries and Fauna make a biological survey of the reserve to report on its adequacy as a Wildlife Sanctuary.

8.9 MARBLE BAR AREA

The Committee inspected this area of vacant Crown land from the air. Most members are individually familiar with the area. Though scenically and biologically impressive it is also highly prospective for gold, base metals, tin and possibly other minerals and contains a large number of mining tenements.

Recommendation

The Committee recommends that the future of the area as a conservation reserve be re-examined in 10 years; meantime, that no additional pastoral leases be granted in the area without full appraisal being made of the effect of a lease on the decision to be made in 10 years' time.

8.10 NULLAGINE AREA

The Committee inspected this area of vacant Crown land from the air. Most members are individually familiar with the area. It is not as interesting as the Marble Bar area and furthermore it contains a large number of mining tenements. The Committee makes no recommendations concerning it.

8.11 ABANDONED MT. FRASER PASTORAL LEASE

The Committee viewed this area from the air. It consists mostly of extensive spinifex-covered plains with occasional sand dunes. Some degenerate mulga communities occur, particularly in the northern third. The Committee makes no recommendation for change in status.

8.12 CHICHESTER RANGE NATIONAL PARK

The Chichester Range lies to the north of the Fortescue River valley and runs approximately parallel to it from near Roy Hill in the east to near Millstream in the west.

The National Park was created in 1969 on the recommendation of the Reserves Advisory Council following representation by the WA Naturalists' Club. Situated in the western part of the range, it encompasses a tableland dissected by the headwaters of the Harding, George and Sherlock Rivers. At its northern edge is an escarpment where the tableland gives way to the coastal plain. Fine panoramic views of the plain, including Pyramid Hill and other features, can be seen from the top of the escarpment in the vicinity of Mt. Herbert.

Other features in the Park include Python Pool, a well-publicised beauty spot readily accessible from the Roebourne-Wittenoom road, and many aboriginal engravings, especially at Black Hill and Narrina Pool (Wright 1968). The hills are covered with spinifex (Triodia spp.) and the water courses contain shrubs and trees. Euros (Macropus robustus) are common.

Vacant Crown land borders the eastern and western boundaries of the Park. The land on the western side was inspected by the Committee and found to be unimpressive; the land on the eastern side includes Nunyery Creek, the course of which contains many aboriginal rock engravings.

Although the original submission from the Naturalists' Club recommended that the Crown land to the east be included, this was not adopted when it was shown that the area contained a large number of mineral claims and temporary reserves. Current maps (1973) show that only three mineral claims are now held in the area. Nevertheless, the region has produced chrysotile asbestos and copper, and the presence of serpentinite and basic rocks identifies it as a prospective region for base metal deposits.

Recommendations

The Committee endorses the purpose, status and vesting of the Chichester Range National Park and recommends that the area of vacant Crown land to the east of the Park, around Nunyerry Creek, be examined by the WA Museum for aboriginal rock engravings with a view to including it in the park and that any outstanding areas be reserved for the Preservation of Aboriginal Art.

8.13 MILLSTREAM

Millstream has long been recognised as a unique and outstanding area, both biologically and scenically. The oasis nature of Millstream, and its proximity to the Roebourne - Wittenoom Road attracts increasing numbers of local people and tourists. The crystal-clear running water, cadjeput and palm trees surrounding deep pools, colonies of flying foxes and the variety of spectacular birds, all contrasting with the surrounding dry, dusty plains and ridges, make Millstream a unique experience for the visitor (Figs 8.5, 8.6, 8.7).

It supports an extremely wide range of animal and plant life, much of it not found elsewhere in the Pilbara. Records include 9 species of fish, 108 species of birds and 29 species of dragon and damselflies, some of which are endemic (Burbidge, 1971 a ; Watson, 1969). An outstanding plant is the Millstream Palm (Livistona alfredii).

Millstream Wildlife Sanctuary, a small reserve of 440 ha was created in 1956 at the suggestion of the Forests Department, in order to prevent the cutting of the fine stands of cadjeput (Melaleuca leucadendron). The reserve was of Class A, for the purpose of "National Park", and was not vested. In 1961 Parliament amended the purpose to include "Conservation of Indigenous Flora and Fauna" to allow Fisheries and Fauna's District Fauna Wardens and Honorary Wardens to prevent shooting of wildlife and despoliation of the area. The reserve was vested in the WA Wild Life Authority in 1964. The powers of the Department have always been limited by the smallness of the reserve which includes only a small portion of the Millstream area (see Fig 8.8).

Millstream is also an important link in the development of water resources for the Pilbara. A large isolated calcrete aquifer occurs at Millstream as an arcuate trough on part of the Fortescue Plain, extending across the Fortescue River upstream from Gregory Gorge.

Natural overflow from the aquifer via a number of springs supplies both a fast-running stream and four large permanent pools in the Fortescue River within a 5 km radius of Millstream homestead. These pools - Deep Reach, Crossing Pool, Millstream Pool and Palm Pool - overflow one into another. Studies indicate that an average of 35 million litres per day is being discharged into the system (Davidson, 1969). The spring-fed river pools are comparatively large and deep. Deep Reach, the longest, is 2.5 km long and about 15 metres deep.

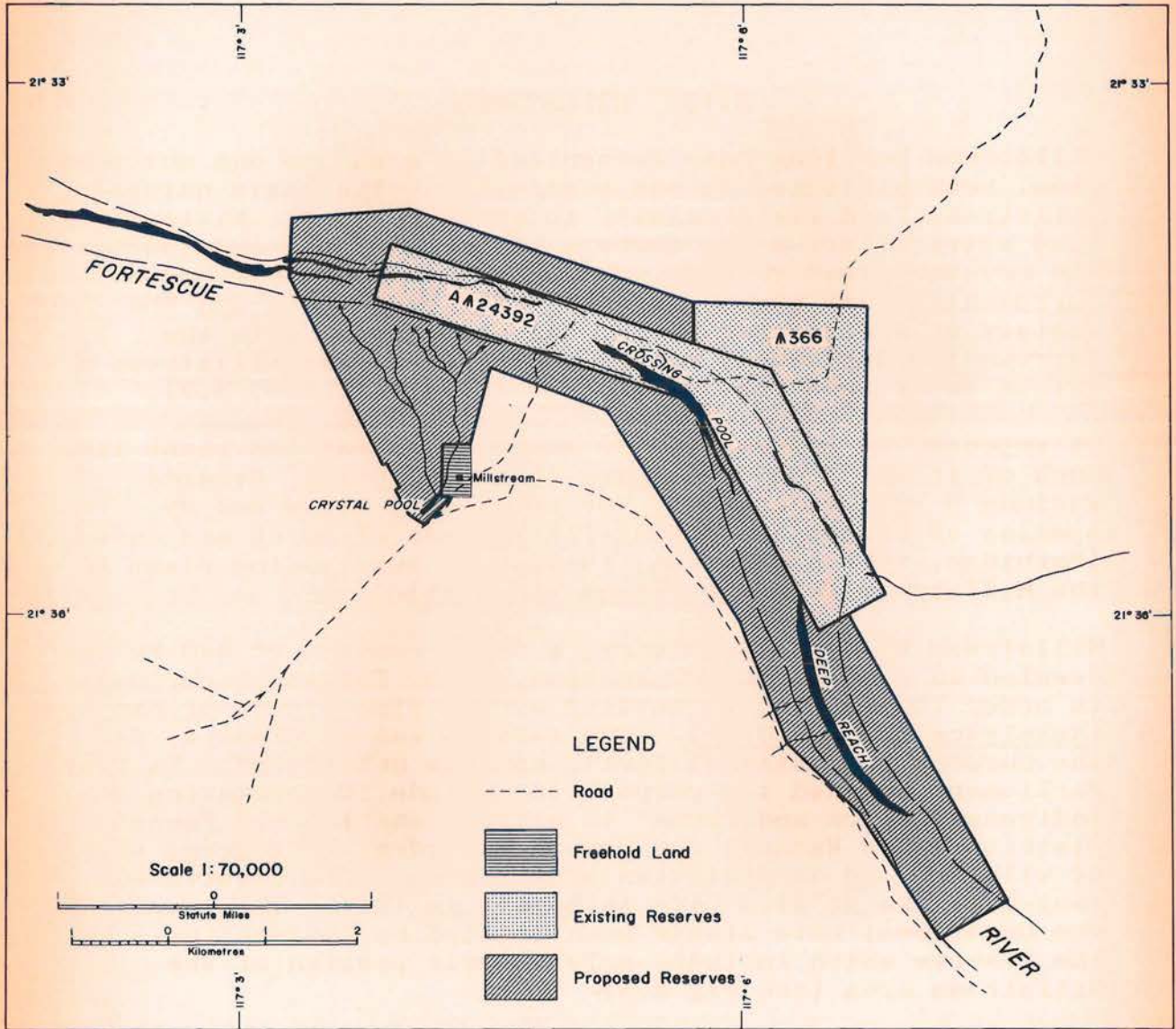


Figure 8.8 Area map of Millstream



Figure 8.5. Millstream: Crossing Pool from "Cliff Scene", showing River Gums (*Eucalyptus camaldulensis*), Cadjeputs (*Melaleuca leucadendron*), and Millstream Palms (*Livistona alfredii*); dry hills beyond, with spinifex and Migum.



Figure 8.6. Millstream: Crossing Pool, with Cadjeputs (Melaleuca leucadendron).



Figure 8.7. Millstream: Crystal Pool, with Cadjeputs (Melaleuca leucadendron), aquatic fern Ceratopteris thalictroides, and introduced date palms and water lilies.

The aquifer is being utilised to provide potable water for the coastal towns. This development has not affected Millstream so far, the flow of water through the springs have been maintained, Even if the water level in the aquifer was reduced so as to slow or stop the natural flow of the springs, water could be pumped from the bores to maintain the area.

A greater problem is the possible siting of a dam in Gregory Gorge, down river from Millstream. Purely from a water supply viewpoint it is desirable, and possible, to construct a dam which would flood the Millstream area and assist in recharging the aquifer, which might be heavily depleted when the dam was dry in time of drought.

The Committee believes that the scientific and recreational value of Millstream demands a compromise whereby any dam constructed would leave a significant portion of the Millstream area unflooded. Further, the area is so important that a much larger Wildlife Sanctuary than the existing 440 hectares should be declared.

Recommendations

The Committee recommends that the existing Class A reserve be enlarged to include Deep Reach, Crossing Pool and the Millstream as shown in Fig 8.8. The Reserve is currently vested in the WA Wild Life Authority and the Committee believes that this vesting should remain.

The design of any proposed dam on the Fortescue River should ensure that there will be no flooding of the Reserve, nor should the extraction of water from the aquifer be to the detriment of the reserve.

8.14 HAMERSLEY RANGE NATIONAL PARK

The scenic grandeur, wildflowers and iron ore deposits of the Hamersley Range area place it high on the list of major tourist attractions in Australia. The iron ore deposits are of great economic importance to the nation and should be exploited, but because of the scenic and biological value of the area, the Committee believes this should be done without undue destruction of the natural environment.

The large belt of elevated country lying between the Fortescue and Ashburton Rivers is often referred to as the Hamersley Range. However, the Hamersley Range proper comprises only the northern third of this area. Both outer margins of the Range are bounded by pronounced erosion scarps, capped by erosion-resistant banded iron formation. The northern front of the Range, the Hamersley Scarp, is much indented by recent erosion and is buttressed by long, scree-covered spurs.

Behind the scarp, the narrow elevated scarp ridge is heavily dissected by chaotic gullies and steep valleys providing an extremely rugged landscape. Because few of the streams draining the Hamersley Range flow to the south, the southern scarp is little eroded, contrasting with the Hamersley Scarp, and for many miles it forms a long unbroken wall more than 300 metres in height. Numerous high peaks exist along the Range. Between the two scarps is a high basin, the surface of which is being incised by intermittent streams forming spectacular waterfalls and gorges.

To the south of the Hamersley Range proper lies an area of mainly southern drainage, termed by the Committee the "Southern Watershed". This area can conveniently be divided into four sections:

- a) the Central Valley. Developed in the Wittenoom Dolomite, it separates the rugged Hamersley Range from the generally lower country to the south. The isolated Mt. Bruce (1235 metres) is a striking feature of the valley.
- b) the Western Section. A folded area with long, deep and narrow valleys. Drainage is generally westward via Duck Creek or southward toward the Ashburton River,
- c) the Central Section. A broad low-level basin around Mt. Tom Price which separates areas of tightly folded and faulted rocks to the west and east.
- d) the Eastern Section. Characterised by long narrow ridges trending in a generally easterly direction. Much of the country is broken and rough with many prominent ranges of iron formation rising 450 to 600 metres above the general level. Many peaks approach 1200 metres and one, Mt. Meharry, at 1245 metres is the highest point in Western Australia. Large plains occur at Wanna Manna Flats and in the Turee Creek Syncline.

The Hamersley Range National Park was declared in 1969 following a recommendation by the Academy of Science Committee on National Parks in 1962 which was reviewed by the Reserves Advisory Council in 1969. The reserve encompasses a section through the Hamersley Iron Province from the northern scarp of the Hamersley Range to the Turee Creek area. It contains a good cross section of the vegetation of the area, including open woodland formations, northern mulga and the interesting plant communities on top of the mountains and in the gorges. It also contains some striking gorges including Red Gorge, Knox Gorge, Yampire Gorge and part of Dales Gorge.

Mt. Bruce is within the park, but Mt. Meharry, which was unknown when the boundaries were recommended in 1962, lies just outside it. The park includes only a small portion of the Fortescue Plain along the Wittenoom - Roy Hill Road.

The Committee has considered a number of submissions suggesting altered boundaries for the National Park. These cover a number of areas.

1. Hamersley Gorge. This is one of the most striking features of the area being structurally quite different from gorges included in the reserve (Figs. 8.9, 8.10). A number of submissions suggested its inclusion in the park. Hamersley Gorge is visited by an increasing number of tourists as well as parties from the nearby iron-ore towns. The Committee recommends that it be added to the National Park.
2. Dales Gorge. The lower part of Dales Gorge, including Wingermoontha Pool, is not in the National Park. It was originally within a Flora and Fauna Reserve before the National Park was created but was excised to permit the declaration of a Mining Act temporary reserve for iron ore (now TR 4943H, occupied by Mt. Bruce Mining Pty. Ltd.). The Committee recommends that the boundaries of the National Park be readjusted to include the whole of Dales Gorge and that mining be not allowed to interfere with the scenic quality or ecology of the gorge.
3. Mt. Meharry. It is incongruous that the highest point in the State is not within the National Park and the Committee recommends that the National Park boundary be extended to include it. Mt. Meharry is at present within TR 3156H, the "Area C" held by the Mt. Goldsworthy consortium under the Iron Ore (Mt. Goldsworthy) Agreement Act, 1964. Negotiations should be held between the Government and the companies concerned, with a view to excising Mt. Meharry from the temporary reserve.
4. Juna Downs Station. The Committee understands that the Department of Lands and Surveys is examining the pastoral lease areas held by Juna Downs Station with a view to consolidating them into one viable block. Cattle wandering from the station into the park also pose management problems. The Committee recommends that if lease areas extending into the National Park are released they be added to the Park.

The addition of the northern of the two lease intrusions into the eastern boundary of the park would add an area of mulga to the reserve as well as including Mt. Windell (1110 m) and removing the cattle problem noted above. The addition of the lease on the southern boundary would further rationalise the boundaries.

5. Fortescue Plain. An insignificant portion of the Fortescue Plain is included in the National Park and more should be included if it is to be truly representative of the region. However, all parts of the Fortescue Plain abutting the park are within Mt. Florence and Mulga Downs Stations. The Committee recommends that part of the Fortescue Plain be included in the National Park at a suitable time or on expiry of an appropriate lease.

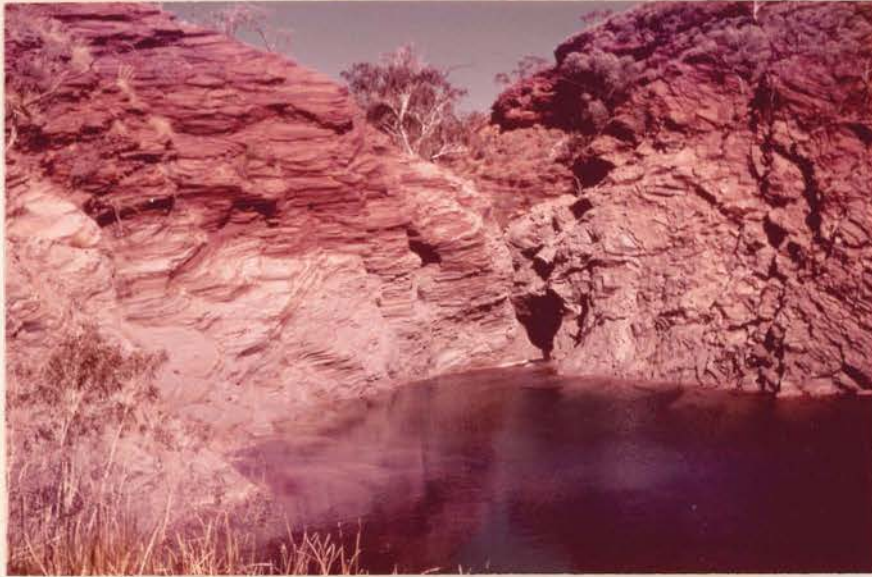


Figure 8.9. Hamersley Gorge.



Figure 8.10. Hamersley Gorge.

6. Palm Springs - Mt. Brockman Station. A submission from the Director of Kings Park and Botanic Garden records an occurrence of the Millstream Palm (Livistona alfredii) in an area on Mt. Brockman Station (Fig 8.0, Area 14.1). This occurrence may be of importance when the possible flooding of part of Millstream by a dam is considered. This area is not known to the Committee. It recommends that it be investigated by the WA Herbarium.

Summary of Recommendations, Area 8.14

1. Hamersley Gorge to be added to the Hamersley Range National Park.
2. The whole of Dales Gorge to be included in the National Park and mining to be prevented from interfering with the scenic quality or ecology of the gorge.
3. Mt. Meharry to be included in the National Park.
4. Those parts of Juna Downs Station at present extending into the eastern and southern boundaries of the National Park to be added to the Park if released.
5. A portion of the Fortescue Plain to be added to the Park at an opportune time.
6. The WA Herbarium to examine the Palm Springs area of Mt. Brockman Station and report on its suitability as a reserve.

8.15 BARLEE RANGE WILDLIFE SANCTUARY

The Barlee Range Wildlife Sanctuary is at present a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority. The Sanctuary is an area representative of the rugged, much dissected Proterozoic sediments of the southern Pilbara. It contains some spectacular scenery, especially the steep sided Kookhabinna Gorge which retains permanent pools containing interesting fresh-water flora and fauna.

The vegetation of the rugged hilltops is dominated by spinifex (Triodia spp.) with a few small shrubs. In the valleys, eucalypts and cadjeputs occur with various Acacia and Eremophila species. Sedges occur on the banks of the streams.

The larger mammals are typical of that part of the State, both Euros and Rock-wallabies being present. The relationships of the smaller animals indicate that the reserve contains relicts of southern and northern elements. This is suggested by the skink Lerista frosti, by the snails and, in particular, by a bivalve. In addition there are six or seven species of fresh-water fish and a fresh-water bryozoan ("moss animal") in the streams.

The Committee endorses the principle that this reserve remain a wildlife sanctuary, undisturbed by development.

8.16 MT. AUGUSTUS

Mt. Augustus is an impressive mountain at the western end of a long ridge to the south of the upper Lyons River. It reaches 1105 metres, some 700 metres above the surrounding plain and consists of rock of Upper Proterozoic age comprising sandstone and conglomerate strata of the Bangemall Group lying on a granitic basement.

The strata have been folded into an anticline at Mt. Augustus and the northern side has been eroded to form a steep and rugged bluff.

Contrary to some published claims, Mt. Augustus is not the largest rock or monadnock in Australia and comparisons with Ayers Rock and the Olgas are scientifically invalid. However it certainly has scenic grandeur from some viewpoints.

The vegetation is a tall, open shrubland, dominated by mulga (Acacia aneura). There are many other wattles, poverty bushes (Eremophila), hophushes (Dodonaea), etc., while many herbaceous plants appear after suitable rains. Several unnamed species are known only from the mountain, e.g. a Hibiscus, a mulla mulla (Ptilotus) and a spectacular native foxglove (Pityrodia).

To the north of the mountain, the Lyons River contains a large permanent pool known as Cattle Pool, while to the south-west is a spinifex plain carrying a different flora again.

A report from the Chief Pastoral Inspector included the following comments on Cattle Pool:

Cattle Pool is the only watering place in the south-west sector of Mt. Augustus bullock paddock. There is a nearby bore, however this is marked N.I.U. (not in use), reasons not given. If an area surrounding the pool was resumed, lessees would have to find water somewhere in the vicinity. This should not be impossible somewhere along the Lyons River.

Recommendations

The Committee recommends that the Mt. Augustus area, as shown in Fig. 8.11, be declared a Class A reserve for National Park and vested in the National Parks Board.

Because Mt. Augustus is too far from any urban area for a day trip, part of Cattle Pool is recommended for inclusion as a camping place. The proposed boundaries follow existing fences and leave part of Cattle Pool in the pastoral lease. It is not the Committee's intention to exclude the station's access to water and details should be worked out between the lessee and the National Parks Board so that water from Cattle Pool can be used for stock without deleterious effect to the proposed National Park.

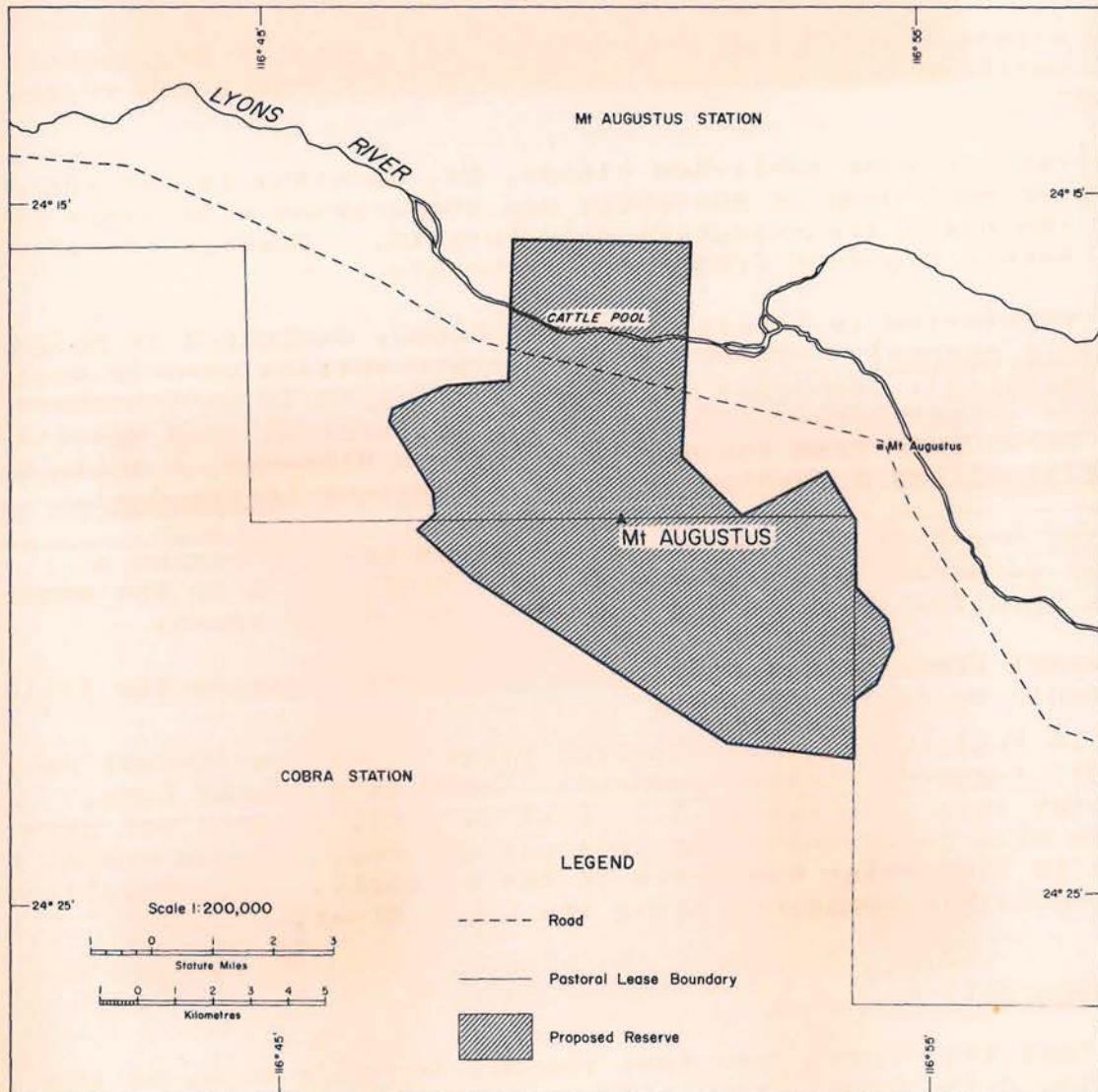


Figure 8 II Area map of Mt. Augustus

8.17 TEANO RANGE AND FORMER JEEALIA RIVER DOWNS STATION

The Teano Range lies between the Ashburton and Gascoyne Rivers about 250 km south of Wittenoom. Part of the range is within Woodlands Station, while part is vacant Crown land. The vacant land extends some distance to the north and east. The range itself consists of a series of ramparts while the country to the north-east is rugged and dissected with striking gorges along Gorge Creek.

The Committee viewed the area from the air and found it scenically attractive. The area appears to have little pastoral value and it contains no current mining tenements.

To the north-west of the Teano Range lies vacant Crown land within and adjacent to the former Jeealia River Downs Station. This area is not known to the Committee.

Recommendation

The Committee recommends that the two areas be made unvested C Class reserves for the Conservation of Flora and Fauna under the Land Act and that further decisions on the area await a biological survey of both these and the Collier Range area, as well as an examination of the alternative uses.

8.18 COLLIER RANGE AREA

Lying between the upper reaches of the Ashburton and Gascoyne Rivers, the Collier Range area (Fig. 8.12) represents a region which at present contains no reserve. It is geologically and biologically diverse with colourful scenery.

The ranges vary from low hills to high ridges often bounded by cliffs. The vegetation is dominated by mulga, Acacia aneura, and spinifex, Triodia spp., while eucalypts occur along many creek-lines. To the north east are plains carrying mulga groves, where colourful displays of mulla mullas, Ptilotus spp., occur in good seasons.

West of the Range are extensive spinifex plains, and in the far west of the area, near Coobarra Creek, are sand dunes carrying a flora different from that of the hills. The area contains no current mining tenements.

Recommendation

The area is recommended for reservation as a Class C reserve for the Conservation of Flora and Fauna to be vested in the WA Wildlife Authority, as being a representative sample of the region. A decision on upgrading to Class A should be made after a biological survey of this and the Teano Range Area.



Figure 8.12. Collier Range from the air; mulga and spinifex on the hills and plains.

BIBLIOGRAPHY

- Anon. 1962. Report of the Western Australian Sub-Committee of the Australian Academy of Science Committee on National Parks. Mimeographed report.
- Anon. 1971. Developing the Pilbara Iron Province as a Travel Region. Australian National Travel Association.
- Anon. 1972. The Pilbara, A Development Concept for the 1970's Department of Development and Decentralisation, WA
- Burbidge, A.A. 1971, a. Results of a Biological Survey of the Millstream Area. Report No. 7, Department of Fisheries and Fauna, WA
- Burbidge, A.A. 1971, b. The Fauna and Flora of the Monte Bello Islands. Report No. 9, Department of Fisheries and Fauna, WA
- Burbidge, A.A. and Main, A.R. 1971. Report on a Visit of Inspection to Barrow Island, November 1969. Report No. 8, Department of Fisheries and Fauna, WA
- Burbidge, A.A. and Prince, R.I.T. 1972. The Fauna, Flora and Planned Usage of the Dampier Archipelago. Report No. 11, Department of Fisheries and Fauna, WA
- Butler, W.H. 1971. A Summary of the Vertebrate Fauna of Barrow Island. West. Aust. Nat. 11 (7).
- Davidson, W.A. 1969. Millstream Hydrogeological Investigation. West. Aust. Geol. Survey Record 1969/3 (unpublished).
- Erickson, Rica, George A.S., Marchant N.G., and Morcombe M.K. 1973. Flowers and Plants of Western Australia. A.H. and A.W. Reed, Sydney.
- McLeod, W.A. 1966. The Geology and Iron Deposits of the Hamersley Range Area, Western Australia. West. Aust. Geol. Survey Bull. 117.
- Serventy, D.L. and Marshall, A.J. 1964. A Natural History Reconnaissance of Barrow Island and the Monte Bello Islands, 1958. C.S.I.R.O. Division of Wildlife Research, Technical Paper No. 6.
- Serventy, D.L. Serventy V.N. and Warham, J.H. 1971. A Handbook of Australian Sea-Birds. A.H. and A.W. Reed, Sydney.
- Snell, W. 1969. The Hamersley Iron Workforce. Economic Activity 12 (3).
- Watson, J.A.L. 1969. Taxonomy, Ecology and Zoogeography of Dragon Flies (Odonata) from the North-West of Western Australia. Aust. J. Zool. 17: 65-112.
- Wright, B.J. 1968, Rock Art of the Pilbara Region, North-West Australia, Occ. Papers Ab. Studies No. 11, Australian Institute of Aboriginal Studies, Canberra.

SYSTEM 9 - CENTRAL WEST COASTINTRODUCTIONArea and Physiographic Features

System 9 includes the west and east Gascoyne districts and the northwest part of the Murchison district. It extends along the coast from just north of Kalbarri to the Mary Anne Islands north of Onslow, and inland to Gascoyne Junction (Fig. 9.0), and is some 94,910 km² in area. The greater part lies in the geological province known as the Carnarvon Basin, which contains thick sedimentary sequences of Palaeozoic, Mesozoic and Tertiary age (Condon, 1954, 1967). There are three major physiographic units in the System:

- a) Dirk Hartog-Rowley Shelves (Carrigy and Fairbridge, 1957)
- b) Bullara Sunkland (Logan *et al.*, 1970)
- c) Wooramel, Gascoyne, Minilya River drainage basins, termed here the hinterland unit.

These units are the framework of a proposed system of reserves and are briefly described below.

The Dirk Hartog continental shelf is broad in the south but narrows in the vicinity of North West Cape. Mostly, the coastal border of the shelf is delineated by cliffs that extend from Edel Land along Dirk Hartog and the Bernier and Dorre Islands, and thence from Quobba Point to Cape Farquhar; coral reefs fringe the shore from Cape Farquhar to North West Cape. The Rowley continental shelf is a broad shallow platform extending along the continental margin from North West Cape to beyond Dampier Archipelago. On this shelf there are offshore islands, coral patch-reefs and shoals; the coast comprises vast tidal flats with numerous tidal channels and extensive mangrove thickets.

The Bullara Sunkland is an elongate depression that trends roughly parallel to the coast between Exmouth Gulf and Shark Bay (Fig. 9.0). The Sunkland is flanked by several low ranges. On the west there is the Cape Range, and a high ridge between Cape Cuvier and Warroora; bordering ridges extend southward and include Bernier, Dorre and Dirk Hartog Islands which are composed of aeolianite. The eastern margin of the Sunkland is sharply defined on flanking uplifts (Chargoo, Geradi, Chirrida and Grierson anticlines) or merges into low alluvial plains that extend into the hinterland along the river channels. The terrain comprises dune fields, red deltaic plains and coastal aeolianites.

Low areas of the Sunkland have been flooded by the sea in Quaternary times to form Exmouth Gulf, Lake MacLeod (now cut off from the Indian Ocean) and Shark Bay. Shark Bay is a shallow marine embayment of approximately 13,000 km² in total area. Average depth in this vast body of water is about 9 metres, but about a quarter of the area is occupied by shoals lying in depths of a metre or so. The water mass is partly cut off from the Indian Ocean by aeolianite barrier ridges, and the embayment is broken into a series of gulfs, inlets and basins by north-trending dune ridges and by sea-grass banks. Accounts of major

features are given by Logan and Cebulski (1970) and Logan et al. (1970).

To the north, Lake MacLeod occupies an elongate depression of approximately 2200 km² and for the most part the lake surface lies below present sealevel. The Lyndon and Minilya Rivers enter Lake MacLeod, but these are intermittent streams that flow only after cyclonic rains in the hinterland. Exmouth Gulf is a shallow marine gulf lying between the Cape Range on the west and a broad system of tidal-supratidal flats on the mainland shore to the east. The gulf is deepest at 20 metres, and slopes gently from south to north; numerous islands occur throughout.

The hinterland unit comprises the lower parts of the drainage basins of the Wooramel, Gascoyne, Lyons, Minilya, Lyndon and Ashburton Rivers. In this part of the System there are vast alluvial plains and red dune belts which are interspersed among low ranges, e.g. Kennedy Range, composed of sedimentary rocks of Palaeozoic and Mesozoic age.

The climate of the System is semi-arid to arid with rainfall averaging 200 to 300 mm a year and evaporation 1780 to 3050 mm per year. The major rainfall is in winter, but rainfall averages are affected by aperiodic rains which accompany summer cyclonic disturbances. Summer temperatures are extreme but the winter temperature range is comfortable.

Population

The main population centres are Carnarvon (4222), Exmouth (2638), Denham (323) and Onslow (249). The first two are defined as urban areas, and together contain more than half the System's estimated total population.

Land Use

The total area of System 9 is about 94,910 km². Approximately 80% of this is held under pastoral leases that range from 80,000 to about 400,000 hectares. Areas held under tenement for mining of salt and gypsum are:

1. Lake MacLeod, Texada Mines Pty. Ltd.; 2200 km² special agreement lease.
2. Exmouth Gulf: Exmouth Salt Pty. Ltd.; temporary reserve under Mining Act, No. 5350; 1795 km².
3. Useless Loop: Shark Bay Salt Pty. Ltd.; special lease under Land Act, Lease No. 3116/4315; Edel Location 44; 1978 hectares.

There are relatively small areas of vacant Crown land, east of Nerren Nerren, south of Urala, and on the western and northern sides of North West Cape.

The area of conservation reserves is small: 13,424 hectares in the Cape Range National Park and 10,522 hectares in the Bernier-Dorre Island Wildlife Sanctuary. Additionally there are some small islands that are wildlife sanctuaries, and a small narrow reserve around the shore of Hamelin Pool.

Primary Industry

Grazing (sheep and beef cattle) is the main primary industry in System 9. Commercial fishing ranks second, with prawn fisheries in Shark Bay and Exmouth Gulf earning \$4.5 million (export) in 1970/71; processing works are at Carnarvon and Learmonth. Scale fisheries based on whiting, schnapper and mullet also are significant and there are possibilities for future exploitation of tuna and mackerel in offshore waters. Vegetables and fruit produced at Carnarvon are dependent on irrigation from the Gascoyne River.

Mining and Industrial Development

The Carnarvon Basin has been extensively explored for petroleum but there has been no commercial production in the area of the System, so far. The largest mining operations are for evaporite minerals, rock salt, langbeinite and gypsum. An agreement between the State Government and Texada Mines Pty. Ltd. relating to the production of potash and other evaporites at Lake MacLeod was ratified by Act of Parliament in 1967. A subsequent amended agreement has permitted this company to concentrate on salt production for export. Gypsum also is extracted from small lake deposits in the Shark Bay area. At the present time a company is engaged in salt production at Useless Loop in Shark Bay, and further development of a solar salt project at Exmouth Gulf has been deferred pending recovery of the world market.

Calcium carbonate deposits occur in the System, particularly along the coast, and are a potential source for industrial use such as in steel production and cement manufacture. The potential for base metal exploitation is low.

Recreation and Tourism

The System contains abundant resources for recreation and tourism - with protected marine waters for aquatic activities, coral reefs, picturesque coastal scenery and rugged gorge and range country. Extreme heat and high winds inhibit recreational activities in summer except in coastal areas, but the mild winter climate makes the region attractive for tourists. The tourist industry is centred on Denham, Carnarvon and Exmouth.

CONSERVATION RESERVES

System 9 is deficient in conservation reserves. The only major reserves are the Cape Range National Park (C Class), and Bernier and Dorre Islands (A Class) for the Conservation of Flora and Fauna.

These reserves are inadequate as the basis of a conservation reserve system, since they do not provide representative coverage of flora and fauna or include many of the outstanding natural features that occur in the region, nor do they adequately cater for increasing public use for recreation and tourism.

The committee has examined submissions made to it and also vacant Crown land in System 9. It also visited the area. Those areas it decided to report on are:

1. Shark Bay, including embayment waters and islands
2. Cape Range
3. Ningaloo reef tract
4. Lake MacLeod
5. Kennedy Range
6. Vacant Crown land east of Nerren Nerren Station
7. Islands, Exmouth Gulf and Rowley Shelf
8. Coastal region, Exmouth Gulf to Mary Anne Islands.

The main concern in considering conservation reserves in System 9 has been the growth of recreation and tourism, and the pressures that these factors impose on environment, flora and fauna, and primary industry. The reserves system proposed here is designed to reconcile public recreational use with a fragile natural environment. It is recognised that this usage will be mainly confined to coastal zones of the Bullara Sunkland, principally Shark Bay, the Ningaloo reef tract and Exmouth Gulf, where protected waters suit aquatic activities. Inland areas of significance for recreation include Cape Range in the Bullara Sunkland and Kennedy Range in the hinterland.

Solar salt extraction is particularly destructive to natural and biological features, with large areas required for evaporating pans. Already the marine inlets Useless Loop and Useless Inlet have been closed, Lake MacLeod is under lease and large temporary reserves are held on much of the eastern shore of Exmouth Gulf. On arid coasts, inlets and tidal flats are nutrient sources and habitats for juveniles of many marine species including commercial prawns. Attention, therefore, has been directed to conservation of shallow marine inlets and channels, seagrass banks, and the mangrove-lined tidal flats. These features extend from Shark Bay, through Exmouth Gulf to the limits of the System at the islands of the Mary Anne Group..

Mining of gypsum and limestone is an environmental hazard. The Shark Bay stromatolites (Logan, 1961), Wooramel seagrass bank and Ningaloo reef tract are outstanding natural features that are composed of calcium carbonate and could be threatened. Such mining detracts from the scenic value of the landscape. The Committee recognises that gypsum and limestone are economic resources for which there will be future demand but recommends that any exploitation be excluded from reserves proposed here.

Dune erosion and migration, caused by human activity, are a potential environmental problem in System 9. The problem is particularly evident in the coastal area, including Edel Land Peninsula, Dirk Hartog Island and the Carnarvon to Point Cloates tract (Fig. 9.1) which are terrains of calcareous aeolian dunes. Younger dune systems in these areas are fixed by a sparse vegetation, older dunes are lithified (cemented) and have soil cover but there also are large belts of mobile dunes and in many locations remobilisation is occurring.

Dunes are stabilised by plants, and the denser the vegetation the more stable the dunes; lithification is a secondary process that follows stabilisation. In the semi-arid to arid conditions of System 9 stabilisation is slow and easily reversed by natural causes and human activities. Fires, overstocking, clearing and excavating are deleterious to plant cover and hasten natural erosive processes, leading to remobilisation of formerly stable dunes. Once initiated, dune migration can cause further deterioration as plants are overwhelming in the path of the moving sand.

On the Edel Land Peninsula and Dirk Hartog Island, migrating dunes spill over into marine loops and inlets, and cause deterioration by shoaling and by the formation of unproductive sand flats (Read, 1971a).

Problems of dune erosion and migration can be obviated by careful management which must be co-ordinated and involve both private and governmental agencies. This has been one of the main considerations of the Committee in recommending controlled development in coastal areas adjacent to the Ningaloo reef tract and in the Edel Land Peninsula.

9.1 SHARK BAY

The Shark Bay region (Figs. 9.1, 9.2) contains places important in science and history. Plants and animals found nowhere else in the world occur here. Parts of the marine embayments are environments unique in modern seas and contain a wealth of natural features, notably stromatolites, seagrass banks and coquina deposits which are invaluable for scientific and educational purposes. In the 1600 km of the west coast south of North West Cape, Shark Bay and Cockburn Sound are the only protected marine embayments. It is clear that there will be intensive pressure for recreational development of the Shark Bay region in the next few decades. During 1972-73, approximately 7000 tourists visited Denham, and about 800 small craft used this town and nearby Monkey Mia as bases for sport fishing. These figures can be expected to rise substantially when the access road is sealed and tourism will then become the principal economic industry in the area.

The embayment supports prawn, scallop and scale fisheries worth \$3,275,000 (value of landed catch) in 1970/71. The maintenance of these fisheries is dependent on the marine ecosystem, particularly the shallow bays and seagrass banks, and the recommendations for reserves in the area takes cognisance of this point.

The Shark Bay region is recommended as a multipurpose national park for public recreation, conservation of flora and fauna and unique natural features. Areas of the proposed national park are:

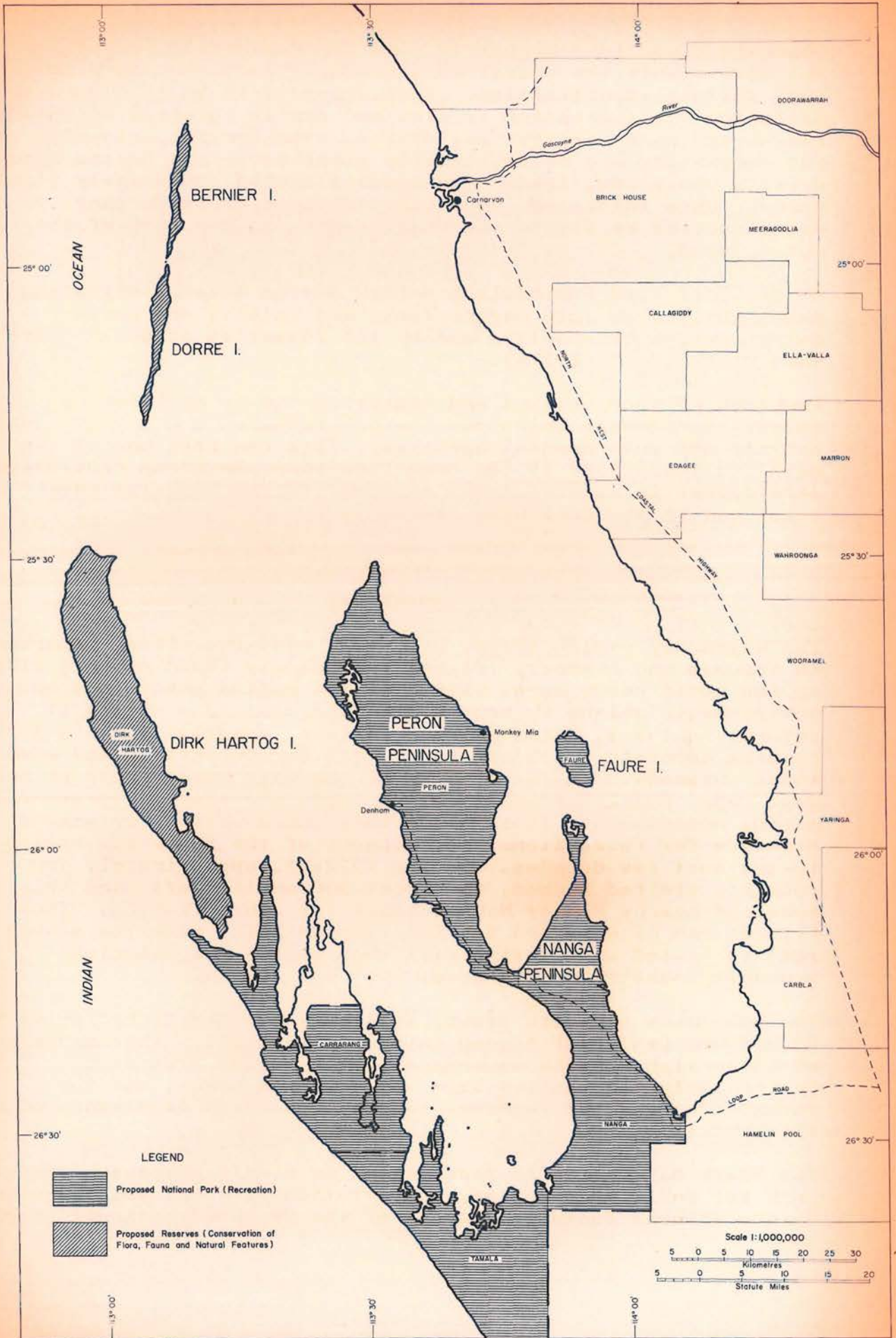


Figure 9 | Shark Bay region, showing proposed reserves

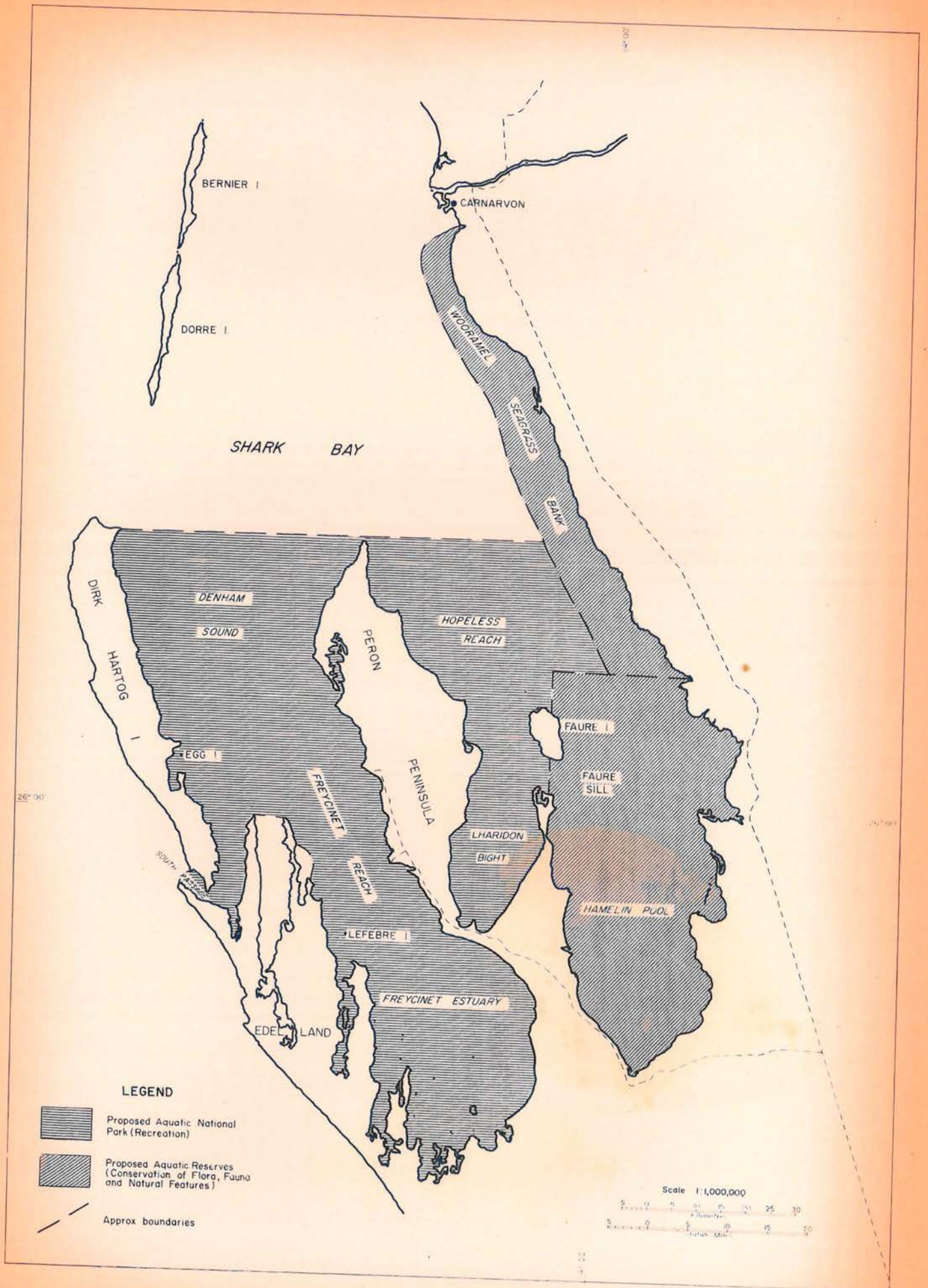


Figure 9 2 Shark Bay region , showing proposed aquatic reserves

1. Bernier and Dorre Island
2. Dirk Hartog Island
3. Edel Land peninsula, loops and inlets
4. Peron - Nanga area
5. Small islands of Shark Bay
6. Hamelin Pool and Faure Sill
7. Wooramel Seagrass Bank
8. Denham Sound, Freycinet Reach and Estuary;
Hopeless Reach and Lharidon Bight.

Bernier and Dorre Islands

Bernier and Dorre Islands (Fig. 9.1) are Class A reserves for the conservation of flora and fauna vested in the WA Wild Life Authority. They are wildlife sanctuaries of world importance. Their biology has been documented by Ride et al (1962). Natural history records for the islands date back nearly 200 years. The islands present a diverse pattern of steppe, scrub and dune formations.

The flora combines elements from all three botanical provinces, especially the South-West and Eremean. It provides an interesting yardstick against which that of Dirk Hartog Island can be compared, while that of the adjacent mainland provides a further comparison.

The islands contain the only known populations of the Banded Hare-wallaby (Lagostrophus fasciatus), Marl or Barred Bandicoot (Perameles bougainville) and the Shark Bay Mouse (Pseudomys praeconis). They share with Barrow and Boodie Islands, populations of the Boodie (Bettongia lesueur). They also contain populations, possibly the only ones extant, of the Western Hare-wallaby (Lagorchestes hirsutus).

Recommendations

The Committee endorses the status, purpose and vesting of Bernier and Dorre Islands. It recommends that the reserve boundaries be extended to low water mark, and that public access to the islands be strictly controlled.

Dirk Hartog Island

Dirk Hartog Island is under pastoral lease. The biology of the island has been described by Burbidge and George (1973). Plant life is diverse, over 250 species having been recorded. Some of these are endemic to the island while others are little-known plants rarely collected on the mainland or occurring well away from their mainland range.

Dirk Hartog once had populations of marsupials of the same species as occur on Bernier and Dorre Islands but they have been killed by introduced cats and are now extinct there. The Sandy Inland Mouse (Pseudomys hermannsburgensis) and a variety of birds, notably the Black-and-white Wren (Malurus leucopterus), occur there. The latter is restricted to Dirk Hartog and Barrow Islands. As the largest island off the western coast, Dirk

Hartog is ideal for the re-establishment of native fauna under controlled conditions and in the absence of terrestrial predators or competitors. Work on this repopulation has already commenced, with the assistance of the present lessee, Sir Thomas Wardle.

The island is also historically important as the site of the first documented landing of a European in Australia, Dirk Hartogs in 1616. It was also visited by Vlamingh in 1697, William Dampier in 1699, French scientific expeditions in 1801 and 1818 and British explorers in 1812 and 1837.

Recommendations

The Committee recommends that in accordance with the desires of Sir Thomas Wardle the Dirk Hartog pastoral lease and the accompanying freehold land be acquired as a reserve in the event of the present lessee relinquishing it; alternatively, when the lease expires it should not be renewed. The island should then be designated a Class A reserve extending to low water mark for the Conservation of Flora and Fauna, vested in the Western Australian Wild Life Authority.

Edel Land Peninsula, Loops and Inlets

Edel Land Peninsula and enclosed marine inlets and loops (Fig. 9.2) form a unit that is recommended as a National Park with recreational emphasis.

The area is a terrain of calcareous aeolianite dune ridges and interdune depressions. The western margin, fronting the Indian Ocean, is formed by the majestic Zuytdorp Cliffs that rise to heights of 70 to 170 m above sealevel and descend sharply to depths of about 40 m. The cliffs are greatly undercut at sea-level by heavy swells from the Indian Ocean; beach-lined embayments break the otherwise continuous cliffs at Dulverton Bay and False Entrance.

The eastern margin of the peninsula contrasts with the west. It is a region of calm bays and inlets. The inlets include Blind Strait, Useless Inlet, Boat Haven Loop - Brown Inlet, Depuch Loop and Disappointment Loop (Fig. 9.2). The inlets are picturesque, being bordered by sandy beaches that are interspersed with rocky platforms and headlands of aeolianite; they terminate on the south in elongate supratidal and intertidal flats. North-trending ridges up to 70 m high border the inlets and extend below sealevel into Freycinet Reach as a series of shallow banks.

The Committee views Edel Land Peninsula as one of the major areas for public recreation in the proposed Shark Bay National Park. The protected inlets are ideal for aquatic activities, such as boating and fishing, and additional scenic attractions include the rugged Zuytdorp Cliffs and the more serene inlets.

The southern parts of Tamala Station fulfil the requirements of a wilderness area and include the "Zuytdorp" wreck site.

There also are conservation requirements: i) the inlets are part of the Shark Bay marine ecosystem; ii) there are many features of scientific interest. Exposures of calcrete soils occur in many locations with classic sections at Baba Head (Read 1971b). Marine Pleistocene sequences crop out at the margins of tidal flats and interfinger with the soils. These features are being used in geological education (e.g. ANZAAS field trip, August 1973). Development of Edel Land Peninsula as a recreational area should take place under controlled conditions compatible with environmental requirements.

The proposed reserve includes Carrarang Station above low water level, excluding Useless Inlet, Useless Loop and those areas already given over to the production of solar salt (Fig. 9.1). It also includes Tamala Station, and is bounded on the east by the Tamala-Nanga Station boundary (Fig. 9.1).

In the following recommendations the designation of the inlets as aquatic reserves for recreational use is based on the view that in the future careful management involving regulation of fishing and other aquatic activities, resort development and extractive exploitation will be required.

The Committee recommends:

1. that Carrarang Station be acquired by negotiation with lessee, declared a Class A reserve for National Park and placed under the control of the National Parks Board of WA;
2. that Tamala Station be acquired on termination of the lease, or sooner in the event of sale, declared a Class A reserve for National Park and placed under the control of the National Parks Board of WA; in the meantime no proposal to develop any part of the northern part of Tamala Station be approved without the concurrence of the National Parks Board;
3. that Boat Haven, Depuch and Disappointment Loops and Blind Strait be set aside for fisheries management and aquatic recreation and placed under the control of the Director of Fisheries.

Peron-Nanga area

The Peron-Nanga area (Fig. 9.1) is a physiographically distinct region which is underlain by quartz sandstone (Peron Sandstone). The area includes the north-trending Peron and Nanga Peninsulas, which divide southern waters of Shark Bay into a series of broad, semi-enclosed gulfs; from west to east these are Freycinet Reach and Freycinet Estuary, Hopeless Reach, Lharidon Bight and Hamelin Pool.

The coast in the Peron-Nanga area contains narrow beaches and headlands. The beaches are covered with quartz sand and the Peron Sandstone is exposed to erosion on the headlands. There are wide expanses of intertidal and supratidal flats and beach

ridges of coquina and sand in the southern parts. The landscape comprises broad, undulate, red sand dunes fixed by a vegetation of sclerophyllous plants. Maximum elevations are about 45 m, whereas interdune depressions are only a metre or so above present sealevel. Most of the topography is controlled by a zone of calcrete which lies between the dune sands and the Peron Sandstone. This calcrete zone, which is exposed in coastal cliffs, ranges from 2 to 45 m above sealevel.

Many of the interdune depressions contain evaporite pans called "birridas" in local usage and "montbazin" by Freycinet (1818); several contain marine lagoons. Most of the pans lie in closed, amphitheatre-like depressions surrounded by dunes. A few have remnant, evaporite-filled channels which open to the adjacent coast, but these pans are flooded by seawater only during periods of abnormally high storm tides. The pans range from a hundred metres to a kilometre in width.

Lying at the northern end of the South-West Botanical Province, the area is the northern limit for many plant species. The southern end of Nanga Station contains dense tall sandplain vegetation with many species of genera such as Grevillea, Hakea, Calothamnus, Hibbertia, Banksia, Pityrodia, Conospermum, Newcastelia and Eucalyptus, all typical of the South-West. Northwards along the Peninsula, the South-Western species gradually disappear and the dense heath is replaced by an open shrub-spinifex steppe. Species of Acacia and spinifex (Triodia/Plectrachne) become dominant.

In the dense heath at the southern end of Nanga, several species are of outstanding interest, e.g. Eucalyptus roycei, Adenanthos acanthophyllus, Grevillea rogersoniana, Newcastelia chrysophylla and Lamarckea hakeifolia var. hakeifolia. Near the Tamala Station boundary and near Peron homestead are populations of Eucalyptus which are undescribed and are being currently studied.

A number of blue-flowered plants which so impressed William Dampier during his visit in 1699 are readily visible to the visitor using main roads and tracks. They include Halgania littoralis, Brachycome latisquamea, Solanum spp. and Porana sericea (George 1971).

Three species of Kangaroo are present: Red (Megaleia rufa), Grey (Macropus fuliginosus) and Euro (Macropus robustus). This is the northernmost limit in Australia of the Western Grey Kangaroo. Other species recorded include the Echidna (Tachyglossus aculeatus) and hopping mice (Notomys spp.). The area is very rich in bird life, field camps by the Royal Australasian Ornithologists Union having recorded about 100 species, compared with 75 recorded from Dirk Hartog Island. A bird which reaches its southern limit on Peron Peninsula is the Yellow Silvereye (Zosterops lutea). It is interesting to see this species and the Western Silvereye (Z. lateralis gouldi) in close proximity, yet never actually intermingling. The former is restricted to mangroves while the latter never leaves the scrub and thickets. Some south-western species are at the northern end of their range, such as the Mallee-Fowl (Leipoa ocellata) and the Southern-Scrub Robin (Drymodes brunneopygia).

Faure Island is the site of sea-bird breeding colonies. One interesting record is a skull of the Woilie (Bettongia penicillata) which is now restricted to small areas of the South-West. Skulls of this species have also been found in cave deposits on Dirk Hartog Island and there is a record of it from Shark Bay in the British Museum.

Peron Peninsula is the core of the proposed Shark Bay National Park system and is the area most used for recreational purposes, with resorts at Denham, Monkey Mia and Nanga (Fig. 9.1). Approximately 7000 visitors stayed at Denham in 1972-73 and substantial increases can be expected with the sealing of the main access road and active promotion of the tourist industry.

The main recreational base is aquatic (boating, fishing, shell collecting) but there are other attractions including coastal scenery, interdune lagoons (Fig. 9.3), flora, wildlife and historical associations. The area borders on the proposed Hamelin Pool-Faure Sill nature reserve with its unique natural features, and there is the possibility of controlled public access to this reserve from the Denham road. Development of facilities and access to a wider area of the peninsula should be encouraged.

The peninsula has an insular character, being connected to the mainland at the narrow Tailefer Isthmus across a tidal-supratidal flat that was once a shallow seaway connecting Freycinet Estuary and Lharidon Bight (Logan et al., 1970). The narrow width of the isthmus has led to suggestions that the peninsula could be sealed by fencing, and native fauna re-introduced after eradication of the introduced fox, cat and rabbit.

Peron Station lease which includes all the Peninsula north of Tailefer Isthmus was offered for sale to the State as a possible National Park in 1972. The National Parks Board, WA Wild Life Authority and the Department of Fisheries and Fauna supported this acquisition but funds were not then available and the lease passed on to private hands.

Recommendations

The Committee recommends:

1. that the Peron-Nanga area be acquired by negotiation with the lessees and declared a Class A reserve for National Park and placed under the control of the National Parks Board. Provision should be made for recreational facilities including roads and accommodation;
2. that the proposed reserve comprise Peron and Nanga Stations above low water mark, as well as interdune lagoons in the vicinity of Denham and Cape Lesueur.

Small Islands, Shark Bay

The Shark Bay area contains a number of small islands, many of which are of conservational importance, particularly as sea-bird breeding sites. Some of these are:



Figure 9.3. Interdune lagoons, Peron Peninsula, Shark Bay.



Figure 9.4. Hamelin Pool (top), Lharidon Bight (foreground), and the Faure Sill (top left), southeastern Shark Bay.

Freycinet Estuary

Salutation Island
 North and South Guano Islands
 Three Bays Islands
 Baudin Island
 Wilds Island
 Double Island
 Freycinet Island
 Mary Anne Island
 White Island
 Slope Island

Denham Sound

Sunday Island
 Egg Island
 Meade Island

Hamelin Pool

Pelican Island

Recommendations

All the islands listed above with the exception of Slope Island are reserves vested in the WA Wild Life Authority and comprise a Wildlife Sanctuary. They, and any others found to be of importance, should remain protected and undeveloped in the future. Slope Island, previously included in the Wildlife Sanctuary, is now used as a port site by Shark Bay Salt Pty. Ltd. and has been connected to the mainland by a causeway. Many breeding burrows of an important colony of Wedge-tailed Shearwaters (Puffinus pacificus) have been destroyed, while foxes which have crossed the causeway are taking a heavy toll of the remaining population.

Recommendation

The Committee endorses the status, purpose and vesting of the small islands currently reserved in Shark Bay, and recommends that, should Slope Island be released in the future, it be re-included in the reserves and the causeway severed.

Hamelin Pool and Faure Sill

The area including Hamelin Pool and the Faure Sill is of paramount scientific importance as a unique marine environment and a major field laboratory for continuing education and research in carbonate sedimentation, marine biology, physical oceanography and geochemistry.

The environments also are an integral part of the Shark Bay ecosystem, and conservation of commercial fisheries and marine biota of the embayment requires the maintenance of the natural hydrologic system to which all marine species are geared.

Hamelin Pool is a landlocked marine basin partially separated from Shark Bay by a shallow barrier bank, the Faure Sill (Fig. 9.4). The basin is one of the few areas in the world where marine waters are hypersaline with salinities of 55 to 70 parts per thousand, almost twice the salinity of normal seawater. The size, depth and other geomorphologic features of the basin combine with salinity to make this an environment unique in modern seas.

Hypersaline conditions in Hamelin Pool have led to the development of a number of unique geological and biological features. Outstanding among these are algal stromatolites (Fig. 9.5) which are "living fossils" of comparable scientific importance and rarity to protected elements of the Australian fauna and flora. There also are restricted communities of marine organisms tolerant of hypersalinity, vast deposits of organic shells (coquinas), ooid shoals and lithified sediments of Recent age, all rare or scientifically important. The biota inhabiting hypersaline waters is of special interest to marine biologists because of physiological adaptations necessary for life in waters of these high concentrations.

A key element in the formation and maintenance of the hypersaline environment has been the growth and shoaling of the Faure Sill. This structure is a barrier bank constructed in the past 5000 years through the accumulation of skeletons of marine organisms living in seagrass meadows that flourish on the bank surface. Shoaling and growth have led to restriction of tidal influx into Hamelin Pool and to the development of hypersaline concentrations. The progression to hypersalinity from low (oceanic) salinities can be "read" from sediment cores taken in the basins (Hagan 1973).

Conservation of the Hamelin Pool environment depends primarily on maintenance of hydrologic conditions in the area of the Faure Sill. Unnatural interference with the Sill could lead to an increase in tidal exchange and salinities in the Hamelin Pool basin would fall to normal levels. This would lead to widespread changes in biota and in sedimentation resulting in the destruction of algal stromatolites, molluscan populations and a cessation of ooid formation and lithification.

The inclusion of the Sill in any reserve is therefore essential. The preservation of algal stromatolites, coquinas, ooid shoals and cemented sediments also requires measures which will prevent destruction by activities of man.

The Hamelin Pool stromatolites between high and low water marks are at present protected by a Class A reserve, No. 30885 for the "Protection of Sedimentary Deposits" (not vested). This reserve was created in response to a request made in 1968 to the Department of Lands and Surveys by the Department of Geology, University of Western Australia, for a reserve covering Hamelin Pool, the Faure Sill, and the coast up to 5 chains (100 metres) inland.

This proposal was supported by the Western Australian Geological Survey Branch of the Mines Department. However, it was decided to reserve only the intertidal areas because the State had no legislation authorising the creation of marine reserves, and a



Figure 9.5 Columnar stromatolite structures, intertidal zone, Hamelin Pool.

5-chain reserve above high water mark would have required resumption of land from the adjoining pastoral properties. The boundary of these properties lies 2 chain above high water mark, and the 2-chain strip could be included in the reserve without resumption.

A committee of international experts (Environmental Protection Authority Report, 1973) met in Perth on 24, 25 and 26 August 1973 and prepared a report on conservation measures for the Hamelin Pool area. This group unanimously recommended that Hamelin Pool and the Faure Sill be classified as an A Class reserve, vested in the Western Australian Wild Life Authority in terms of the existing legislation, without power to lease. Among their major recommendations were that:

1. the existing Class A reserve No. 30885, as administered by the Department of Lands and Surveys, be extended to 2 chains (40 metres) inland above high water mark, and, once appropriate legislation is enacted, that the area of the balance of Hamelin Pool, as defined further below, be included in this reserve;
 2. the purpose of the reserve be extended to include conservation of sedimentary deposits, fauna and flora used in geological and biological education and scientific research;
 3. in the interim, the Department of Fisheries and Fauna be requested to prohibit interference with fauna and flora on the seafloor of this area as far as practicable;
 4. tourist access be prohibited, except as follows, with the permission of the WA Wild Life Authority. Public access to the coastal area of stromatolites and beach ridges should be provided from the road to Denham on the western side of Hamelin Pool in the vicinity of Nilemah. Tourist sites should be selected by the management authority in conjunction with expert advice;
 5. honorary wardens resident in the district be appointed to assist in policing the reserve;
 6. no vehicles or power boats be permitted on the reserve without permission;
 7. no development, exploration or mining within the reserve, or within 5 chains of its boundaries, be allowed without permission of the Department of Environmental Protection;
 8. resort development and unauthorised camping be prohibited in the Hamelin Pool area.
- The future need for additional tourist development in the Shark Bay area is recognised, but there are more attractive places than Hamelin Pool for tourist development, e.g. Lharidon Bight, Freycinet Estuary and Dirk Hartog Island.
9. the entrance channels be not interfered with, particularly by any attempt to introduce commercial prawn cultures in Hamelin Pool or on the Faure Sill with attendant disturbance of the sea bed;
 10. existing levels of commercial fishing do not appear to be interfering with the present ecology in the area and there does not seem to be any need to restrict the present level of activity.

The committee of international experts further recommended the proposed reserve as follows:

11. Hamelin Pool and its margins south of Australian National Grid, Zone 1 co-ordinate 1,770,000 yards north and including the coast to 2 chains (40 metres) inland from high water level;
12. the Faure Flats area north of Hamelin Pool, including the submerged banks and channels in the area bounded to the north by the 1,800,000 yards north co-ordinate; bounded by the co-ordinate 170,000 yards east, and to the east by the mainland coast extending to a distance of 2 chains (40 m) inland from high water level.

This committee of experts stressed that conservation measures which do not include the protection of the Faure Sill would be ineffectual, as this barrier has been the key element in the development of the environment and in the maintenance of hypersaline conditions in Hamelin Pool.

The Conservation Through Reserves Committee has considered these recommendations and endorse their intention.

Recommendations

The Committee recommends:

1. that the existing Class A reserve, No. 30885, be extended to 44 m above high water mark, have its purpose amended to Protection of Sedimentary Deposits and Conservation of Flora and Fauna, and be vested in the WA Wild Life Authority;
2. that the area of Hamelin Pool and Faure Sill below low water mark as designated in Fig. 9.4, be declared an aquatic reserve for Protection of Sedimentary Deposits and Conservation of Flora and Fauna, vested in the WA Wild Life Authority;
3. that until Legislation is enacted to allow conservation reserves to include submarine lands, the Fisheries Act be employed to protect the marine areas designated in recommendation 2 and the Director of Fisheries be made responsible for their protection.

Wooramel Seagrass Bank

The Wooramel seagrass bank forms a shallow marginal platform along the eastern shore of Shark Bay (Fig. 9.1). The bank covers an area of 1030 km² and is 129 km long; average width is 8 km.

The bank structure is a wide-shaped body of sediment, composed mainly of biogenic carbonate debris that is admixed with terrigenous detrital grains. There is no rigid skeletal framework within the bank. The bank was built in a high-energy environment of tidal currents and waves generated by strong, prevailing southerly winds. Formation and preservation of the banks in this environment are attributed to the modifying influence of seagrasses on processes of sedimentation (Fig. 9.6).

The seagrasses act as organic baffles, and also provide habitats for organisms which contribute skeletal carbonate. Fifty-four

tidal channels are the main paths for tidal-water exchange across the intertidal and sublittoral zones. The Wooramel bank contains a variety of marine habits. The outer margin, channel levees and floors are populated by seagrass communities; wide sublittoral and intertidal sandflats are inhabited by molluscan faunas and there are extensive mangrove or algal-mat communities in the intertidal and supratidal zones. The bank is one of the largest bodies of carbonate sediment formed by an organic baffle yet recorded from a modern environment. The only deposits of similar origin and comparable size are the seagrass-bound "mattes" on the Mediterranean coast of France, described by Molinier and Picard (1952). Smaller seagrass-covered banks have been described by Ginsburg and Lowenstam (1958) and Baars (1963) from the Florida region.

The Wooramel seagrass bank was documented by Davies (1970a) in a paper that has become a standard reference for research on carbonate banks, seagrasses and other organic baffles. The bank remains the main field reference for scientific purposes. The majestic proportions of this seagrass bank must be emphasized. In size, continuity, growth rate and variety of features it surpasses most modern coral reefs that have long fascinated scientist and layman. The scientific research potential of the structure has been only partially exploited and there remain significant projects in sedimentation, marine biology and physical oceanography.

The bank structure is a major part of the Shark Bay ecosystem. Its southern parts are nurseries for prawns on which the commercial fishery is based and it is probable that the jungle-like growths of seagrass form an important element in the nutrient cycles of the marine biota throughout Shark Bay. Tidal waters draining from the structure influence the hydrology of the embayment and contribute to the unusual steady-state conditions which pertain (Logan and Cebulski, 1970).

Recommendations

The Committee recommends:

1. that the Wooramel seagrass bank be reserved in a manner which will protect the seagrass and its environment. When appropriate legislation is available, the seagrass bank should be reserved for fisheries management and recreation under the control of the Director of Fisheries who should be required to manage it as though it were a National Park;
2. that the boundaries of the reserve include the area below high water mark extending seaward to the 25 metre isobath, between latitudes 25° S and 26° S, including adjacent tidal flats.

Denham Sound, Freycinet Reach and Estuary, Hopeless Reach and Lharidon Bight

Denham Sound, Freycinet Reach and Estuary, Hopeless Reach and Lharidon Bight are broad gulfs (Fig. 9.1) bordered by shallow platforms and seagrass banks (Fig. 9.7). The gulfs contain prolific marine life and support a commercial scale fishery, intensive sport fishing and shell-collecting by amateurs and



Figure 9.6. Tidal channel, levee and fan system, Wooramel seagrass bank, Shark Bay.



Figure 9.7. Seagrass patch bank, Freycinet Estuary, Shark Bay.

professionals. The biota also includes the rare dugong, turtles, rays, sharks and giant cod. There also are populations of immature prawns. Freycinet Reach and Estuary are dotted with numerous small islands most of which are wildlife sanctuaries established to protect sea-bird breeding sites.

The area is picturesque with broad stretches of relatively protected water, colourful coastal cliffs, beaches and lagoons (see Peron-Nanga area; Edel). There are numerous sheltered anchorages for small craft in bays and behind islands and shoals. Tourism at the centres of Denham, Nanga and Monkey Mia is largely based on sport fishing but yachting, cruising and other aquatic activities are developing and will expand with public realisation of the attractions of the region.

The scale fishery is a major industry. The principal commercial species are whiting (Sillago spp.), Schnapper (Chrysophrys sp.) and mullet (Mugil sp.). Netting for whiting and mullet is carried out mainly in sublittoral sandflat environments. Whiting populations use metahaline (salinities 40 to 53 parts per thousand) areas as nurseries and large populations of young are found in southern parts of Hopeless Reach and Freycinet Reach (Lenanton, 1970). The whiting catch in 1970-71 was 326,000 lbs worth \$158,000. The main schnapper fishery is located in Freycinet Reach and Denham Sound but this species also is taken in Hopeless Reach; the total commercial catch in 1970-71 was 247,000 lbs valued at \$100,000. Sport fishing is intensive and expanding. Schnapper and other species are favoured. No statistics are available for the amateur catch but it is believed to be in the order of several tens of thousands of pounds and may eventually impose pressures on commercial fishing.

Commercial trawling is prohibited in the areas south of latitude 25° 30' S and east of the Peron Peninsula, and in Freycinet Reach and Estuary south of latitude 26° S. These regulations are to protect immature prawn populations and nursery areas for other species.

The Committee proposes that the area as shown in Fig. 9.2 should be reserved but recognises that management of it will eventually involve reconciliation between commercial and sport fishing, control of small-craft movements, and conservation of islands as wildlife sanctuaries. In addition, marine invertebrates (mainly mollusca) must be protected against over-collecting. The stability of the ecosystem must be maintained because of the relationships between this area and the important prawn and scallop fisheries in northern Shark Bay.

Recommendation

The Committee recommends that the area of Denham Sound, Freycinet Reach and Estuary, Hopeless Reach and Lharidon Bight as shown in Fig. 9.2 be set aside for fisheries management and aquatic recreation and placed under the control of the Director of Fisheries.

9.2 CAPE RANGE NATIONAL PARK

This area is recommended as a national park for public recreation, conservation of flora and fauna, protection of natural features, and historical interest.

The present Cape Range National Park was gazetted a C Class reserve in 1954 with boundaries as shown on the accompanying map (Fig. 9.8). At the time this area was vacant Crown land enclosed by Yardie Creek and Exmouth Stations. Yardie Creek Station was purchased by the Government in 1969. The existing park is inadequate in view of the important features of the surrounding country, and it is recommended that the boundaries be expanded as described below.

The Cape Range consists of Tertiary limestones which have been carved into deep canyons, providing spectacular scenery (Fig. 9.9). The surface is extremely rugged and beneath it are caves in which live specialised fauna that show adaptation to this environment.

The vegetation of the Cape Range is predominantly a shrub steppe dominated by Acacia and Eucalyptus species, with a lower storey of small shrubs and spinifex. Due to a combination of summer and winter rains, the floristic elements represent all three botanical provinces of Western Australia, the South-West, Ereman and Northern, while about 10 species are confined to the Range. Among the latter are the remarkable Yardie Morning Glory (Ipomoea yardiensis), two Grevillea species, and new species of Eucalyptus and Verticordia. Some of the south western species here are isolated from the main populations far to the south.

A narrow coastal plain runs along the western side of the Cape Range. Spectacular alluvial fans have developed at the outlets of the larger creeks, and coastal dunes mark the western edge of the plain. The vegetation is mostly a low open shrub steppe dominated by Acacia, Cassia and spinifex species. Among the more interesting plants occurring here are the Minilya Lily, (Crinum flaccidum) and undescribed species of Acanthocarpus, Acacia, and Arthrocnemum. The eastern coastal plain is generally wider than the western and is much more regular, the beaches that face Exmouth Gulf more sheltered. There also are marked differences in flora, the vegetation being an open to dense shrub steppe dominated by Acacia and Eucalyptus species.

Yardie Creek is an unusual feature. Its lowest reach, across the narrow plain between the range and the sea, is a tidal estuary lined with species of mangrove, Avicennia marina and Rhizophora mucronata. Above this is a pool of fresh water lined with bullrushes between vertical red rock walls. This is the only permanent freshwater pool in the Cape Range.

The fauna is interesting. Red Kangaroos (Megaleia rufa) occur on the plains while Euros (Macropus robustus) and Rock Wallabies (Petrogale penicillata) occur in the range. Probably nowhere else in Australia do so many species of Dragon Lizard (Agamidae) occur in one area. The change in reptilian species from the western coastal plain to the eastern is dramatic. The area is

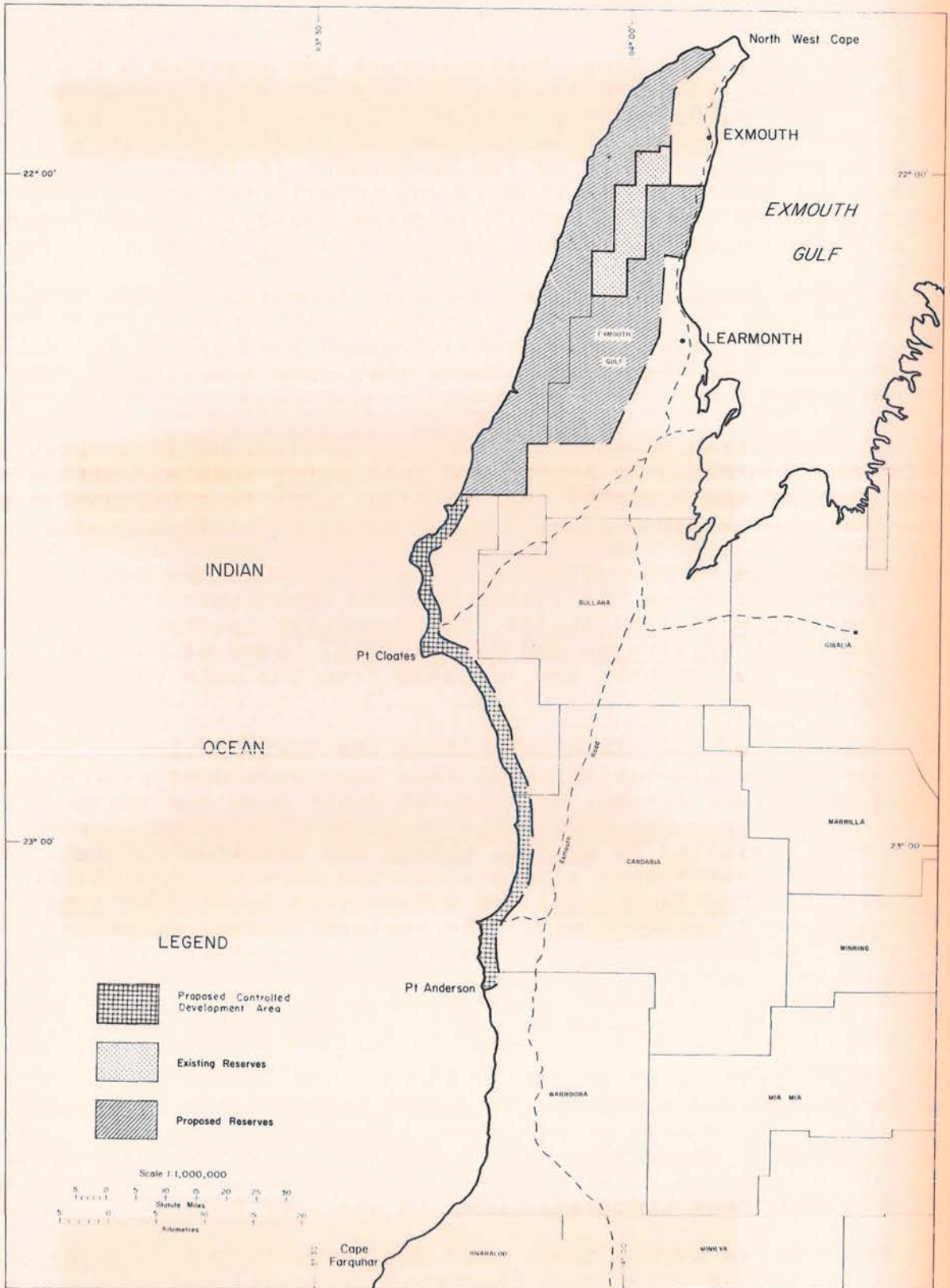


Figure 9-8 Area map of Cape Range National Park and proposed extensions



Figure 9.9. Canyon country, Cape Range.

the southernmost locality for the tropical skink genus, Carlia. The birds also are of interest, the Cape Range being the type locality of the Spinifex-bird (Eremiornis carteri); the Blue-and-white Wren (Malurus leuconotus) and White-backed Swallow (Cheramoeca leucosternum) are common. The area is the northern limit of the Field Wren (Calamanthus fuliginosus).

A freshwater cave fauna of blind, colourless aquatic animals has been found in wells on Yardie Creek Station. It consists of four species; a Synbrachid eel (Anommatophasma candidum), the Eleotrid fish (Milyeringa veritas) and two species of Atyid shrimps (Mees, 1962). Cave deposits contain fossil mammalian faunas which differ from the modern fauna. The intensively-studied Monajee Cave has revealed 21 vertebrate species, including a thylacine and a dog (possibly a dingo). Deposits of shell artifacts are evidence of previous use by aborigines.

The range, peninsula and offshore waters provide many recreational opportunities including spectacular scenery, wildflowers in season, swimming and fishing beaches, deep-sea fishing. Point Cloates, recommended for inclusion in the park, is the site of an early whaling station. Nearby are the old Ningaloo Homestead, and the Point Cloates lighthouse.

Within the proposed park, on the west coast south of Vlaming Head, is reserve no. 31637 of 1.2 ha for Game Fishing Club. In January 1973 it was vested in the Shire of Exmouth, with power to lease. No authorisation to lease has been requested of the Minister for Lands. The Committee believes that development of the area should be considered as part of the management of the total proposed park and therefore left to the National Parks Board.

The proposed reserve extends across the Cape Range to give a representative cross section of the western and eastern coastal plains and the range proper. It includes vacant Crown land, formerly part of Yardie Creek Station, and parts of leases 394/1262 and 394/1248 presently held by Exmouth Gulf Station. The parts of leases 349/1262 and 394/1248 to be acquired are defined on the east of the boundary fence of Exmouth Gulf Station and are not used for grazing. Excluded is that land around the Learmonth RAAF base.

The existence of several mineral claims for limestone within the boundaries of the proposed reserve is noted. If mining is permitted in such areas it should be under conditions prescribed by the Environmental Protection Authority.

Recommendations

The Committee recommends:

1. that the Cape Range National Park be extended to the boundaries shown in Figure 9.8;
2. that the status and purpose of the park be amended to Class A for National Park and that it be placed under the control of the National Parks Board of WA with power to lease;

3. that reserve No. 31637 be cancelled and its area added to the park;
4. that the Environmental Protection Authority prescribe conditions over any mining which may be permitted in the National Park.

9.3 NINGALOO REEF TRACT

A coral reef, here termed the "Ningaloo Reef", extends from North West Cape along the seaward margin of the proposed Cape Range National Park and southward to the vicinity of Cape Farquhar, a distance of about 160 km (Fig. 9.10). The main element in the reef complex is a wave-resistant wall that has been constructed by corals. The reef wall rises from oceanic depths on the seaward side and culminates in a reef flat of variable width that is exposed at low tide. Behind the reef wall is a picturesque lagoon bordered on the shoreward side by sandy beaches (Fig. 9.11) and spits, rock platforms and, in places, by mangrove thickets. The lagoon depths range from 1 metre to 8 metres and it is floored with calcareous sands, coral meadows and sparse seagrass. The reef wall absorbs waves from the Indian Ocean but surge waters spill over into the lagoon. Circulation and exchange between oceanic and lagoon waters is by passage of surge and tidal waters through numerous deep gaps in the reef wall. Aerial inspection suggests that delicate hydrologic balances are maintained by a complex system of currents.

The reef tract is a major recreational resource, in some respects superior to the Florida, Bahamas, British Honduras (Belize) reefs and the Great Barrier Reef. The Ningaloo reef is very accessible, being close to the mainland; the lagoon is protected and sandy; and the mainland shore also is attractive with sandy beaches and rocky headlands, unlike most reef-fringed coasts that are characterised by mangrove-lined mud flats and coastal swamps. Waters around the reef abound in game fish such as marlin and mackerel; protected lagoonal waters and beaches offer much for all aquatic activities; reef communities fascinate the layman and scientist; and winter climate is pleasant. With public recognition and population growth in the South-West and adjacent Pilbara regions, pressures for development are likely.

Experience from other coral-reef terrains such as Florida and the Great Barrier Reef indicates that reef communities react unfavourably to many of the pressures imposed by man - sewage and other effluents inhibit reef organisms and may destroy the living surface; collecting of reef organisms by amateurs and professionals may disrupt ecological balances. Poor planning of resort developments also may be deleterious to the scenic and other attractions of the shoreline. Human pressures on the Ningaloo reef tract and adjacent shores presently are minimal, as the only nearby resort centres are at Exmouth and Coral Bay (Fig. 9.8). An unusual opportunity therefore exists to institute management measures that will ensure the conservation of this natural resource, before development takes place.

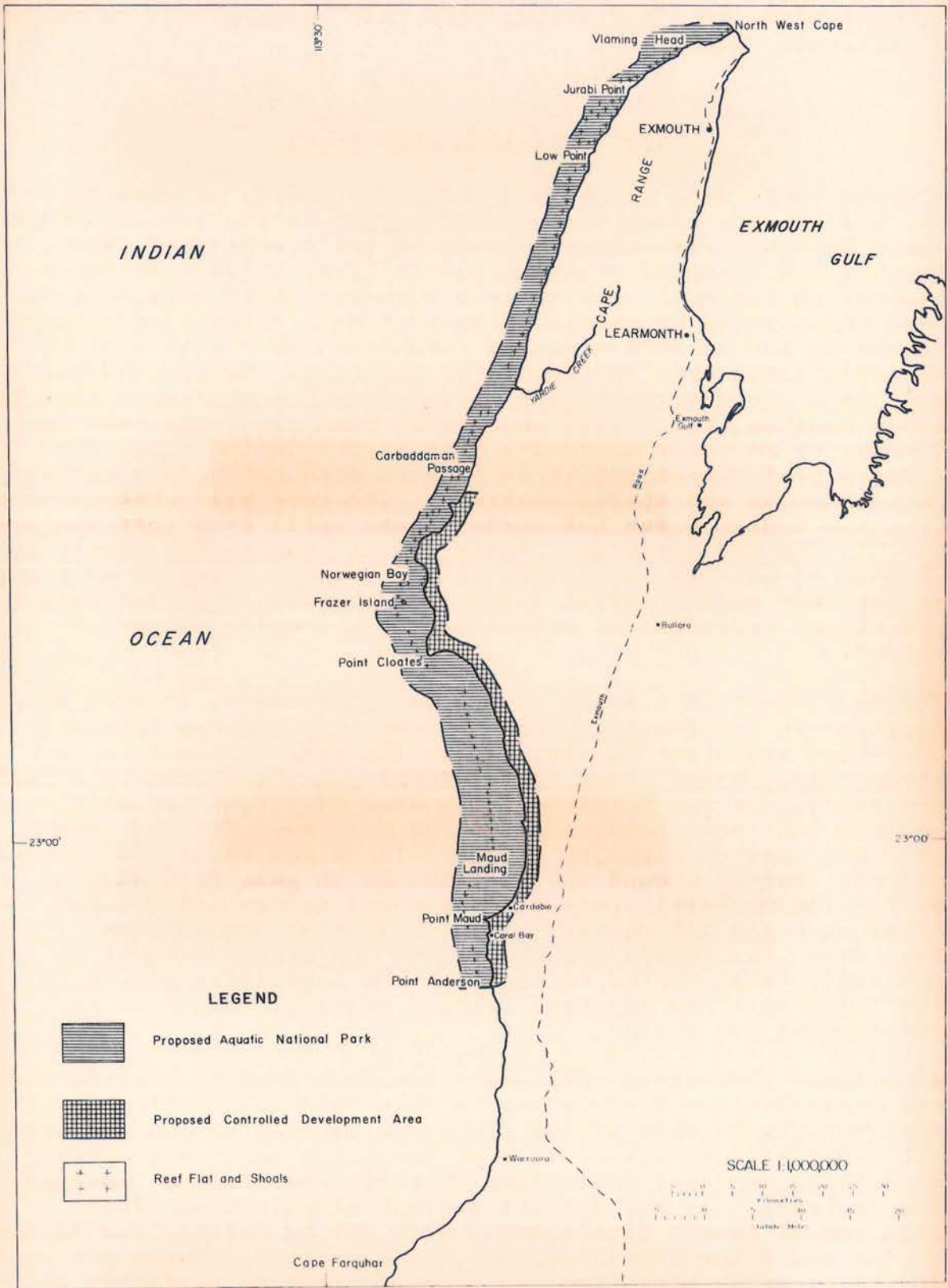


Figure 9 10 Area map of Ningaloo reef tract, showing proposed reserves



Figure 9.11 Aerial view of Ningaloo reef and lagoon, vicinity of Coral Bay.

The Committee's recommendations emphasise management of the reef tract as a recreational resource. The conservation of reef tract flora and fauna is an important secondary objective. The Ningaloo reef is one of the major reefs of the World, rivalling in size and diversity the reefs of Florida, the Bahamas and British Honduras. The Ningaloo reef also has great potential for geological, biological and oceanographic studies. It is located at the southern extremity of the Indo-Pacific coral reef province in a zone of biological transition, between the organic assemblages typical of temperate waters to the south and the tropical waters to the north. A major interest is also provided by the transition from seagrass communities and banks in Shark Bay to the south, and the progressive dominance of coral communities and reef structure to the north.

Recommendations

The Committee recommends:

1. that when appropriate legislation is enacted, the Ningaloo reef tract be designated a National Park for the dual purposes of recreation and conservation of flora and fauna and placed under the control of a committee of the National Parks Board and the Director of Fisheries;
2. that the boundaries of the proposed Ningaloo reef tract reserve include the reef, lagoon and adjacent shores between North West Cape and Point Anderson (Fig. 9.10) extending seaward from 44 m above high water mark to the 100 m isobath.
3. that no proposal to develop any part of coastal areas up to 2 km inland from high water mark lying within the boundaries of the Ningaloo, Cardabia and Warroora pastoral leases be approved without the concurrence of the Committee of Control of the National Park;
4. that Ningaloo Station be acquired on expiry of the lease or by negotiation with the lessee;
5. that until legislation is enacted to allow National Parks to include submarine lands, the Fisheries Act be employed to protect the marine areas within the boundaries, and the Director of Fisheries made responsible for their protection.

9.4 LAKE MACLEOD

Lake MacLeod is an evaporite (playa) basin lying to the north of Shark Bay and separated from the Indian Ocean by a barrier ridge formed by the Cuvier and Gnoraloo-Warroora Anticlines and complexed of high dunes. In Pleistocene times the basin was a marine gulf connected to Shark Bay through a narrow entrance located 25 km north of the Gascoyne River mouth. The entrance was closed by beach ridges and dunes associated with the Gascoyne delta, and thick evaporites - gypsum and halite-were deposited from the impounded seawater. The lake surface has an area of about 2900 km² and for the most part lies 1-3 m below sea level. The Lyndon and Minilya Rivers enter the lake but these are intermittent streams that flow only after cyclonic rains in the hinterland. The surface of the lake is normally dry but along the northwestern shore there are large irregular ponds (Fig. 9.12) that contain seawater of near-normal salinity.

Seawater continually wells up from subterranean caverns and recharges the ponds. They are bordered by mangroves and contain fish and other marine organisms.

The ponds are important wildlife refuges. Birds usually present in large numbers include Black Swan, Pelican, Pied Cormorant, various terns, ducks and wading birds. An aerial survey in April, 1973, revealed over 3000 transequatorial migratory waders, and the lake appears to be an important resting place for flocks of waders migrating between Asia and Australia.

Lake MacLeod is the subject of the Evaporites (Lake MacLeod) Agreement Act 1967-73, between the Government and Texada Mines Pty. Ltd. This Company has a works on the lake for the production of salt and potash. The Agreement Act lays down that there shall be no resumption of the salt lease without the consent of the Company.

Recommendations

The Committee recommends:

1. that in the event that the lease is relinquished, the ponds and adjacent areas of Lake MacLeod be designated an A Class reserve for the conservation of flora and fauna and vested in the WA Wild Life Authority;
2. that in the event that the lease is renegotiated, provisions be inserted to protect the environment.

9.5 KENNEDY RANGE

The Kennedy Range lies approximately 150 km east of Carnarvon and 20 to 80 km north of Gascoyne Junction. The range provides the most attractive scenery of the Carnarvon hinterland.

Geologically the dominant feature within the proposed reserve is the mesaform erosion residual of Permian (Kennedy Group) arenaceous rocks that compose the Kennedy Range. Topping the range are west-northwest trending red sand dunes derived from an earlier laterite profile. The western and southern parts of the Kennedy Range plateau are extensively dissected and the eastern edge is flanked by a prominent cliff (Fig. 9.14). East of this cliff and disconformably underlying the Kennedy Group rocks there are small outcrops of some members of the Permian Byro Group, overlain by Recent brown sands in which are numerous claypans. Most of the Permian rocks are fossiliferous, the Wandagee Formation of the Byro Group having a particularly rich assemblage (Condon, 1967). Deposits of semi-precious stones and fossils have attracted much attention from commercial and amateur collectors over recent years.

The flora and fauna of the area has not been studied.

There is at present no conservation reserve within the region and the Committee believes that the Kennedy Range area could be the basis of an outstanding National Park, combining scenic attractions with conservation of flora and fauna.



Figure 9.12. Ponds, Lake MacLeod, bordered by mangroves, Avicennia marina.

The recommended boundaries (Fig. 9.13) largely follow existing fence lines or pastoral lease boundaries and enclose four main areas:

- a) the Kennedy Range Cliff
- b) a portion of the claypan area below the cliff
- c) an area of sand dunes, lying above and to the west of the cliff
- d) the highly dissected southern and western parts of the range including the springs (Churdiwoodalya, Bulliyolya, Binthalya, Yenni, Kangaroo and Mocka) at the southwestern corner.

The land within the proposed National Park is at present in five pastoral stations - Moogooree, Lyons River, Binthalya, Mooka and Bidgemia. Much of this land is believed to be of low pastoral value and much is not currently used for grazing, but the Committee is aware that its proposals may require special provision to be made for waters within the proposed park to continue to be made available to adjacent leases.

The dune systems are vulnerable to the effects of grazing and trampling. They support a distinctive vegetation different from that of the surrounding country.

Fossils and gemstones in the vicinity of the Range are currently in danger of over-collection.

Recommendations

The Committee recommends:

1. that by negotiation with the lessees, a National Park be created in the Kennedy Range area with boundaries as shown in Fig. 9.12;
2. that the National Park be an A Class Reserve for National Park and be placed under the control of the National Parks Board of WA;
3. that during the period prior to acquisition, ways be explored to regulate public access, development, and the removal of gemstones and fossils;
4. that subsequent to acquisition, access to underground water resources within the park be given to pastoral lessees if this is essential to the operation of adjoining stations.

9.6 NERREN NERREN EAST AREA

East of Nerren Nerren and Meadow pastoral leases is a large area of vacant Crown land (Fig. 9.0). It is a flat or gently undulating plain with red sand and sandy loam soils overlying Tertiary sediments. There is no surface drainage.

The vegetation is a woodland dominated by York Gum (Eucalyptus loxophleba) and a tall shrubland containing a wide variety among which Acacia species are prominent. Mallee eucalypts include Eucalyptus eudesmoides.

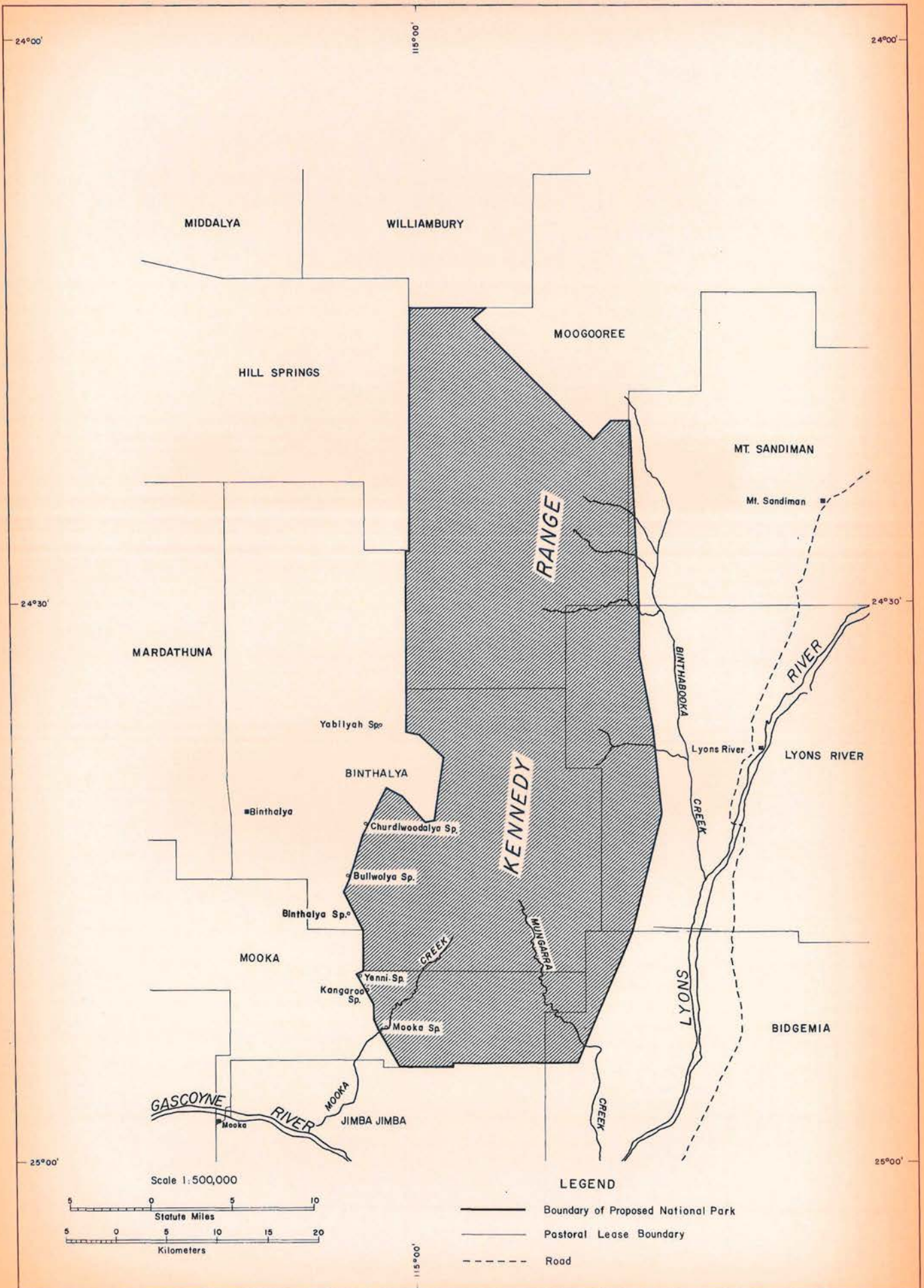


Figure 9 13 Area map showing boundaries of proposed Kennedy Range National Park.

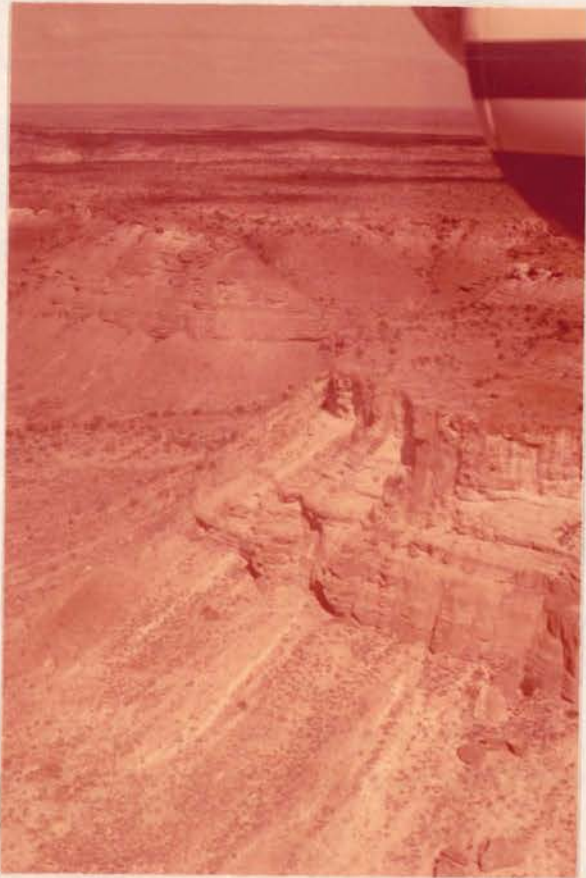


Figure 9.14. Kennedy Range - aerial view of the escarpment.

The area lies within the transitional zone between the South-West and Eremean Botanical Provinces. This zone is an important one biologically, since many species are at or near the limit of their distribution and therefore of their tolerances. They can be studied under conditions to which they are either adapting or succumbing. There also are species endemic to this zone. At present there are insufficient reserves in the transitional zone.

Recommendations

The Committee recommends that a biological survey of this region be carried out, co-ordinated by the Department of Fisheries and Fauna with a view to selecting an area for reservation. Until this has been done and reserve boundaries designated, the area should not be made available for pastoral leasing.

9.7 ISLANDS, EXMOUTH GULF AND ROWLEY SHELF

Between the southern end of Exmouth Gulf and the Dampier Archipelago there are many small islands (Fig. 9.15). With the exception of the Muiron Islands and Locker Island which are wildlife sanctuaries and the islands owned by the Australian Government as lighthouse sites (Anchor, Airlie, Great Sandy or Beagle, North Sandy), the islands remain vacant Crown land.

The islands have never been properly surveyed but a number are known to be of value as sea-bird breeding sites (e.g. Round, Whalebone, Weld, Anchor, Airlie and Little Rocky), turtle breeding sites (e.g. Serrurier Island) or areas of geological interest (e.g. Whitmore, Roberts and Doole Islands). Of special interest are Simpson and Tent Islands which harbour small populations of kangaroos, and Thevenard Island which as well as having sea-bird colonies contains a native mouse (Pseudomys forresti) and various reptiles.

The islands are gradually becoming more used by tourists, fishermen and shell collectors. On Thevenard Island a lease for tourist purposes has been granted.

The islands which are little-known require protection as described in the Introduction but others have such great biological importance that there are ample grounds for their reservation and proper management.

Recommendations

The Committee recommends that the following islands be designated A Class reserves for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority - Simpson, Tent, Round, Whalebone, Weld, Little Rocky and that portion of Thevenard Island that is vacant Crown land. The Conservation requirements of the remaining islands be met as discussed in the Introduction.

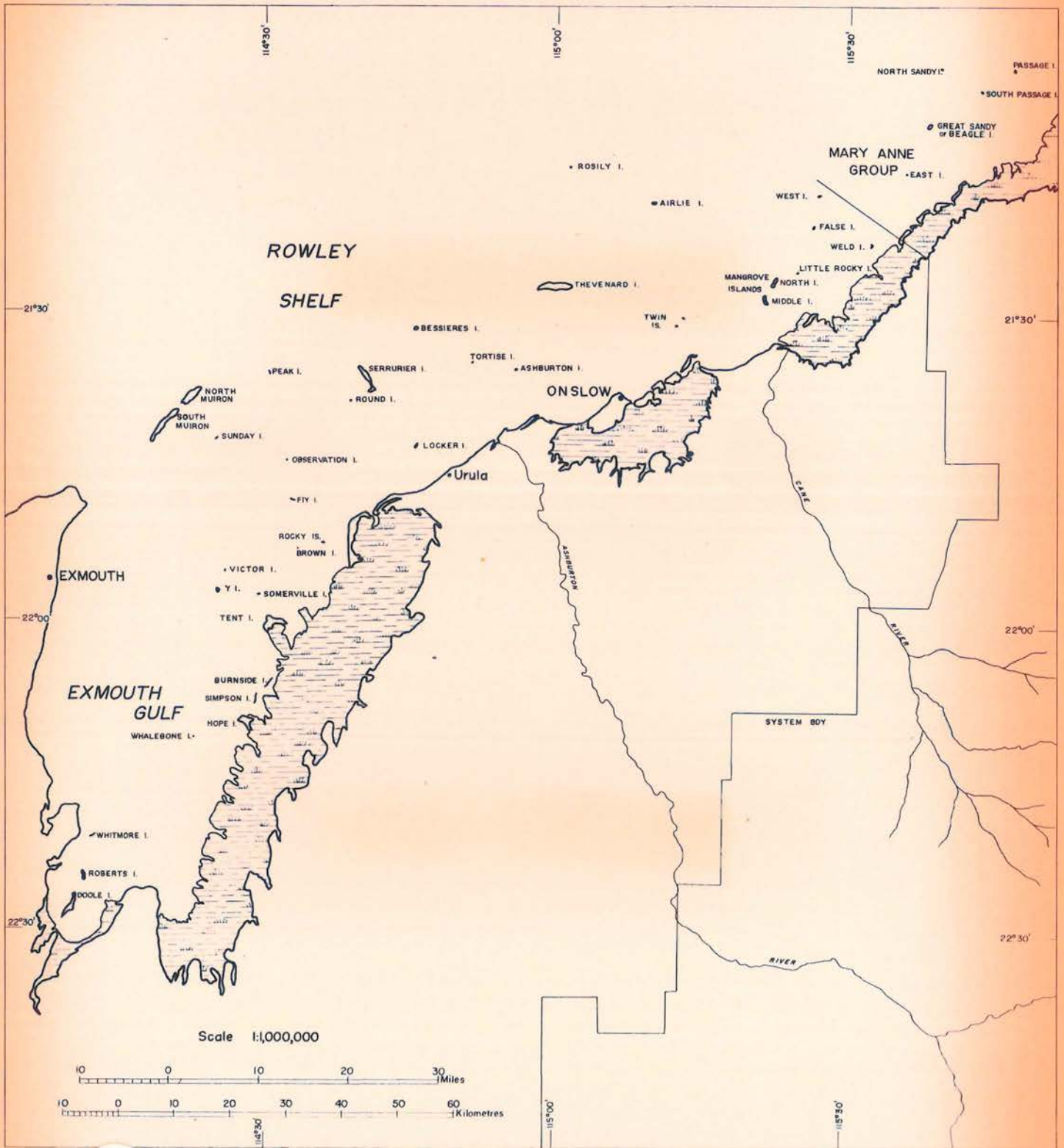


Figure 9.15 Area map of the Rowley Shelf showing offshore islands and tidal flats.

9.8 COASTAL REGION,

EXMOUTH GULF TO MARY ANNE ISLANDS

The eastern shore of Exmouth Gulf and the coast from Urala to the Mary Anne Islands is characterised by tidal-supratidal flats up to 20 km wide (Fig. 9.15). Numerous ramifying tidal channels extend landward from the sublittoral zone and carry tidal waters to the interior. The channels and inter-channel areas on the seaward margin of the flats are bordered by extensive mangrove thickets and terrains of algal mat (Figs. 9.16, 9.17). This is an arid coast characterised by negligible influx of nutrient-bearing waters from mainland rivers; no rivers enter the sea in the Exmouth Gulf sector and the Ashburton and Cane Rivers between Urala and Mary Anne Island are intermittent streams that rarely flow.

Because of the lack of run-off of nutrient-bearing waters from the hinterland and the broad nature of the Rowley Shelf it is probable that the mangrove-algal mat association is a key element in the nutrient cycle for all organisms that inhabit the shelf zone. Broad salt evaporation pans situated in the area of the mangrove-algal mat association disrupt the cycle.

The extensive tidal channel system also is a habitat for juveniles of many marine species, including the commercially important prawns.

Recommendations

The Committee recommends:

1. that biological and sedimentological surveys be carried out on tidal-supratidal flats in the coastal segment from southern Exmouth Gulf to Cape Keraudren (See System 8);
2. that prior to these surveys, further development for solar salt production be restricted to the supratidal zone landward of the mangrove thickets, and that any extension require the approval of the Environmental Protection Authority.



Figure 9.16. Mangrove-lined tidal creeks, eastern shore of Exmouth Gulf.



Figure 9.17. Destruction of mangrove thickets and tidal channel environment by solar salt works, Dampier,

SELECTED BIBLIOGRAPHY

- Baars, D.L. 1963. Petrology of carbonate rocks, in Shelf carbonates of the Paradox basin. Four Corners Geol. Soc. Symposium, 4th Field Conf. pp 101-129.
- Burbidge, A.A. and George A.S. 1973. Report on a visit to Dirk Hartog Island with recommendations on the re-establishment of marsupials. Unpublished.
- Carrigy, M.A. and Fairbridge, R.W. 1954. Recent sedimentation, physioigraphy and structure of continental shelves of Western Australia. J. Roy. Soc. W. Austr., 38: 65-95.
- Condon, M.A. 1954. Progress report on the stratigraphy and structure of the Carnarvon Basin, Western Australia. Austr. Bur. Mineral Resources Report 15: 1-163.
- Condon, M.A. 1967. The geology of the Carnarvon Basin; Part 3, Post - Permian stratigraphy, structure, economic geology. Austr. Bur. Mineral Resources Record 1967/124, 63 p.
- Davies, G.R. 1970 a. A Recent seagrass bank, Shark Bay, Western Australia. In Logan et al., Carbonate Sedimentation and Environments, Shark Bay, Western Australia; American Association of Petroleum Geologists, Memoir 13: 85-168.
- Environmental Protection Authority. 1974. Annual Report, 1973, pp 55-56.
- George, A.S. 1971. The plants seen and collected in north-western Australia by William Dampier. W. Australian Nat. 11 (8): 173-178.
- Ginsburg, R.N. and Lowenstam, H.A. 1958. The influence of marine bottom communities on the depositional environment of sediments. J. Geology, 66 No. 3. 310-318.
- Hagan, G.M. 1973. Carbonate banks and hypersaline basin development, Shark Bay, Western Australia. Ph.D. Dissertation, Univ. of WA. 116p.
- Lenanton, R.C.J. 1970. The biology of the commercially fished whiting (*Sillago* spp.) in Shark Bay, Western Australia. M. Sc. Thesis. Department of Zoology, University of Western Australia.
- Logan, B.W. 1961. Cryptozoon and associate stromatolites from the Recent, Shark Bay, Western Australia. J. Geol. 69(5): 517-533.
- Logan, B.W. and Cebulski, D.E. 1970. Sedimentary environments of Shark Bay, Western Australia. In Logan et al. Carbonate Sedimentation and Environments, Shark Bay, Western Australia: American Association of Petroleum Geologists, Memoir 13: 1-37.

- Logan, B.W., Read, J.F. and Davies, G.R. 1970. History of carbonate sedimentation, Quaternary Epoch, Shark Bay, Western Australia. In Logan et al., Carbonate Sedimentation and Environments, Shark Bay, Western Australia. American Association of Petroleum Geologists, Memoir 13: 38-84.
- Mees, G.F. 1962. The Subterranean Fauna of Yardie Creek Station, North West Cape, Western Australia. J. Roy. Soc. West. Aust. 45(1): 24-32.
- Molinier, R., and Picard, J. 1952. Recherches sur les herbiers de phenerogames marines du littoral. Mediterraneeen francais. Inst. Oceanog. Annales, 27, No. 3: 157-234.
- Read, J.F. 1971 a. Carbonate bank and wave-built platform sedimentation, Edel Province, Shark Bay, Western Australia. Ph.D. Dissertation, Univ. of WA, 100p.
- Read, J.F. 1971 b. Calcrete deposits and Quaternary Sediments, Edel Province, Shark Bay, Western Australia. Ph.D. Dissertation, Univ. of WA, 53p.
- Ride, W.D.L., Mees, G.F., Douglas, A.M., Royce, R.D. and Tyndale-Biscoe, C.H. 1962. The Results of an Expedition to Bernier and Dorre Islands, Shark Bay, Western Australia in July, 1959. Fauna Bulletin No. 2. Ed. A.J. Fraser, Fisheries Department, Western Australia.

SYSTEM 10 - THE MURCHISONINTRODUCTIONArea, Physiography and Biology

The Murchison System as delineated by the Committee includes about 208,370 km² of semi-arid country (Fig. 10.0). It extends from the Gascoyne River in the north to Lake Moore in the south and from Gascoyne Junction in the west to the No. 1 Rabbit Proof Fence in the east.

The area consists mainly of Archaean igneous and metamorphic rocks. There is little topographic relief although occasional low ranges occur, such as the Jack Hills, Robinson Range, Weld Range, Mt. Singleton and Mt. Gibson, as well as breakaways (Fig. 10.1).

The vegetation is dominated by Mulga (Acacia aneura) (Fig. 10.2) and other Acacia species, the only trees of any size being River Gums and Coolabahs along creeks and rivers. In the south, adjoining the wheatbelt, the vegetation is more diverse with South Western elements mixed with the Eremean or desert flora.

A feature of the region is the appearance, after rains, of countless ephemeral herbs such as everlastings. In good seasons these make colourful displays covering hundreds of square kilometres (Figs. 10,3,4). Taller shrubs contribute to the spectacle and mostly belong to genera different from those of the South-West, e.g. poverty bushes (Eremophila), cassias and mulla mullas (Ptilotus) (Erickson et al. 1973).

The Murchison System is within the Eyrean zoogeographic region which includes most of the arid central parts of Australia. The most obvious large animals are the Red Kangaroo, Euro and Emu. For an arid area it is rich in birds and reptiles.

Population

The area has a small population of approximately 3100. Only three towns have more than 200 persons, these being Meekatharra, Cue and Mount Magnet. About 60% of people live in towns, the remainder being rural.

Land Usage

Almost 100% of the Murchison System is occupied by pastoral leases. The largest area of vacant Crown land is in the vicinity of Lake Moore.

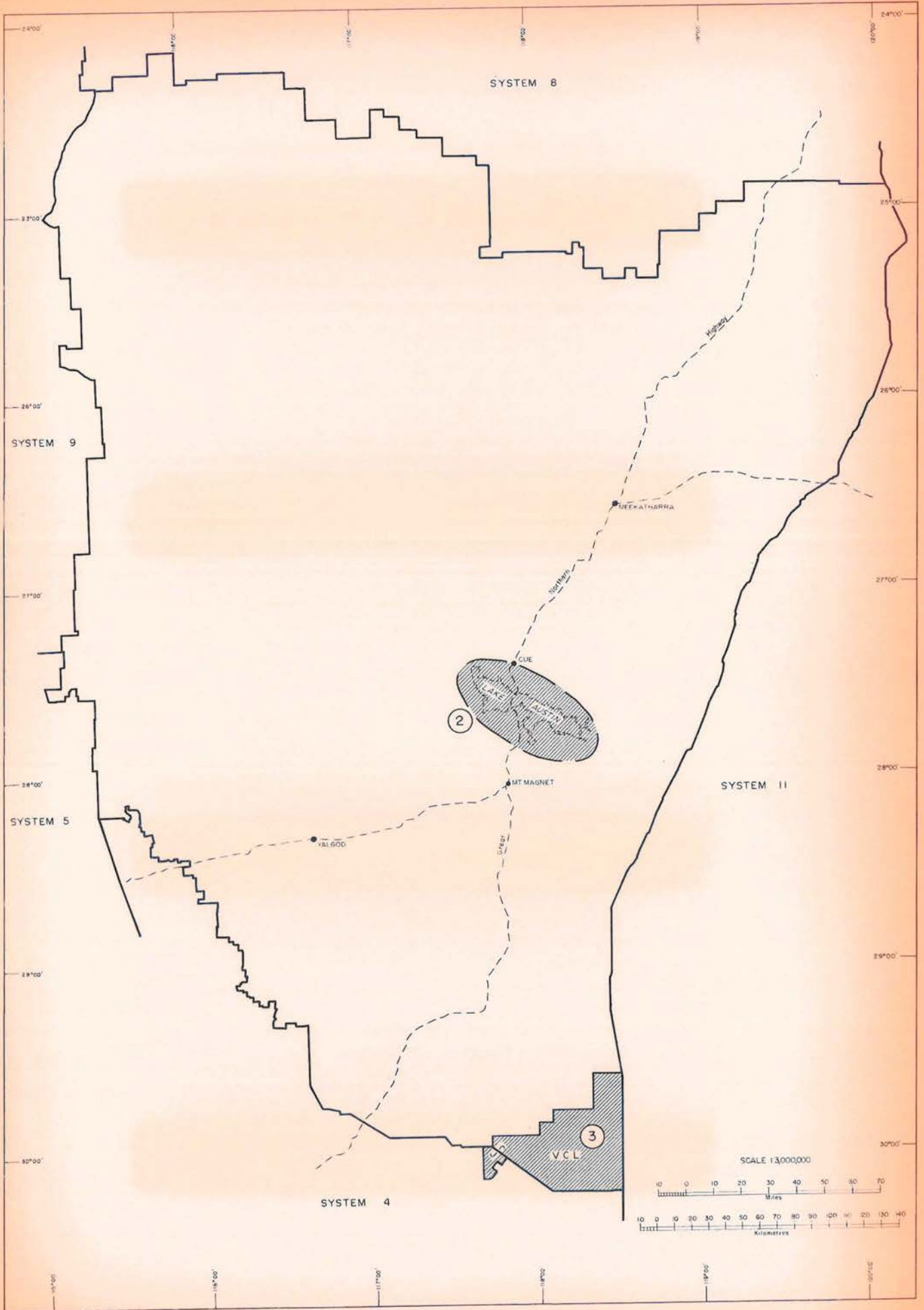


Figure 10-0 System map



Figure 10.1. Central Murchison; breakaway with mulga plains beyond.



Figure 10.2 Mulga (Acacia aneura) country south of Meekatharra.



Figure 10.3. Mulga with everlastings (Helipterum splendidum) near Mt. Magnet.



Figure 10.4. Mulga with everlastings near Cue.

Primary Industry

Sheep grazing is the major usage of occupied lands; some beef cattle are also grazed. Harvesting of Red Kangaroos and Euros provides some income to professional Kangaroo shooters.

Industrial Development and Mining

Gold mining has been a major industry in the past but today production is small. Manganese is being worked in the Peak Hill area. Possible future developments centre around the mining of iron ore which occurs in the Weld Range and at Mt. Gibson and Tallering Peak in the south and at Mt. Hale, Mt. Gould and Mt. Matthew in the north. Some indications of nickel have been found.

Recreation and Tourism

Tourists are not greatly attracted to the Murchison due to its uniformity, lack of topographic relief and the lack of visitor facilities. However, many visitors pass through the area in transit between Perth and the Pilbara and, if better facilities were provided, they might visit such attractions as the Wilgie Mia aboriginal ochre mine in the Weld Range. Wildflowers, which are prolific after winter rains, also attract visitors.

CONSERVATION RESERVES

There are no conservation reserves in the Murchison System, the area being almost totally committed to the pastoral industry. The justification for reserves in the area is based largely on the conservation of animals and plants, although a reserve could become a tourist attraction in the future.

Australia's large native animals are soft-footed and not gregarious. The introduction of hooved flocking animals like sheep and goats has caused the break-up of the surface soils. In the presence of degraded vegetation caused by over-grazing or by the selective grazing of particular plant species, this has led to the loss of valuable top soil (Wilcox and McKinnon, 1973).

Many native animals are at a disadvantage in areas occupied by sheep, especially those which are seed-eaters, such as native rodents, parrots, pigeons, quail and Mallee-Fowl. Sheep consume much of the seed on which these animals depend in the spring and summer.

A reserve in the Murchison would also provide an area where, in the absence of conflict with the pastoral industry, large numbers of Red Kangaroos (Megaliea rufa) could be seen by tourists and studied by scientists. Similarly, the Bustard (Eupodotis australis) a slow breeding but heavily poached species, would be encouraged to remain in the reserve.

The Committee has examined submissions concerning this System and reports on the following areas:

1. Central Murchison
2. Lake Austin
3. Lake Moore Area

10.1 CENTRAL MURCHISON

As stated in the Introduction there is a need for a major conservation reserve in the Central Murchison.

There is at present no major National Park or Wildlife Sanctuary containing the full range of plant and animal species found in better-quality pastoral country. This situation is typified by the Red Kangaroo (Megaliea rufa), a species which is the subject of much public interest. Western Australia has developed a management plan for kangaroos which, while maintaining a fairly stable breeding stock, permits "harvesting" in areas where they conflict with agriculture or pastoral pursuits.

Australia has received much adverse publicity overseas, as has WA in some circles in the eastern states, both for allowing kangaroos to be killed and for not providing adequate reserves where Red Kangaroos can be protected and seen by the public. A reserve in this area would be the only one in Western Australia where even moderate numbers of Red Kangaroos could be found. Although occurring sporadically on some existing conservation reserves, eg Wanjarri Wildlife Sanctuary (Area 11.2) and Mungaroona Range Wildlife Sanctuary (Area 10.8), these cover mostly hilly country which is the preferred habitat of the Euro (Macropus robustus), the Red preferring the grassy plains.

A reserve where indigenous plants and animals could flourish in the absence of sheep would also serve as a comparison with stations which continue to carry stock, enabling measurements to be made of grazing effects and allowing remedial measures to be adopted in eroded areas.

Recommendation

The Committee recommends that \$350,000 be appropriated to acquire the lease of a suitable station in the Central Murchison. The station should be purchased only after biological survey and on terms negotiated with the lessee.

The Committee emphasises that the area purchased should be representative of the region, thus the purchase of a marginal, comparatively small station, would not be desirable.

10.2 LAKE AUSTIN

The Lake Austin area has some interesting plants including Selenothamnus helmsii (Dunna Dunna) and an unusual form of

Cancer Bush, Scaevola spinescens. There is some vacant Crown land in the area, but insufficient to provide a representative reserve.

Lake Austin lies astride an area of basic igneous rocks which have produced gold and which are being investigated for other minerals, especially nickel.

The Committee makes no recommendation concerning the area.

10.3 LAKE MOORE AREA

This general area is important for a number of reasons :

- a) It is on the boundary between the South Western and Eremean Botanical Provinces. This interzone is noted for its diversity of vegetation types and degree of endemism. (Burbidge, 1960; Marchant, 1973)
- b) The area, particularly the mallee country, contains a number of birds, which are rare to the region. These include the Major Mitchell Cockatoo (Cacatua leadbeateri), Red-tailed Black Cockatoo (Calyptorhynchus banksi), Mallee-Fowl (Leipoa ocellata) and Gilbert Whistler (Pachycephala gilberti).
- c) The area is representative of both the Southern Murchison and the Northern Wheatbelt. Neither area contains existing large reserves.

A biological survey of an area of vacant Crown land to the east of Lake Moore is being carried out by the Department of Fisheries and Fauna. Preliminary results indicate a variety of animal life. Mammals include a hopping mouse (Notomys mitchellii), the Sandy Inland Mouse (Pseudomys hermannsburgensis) and a wide variety of bats. An interesting reptile is the skink Ctenotus uber, this being the southernmost record of a species otherwise confined to the desert.

Recommendation

The Committee recommends that a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, be declared east of Lake Moore, the boundaries to be considered after the completion of the survey by the Department of Fisheries and Fauna. Until the reserve has been declared no release of vacant Crown land in this area should be made without reference to the Environmental Protection Authority.

BIBLIOGRAPHY

- Burbidge, N.T., 1960. The phytogeography of the Australian Region. *Aust. J. Bot* 8 : 75-211.
- Davies, S.J.J.F., 1970. A list of plants and animals found at Mileura, Western Australia, Lat. 26° 22' S, Long. 117° 20' E. Technical Memorandum No. 3, CSIRO Division of Wildlife Research.
- Erickson, Rica, George, A.S., Marchant, N.G. and Morcombe, M.K., 1973. *Flowers and Plants of Western Australia*. A.H. & A.W. Reed, Sydney.
- Marchant, N.G., 1973. Species diversity in the South Western Flora. *J. Roy. Soc. W.Aust.* 56 : 23-30.
- Wilcox, D.G. & McKinnon, E.A., 1973. A report on the condition of the Gascoyne Catchment. Departments of Agriculture and Lands and Surveys, Western Australia.

SYSTEM 11 - THE GOLDFIELDS *INTRODUCTIONArea and Physiography

The Goldfields System (Fig. 11.0) covers about 295,100 km², bordered on the east by desert, on the south by coastal sandplains and on the west and north-west by the No. 1 Rabbit Proof Fence.

Geologically, the Goldfields form the eastern, and most economically important, part of the Yilgarn Block, one of the stable, Precambrian, crustal nuclei of the Australian continent. Its most ancient areas consist of strongly deformed volcanic and sedimentary rocks of Archaean age. These are now exposed in sinuous belts which trend in a NNW direction and three broad lithological divisions are recognisable within these early Archaean successions. The oldest comprises extrusive and intrusive ultramafic and mafic igneous rocks, some of which are layered; these pass upwards into volcanics of intermediate composition, which are, in turn, succeeded by a group of mixed sedimentary and varied igneous rocks. Most commercially-important mineral deposits in the Goldfields System occur within these oldest Archaean successions which are customarily, if not always aptly, referred to as greenstones. Crustal material older than the greenstones has not been recognised, perhaps because it was completely digested or remobilised by subsequent granite intrusions. The first of these occurred about 2,900 million years ago and another major period of granite intrusion occurred about 300 million years later. Volumetrically, granites and gneissic rocks are much more significant than greenstones, and occupy about 70% of the area. Quartz veins and gold mineralisation appear to have been contemporaneous with these intrusive granites. Granites, and their associated gneisses, as well as the greenstones, are intruded by younger basic dykes.

Occasional hills and ridges, seldom more than 50 m high, provide the only relief in the topographically monotonous plateau. These often consist of resistant jaspilite, an unusual sedimentary rock that may be a source of commercial deposits of iron-ore in areas where it has been suitably enriched.

Remnants of early Tertiary drainage systems are represented by chains of extensive playa lakes, some of which contain marine and continental sediments of Eocene age. After one of the area's rare periods of heavy rain, these lakes are briefly linked by sheet-flooding. High evaporation rates rapidly return them to their normal condition - broad flats of clay, halite and gypsum. Secondary uranium ores recently discovered at Yeelirrie occur in calcrete rock occupying a Tertiary or Quaternary stream valley.

Much of the Goldfields, especially the granite areas, is covered by thin deposits of Quaternary sand and loam.

* The name chosen for the System reflects the fact that it contains the most productive of Western Australian Goldfields - the Eastern Goldfields.

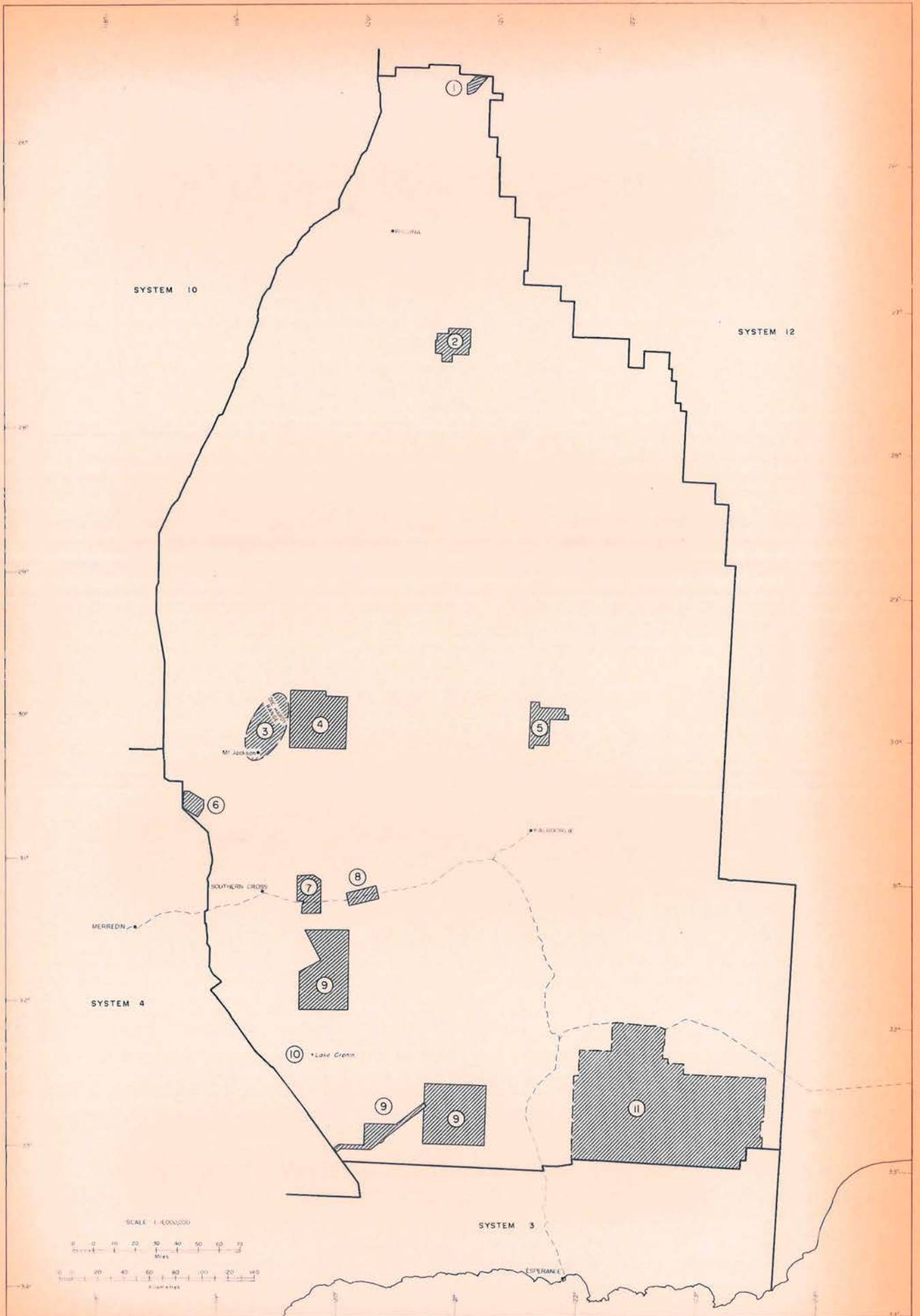


Figure 11-0 System map

Biology

The vegetation of the northern third of the System is dominated by mulga (Acacia aneura) associations on loamy soils, spinifex (Triodia spp.) on sand, and halophytic associations on salt lakes. The southern part is largely within "transitional woodland" (Erickson et al., 1973) with a small area more typical of the wheatbelt in the south west, adjacent to the South West Land Division. The transitional woodland is in the region of overlap between the South West and Eremean Botanical Provinces, an area noted for its high degree of speciation and endemism. A number of plants occurring along this zone have very restricted distribution; in System 11 they include Banksia audax, Eucalyptus stricklandii, E. woodwardii, E. carnei, Dryandra arborea, Eremophila calorhabdos and Scaevola oxyclona. A more detailed description of the vegetation of transitional woodland can be found under Area 11.8.

Zoologically the System comprises a mixture of Bassian (humid/winter rainfall) and Eyrean (desert) elements. Many southwestern species have their eastern distribution limit in the System, particularly the southern half, while other Goldfields species are typical of the arid areas of Australia. No birds or mammals are known to be restricted to the area but it is the stronghold of some species, e.g. the Weebill (Smicrornis brevirostris) and White-eared Honeyeater (Meliphaga leucotis). Two lizards, Egernia formosa and Lerista punctata, are restricted to the System while the gecko Nephrurus stellatus is known elsewhere only on Eyre Peninsula in South Australia (Dr. G.M. Storr, pers. comm.).

Population

The population of the Goldfields is about 35,000 of whom about 21,000 live in Kalgoorlie. Kambalda and Norseman are the only other centres classed as urban (1000 persons or more, WA Year Book), while Southern Cross, Coolgardie, Leonora and Koolyanobbing have more than 200 people. The System contains many towns which once had fairly large populations but which decreased in importance when the mines which supported them ceased production. These include Wiluna, Sandstone, Laverton, Menzies, and Bullfinch. About 78% of the population live in urban centres, the remainder being rural.

Land Use

About 65% of the System consists of pastoral leases, while less than 5% is taken up for agriculture, mainly in the Southern Cross and Salmon Gums areas. The remainder is vacant Crown land or reserved. Except for some vacant Crown land north of Wiluna and the Wanjarri Wildlife Sanctuary between Wiluna and Leonora, all the Crown land is in the southern half of the System.

Primary Industry

Sheep grazing is the main land use on pastoral leases, but some cattle are also run. Harvesting of Red Kangaroos and Euros provides income to professional kangaroo shooters. Commercial fruit-growing has commenced at Wiluna.

Mining and Industrial Development

Mining is the major economic activity in the Goldfields. The area is famous for its production of gold which has been mined continuously since about 1891, but many deposits are now exhausted. More recently the discovery and production of nickel has maintained the economy of the area. Other minerals produced include iron ore at Koolyanobbing, gypsum at Lake Seabrook and pegmatite minerals southeast of Coolgardie. Possible future developments include the mining of uranium at Yeelirrie.

Industry is largely concerned with the processing of minerals or servicing the mines.

Recreation and Tourism

The main rail and road routes between eastern and Western Australia pass through the eastern Goldfields and are used by large numbers of interstate tourists. There is increasing interest in the history of gold discovery and in the early mining settlements. Of particular interest are the massive buildings typical of the "official" architecture of the period of optimism in the gold rush days. Coolgardie is noteworthy in this respect. Enterprising development of ghost towns could undoubtedly increase the tourist potential of the area, particularly during the winter months.

In the south-west of the System, wild flowers, especially on sandheaths where plants such as featherflowers (Verticordia) are most colourful, have the potential to become a major tourist attraction. So also has Peak Charles, a spectacular but poorly known granite monadnock about 100 km south-west of Norseman.

CONSERVATION RESERVES

Only three major conservation reserves exist in the Goldfields. These are the Wanjarri Wildlife Sanctuary, the Lake Barker Wildlife Sanctuary and the Frank Hann National Park. Only one, Wanjarri, is a Class A reserve. In the Committee's opinion this falls far short of a representative situation. For example, no large areas of typical Goldfields woodland are reserved although a little is found in the Lake Barker Wildlife Sanctuary.

The Forests Department (Anon. 1973) has recently recommended for reservation some small areas containing representative samples of Goldfields eucalypts. This report highlights the problems

of competing land usage in woodland areas, since five of the six areas suggested as reserves are largely covered with mining tenements and are partly or wholly under pastoral lease. The Committee supports the concept of reserving areas of Goldfields woodland but believes that larger areas are needed than those presently recommended by the Forests Department.

Other natural areas are also poorly represented in conservation reserves. In the north of the System the only reserve is Wanjarri Wildlife Sanctuary which includes only small areas of typical mulga. The Committee has recommended one further reserve in this area, and if recommendations for reserves in System 10 (Murchison) and System 12 (Desert) are implemented this vegetation type may be adequately protected. Further south the sandheaths with their spectacular spring shows of wildflowers are also poorly protected. Lake Barker Wildlife Sanctuary and Frank Hann National Park both contain some heaths but the Committee believes that a more comprehensive representation should be provided.

The Committee has examined submissions concerning this System. The areas it decided to report on are as follows:

1. Windich Spring
2. Wanjarri Wildlife Sanctuary
3. Mt. Jackson - Die Hardy Range area
4. Mt. Manning Range area
5. Goongarrie area
6. Walyahmoning Rock area
7. Yellowdine area
8. Boorabbin area
9. South Yilgarn
10. Lake Cronin
11. Dundas area.

11.1 WINDICH SPRING

Windich Spring is a permanent waterhole on the Canning Stock Route about 120 km north-east of Wiluna. Biologically it is of interest because of the animals that water there. Thousands of birds of up to 70 species use the Spring and there also occurs an isolated population of the Dinnerplate Tortoise (Chelodina steindachneri).

Windich Spring was discovered by John Forrest in 1874 and was later an important watering point on the Canning Stock Route. It is an important historic site both because of its associations with explorers and the stock route and because of the stone walls constructed there, possibly by the Aborigines.

The Spring lies within the Stock route on Cunyu Station.

Recommendations

The Committee recommends that Windich Spring be declared a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority. The reserve should be defined as that part of the Canning Stock Route lying between lat. 25° 30' S and long. 120° 46' E.

11.2 WANJARRI WILDLIFE SANCTUARY

Wanjarri Wildlife Sanctuary is a Class A reserve for the Conservation of Flora and Fauna vested in the WA Wild Life Authority. Originally Wanjarri Station, it was purchased by the Government in March 1971 for a reserve. Its area is about 53,200 ha.

Wanjarri is a sand-covered plain interrupted by breakaways with some loamy soils below. The sandplains are covered with spinifex (mostly Triodia basedowii and Plectrachne melvillei) with occasional mallees (Eucalyptus spp.) or shrubs of Hakea, Grevillea or Acacia. The laterite breakaways and stony outwash plains fronting them support a sparse but characteristic and diverse vegetation notable for such plants as Callitris huegelii, Calytrix spp. and Scaevola sp. Mulga (Acacia aneura) dominates the lower, loamy soils in association with perennial grasses such as Danthonia bipartita, Eragrostis lanipes, E. eriopoda and Eriachne aristidea. Bowgada (Acacia linophylla) replaces mulga on the sandier soils.

Wanjarri is an outstanding area for birds, records having been kept since 1940 (Moriarty, 1972). Some 111 species have been recorded, and it is apparent that Wanjarri lies in a zone in which ranges of species with a predominantly southern and a predominantly eastern or northern distribution overlap. For example the Mallee-Fowl (Leipoa ocellata), Regent Parrot (Polytelis anthopeplus), Splendid Wren (Malurus splendens), Western Grass-Wren (Amytornis textilis), Grey Currawong (Strepera versicolor) and Western Magpie (Gymnorhina dorsalis) are at the northern end of their range while the Alexandra Parrot (Polytelis alexandrae), Bourke Parrot (Neophema bourkii), Rufous-crowned Emu-wren (Stipiturus ruficeps), Striated Grass-Wren (Amytornis striatus), Grey Honeyeater (Conopophila whitei), Spotted Bower-bird (Chlamydera maculata) and Black-backed Magpie (Gymnorhina tibicen) are close to the western or south western limits of their distribution.

Mammals include the Red Kangaroo (Megaliea rufa), Euro (Macropus robustus), Red-eared Antechinus (Antechinus macdonnellensis), Mulgara (Dasycercus cristicauda) and a Hopping Mouse (Notomys sp. probably N. alexis). Reptiles have not been extensively collected but a variety of species is known.

The Committee endorses the status, purpose and vesting of the Wanjarri Wildlife Sanctuary.

11.3-4 MT. MANNING RANGE AREA

The Mt. Manning Range is a series of hills lying some 150 km north-north-east of Southern Cross. The hills consist of jaspilite (banded iron formation) which in places has been contorted by folding, and has also been enriched to form high-grade iron ore. The jaspilites are flanked by "greenstones", the whole forming a sinuous belt of Archaean rocks which have survived extensive granitisation. Surrounding the range are extensive loamy plains overlying Archaean granite. This area (11.4, Fig. 11.0) was recommended as a reserve in the National Parks Report (Anon. 1962). It was intended as an area representative of ungrazed country containing southern mulga. Most mulga in Western Australia is within pastoral leases and the catastrophic effects of grazing on the plant communities are clearly visible in many places. The Mt. Manning Range area was intended as a place where natural mulga associations could be preserved and studied, and comparisons made with grazed areas.

In 1969 the Reserves Advisory Council also recommended that the area be made a Flora and Fauna reserve vested in the West Australian Wild Life Authority, but no action was taken, largely because of the existence of mining tenements in the area.

No further information on the flora and fauna of the area is available to the Committee. Members of the Committee inspected the region from the air in November 1973. It appeared that the proposed reserve was largely covered by Casuarina or Eucalyptus - dominated scrub, and it is not yet known whether its boundaries include the best ungrazed mulga in the area. Irrespective of the distribution of mulga, and because of the scarcity of good ungrazed land in pastoral leases, the area is a valuable yardstick against which pastoral use can be compared.

West of this area are Mt. Jackson and the Die Hardy Range (Fig. 11.0). They are sinuous belts of Precambrian metavolcanic and metasedimentary rocks, within which jaspilites stand up as erosion-resistant ridges. Some gold has been won from the area.

The ranges are important floristically, for many of the plants do not occur on the surrounding plains, and some are entirely restricted to the hills. The vegetation is a dense, tall scrub containing many species, some representing the South Western flora, others the Eremean.

Yilgarn Dryandra (Dryandra arborea Fig. 11.1) is one of the unique species of these hills. This is the most inland occurrence of any species of Dryandra, a genus confined to the South-West of Western Australia. In spite of existing in a dry region, it is a much larger shrub than are most other species, and has the most massive trunk of any species.

Tetratheca harperi is another unusual species endemic to these hills. It is a perennial herb with bristly leafless stems, different from most other species of the genus.

Orchids are confined mainly to the wetter parts of the State, but several species are found here and are mostly poorly represented in reserves. They include Caladenia sigmoidea (a spider orchid) and undescribed species of Caladenia and Pterostylis.



Figure 11.1. Yilgarn Dryandra (Dryandra arborea) on Mt. Jackson.



Figure 11.2. Goongarrie area: Mulga (Acacia aneura) association with a lower storey of Bowgada (A. linophylla) and Kurar (A. tetragonophylla) and ground cover of ephemeral spear grass (Stipa sp.).

A species of mulla mulla here is also unusual and not known to occur in a reserve: Ptilotus helichrysoides is a perennial shrubby plant covered with felt-like hairs, very different from most other species.

Many Eucalyptus species occur on the hills and the surrounding plains. One which appears to be endemic is Eucalyptus formanii, which has the narrowest leaves of any eucalypt. Eucalyptus ebbanoensis, and E. ewartiana are other species of interest due to their variability.

Mt. Jackson lies within a Mining Act temporary reserve for iron ore. A few mineral claims have been pegged in the Die Hardy Range. The areas surrounding Mt. Jackson and the Die Hardy Range are within pastoral leases.

The area including the Mt. Manning Range, Mt. Jackson and the Die Hardy Range is of considerable importance due to the flora of the ranges and the presence of ungrazed land.

Recommendations

The Committee recommends

- 1) that the Mt. Manning Range area as shown in Fig. 11.0 be declared a C Class reserve for the Conservation of Flora and Fauna, vested in the West Australian Wild Life Authority;
- 2) that the West Australian Wild Life Authority be asked to examine the possibility of extending the boundaries to include Mt. Jackson and the Die Hardy Range.

11.5 GOONGARRIE AREA

The Goongarrie area of about 59,500 ha lies some 55 km southeast of Menzies. It was formerly part of Redcliffe Station but is now vacant Crown land. The Shire of Menzies has requested that the area be set aside as a flora and fauna reserve.

An inspection by the Forests Department revealed a variety of vegetation types. Mulga (Acacia aneura) is widespread, often in association with Bowgada (A. linophylla) and Kurara (A. tetragonophylla), with a shrub layer of Poverty Bushes (Eremophila spp.) and a ground cover of speargrass and other ephemerals (Fig. 11.2). In some areas mulga is associated with mallee (Eucalyptus oleosa) and York Gum (E. loxophleba). Mallees (e.g. E. concinna and E. oleosa) dominate in places usually with a shrub layer of Acacia spp., Eremophila spp. and Exocarpos sp. York Gum is also developed as a woodland. Here it has an understory of mulga and Jam (Acacia acuminata) and a ground cover of mulla-mulla (Ptilotus obovatus) and everlasting (Fig. 11.3). Sheoak (Casuarina cristata) is dominant in places in association with Pittosporum phillyraeoides, Dodonaea sp. and Eremophila spp. (Fig. 11.4).



Figure 11.3. Goongarrie area: York Gum (*Eucalyptus loxophleba*) woodland. The understory is Mulga (*Acacia aneura*) and Jam (*A. acuminata*) and the ground cover is mulla mulla (*Ptilotus obovatus*) and ephemeral everlastings.



Figure 11.4. Goongarrie area: She-oak (*Casuarina cristata*) association. Understorey is Weeping Pittosporum, (*Pittosporum phillyraeoides*), *Dodonaea* sp and *Eremophila* sp.

Granite outcrops provide a habitat for different plants, and there are numerous fresh water swamps in the western part. Salt lakes and their associated halophytic vegetation, especially in the north-west, add further variety.

The country is not good pastoral land and has never been stocked; thus it possibly contains plants not to be seen in surrounding country which has been stocked for 50 years or more.

A place of historical interest is Deadman Rocks. Here the grave of a young European, speared by the Aborigines in 1896, is still fenced and in good condition.

The Goongarrie area is within a reasonable distance (about 100 km) of Kalgoorlie and could become a tourist attraction, especially in good seasons. The Menzies Shire Council has constructed a new road passing within and close to the northern boundary of the proposed reserve. This would enable tourist buses and cars to travel a loop via Kanowna and Gindalbie to the area, returning to Kalgoorlie via Menzies, Comet Vale and Broad Arrow.

Recommendation

The Committee recommends that the Goongarrie area be declared a Class A reserve for National Park, and placed under the control of the National Parks Board of WA.

11.6 WALYAHMONING ROCK AREA

An area of approximately 20,000 ha around Walyahmoning Rock has been proposed as a Wildlife Sanctuary by the Department of Fisheries and Fauna, and action to reserve the area is being completed by the Department of Lands and Surveys.

The proposed reserve lies close to the boundary of the Eremean and South-West Botanical Provinces. It has a diverse vegetation of three main types:

1. Sandplains, varying from association of mallee, Callitris, Hakea and many myrtaceous species on yellow sand through to dense, fairly pure stands of Casuarina on brown gravelly-sand.
2. Dense stands of Melaleuca or White-gum woodlands on red-brown loams below breakaways.
3. Lithosol areas, carrying a characteristic flora around extensive granite outcrops.

The area has a fauna rich in both South-Western and Goldfields forms. An important mammal record is the Common Dunnart (Sminthopsis murina), a Bassian species at the northeastern edge of its range. South-Western bird species include the Grey Fantail (Rhipidura fuliginosa), Blue-breasted Wren (Malurus pulcherrimus), both Yellow-plumed and White-eared Honeyeaters (Meliphaga ornata and M. leucotis), and the Rufous Tree-creeper (Climacteris rufa). Among the reptiles, the dragon lizards Amphibolurus maculatus griseus and A. ornatus represent the South-West while A. cristatus and A. scutulatus are dry country species. The geckoes Diplodactylus maini and D. vittatus are common here.

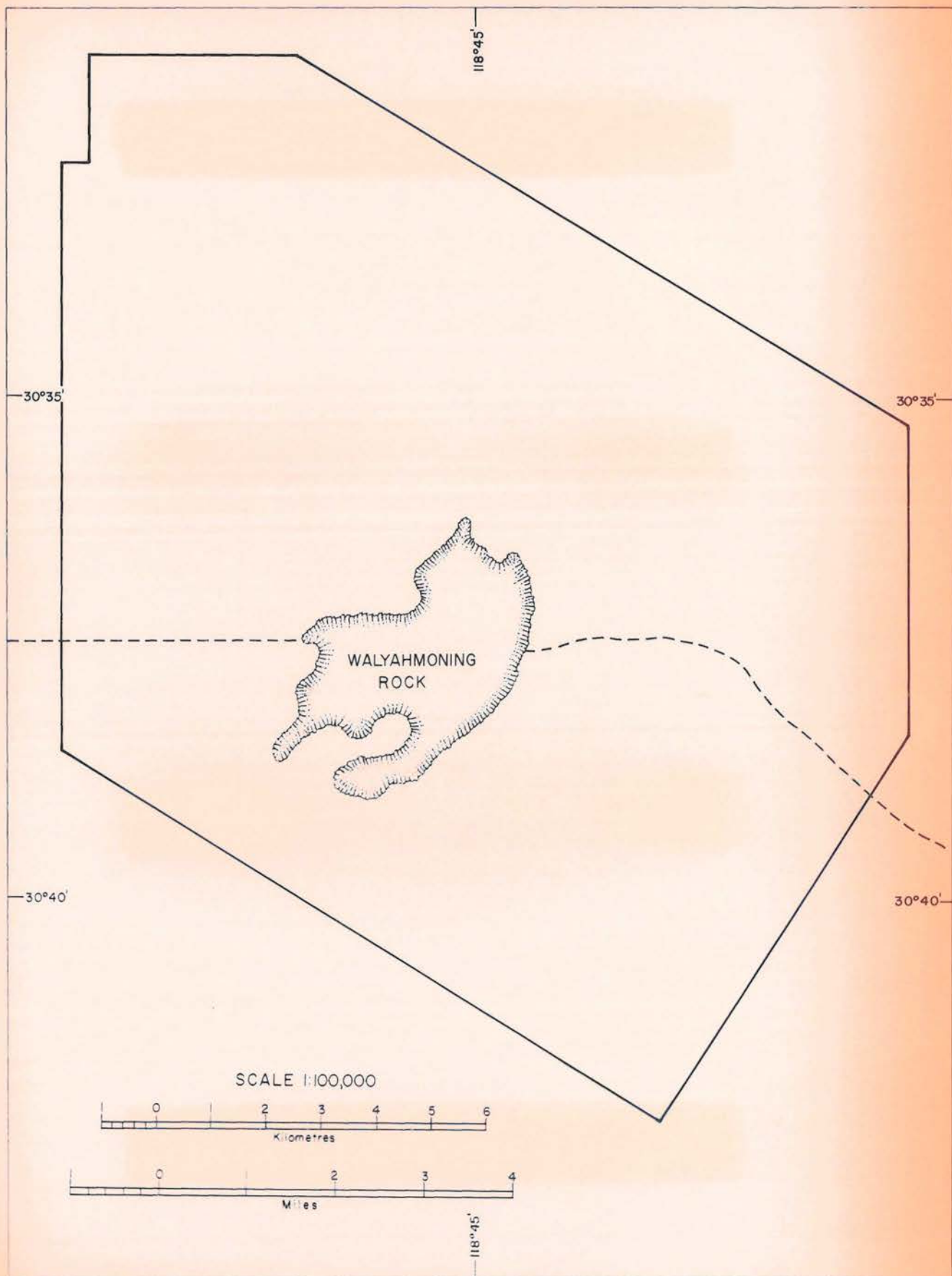


Figure 15 Area map of Walyahmoning Rock area

Recommendation

The Committee endorses the proposal for a reserve in the Walyahmoning Rock area as shown in Fig. 11.5 and recommends that it be of Class A and vested in the West Australian Wild Life Authority.

11.7 YELLOWDINE AREA

Near Yellowdine there are four small flora and fauna reserves. At Duladgin Rock, 16 km north of Yellowdine, there are two small adjoining reserves, these being Reserve No. 2179 of about 1360 ha for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority and Reserve No. 3112 of about 260 ha for Water and the Conservation of Flora and Fauna, vested in the Minister for Water Supplies.

To the east of Duladgin Rock there is another small (260 ha) reserve at Weowanie Rock (Fig. 11.6). This reserve, no. 3113 for Water and the Conservation of Flora and Fauna, is also vested in the Minister for Water Supplies. About 3 km south of Yellowdine lies Condarnin Rock, which is also a small (260 ha) reserve (No. 29823) vested in the WA Wild Life Authority.

Duladgin Rock is a low, unspectacular, granite rock lying alongside the Yellowdine-Lake Seabrook Road. To the west of the rock lies a quartzite ridge which extends southward towards Yellowdine.

The Duladgin Rock area has a flora containing a number of plants of outstanding interest; some of them are unique to the area. These include at least three species which are yet to be described - a Verticordia (featherflower) and a Grevillea which are restricted to the area and a Brachycome (daisy) which is also known from Yorkrakine Rock, north of Tammin. The area is a meeting place of plants ranging into wetter and drier areas. An example is Conostylis androstemma subsp. argentea which here occurs more than 200 km from its nearest other recorded locality; it is also the most inland occurrence of any member of the genus. Calothamnus quadrifidus, the One-sided Bottlebrush, and Wilsonia humilis, a herb, are also at their most inland periphery. On the other hand Ptilotus obovatus, a mulla mulla, occurs here at its southwestern extremity, being a species which extends through the deserts and into Queensland.

All these plants are confined to the periphery of the granite rock or the quartzite ridge.

Study of the animals reveals a similar situation. Duladgin is the easternmost known locality for the frog Pseudophryne guentheri and many other animals occur at or near their eastern limit.



Figure 11.6. Weowanie Rock, north of Yellowdine.

Weowanie rock provides an interesting contrast with Duladgin, e.g. the frog Pseudophryne occidentalis, a desert species, occurs there. One interesting occurrence is the shrub Kunzea pulchella (Granite Kunzea). In the southwest it has bright red flowers. In the Yellowdine-Duladgin Rock area both red and white flowers occur but at Weowanie and further eastward only white flowers are found. It is believed that this change in flower colour reflects the fact that in the South-West the flowers are pollinated by day-flying birds, whereas in this transition zone and at Weowanie the white flowers are pollinated by night-flying insects typical of the desert. The insects and birds which pollinate these flowers do not spend their life on the granite rocks on which Kunzea is a conspicuous shrub. They breed and live in the adjacent scrub and woodland, and fly to the nectar-bearing flowers to feed, at the same time pollinating the flowers. In order to study and maintain such a phenomenon as day or night pollination in these plants, it is essential not only that the rocks remain undamaged, but also that the adjacent flora be preserved.

The Rock Isotome (Isotoma petraea) occurs as isolated populations on rock outcrops, especially granite, in arid Australia. To survive the inbreeding imposed by its "insular" distribution, this autogamous species has evolved a system of permanent hybridity. Most populations have a chromosomal arrangement of 7 bivalents, but in the eastern wheatbelt and Yellowdine area they have a system of complex hybridity involving chromosomal rings. These complex hybrids are true breeding, stabilised by a balanced lethal mechanism. The populations in the Yellowdine area are important in studies of this species.

Between Duladgin and the Weowanie Rocks a salt lake system runs in a north-south line. It continues between Condarnin and High Rocks to the south of Yellowdine. Between many of the lakes are sandy ridges which have an interesting flora different from that of the surrounding country. It includes Kochia, Callitris, Jacksonia, Verticordia and Stylidium species.

The area between the three existing reserves is either vacant Crown land or timber reserve (No. 18966). This reserve was created to supply firewood for the pumping stations on the pipeline between Mundaring and Kalgoorlie but the pumps are no longer wood-fired. A larger reserve in this locality would also protect areas of wildflowers along the Great Eastern Highway allowing travellers from Kalgoorlie to Perth to see the spring displays.

There are current mining tenements near Duladgin Rock and around High Rock.

The area contrasts with the existing Lake Barker Wildlife Sanctuary in being a different type of country, especially in its granite rocks and salt lakes.

Recommendations

The Committee recommends that a Class C reserve for the Conservation of Flora and Fauna, vested in the West Australian Wild Life Authority, be created in the Yellowdine area, the boundaries to be as shown in Fig. 11.7. It should include existing reserves Nos. 2179, 3112, 3113, 29823 and part of 18996, as well as the vacant Crown land between them.

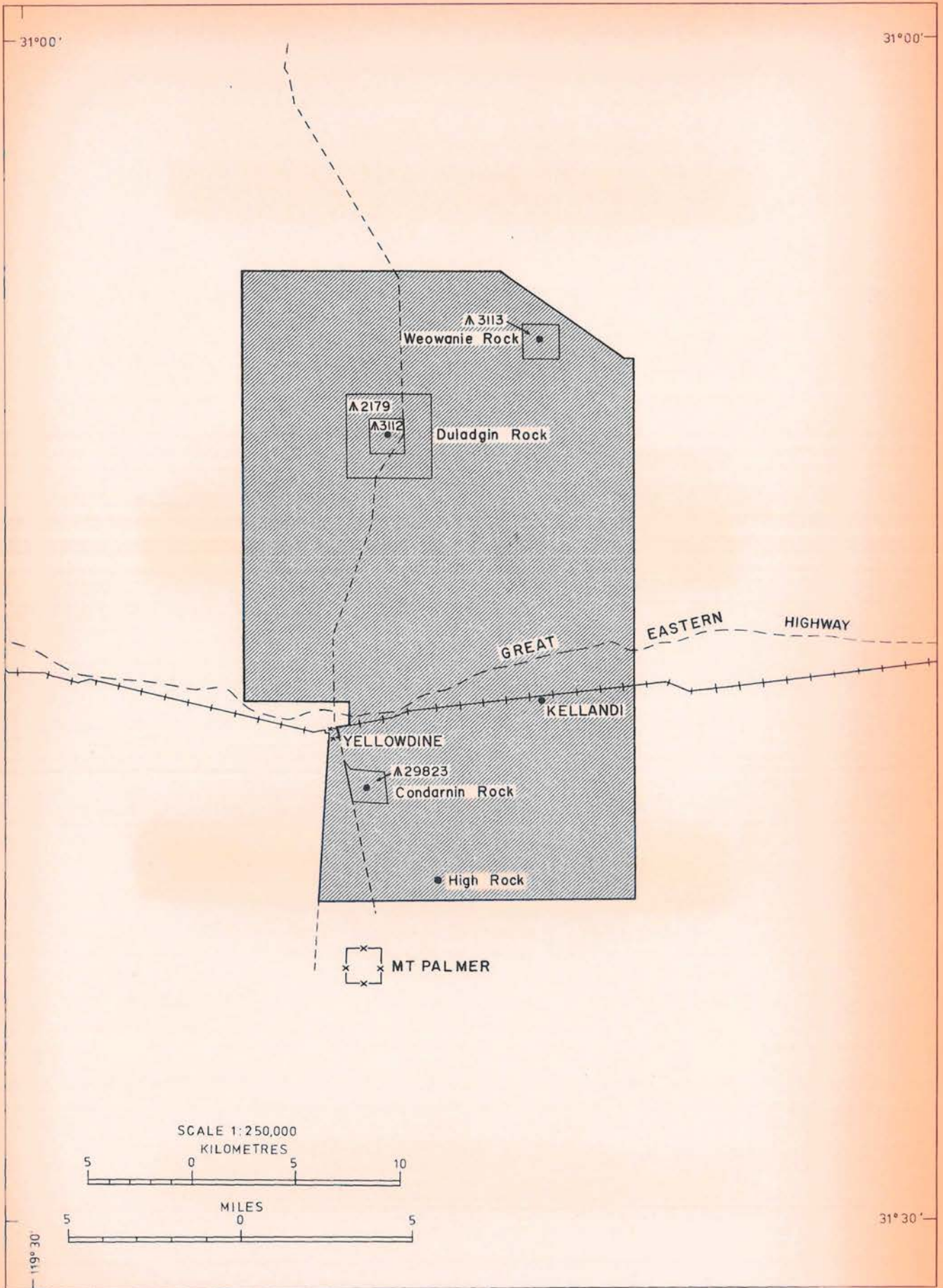


Figure 11.7 Area map of Yellowdine area

11.8 BOORABBIN AREA

The Great Eastern Highway, National Route 94, passes through extensive bushland east of Southern Cross. The long section to Coolgardie traverses undulating country from the high points of which one obtains extensive views across wide plains and woodlands. Vegetation is variable and there are large tracts of sandheath. In spring, wildflowers are colourful and plentiful on the heaths, and are an important visual asset. For travellers from the east this area is the first real introduction to the floral wealth of the State, and is the only large undisturbed area of sandheath along the Highway to Perth.

The vegetation of the heaths has been described by Beard (1969). It is complex and very rich in species, of which some are widespread, others restricted to this region e.g. Eriostemon pachyphyllus and E. coccineus. The myrtle, banksia and legume families are the most prominent, but many others are represented. The flora is mostly typical of the South West Botanical Province but occurs here almost within the transition to the Eremean Province. Species representing the latter are therefore present also.

The most interesting area of heath along this part of the Highway lies between Koorarawalyee and Boorabbin. Here there are extensive heaths on each side of the road. Eastwards the vegetation is mostly woodland, while to the west one soon enters the agricultural districts.

Recommendation

The Committee recommends that a strip of country 10 km wide and 30 km long be reserved between Koorarawalyee and Boorabbin. The centre of the strip should be the Great Eastern Highway. The reserve should be Class A, for National Park, and placed under the control of the National Parks Board of WA.

11.9 SOUTH YILGARN

In this region are two existing and one proposed Conservation reserves. These are:

1. the Lake Barker Wild Life Sanctuary which is a Class C reserve (No. 24049) and is not vested. It is controlled by the Department of Fisheries and Fauna under the provisions of the Fauna Conservation Act;
2. the Frank Hann National Park is also a Class C reserve (No. 27023); it is under the control of the National Parks Board;
3. the Bremer Range Area was proposed as a reserve in the National Parks Report (Anon., 1962). Although further recommended by the Reserves Advisory Council in 1969 no action has resulted, largely because of objections by the Mines Department.

Each of these areas is discussed further below.



Figure 11.8. Woodland on Lake Barker Wildlife Sanctuary. The upper storey is Salmon Gum (Eucalyptus salmonophloia), with a lower storey of Boree (Melaleuca sheathiana) and quondong (Santalum acuminatum).

1. Lake Barker Wildlife Sanctuary

This reserve emanated from a proposal made in 1950 by Mr. C.A. Gardner, then Government Botanist. The area originally proposed was about 110 by 100 km and its western boundary was the No. 1 Rabbit Proof Fence. Following consideration by the Department of Lands and Surveys the northeast corner of the original area was set aside in 1954 as Reserve 24049 of 208,000 ha (516,000 acres).

Geologically the area comprises Archaean granite and gneiss overlain by eluvial sand. Part of the belt of metamorphic rocks running from north of Bullfinch to Hatters Hill, lies within the reserve and has been extensively pegged by mining companies seeking deposits of nickel and other base metals.

The vegetation on the metamorphic rock belt is a eucalypt woodland (Fig. 11.8), mainly Salmon Gum (Eucalyptus salmonophloia) and Gimlet (E. salubris) with pockets of Morrel (E. longicornis), Merrit (E. flocktoniae) and E. transcontinentalis. The understorey consists of a large variety of shrubs, the species varying from one locality to another. Boree (Melaleuca sheathiana) is common in some areas, while in others species of Acacia and Grevillea are prevalent.

Sandy soils overlying granitic rocks are covered with a variety of vegetation types, including mallees (E. leptopoda, E. eremophila, E. annulata, E. burracoppinensis, etc.), often associated with native-pine (Callitris sp.), Casuarina and a great variety of Acacia spp. and myrtaceous and proteaceous shrubs. The sand-plains show a variety of forms, the northern areas supporting a typical wodjil (Acacia spp.) association while tamar scrub, an association dominated by Casuarina campestris, occurs along the western boundary. In the south and southeast are large areas of sandheath with a complex vegetation. Chains of salt lakes lie on the eastern boundary and in the northwest. These support a characteristic halophytic vegetation.

The fauna is probably typical of this part of the State, being predominantly representative of the South-West, but with Goldfields and desert influences. Mammals are not common, excepting bats, but birds and reptiles are plentiful (Butler, 1970). Birds recorded number 103 species. South-western species at or near their eastern or north-eastern limit include the Silvereye (Zosterops australasiae), Purple-gaped Honeyeater (Meliphaga cratitia), Spotted Scrub-Wren (Sericornis maculatus), Raven (Corvus coronoides), Western Yellow Robin (Eopsaltria griseogularis) and Elegant Grass-Parrot (Neophema elegans). The desert influence is noted in the presence of the Crow (Corvus ceciliae), Pied Butcher-bird (Cracticus nigrogularis) and White-browed Tree-creeper (Climacteris affinis). The reptiles are a mixture of southwestern and desert types, 33 species being known.

2. Frank Hann National Park

Set up to protect wildflower country along the Norseman-Lake King Road, the reserve originally consisted of a strip one mile (1.6 km) wide on each side of the road between the No. 1 Rabbit Proof Fence and the junction of the Wellsteads track. It covers an area of about 26,100 ha. Recently an area of 39,250 ha was added.



Figure 11.9. Wildflowers on sandplain near Frank Hann National Park; yellow, pink and white featherflowers (Verticordia spp.).



Figure 11.10. Verticordia mitchelliana, Frank Hann National Park.

The road between Lake King and Norseman has recently been realigned in the area immediately east of the Rabbit Proof Fence and the first 27 km does not now lie within the reserve.

Wildflowers here are spectacular in spring (Figs. 11.9, 11.10) but little else is known of the flora and fauna of the National Park. It lies in an area of mixed sandplain, mallee and woodland.

3. Bremer Range Area

This proposed reserve lies about 80 km southwest of Norseman and covers an area of approximately 233,090 ha.

The outstanding natural feature of the area is Peak Charles (Figs. 11.11, 11.12, 11.13), a granite monadnock about 658 metres high, standing some 500 metres above the surrounding plain. Its shape varies continuously according to the direction and distance of viewing. The surface has weathered to various orange and brown hues and there are many unusual rock formations. A shrubby vegetation occurs in soil pockets, and near the summit lichens festoon the plants. An undescribed Calothamnus (one-sided bottlebrush) occurs on the peak and interesting species of Darwinia, Acacia, Drummondita and Leucopogon are found there. The slopes and base of the peak are rich in orchids.

Peak Eleanor, a lesser but still conspicuous prominence with similar plant associations, occurs 10 km to the south.

Most of the area is underlain by Archaean granites or Quaternary sediments but in the northwest corner a small part of the Bremer Range is included. This low range is a belt of predominantly meta-igneous Precambrian rocks with minor beds of metasediments. It has attracted the interest of prospectors and 9 mineral claims are current near Mt. Glasse. The southern part of the area is occupied by the Lake Tay and Lake Sharpe salt lake systems and is representative of the halophytic plant associations of the widespread salt lake systems of the State.

The whole area is rich floristically and is noted especially for the number of eucalypts.

Synthesis

Biologically the whole of the South Yilgarn is of interest. A narrow strip east of the No. 1 Rabbit Proof Fence is typical of the wheatbelt but most of the region lies within the "transitional woodland" of Erickson et al., 1973. The vegetation of this area is quite variable, containing sand heaths, scrub and mallee as well as the woodland which is so striking in this low rainfall area. The animal life is similarly varied, birds and reptiles in particular being well represented.

A high proportion of the area is vacant Crown land, agriculture intruding only in the area south of Southern Cross and in the Kumarl-Salmon Gums region. The "greenstone" country between Kalgoorlie and Norseman is utilised by the pastoral industry.

There is no doubt that conservation reserves are needed in this region, urgently in the west where there is a possibility of agriculture extending eastwards.



Figure 11.11. Peak Charles from west.



Figure 11.12. Peak Charles and Peak Eleanora from Dog Rock.

However, the main problems in providing an adequate system of conservation reserves in this region are both a lack of detailed biological information and conflict with mining interests.

Lack of biological information makes it difficult to evaluate the present siting of the Lake Barker Wildlife Sanctuary. It is apparent from our examination of Lands Department records that this reserve is centred not on the area originally proposed by the Government Botanist in 1950 but in its extreme northeastern corner; the reason for the altered location is unknown. Similarly the location of the Frank Hann National Park may be questioned. The original plan of providing a strip of country either side of what may become an important east-west highway has been negated to some extent by the relocation of the road.

Conflict with mining interests centres principally on the "greenstone" areas. Superficially these appear to carry the best example of Goldfields woodland, a vegetation type of much interest. From the economic timber point of view its capacity to form relatively tall woodlands under low rainfall regimes, to produce substantial volumes of wood, and to regenerate adequately after cutting makes it most valuable (Anon., 1973). Many of these eucalypts are now being grown elsewhere in dry areas of Australia and of the world. From the conservation viewpoint the woodlands include species different from the mallee or scrub.

Some "greenstone" areas are known to be of particular interest. These include Mt. Holland; North, Middle and South Ironcaps, and Hatters Hill. Some plants are restricted to one or more of these hills. Examples are Boronia revoluta (South Ironcap and Hatters Hill), undescribed species of Dryandra and Dodonaea (Hatters Hill) and a new species of Thomasia (Mt. Holland).

Lake Cronin, another important area, is described below (Area 11.10).

Mining for base metals is usually carried out in underground operations and disturbance of the surface is not as extensive as it is in open-cut mining. However exploration based on bull-dozed grid lines can be damaging and is aesthetically unattractive, although regeneration should occur eventually. It is probable that very few of the areas now being explored will produce economic deposits and the total area disturbed will be small. Agriculture, on the other hand, requires extensive clearing for the production of crops or grazing pastures and is potentially much more damaging to the natural flora and fauna.

It is of considerable importance that greater biological knowledge of these areas be obtained.



Figure 11.13. Wave rock formation, Peak Charles.



Figure 11.14. A Jewel beetle, *Themognatha ducalis*, on mallee flowers near Lake Cronin.

Recommendations

The Committee believes that existing conservation reserves in this area should be made more secure and then boundaries relocated if need be, through the application of further biological knowledge than is currently available. The reserves should become Class A when adequate boundaries can be determined. If possible, areas of mining interest should be excluded from the reserves through relocation of the boundaries.

If it is not possible to provide fully representative reserves without including greenstone country, then exploration and mining should be allowed to proceed in specified areas.

The Committee recommends:

1. that the purpose of reserve No. 24049 be altered from "Flora and Fauna" to "Conservation of Flora and Fauna" and that it be vested in the WA Wild Life Authority, for the present it should remain C Class;
2. that a reserve be declared to include Peak Charles, Peak Eleanora and Dog Rock. The reserve should be 20 km square (i.e. 400 km²) with the southeastern corner at 33° 00' S, 121° 00' E. The reserve should be of Class C for National Park, and placed under the control of the National Parks Board;
3. that the Environmental Protection Authority recommend to the Minister for Mines that conditions to protect the environment be placed on mining tenements on and adjacent to Mt. Holland, North, Middle and South Ironcap, and Hatters Hill.

11.10 LAKE CRONIN

Lake Cronin is a small semi-permanent freshwater lake about 90 km east of Hyden. A body of freshwater in this arid area is worthy of protection in itself, but Lake Cronin is also important for biological reasons. Studies by the Zoology Department, University of WA, have shown that a population of the frog Crinia pseudinsignifera occurring there has become adapted to the permanent, relatively warm, fresh water and is genetically different from all other populations in the region which are adapted to cold, shallow, temporary swamps.

Lake Cronin and environs contain the highest known concentration of jewel beetles (Buprestidae) in Australia. Over 20 species of these colourful insects have been collected within 8 km of the lake, including large species such as Themognatha heros, T. mniszechi, T. duralis (Fig. 11.14) and T. pictipes. Many of the species are endemic to WA. While the adult beetles feed on flowering mallee eucalypts (up to 10 species may be seen on one tree), the larval stage lives in the roots of mallees.

In addition the lake harbours a wide range of aquatic plants and animals, unusual in this dry area. An undescribed species of featherflower (Verticordia) is known from the area.

The source of the water in the lake is unknown. Suggestions for the reservation of Lake Cronin have been made since 1962. However, reservation has been opposed by the Mines Department because the lake lies within a "greenstone" area, prospective for nickel and other base metals. Lake Cronin is at present within a mineral claim. Any reserve around the lake should be large enough to ensure that any future agricultural development will not cause the lake to become saline.

Recommendations

1. The Committee strongly endorses the proposals for a reserve including Lake Cronin. Such a reserve should be of Class A, for the Conservation of Flora and Fauna and vested in the West Australian Wild Life Authority.
2. Before any reserve is declared a study should be carried out by the Geological Survey of WA to elucidate:
 - a) the origin of the water in the lake and what measures are necessary to prevent increasing salinity; and
 - b) the value of mineral claims surrounding the lake.
3. When this information is available it should be submitted to the Environmental Protection Authority for a final recommendation.
4. In the meantime, conditions should be placed on mining tenements including and surrounding Lake Cronin to provide the maximum protection of the environment.
5. Until a reserve is declared, no land within 10 km radius of Lake Cronin should be alienated.

11.11 DUNDAS AREA

East of Lake Dundas to about 123° 30' E and south from the Eyre Highway to about 33° 05' S is a large area of country which is mostly vacant Crown land and uninhabited. Geologically it consists of Precambrian granite, gneiss and migmatite, with some superficial Quaternary sediments in the south-west. There are extensive salt lakes in the western parts, as well as smaller lakes scattered throughout. A few claypans may be fresh but hold water only after rain. Some low hills and granite outcrops rise a little above the generally flat plains.

The vegetation is predominantly woodland with a great variety of Eucalyptus species typical of the southern part of the eastern Goldfields. There are scattered areas of heath which are more numerous to the south.

At present there is no conservation reserve within the area.

Recommendation

The Committee recommends that the Environmental Protection Authority commission a biological survey of the Dundas area, with a view to creating a large flora and fauna reserve or National Park in the region.

BIBLIOGRAPHY

- Anon. 1962 . Report of the Western Australian Sub-Committee of the Australian Academy of Science Committee on National Parks.
- Anon. 1973 . Proposals for the reservation of some inland ecotypes. Forests Department, Western Australia.
- Beard, J.S. 1969 . The vegetation of the Boorabbin and Lake Johnston areas, Western Australia. Proc. Linn. Soc. N.S. Wales 93(2): 239-269
- Butler, W.H. 1970 . Report on a survey of the vertebrate fauna of Lake Barker flora and fauna reserve, outer eastern wheatbelt of Western Australia. Unpublished report to Department of Fisheries and Fauna.
- Erickson, Rica; George A.S., Marchant N.G., and Morcombe M.K. 1973 . Flowers and Plants of Western Australia. A.H. & A.W. Reed, Sydney.
- Moriarty. T.K. 1972 . The birds of Wanjarri ($27^{\circ} 25' S$, $120^{\circ} 40' E$): Emu 72(1): 1-7

SYSTEM 12 - THE DESERTS AND NULLARBOR PLAININTRODUCTION

The desert regions of the State (including the Nullarbor Plain) and a few pastoral areas northeast of Wiluna make up System 12 (Fig. 12.0). It covers an area of about 947,280 km². The pastoral areas of this System are mostly represented biologically in pockets of similar country within the deserts, and in these areas only sites of special interest have been recommended for reservation. The System therefore is essentially a desert one. In the treatment below it is divided into two sections - the deserts and the Nullarbor Plain.

THE DESERTSArea, Geology and Biology

About two fifths of Western Australia is regarded as desert and is mostly uninhabited. Vast areas of sand dunes, lateritic and sandy plains, salt lakes and claypans, hills and mountain ranges make up a region where the phrase "wide open spaces" has real meaning. While many parts appear relatively uniform and monotonous, there is yet much variety within the region. Botanically the desert has been classified into seven regions (Beard, 1969), including the Nullarbor Plain. Other biological variety tends to follow botanical variation. Geologically the central desert regions are fairly uniform, but the western margins and the eastern ranges are complex. Floristically the Little Sandy Desert and the Tanami Desert (with which Beard's Balwina Desert is synonymous) are similar to the Great Sandy Desert. For convenience, they are included here within the latter. The Great Sandy Desert, the Gibson Desert and the Great Victoria Desert for the most part lie within the Canning Basin and the Officer Basin. Permian and Mesozoic sedimentary rocks are widespread, overlain frequently by Quaternary sand and alluvium derivatives.

Much of the region is still unexplored, but improved access and adequate vehicles have made it possible to visit many areas. Besides exploration for oil, minerals, and for biological and geological surveys, there is already limited tourist use of some areas, and pressures from all these and other aspects will increase. As can readily be seen elsewhere in the world, desert regions are easily damaged and their biota irreversibly altered by undue interference. It is desirable that reserves be created now so that they can be adequately protected.

There is no agreement as to what constitutes a desert. Definitions vary from author to author and from country to country. In Australia, the regions receiving less than 300 mm of rain could loosely be referred to as deserts. This includes large areas of pastoral country, and in practice such areas are generally excluded from the deserts in the Australian context.

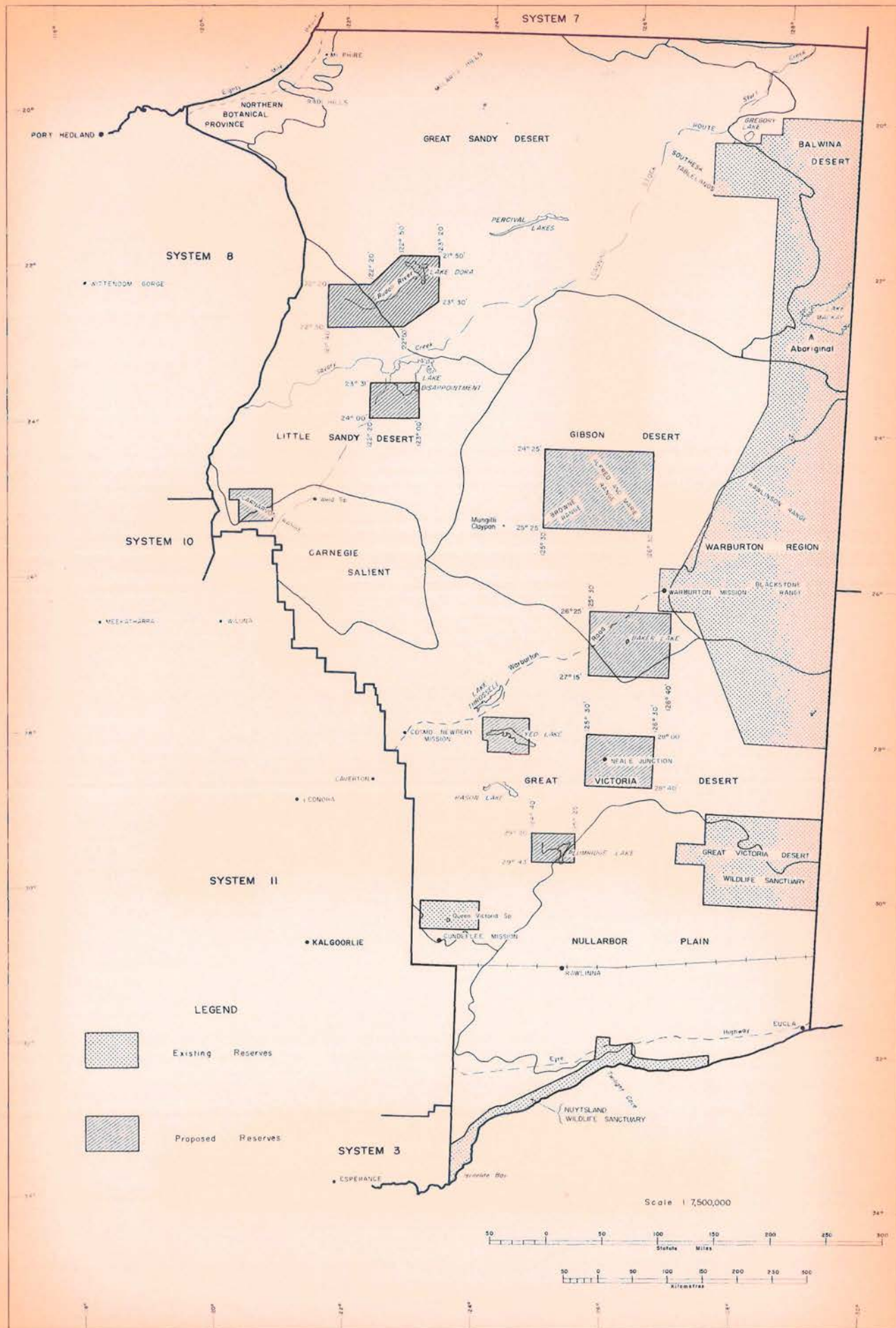


Figure 12-0 System map Nomenclature of deserts after Beard (1969)

However, the deserts of Western Australia are similar in some ways to the pastoral areas. They are a little drier, and the rainfall is less reliable. Geologically they differ considerably in being more recent than the pastoral areas which are underlain mostly by Precambrian rocks. The different soils derived from these have led to the development of different floras. Sand dunes and plains cover much of the desert, and have a spinifex-dominated vegetation which is unsuited to pastoral use. There are large areas of gravelly plains where spinifex is again dominant. Where mulga country occurs, it has a poor ground flora which contains few palatable species. There is very little bare, unvegetated land in the WA deserts; they are mostly covered with a sparse to moderately dense vegetation which is sufficient to hold the soil and prevent large-scale movement of it.

It is important to understand the cyclic nature of seasons in the desert, and the effect on the plants and animals. The seasons, dependent on rainfall, tend to run in cycles of good and drought years, each cycle lasting several years. In drought years water supplies are diminished, the vegetation becomes dormant or dies, and animals migrate to better areas, become dormant, or even die. The reverse occurs in good years. This pattern can be widespread or local. For example, in 1966 the Warburton area was in the middle of a cycle of good years and the vegetation was in good condition. East of Neale Junction, about 250 km to the south, drought conditions had apparently existed for some years.

Under such a pattern many nomadic animals tend to follow the rain in their search for adequate food supplies, and their populations are of low density. Thus it can be seen that in the desert, large reserves are essential to provide adequate areas for the survival of species.

Due to the very slow regeneration of desert vegetation, any project which involves destruction of the present cover should be very closely examined before approval; in fact such activities could lead to Sahara-like situations and should probably be prohibited completely.

Land Usage

Apart from a few pastoral homesteads along the western fringe, the only permanent settlements in the desert are three aboriginal missions, at Cosmo Newberry, Cundeelee and Warburton, and a weather station, at Giles. The population of these settlements together is less than 1000.

Aboriginal Reserves

Aboriginal reserves occupy large areas of the desert, especially at Cosmo Newberry, Cundeelee and adjacent to the State border. Within them, Aboriginal populations have been

concentrated around the missions, and subsistence in the traditional manner has almost disappeared. The reserves have in effect served as flora and fauna sanctuaries. With increasing pressure for Aboriginal land rights and the availability of funds for development, it seems certain that attempts will be made to use the reserves. Since they are, at best, marginal for pastoral or agricultural use, such activity could cause serious degradation. It may be more economical to purchase pastoral leases elsewhere and exchange them for land in Aboriginal reserves. On the other hand, the reserves or parts of them may in the long term be more profitably used as national parks.

In proposing the new conservation reserves below, it is not intended that Aborigines be denied access to traditional sites within them. However, in reserves created for the conservation of flora and fauna, hunting and food-gathering would be prohibited.

CONSERVATION RESERVES

While knowledge of our deserts has increased rapidly over the past ten years, there are still many unknown areas. In the submissions below, certain areas are recommended for reservation immediately. Others are known to be of interest, but information at present is insufficient for definite recommendations to be made. In these cases further investigation is recommended; while this is not urgent, should any other proposals arise concerning such areas then biological surveys should be made forthwith to determine their value as conservation areas.

It should be noted that no recommendation is made at this stage for a large representative reserve in the Great Sandy Desert, since knowledge is still inadequate.

The desert areas reported on by the Committee are as follows:

- a) Great Sandy Desert
 - 1. Mt. Phire - Munro Block
 - 2. Radi Hills and Samphire Marsh
 - 3. Percival Lakes
 - 4. Gregory Lake
 - 5. Wolf Creek Crater
 - 6. Eastern Ranges
 - 7. Rudall River area
 - 8. Lake Disappointment
 - 9. Carnarvon Range
 - 10. Weld Spring
- b) Gibson Desert
 - 11. Gibson Desert area
 - 12. Mungilli Claypan
 - 13. Baker Lake

- c) Great Victoria Desert
14. De la Poer Range
 15. Lake Throssell - Yeo Lake
 16. Neale Junction area
 17. Queen Victoria Spring Wildlife Sanctuary
 18. Great Victoria Desert Wildlife Sanctuary
- d) 19. Ranges of the Western Desert

GREAT SANDY DESERT

There are at present no conservation reserves within this desert.

12.1 MT. PHIRE - MUNRO BLOCK

This area appears to be an old drainage basin and contains a wide range of both desert and northern riverine flora. Some surface water is present. Animals include the Dalgyte or Rabbit-eared Bandicoot (Macrotis lagotis) and rodents. Mt. Phire is sacred to the aborigines and may still be in use. Further investigation is recommended.

12.2 RADI HILLS AND SAMPHIRE MARSH

The hills are desert breakaways of some biological and scenic interest. The marsh, probably a tidal flat system now cut off from the sea, contains a population of the mangrove Avicennia marina (Beard, 1967). Apart from an occurrence of the same species under different conditions in Lake MacLeod, mangroves otherwise are strictly coastal in this State. Further investigation is recommended.

12.3 PERCIVAL LAKES

This area has not been examined biologically, but would probably be a good representative section of the central Great Sandy Desert. It also contains aboriginal sites. Further investigation is recommended.

12.4 GREGORY LAKE

Gregory Lake lies at the lower end of Sturt Creek on Billiluna Station, south of Halls Creek. It is a large body of water which is apparently quite fresh after rain but becomes brackish or saline as the level recedes, though it never dries completely. Vegetation of the lake margins is mostly halophytic, but there are dense belts of Acacia species. The area was visited by the botanist Ferdinand von Mueller with Gregory in 1856, and is the type locality for a number of his species.

Bird life around the lake is spectacular. There are often flocks of black swans, pelicans, ducks, Major Mitchell cockatoos, brolgas and other wading birds.

The Lake is within Wolmadjari tribal territory. Its aboriginal name is Parugu, and it lies on the track of the Wonji group of dreamtime culture heroes.

The sediments surrounding the lake are a likely site for the preservation of Cainozoic marsupial fossils.

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, co-ordinated by the Department of Fisheries and Fauna, and recommendations drawn up for a conservation reserve there.

12.5 WOLF CREEK CRATER

A geological site of worldwide significance, Wolf Creek Crater is probably a meteorite crater, the fourth largest of its type in the world. It is already a C Class Reserve No. 29457 vested in the National Parks Board of WA. The Committee recommends that the classification be upgraded to A Class, and that the vesting remain unaltered.

12.6 EASTERN RANGES

The South Esk Tableland, Roberts Range, Stretch Range and Stansmore Range should be investigated as possible reserves. At present there is no reserve for flora and fauna in the north-eastern Great Sandy Desert, but information is insufficient for a recommendation to be made.

12.7 RUDALL RIVER AREA

From its origin about 240 km east of Roy Hill, the Rudall River follows an east-northeasterly course to Lake Dora, on the edge of the Great Sandy Desert. The upper watershed is an area of colourful rugged hills of Proterozoic migmatites and sedimentary rocks with a few pockets of Permian sediments. The lower reaches lie in sand dune country, overlying Permian sediments. Lake Dora is the lower end of a long chain of salt lakes known as the Percival Valley, extending for hundreds of kilometres to the east. On the eastern side of Lake Dora are Permian and Jurassic sediments. However, the geology of the area is still poorly known, though initial exploration has indicated some mineral potential. Gold has been found in the Paterson Range which lies to the north of the proposed reserve.

Rainfall is unreliable in the area, but after heavy falls the creeks and river flow strongly, and later many pools remain for some time (Fig. 12.1). These provide niches where many small plants and animals live, either in the water or on the pool margins. The river banks are lined with River Gums and Coolabah, Yulbah (Erythrina vespertilio) and a variety of other shrubs and herbs.



Figure 12.1. Rudall River: a temporary pool lined with River Gums (Eucalyptus camaldulensis).



Figure 12.2. Rocky hills and valleys near the Rudall River: open spinifex (Triodia) steppe on the slopes, tall shrubs along creeklines.



Figure 12.3. Sand dune near the Rudall River: open steppe with spinifex (Triodia), shrubs and scattered bloodwoods (Eucalyptus sp.).

Away from the river are rocky hills and plains, much dissected by creeks (Fig. 12.2). Some of the hills are very colourful and carry an interesting flora. There are several permanent waterholes, the most important being Curran Curran near the head of the river, where there are old aboriginal campsites.

There are extensive areas of sand dunes both to the south of the upper watershed and in the lower reaches of the river (Fig. 12.3). These again have a different flora and fauna. Lake Dora provides further diversity with a saline environment, and will probably be an important site for aboriginal artifacts and Pleistocene fossils.

About 300 species of plants have so far been recorded for this area, but many more have yet to be collected, especially around Lake Dora. Important plants include unnamed species of Eucalyptus, Acacia, Grevillea and Bassia. For some species more typical of the northern regions of WA this is the southern-most locality known. Other species are represented here by populations well isolated from their main centres in the Hamersley Range.

The area has a rich insect fauna with a mixture of south-western, desert and northern species. On the other hand the lycosid spiders are typical of the Murchison, Gascoyne and Fortescue River areas.

In all, the area is scenically attractive and contains a diversity of flora and fauna, some typical of this part of the desert, some representing biota from other regions.

The area covers about 12042 km² and is at present vacant Crown land.

Recommendations

The Committee recommends that the area as outlined below and shown in Fig. 12.0 be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority.

Boundaries

The proposed boundaries are as follows:

From a point at 22° 20' S, 121° 40' E, east to 122° 20' E, then northeast to 122° 50' E, east to 123° 20' E, south to 22° 30' S, southwest to 122° 50' E, west to 121° 40' E, then north to the original point.

12.8 LAKE DISAPPOINTMENT AREA

A large area of desert was described and recommended in the National Parks Report (Anon, 1962), but no reserve has been declared here. The recommendation was made in the light of then current knowledge, and at that time little was known of the desert with regard to geology, flora, fauna, etc. Information has steadily accumulated since then, and while many areas remain poorly known, sufficient information now exists for a new appraisal. The Committee feels that the original Lake Disappointment proposed reserve does not include enough of the variety of the deserts, and that a modified reserve here together with new proposals elsewhere will provide a much better reserve system.

The area within the proposed reserve which should be considered is centred on the Durba Hills.

The Durba Hills are an isolated outlier of sedimentary rocks forming a plateau capped by sandstone. The plateau is bordered by vertical cliffs, and is dissected in places by steep-walled gorges. There are several permanent springs in the hills, notably Durba and Killagurra Springs.

Durba Spring lies at the head of a colourful gorge and is surrounded by River Gums, Eucalyptus camaldulensis, and a natural sward of Couch Grass, Cynodon dactylon.

The Hills support a significant fauna including Rock-wallabies (Petrogale sp.), Echidna (Tachyglossus aculeatus), Antechinus sp., Notomys sp., Little Falcon, Grey Falcon, Scarlet-chested Parrot, etc. There is a wide variety of reptiles (Butler, 1971).

Five major areas of aboriginal paintings have been recorded for the Hills, as well as three sites of engravings. There are also many stone artifacts in the area.

South of the Hills is a large claypan which holds water for some time after rain. At such times it is rich in bird life, including Pink-eared Duck, Stilts, Honeyeaters and Black Swans.

The Hills and an area of the surrounding plains are worthy of reservation as examples of both the typical and the unusual in this part of the desert.

The proposed reserve includes the southern end of Lake Disappointment, and several small ranges to the south - the Sir Fowell Headland, the Lady Victoria Hills and the Calvert Range. The area covers about 3564 km² and is at present vacant Crown land.

Recommendation

The Committee recommends that the area as shown in Fig. 12.0 and outlined below be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority.

Boundaries

The proposed reserve is a rectangle, bounded by $23^{\circ} 31' S$, $123^{\circ} 00' E$, $24^{\circ} 00' S$, $122^{\circ} 20' E$.

12.9 CARNARVON RANGE

This range lies 280 km north-east of Wiluna, with Mt. Methion and Mt. Essendon nearby. Peaks rise high above the surrounding plains, the highest being Mt. Essendon at 950 metres. They consist of cross-bedded sandstones probably of Middle to Upper Proterozoic age, which have been eroded and weathered to colourful formations. Gorges contain a few permanent and semi-permanent waterholes. The scenery is spectacular.

Botanically, the ranges are important as supporting outlying populations of species otherwise known only from the Hamersley Range and areas further north, e.g. Eucalyptus setosa. The surrounding plains carry mainly spinifex associations typical of the western sandy desert, with some areas of mulga. Blackboys (Xanthorrhoea sp.) occur on the sand dunes. The area thus combines unusual features with those typical of the region.

The Carnarvon Range contains a number of aboriginal sites, including displays of paintings.

The area proposed for reservation covers about 2580 km². Most of it is at present vacant Crown land.

Recommendations

It is recommended that the area, as shown in Fig. 12.4 and described below, be declared an A Class reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

Part of the Carnarvon Range lies within Blue Hill pastoral lease. Negotiations with the lessee should be undertaken with a view to acquiring this part of the Range; alternatively it could be removed from the lease when it lapses in the year 2015.

Boundaries

From the northeast boundary corner of Marymia pastoral lease (approximately $24^{\circ} 52' S$, $120^{\circ} 18' E$) east to $120^{\circ} 52' E$,

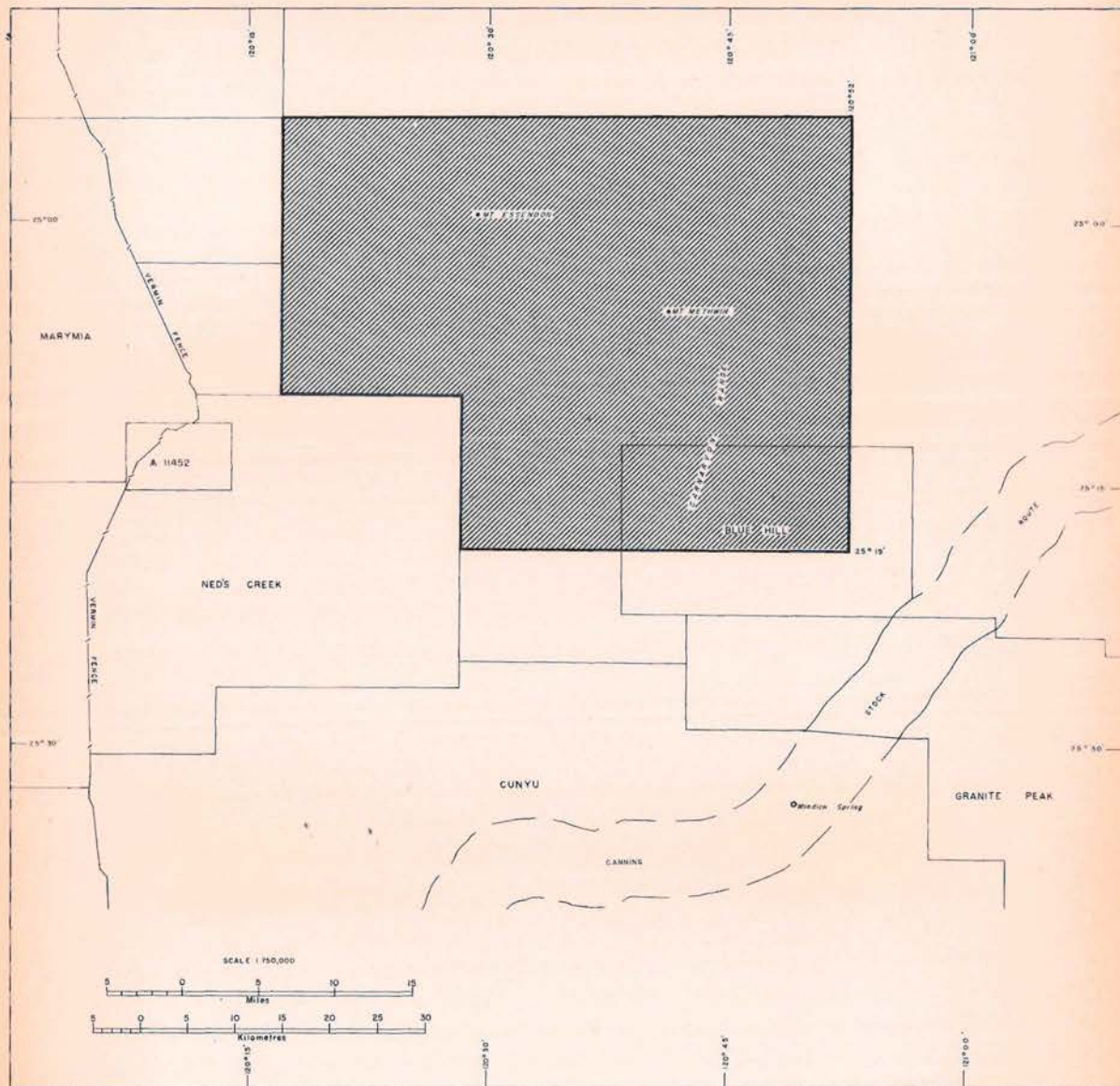


Figure 12-4 Area map of Carnarvon Range area

south to $25^{\circ} 19' S$, west to the boundary of Neds Creek pastoral lease (approximately $120^{\circ} 28' E$), north west to approximately $120^{\circ} 18' E$, then north to the starting point.

12.10 WELD SPRING

John Forrest's Fort is at Weld Spring on the Canning Stock Route. It was constructed by John Forrest and his party in 1874 as protection against aborigines during their stay at the Spring. Much of it is still standing, but protection against vandalism is required. The locality is interesting biologically, due to the permanent supply of fresh water. It is at present part of the Canning Stock Route, which is vacant Crown land.

Recommendation

The Committee recommends that a square reserve of 1000 hectares be declared with the Weld Spring at its centre. It should be A Class for the preservation of a historic site and the Conservation of Flora and Fauna, and vested jointly in the WA Wild Life Authority and the WA Museum.

GIBSON DESERT

12.11 GIBSON DESERT AREA

There is at present no conservation reserve in the Gibson Desert. This Desert is typified by undulating lateritic plains, the surface covered with fine gravel, and supporting a sparse spinifex (Triodia) steppe (Fig. 12.5). Scattered mulga, Acacia aneura, occurs where the soil is loamy. Occasional lateritic mesas and low hills also support mulga, with localised plants occurring in very rocky areas, e.g. break-away edges. The underhangs of breakaways provide sheltered habitats where a few more delicate plants occur. Sand dunes are present in some parts of this Desert (Fig. 12.6). They carry a different suite of plants, the spinifex being Plectrachne, and the shrubs including Grevillea species, Eucalyptus, Thryptomene, etc. There are a few salt lakes, as well as some claypans which show no salt accumulation.

Within this Desert, a large reserve is required to provide adequate protection for the plants and animals. The area selected contains many of the features of the Gibson Desert. It includes the Browne Range, Young Range, and Alfred and Marie Range. Between these are extensive gravelly plains, while to the east of the latter is a region of sand dunes. Here also are the Newell Lakes which are saline. In the south of the area is Lake Gruszka, a freshwater claypan, while in the northwest, Lake Cohen also holds fresh water after rain. At such times the lakes are havens for birds.



Figure 12.5. Gibson Desert: low gravelly hill with sparse spinifex (Triodia) steppe and occasional mulga (Acacia aneura).



Figure 12.6. Gibson Desert: Grevillea juncifolia in flower on spinifex steppe in sandy swale between dunes.

Most of the area which covers some 17,400 km² is vacant Crown land. There is a small reserve, No. 29452, around the Clutterbuck Hills in the east of the area, for the use and benefit of Aborigines.

Recommendations

The Committee recommends that this area be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority. It should be the major reserve typifying the central Gibson Desert.

Boundaries

The proposed reserve is a rectangle with the following boundaries: 24° 25' S, 126° 20' E, 25° 25' S, 124° 40' E.

12.12 MUNGILLI CLAYPAN

These claypans hold fresh water and are therefore valuable as fauna sanctuaries (Fig. 12.7). The vegetation differs from that of the surrounding desert, the coolabah, Eucalyptus microtheca, being common. The tall perennial grass Eragrostis australasica forms large clumps and is probably a refuge for smaller fauna. Bird life is attracted to the claypans after rain. Since water, especially fresh, is scarce in the desert, the Committee considers this area worthy of reservation.

Recommendation

The Committee recommends that the area of about 30 km² as shown in Fig. 12.0 and described below, be declared an A Class reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

Boundaries

The proposed reserve is a rectangle with the following boundaries: 25° 22' S, 124° 18' E, 25° 25' S, 124° 14' E.



Figure 12.7. Mungilli Claypan: one of the freshwater claypans, surrounded by Coolabah (Eucalyptus microtheca), shrubs of Rhagodia and the grass Eragrostis australasica.



Figure 12.8. Breakaways at Point Watt: low open steppe below, mulga (Acacia aneura) on slopes.

12.13 BAKER LAKE

Baker Lake, a broad saline expanse dotted with islands, is about 80 km south-west of Warburton Mission. It lies in a wide, shallow valley of Quaternary sands and alluvium, underlain and flanked by Permian sediments. The latter are duricrusted and have been eroded into high breakaways such as Point Watt (Fig. 12.8). Permian sediments at Sharpes Bluff have yielded fossil molluscs and plants. The Laverton-Warburton road crosses the north-west corner of the area where it passes Yowalga, Gahnda and Winduldarra rockholes - small permanent waters among breakaways which were used by early surveyors and travellers. Aboriginal artifacts and sites occur near the rockholes.

Sinkholes and caves have formed in a small area of calcrete (?) northeast of Baker Lake. Exploration of this, a rare feature in the desert, may yield fossil material. Australites have been collected at Baker Lake.

Halophytic vegetation occurs on the lake and its margins. Surrounding sand plains and dunes carry mallee-spinifex and shrub associations with a wide variety of species. Below the breakaways are loamy wash areas with a semi-halophytic steppe interspersed with mulga (Fig. 12.9). Above the breakaways is a lateritic plateau supporting an open spinifex steppe, with mulga in gullies. The flora of the area is varied, almost 100 species having been recorded so far. It is the only known locality in WA for two grasses, Eragrostis clelandii and Sporobolus elongatus. Many ephemeral herbs appear after rain.

The area contains a typical desert mammal fauna, e.g. Larapinta (Sminthopsis froggatti), Spinifex Hopping-mouse (Notomys alexis) Sandy Inland Mouse (Pseudomys hermannsburgensis) and Ghost Bat (Macroderma gigas), the last being known from caves at Prideaux Cavern and Gahnda. Nests which are probably those of the stick-nest rat Leporillus apicalis are common in the breakaways.

The area is at present vacant Crown land.

Recommendations

The Committee recommends that the area shown in Fig. 12.0 and outlined below be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority. The proposed reserve covers about 10,500 km².

Boundaries

The boundaries of the proposed reserve are as follows:

26° 25' S, 126° 40' E, 27° 15' S, 125° 30' E.



Figure 12.9. Low, lateritic hills near Point Watt, with mulga (Acacia aneura) and open steppe.



Figure 12.10. Lake Throssell: open saline flats between gypsum ridges on which grow Casuarina cristata and Acacia colletioides.

GREAT VICTORIA DESERT

12.14 DE LA POER RANGE

The De la Poer Range lies about 140 km north of Laverton in the north western part of the Great Victoria Desert. It consists of Archean granites, while to the north lie Middle Proterozoic sediments containing some volcanics. The vegetation includes areas of mulga, spinifex-mallee sandplains and sandridges, lateritic breakaway and salt lake formations. A reserve within this area would probably be worthwhile, but information is insufficient and further investigation is recommended.

12.15 LAKE THROSSSELL - YEO LAKE

Lake Throssell is a system of salt lakes near the Laverton-Warburton Road, about 200 km northeast of Laverton. It lies in a wide, shallow Cainozoic depression over undifferentiated Permian-Mesozoic rocks. The lake floor is mostly vegetated with a rich variety of halophytic plants, including Bassia georgei, which is an unusual bindieye known only from this locality. Between the lake flats are gypsum ridges carrying a Casuarina cristata - Acacia colletioides association which is not known to occur elsewhere in the desert (Fig. 12.10). Yeo Lake is a similar lake system about 25 km to the south of Lake Throssell.

To the west, southwest and north there are extensive sand plains and dunes, interspersed with some areas of rocky hills and breakaways. Spinifex (Triodia) steppe dominates the sandy areas, and mulga (Acacia aneura) the loamy and rocky areas, but there is much variety in the flora. Bara Gums (Eucalyptus gongylocarpa) in places form open park-like woodlands, often mixed with the Ooldea Mallee (Eucalyptus youngiana). Between Blackboy Rocks and Jutson Rock are some fine stands of the Desert Blackboy (Xanthorrhoea thorntonii, Fig. 12.11). Interesting species in the area include the Kurrajong (Brachychiton gregorii), a Sheoak (Casuarina helmsii), Lechenaultia helmsii, an undescribed Dampiera, Eremophila abietina, E. homoplastica, Lamarchea sulcata and Eucalyptus trivalvis.

There are several rockholes in the area which are either permanent or hold water for a considerable time after rain. These are important biologically for the different assemblage of plants and animals present.

In the west of the area are some hills of weathered granite. Several unusual plants inhabit these, e.g. Philothea tubiflora and Mirbelia sp.

East of Rutters Soak is an outlier of Eucalyptus woodland similar to the Goldfields. Species present include E. clelandii, E. concinna, E. comitae-valis and E. striatocalyx.



Figure 12.11. Desert Blackboys (Xanthorrhoea thorntonii) on sandy plain among spinifex (Triodia basedowii).



Figure 12.12. Mulga (Acacia aneura) with a ground storey of spinifex and everlastings (Waitzia acuminata).

Mulga country is at present poorly represented in conservation reserves, and it is important that some be included within them. This will both preserve the biological variety and provide a yardstick against which the condition of mulga on pastoral leases can be measured. Although mulga is not extensive in this area there are many pockets of it.

The area around Dunges Table Hill is rich in reptiles and is the type locality for several species (Storr 1968). Forty species of lizard and 3 species of snakes have been recorded in a relatively small area here (Pianka, 1969).

The area of interest is shown in Fig. 12.1. Part of it consists of aboriginal reserves, Nos. 22032, 25050, 25051 and 20396. Between these is the Yamarna pastoral lease, while to the east and south are four leases which have recently been thrown open.

This country must be considered marginal for pastoral purposes. It is regarded as desert in the Australian context. Rainfall is erratic and unreliable and probably averages 200-250 mm although no recordings have ever been made in the area of the new leases. It tends to run in cycles of several good seasons followed by several drought seasons. Plant growth and regeneration in the desert are slow and may be significant only in very good years which occur infrequently.

Areas carrying suitable stock feed are relatively small and are therefore vulnerable to overgrazing, especially when the slow regrowth rate is considered. The best areas are the floors of the salt lakes such as Lake Throssell and Yeo Lake, where it has been estimated, by the Pastoral Branch of the Department of Lands and Surveys, that the carrying capacity is one sheep to 16-18 hectares. The vegetation here contains small species of saltbush and bluebush. The main shelter for stock is on the gypsum ridges between the salt flats, where Casuarina and Acacia shrubs provide some shade. However, these ridges have a surface crust which would be broken by sheep's hooves, and the underlying powdery gypsum would easily blow away.

Referring to low-lying saltbush-bluebush associations in central Australia, Lazarides (1970) wrote that it "has deteriorated more than any other type under the influence of stocking. In many areas the bush cover has been removed completely and the land surface severely eroded."

The stands of mulga in the area are relatively small and the understorey contains few palatable species. The ground flora after rain consists of many herbs but grasses are few, apart from spinifex which is perennial but unpalatable (the species here is Triodia basedowii) (Fig. 12.12). In many places the mulga is sparse and forms a mixed association in which spinifex and Bara Gum are co-dominant. This country is even less suited to grazing.

Finally, there are extensive areas of sand, either as open plains or dunes, where spinifex, mallees and Bara Gum are dominant. The carrying capacity here has been estimated as one sheep to 25 or more hectares.

There is no surface water except in a few rockholes or after rain. The existence, quantity and quality of underground water are unknown factors.

The western boundaries of three of the new leases are about 220 km east of Laverton, the nearest town, while the fourth lease is a further 70 km to the east.

It is apparent that pastoral leases in this region would be marginal and probably not viable. Those at Yamarna and White Cliffs to the west have not been viable in the past and at present are being used as part of a large area which includes the Cosmo Newberry Aboriginal Reserve. On 13 April 1973, the Department of Lands and Surveys withdrew from further pastoral leasing all land in WA east of 122° longitude and south of 26° latitude. (Government Gazette, WA No. 29 p. 975).

Recommendations

The Committee supports the decision to withdraw this land from further leasing. Of the four new leases referred to above, one had been taken up before the notice of withdrawal was published. The Committee recommends that this be cancelled if possible, and that the other three should be discontinued. The area is of great biological importance, and a reserve should be created there.

The Committee recommends that the area round Yeo Lake as shown in Fig. 12.13 be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority. Further if the new pastoral lease over Lake Throssell is cancelled, its area should be included in the proposed reserve. Further, if at any future time the position concerning the aboriginal reserve is reviewed, consideration should be given for those areas marked to be added to the proposed reserve. The Yamarna pastoral lease and part of White Cliffs should also be considered for reservation.

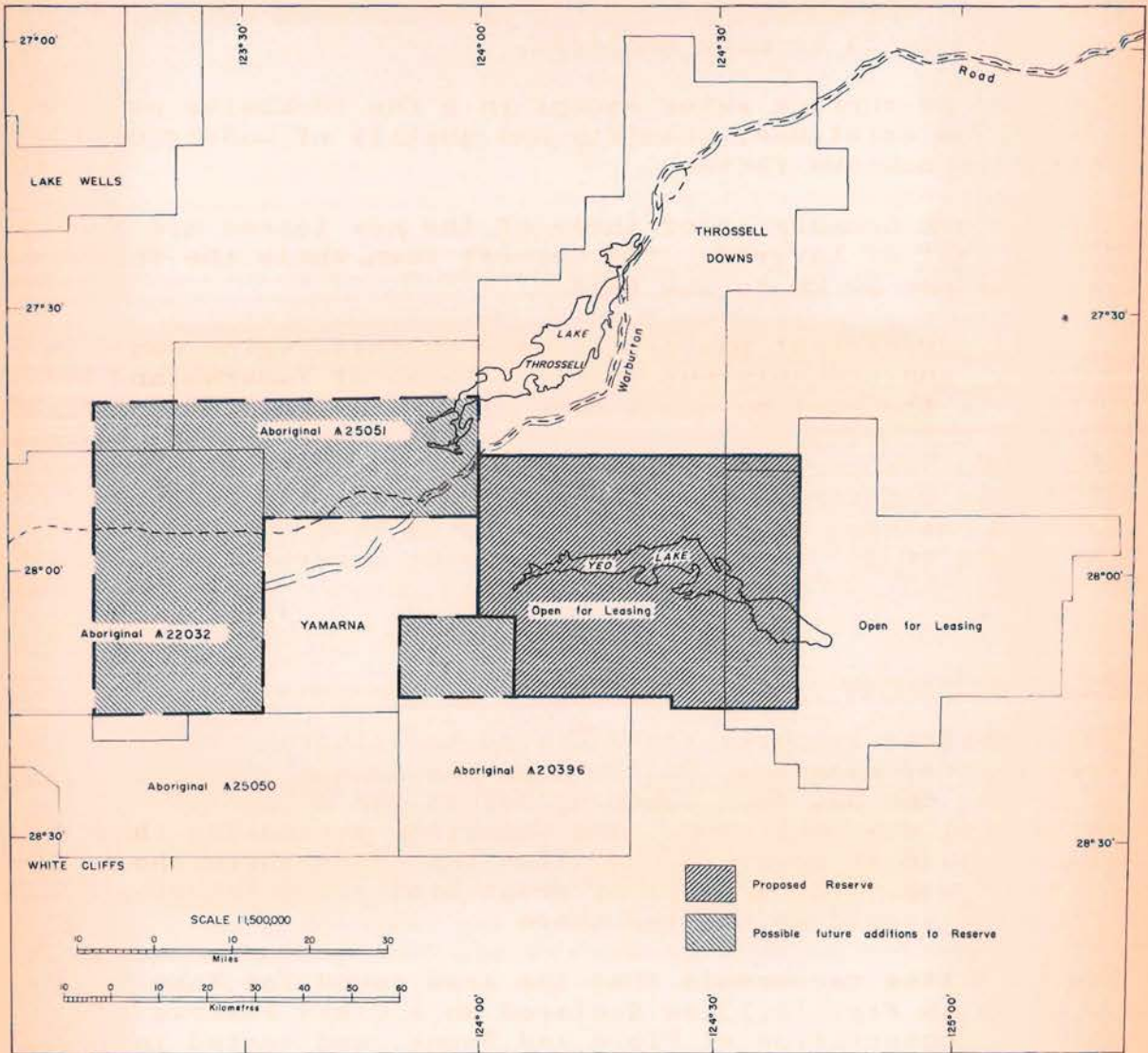


Figure 12.13 Area map of Lake Throssel-Yeo Lake area

12.16 NEALE JUNCTION AREA

An area of the desert, near Neale Junction, should be reserved to provide a representative sample midway between the Great Victoria Desert Wildlife Sanctuary and the Queen Victoria Spring reserve. This southern desert region is important biologically as a corridor along which animals (especially birds) and perhaps plants are able to migrate between the wetter parts of western and eastern Australia.

The Naretha Parrot, Psephotus haematogaster narethae, lives in this area north of the Nullarbor. Other birds using it as a corridor include the Rufous Tree-Creeper, Brown Flycatcher and Chestnut Quail-Thrush (Ford, 1971).

The corridor role of this region botanically is illustrated by the presence of such plants as Eucalyptus concinna, E. leptopoda, Choretrum chrysanthum, Hakea francisiana, Acacia murrayana, Leptospermum roei and Pityrodia loricata. These all have an east-west distribution through this belt of the desert, with their main centres either on the Western Goldfields or in South Australia.

The area is mostly a gently undulating sandy plain, covered with an attractive open, park-like vegetation dominated by Bara Gums, Eucalyptus gongylocarpa, with a spinifex ground layer (Fig. 12.14). Sand dunes cover extensive areas and carry some different species, such as the native cypress, Callitris preissii subsp. preissii. There are occasional lateritic breakaways, where the plants differ again: several species of Thryptomene and Calytrix are known only from breakaways in this area. Other interesting species in the area include a fringed lily (Thysanotus sp.), an unusual triggerplant (Stylidium humphreysii), Microcorys macedonia, and new species of Micromyrtus and Dampiera.

The area is rich in reptiles, over 35 species of lizards and snakes having been recorded here (Pianka, 1969).

The southern part of the proposed reserve includes the transition from desert to Nullarbor Plain. There is a gentle escarpment where the desert descends to the northern level of the Plain. The vegetation changes from Bara Gums and Spinifex to tall open mallee shrubland with a different association of species.

Recommendation

The Committee recommends that the area shown in Fig. 12.0 be classified an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority. The proposed reserve covers about 7414 km².



Figure 12.14. Undulating sand plains near Neale Junction, with Bara Gums (*Eucalyptus gongylocarpa*) and spinifex (*Triodia*).



Figure 12.15. Queen Victoria Spring: the claypan filled with water and surrounded by a band of the pink-flowered parakeelya (*Calandrinia polyandra*); wattles (*Acacia*) on the sandy slopes, and native cypress (*Callitris preissii*) on the far rim.

Boundaries

The boundaries of the proposed rectangular reserve are as follows: 28° 00' S, 126° 30' E, 28° 40' S, 125° 30' E.

12.17 QUEEN VICTORIA SPRING WILDLIFE SANCTUARY

This area was described as follows in the National Parks Report (Anon 1962):

"Queen Victoria Spring was discovered in 1875 by the explorer Ernest Giles who named it after Her Majesty Queen Victoria. The Spring is a soak situated in the centre of 20 to 30 acres of grassland which are surrounded by small bushes, Eucalypts, Acacias and Triodia. The soak itself is in sand on a clay bottom and has apparently formed in an old clay pan which has been filled with drifting sand. The highest feature in the area which is proposed as a reserve is Streich Mound, a high sandhill about nine miles east-southeast from the Spring.

The area of the proposed reserve has numerous sand dunes in it. These dunes overlie gneiss, and are representative of the environment typical of the boundary of the sandy desert of the interior and the metamorphosed Precambrian of the Goldfields. The flora is interesting in that it is a desert association which includes winter rainfall Mulga. The predominant vegetation in the area is Triodia steppe and the several species of Triodia form the dominant vegetation over the greater part of the area. In certain sections these grasses are replaced by Eriachne, Eragrostis, and Aristida. Goodeniaceae is well represented among the shrubs, while species of the family Malvaceae, Leguminoseae, Proteaceae, Compositae, Chenopodiaceae are common (sic). The tree storey consists chiefly of Eucalyptus, the principal species being E. gongylocarpa, transcontinentalis, E. flocktoniae, and the mallees E. cylindrocarpa, E. concinna and E. leptopoda. Acacia is well represented, as are Callitris and Eremophila. Two interesting features are the numerous isolated patches of Mulga, and the very large specimens of the grasstree or Blackboy Xanthorrhoea thorntoni which are common in the area.

No comprehensive studies have been made of the fauna of the area but records occur in the literature. For example, this is the furthest eastern locality of the frog Neobatrachus sutor; the rare desert Gecko, Lucasius damaeus, also occurs in the area together with a new species, Diplodactylus maini, which was undescribed until 1962."

The dragon lizard Diporiphora reginae is restricted to the area (G.M. Storr, pers. comm.). It is now considered that the blackboy here is an unnamed species restricted to the area.

The Sanctuary was created in 1970 as reserve number A 30491 for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

The Committee endorses the purpose, status and vesting of the Sanctuary.

12.18 GREAT VICTORIA DESERT WILDLIFE SANCTUARY

This was described in the 1962 Report as follows:

"This large area of country includes regions which are representative of all the geological formations of the northern Nullarbor area, and their associated vegetation which ranges from the typical almost treeless flat-lying marine limestone of the Nullarbor to the Precambrian areas further north.

The southeastern corner of the area lies 33 miles to the north of Deakin on the Transcontinental Railway line and stretches for a distance of some 95 miles to the west. The northern boundary is about 30 miles north of Forrest Lakes in the east and Lake Ell in the west. About 60 miles north of the south-western corner lie the Shell Lakes which have also been included in the proposed reserve.

A transect from the southwest towards the northeastern corner of the reserve broadly illustrates the regions of the area.

- 1) The southern edge is typical almost flat, limestone country of the Nullarbor. Numerous dongas act as drainage channels. The general vegetation is a grassland of Stipa with Sturt Pea and Swainsona. Where thickets occur, the principal trees are Myoporum, Pittosporum phillyraeiodes and Curara (Acacia tetragonophylla).
- 2) To the north of the grassland, the limestone country continues, but the vegetation changes to an open woodland of Myall (Acacia sowdenii) with an understorey of Bluebush (Kochia spp.).
- 3) Further north the geological nature of the country changes. The dominant rocks are micaceous sandstone while the country becomes more undulating with rolling hills and broad valleys in which are poorly defined water-courses. Myall and Bluebush are still dominant on the rises but Curara, Mulga and Myoporum, occur in the valleys.

- 4) To the north is a rather narrow belt of sands not blown into dunes, on which occur the first eucalypts (E. oleosa and E. gracilis). Beyond these sands are Shell Lakes, one of the series of large salt pans which extend across the northern limit of the Nullarbor.

Eastward from the Shell Lakes to north of Forrest Lakes, the country is, geologically, a complex of Permian glacial beds, flat-lying well-bedded sandstones, limestones of the Nullarbor complex, and Precambrian quartzites. The whole of this area is traversed by innumerable east-west sand dunes which are blown over all of these rock types.

The vegetation is rich and extremely varied. On sand hills, spinifex, mallee and acacia are dominant. In the hollows between dunes the vegetation varies with the soil type but eucalypts such as E. oleosa together with Mulga (Acacia aneura) are common.

Around the salt flats are found Atriplex spp., Rhagodia spp., Kochia spp. and Arthrocnemum.

The floral diversity of the region is shown by the common genera which are represented as follows:

Eucalyptus (9 species): Acacia (8 species):
Eremophila (8 species).

Also in the flora are such genera as Stylidium, Daviesia, and Templetonia.

Mygalomorph spiders, frogs, reptiles and birds suggest that this region on the northern side of the Nullarbor is, even now, acting as a corridor connecting the faunas of eastern and western Australia. Mammals are not in great variety in the area but the Marsupial Mole (Notoryctes) is found in the desert sand dunes and is said by local Natives to be abundant at Eltoon."

In 1970, the Sanctuary was set up as reserve number A 30490 for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority. The Committee endorses the purpose, status and vesting of the Sanctuary.

12.19 RANGES OF THE WESTERN DESERT

In the eastern region of WA are many mountain ranges which are the western extension of the central Australian range complex. They reach their western limit in the Warburton Range, and are varied in size, topography, geology and biology. In WA the largest is the Rawlinson Range which extends in a large arc for some 80 km and continues for another 50 km as the Schwerin Mural Crescent. The highest mountain in the region is the solitary Mt. Aloysius which reaches 1080 m.

The varied topography and geology are reflected in the scenery which is colourful and often spectacular. Many gorges and valleys have been carved into the hills, and occasionally permanent waterholes are found at their base.

For some distance east of the Warburton Range, the hills are granitic, with many large rounded boulders on their rocky slopes, the vegetation mostly mulga, Acacia aneura, with associated Eremophila and Cassia species common. The Blackstone Range (Fig. 12.16) contains basic dykes and layered sills, and has many steep scree slopes of irregular boulders with no vegetation, similar to some hills of the Pilbara. Where vegetation occurs it is a spinifex steppe, with scattered Eucalyptus and Acacia species. Mt. Aloysius is a hill of regular aspect, its slopes rising quite gradually to a single summit. Most of it is covered with a spinifex steppe.

The Rawlinson Range and the Schwerin Mural Crescent consist of Upper Proterozoic Dean Quartzite and sedimentary rocks, tightly folded in some places. The summits are fairly regular and the edges of the range have been formed into high colourful ramparts. Steep-sided gullies and gorges occur, e.g. the Pass of the Abencerrages, Glen Helen and Glen Cumming. These add to the variety of habitats. The two ranges support a rich flora which essentially constitutes a shrub-spinifex steppe. To the north is the colourful Anne Range (Fig. 12.17).

The Walter James Range also consists of Upper Proterozoic sedimentary rocks, steeply tilted and eroded to give the Range an extremely rugged surface. Vegetation is relatively sparse in many places, being mainly a spinifex steppe, though mallee eucalypts, especially Eucalyptus oxymitra, are frequent. A spectacular feature of the range is Bungabiddy Rockhole, a permanent pool of fresh water at the foot of a cleft with red rock walls rising almost vertically for well over 100 metres (Fig. 12.18). Aboriginal paintings occur here.

To the north lies the Sir Frederick Range (Fig. 12.19) which differs from the others in consisting of boulder, cobble and pebble conglomerate, the younger Upper Proterozoic Sir Frederick Conglomerate. The weathered surface of this formation presents the appearance of a huge rock pile. The hills are rounded and carry a sparse vegetation which, however, contains many species.

The flora of the ranges is diverse. Although flowers are prominent mainly in years of good rainfall, the plants add to the colour of the hills at all other times as well - white-barked Eucalypts, grey-leaved perennial mulla mullas, the many greens of the foliage, straw-coloured spinifex, etc. While many species are widespread, others are confined to small niches, and most of the ranges have species which are endemic or almost so, e.g.:



Figure 12.16. The Blackstone Range: bare screes and spinifex steppe on the hills, open mulga and corktree (Hakea lorea) on the plain.



Figure 12.17. The Anne Range, seen across sand dunes carrying an open mallee - spinifex steppe.



Figure 12.18. Bungabiddy Rockhole in the Walter James Range: Rock Figs (Ficus platypoda) and Ghost Gums (Eucalyptus papuana) at the base.



Figure 12.19. The Sir Frederick Range, with open spinifex steppe.

Blackstone Range - Acacia validinervia, Eucalyptus sp. nov.
 Rawlinson Range - Prostanthera sp. nov.
 Rawlinson Range and Walter James Range - Ptilotus royceanus.

For some species these ranges represent the only WA occurrence, e.g.: Olearia ferresii, Baeckea polystemona, Pandorea doratoxylon, Cryptandra sp. nov., Triodia spicata, Helichrysum kempei, Helipterum tietkensii, Eucalyptus sessilis and Senecio laceratus.

There are also relict populations of species more typically found in wetter northern Australia, especially some found in the gorges, e.g. the sundews, Drosera burmannii and D. indica. The rare central Australian triggerplant, Stylidium inaequipetalum, occurs in Glen Helen and Glen Cumming of the Rawlinson Range.

The plains surrounding the ranges are sandy, loamy or rocky and also vary in vegetation, supporting spinifex, mulga and open steppe formations. There are some extensive stands of the Desert Oak, Casuarina decaisneana (Fig. 12.20). Stream systems are very few, the largest being Giles Creek, which has a sandy or rocky bed lined with River Gums, Euc. camaldulensis. In good seasons, the displays of wildflowers (everlastings, mulla mullas, etc.) are very colourful on the plains (Fig. 12.21).

To widen the representation of desert biota, there is also Lake Hopkins, a large series of salt lakes lying between the Walter James Range and the Sir Frederick Range. Here the saline soils support a halophytic vegetation while the margins have thickets of wattle and tea-tree. Interesting species include Atriplex limbata, Calocephalus platycephalus and Pachycornia tenuis.

At present, the ranges are included in aboriginal reserve no. 17614 (covering 8,016,568 ha). Tourism has already arrived in the form of safari tours from Perth to Alice Springs and return. The scenic and wildlife attractions are such that tourism is certain to increase.

The Committee considers these ranges to have conservational and recreational value equal to or greater than that of Ayers Rock. Some protection is already afforded by their inclusion in the Aboriginal Reserve. We firmly believe that no pastoral or agricultural use should be made here since this will lead to its degradation. Mineral exploitation, if it occurs, should be allowed only if it will cause no serious despoliation. Full consideration will also have to be given to problems of the protection of Aboriginal sites in the area, and in particular to sites of sacred significance. Some of these consist only of natural features.



Figure 12.20. Desert Oaks (Casuarina decaisneana) on sand dunes, south of the Sir Frederick Range.



Figure 12.21. Sand plains north of Mt. Aloysius; open spinifex steppe with scattered mulga (Acacia aneura) and a carpet of everlastings (Helipterum stipitatum).

The Committee supports the concept of a conservation reserve in which aborigines will participate in management in ways similar to those recommended for Ayers Rock (Anon. 1973). This concept was suggested by the Prime Minister in his election policy speech in 1972; viz. that the Government would "invite the governments of West Australia and South Australia to join with the Commonwealth in establishing a Central Australian Aboriginal Reserve (including Ayers Rock-Mount Olga) under the control of Aboriginal trustees."

The Committee recommends that the Aboriginal Affairs Planning Authority examine ways of developing reserve no. 17614 for conservation and recreation.

THE NULLARBOR PLAIN

Area, Geology and biology

The vast expanse of the Nullarbor Plain occupies most of the area between the Great Victoria Desert and the Great Australian Bight. Physically it is one of the most featureless large areas in the world. It consists of horizontal Tertiary strata of limestone and slopes gradually from an elevation of about 300 metres along the northern margin to 60-110 metres in the south. Its flatness is due to regular weathering and the absence of tectonism.

The surface does in fact undulate gently. Small shallow depressions are known as dongas, while there are some remnants of old river systems. Caves are numerous and often large, and are rich sources of fossils as well as harbouring some living fauna.

Geologically the plain is part of the Bunda Plateau, which also includes the Nyanga Plain, the Carlisle Plain, the Hampton Tableland and the Mardabilla Plain (Lowry, 1970).

The vegetation is a shrub or low tree steppe. The real Nullarbor has a low steppe dominated by shrubs of the saltbush family, (Chenopodiaceae), the most common species being Bluebush (Kochia sedifolia). Many ephemerals, especially grasses, appear after rain. The dongas have deeper clay soil and support a few taller shrubs and trees. Lower scattered trees, mostly Myall (Acacia sowdenii) occur in some areas, and become more frequent around the margins of the Plain. The vegetation formations here occur nowhere else in the State, while some of the plants are endemic on the Plain, e.g. the Nullarbor Frankenia (Frankenia densa).

Along the coastal strip the vegetation is more dense and includes a greater variety of species, mallee eucalypts often being common. This is a corridor, similar to that along the northern Nullarbor fringe. Here however, the plants and animals are south coastal species. Near Twilight Cove, for example, is an area of sand-heath containing outlying populations of many species found on

heaths west of ^Israelite Bay. There are also species endemic to the region, e.g.: Adenanthos forrestii, Styphelia hainesii, Grevillea sparsiflora and Pimelea serpyllifolia. The limestone cliffs are the habitat of the only Correa known to occur in WA, C. reflexa.

The Nullarbor fauna contains a number of interesting species some of them confined to the caves. The latter include troglobites - blind spiders, a centipede, cockroaches, etc - while the fossil remains are also substantial and important. The Hairy-nosed Wombat, Lasiorhinus latifrons, common in South Australia, in this State occurs only on the Nullarbor as far west as Caiguna. An unnamed species of dunnart, Sminthopsis sp., is confined to the Plain and the skink lizard Lerista baynesi is confined to this region.

An outstanding feature is the large number of caves, especially in the southern half. Exploration of these has been carried out by speleological groups from both eastern and Western Australia and is continuing.

Land Usage

Large areas of the Nullarbor are occupied by pastoral leases, since the vegetation contains a number of species palatable to stock. However, mismanagement has led to overgrazing in many parts. Along the Trans-Australia Railway Line are several small settlements occupied by people serving the railway and by a few doggers. A few motels serve travellers along the Eyre Highway, the only southern road-link between eastern and Western Australia. Total population of the Plain is several hundred.

CONSERVATION RESERVES

Some of the Nullarbor region is already included in major reserves. The Great Victoria Desert Wildlife Sanctuary includes sections of the Carlisle, Nyanga and Nullarbor Plains. On the coast, the Nuytsland Wildlife Sanctuary includes sections of the Roe Plain, Hampton Tableland and Hampton Range as well as the Baxter Cliffs, Wylie Scarp and ^Israelite Plain. However, further representation within reserves is still required.

The areas reported by the Committee are:

20. Plumridge Lakes area
21. Nuytsland Wildlife Sanctuary
22. Eucla
23. The Nullarbor Caves

12.20 PLUMRIDGE LAKES AREA

The Great Victoria Desert Wildlife Sanctuary includes a section of the Nullarbor Plain near the WA-SA border. This is the only representation of the true Plain within a reserve, since the reserves on the coast cover different landform and vegetation types. None of the western part of the Plain is reserved, and there is a wide gap between the Great Victoria Desert Wildlife Sanctuary and the Queen Victoria Spring Wildlife Sanctuary which occupies different country, to the west of the Plain.

The Plumridge Lakes and surrounding country as shown in Fig. 12.0 include part of the Carlisle Plain system of the Nullarbor, and extend westwards into sand dune country on the margin of the Great Victoria Desert. There is an extensive salt creek which follows a winding course through the area. The proposed reserve thus contains a variety of landforms with their attendant vegetation types.

Recommendation

The Committee recommends that this area covering about 2621 km² be declared an A Class reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority.

Boundaries

The boundaries are as follows: 29° 20' S, 125° 25' E, 29° 43' S, 124° 40' E.

To the north west of this proposed reserve is another system of lakes centred on Rason Lake. Adjacent to this are a number of rocky hills and small ranges while extensive areas of sand dunes lie around these and to the south of the lake. Further investigation of this region is recommended, since it probably contains a diversity of plants and animals and would make a useful addition to the proposed reserve.

12.21 NUYTSLAND WILDLIFE SANCTUARY

This Reserve, No. A27632, was gazetted on 25 June 1965 for the purpose of "Primitive Area for the Preservation and Study of Flora, Fauna Geological and Anthropological features". It was proclaimed Class A on 7 November 1969, and vested in the Western Australian Wild Life Authority on the same date.

The reserve is named after the Dutch explorer Pieter Nuyts who sailed this coast in 1627. It embraces a long coastal strip of land representing both the high cliffs of the Great Australian Bight and the ocean beaches, sand dunes and sand plains at Eyre and Israelite Bay. Near Cocklebidy it extends inland across the Eyre Highway. The Sanctuary contains one of Australia's scenic features, the 190 km long, 80 km high cliffs at the southern extremity of the Nullarbor Plain. These cliffs are believed to be the longest unbroken cliffs in the world.

The area was traversed by John Eyre during his journey from South Australia to Albany in 1841. It also includes some of the old overland telegraph line constructed in 1876.

Israelite Bay is at the southern end of the boundary between the South West Botanical Province and the Eremean Province. This overlap Zone is noted for its high degree of speciation and endemism. This means that a comparatively large number of plant species along the line have a very restricted distribution. An example at Israelite Bay is the mallee Eucalyptus angustissima. A large number of plant groups common in the South West reach their easternmost limit at Israelite Bay. An example is the genus Banksia. Other plants are restricted to the reserve, e.g. Pimelea serpyllifolia which grows only the cliffs, and Adenanthos forrestii which occurs only near Twilight Cove.

From a zoological viewpoint the Israelite Bay area again is the southern end of the boundary between the South-West (or Bassian) and the desert (or Eyrean) faunas. Many species have their easternmost WA distribution in the area. Examples are the Honey Possum (Tarsipes spencerae), the Southern Bush-Rat (Rattus fuscipes) the Pigmy Possum (Cercartetus concinnus), the Dunnart (Sminthopsis murina) and the Ashy Mouse (Pseudomys albocinereus); and among birds the New Holland Honeyeater (Meliornis novae-hollandiae), Western Spinebill (Acanthorhynchus superciliosus), White-cheeked Honeyeater (Melithreptus lunatus), Little Wattle-bird (Anthochaera chrysoptera) and White-tailed Black Cockatoo (Calyptorhynchus baudinii).

It is of scientific value to preserve animals such as these at the extremes of their range because often they show many adaptations to the more harsh climatic conditions than occur over the major part of their range and these give an understanding of the factors controlling species distribution and influencing evolution. The long, narrow shape of the reserve reflects the role that the area has played in both the past and present. During the ice ages of the past one to two million years (the Pleistocene Age) rainfall in the southern half of Australia underwent a series of fluctuations and on a number of occasions a humid corridor was opened up along the southern coastline between the southeastern and southwestern corners of the continent. This allowed the movement of many animals and plants from east to west and, to a lesser extent, from west to east.

These movements are evidenced by situations where a number of closely-related species occur in the South West, all of which are derived from a parent stock in the south east of Australia. These migrations are also proven by fossil deposits of bones and pollen in caves and in areas covered by dunes.

Yellow Lake and other lakes near Israelite Bay have yielded interesting specimens of tectites which are now lodged in the WA Museum. These specimens have been in demand for loan overseas. Deposits of Quaternary marine mollusc fossils, probably of different ages, are also exposed in the lakes and are currently under study by the WA Museum.

Beyond the western end of the reserve is a group of quartzite hills including the Russell Range and Mt. Ragged. Their geology and flora are described in System 3.4, where a recommendation is made to include some of the hills and an area to the north in the Cape Arid National Park. Such an addition would give the Park further variety and importance while retaining rational boundaries to simplify management. The hills are not extensive, and it is essential to preserve as much of them as possible. The remainder should be added to the Nuytsland Wildlife Sanctuary. Again, this would add to the variety of the reserve but would retain rational boundaries (Fig. 3.13). The area is at present vacant Crown land.

Within the Sanctuary are the following small reserves:

- 522 - Public Purposes
- 682 - Public Purposes
- 3806 - Public Utility Purposes
- 3805 - Camping
- 7095 - Water

The Committee endorses the purpose, status and vesting of the Sanctuary.

Recommendations

The Committee recommends that an area as shown in Fig. 3.13 be added to the reserve.

To facilitate management of the reserve, the Committee recommends that the small reserves be cancelled, and their areas added to reserve A27632. The reserve should be extended to low water mark.

In the Israelite Bay area there are three Crown Grants, Mardarbilla Locations 1 (81 ha), 2 (202 ha) and 6 (0.8 ha). The Committee recommends that these be purchased and added to the reserve.

12.22 EUCLA

In the southeastern corner of the State, a small area is worthy of reservation for its scenery and historical associations and to a lesser extent its biology. The old Eucla Telegraph Station is a relic of the original overland telegraph line. Now abandoned and threatened by drifting sand, it is worth preserving so that, at some time, it can be restored and perhaps made a local museum. The sand dunes to the east are known as the Delisser sand-hills.

On the border, Wilson Bluff is a high limestone cliff which provides a vantage point for viewing the spectacular cliffs of the Bight to the east and west (Fig. 12.22). Several interesting plants occur here, especially a species of Senecio (daisy) which



Figure 12.22. Wilson Bluff: limestone cliffs of the Great Australian Bight.

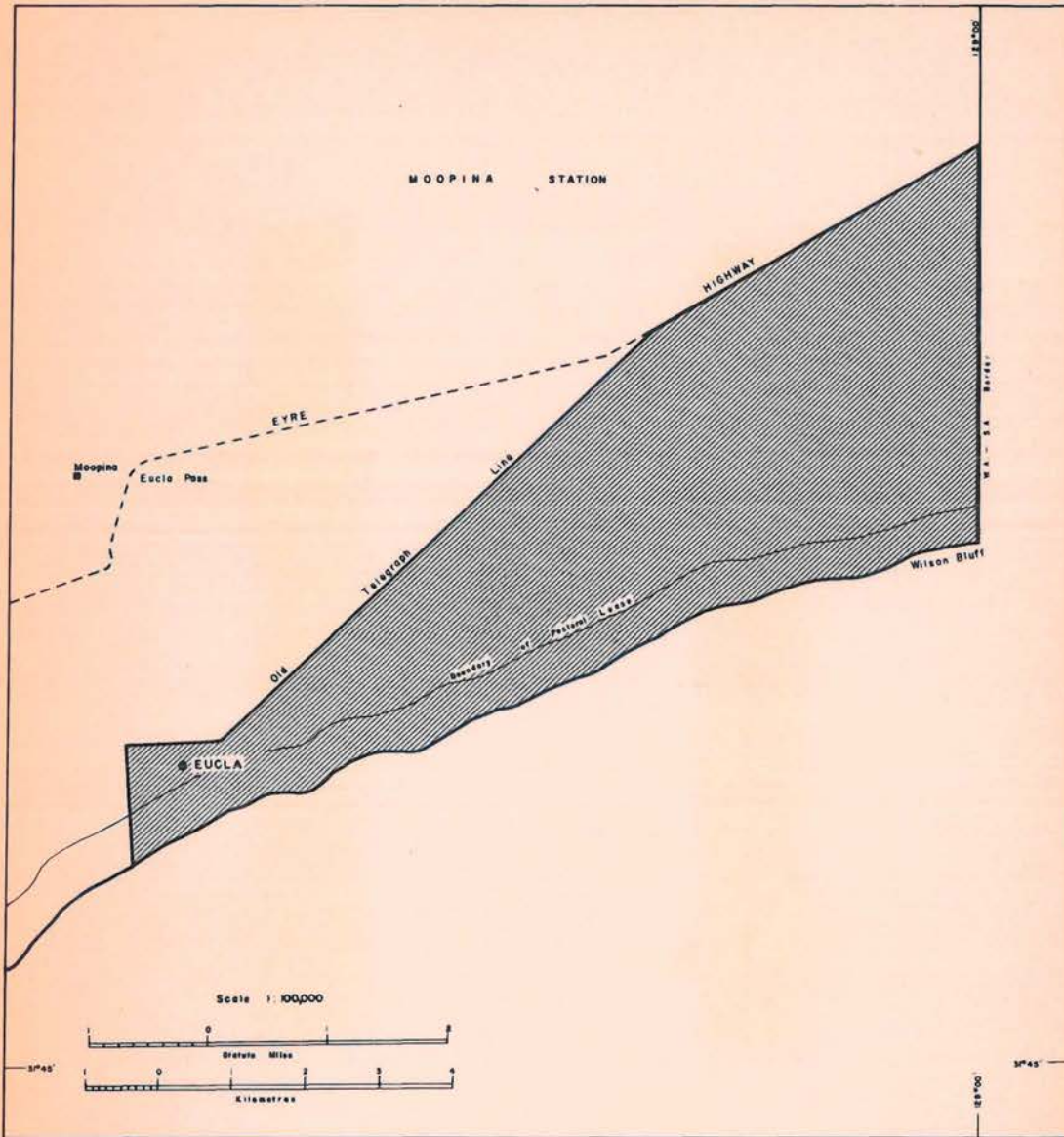


Figure 2.23 Area map of proposed Euccla reserve

is not known from any other locality. Two other species, Templetonia battii and Olearia exiguifolia, are known only from the limestone cliffs of the Bight, while Pomaderris forrestiana is another rare species found here (Willis, 1959).

The Eyre Highway here is closer to the cliffs than at any other point either in WA or SA. It is used by an increasing number of travellers, and the locality is a resting place on the long road journey across the Highway. It is at present part of Moopina pastoral lease.

Recommendations

The Committee recommends that the area shown in Fig. 12.23 be acquired at a suitable time and classified as A Class reserve for the Preservation of Historic Sites and Conservation of Flora and Fauna. The reserve should extend to low water mark. It should be placed under the control of the National Park Board, with power to lease.

Until the area is acquired, the lessee should not be allowed to overstock it or to carry out any developments which would be detrimental physically or biologically.

12.23 THE NULLARBOR CAVES

The existence of caves in the limestones of the Nullarbor Plain has been known for many years, and they have attracted speleologists and scientists from all parts of Australia. Exploration and documentation are continuing processes. The caves are highly significant in respect of their physiography, geology, meteorology and biology, containing many unique features. These have been documented in a number of publications (e.g. Lowry, 1970; Hill, 1966).

The caves are vulnerable to damage and pollution by visitors. The need is to control access and preserve the underground environment. Except for the cave entrances, the surface above them can be left to its present use (mainly pastoral).

Few caves are included within existing reserves. Those which have been listed as especially significant are:

Abrakurrie, Cocklebidy, Weebubbie, Mullahmullang,
Murra-el-elevyn, Roaches Rest, Lynch and Thylacine.

The Committee supports the concept of cave protection. It recommends that the WA Speleological Group be invited to make recommendations for the protection of caves on the Nullarbor Plain and submit them to the Department of Environmental Protection.

BIBLIOGRAPHY

- Anon. 1962. Report of the Western Australian Sub-Committee of the Australian Academy of Science Committee on National Parks.
- Anon. 1973. Ayers Rock - Mount Olga National Park. Report from the House of Representatives Standing Committee on Environment and Conservation.
- Beard, J.S., 1967. An inland occurrence of Mangrove. W. Austral Nat. 10: 112-115
- Beard, J.S., 1969. The Natural Regions of the Deserts of Western Australia. J. Ecol. 57 677-711
- Butler, W.H., 1971. Report on an Expedition to the Durba Range, Canning Stock Route, WA. Unpublished.
- Ford, J. 1971. Distribution and Taxonomy of southern birds in the Great Victoria Desert. Emu 71: 27-36.
- Hill, A.L., 1966. MullaMullang Cave Expeditions 1966. Cave Exploration Group. Occasional Papers No. 4.
- Lazarides, M., 1970. The Grasses of Central Australia. Australian National University Press, Canberra.
- Lowry, D.C., 1970. Geology of the Western Australian part of the Eucla Basin. Geological Survey of WA Bulletin 122.
- Main, A.R., 1968. Ecology, systematics and evolution of Australian frogs. In Advances in Ecological Research, Vol. 4.
- Pianka, E.R., 1969. Habitat specificity, speciation, and species diversity in Australian desert lizards. Ecology 50: 498-502.
- Storr, G.M., 1968. The genus Ctenotus (Lacertilia, Scincidae) in the Eastern Division of Western Australia. J. Roy. Soc. W. Austral. 51, 4: 97-109
- Storr, G.M., In press. Agamid lizards of the genera Caimarops, Physignathus and Diporiphora in Western Australia and the Northern Territory. Rec. W. Austral. Museum.
- Willis J.H., 1959. Notes on the vegetation of the Eucla district, WA. Muelleria 1, 2: 92-96.