CONSERVATION RESERVES
IN WESTERN AUSTRALIA

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

C O N S E R V A T I O N R E S E R V E S

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W E S T E R N A U S T R A L I A

REPORT OF THE

CONSERVATION THROUGH RESERVES COMMITTEE

TO THE

ENVIRONMENTAL PROTECTION AUTHORITY

1974

ENVIRONMENTAL PROTECTION AUTHORITY
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Over the past three years, the Conservation Through Reserve Committee of the Environmental Protection Authority has been engaged in evaluating and reviewing the requirements for National Parks and Nature Reserves throughout Western Australia. The findings of the Committee have now been presented to the Environmental Protection Authority for its review and the EPA is making available the complete text of this report as part of its practice in matters of such fundamental importance to the public.

The report at this stage does not necessarily reflect the views of the Environmental Protection Authority, and as such, the report has no official endorsement.

It is important for readers to note that, where management of reserves is discussed, the Committee worked on the basis of legislation as it existed in early 1972.

Nevertheless the report, even in its present form, will prove of interest, not only to those who assisted in its preparation but also to the general community and responsible authorities.

The report complete with colour section is available for public scrutiny in the Department of Environmental Protection, the State Public Library and the Parliament House Library. Comments will be accepted until March 20th and the Environmental Protection Authority will then review the report and comments, before reporting to the Government.

What the Environmental Protection Authority can do immediately is to thank all those who helped in the preparation of the report. Thanks are due particularly to the Committee and its Technical Sub-Committee for their diligence and hard work. As a result of their very great efforts over the past three years, the Report is a very significant milestone in the history of environmental care and management in Western Australia.

Brian J. O'Brien

CHAIRMAN

31.1.75

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PREAMBLE

Western Australia has long been isolated from the mainstream of world industrial development but, despite this, it has experienced a decade of rapid economic growth initiated and sustained primarily by the exploitation of land for mineral and other natural resources. This has produced a marked effect on its physical environment - a process which in other parts of the world has led to widespread concern for the preservation and efficient management of natural resources.

Throughout the work which led to this report the Conservation Through Reserves Committee has been especially concerned that sufficient areas of native habitat be preserved and managed both for the preservation of animals and plants and for the enjoyment and education of the population. People gain inspiration from contact with nature, whether through recreation or study, and this can only be secured for the future people of this State by well-managed conservation reserves containing healthy natural ecosystems of sufficient size to withstand extensive human use.

Perth
August, 1974

W.D.L. RIDE (Chairman)
R.T. APPLEYARD
B.E. BALME
J.F. MORGAN

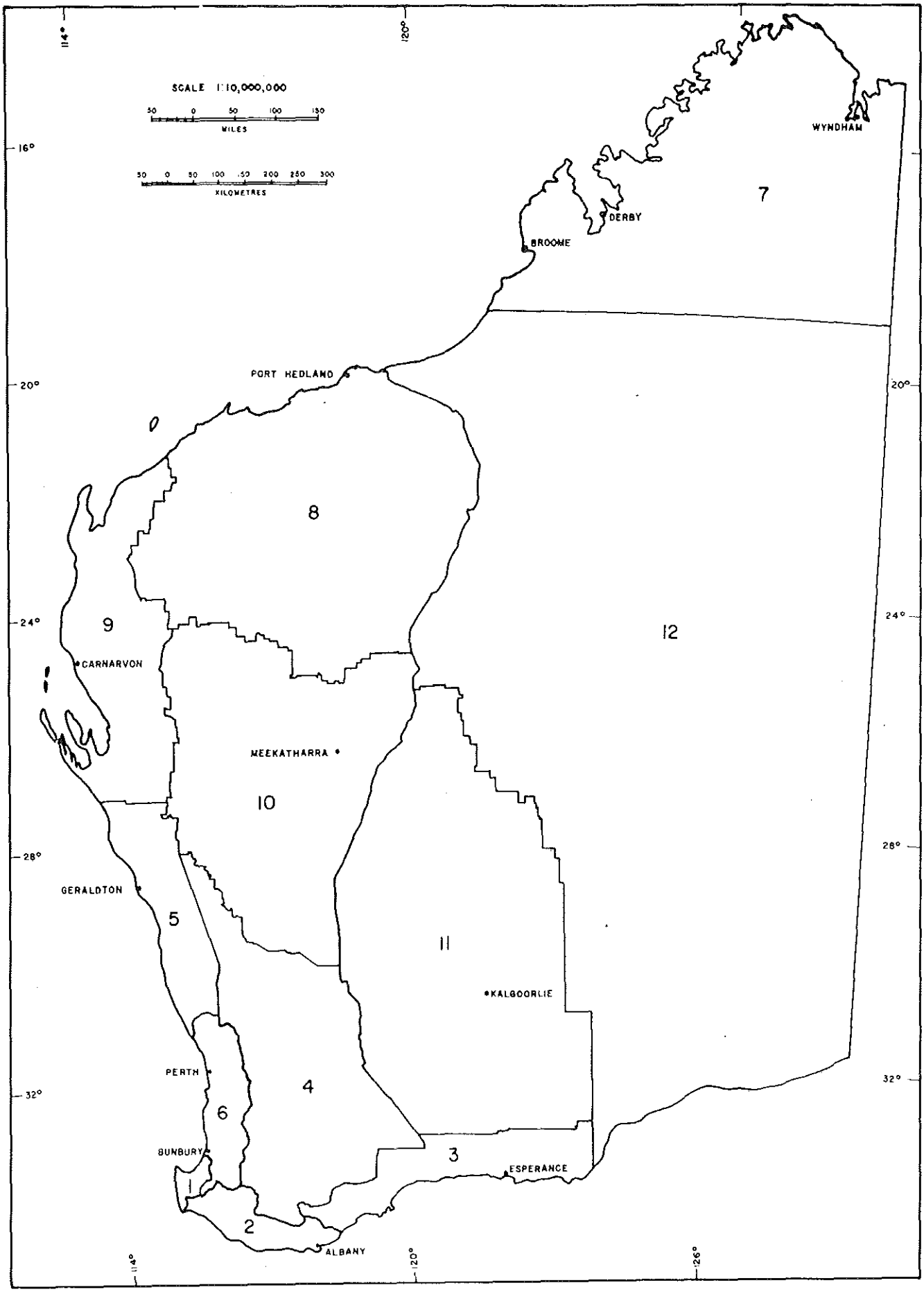

Figure 0 · 0 Systems

INTRODUCTION

In this Report the Conservation Through Reserves Committee of the Environmental Protection Authority recommends to the Authority a system of reserves which, if suitably managed, will conserve examples of the principal environmental and scenic variety in Western Australia, thus providing for public enjoyment, education, and relaxation among the many facets of the natural landscape. These reserves are chosen to provide an integrated pattern of national parks and reserves of equivalent status, so that the needs of a growing and active population will be met in the latter part of this century and beyond.

In presenting its Report, the Committee is confident that if its proposals are adopted, Western Australia will possess a planned system of conservation reserves adequately representing the variety of nature in a manner unsurpassed in Australia. Environmental planning in Western Australia has come early enough, by comparison with the selection of land for other uses, to enable the conservation of a representative selection of environmental types. Development is nevertheless accelerating so rapidly that the Committee finds it necessary to advise that early action must be taken on its proposals if this aim is to be achieved.

As a result of its considerations, the Committee makes recommendations that a further 86,000 km^2 be added to existing conservation reserves. These recommendations do not include consideration of the Darling and Kimberley Systems which are to be the subjects of separate reports.

The aggregate of the areas of both proposed and existing reserves described in the Report represents approximately 6.8% of the area so far reported on by the Committee, but this percentage is not distributed evenly throughout the State. For example, the relatively high percentage of the State's land recommended as conservation reserves in the South West and South Coast regions (see table on page 0- 7) reflects not only the scientific importance of these areas but also their potential for recreational use in the near future. On the other hand, the relatively low percentage of land recommended for new conservation reserves in the wheat belt is the result of the scarcity of uncommitted bushland in this area due to clearing for agriculture.

To provide a frame-work for assessment the Committee divided the State into 12 Systems (see Figure 0.0), each representing a natural and demographic entity. Each proposal for the creation of a reserve was appraised on the following bases:

1. The area's recreational and scientific values;

2. whether it is needed to augment the present pattern of conservation reserves within or adjoining the System that contains it;

3. whether it is representative of the natural features of the System;

4. the presence within it of unique or spectacular natural features;

5. its location in terms of current and future likely use based on projected population growth and distribution;

6. any conflict of potential use (e.g., whether the area proposed has mineral, agricultural/pastoral, or urban potential and how this should be evaluated against its conservation value); and

7. its status (e.g. whether it is an existing reserve, a reserve recommended by an earlier committee, a new proposal or whether vacant Crown land, leasehold, or freehold).

Conservation Reserves: National Parks and Nature Reserves (Wildlife Sanctuaries)

The International Union for the Conservation of Nature and Natural Resources (IUCN) has defined a National Park as:

"..... a relatively large area

1. where one or more ecosystems are not materially altered by human exploitation and occupation, where plant and animal species, geomorphological sites and habitats are of special scientific, educative and recreative interest or which contains a natural landscape of great beauty; and

2. where the highest competent authority of the country has taken steps to prevent or to eliminate as soon as possible exploitation or occupation in the whole area and to enforce effectively the respect of ecological, geomorphological or aesthetic features which have led to its establishment; and

3. where visitors are allowed to enter, under special conditions, for inspirational, educative, cultural and recreative purposes."

The IUCN describes similar areas from which the public is excluded as National Nature Reserves.

These definitions do not differ in essence from those adopted by the Western Australian Sub-Committee of the Committee on National Parks and Native Reserves of the Australian Academy of Science in its report (see National Parks Report, 1962), which may be regarded as the starting point of the work of the Conservation Through Reserves Committee (see p. O-6), although practice and existing legislation in Western Australia have somewhat modified the concepts. Thus in Western Australia the term "National Park" has been applied to some areas which do not meet all the above criteria, especially in terms of size. The official definition now employed is provided by the National Parks Board of WA in terms of the following criteria:

1. National Parks should be spacious land and water areas so outstandingly superior in natural qualities and beauty as to make imperative their preservation by Government for the enjoyment, education and inspiration of all people.

2. National Parks should be sufficiently large to permit public use and enjoyment together with the continuous effective management of their plant and animal communities.

3. National Parks should be adaptable to the type of management that can provide a wide range of opportunities for enjoyment, such as camping, picnicking, hiking, horse-riding and sight-seeing in a natural setting; such activities always to be consistant with the preservation of the characteristics or features that merited the establishment of a National Park.

4. National Parks will usually contain a diversity of natural resources, including fine scenery and features of scientific interest.

The term 'Nature Reserve' is not used officially in Western Australia. Any reserve vested in the WA Wild Life Authority or other reserve set aside wholly or partly for the Conservation of Fauna is termed a 'Wildlife Sanctuary'. The Wild Life Authority also controls reserves where hunting of declared game species (mostly ducks) is permitted in season. Such an area is known as a 'Game Reserve'. The WA Wild Life Authority has power to prohibit public access to its reserves but has exercised this power in only a very few cases (e.g. Dorre Island) and the public is permitted access to most wildlife sanctuaries.

Under the Land Act, reserves may be set aside for the Conservation of Fauna, the Conservation of Flora or for a combination of both purposes. No statutory authority or board is automatically responsible for reserves set aside solely for flora conservation.

In this report most areas are recommended for control by either the National Parks Board of WA or the WA Wild Life Authority. In each case we have assumed that management will provide both for plants and animals as interdependent parts of natural ecosystems. In general we have recommended areas for control by the National Parks Board of WA where, in addition to wildlife, the land contains features of outstanding attraction to the general public. If wildlife conservation is the primary purpose of the reserve, the Committee has recommended control by the WA Wild Life Authority.

In this Report the term 'Conservation Reserve' includes National Parks, Wildlife Sanctuaries and other areas with similar functions.

We support the views expressed in the National Parks Report, 1962, that the needs of the general public and the scientific worker and naturalist will only be achieved when there is a planned system of parks and reserves combined with efficient management. Without planning and proper control, parks and nature reserves soon degenerate by losing their natural charm and their value is lost both to the tourist and the naturalist.

Summary of Recommendations

Appraisals of, and recommendations on, Systems 1 to 5 and 8 to 12 are presented in Sections bearing individual System numbers. System 6 (Darling) and System 7 (Kimberley) are not included here. In the case of System 6, the complexity of conflicting demands for land use required a broader range of expertise and greater time

for appraisal than has been available to the Committee so far. System 7 has been left in abeyance because of inadequate data. Recommendations on these two Systems will be presented at a later date.

The figures in the table 0.7 show the available vacant Crown land in each System and indicate the pattern of land commitment in this State. It follows from the small percentages for conservation reserves in Systems 4 and 10, and the low figures for vacant Crown land in these Systems, that human use has already so modified most of the natural ecosystems in them that it is now too late to establish additional viable conservation reserves without major acquisition of freehold or leasehold land and prolonged restoration programmes. This is not the situation in most other Systems where greater areas of vacant Crown land are available.

The high percentage of land recommended for conservation reserves in Systems 2 and 3 (western and eastern south coast) expresses the projected recreational needs of the growing population. It is probable that these areas, together with Systems 1 and 6, will be the main recreational zones, but there is also a need for additional recreational facilities in parts of Systems 5, 8 and 9. The Committee also sees a need for further reserves in System 11 (Goldfields) but it has been unable to recommend exact areas because of lack of data.

Historical Background

In 1958 the Australian Academy of Science appointed a Committee on National Parks and Nature Reserves to provide information that might lead to the establishment of a comprehensive system of reserves for the Australian continent. The Committee, in turn, established State sub-committees to determine what had already been done, what was being done and what should be done to have adequate land set aside for National Parks and Nature Reserves. The Western Australian sub-committee presented a report to the Academy in 1962 (National Parks Report, 1962) which contained a historical survey of nature reserves in Western Australia, a list of existing nature reserves and an interpretation of the legal position in relation to security of reserves. But, most important, the sub-committee saw the need for a pattern of reserves to be representative of 'all major communities of natural wildlife and scenery types in Western Australia' and selected new areas towards this end. (This report was published in Western Australia as "National Parks and Nature Reserves in Western Australia", 1965.)

The Academy sub-committee recognised that likely future expansion of pastoral and agricultural interest would place many animal and plant communities in danger of extinction, and would also greatly change the scenic landscape. They also anticipated that patches of original bush would one day be 'things to remark upon', and that families would need more natural areas for recreation in the future.

SYSTEM NO.	SYSTEM NAME	TOTAL LAND AREA (km^2)	VACANT CROWN LAND (km^2)	EXISTING RESERVES (km^2)	PROPORTION OF SYSTEM IN EXISTING RESERVES (% Total Area)	PROPOSED ADDITIONAL RESERVES	TOTAL EXISTING AND PROPOSED RESERVES (km^2)	PROPORTION TOTAL AREA IN EXISTING AND PROPOSED RESERVES (% Total Area)
1	South-west	3970	96	232	5.8	40	272	6.9
2	Western South Coast	18460	1469	2098	11.6	220	2318+	12.6
3	Eastern South Coast	49690	14320	6628	13.3	891	7519	15.1
4	Wheatbelt	134800	3436	1459	1.1	533	1992	1.5
5	Northern Sandplains	44520	6178	3553	8.0	420	3973	8.9
6	Darling	25470	411	-	-	-	-	-
7	Kimberley	302580	37129	-	-	-	-	-
8	Pilbara	271750	59172	9736	3.6	4690	14426	5.3
9	Central West Coast	94910	4133	238	0.3	8088	8326	8.8
10	Murchison	208370	5409	0	-	4000	4000	1.9
11	Goldfields	295100	79114	3284	1.1	3925	7209	2.4
12	Desert	947280	704345	26583	2.8	63450	90033	9.5
Western Australia		2,396,900	915,212	53,811*	2.6*	86,257*	140,068*	6.8*

* 1. Excluding Systems 6 and 7.
2. Existing Reserves includes reserves of various purposes, classes and vestings and also includes State Forest areas included in recommendations.
3. Proposed Reserves includes vacant Crown land, leasehold and freehold land, Figures for existing reserves are accurate. Figures for proposed reserves include a number of estimates, e.g. In System 10 two reserves of at present unknown size are recommended and it has been assumed that each will be 2,000 km^2

\+ Does not include an area of about 250 km^2 foreshadowed in a proposal to establish a National Park for conservation of wet sclerophyll forest.

In selecting areas for reserves the sub-committee declared that it had not been influenced solely by the needs of scientific workers. 'The wild life and scenery of some of these areas', they wrote, 'is so remarkable that they clearly form part of the heritage of ordinary people and, no matter what is scientifically desirable entry will ultimately be demanded to them'. In consequence, the sub-committee noted the danger inherent in uncontrolled public use and made recommendations for the protection and management of reserves in order that public use could be balanced against the purpose for which the reserve was to be set apart.

The Western Australian sub-committee's primary objective was to select reserves which would preserve biological communities for all time. In many respects, the National Parks Report was a landmark in the history of conservation in Western Australia, not only through the establishment of some new reserves but also because it recognised the need for a pattern of reserves representing all natural ecosystems and scenic types. Although a number of its recommendations were acted upon by the Minister for Lands, conflicting interests impeded the implementation of others.

In 1969 the State Government appointed a committee - The Reserves Advisory Council - with terms of reference to:

1. consider ways and means of protecting natural scenery in Western Australia;

2. consider all matters relating to National Parks and relative reserves;

3. consider existing legislation in Australia for the protection of natural scenery; and

4. recommend appropriate action in relation to the foregoing and legislation, if necessary, to achieve desired objectives.

During 1969 and 1970 the Reserves Advisory Council recommended the creation of a number of reserves, resulting in the establishment of such areas as the Victoria Desert Wildlife Sanctuary and the Chichester Range National Park. Recommendations for the reservation of other areas, such as the Drysdale River region, were not implemented.

In December 1971 the Environmental Protection Authority (EPA) was established to, among other things, 'consider and initiate the means of enhancing the quality of the environment' (Environmental Protection Act, 1971, Section 29(a)). The Authority recognised that the establishment of an adequate conservation reserves system would be an important mechanism for achieving this objective. Accordingly, it established a Conservation Through Reserves Committee (CTRC), which met for the first time on February 15 1972.

The Committee comprises:

Dr W.D.L. Ride (Chairman), Director, Western Australian Museum
Mr J.F. Morgan, Surveyor General of Western Australia
Dr B.E. Balme, Reader in Geology, University of Western Australia, and

Professor R.T. Appleyard, Professor of Economic History, University of Western Australia.*

A full time Secretary was appointed.**

The terms of reference of the Committee are:

1. to review and update firm recommendations of the Western Australian Sub-Committee of the Australian Academy of Science Committee on National Parks in respect of National Parks and Nature Reserves;

2. to review National Parks and other significant reserves controlled by the National Parks Board of WA and the Pemberton National Parks Board, and large wildlife sanctuaries controlled by the WA Wild Life Authority.

3. to review areas recommended to the Minister for Lands by the Reserves Advisory Council;

4. to consider proposals for reserves submitted to it in writing by interested members of the public and organisations and by Local Authorities and State and Commonwealth Government instrumentalities.

PROCEDURE

The Committee established two main guidelines:

a) to recommend adequate reserves to secure the conservation of representative biological and geomorphic types occurring in Western Australia, as well as other features of special scientific significance, and

b) to recommend adequate areas of National Parks (additional to those in (a) above, where necessary) to meet project population growth, distribution and mobility.

The Committee's review function has been found to be indivisible from its initiating function, an indivisibility which is represented in the Recommendations made in this Report. In addition, public participation was not only necessary but essential. Accordingly written submissions were sought through advertisements in the Government Gazette and in the press. Organisations known to be interested in conservation were invited to make submissions and 103 submissions were received. Many dealt with more than one area and the Committee found itself assessing over

* Added to the Committee at a later date in his capacity as Convenor of the Technical Sub-Committee.

** Mr G. Rundle was seconded from the Main Roads Department on January 24 1972 and on April 17 1974 was succeeded by Mr L. Goodridge.

200 separate areas additional to those previously reviewed by the earlier committees.

The Committee took the view that specialised technical knowledge was necessary to assess these areas. Accordingly, it established a technical sub-committee to consider all proposals in detail. The Committee comprised:

R.T. Appleyard, M.A., Ph.D., F.A.S.S.A., Professor of Economic History, University of Western Australia (Convenor)
A.A. Burbidge, B.Sc.(Hons.), Ph.D., Senior Research Officer, Fauna Research Branch, Department of Fisheries and Fauna
A.S. George, B.A., Western Australian Herbarium, Department of Agriculture
B.W. Logan, B.Sc.(Hons.), Ph.D., Reader in Geology, University of Western Australia; and
J.H. Lord, B.Sc., F.G.S., M.Aus. I.M.M., Director, Geological Surveys Branch, Mines Department.*

Although the technical sub-committee met frequently between August 1972 and June 1973, its members soon realised that the magnitude of the task demanded sustained effort. Agreement was therefore reached between EPA and relevant Government departments and the University of Western Australia, for members of the technical sub-committee to be seconded to the Department of Environmental Protection for up to three days each week between August and November, 1973, when they assessed all proposals. Since November 1973 the technical sub-committee has met frequently to prepare drafts for the Committee. Extensive travel was necessary to investigate submissions received. The advice and opinions of persons with special knowledge of the areas under consideration were also sought.

As mentioned above the State was divided into twelve Systems (see Figure 0.0) each representing, as nearly as possible, a natural and demographic entity. Existing conservation reserves in each System were drawn on maps, together with the additional areas under review as well as all new proposals. Each area was appraised on the basis of the seven criteria listed on page 0-3.

During the compilation of drafts the technical sub-committee has worked in close liaison with the Conservation Through Reserves Committee. Professor Appleyard was a member of both the technical sub-committee and the CTRC and he and the Secretary attended all meetings of the technical sub-committee. In addition, many of the recommendations contained in this Report were made only after full discussion at joint meetings of the CTRC and its sub-committee. However, the text of the final report and the recommendations that it contains are the responsibility solely of the CTRC and represent the unanimous views of that Committee.

* Mr Lord was represented at most meetings of the sub-committee by Mr R. Connolly, a Geologist of the Geological Surveys Branch, Mines Department.

Considerations

The Committee recognised the growing awareness in Western Australia, and throughout the world, of the pressures that man has imposed, and continues to impose, upon his environment, and of his recent determination to strike a balance between legitimate exploitation and preservation of resources. This awareness has been epitomised in the report of the United Nations Conference on the Human Environment held at Stockholm in 1972, some principles of which express the Committee's view of the importance of its task:

> Principle 2
>
> The natural resources of the earth including the air, water, land, flora and fauna and especially representative samples of the natural ecosystems must be safeguarded for the benefit of the present and future generations through careful planning or management, as appropriate.
>
> Principle 4
>
> Man has a special responsibility to safeguard and wisely manage the heritage of wildlife and its habitats which are now gravely imperilled by a combination of adverse factors. Nature conservation including wildlife must therefore receive importance in planning for economic development.

In supporting the ideals expressed by the United Nations Conference, the Committee has been deeply conscious of the need to provide adequate reserves to cater for the recreational requirements of present and future generations. Though many of the areas it has recommended for reservation may not be utilised for years to come, they must be reserved now before further inroads are made into their primitive state.

Throughout its work the Committee has been especially concerned that sufficient areas of native habitat be preserved and managed both for the preservation of animals and plants and for the enjoyment and education of the population. People gain inspiration from contact with nature, whether through recreation or study, and this can only be secured for the future people of this State by well-managed conservation reserves containing healthy natural ecosystems of sufficient size to withstand extensive human use.

The task of securing this land against other pressures is urgent and the Committee hopes that none will be misled, by the quantity of vacant Crown land which is indicated in Table O-7, into thinking that there will still be opportunity for yet another round of assessment and recommendations. Whilst the Committee is sure that large areas of vacant land may be available in some remote parts of the State for some years, it finds from the experience of those of its members who had served on all three Committees over the last decade that, although a large number of hectares may remain available, they are not representative of much variety so that the opportunity for choice is not likely to remain for long.

A salient feature of the Western Australian economy is its reliance upon primary resources that require the use of land. Exports comprise mainly natural materials (ores and timber) or agricultural products (wheat and wool), and are the basis of the State's very favourable external balance of payments. Relative lack of industrial infrastructure is the main reason why the State has a very unfavourable balance of payments with other Australian States. This reliance on primary products, and especially growth in income from this source since 1962, when the National Parks Report was submitted, has led to the alienation of millions of hectares of virgin land for agriculture.

The main basis of growth, however, has been the exploitation of mineral deposits which occurred during the same period. Aside from investment of $1,600 million in infrastructure and mining equipment in the Pilbara alone, to pay for a complex of mines, railways, ports and towns, the mineral 'boom' has led to widespread exploration of the State. As a result, areas which hitherto had been untouched were surveyed and explored and, although only a minute fraction of the mineral leases was developed, the teams left widespread evidence of their activities in the form of cleared tracks, seismic lines, grids and campsites. But of equal environmental importance, they demonstrated that previously inaccessible areas were accessible and today an ever increasing number of people are moving in their tracks.

More recently, too, has come the impact of intensive timber industries on the forests of the south-west. In a single agreement (between the WA Chip and Pulp Co. and the State of Western Australia) a major part of the total area of the unique karri-marri forests of Western Australia will be harvested in a manner that will drastically alter their present character.

In summary then, despite its isolation from the main-stream of world industrial development, Western Australia has experienced a decade of rapid economic growth initiated and sustained primarily by the exploitation of land for mineral and other natural resources. This has produced a marked effect on its physical environment - a process that in other parts of the world has led to widespread concern for the preservation and efficient management of natural resources.

Despite enormous direct investment in mining activities in the Pilbara, Eastern Goldfields and elsewhere, the major employment and investment multipliers have been felt in the Perth metropolitan area, whose population is the main potential user of National Parks. Even though population growth in the Pilbara quadrupled between 1966 and 1971, this represented an increase of only 21,602 persons. The population of the Perth area, on the other hand, increased by 144,378 during the same period. Whereas population growth in the State as a whole averaged only 2.5% during the early 1960's, it rose to 3.7% in 1965/66 and remained around this level until 1970/71. In one year, 1968/69, it was 4.3%, which was double the Australian average. Economic development associated with these rates has led to a steady increase in per capita income which, in turn, has meant more motor cars, more leisure (especially longer annual holidays), and better roads (e.g. a sealed highway from Perth to the Pilbara). Holiday makers are therefore ranging much more widely than was possible 15 years ago. In addition, the proliferation of four-wheel drive and "all-terrain" vehicles has opened up many areas still inaccessible to conventional vehicles.

The Committee is certain that uncoordinated and unplanned use will have permanently adverse effects on previously untouched areas. Furthermore the State's continuing development will inevitably impose further pressures on existing conservation reserves, if only because of increases in population and per capita income.

LAND USE

Agricultural, pastoral and silvicultural pursuits, mining, secondary industries and urban development are all contenders for land that may have conservational significance, and clear-cut criteria seldom exist for allocating land to competing industries. If the competitors are commercial, then relative profitability may be the decisive factor, but where a commerical venture is opposed to a conservational need there is no obvious common factor available for direct comparison.

There is, however, an increasing community acknowledgement that unique, beautiful or scientifically important features have a real value which, although difficult to quantify, must be recognised when there are conflicting demands for land use.

Providing that equally satisfactory areas can be found elsewhere, the Committee has sought to avoid recommending areas as conservation reserves which will lead to conflict with commercial interests Where solutions of this kind have not always been possible the Committee has exercised its judgement.

Many submissions received by the Committee expressed concern at the possible environmental damage resulting from exploration and mining on present and future reserves. Some sought to ban mining on all reserves but most regarded only the Class A reserve as inviolate. In a similar manner much evidence presented to the 1971 Committee of Enquiry into the Mining Act related to the issue of mining and conservation.

While many other types of development are more generally devastating to the natural environment, mineral exploration and mining are often singled out as the prime destructive agents. By contrast agricultural development largely escapes public censure because it replaces bushland with an alternative man-made landscape of comparable attraction.

The question of mining on reserves has been a continual preoccupation of committees concerned with conservation and has been no less so with this Committee. At the present time, the dependence of the State's economy on mineral production demands the encouragement of mineral exploration. Such encouragement can only be real when the conditions attaching to the exploitation of a commercial deposit are known, in general, by private companies, before they begin the expensive and often unrewarding exploration phase of their activities. Some areas recommended as conservation reserves in this report have not been exhaustively explored for minerals. Recommendations in this report concerning them must therefore be viewed with knowledge of the attitude of the Committee in regard to exploration and mining in reserves.

The Committee is not currently opposed to mining in all conservation reserves. While mining may be disruptive, the disruption it

causes will depend on many factors, including the type of mine, the distribution of physical and chemical by-products of mining activitiy, the size and purpose of the reserve, its distance from populous centres and the concentrations of population necessary to support the mining operation. The decision to allow mining in a reserve is one for the community as a whole, which must assess its current priorities. Such priorities may change from time to time and no ad hoc committee can hand down irrevocable standards.

The Committee agrees with the Committee of Enquiry into the Mining Act (1971) to the extent that within the South Western Area (as defined in their recommendation No.8), prospecting and mining on existing and proposed A class reserves and National Parks should require Parliamentary approval. Unless explicitly excluded in the Committee's recommendations, these recommendations are made in the knowledge that elsewhere in the State exploration and mining are permissable in A class reserves as provided for under the existing Mining Act 1904-1968. Such exploration and any subsequent mining activity should be subject to safeguards provided under other legislation such as the Environmental Protection Act (1971). Such safeguards should as far as is practicable, be determined and made clear to all applicants before tenements are approved.

Where the Committee considers that mining or other forms of exploitation should not take place on a proposed reserve, it has made this clear in its recommendations.

Apart from mining other land uses within reserves that have been considered include agriculture, grazing, forestry, fishing, game shooting and private development. Thus, the proposed excision of the Shannon River drainage basin from the area to be harvested initially under the Woodchipping Agreement, and the establishment of Reserves in the Whicher Ranger and the Wonnerup-Ludlow area, were recommended only after discussing the likely effects on the timber industry with officials from the Forests Department. Similarly, recommendations concerning the future use of Dampier Archipelago take into account likely industrial and recreational activities accompanying development in the expanded Pilbara. Recommendations concerning the Abrolhos Islands and Shark Bay also took into account the needs of the fishing industry.

But the fact that discussions were held with various authorities does not imply that the personnel involved in them necessarily agree with the conclusions reached by the Committee.

Vesting and Management

As an integral part of each recommendation concerning the reservation of land, the Committee has included recommendations on vesting and management on the basis of existing legislation and currently responsible authorities. In addition, where certain preliminary tasks such as biological surveys were considered necessary, the Committee also nominated the appropriate existing body to be responsible.

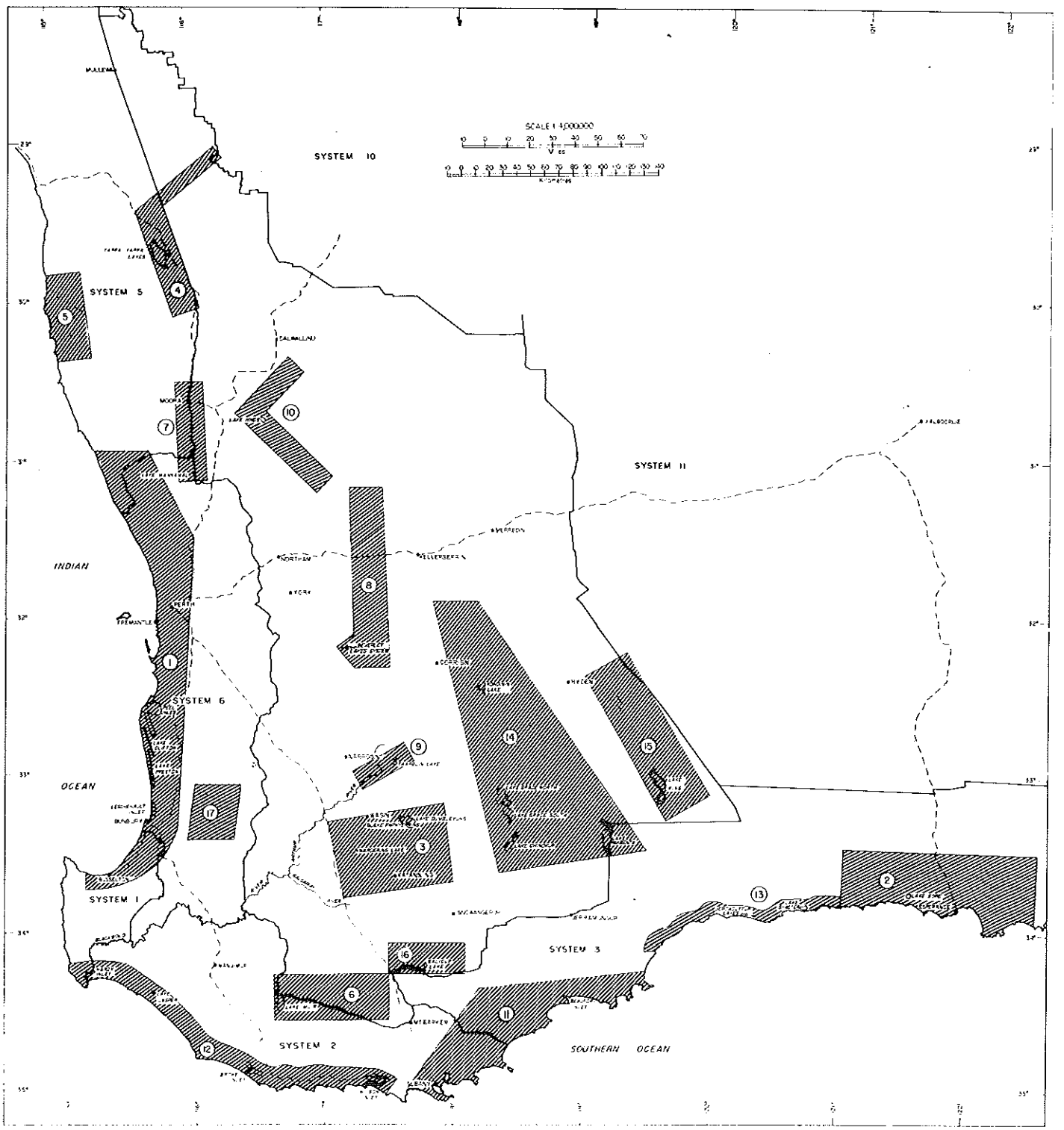

Figure 0.1 Wetland complexes of the South West

The Committee's terms of reference did not permit recommendations on the creation of new or modified management authorities. This function was that of a Committee known as the National Parks Review Committee which met during 1972/73 and reported separately to the Minister for Lands.

So that the Committee's recommendations may be better understood, it is necessary that details be provided concerning the three principal management authorities to which the Committee has accorded roles:

The National Parks Board of Western Australia: This Board is constituted under the provisions of the Parks and Reserves Act, 1895-1963. It consists of six persons appointed by the Minister for Lands and currently employs one professional officer (the Director), the administrative staff and park rangers. In addition, the salary of a botanist attached to the Western Australian Herbarium is provided by the Board; he works on botanical problems associated with national parks. The Board also employs the Western Australian Museum to conduct biological surveys on its behalf.

The Western Australian Wild Life Authority: The Authority is constituted under the provisions of the Fauna Conservation Act, 1950-1970. It has eleven members, four of whom are ex officio; of the remainder, at least three are required by the Act to be biologists. The Chairman is the Director of Fisheries and Fauna. The Authority has no direct allocation of staff or finance, but its needs, including those of biological survey and reserve management, are met (and its decisions implemented) by the Department of Fisheries and Fauna. This Department has a staff of professional officers and fauna wardens as well as administrative staff. Like the National Parks Board, the Western Australian Wild Life Authority also contracts for biological surveys with the Western Australian Museum.

The Forests Department: This Department is responsible for the management of State forests which are located, in particular, in Systems 1, 2, 4 and 6. It has an active Wildlife Research Unit which is currently engaged in studying the relationship between forest management procedures and forest fauna. The Conservator of Forests is responsible for the administration of the Native Flora Protection Act, 1935-1938.

As well as the above bodies, there are a number of others which control land set aside as conservation reserves. These include the Pemberton National Parks Board and various Shire Councils.

The National Parks Report of 1962 expressed the view that the system of management at that time would be inadequate to meet the objectives it had set for the future. Apart from the great increase in numbers of professional staff working for the Western Australian Wild Life Authority since that time and the considerable strengthening of the means of administrative control of national parks (including control by rangers), the position today is much as it was then. In 1962 the Academy Sub-Committee wrote: "It appears that what is needed now is the development of a new policy towards obtaining for Western Australia a carefully planned reserve system, perhaps under the control of a single authority .... The duty of the controlling authority should be to protect and administer the reserves to

the best advantage both of the reserves themselves as natural areas, and for the public who may wish to visit and enjoy them" (National Parks Report, 1962).

When looked at in retrospect, this request for consolidation was obviously premature. In a mendicant state within a climate of general environmental unconcern, it was understandable that responsibility for conservation of reserves should continue to be delegated to understaffed departments whose personnel had other utilitarian functions and who, together with the National Parks Board, relied for professional knowledge of reserve management upon the expertise of voluntary members of committees.

Since 1962, however, the Western Australian Wild Life Authority and Department of Fisheries and Fauna have developed wildlife management to a level unsurpassed in Australia. Further, staff of the Wildlife Research Unit of the Forests Department has conducted detailed studies in forest management. The National Parks Board has advanced considerably its ability to control the public within its parks. Biological knowledge of parks and reserves has also greatly increased as a result of studies made by these bodies and the University of Western Australia, and as the result of surveys carried out by them and by the Western Australian Museum and the Western Australian Herbarium.

Reservation and management are insparable components in the process of conservation through reservation. The Committee's purpose is to recommend reserves, but if these recommendations are to achieve the ends of conservation in the public interest it is inescapable that the Committee must also state the need for management of the resource by a staff trained to high levels in the various fields of park administration and education, including natural and environmental science. The effort which the State must make should be commensurate with the fact that the National Parks and conservation reserves of Western Australia together constitute a land holding for a specific purpose larger than any other in the State apart from land set aside for use by aborigines.

In this regard, the Committee believes that reorganisation and rationalisation of the management of the State's conservation reserves is urgently necessary. Whether or not they are placed under control of a single authority is immaterial providing the responsibility for the outcome is accepted by the Government of the day as a public necessity and is delegated to an agency (or agencies) equipped for the task. Conservational management today is a sophisticated procedure that demands a dynamic attitude to the problems of constantly changing environmental pressures. It can only be effectively accomplished if, whatever managing bodies are set up, they are, themselves, responsible for the gathering, collation and interpretation of scientific data relating to the management of areas that they control, and are accountable for the outcome. In this they must be well equipped to cater for all appropriate aspects of human usage. In providing for popular use, management must be able to work towards creating an educated public enthusiasm and respect for the land and its wildlife.

Special Matters Considered by the Committee

In addition to ensuring that conservation reserves are planned and that, through them, adequate provision has been made for the establishment of recreational facilities commensurate with public demand, the Committee has had to consider other special aspects of conservation relating to the use of land. These were:

(i) the need for environmental control in some areas, even when these are not reserves;

(ii) the need for special safeguards over coastal lands and islands;

(iii) the need for legislative provision in the Forests Act, 1918 and amendments, to permit areas to be set aside within State forests to be Forest Parks having the same environmental security as National Parks but controlled and managed by the Conservator of Forests;

(iv) the need for new legislation to permit aquatic reserves to be set aside;

(v) the special problem of wetlands;

(vi) the problem of reserving sites of geological importance;

(vii) the special problem of road reserves and small reserves along roads;

(viii) remaining vacant Crown land;

(ix) future reviews.

Environmentally Controlled Areas: During its study of agricultural districts the Committee has become convinced of the great recreational value of the man-made rural environment. It believes that development in some outstanding areas of the rural environment should be controlled in the public interest as what might be called "scenic reserves". Although the Committee has not made specific recommendations giving boundaries to such "reserves", it takes the view in its report of the Naturaliste-Leeuwin Ridge (System 1, Area 1.4) that this is an area that must be treated in this manner. It is a landscape of great beauty in which the intermingling of reserves, forests and rural land provides an outstanding public asset. This asset is vulnerable to destruction through indiscriminate piecemeal development when it is permitted to proceed without regard to its total effect.

The Committee RECOMMENDS that the Environmental Protection Authority implement planning procedures to enable the Crown to:

(i) designate specific areas as "scenic reserves" irrespective of the ownership and nature of development of the contained lands; and

(ii) enable control of these by an authority to preserve the character and value of such areas.

The Protection of Islands and Coastal Lands:

(a) Islands: A large number of islands are found around the Western Australian mainland. Few are reserved and, when

the Committee came to consider the reservation of islands, it reached the conclusion that, while there is overwhelming argument for the reservation of some of them for the purposes of wildlife conservation, others will be of considerable importance for other public uses including recreation. But all islands are especially vulnerable and are very liable to misuse. Therefore, while the Committee has been unwilling to recommend that all islands be set aside as wildlife sanctuaries or National Parks, it is nevertheless convinced that islands require protection.

The problem is of considerable magnitude because of the many islands concerned. The list of official names of islands records some 320, but the actual number far exceeds this figure; these range in size from a few square metres at one extreme to Dirk Hartog Island of 62,000 ha and Barrow Island of 20,000 ha at the other. They occur off most stretches of the coast except in the Great Australian Bight.

South sea islands are, by reputation, idyllic but most Western Australian islands are very different from such imaginings. These offshore islands are small fragments of the mainland which have been isolated by rising sea levels during the past 8,000 years. They are mostly windswept and desolate, cold in winter and sun-baked in summer. The island faunas and floras are fragments of mainland biotas modified by island size, geology, soil and climate; they represent modified fragments of the fauna and flora of the adjacent mainland as it was at the time of its isolation. Thus, the surviving species on these islands give a valuable indication of the ecology and faunal composition of the adjacent mainland at the time of separation. They give insight into past climate and, most importantly, they give a clear indication as to what may happen in mainland reserves when these are limited in size by artificial boundaries and are deprived from direct contact with adjacent natural bush by altered and alien agricultural fields, or by similar man-made environments.

As well as being valuable natural laboratories, some islands contain unique species, subspecies, or varieties which are not found elsewhere. Some of the best known examples of island forms in Australian mammalogy are known to occur on Western Australian islands.

In addition, unlike the mainland, many Western Australian islands have not been directly altered by man through pastoral and agricultural activity or other development. In addition, few islands have had non-native animals introduced to them such as predators (e.g. dingo, fox and cat), herbivores (e.g. rabbits, goats and sheep) and rodents (such as the house mouse and ship rat). As a result of the lack of terrestrial predators on some islands, a number of mammals now extinct, or very rare, on the mainland, survive. In addition, ground-nesting seabirds have remained unmolested. Also vegetation has not suffered from mechanical damage or from browsing.

In Western Australia almost all islands still remain Crown land. Because islands are much in demand for public recreation, private homebuilding, sites of fishing clubs and tourist centres, or port sites, etc., the Committee anticipates that pressure to release

them for such purposes will become very great and for various environmental reasons it is clear that they are liable to degradation unless their use is carefully planned. The Committee takes the view that some form of overall protection should be applied to all islands so that any request to alienate an island, or to reserve it for some public purpose is carefully examined in the light of all environmental factors.

The Committee considers that this may be achieved through Section 54 of the Environmental Protection Act, although if it were considered desirable to avoid using that provision, it might be possible to gain adequate protection for islands through their creation as Class B Reserves under the Land Act for the purpose of the Conservation of Flora. Any request to the Minister to alienate such a reserve would, if the Minister agreed to permit the action, be reported to both Houses of Parliament and subject to disallowal. The Committee prefers the former alternative and therefore RECOMMENDS that all islands, presently Crown land, be protected under Section 54 of the Environmental Protection Act, 1971.

(b) Coastal Land: Coastal lands are also particularly vulnerable to environmental degradation and, because the coastline is one of the most attractive recreational parts of our environment, and the greater part of the population lives close to the coast, these lands are under heavy environmental pressure.

The seriousness with which the problem of conserving the coastal environment is regarded has led, in recent years, to official concern being expressed and some progress is being made towards its overall conservation. The Committee takes the view that coastal lands in the south-western portion of the State require urgent and special attention.

Today, increasing mobility of sand dunes, as well as the multiplicity of vehicle tracks and the presence of squatters, provides evidence of deterioration of many coastal lands. Though the causes of dune erosion are complex, there is no doubt that the construction of tracks to beaches and fishing spots, the use of all-terrain vehicles, grazing by domestic stock, and frequent burning have contributed to the present condition.

In addition, the siting of works, such as groynes and retaining walls, even with careful overall environmental planning and understanding of the physical factors which control coastal movement, can produce serious effects such as those which appear to have resulted at Mandurah and Busselton. The coastal movements in these areas have caused concern to owners whose properties have been endangered. Similar movement with less serious consequences has been observed in many other places along the coast.

In addition to the publicly owned foreshores and beaches, many areas, such as those between Lancelin and Cape Arid, for example, contain reserves for such purposes as "common", "recreation and camping", and "excepted from sale". The Committee takes the view that all of these, together with the general health of the coastal environment are a priceless asset worthy of great public concern.

The Committee supports the view expressed by the Committee of Inquiry into the Mining Act (1971) which recommended that all prospecting and mining be prohibited, except with the consent of Parliament, in the lands and waters on the sea frontage from a point on the coastline marking the northern boundary of the Shire of Northampton (System 5) around the coastline to the eastern boundary of the Shire of Esperance (System 3), extending inland for forty chains from high water mark on the foreshore and, subject to constitutional limitations, extending seaward to the fifteen fathom contour line and also including the waters, the beds, and the beaches of all rivers and estuaries which flow through this coastal strip.

The Committee also supports the general conclusions of policy on this coastal strip which have been reached by the Environmental Protection Authority and the Environmental Protection Council. In particular, it draws attention to the statement by the Authority that:

> "The Authority considers that adequate management of the coastal strip not only as pertains to mining, but also to residential development, recreational use and the like, is of very great importance in total environmental planning in the State. It is expected that coastal developments will continue to dominate the residential needs and desires of the population. It is therefore apparent that the coastal strip must be adequately managed in order that, for example, recreational usage should not be so heavy or concentrated as to be self-defeating and destructive of the natural ecology. The Authority notes with pleasure the establishment by the Town Planning Department of a sub-committee which includes a representative of the Department of Environmental Protection, to investigate such problems further (Sand Drift and Sea Erosion Committee)."
> (Environmental Protection Authority, 1972)

The Committee welcomes the decision which the Environmental Protection Authority has taken towards making the coastline subject to Environmental Protection Policy under Section 39 of the Environmental Protection Act and hopes that the investigation which it is conducting towards this end, and which was initiated early in 1972, will receive all possible support to enable them to reach their conclusions.

In considering the details of coastal Crown lands in Systems 2, 3 and 5 the Committee has been impressed by the complex management problem which they present both concerning the control of human use and of the environment generally. The Committee has taken the view that even before the broader requirements of stated Environmental Protection Policy are formulated, there is need for immediate coordination and restraint at a local level. Accordingly, in respect of these Systems it has recommended that authorities be established (following study by a working group to define their terms of reference). These authorities would combine experience from both State and Local Government and would provide for local public involvement. As in the case of "scenic reserves" (see Environmental Controlled Areas above) the Committee RECOMMENDS that the Environmental Protection Authority implement planning

procedures to enable any authority, appointed as a result of these recommendations, to control the coastal strip and associated Crown lands allocated to it as a unit in order to preserve their character and value.

Forest Parks: In its consideration of forest areas in the South-West the Committee has been made aware of the special problems of managing reserves set aside to preserve forests and of the fact that the Forests Act regards forests as places set aside for the productionof timber. It makes no special provision for certain forests (or portions of forests) to be managed by the Conservator as reserves as though they were National Parks and set aside with the same degree of environmental protection and security of purpose as Class A Reserves for the protection of flora and fauna under the Land Act, or National Parks.

It is clear that the environmental health of such forests requires great expertise in all aspects of forest management and, while it is clearly desirable that, in due course, such expertise should also be available in all management authorities of reserves the expertise today rests exclusively with the staff of the Forests Department and the State should be able to take advantage of it. In reading this report, where it concerns forested areas, it should be remembered that its recommendations are constrained by what is possible under current legislation. The Committee has no doubt that the statutory powers of the Conservator should be broadened to enable him to manage forests set aside for recreational and reservational purposes other than the production of timber. The Act should also be broadended to secure areas within State Forests for this purpose. Accordingly the Committee RECOMMENDS that the Forests Act be amended to make provision for areas to be set aside within State Forests for the purpose of the conservation of fauna, flora and/or public recreation to be managed by the Conservator of Forests for these purposes; and to provide that the purposes of such areas, once designated, be only set aside by Act of Parliament in the same manner as is required for the emendation of purpose of a Class A Reserve under the Land Act.

Where, in this report, recommendations are made that an area of State Forest should be managed as if it were a National Park (see Shannon River Catchment, and State Forest 45 in the Leeuwin-Naturaliste Ridge) it is understood by us that these areas would be designated Forest Parks should the Forest Act be amended as is recommended here.

The above recommendation is made with the intention that areas which are currently State Forest can be taken out of production and dedicated for the conservation of flora and fauna and/or public recreation but still remain managed by the authority responsible for managing the adjacent or surrounding forest as a single unit. It is not the intention of the Committee that the Forests Department should become an authority to manage National Parks or Reserves containing forest where this is not State Forest, or where it is desirable for other reasons to exclude them from State Forest. It is expected that in due course, the authority responsible for National Parks would be equipped to manage such areas.

Aquatic Reserves: The need for aquatic reserves is widely recognised in Australia today. The argument for them is summarised in a statement by Dr. D.F. McMichael in the Report of the Australian Academy of Science on National Parks and Reserves in Australia (1968). The Conservation Through Reserves Committee has recommended in this report that a number of aquatic reserves be established. It has also recommended their control through the Fisheries Act because there is no other statutory provision which can be used for this purpose despite the fact that the Fisheries Act was intended to provide for the conservation and exploitation of commercially important marine life. The Committee is convinced that new legislation will be required to ensure protection of marine life generally, but the question must be asked whether control should be exercised in a manner similar to the Land Act - namely by vesting a defined marine area in a body and empowering it to regulate the use of the area, or whether control should be exercised in the manner of the Maritime Archaeology Act, 1973, which sets out to control the activity of persons within defined areas without vesting them. In view of the current constitutional problems concerning the control of the sea bed, the Committee has taken legal advice and concurs with the view that the second alternative is preferable. It believes that there is no need for the State to delay in preparing such legislation on the grounds that the sea bed question has not yet been determined.

Meanwhile the Committee has no doubt that partial control should be exercised through the Fisheries Act.

In cases where aquatic reserves are adjacent to coastal zones which are also reserves, control of the coastline may be obtained through the Land Act (for examples, see recommendation on Areas 9.1, Shark Bay, and 9.3 Ningaloo Reef Tract).

Control of marine areas requires special skills and the Committee takes the view that, initially at least, the State should make use of the skills, equipment and personnel of the Fisheries Department. It also draws attention to special problems created by the extensive use of SCUBA equipment in Western Australia. The Committee believes that the Environmental Protection Authority should consult the Council of Underwater Activities with a view to obtaining specific recommendations relating to problems arising out of the control of skin diving.

The Committee RECOMMENDS that the Environmental Protection Authority:

(i) obtains legislation to enable the proper control of aquatic reserves: and

(ii) seeks the cooperation of the Minister for Fisheries to obtain such control as is possible under the Fisheries Act for all aquatic areas recommended for conservation through reservation in this Report.

Wetlands: Wetlands (lakes, swamps, river and estuaries) are one of the scarcest resources in Western Australia and the conservation of waterfowl is dependent upon their preservation and maintenance. The conservation of wetlands is a matter of great importance. Special reference is made to wetlands in the reports on Systems 1-5.

The descriptions of the wetlands of the south-west refer particularly to their value to waterfowl and other water birds but it should not be forgotten that wetlands support a wide range of aquatic organisms. The Committee's recommendations on wetlands have been greatly influence by a report prepared by Dr. T.L. Riggert, of the Department of Fisheries and Fauna, which embodies the results of studies he has made over the past ten years.

Special problems arising out of the consideration of wetlands and their use result from:

(i) the need to maintain populations of waterbirds which move widely over a series of wetlands as these change due to weather conditions;

(ii) different species of waterfowl requiring different conditions for breeding so that a wide range of wetland is necessary;

(iii) the human use of adjacent lands which has caused an increase in the salinity of many waters in the south-west and consequent reduction of their ability to support species requiring fresh water;

(iv) the fact that wetlands are conserved for purposes which include recreational shooting. This activity is foreign to national parks and most reserves.

Western Australia's climate requires a general pattern of movement among south-western waterfowl. They disperse throughout the agricultural districts and goldfields to breed in the winter and spring and concentrate mainly in the coastal wetlands in summer where they are cropped by duck shooters. The result is that wetlands along the coast are of prime importance. It is in precisely these areas that wetlands are most affected today by drainage operations. sanitary landfill, reclamation and alteration.

The Committee concludes that, in addition to their importance as native species, waterfowl are an important recreational resource which require special conservation measures. Because of the mobility of the resource, these cannot be provided for by the maintenance of populations within special reserves. Provision must be made for waterfowl throughout their range by the special protection of bodies of water irrespective of the purpose of the land surrounding them. The use of this land may jeopardise the permanence and nature of wetlands and the Committee concludes that special provisions must be made to prevent further destruction of wetlands and to enable activities on land adjacent to them to be controlled.

The Committee RECOMMENDS that the Environmental Protection Authority -

(i) set up a special committee to examine legislative requirements for the special control of wetlands;

(ii) require all applications for Crown land surrounding wetlands to be referred to it.

Geological Sites: In 1962 the National Parks Report contained recommendations that 24 sites containing important geological features should be protected. These were the type-sections of geological formations, important features which are used for teaching purposes in the study of geology, and unique geological features of special scientific interest. It is clear that the number of sites known to the Sub-Committee could now be increased many times but the Conservation Through Reserves Committee does not have this information at present.

Moreover, the preservation of geological sites presents special problems of reservation and management. Some sites have deteriorated and, in a State with important geological resources, the preservation of principal reference features is urgent.

Sites such as fossil localities are particularly vulnerable to over-collection and the Conservation Through Reserves Committee takes the view that the Environmental Protection Authority should obtain information from a special committee to enable action to be taken.

In particular, the Committee RECOMMENDS that the Environmental Protection Authority seek the approval of the Hon. Minister for Mines for a committee to be set up with representatives from the Mines Department, tertiary educational institutions, learned geological societies, the Western Australian Museum, and commercial mining interests. The Committee should have the task to report and recommend as stipulated below. The Director of the Geological Survey Branch, Department of Mines, would be an appropriate Convenor.

It is RECOMMEDED that the Committee be asked to:

(i) prepare an inventory of geological sites in Western Australia which merit protection;

(ii) allocate priorities for the preservation of the sites;

(iii) review legislative provisions and recommend new legislation if necessary;

(iv) advise on management technique and the appropriate authority to control geological reserves where these are not already contained within national parks and reserves and protected thereby.

Reserves Along Roads: While the Committee has, in the main, been concerned with the reservation of areas of land large enough to preserve representative faunas and floras, it has also directed its attention to small uncleared areas of land,

and roadside reserves, which clearly play an important part in the preservation of the countryside. Such reserves are of considerable importance in the preservation of some species, especially those (such as some birds) which use the continuity provided by roadside vegetation and small reserves to permit them to move across what would otherwise be a hostile environment. Such areas also provide important stopping and picnic places for travellers.

Following the expression of considerable public concern about the need to preserve road verges, and especially their flora, the Government set up a Road Verge Committee which submitted its report to the Government in November, 1970. Two of the recommendations made in this report, which were subsequently accepted by Cabinet, are that:

(i) roadside flora areas should be provided at intervals along existing narrow road reserves; these areas should be selected in Crown land where possible, but the resumption of suitable areas of private land should be considered where necessary; and

(ii) a specialist committee consisting of a highway engineer, a botanist and a forester should be constituted to select and recommend suitable sites for these flora areas.

Subsequently, a sub-committee of the Road Verge Committee examined the State road system, allocated priorities for overall examination, and then selected the Newton-Augusta Road for a detailed pilot inspection in order to determine the feasibility of implementing the recommendations. This pilot inspection showed that there are three broad types of areas which influence not only road verge conservation, but the general landscape as seen by the road user. These are broad acre reserves, small roadside flora areas, and highway landscape features.

It was clear to the Sub-Committee that there are many problems relating to the manner in which such areas can be obtained and controlled, the main variables being size and the nature of tenure of desirable areas. For example, selected areas may be private property, Crown grant, conditional purchase lease, existing reserves vested in various authorities or vacant Crown land.

Taking into account the need to provide for such matters as flora diversity, floral vigour, uniqueness, value as shade and shelter, water features, and the contribution which areas make to the overall landscape, it became apparent to the Sub-Committee that, in many cases, resumption will be required. On classified main roads limited areas could be obtained by the Commissioner of Main Roads for purposes of road reserve widening or provision of roadside stopping places. However, as roads controlled by the Commissioner of Main Roads represent only approximately 8% of the State's total road system, the contribution from this source to effective roadside reserves of the State, whilst worthwhile, would be quite small.

There are many uncleared areas in alienated lands which contribute to an overall pleasant landscape. Typical examples are uncleared hilltop areas surrounded by totally cleared farmland. At present, there is no guarantee that these areas will remain uncleared. Therefore, provision must be made for some form of tree preservation order. Whilst such a provision would not deny the use of the land for grazing and shelter of stock, it would result in the preservation of the major vegetation contributing to the general appearance of the landscape. Apart from considerations of landscape and vegetation conservation, sensibly applied tree conservation orders could lessen potential for soil erosion.

One disturbing feature remarked upon by the Sub-Committee during its inspection of the Newton-Augusta Road was the extent of clearing which has occurred in recent years. Many uncleared areas shown on 1968 aerial photos, and considered as potentially suitable for protection, no longer existed when inspected early in 1974.

Work by the Sub-Committee to date indicates that to implement sound but realistic conservation measures could require many departures from long standing customs and procedures. Particularly in view of the decreasing availability of suitable areas, there is a need to establish as a matter of urgency firm Government policies with subsequent development of acquisition and funding procedures. The Conservation Through Reserves Committee RECOMMENDS urgent consideration be given to the report of the Road Verge Committee and to the implications arising out of the study of the Newton-Augusta Road by the Environmental Protection Authority.

Remaining Vacant Crown Land: Today, outside the Goldfields, Kimberley, Pilbara, and Desert Systems, only 2% of the State's land is vacant Crown land and this must be regarded as one of the State's most precious resources. If the Government accepts the view expressed in this Report, that reservation for conservation is an important form of land use for the benefit of the community as a whole, it should be a part of public policy to assess the conservational potential of any major area of Crown land when an application for its alienation is being considered.

The Committee RECOMMENDS that, in view of the statutory responsibilities of the Environmental Protection Authority, any application for the alienation of major areas of vacant Crown land should be referred to the Authority to enable it to assess its conservation potential, including recreation.

Future Review

The Conservation Through Reserves Committee was charged with the task of assessing for the Environmental Protection Authority the needs of Western Australia for conservation reserves. With the completion of its Report the Committee's work may be said to be ended. However, it is clear from its work, and the work of the two committees that preceded it (one unofficial and

one official), that community needs are constantly changing in this area. Moreover, as data upon which needs are assessed continually accumulate, a more rigorous scrutiny of the problem is required. It is also our experience that the existence of more than one management body can lead to undesirable competition for land for a single public purpose and to conflicting advice.

The Committee RECOMMENDS that the task of advising the Government on its needs for further land for conservation through reservation should be the continuing responsibility of the Environmental Protection Authority, rather than any management authority, and that a permanent bureau be set up under the jurisdiction of the Environmental Protection Authority to monitor and assemble data for constant review.

SYSTEM 1 - SOUTH WEST

INTRODUCTION

Location and Area

The South West System is located in the extreme south-west of the State (Fig. 1.0). Roughly 3970 km^2 in area, it comprises mainly the Shires of Augusta-Margaret River, Busselton and Capel.

Geology and Geomorphology

Geologically, the System consists of two sharply contrasting areas (Johnstone, Lowry and Quilty, 1973). Its eastern portion lies in the Bunbury Sub-Basin which contains more than 5,000 m of Palaeozoic and Mesozoic sediments. The Bunbury Sub-Basin is bordered on the west by the Leeuwin-Naturaliste Block, an inlier of Proterozoic, crystalline, metamorphic rocks. These resistant gneisses and granulites give rise to an elevated coastal belt about 20 km wide extending from Cape Naturaliste and forming a physiographic entity sometimes known as the Leeuwin-Naturaliste Ridge.

There are few exposures of pre-Quaternary sediments in the Bunbury Sub-Basin, which is generally flat and drained by mature river systems. Virtually its only obvious topographic feature is the Whicher Range, a north-facing escarpment about 100 m high, which runs in a north-easterly direction from the vicinity of Cape Naturaliste to the Darling Scarp. It is thought to represent a linear coastal shoreline formed at a period of high sea-level during the Pleistocene. South of the Whicher Range, the undulating sandy country slopes gently to the Scott Coastal Plain, which borders the south coast. This low plateau subsequently will be referred to as the Blackwood area.

The area of System 1 lying north of the Whicher Range and adjacent to the shores of Geographe Bay is the southern extremity of the Pinjarra Plain. It consists principally of fluviatile sediments and coastal sand-dune systems of Quaternary age. Geomorphologists recognise three generations of dune systems, paralleling, in a general way, the present coastline (McArthur and Bettenay 1960). The oldest, and most easterly, is the Bassendean Dune System, a belt of partially consolidated quartz sand dunes of Pleistocene age. Bassendean Dunes lies about 5 km inland around the margins of Geographe Bay. A further set of Pleistocene dunes, the Spearwood Dune System, extends westward from the Bassendean System to, and beyond, the present coastline. Geologists include the Spearwood Dune System in the Coastal Limestone. The Coastal Limestone is predominantly a wind-deposited sediment or aeolianite, but in places contains abundant fossil remains of molluscs, coral and other marine organisms. Slightly acid groundwaters have partly dissolved the Coastal Limestone where it overlies the Leeuwin-Naturaliste Block and created a complex of spectacular caverns. Dunes at present forming along the coast are classified as the Quindalup

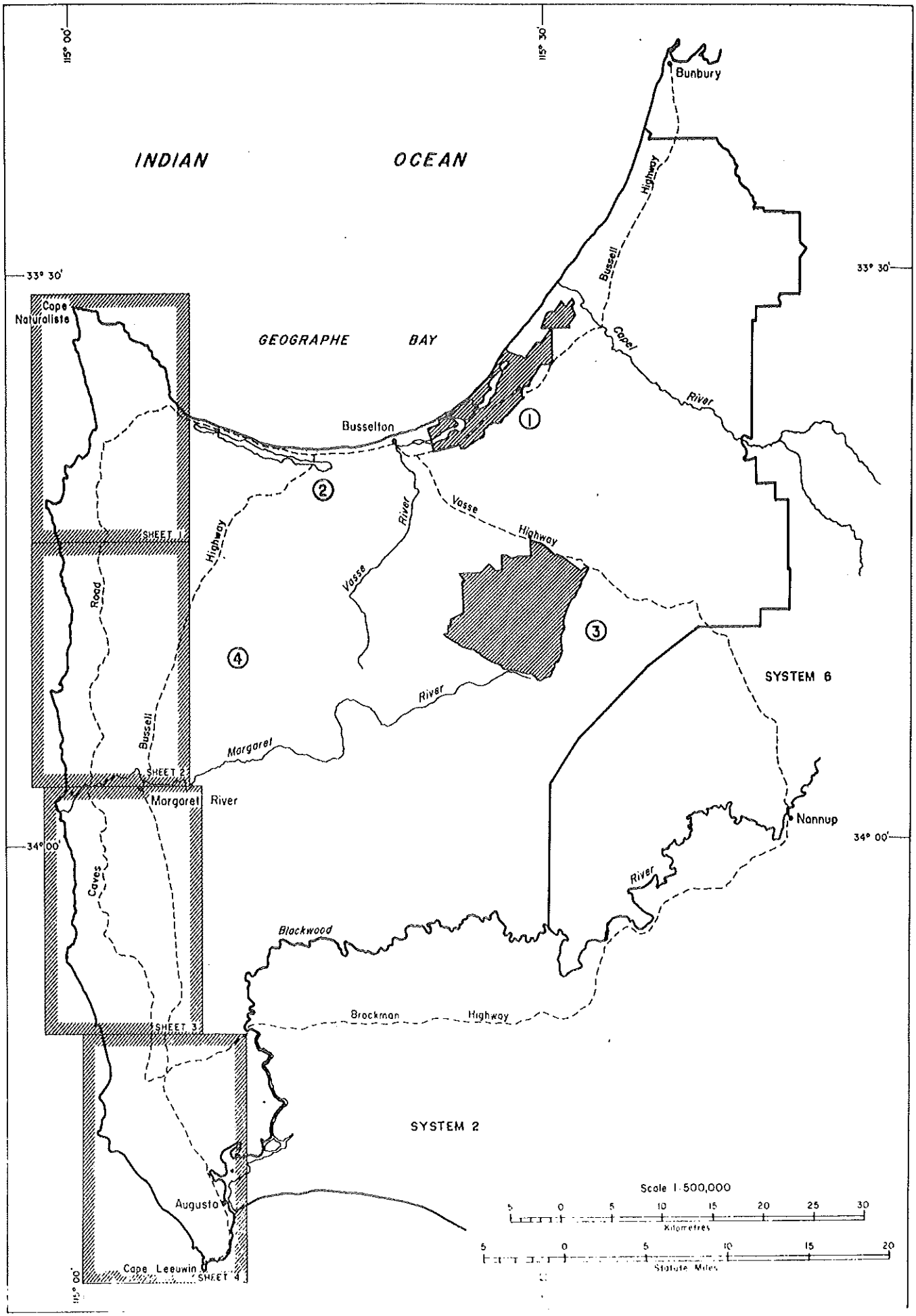

Figure 1·0 System map

Dune System. This belt is about 1 km wide around the shores of Geographe Bay, and dunes composing the Quindalup System are mainly unconsolidated calcareous sands.

Streams flow on to the Pinjarra Plain from the adjacent uplands of the Darling Scarp, Whicher Range and Leeuwin-Naturaliste Ridge. On the Plain they coalesce and enter Geographe Bay at only a few points. The Vasse-Wonnerup Estuary is the most important of these.

Drainage in the Blackwood Area is principally towards the west and south-west, through the Blackwood and Margaret River systems. The Margaret River flows across the Leeuwin-Naturaliste Ridge into the Indian Ocean. The Blackwood enters the ocean at Augusta, after flowing over half a dozen falls in the lower part of its course.

The western coastline, between Capes Leeuwin and Naturaliste, is one of the most imposing in Western Australia. Promontories of crystalline rocks overlain by Coastal Limestone are separated by sandy bays and shingle beaches. Reef patches lie off-shore, and small islets occur near Hamelin Bay and Cape Leeuwin. The sea-floor shelves rapidly, and the 40 m bathymetric contour lies close to the shore. In winter the unprotected coastline is subjected to gales and wave action on a spectacular scale, and the storms of Cape Leeuwin rival those of Cape Horn in maritime tradition. Even in summer the surf is heavy and the coast a treacherous one, although Yallingup is a popular beach for the skilled surfer.

Biological Features

The Pinjarra Plain and part of the Leeuwin-Naturaliste Ridge have been cleared and are used mainly for grazing of dairy and beef cattle. In contrast, the Blackwood Area is little developed.

In the Blackwood Area and the uncleared parts of the Leeuwin-Naturaliste Ridge, iron-rich soils are continuous, except for the limestone belt along the west coast, and support a Jarrah (*Eucalyptus marginata*) forest formation with some Marri (*E. calophylla*). In places the understorey is dense with shrubs; in the extreme south-west the forest contains some unusual species, e.g. Pineapple Bush (*Dasypogon hookeri*) and Koolah (*Podocarpus drouyniana*).

The Leeuwin-Naturaliste Ridge contains an outlier of Karri (*E. diversicolor*) between Karridale and Forest Gove, as well as several small patches along inland gullies extending as far north as Ellen Brook. There is also an admixture of Jarrah and Marri with an understorey of *Banksia*, *Agonis* and and often dense layers of shrubs. Coastal heath supports *Acacia* and *Casuarina*. Near the Boranup Sand Patch is the only known locality of a recently-named mallee, *Eucalyptus calcicola*.

Though the Pinjarra Plain is devoted largely to grazing, there are remnants of Jarrah-Marri forest, with undergrowth of Common Blackboy (Xanthorrhoea preissii), Black Gin (Kingia australis), Bull Banksia (Banksia grandis) and Christmas Tree (Nuytsia floribunda) on the alluvial soils. The adjoining Bassendean Dune System has a low woodland vegetation. Jarrah is often present but never dominant. Closer to the coast, Tuart (Eucalyptus gomphocephala) forest with an understorey of Peppermint (Agonis flexuosa) is prevalent on the Spearwood Dune System from Busselton northwards. Flooded Gum (E. rudis) and Yate (E. cornuta) grow in the swampy swale depression lying between the Spearwood and Quindalup Dune Systems, and many wattles (Acacia spp.) are found along the coast.

Large mammals in System 1 are typical of those found in Jarrah forest: Grey Kangaroo (Macropus fuliginosus) and Brush Wallaby (Macropus irma). It is also a stronghold for Ringtail Possum (Pseudocheirus peregrinus), Honey Possum (Tarsipes spenserae), South-western Pigmy Possum (Cercartetus concinnus), Common Dunnart (Smithopsis murina), Common Wambenger (Phascogale tapoatafa) and Short-nosed Bandicoot (Isoodon obesulus). Rarer mammals are Quokkas (Setonix brachyurus) in the thickly vegetated swamps, and on rocky islands offshore from the Leeuwin-Naturaliste Ridge, the White-naped Hair Seal (Neophoca cinerea).

Birds are numerous, but the System is especially important as containing, at Sugarloaf Rock, the southernmost breeding locality of the Red-tailed Tropic Bird (Phaeton rubricauda). It also has the only locality in Western Australia for the rare and endangered Rufous Bristle-bird (Dasyornis broadbenti litoralis).

The Pinjarra Plain within System 1 also forms part of the State's most important wetland complex.

Climate

The peninsular nature of the Leeuwin-Naturaliste block has a moderating effect upon temperature variation. Mean winter temperatures vary between 10° and 15° C. Summer average maxima are in the mid - 20's for Busselton and low 20's for the Capes. Records show that high temperatures are rare close to the coast; 32° C being reached very infrequently. In comparison, Perth's mean maximum temperature for February is 30° C. Although it has cooler summer temperatures, System 1 has winter temperatures similar to those of Perth. The weather tends to be more cloudy, however, although completely sunless days are rare.

Annual rainfall averages 900-1200 mm. The lowest occurs along the north (Geographe Bay), west and south coasts, increasing towards the hinterland centre east of Margaret River township. Most of the rain falls during winter. The average number of rainy days during May-September is 20-40% greater than for the Perth Metropolitan Region.

Land Use

Though farming and forestry are the main industries in System 1, only about 60% of rural holdings are devoted to crops and pastures. The remaining uncleared farmland, together with a large area of State Forest, means that uncleared land comprises about one-half the entire System. Though most of the State Forest is in the Blackwood Area, it does not contain prime Jarrah for timber production. Proposals for pine plantations on a "patchwork" basis in this area have been made by the Forests Department.

None of the streams flowing through System 1 has been dammed, and, apart from a small urban water system which supplies Margaret River, none has been developed as a public water supply. Busselton, the main town in the System, is situated in the Perth Basin and relies on artesian water from that source.

Mining interest is confined mainly to concentrations of heavy mineral sands on the Pinjarra Plain and the Leeuwin-Naturaliste Ridge.

Visitors and Tourism

Because of the rapidly increasing importance of tourism as a major industry, its potential, and the fact that many submissions emphasised recreation, the Committee has studied the findings and the implications of two recent tourist surveys: the 1970/71 Busselton Visitor Survey and the 1972/73 Australian National Travel Association (ANTA) survey of the South West Travel Region (i.e. Mandurah to Albany). The Busselton Survey showed that the peak season for tourism is between Christmas and Easter when some 34,000 people visited the Busselton Shire and stayed overnight. Seventy per cent of visitors originated from Perth and 26% from other parts of the State, and 97% of all visitors travelled by car. Aquatic activities, coastal scenery, forests and caves were the main attractions in the Shire.

The ANTA Survey conducted in the South West region (Mandurah to Albany) in 1971/72 confirms these estimates: 76.9% of respondents were residents of Western Australia, 18.5% came from the eastern States and 4.6% were visitors from overseas. Three quarters of all respondents came to the area solely for a holiday, and 85% travelled by road in their own vehicles. The ANTA Survey concluded that tourism is already a major industry in the region and will become increasingly important. About a quarter of a million people visited the region in 1971/72 and spent over $8 million. It was predicted that expenditure would increase to about $10 million by 1977. Although tourism was directly responsible for the employment of 5% of the region's workforce, its indirect effects on employment increase substantially during the summer months.

As part of its planning programme, the Main Roads Department has established a permanent traffic-count station on the Bussel Highway near Busselton. In 1969/70 average annual daily use was 1500 vehicles (both directions, combined), but this almost doubled during long weekends and averaged 2000 in the summer vacation period. Other surveys conducted by the same Department

indicated that in 1969 an average of over 600 vehicles per day used the Bussel Highway and Caves Road, the main link through the Leeuwin-Naturaliste area. Later counts indicate an increase in traffic volume.

Special Tourist Attractions

Coastal and rural scenery, forests, caves and a moderate climate are attractions of System 1.

The coast between Capes Naturaliste and Leeuwin, where the Indian and Southern Oceans meet, affords panoramic views of an imposing succession of exposed rocky headlands, sandy beaches and rugged limestone outcrops. On the north coast, where small sandy bays are sheltered behind Cape Naturaliste, shady valleys and wooded hills extend almost to the water; further inland undulating farmland alternates with forest and bushland.

The Pinjarra Plain flanking Geographe Bay contrasts sharply with the Leeuwin-Naturaliste Ridge. Wide sandy beaches border the quiet waters of the Bay offering ideal conditions for family recreation. On the south coast, the Hardy Inlet and lower reaches of the Blackwood River form one of the most extensive inland waterways in the State. The Blackwood River is navigable for small craft from its mouth at Augusta upstream beyond Alexandra Bridge. The System contains especially attractive forests of Tuart, Karri and Jarrah-Marri, all accessible to the motorist. There is a variety of fishing attractions, including rock-fishing along the Leeuwin-Naturaliste coast, boat and jetty fishing in Geographe Bay, and bank and boat fishing and crabbing in the Blackwood River. The limestone caves in the Yallingup-Augusta area are important scientifically as well as being popular tourist venues. In 1972/73, over 60,000 people visited the four caves open to the public.

The ANTA Survey also stressed the need for greater planning of tourist facilities and development, and expressed the view that improvements were needed in urban landscaping, boating and swimming facilities, museums and historical displays and scenic drives.

As a result of the finds of the earlier Busselton Visitor Survey the Tourist Development Authority considered that the area's relaxing holiday atmosphere and attractive scenery should be promoted. Visitors indicated that aquatic activities and coastal scenery were the most popular attractions, followed by caves, clean beaches and the general landscape. Twenty-one per cent of visitors had no "bad impressions", but many complained of the flies. Two-thirds of the visitors indicated that they had visited the area more than once, and 95% stated that they would visit it again and recommend it to others.

CONSERVATION RESERVES

A large proportion of the System is State Forest, The Leeuwin-Naturaliste Ridge contains several small National Parks and reserves which are discussed below under Area 1.4.

Recommendations are made on the following areas:

1. Ludlow-Wonnerup area
2. the Broadwater
3. Whicher Range
4. Leeuwin-Naturaliste Ridge

1.1 LUDLOW-WONNERUP AREA

Special features of the Ludlow-Wonnerup area are the well-developed Ludlow Tuart forest (Fig. 1.1), the open water of the Vasse-Wonnerup estuary (Fig. 1.2), the beach on Geographe Bay, and a number of historic sites. The Committee concludes that a conservation reserve extending from the Tuart forest to the coast should be established for the following reasons;

a) the aesthetic value of the three main components of this area;
b) the biological value of the Tuart forest and of the wetlands within the estuaries;
c) the popularity of Busselton as a holiday resort to which people are attracted from considerable distances;
d) the developing urban and industrial centre at Bunbury only a short distance to the north;
e) the absence of any substantial area of public land between the two coastal centres of Bunbury and Busselton; and
f) the view held by the Environmental Protection Authority that adequate management of the South West coastal strip is of very great importance in total environmental planning in the State.

The only extensive areas of publicly owned land in this district are sections of State Forest (between Wonnerup and Capel) and the open-water sections of the Broadwater-Vasse-Wonnerup estuary system. Numerous small reserves of the urban open-space type exist within the Busselton townsite, including those along Geographe Bay and the shores of the estuary. Otherwise the area comprises mainly freehold land.

The Ludlow-Wonnerup area is a unique biological/recreational entity. Under proper management a national park including the open bay, estuary, forest and historic buildings would be a public asset of great significance.

Tuart Forest

The Tuart forest on the eastern side of the proposed park is of special interest to visitors and to botanists. Tuart is confined to Coastal Limestone between the Hill and Sabina Rivers, and the best stands occur in the Ludlow area.

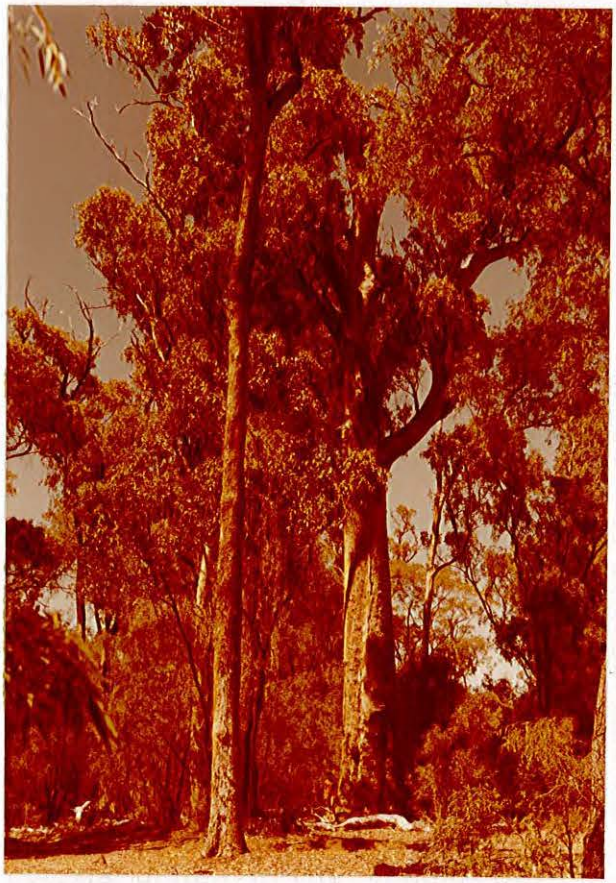

Figure 1.1. Ludlow forest with Tuart (*Eucalyptus gomphocephala*) and Peppermint (*Agonis flexuosa*).

Figure 1.2. Aerial view of Ludlow - Wonnerup area, showing Tuart forest and the estuary.

The main values of the Tuart forest at Ludlow may be outlined as follows:

a) It is probably the type locality for Tuart (Eucalyptus gomphocephala) first described by de Candolle from a collection made by Leschenault in 1803 from "Geographe Bay".

b) It is the only savannah forest in the southern part of the State.

c) The forest is scenically attractive. The trees are tall (up to 42 m) with high shady canopies. The trunks have light grey bark different from that of other forest trees in the South-West. The forest has a drooping under-storey of Peppermint (Agonis flexuosa). These characteristics combine to provide a beauty that is unusual in the South-West.

d) The forest is a source of Tuart seed stock.

Part of the State Forest at Ludlow was planted with pines many years ago (810 ha of a total 3230 ha), and grazing has been permitted within the natural forest to reduce the need for protective burning. The forest was first dedicated under the Forests Act of 1918 and, to safeguard it, nearby private land was purchased in 1919. The Forest Department's aim is to perpetuate the Tuart through a carefully controlled regeneration programme. As part of its forest recreation programme, the Forests Department has recently provided picnic tables, benches and barbecue facilities beneath the trees.

Estuaries

A special feature of the estuary system is the permanence of its open water which provide valuable wetlands.

The Wetland Complex of the Pinjarra Plain is the most important in the State, and is a drought refuge to which waterfowl migrate from other wetland systems further inland. Though extensive areas of the System are flooded during winter, its capacity as a refuge relies on the maintenance of permanently-flooded areas. These wetlands have been subject to competing uses which have resulted in their partial destruction as a waterfowl habitat (Riggert 1966).

The Vasse Estuary attracts many waterfowl during drought. It is also their breeding ground during winter. Black Swans (Cygnus atratus) have a large nesting colony along the northern and western sides of the estuary. Aerial surveys at the end of the breeding season have shown as many as 20,000 swans and 25,000 ducks. Also to be seen are large numbers of White Egrets (Egretta alba), White-faced Herons (Ardea novaehollandiae) Pacific Herons (Ardea pacifica) and many other wading birds. The area maintains these large residential and breeding populations because the dense vegetation along the shoreline provides cover and nesting sites.

In its present state the Wonnerup Estuary contains fewer waterfowl than in the adjoining Vasse Estuary, mainly because it has been drained so that livestock may graze after early summer. Grazing is so intense that there is little vegetation regrowth during the wet season and many waterbirds cannot find suitable nesting cover. The area should be restored as a wetland equal in significance to the Vasse. The estuaries are not suitable for recreational sports such as water skiing and swimming but are particularly suitable as wildlife habitats.

Landscape

The third component of the Ludlow-Wonnerup Area is the land surrounding the estuarine system, lying between the Tuart forest and Geographe Bay. The area is traversed by several attractive Tuart-lined country roads.

The area is rich in local history. The National Trust of Australia (WA) has acquired and restored "Wonnerup House", situated off Layman Road west of the Tuart forest. It was opened to the public in November 1973. Further west on Wonnerup Inlet is historic "Lockville" which is privately owned. Wonnerup is also the site of a timber-milling enterprise for which the State's first railway was constructed over a century ago. The "Ballarat", one of the original locomotives, is on display in Busselton.

The area also contains other historically important homesteads such as "Cattle Chosen", which are not open to the public.

The remainder of the area is relatively unknown to visitors who use the popular beachfront closer to Busselton. Minor public use is made of foreshore localities within or adjacent to the area at Wonnerup and Forest Beach.

The restoration and opening of "Wonnerup House" by the National Trust has generated considerable interest in the Ludlow-Wonnerup Area. The Forests Department recently acquired and incorporated into the State Forest a block of undeveloped land on Layman Road opposite "Wonnerup House" for recreational purposes.

Possible developmental pressures

Current developmental pressures could substantially reduce the conservation/recreational values of the Ludlow-Wonnerup area.

Housing development is the most threatening of these. Geographe Bay opens to the north; its shores are partially sheltered from prevailing winds, and its waters are generally quiet. This contributes to the popularity of Busselton as a resort and encourages housing development along the coast from Wonnerup to Dunsborough.

The only housing development between Busselton and the Capel River is at Peppermint Grove Beach. There is a danger that, even with control of subdivision, housing development may occur throughout this area by the promotion of share schemes similar to those elsewhere along the coastline.

Proposals have also been made to develop part of the Wonnerup area as a caravan park.

Mining interest has been shown in Geographe Bay and estuary foreshores and the Tuart forest. Mineral sand deposits occur in the Quindalup Dune System along the Geographe Bay foreshore, and in the Spearwood Dune System about 5 km inland, stretching from north of Capel to Ludlow. Ilmenite is the dominant heavy mineral with subsidiary rutile. While minor dredging has been carried out in the vicinity of Wonnerup Inlet and other mining (outside of Area 1.1) is taking place in State Forest pine plantations near Capel, no approval has yet been given to the numerous mineral claims in the Tuart forest.

A minor developmental pressure results from the possible modification of Bussell Highway (to accommodate increasing traffic) which would require felling of some Tuart trees, and would interfere with the character of the road verge.

The National Parks Report (1962) recommended that:

"1. a strip of five chains in width on either side of the main road where it passes through Ludlow State Forest be set aside and proclaimed a Class A reserve for the preservation of flora (i.e. Tuart Forest) and vested in the Conservator of Forests as a National Nature-Reserve;

2. should any portion of the Ludlow State Forest still carrying Tuart become no longer economically important for the preservation of Tuart for forestry purposes, it be proclaimed a Class A reserve for the preservation of flora and vested in a Statutory Body having control of other National Parks;

3. the assurances of the Conservator of Forests should be sought that the area of Ludlow State Forest still carrying Tuart should on no account be cleared of Tuart Forest and replanted with alien timber."

Submissions received by the Committee suported these recommendations. The Conservator of Forests endorsed the above recommendations but considered that the Working Plan prepared under the Forest Act provides adequate protection. However, the Conservator also suggested that the Committee "may care to recommend against any mining or prospecting developments on the remaining portions of State Forest 1 and 2 still carrying Tuart".

A submission by the Department of Fisheries and Fauna recommended that the Vasse Estuary be preserved as a waterfowl sanctuary, giving it full protection against commercial development and recreational activities; and that the Wonnerup Estuary in its entirety be acquired for the same purpose. The Department also proposed a management programme to return the water to its normal level, to exclude livestock and to allow normal vegetational re-growth.

The Town Planning Department, which recently conducted and reported on a recreational/resort development survey of the South West coast identified a need for "Natural Environment Areas" along the coastline between Mandurah and Cape Leeuwin and focussed attention on the Wonnerup area.

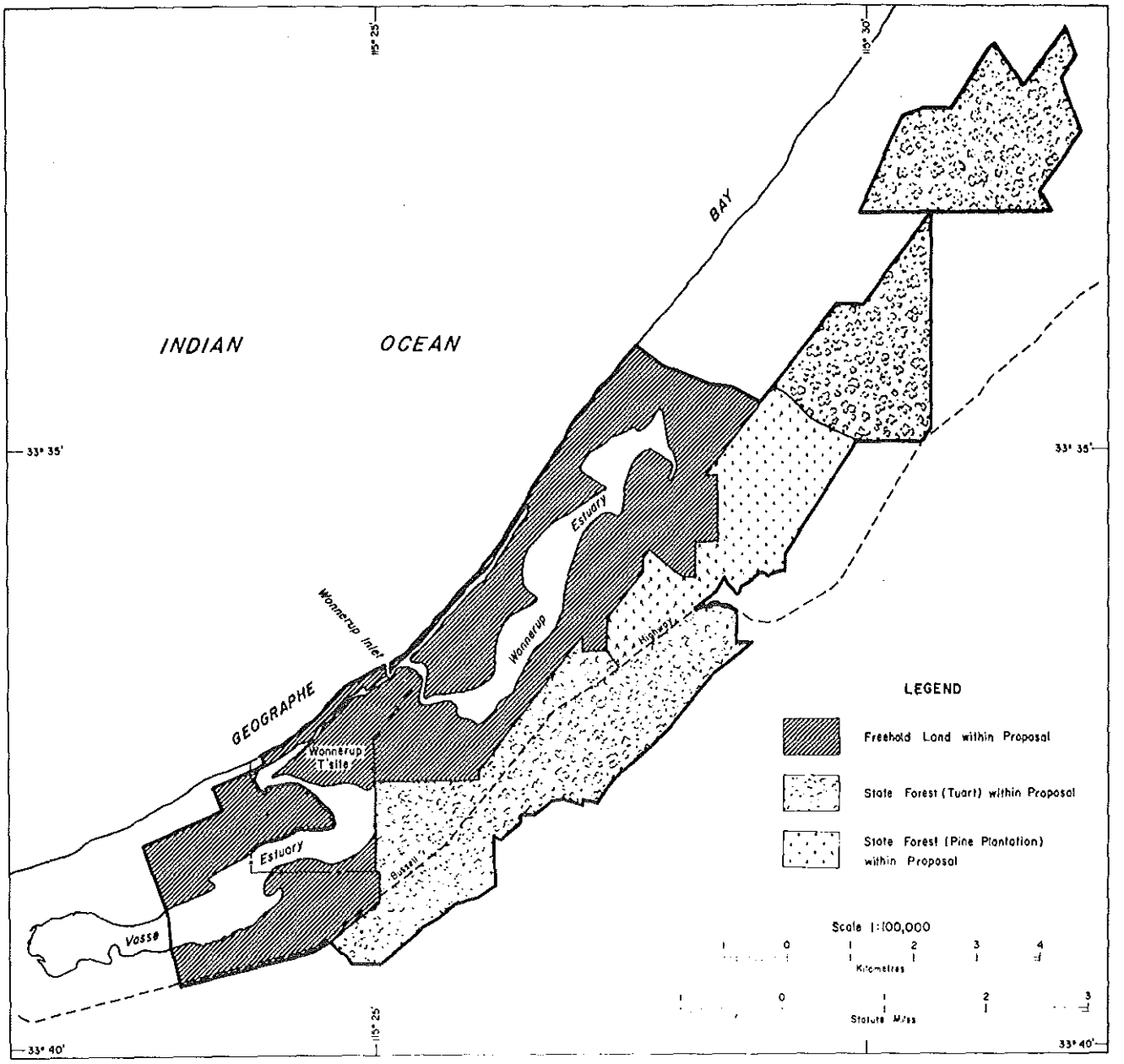

Figure 3 Eudlow - Wonnerup area map

Recommendations

The Committee recommends:

a) General

1. that the Ludlow-Wonnerup area, as delineated in Fig. 1.3, be managed by a Committee of Management as though it were a National Park;

2. that the Committee of Management comprise representatives of appropriate public authorities - the Forests Department, the proposed Estuarine Conservation and Management Committee of the Environmental Protection Authority, the National Parks Board and such other Authorities as might be considered appropriate;

3. that the Government purchase all freehold land within the delineated area and place it under the control of the proposed Committee of Management;

b) Ludlow Tuart Forest

4. that all of Ludlow forest as delineated in Fig. 1.3 remain a proclaimed State Forest under the control of the Conservator of Forests and be managed by the Forests Department in liasion with other authorities (through the proposed Committee of Management recommended in 2 above) as though it were a National Park;

5. that the remaining portions of Tuart forest within the area be retained in perpetuity and managed to maintain their conservation/recreation values; that there be no further planting of exotic forest species and that mining be not permitted;

6. that consideration be given to replacing pines with Tuart as pines are cut down, but it is recognised that the management of the forested parts of area 1.1 by the Forests Department may depend on the retention of pine growing/milling operations in the vicinity of Ludlow;

7. that no mining within the pine plantation in area 1.1 be approved until a pilot study has demonstrated that Tuart can be satisfactorily re-established after mining;

8. that, while recognising that proposed extensions of current mining operations near Capel will require the realignment of Bussel Highway and the railway, the Main Roads Department, the Railways Department and local authorities be informed of the special importance attached to area 1.1, and be requested to respect the verge flora associated with the Tuart forest;

c) Vasse and Wonnerup Estuaries as delineated in Fig. 1.3

9. that this area be brought under the control of the proposed Estuarine Conservation and Management Authority of the Environmental Protection Authority and that they investigate the boundaries with a view to deciding whether these should be extended to include more of the Broadwater-Vasse-Wonnerup estuary;

10. that the proposed Estuarine Conservation and Management Authority of the Environmental Protection Authority be asked to investigate the desirability of continuing the lease of Crown land on the margin of Wonnerup Inlet at the mouth of Malbup Creek;

11. that no mining be permitted within the Vasse-Wonnerup Estuary;

d) Geographe Bay Coast

12. that the following camping and recreation reserves situated on the shores of the Vasse-Wonnerup Estuary or nearby Geographe Bay foreshore, be

a) consolidated and enlarged where possible, and extended to the low water mark of adjoining tidal waters;

b) proclaimed Class A for National Park and placed under the control of the National Parks Board of Western Australia;

These are:

reserve No. 31188, C Class for Recreation Area, not vested, area 4 ha ; (locality C, Fig. 1.3)
reserve No. 385, A Class for Camping and Recreation Area, controlled by the Busselton Shire Council, area 11 ha;
reserve No. 5217, A Class for Camping and Recreation Area, vested in the Busselton Shire Council, area 11.2 ha;
reserve No. 22952, C Class for Camping and Recreation Area, vested in the Busselton Shire Council;

13. that no extension of existing approved mining tenements be granted and that consideration be given to discontinuing their tenure forthwith. There should be no further approval of applications to mine within Sub-area 1.3.

1.2 THE BROADWATER

The Committee considered the current status of The Broadwater, a narrow central strip of which is a Class C reserve for the "Conservation of Flora and Fauna" vested in the WA Wild Life Authority. The remainder is freehold. The Broadwater, which lies west of Busselton, forms part of the loosely connected estuary system within the Stirling Swale that naturally intercepts streams flowing toward the coast from the Whicher Range. Originally, the whole system had a common outlet to the sea through Wonnerup Inlet, and swampy country west of Busselton drained eastward within the swale to the Broadwater, which forms a freshwater swamp.

Recommendation

The Committee recommends that the West Australian Wild Life Authority be asked to give an opinion as to whether it would be desirable to enlarge the reserve and whether any other measures are needed to conserve its value as wildlife habitat.

1.3 WHICHER RANGE

The Whicher Range forms a low, curving scarp between the southern end of the Darling Scarp and the Leeuwin-Naturaliste Ridge. South and southeast of Busselton, between Jalbarragup Road and Vasse Highway, it is over 100 m high and consists of Mesozoic sediments with a laterite capping. The foot of the scarp is an old shoreline and abuts the low-lying Pinjarra Plain. A number of ephemeral or semi-permanent streams form the headwaters of the Sabina River, which flows north into the Vasse Estuary, and the north branch of the Margaret River which flows westward. The vegetation of the Range is predominantly a Jarrah-Marri forest interspersed with sandy areas dominated by Banksia attenuata.

The Mountain Marri (Eucalyptus haematoxylon) occurs in the area and is one of the few other Eucalypts which are associated with Jarrah-Marri forest. It is a rare species unique to the South-West, growing only in one other area, near Pinjarra.

The flora is rich, and while many species are typical of Jarrah forest, a number indicate that the area has a special significance in the floristics of the South-West. There are several relict populations of species which have their principal distributions elsewhere, e.g. Dryandra baxteri and D. formosa, the main populations in the Albany region, a white Smokebush (Conospermum acerosum Fig. 1.4) between Perth and Eneabba; the Dwarf Cypress (Actinostrobus acuminatus) near Badgingarra. Others are endemic to the Whicher Range. They include Grevillea brachystylis, an as yet unnamed Grevillea and a subspecies of Banksia meisneri. Some of these occur on road verges at the foot of the Whicher Range. Wildflowers are profuse in winter and spring.

A detailed study of Dampiera linearis has shown that in the Whicher Range there are two chromosomal races - a diploid on the old lateritic soils and a tetraploid on the lower, younger soils. Further, the diploid plants contain from one to five B chromosomes, and plants with these have a range extending beyond that of the normal diploids. This species offers an excellent opportunity to study the process of speciation. Several important populations are now confined to road verges at the foot of the scarp. (Bousfield, 1971).

There is a wide variety of bird life and Grey Kangaroo and Brush Wallaby are plentiful, but the fauna has not been studied in detail.

The area is scenically attractive and biologically important. The Range provides extensive views across the Pinjarra Plain to the sea.

The area proposed for reservation is part of State Forest No. 33. It contains no natural commercial timber. The Forests Department has established pine plantations in the vicinity, but at present there are none within the proposed reserve.

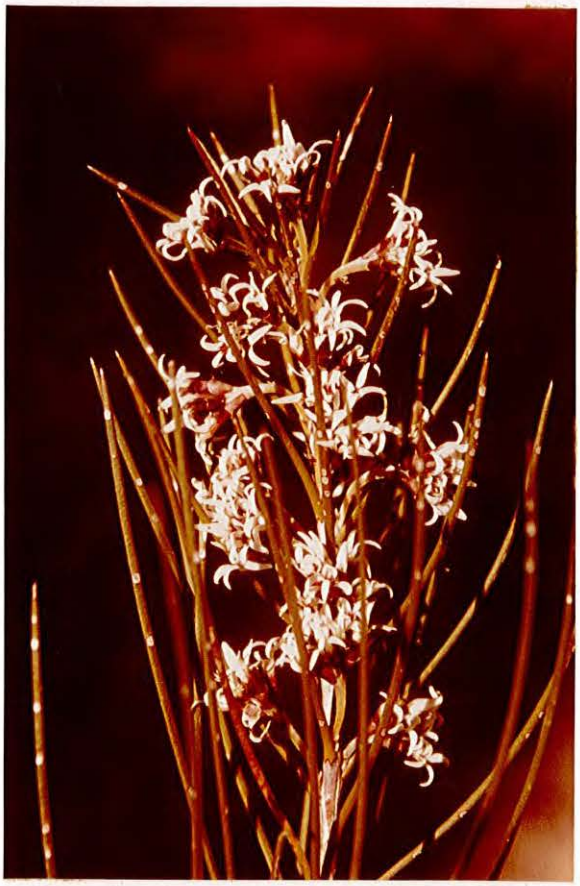

Figure 1.4. Needle Smokebush (Conospermum acerosum) from the Whicher Range

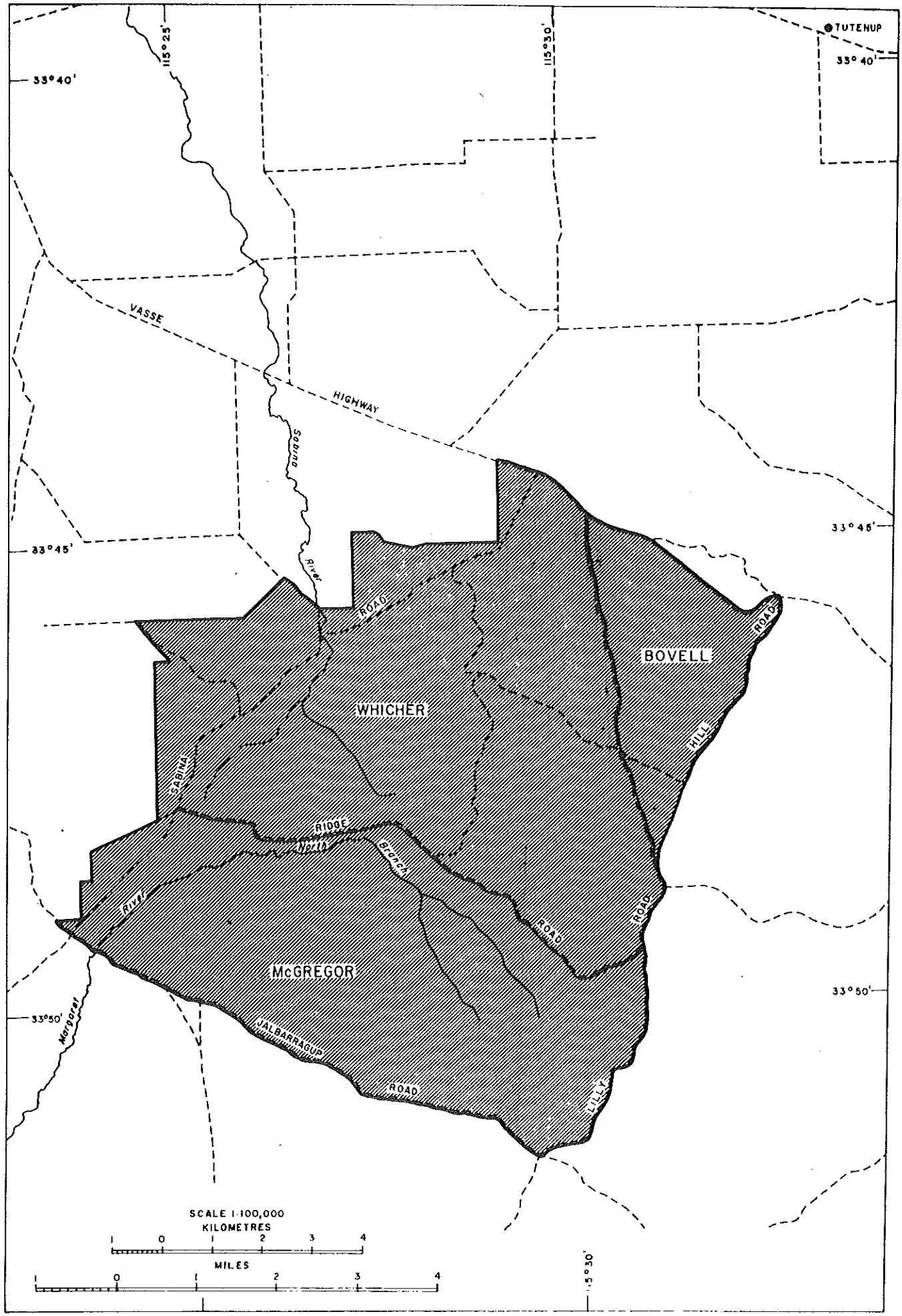

Figure 1 5 Area map of proposed Whicher Range reserve

Recommendation

The Committee recommends

1) that the following blocks of State Forest No. 33 be released from the State Forest and made a Class A reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority; namely McGregor, Whicher and part of Bovell as shown in Figure 1.5;

2) that, on the coastal plain between Jalbarragup Road and Wonnerup Road, road verges still carrying natural vegetation be protected.

1.4 LEEUWIN-NATURALISTE RIDGE

The Committee received many submissions recommending the creation of new reserves along the Leeuwin-Naturaliste Ridge, between Caves Road and the coast. Much of this area is cleared and is used for dairying, beef cattle and, in recent years, viticulture. Because of the far-reaching implications of some proposals contained in the submissions, the Committee has also considered the eastern side of the Ridge. General recommendations concerning this area are embodied in its report.

The area's outstanding physical features, its moderate climate and its proximity to the Metropolitan Area, have already led to a striking increase in the numbers of visitors (see figures above).

Of the multiplicity and beauty of the Ridge's natural assets there is no question. Between the Capes, beaches alternate with rugged headlands and cliffs (Fig. 1.6); many are accessible only with difficulty.

A carefully planned system of spur roads from Caves Road to the many swimming, surfing and fishing spots would undoubtedly attract even greater numbers of visitors and holiday-makers.

These beautiful places should be seen and enjoyed by as many people as wish to visit them. But the Committee is nevertheless apprehensive at the prospect of unco-ordinated development, especially on freehold land, some of which extends to within a short distance of the coast. Our visit to the area and inspection of aerial photographs convinced us of the high incidence of sand erosion, which may have been caused or exacerbated by human activity. On this exposed, windy coastline, damage to, or removal of, the protective coastal vegetation inevitably causes rapid drift of the sand dunes.

Development along the western coast between the Capes should, as far as possible, be confined to areas of existing townsites such as Yallingup, Cowaramup and Prevelly Park. Vehicular access to the coast between these settlements should be limited to a few spur roads. We suggest the establishment of a system of walking trails, supplemented perhaps by one or two

Figure 1.6. Coast near the mouth of Willyabrup Brook

access roads. If imaginatively designed, these trails could become an important attraction. Walkers could, for example, easily manage the journey from Naturaliste lighthouse to Sugarloaf Rock in one day and camp in the vicinity overnight. They could then either move on to Yallingup the next day or drive to another path in the Leeuwin-Naturaliste area. The Committee's excursion from near Moses Rock, across moors richly carpeted with wildflowers, to a spectacular but little-known waterfall on Quininup Brook (Fig. 1.7), all within in sight of the ocean and coastline, and the return across cleared pasture, emphasised the enhancing role which agricultural land can play in "breaking" natural landscape. There is no reason why walking trails such as these need be confined to the coast. The forests, caves, vineyards and historic sites further inland could easily be connected with coastal trails, thus extending the range of interest and enjoyment.

The area contains a large number of limestone caves which are archeologically important and naturally beautiful. On the Leeuwin-Naturaliste Block, the soluble Coastal Limestone lies upon gneissic base rocks which are almost impermeable, and ground water is concentrated in streams that flow through cavernous channels just above bedrock (Bastian, 1964). These high and spacious cave systems form an interconnected complex through which the streams eventually make their way to the coast, where many emerge as seafront springs.

Some cave formations are exceptionally well developed: straw stalactites (Fig. 1.8) helictites, shawls and lake and pool deposits. Some cave floor deposits in the area contain many remains of extant and locally or totally extinct marsupials including the nototherе (Zygomaturus mitchellii), Giant Echidna (Zaglossus hacketti), Tasmanian Tiger (Thylacinus cynocephalus), Tasmanian Devil (Sarcophilus harrissii) and Koala (Phascolarctos cinereus). The best-known fossil locality is Mammoth Cave, although Devils Lair in the Boranup district is of equal or greater scientific importance. Associated with the marsupial remains are fossil human teeth and bone fragments of great antiquity. Their archaeological and anthropological significance cannot be overstressed, for radiocarbon dates obtained from them demonstrate unequivocally that Australia has been occupied by man for tens of thousands of years. The beauty of these caves attracts many thousands of visitors who are at present restricted to a few caves open for public inspection. There will undoubtedly be future pressure to open additional caves. The Committee believes that to preserve the essential features of the cave system, carefully planned and co-ordinated management is necessary.

Several majestic stands of Karri in the southern part of the area are outliers of the main Karri belt centred on Pemberton, 160 km to the east. The stands remaining in State Forest No. 45, near Karridale (the headquarters of M.C. Davis's timber empire in the late nineteenth century) and Augusta are impressive and should be preserved to retain variety in this outstanding recreation and conservation area.

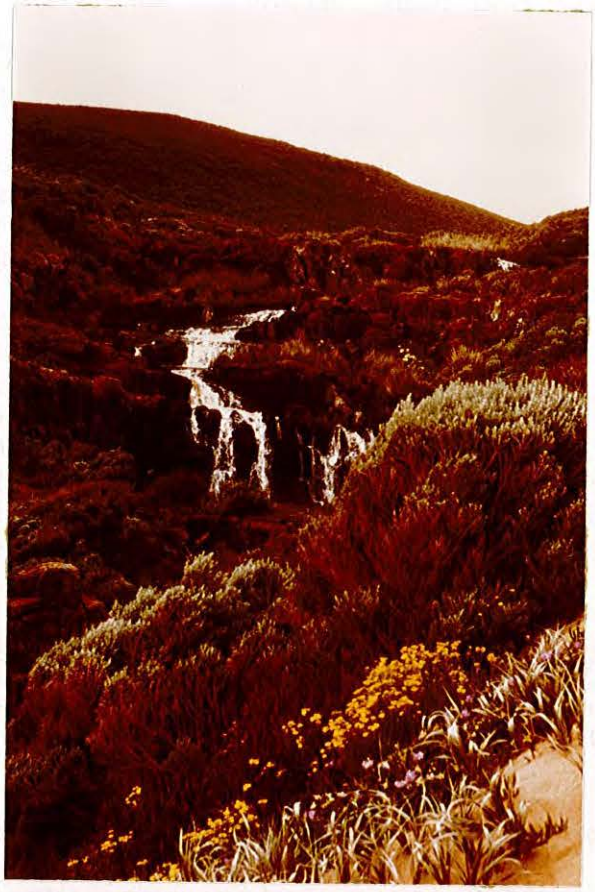

Figure 1.7. Waterfall on Quininup Brook.

Figure 1.8. Straw stalactites in Easter Cave.

North of the Boranup Sand Patch is an area of vacant Crown land which, together with a Temporary Reserve (part of Sussex Location 1358), is currently held as a Grazing Lease, no. 3116 - 3718, on an annual basis. The area contains nearly all the natural occurrence of the recently named and rare mallee Eucalyptus calcicola. This lime-loving species has great potential for protective planting in coastal areas, and its seed source should be preserved.

The vegetation here is diverse and has also a protective function in preventing erosion. Soils are sandy occurring either as dunes or lying shallowly over limestone. Rough grazing is the only feasible primary industry here, and the periodic burning for "pasture improvement" presents a fire hazard to surrounding reserves and State Forest.

It is anticipated that reserves to the north and south will be consolidated into a national park, and that State Forest No. 45 will be managed as though it were a national park. Only a narrow strip along the coast is at present reserved. The area of the temporary grazing lease should be incorporated within the proposed park for conservation and recreational reasons.

The area is of great historic significance to Western Australia. Here are farms settled by some of the first European colonists, as well as relics of early whaling activities, remnants of the once-important timber port at Hamelin Bay, the old settlement site at Karridale, and two lighthouses.

It is clear to the Committee that for various reasons some land currently in private hands should be acquired. There are, for example, some reserves presently separated by uncleared freehold land, and the establishment of continuity would greatly increase their value for conservation purposes. The Committee recognises that little money is available for acquisition of freehold land by the Crown. Nevertheless we emphasise that in the area of the Leeuwin-Naturaliste Ridge, relatively small expenditure on the purchase of carefully selected blocks could result in the establishment of enlarged reserves, which will return a value both in land acquired and in the enhancement of existing reserves.

The National Parks Report (1962) recognised the importance of preserving the southern portion of the Leeuwin-Naturaliste Ridge when it recommended that an expert committee be established to make recommendations on its division into either a Class A reserve for fauna and flora or a Class A reserve for public recreation. What the Academy committee wrote of the southern portion of the Ridge (designated in the report 'The Margaret River-Hamelin Bay area') is, in our view, equally applicable to its whole: "The area is an outstanding one and its proper control and development will play a great part in the future of tourist activity in the Margaret River, Augusta and Busselton district."

ost submissions received by the Committee supported this ssessment. The author's of one considered the country west f the disused Busselton-Augusta railway line to be "....outtanding in its beauty, geology and its importance as a recent ecological island'." The Conservation Council of WA accorded he area urgent priority in view of its quality, "enormous ecreational and scientific potential" and its attraction to eople from the Metropolitan Area and expanding towns of the outh-West. A seminar organised by the University of Western ustralia's Extension Service at Busselton concluded that the est coast and the Capes are the most (their emphasis) important tourist ssets of the region. And the Department of Fisheries and auna noted that the Margaret River-Hamelin Bay region contains he best caves in the South-West and has outstanding scenery nd vegetation. Other submissions contained similar statements nd emphasis.

he Committee inquired into the mineral potential of the eeuwin-Naturaliste area west of Caves Road. It was accompanied n its field trip by an officer of the Geological Survey of estern Australia who had expertise in the geology of mineral ands. He explained that mineral-sand deposits along the eeuwin-Naturaliste coast occur in restricted pockets and hat it might be possible to exploit these with little disurbance to the total coastal system. A Confidential Appendix is attached to this Report.

e consider it important that mining operations be not permitted ntil an investigation has assessed their environmental impact nd that, if mining is permitted it should be subject to lose and constant supervision by the Environmental Protection uthority.

urrent Reserves

arly interest in caves and associated resort development led o the establishment in the area of a large number of small eserves (Figs. 1.9-12) with a total area of about 10,000 ha, ncluding 4,600 ha of cave reserves. In addition, early oresight led to the establishment of a foreshore reserve of t least 200 m along most of the coast between the Capes. uring the last few years, some of these reserves have been ncorporated into four small National Parks, viz:

allingup	1885 ha
owaramup	880 ha
amelin Bay	1260 ha
ape Leeuwin	1101 ha
	5126 ha

he last area was recently purchased by the State Government.

espite this advance the distribution of reserves in the area emains uneven. There are too few in the northern two thirds f the Ridge, and many reserves are separated by adjoining locks of private land. The Leeuwin-Naturaliste Ridge is n outstanding natural asset. Its potential is inestimable, specially for Western Australians living in the populous outh-West.

We have already noted that much of the considerable scenic beauty of the Leeuwin-Naturaliste Ridge lies in its harmonious integration of diverse natural and man-made landscapes. If this identity is to be preserved, development in the area and the uses to which both public and private lands are put must be carefully planned and controlled.

Recommendations

The Committee recommends:

1. that all reserves in the area (Figs. 1.9 to 1.12) be consolidated into a single Class A reserve for National Park and be placed under the control of the WA National Parks Board;

2. that all vacant Crown land as shown in Figs. 1.10, 1.11 and 1.12 be incorporated into the proposed National Park;

3. that the Conservator of Forests be asked to manage State Forest No. 45 (Figs. 1.11, 1.12) as if it were a National Park, and that the methods employed take account of possible direct mechanical damage to caves, as well as indirect deleterious effects such as those resulting in interference with the watertable;

4. that an expert Committee be appointed by the Environmental Protection Authority to co-ordinate the management of the area, and that this Committee comprise representatives of the National Parks Board, the Conservator of Forests, the West Australian Wild Life Authority and such other persons, or representatives of Authorities, as the Environmental Protection Authority deems appropriate;

5. that selected freehold land be purchased and included in the proposed National Park.

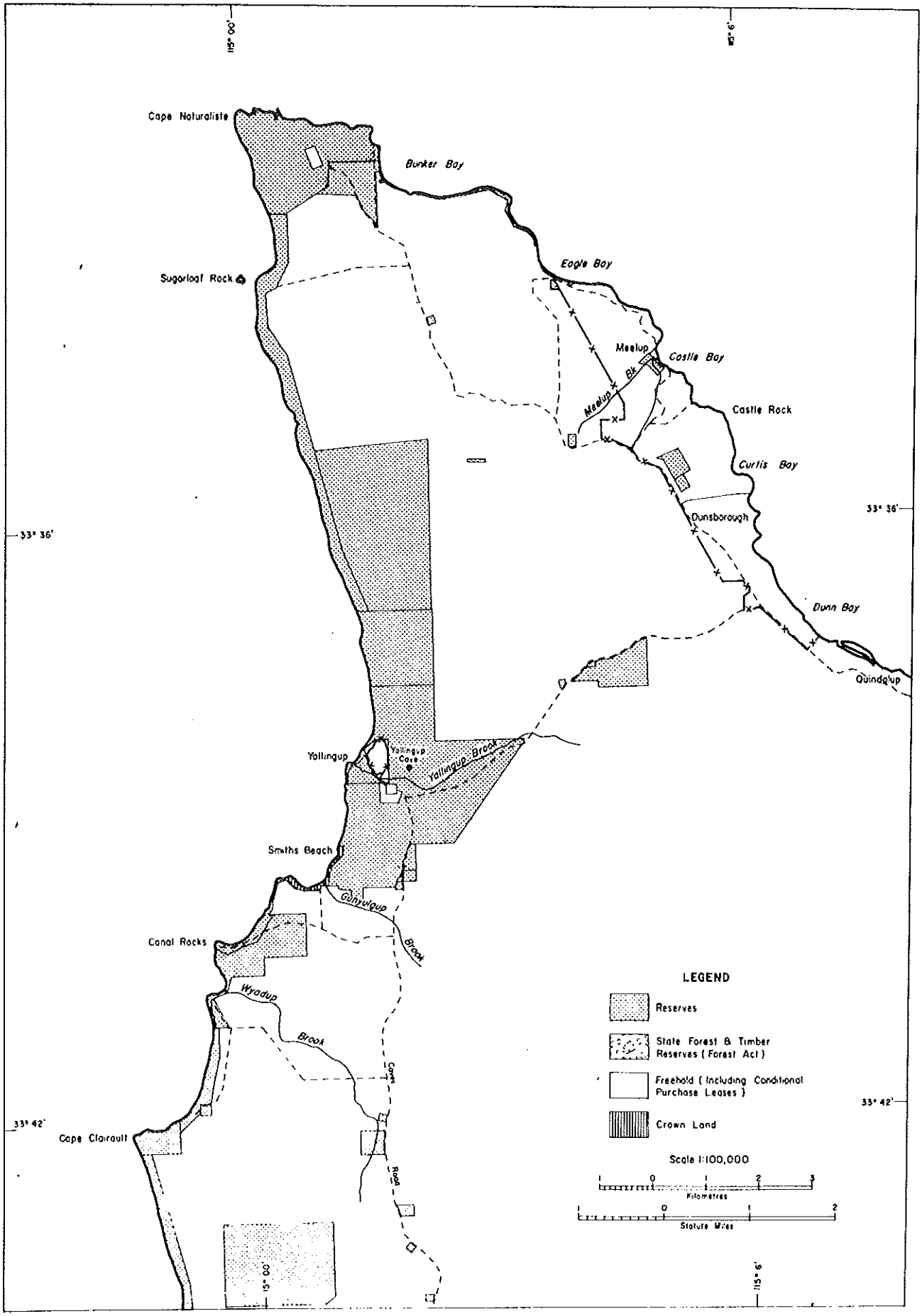

Figure 1·9 Leeuwin – Naturaliste area map 1.

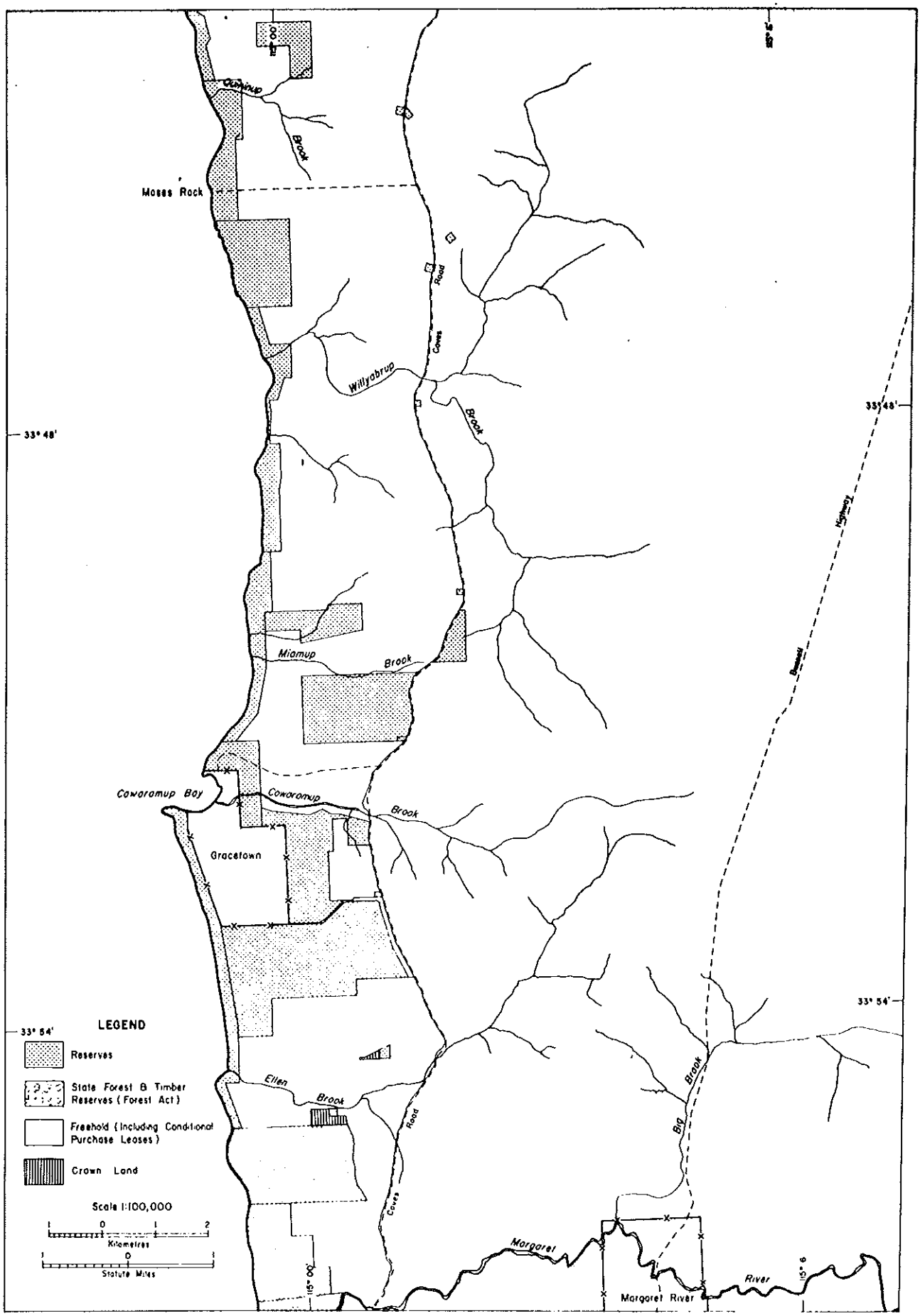

Figure I 10 Leeuwin - Naturaliste area map - 2

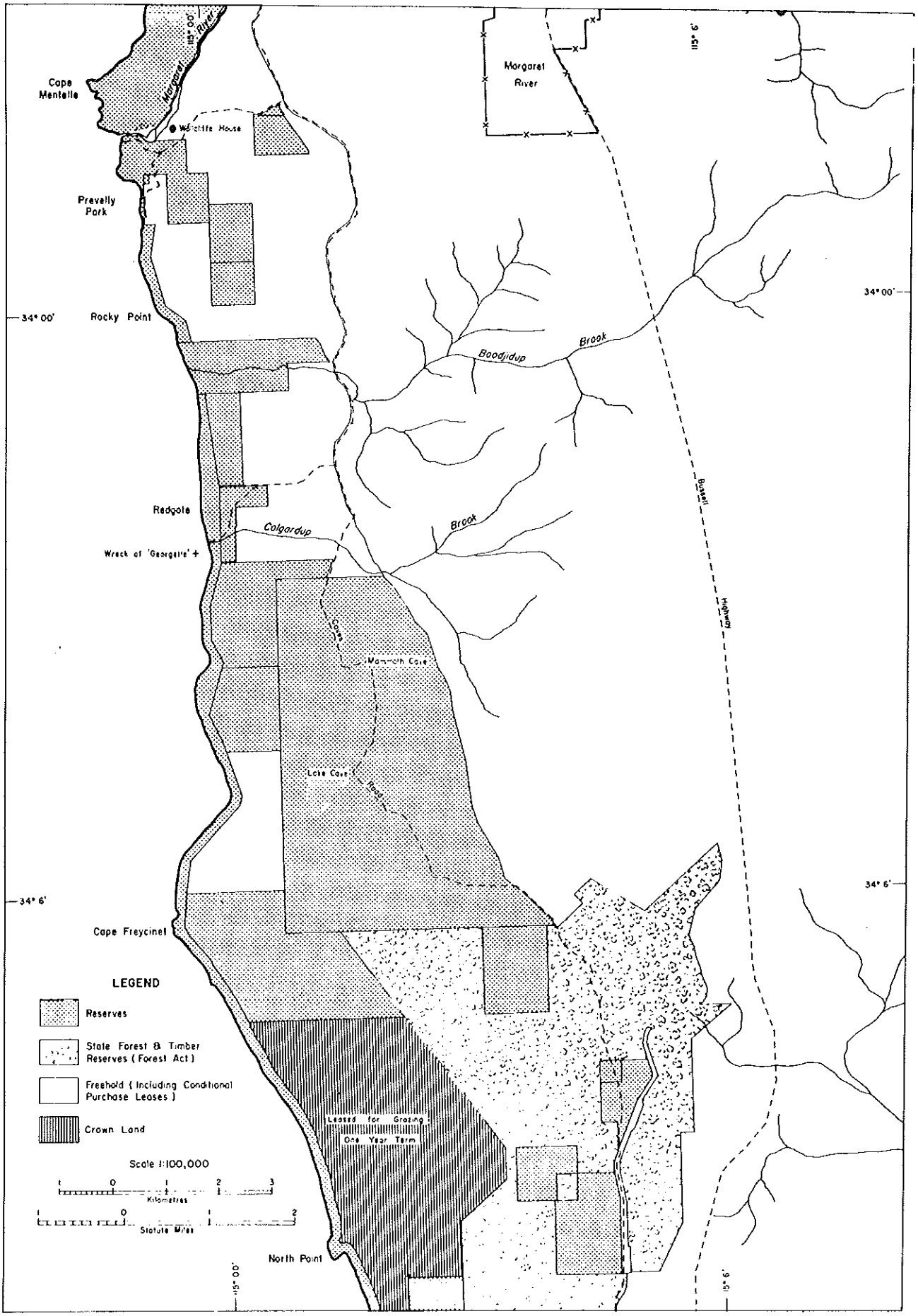

Figure I-11 Leeuwin - Naturaliste area map - 3

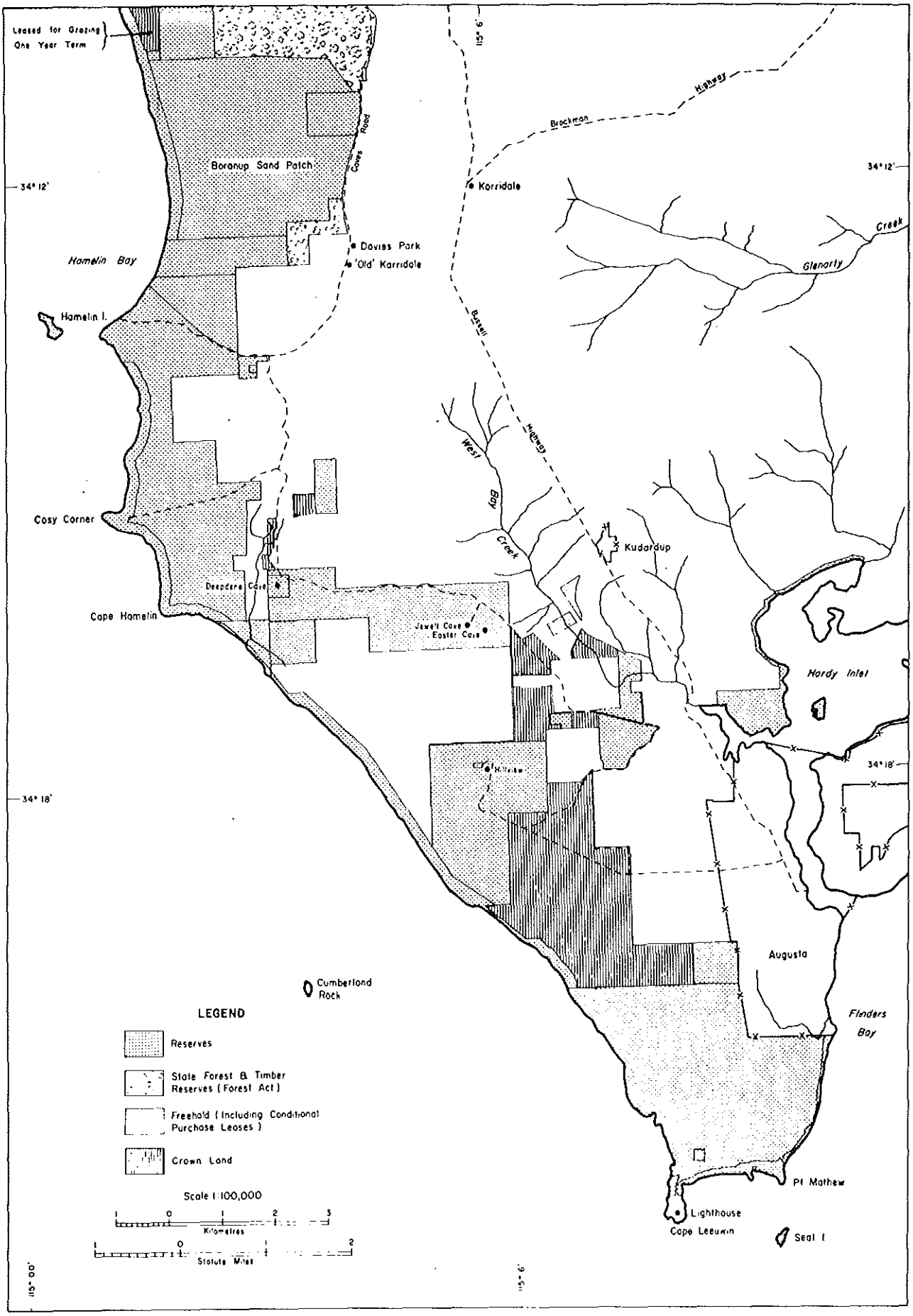

Figure 1-12 Leeuwin - Naturaliste area map - 4

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SYSTEM 2 - SOUTH COAST

INTRODUCTION

Area and Physiographic Features

As delineated in Fig. 2.0, System 2 comprises about 18,460 km^2. Its southern border is the coast between Augusta and Hassell Beach; inland the boundary stretches in a south-east direction north of Donnybrook. Bridgetown, Rocky Gully and Mt. Barker.

The area between Augusta and Pt. D'Entrecasteaux lies within the southern portion of the Perth Basin where a considerable thickness of Phanerozoic sedimentary rocks has been deposited west of the Darling Fault. The northern Blackwood area within this province is mainly undulating hills of Mesozoic sedimentary rocks capped with laterite and sand (Lowry, 1967).

The southern part, the Scott Coastal Plain, is mainly low lying swamp which was formed when coastal dunes blocked an earlier drainage system. It extends from Hardy Inlet to the vicinity of Point D'Entrecasteaux.

The Bunbury Basalt issued from fissure vents along the Darling Fault during the Early Cretaceous and flowed down valleys on an ancient land surface. Small outcrops of basalt are now exposed at a number of inland localities in the Blackwood area, the Scott Coastal Plain and at Black Point on the south coast.

Precambrian granite, migmatite and metamorphic rocks predominate east of the Darling Fault, but the area has not be mapped geologically on a regional scale and the emplacement and structure of these rocks is not fully understood. Prominent exposures of granite occur at Mt. Frankland and Mt. Chudalup, and also in the Porongurup Range and the Albany district. To the north and east of Albany, and as far west as Walpole, Upper Eocene sandstones and siltstones mantle the older rocks.

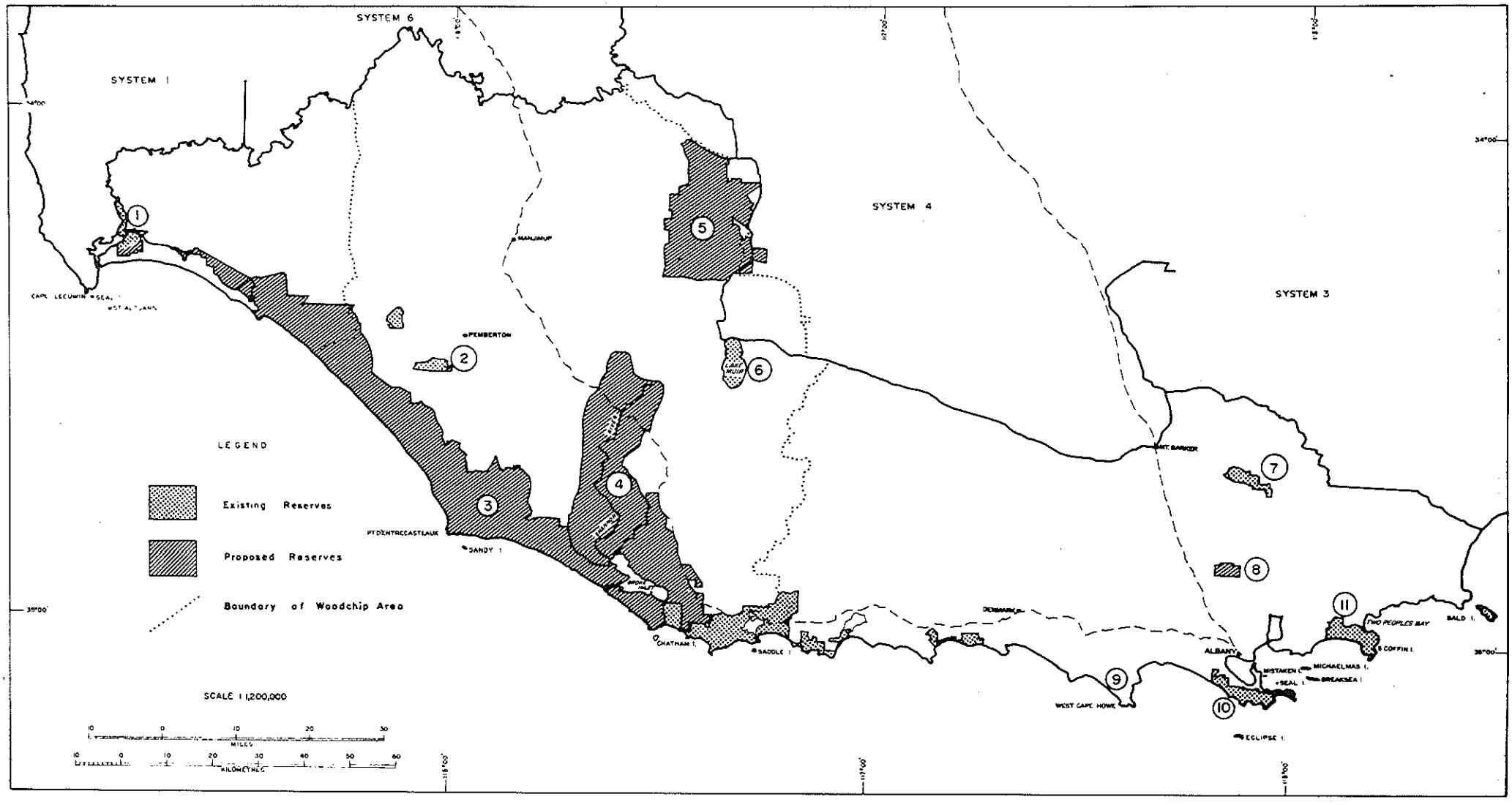
The coastal region between Northcliffe and Walpole has an annual rainfall of 1400 mm, most of which falls in winter. This area has the highest rainfall in south Western Australia. Eastwards the rainfall declines sharply and at Hassell Beach is only 500 mm. Strong, chiefly latitudinal winds characterise the south coast.

Much of the south coast is scenically diverse and attractive. Near Albany precipitous sea cliffs and chasms have been developed by marine erosion along joint planes in the granitic rocks. Elsewhere extensive sandy beaches have been formed by the reworking of younger sedimentary rocks.

Biology

Flora

Nearly all the State's remaining Karri forest occurs in System 2.


SYSTEM 6
SYSTEM 1
SYSTEM 4
SYSTEM 3
LEGEND
Existing Reserves
Proposed Reserves
Boundary of Woodchip Area
SCALE 1:1,200,000
MILES
KILOMETRES
PEMBERTON
MANJIMUP
PT D'ENTRECASTEAUX
SANDY I.
CHATHAM I.
SADDLE I.
ALBANY
WEST CAPE HOWE
MISTAKEN I.
MICHAELMAS I.
SEAL I.
BREAKSEA I.
COFFIN I.
TWO PEOPLES BAY
BALD I.
ECLIPSE I.
MT. BARKER
1
2
3
4
5
6
7
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9
10
11

Karri grows in sandy loams and loams over gneiss and granite in areas receiving an annual rainfall over 1000 mm. The main forest area is south of a line drawn from Nannup, through Manjimup to the Frankland River near Nornalup and in a narrow coastal belt to Denmark and Torbay near Albany. Some small areas occur outside this main area. The best known are those between the Margaret River Caves and Augusta, in the Porongurup Range north of Albany, at the mouth of the Scott River and on the coastal plain south of Northcliffe. The eastern-most outlier of Karri is on the northern slopes of Mt. Manypeaks. Other eucalypts occur either mixed with Karri or surrounding the Karri forests. These include the Tingles (Eucalyptus jacksonii, E. guilfoylei and E. brevistylis) and the Marri (E. calophylla).

The main area of Karri forest contains a layer of smaller trees whose crowns lie far below those of the Karri, but above the dense layer of shrubs which characterises the forest. These smaller trees include Karri Oak (Casuarina decussata), Peppermint (Agonis flexuosa) and Bull Banksia (Banksia grandis). The shrub storey contains such large-leaved shrubs as Karri Hazel (Trymalium spathulatum) which grows in impenetrable thickets up to 10 m high.

The best known shrubs are Crowea (Crowea angustifolia) and the related Karri Boronia (Boronia gracilipes). The pea-flowered family is represented by the attractive Tree Hovea (Hovea elliptica), and the Holly Flame-pea (Chorizema ilicifolium). Water Bushes (Bossiaea aquifolia and Bossiaea webbii) grow in the wetter parts of the Karri and neighbouring forests. The fan-shaped leaves of these species are generally fringed by soft spines which hold drops of water during frequent light rains in the forest. Karri Wattle (Acacia pentadenia) is attractive in Spring. Creepers such as Coral Vine (Kennedia coccinea), Sarsaparilla (Hardenbergia comptoniana) and Clematis (Clematis pubescens) add to the tangled undergrowth. Bracken (Pteridium esculentum), the most common and largest native fern in the south-west, sometimes reaches 2 m in height in the forest and Maiden-hair Fern (Adiantum aethiopicum) grows on most slopes. Many mosses, liverworts and fungi, as well as a few orchids, inhabit the damp forest floor.

The Karri forest is one of the most spectacular and important vegetation types in Australia and very little is reserved. Preservation of at least one area should be a top priority in any conservation programme. It is also important to preserve outlying Karri areas such as those at the Porongurups and Scott River.

Coastal vegetation on sand dunes and granitic hills consists of scrub which is varied in composition and structure. Despite strong prevailing winds which cause low stunted growth, this scrub is often quite dense. It includes species of Eucalyptus, Banksia, Dryandra, Casuarina, and many other genera.

System 2 contains many estuaries, swamps, rivers and salt lakes, each carrying distinctive vegetation. Around the estuaries are halophytic samphire associations together with shrubs and trees such as paperbarks (Melaleuca spp.), Viminaria, and occasionally Yate (Eucalyptus cornuta). Vegetation of the swamps and lakes varies according to the level of the water table. Ephemeral

swamps usually carry a scrub and sedge vegetation, sometimes with scattered trees such as Eucalyptus marginata and Nuytsia floribunda. Typical shrubs are Swamp Bottlebrush (Beaufortia sparsa), Adenanthos obovatus and Oak-leaved Banksia (Banksia quercifolia). Permanent swamps have a denser scrub in which Astartea, Leptospermum, Callistemon speciosus and Melaleuca densa are prominent. Lakes with expanses of open water support thick reed or sedge growth around their margins, behind which are trees and shrub belts. Rivers in the System carry a dense tree and shrub growth along their banks. Jarrah and Karri are the main trees with tall shrubs such as Wattle (Agonis juniperina), Native Willow (Oxylobium lanceolatum), Karri Hazel (Trymalium spathulatum) and Blister Bush (Phebalium anceps).

Many plants are restricted to this south coastal area. Perhaps the most famous is the Albany Pitcher Plant (Cephalotus follicularis), a swamp-dweller which traps insects in the pitchers which are modified leaves. Red-flowering Gum (Eucalyptus ficifolia), well known in cultivation, is native only to a few areas near Nornalup. In late summer, the drier swamps are ablaze with Swamp Bottlebrush (Beaufortia sparsa). The main populations of Scented Boronia (Boronia megastigma) occur in the System, and Red Boronia (B. heterophylla) is restricted to it. This is the richest area in the State for orchids, which abound in swamps and woodlands. Southern Cross (Xanthosia rotundifolia and Albany Cat's Paw (Anigozanthos preissii) are other examples of endemic species.

Fauna

The fauna of System 2 reflects the high rainfall and often dense vegetation of the area. Mammals are varied and plentiful and the System is the stronghold of many "wet adapted" species such as the Quokka (Setonix brachyurus), Ring-tail Possum (Pseudocheirus peregrinus) and Mardo or Yellow-footed Marsupial Mouse (Antechinus flavipes). One wet-adapted species, the Potoroo (Potorous tridactylus) has not been recorded since last century. Surviving individuals, if they exist, will almost certainly be found in this System. The Dibbler (Antechinus apicalis), a mammal thought for many years to be extinct, was recently rediscovered at Cheyne Bay Beach. It appears to be adapted to a particular vegetation type rather than a wet climate.

System 2 also includes the principal habitats of some rare wet-adapted species of birds. They include the Noisy Scrub-Bird (Atrichornis clamosus), the Western Whip Bird (Psophodes nigrogularis), the Bristle Bird (Dasyornis brachypterus) and the Ground Parrot (Pezoporus wallicus).

The distinct south coastal reptile fauna also reflects the cool, humid climate. It contains few species of geckos and dragon lizards, and among the skinks there are many species of Egernia but few of Ctenotus. The region is rich in frogs and some species are restricted to it. These include Metacrinia nichollsi, Crinia rosea, and C. lutea. Metacrinia nichollsi is a species that appears to fill a similar ecological role to terrestrial salamanders in some other regions of the world. Except for isolated populations on peaks in the Stirling Range, it is confined to the wet Karri forest and apparently never enters water. The eggs are laid beneath litter on the forest floor.

A species of freshwater fish has a parallel specialisation. This is Lepidogalaxias salamandroides, a little-collected species which apparently inhabits very shallow, sluggish muddy water in the Karri forest.

Population, Land Use and Primary Industry

System 2 has a population of about 30,000 (1971 census), of whom 13,000 live in Albany, 3,500 in Manjimup, 1,600 in Mt. Barker and 1,500 in Bridgetown. More than half the System is public land, most of which has been set aside as State Forest, mainly west of the Frankland River and between the Frankland and Hay Rivers (including State Forest water catchment reserve and vacant Crown land). Large tracts of coastal land are still Crown land, including the Walpole-Nornalup and Torndirrup National Parks and the Two Peoples Bay Wildlife Sanctuary.

Forestry is a major industry which supports Manjimup, Pemberton, Northcliffe, Nannup and scattered mill settlements. Other primary industries include horticulture and the raising of sheep, and dairy and beef cattle.

Australian salmon (Arripis trutta esper) which school in bays, as well as Herring (Arripis georgianus) and Southern Blue-fin Tuna (Thunnus maccoyi) form the basis of a canning industry at Albany. The estuaries also yield large quantities of fish, especially Sea Mullet (Mugil cephalus), Yellow-eyed Mullet (Aldrichetta forsteri) and King George Whiting (Sillago punctata). In addition Albany has Australia's only operational whaling station.

Mining and Industrial Development

Mining is confined almost entirely to tin at Greenbushes, although there may be commercial heavy mineral sand deposits in the Hassell Beach area east of Albany. A large area of forest north of Walpole has been pegged for bauxite, and extraction of peat has commenced near Lake Muir

Albany, the only port in the region, has a woollen mill, flour mill, fish and vegetable processing factories, a whaling station and a butter factory. It also has the largest superphosphate works outside the Perth Metropolitan Region. Apart from sawmilling, Manjimup, the second largest town, has dairy processing and fruit canning factories.

A survey conducted by the Australian National Travel Association (ANTA 1973) revealed that over 70,000 persons visited the south west region between July 1971 and June 1972 and spent an estimated $8 million. On the basis of a projected growth rate of 3.9% p.a., over 278,000 persons will visit the area by mid 1977, although ANTA expects a much higher growth rate will yield at least 300,000 by this date.

Major holiday centres in the System are Albany, Walpole, Pemberton and Manjimup which are linked with the "Leeuwin Way" (National Route No.1) between Perth and the Eastern States. While an increasing number of interstate tourists are using this route, the System caters mainly for recreational needs of Western

Australians. Growth of tourist facilities at Albany is a useful index to the importance of this industry. Prior to 1960 there were no motels in the town, and families who could not afford, or did not secure, hotel accommodation, stayed at guest houses, or in tents, cabins and flats. Guest house occupancy is falling noticeably and the proprietors now rely mainly on "permanents". Kerr and Treloar (1971) concluded that the town was not utilising its tourist potential as effectively as it could although it was noted that a large number of holiday makers (no estimate given) use camping sites.

The Kerr Report's conclusions on Albany probably apply to the System as a whole. Its tourist potential, especially its relatively cool summer climate, its scenery, beaches, forests, and fishing make it and System 1 the major recreation areas of the State. The relatively small area currently set aside for the Parks and Reserves, is disturbing, especially in view of plans for exploitation of forests and wilderness.

CONSERVATION RESERVES

System 2 contains many small reserves as well as important National Parks at Pemberton, Walpole-Nornalup, the Porongurups and Torndirrup, and wildlife sanctuaries at Two Peoples Bay and Bald Island. There is a need for modification of boundaries of some parks and flora and fauna reserves, while the status, purpose and vesting of other reserves should be changed.

Much of the System is State Forest which includes most of the natural occurrence of Karri (Eucalyptus diversicolor). Too little Karri occurs in current parks and reserves, and a larger area of virgin forest should be protected. This is especially important in view of the new methods of exploitation that will be introduced in 1975.

State Forest No. 37 and Timber Reserves F 103/25 and F 140/25 contain a most important mammal fauna and have been designated by the Forests Department as a Fauna Priority Area.

Wetlands in the System are breeding and feeding grounds for waterfowl and are summer refuges for inland birds. They are at present inadequately represented in reserves.

The areas reported on by the Committee are:

1. Scott National Park
2. Pemberton National Parks
3. Proposed South Coast National Park
4. Shannon River Drainage Basin
5. Tone-Perup River area
6. Lake Muir area
7. Porongurup National Park
8. Millbrook reserve
9. West Cape Howe area
10. Torndirrup National Park
11. Two Peoples Bay Wildlife Sanctuary
12. Wetlands
13. Islands
14. South Coast.

2.1 SCOTT NATIONAL PARK

This park is reserve No.A 25373 for National Park and Recreation, under the control of the National Parks Board. It lies at the junction of the Scott River and the Blackwood, and extends for some distance up the eastern bank of the Blackwood. The area is about 1376 ha. It is low-lying with an open woodland of Jarrah (Eucalyptus marginata), Marri (E. calophylla) and Karri (E. diversicolor). The park is important in providing access for recreation along the river banks, as well as preserving an area of the woodland typical of the area. Wildflowers are plentiful and bloom profusely in spring.

To the south and south-east of the park is an area of vacant Crown land which differs from the remainder of the park. It is swampy and a different range of plants exists. Interesting species include Adenanthos detmoldii, Persoonia graminea, and species of Villarsia and Xyris.

Animal life is plentiful. Mammals include the Western Grey Kangaroo (Macropus fuliginosus), Western Brush Wallaby (M. irma), Quokka (Setonix brachyurus), Brush Possum (Trichosurus vulpecula), Ring-tail Possum (Pseudocheirus peregrinus), Pigmy Possum (Cercartetus concinnus), Honey Possum (Tarsipes spencerae), Short-nosed Bandicoot (Isoodon obesulus), Western Native Cat (Dasyurus geoffroii), Southern Bush Rat (Rattus fuscipes) and Water Rat (Hydromys chrysogaster). The Swamps within the area not only serve as habitat for some of the mammals but provide breeding grounds for waterfowl, and other water birds.

The Scott River plain is a distinctive entity of the Western Australian landscape and is different from the coastal lands to the east of it. Already most of it has been alienated for agriculture, and it is important that representative areas be protected.

Recommendation

The Committee recommends that an area of vacant Crown land as shown in Fig.2.1 be added to the Scott National Park (Reserve A 25373).

2.2 PEMBERTON NATIONAL PARKS

The Pemberton National Parks are a series of Class A reserves near the town of Pemberton. There are two main National Parks and a number of smaller reserves. They are under the control of the Pemberton National Parks Board

The two mainreserves are the Warren Park and the Beedelup Park (Underwood, 1973).

The Warren Park is located astride the Warren River about 10 km south west of Pemberton, and is 1340 ha in area. It is an excellent but small example of prime, virgin Karri (Eucalyptus diversicolor) forest, although Marri (E. calophylla) occurs in admixture. Occasional specimens of Jarrah (E. marginata) and Western Australian Blackbutt (E. patens) occur and there are

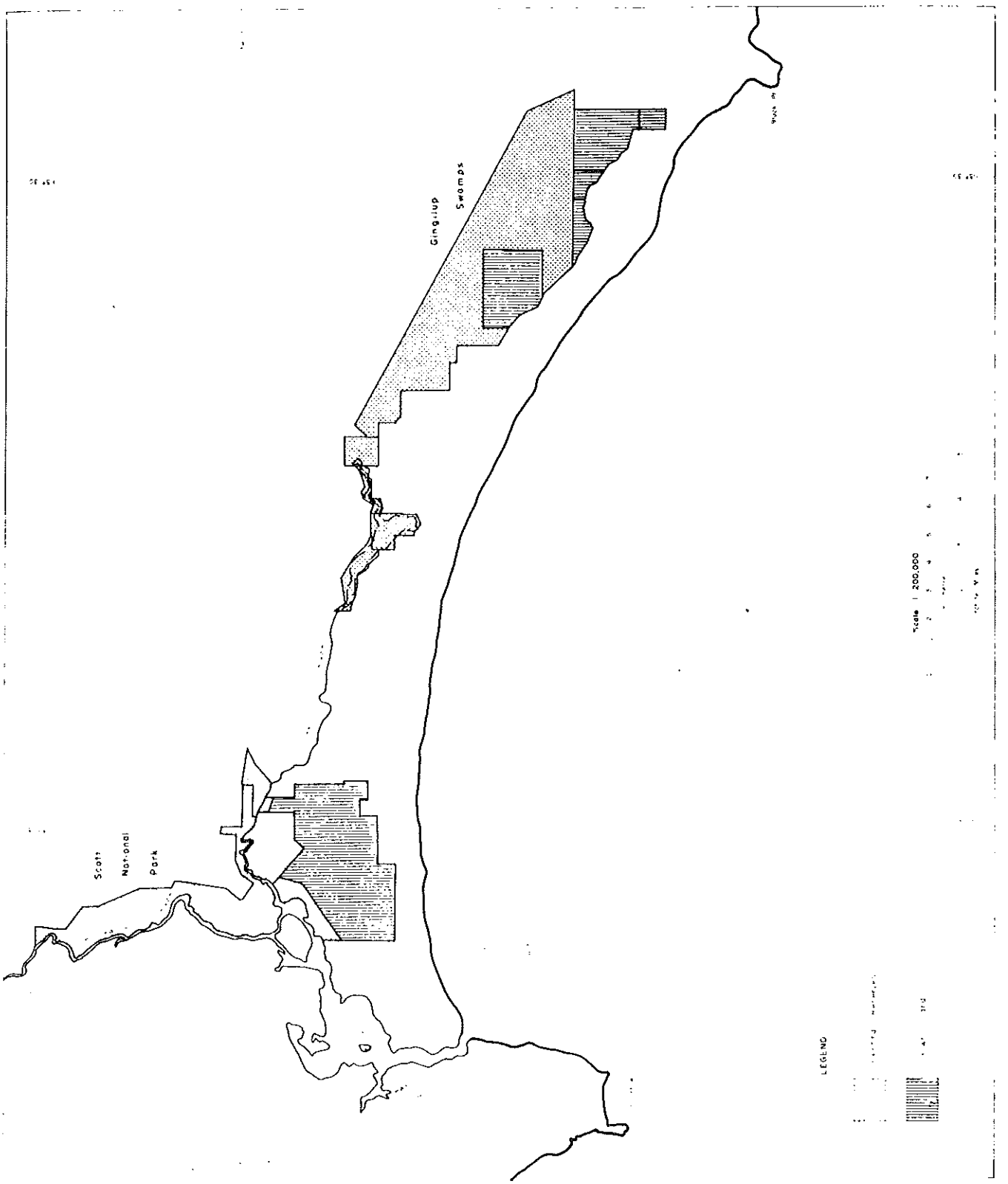

Figure 2-1 Scott National Park and Gingilup Swamps - area map

minor stands of Wattie (Agonis juniperina), Peppermint (Agonis flexuosa), Bull Banksia (Banksia grandis) and River Banksia (B. littoralis). The major understorey tree is Karri Oak (Casuarina decussata) and the ground vegetation and shrub layer are typical of the Karri forest.

The Beedelup Park is 15 km west of Pemberton and has an area of 1340 ha. The Beedelup Falls on the Beedelup Brook are a major feature of the Park. The dominant forest types are Karri, Karri-Marri, Jarrah-Marri and pure Marri in about equal proportions. Particularly notable are the stands of pure Marri. Similar stands elsewhere have been cut over in recent years. Another feature of the Park is the abundance of Crowea (Crowea angustifolia).

The Pemberton National Parks Board dates back to the 1940's when it evolved from the amalgamation of a number of local bodies responsible for the town recreation reserve and swimming pool. Revenue was raised through caravan park rentals supplemented by grants from the State Treasury, Department of Tourism and the Shire of Manjimup. The tenure of the locally controlled Board lasted from 1945 to 1971. Towards the end of this period financial and administrative problems became acute and led to a restructuring of the Board which now comprises only appointees made by the Minister for Lands from the Department of Lands, Forests, and Fisheries and Fauna. A member of the new Board has developed a management plan.

The Committee believes it desirable that eventually all National Parks in Western Australia be controlled by a single authority. However, where competent local control exists there may be a case for delaying transfer until the National Parks Board of WA is able to absorb the Pemberton National Parks into its system without causing administrative problems or a temporary reduction in management efficiency. A complicating factor, in this case, is the problem of the management of the several small reserves in and around Pemberton; at present these are the responsibility of the Pemberton National Parks Board.

Recommendations

The Committee recommends

1. that the Minister for Lands be advised to transfer the control of Warren and Beedelup Parks to the National Parks Board of WA;

2. that the Pemberton National Parks Board confer with the National Parks Board of WA to prepare a timetable for the transfer from the Pemberton National Parks Board to the National Parks Board of WA and make recommendations on the future of the other, smaller reserves.

2.3 PROPOSED SOUTH COAST NATIONAL PARK

A well-documented submission from several officers of the Forests Department proposed that approximately 116,000 ha on the south coast between Scott River and Nornalup Inlet be set aside as a "wilderness area" National Park. Over 95% of the

area proposed is public land, including part of the Walpole-Nornalup National Park.

The proposed park includes about 175 km of coastline, extending inland 5 to 8 km (Figs.2.2, 2.3). The western section is underlain by Pleistocene Mesozoic strata, and the eastern by Precambrian granite and gneiss. The coast is roughly half beach and half rocky cliffs of Calcareous sandstone and granitic gneiss. Spectacular cliffs at Black Point (Cape Beaufort) are composed of well-formed columns of Bunbury Basalt. Coastal Limestone occurs along most of the coastline, and at several places between Cape Beaufort and Broke Inlet, such as Point d'Entrecasteaux (Fig.2.4) has eroded into towering sea cliffs. Elsewhere the Limestone is covered by high dunes. East of Point d'Entrecasteaux the underlying granite and gneiss outcrop through the Pleistocene sequence, and at Point Nuyts and Long Point form massive headlands which rise from deep water.

Most of the coast is backed by vegetated dunes, but between the Donnelly River and Point d'Entrecasteaux extensive areas of mobile sand dunes occur, including the Yeagerup, Callcup, Meerup and Doggerup Dunes.

Back-up and redirection of older drainage lines behind the coastal dunes has led to the establishment of several large lakes and many swamps which make up about one-third of the area and include Naenup Swamp and Lakes Jasper and Maringup.

Six main rivers pass through the proposed park - the Donnelly, Warren, Gardner, Shannon, Deep and Frankland. All are perennial and flow strongly during winter. Minor rivers such as Meerup and Doggerup Creeks rise close to the coast, and many small streams and springs occur in the Coastal Limestone (e.g. Malimup Spring). The Shannon River discharges into Broke Inlet which is shallow and seasonally closed. The Deep and Frankland Rivers enter Nornalup Inlet which is deep and permanently open to the sea.

Sand bars have formed across all the inlets and rivers, but the Warren (Fig.2.5) and Meerup rivers and the Nornalup Inlet are kept open by stream or tidal channels. Other rivers and inlets are closed for long periods.

The proposed park is largely undeveloped and unpopulated and is surrounded by State Forest. National Route No.1 ("The Leeuwin Way") passes through the eastern end of the area between Walpole and Nornalup, but there are few other good roads.

The area contains only 5000 ha of private land, but over 17,000 ha of Crown land are held as grazing or pastoral leases, some of which do not expire until 2015. Though mainly undeveloped, the private and leasehold lands contain many of the most interesting and beautiful places in the area, including Malimup Springs, the southern shore of Lake Maringup, the limestone cliffs east of Black Point, the peppermint savannah north of Fish Creek and part of the Yeagerup Dunes.

Alienation of further tracts for agricultural purposes would detract from the proposed park especially if it required the drainge of wetlands. A recent proposal for the release of

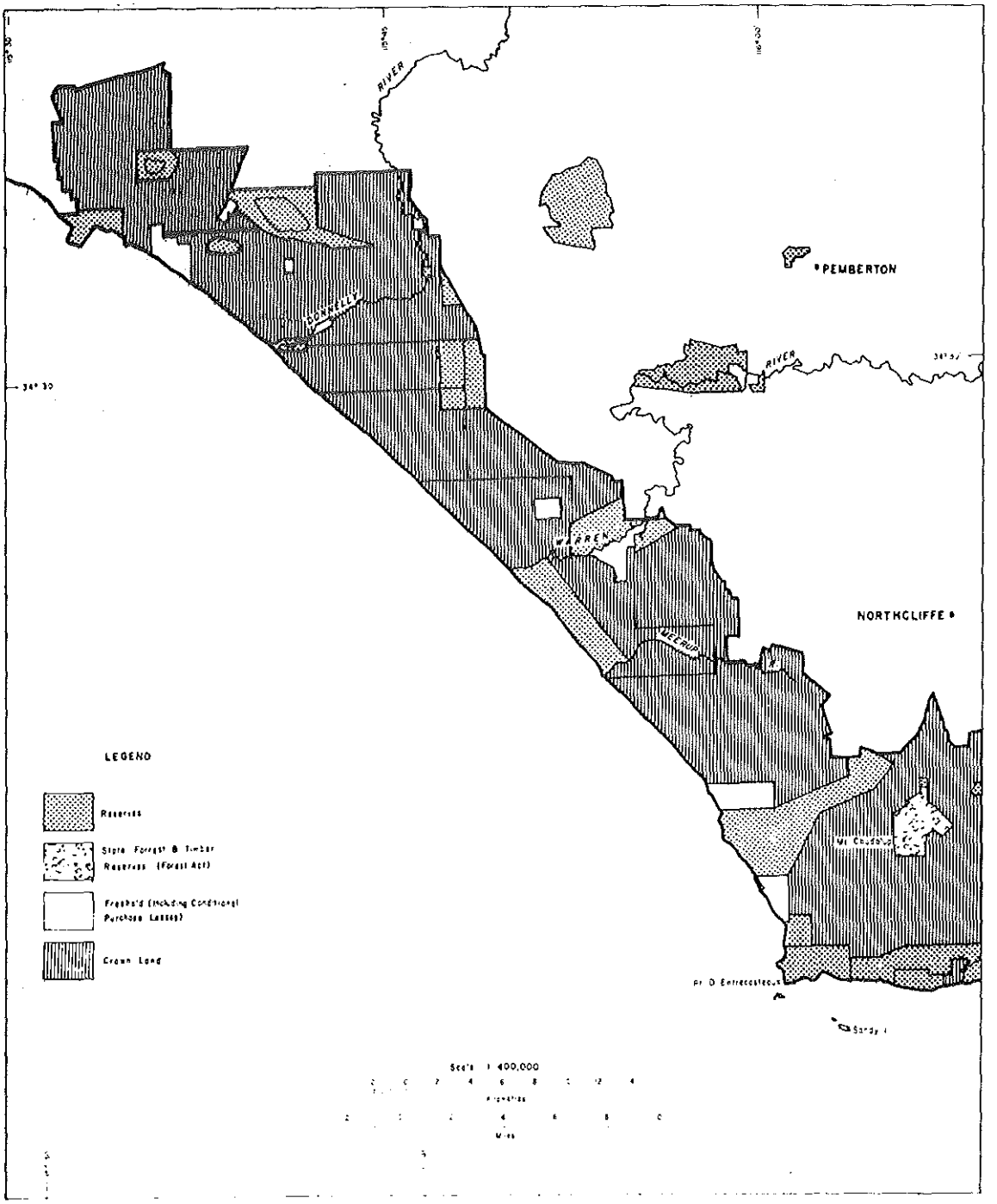

Figure 2.2 Proposed South Coast Park I - Western Section

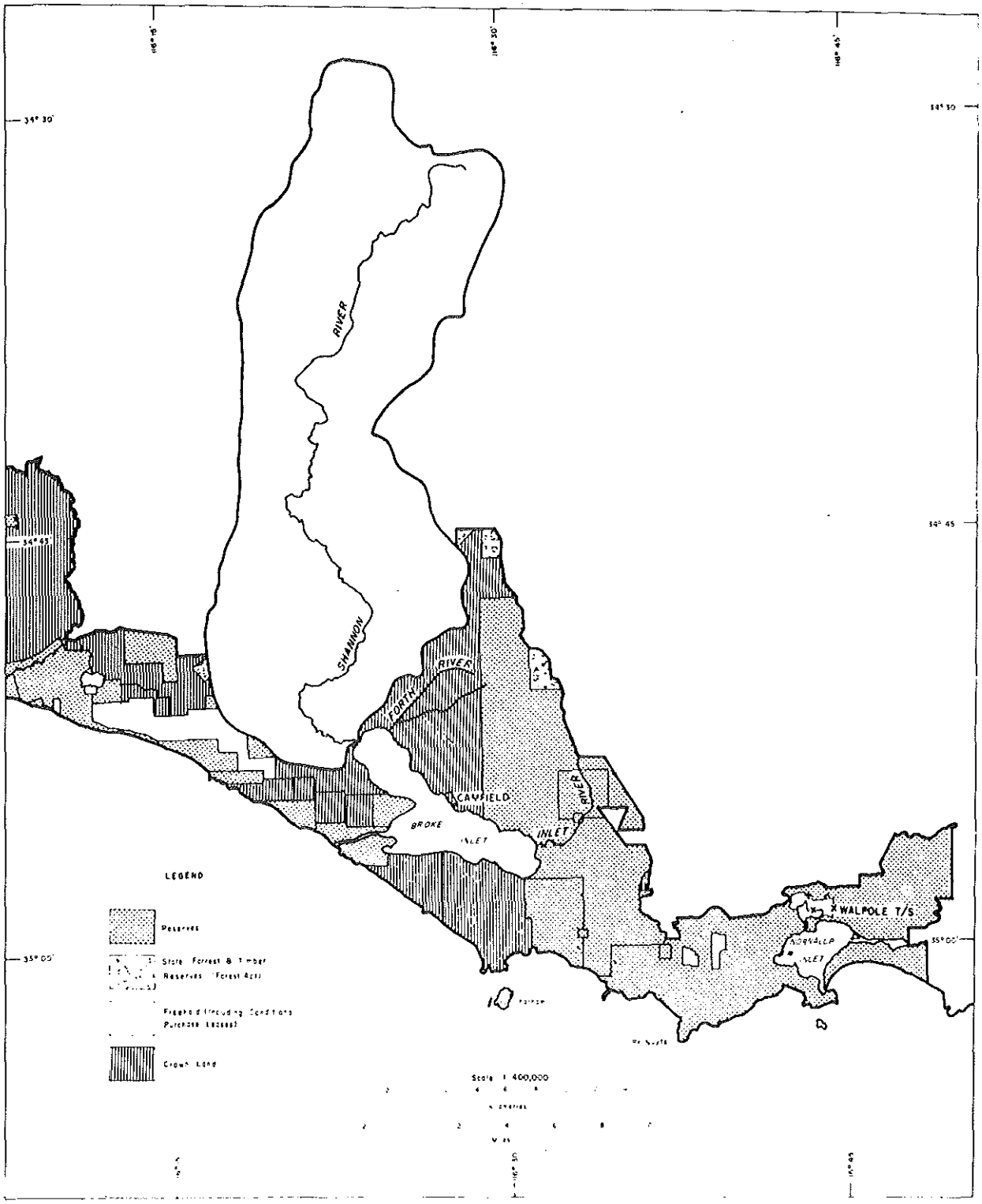

Figure 2-3 Proposed South Coast Park 2 - Eastern Section

Figure 2.4. Point d'Entrecasteaux.

Figure 2.5. Mouth of the Warren River.

land for production of vegetables and for beef, pig and sheep farming included the establishment of an infrastructure which would have had far-reaching effects on the proposed park. Although the Environmental Protection Authority withheld its approval on grounds that it would have adverse environmental effects, especially on the drainage system, the developer persisted with the proposal. It was rejected by the Minister for Lands.

Apart from an important highly successful sand dune stabilisation programme, the Forests Department has not developed the area. Keen interest was shown in the area by mineral sands prospectors during the mineral "boom" in 1969/70, but current interest appears to be slight and is confined to small areas near Malimup Springs and Point d'Entrecasteaux.

In its present primitive state, the proposed National Park has low recreational potential. The absence of good roads discourages tourists (though not those with 4-wheel drive vehicles), and many places can be reached only in small boats. Apart from Walpole, the most developed recreational site is Windy Harbour which has about 120 dwellings, an area set aside for caravans and tents, an ablution block and a boat ramp. Situated on Reserve No. A 17495 for Camping and Recreation, the settlement is vested in the Shire of Manjimup. Another settlement of about 20 cottages has been established at the mouth of the Donnelly River, but the occupants are squatters.

Broke Inlet is a large, shallow estuary linked to the ocean by a narrow channel that passes through high aeolian dune ridges. Marshes border the Inlet on the southwest and northwest margins. One major river, the Shannon, and a number of smaller streams including the Forth and Inlet Rivers enter the Inlet. The entrance of the Shannon River is marked by a low-lying delta. Other shores are composed of sandy beaches interspersed with low rocky headlands of gneiss. The gneissic basement projects above water level to form Shannon, Clark and numerous other small islands.

Estuaries occur along the WA coastline from Kalbarri to Esperance. They are important places for recreation, fishing and the conservation of wildlife. The pressures being placed on estuaries include dredging, reclamation, fishing and boating, and above all the alteration of their catchments with consequent changes in the quantity and especially the quality of the waters entering them. Much scientific work needs to be done concerning the future management of estuarine ecosystems and the establishment of the Environmental Protection Authority's Estuarine and Marine Advisory Committee is directed towards this aim.

Almost all the larger estuaries have already undergone considerable changes, both directly in the form of dredging, reclamation, and urban development on their fringes, and indirectly through the clearing and damming in their drainage basins. The only large estuary left with little fringe development and an intact catchment is Broke Inlet.

The Lands surrounding Broke Inlet are in their natural state and there has been practically no development to disturb this serene body of water. Apart from a small area of freehold land, shacks have been constructed on Reserve No.19787 of 40 ha

for Camping (not vested) and on Crown land near the channel to the sea. The occupants of these shacks appear to have no legal tenure. Perhaps more importantly the entire catchment of Broke Inlet is within Crown land, either State Forest, reserves or vacant Crown land. The boundaries of the proposed South Coast National Park have been designed to include all the catchment not within State Forest.

A submission by the Australian Marine Sciences Association (WA Division) cited Broke Inlet as a possible marine reserve. The Committee supports this concept and believes that Broke Inlet, if left undisturbed, will become a valuable control area for scientific research where comparisons can be made with other altered, estuarine ecosystems. The maintenance of Broke Inlet as an undisturbed hydrological and sedimentological regime is also an integral part of proposals set out under the Shannon Drainage Basin (Section 2.4).

The outstanding features of the proposed park may be summarised as follows:

1. Varied natural features.
2. Extremely diverse vegetation which includes forests, savannah woodland and grassland, heath and scrub, wet flats and swamps. Indeed, even though rainfall in the area is high and reliable, vegetation ranges from none on mobile dunes to dense in Karri and Tingle forests.
3. Varied fauna. The open scrub and woodland provides opportunity for larger species such as the Western Grey Kangaroo (Macropus fuliginosus) to be observed more easily than in the dense forests.
4. The large number of freshwater lakes which from part of the Wetland Complex 12 (Fig.0.1).
5. Magnificent coastal scenery for some 175 km which includes long, broad beaches, spectacular high rocky cliffs and headlands, and a number of cascading waterfalls close to the sea. Of special interest are Broke Inlet, one of the largest on the Western Australian coast and also the better known Walpole-Nornalup Inlet.
6. Six river Systems.
7. The beauty of the large inland dunes.
8. The mild climate.
9. The large area free from human development which provides spaciousness and solitude for visitors.

The Committee considers that the coastal lands from the Walpole-Nornalup National Park to Cape Beaufort (Figs.2.2, 2.3) should be considered a westward expansion of the Walpole-Nornalup National Park. This would bring the biological and recreational management under one authority. The Committee wishes to emphasise the importance which it attaches to the proposed park as a national asset both for public recreation and for its flora and fauna.

Walpole-Nornalup National Park is reserve No. A 31362 of 18,027 ha centred on Nornalup Inlet. It is an area of great natural beauty with coastal scenery, inlets, and tall forests reaching the water's

edge. There are fine stands of Karri forest in which Red and Yellow Tingle (Eucalyptus jacksonii and E. guilfoylei) also occur. Almost half the park is occupied by Karri forest. Woodlands of Jarrah (E. marginata) and Peppermint (Agonis flexuosa) occupy parts of the park, while swamps near the inlets are rich in endemic flora. The park is already a popular tourist resort. Within the western boundary of the park is reserve No.14325 of 71 ha, C Class for Water and not vested, which should be added to the park.

Recommendations

The Committee recommends:

1. that all existing reserves and vacant Crown land as shown in Figs.2.2, 2.3 be added to the Walpole-Nornalup National Park (Reserve No. A 31362) and placed under the control of the National Parks Board of WA; the park to extend to low water mark;
2. that existing leases within the boundaries of the proposed park be terminated and the land contained therein be incorporated within the proposed park;
3. that the Government acquire all private land inside the proposed boundary and that the management authority consult with appropriate Government departments to prepare a priority schedule for acquisition;
4. that as soon as legislation is enacted to permit it, Broke Inlet be declared an aquatic reserve for National Park and placed under the control of the National Parks Board of WA;
5. that reserve 14325 be cancelled and its area added to reserve A 31362.

2.4 SHANNON RIVER DRAINAGE BASIN

Karri (Eucalyptus diversicolor) grows to heights of over 80 m and individuals are among the largest living trees. With their associated understorey, the giant Karris of south Western Australia constitute a unique and ancient forest: one of the great botanical associations of the world. It does not take a forester or botanist to recognise this, and few environmental causes would command more immediate general support than conservation of the remaining Karri forest.

There is current public disquiet that radical new plans for commercial exploitation of the south-western wet sclerophyll forests will irreversibly alter their character. Some of this concern results from faulty understanding of the principles of forest management. There is no likelihood that Karri will become an extinct species. The danger is that Karri forest with its associated flora and fauna will be destroyed as a natural entity. It is true that there is no way of defining scientifically and precisely what is meant by the term 'natural Karri forest'. Almost certainly all existing stands of Karri and Karri-Marri have been modified by fire at sporadic intervals during the past few hundred years. In a sense, therefore they may all be single-age stands. The concept of a natural Karri forest adopted here

is that of an area of commercially undeveloped forest, large enough to conserve as a single unit representative stands of Karri and Karri-Marri associations and their faunas, substantially as these existed at the time of first European settlement. The Committee fears that projected extensive and intensive clear-felling operations, however carefully managed, will prove inimical to this concept of forest conservation.

Western Australian forest resources are uncomfortably small when matched against those of comparable land areas elsewhere in the world. Even if the woodlands of the Goldfields and Murchison are included, forests cover only about 7% of the State's total area. This is also roughly the average figure for Australia as a whole, although it is true that, because much of the nation's forest occurs near the coast, the proportionate area is higher in the more densely populated regions.

Allowing that unequivocal comparisons can be in some ways misleading, it is instructive to compare the areas of forest land remaining in Australia with those of some randomly selected overseas countries. Figures are estimated from Haden-Guest et al. (1956):

Country	Total forested area (millions of ha.)	% of total area forested
Australia	48	6
Canada	950	24
USA (excluding Alaska)	262	34
Argentina	70	25
Brazil	480	57
Scandinavia	52	48
Western Europe	23	22
Central Europe	36	28
U.S.S.R.	1068	62
Japan	25	68
India	62	20

Even the countries of southern Europe - Spain, Portugal, Italy and Greece - whose resources have been exploited for centuries, contain a proportionately greater area of forest than Western Australia.

On a per capita basis Western Australian forest resources naturally compare much more favourably with those of most of the countries cited. At present they amount to roughly 16 ha of forest for every inhabitant, compared, for example, to 3.5 ha for the U.S.A., 0.3 ha for Western Europe and 3.0 ha for Scandinavia.

Population growth in this State is inevitable and there is no question that this per capita advantage will be eroded as development continues.

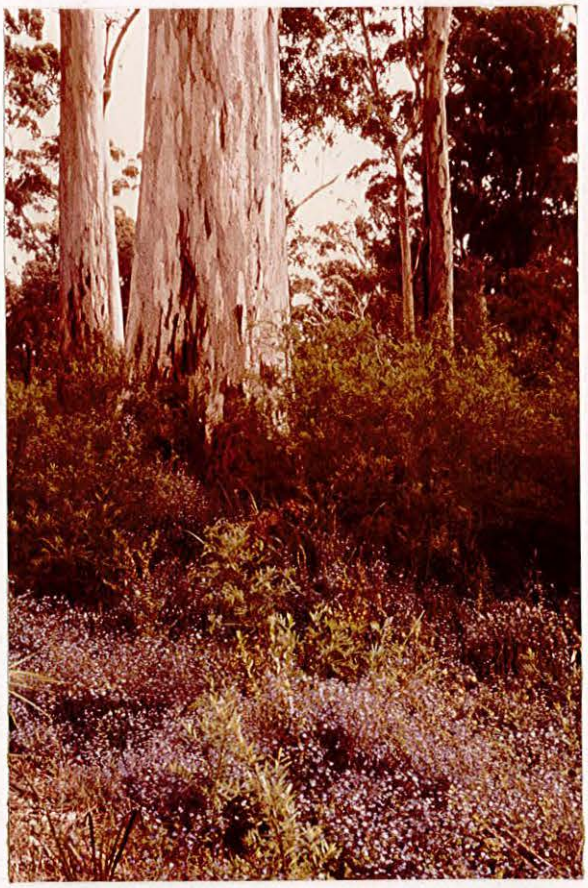

Figure 2.6. Karri forest, showing dense understorey, with Dampiera hederacea in flower.

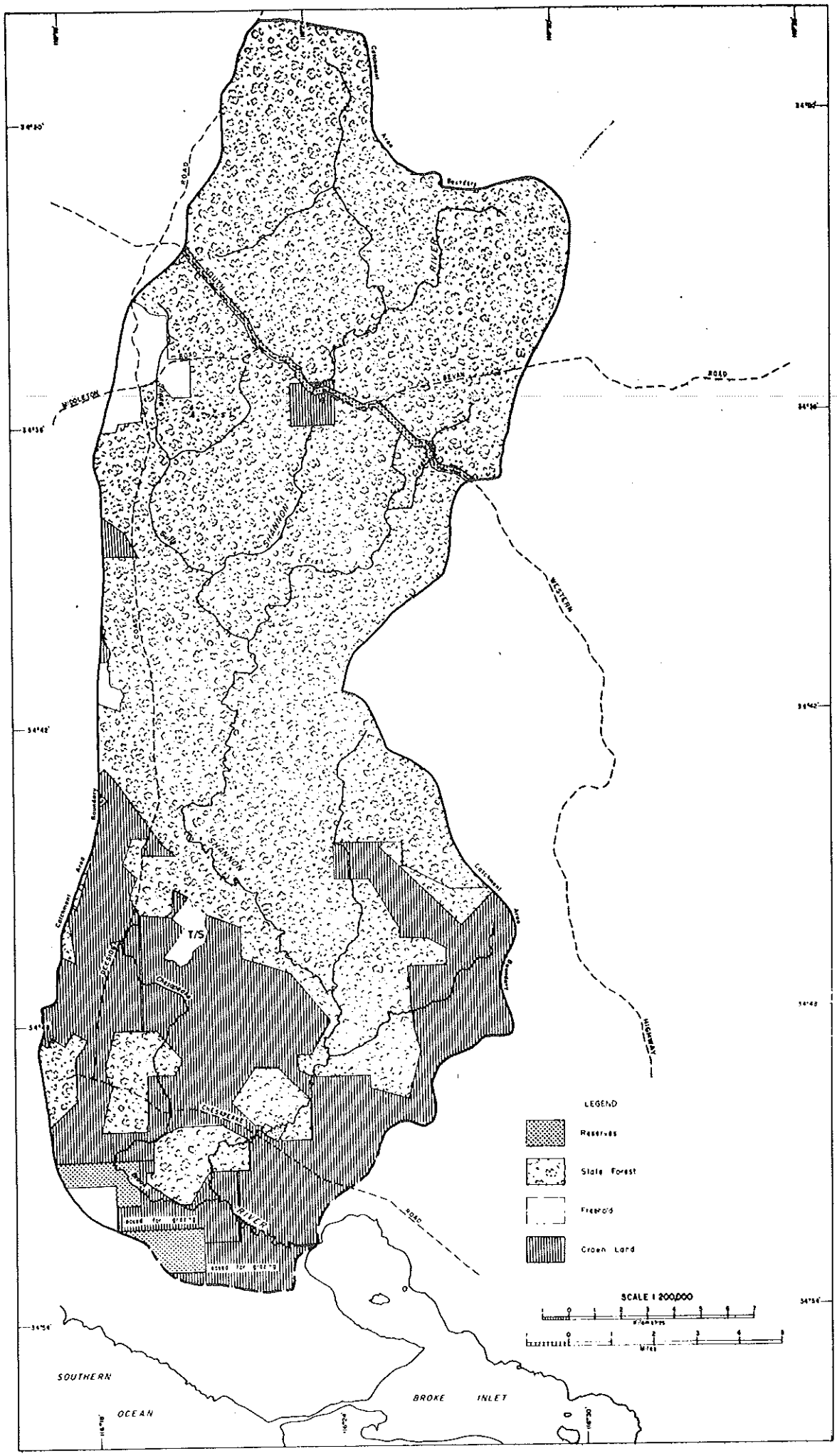

Figure 2.7 Area map of Shannan River catchment

Because the State's forest resources are so small, two extreme positions on their future are possible. The completely utilitarian argument is, that if timber resources are so meagre, it is impossible to justify the non-commercial reservation of more than a token area of natural forest. Conversely, militant conservationists contend that, for the same reason, timber production in wet sclerophyll forests should be completely suspended.

The Committee seeks a compromise between these two viewpoints that will ensure the conservation of Western Australian forests as multiple-purpose assets of incalculable value. It does not believe that the relatively small areas of wet sclerophyll (especially Karri) forest included in existing reserves meet the requirement of conserving a representative forest and its fauna. Nor do the additional stands of Karri that occur in some areas recommended for reservation in this Report contribute significantly to this central objective.

Almost all the remaining undeveloped wet sclerophyll forests in the State occur east of the Donnelly River and south of a line joining Nannup and Denmark. They consist of pure stands of Karri, Karri admixed with Marri, pure Marri or associations of Jarrah and Marri, and these have a natural understorey of smaller trees and shrubs and a characteristic fauna. These forests are almost totally encompassed by the license area of the Wood Chipping Industry Agreement Act (1969). Under this legislation, amended in 1973, the operating company may remove 681,000 tonnes green weight of woodchips per annum for 15 years. In effect, this means that the operators would fell and remove from designated areas within the license area, all timber that is unsuitable for milling and would also in consequence destroy the understorey.

Fig.2 shows the area (883,000 ha) embraced by the Wood Chipping Agreement license; over half this consists of productive forests, viz:

Virgin Karri	85,000 ha
Cut Over Karri	53,000 ha
Virgin Jarrah	223,000 ha
Cut over Jarrah	158,000 ha
	519,000 ha.

An additional 77,000 ha is unproductive forest and the remainder is unforested.

From a commercial viewpoint, the most appealing aspect of the woodchip industry is that most woodchips will be obtained from the hitherto discarded Marri. Karri is still the preferred timber for chipping, but will only provide between 5% and 20% of the total supply. During the first 15 years of the chipping operation, roughly 10,215,000 tonnes of Karri and Marri will be removed, representing about 30% of the resources of these two timbers in the license area. The Agreement also envisages the establishment of a chipwood mill 15 km south of Manjimup, the construction of additional port facilities at Bunbury and the development of independent water supplies for the chipping mill. In addition, the operators are obliged to investigate the feasibility of establishing a pulp mill in the Manjimup region to process woodchips and produce unbleached wood pulp.

If such a plant is established, large volumes of potable water and further supplies of chip wood will be required. The Government has, therefore, agreed to make available, under these circumstances, a further 152,400 tonnes per annum from the Manjimup area and 228,600 tonnes from the Collie-Bunbury district.

The magnitude of the proposed woodchip operation is obvious from the above summary of the license schedule. It affects more than one-quarter of the total area of the State's commercial forests and all but a minute fraction of the remaining Karri forests.

In 1973 the Western Australian Forests Department prepared an Environmental Impact Statement to assess the likely effects of the woodchipping operation. The statement recommended that the project should go ahead, but was more circumspect on the qeustion of establishing a pulp mill near Manjimup. This, it suggested, required separate appraisal. The Environmental Impact Statement was subsequently considered by the EPA and by a special meeting of the Environmental Protection Council. Resolutions carried by this meeting and subsequent action by the EPA were summarised in the Annual Report of that body for 1973.

The relevant passages are as follows (Annual Report, EPA, 1973, p.25):

> "The Council endorsed in principle the recommendation covered in Paragraph 160 of the Report of the House of Representatives Select Committee on Wildlife Conservation adding that it would seek within the machinery of the State Government and its authorities ways to carry out the research needed to fulfil its intent.
>
> The Council also advised the Director of Environmental Protection that an environmental report should cover items additional to Commonwealth recommendations including the provision of refuge areas located to ensure preservation of fauna and flora.
>
> The Council noted safeguards relating to the proposed wood pulping industry but expressed concern about potential pollution, particularly in regard to water resources. It asked to be advised of further investigations before making any recommendations to the Minister.
>
> These resolutions were endorsed by the EPA and forwarded to the Hon. Minister for Environmental Protection with a covering letter expressing the EPA's concern that adequate research should be a mandatory auxiliary to any proposed development. The EPA also noted with approval that certain rights of control were vested in the Conservator of Forests in Section 9 of the Forest Produce Act.
>
> The EPA accepts statements by the Hon. Minister for Forests and the Conservator of Forests that the use of Marri, previously an uneconomic timber resource, would assist the Forests Department in silviculture management.
>
> However, vegetational changes are a particular matter of concern which would affect the hydrological cycle with a possible increase in the salinity and turbidity of fresh water resources.

With further investigations and deliberations to be carried out it would be premature at this stage to make more detailed comment for this reporting period."

An export license was granted by the Federal Government towards the end of 1973, and cutting operations are scheduled to begin in mid-1975. The Environmental Impact Statement has been studied by members of the CTRC and its Technical Sub-Committee, most of whom have also visited the area of the woodchip license. During these trips, the Committee received the complete cooperation of the Conservator of Forests and it is a pleasure to acknowledge the guidance of those officers of the Forests Department who made the visits pleasant as well as instructive.

Accepting that woodchipping for export is at present the optimum method for the commercial exploitation of Karri-Marri forests, the Environmental Impact Statement presents convincing arguments that it is silviculturally practicable. The Committee has no evidence for rejecting the conclusion that the woodchip project is unlikely to cause widespread soil erosion and increased ground water salinity; at least in the high rainfall areas of the license.

The Statement's examination of the effects on forest faunas is more cursory. This is probably because very little is really known of faunal recolonization in Karri-Marri forest that has been subject to clear-felling on the proposed scale. Strong doubt has been expressed to the Committee that the proposed system of forest verges along streams and main roads and of refuge areas, is extensive enough to provide an adequate reservoir of nature fauna and non-commercial flora to re-establish them in regenerating cut-over areas.

The Environmental Impact Statement does not attempt to disguise the fact that most of the consequences of the woodchip project cannot be fully assessed. Among these potential effects are modifications to patterns of stream and ground water hydrology, to the spread of pathogenic organisms and to the distribution of soil nutrients. In its discussion of the adverse effect of the operation on the public's "emotive values", the Environmental Impact Statement correctly points out that the principles of modern forest management are not widely understood. It is not possible to preserve a static virgin Karri forest, if for no other reason than the necessity for controlled burning of the understorey for bushfire prevention. It does not follow, however, that a forest regenerated after clear-felling has the same aesthetic appeal as one in which no large scale commerical felling (and especially clear-felling) has occurred. In the Manjimup-Pemberton district, regenerated stands of Karri, between 40 and 100 years old, have undeniable grace. It is, nevertheless, an orderly rather formal elegance, not the sombre magnificence of ancient forest.

In view of the many imponderables expressed explicitly or which are implicit in the Impact Statement, the Committee believes that the clear-felling of large areas of forest should proceed cautiously, especially during the first license period of 15 years. Cutting should be excluded from a relatively large single continuous area. During this time changes in biological,

hydrological, pedological and sedimentological parameters must be monitored in the other parts of the license concession and the observations assessed. This will help ensure that a large area of virtually untouched Karri-Marri forest remains, should unpredicted, long-term, deleterious effects result from the initial clear-felling operations.

The Committee also believes that a substantial area of this wet sclerophyll forest, containing pure Karri and Karri-Marri associations, should be set aside in perpetuity as a major conservation reserve.

Neither the proposed Perup River "Fauna Priority Area" nor the system proposed in the Environmental Impact Statement of stream and roadside "reserves" and refuge areas is adequate for this purpose. The "Fauna Priority Area" is in a lower rainfall non-Karri area; the reserves form a tenuously connected network, prone to traffic disturbance and of uncertain biological value.

The obvious natural unit for initial interim reservation is the drainage basin of a river system. Excluding the Donnelly and Frankland Rivers, which respectively delineate the western and eastern boundaries of the concession, four river systems flow southward through the area. These are the Warren, Gardner, Shannon and Deep Rivers and their tributaries.

The drainage basin of the Shannon River is best suited to the concept of a controlled area to be exempt from clear-felling activities during the first term of the Wood Chipping Agreement. Most of the catchment area is in undeveloped State Forest, although some blocks, principally in the north-western part of the catchment, have been partially cut-over. In addition, the Shannon flows into Broke Inlet, one of the largest estuaries in the State which, because of its inaccessibility, is still in a fairly intact natural state. Broke Inlet has been recommended for inclusion in the South Coast National Park (2.1 above).

Sediments are transported into Broke Inlet almost entirely by the Shannon River and are deposited as a small delta of classic form (Hassell 1962, unpublished). Sedimentological patterns in the Inlet are therefore sensitively controlled by the load carried by the Shannon. They are susceptible to rapid and irreversible disturbance if increased run-off and erosion in the Shannon Drainage Basin add notably to the sedimentary material transported into Broke Inlet.

The hydrological and biological regimes should remain effectively stabilised in Broke Inlet if no commercial cutting takes place in the Shannon Drainage Basin. They would serve, therefore, as a yardstick to which variations in the characteristics of other rivers within the area of the woodchip concession could be related. Part of the area of Karri and Karri-Marri forest lying within the Shannon Drainage Basin would also provide an incomparable reserve for conservation of the natural wet sclerophyll forest and for controlled public recreation. Even today, the heavy timber country lying between Deeside Coast Road and South Coast Highway is only accessible to tourists with difficulty, and it has not yet been extensively developed as a productive forest. It is therefore the nearest approach to a large primitive forest area remaining in the south-west

of the State. In recognition of the delicacy of the situation in respect to commercial development of the State's wet sclerophyll forests, and of the legal commitments that at present exist, the Committee refrains from making formal recommendations concerning precise boundaries to the proposed forest conservation reserve. Several parties have obvious claims to consultation and under the terms of the original Hawker Siddeley Agreement the question of compensation to the operating company will also arise.

The total area of the Shannon drainage basin is about 50,000 ha, a little less than 6% of the total woodchipping license area, although it contains almost 20% of the available timber. In the Australian context, a forest conservation reserve of this area may sound large; by comparison with the size of Parks established for similar purposes elsewhere in the World it is not. California, with a total area less than one-fifth that of Western Australia and a comparably high proportion of unproductive desert is justly famous for its National Parks. Of these the Sequoia, Kings Canyon and Redwood National Parks, although not comparable in all respects, have broadly similar purposes to the proposed Shannon River conservation reserve. They all contain major associations of the Californian Redwood (Sequoia sempivirens). The Sequoia National Park has an area of 156,600 ha, the contiguous Kings Canyon Park 186,369 ha, and the Redwood National Park, 23,100 ha. The list below is presented as a guide to the areas considered appropriate to forest parks elsewhere in the World, without necessarily suggesting that all the parks listed consist entirely of "natural forest" or that their status is identical in every country.

National Park	Country	Area (ha)
Great Smoky	USA (Tennessee-Carolinas)	209,067
Olympic	USA (Washington)	363,123
Isle Royale	USA (Michigan)	218,433
Soretama	Brazil	29,970
Rio Pilcomayo	Argentina	283,500
Iguazo	Argentina	55,080
Mudus	Sweden	49,000
Borgefjell	Norway	100,051
Khekhtsir	U.S.S.R.	45,266

The Committee believes that a major reserve in the wet sclerophyll forest area of Western Australia would, in time, become a national and international tourist asset, with greater earning potential than it has timber resources. With competent management this recreational potential is also reconcilable with conservation of the forest for biological purposes.

The proposal to set aside such a large area of forest is made in full awareness of the management problems thus created. Forest conservation, whether for commercial, biological or recreational

purposes, is a demanding profession that requires high level training and considerable experience. It is therefore inevitable that, initially at least, management of the proposed reserve would be the responsibility of the Conservator of Forests. The Committee therefore believes that the Forests Department should be intimately involved in the selection of a suitable area for a forest reserve and in drafting plans for its management.

The Committee is aware that, if its recommendations are accepted, the cutting programme for the first license period of the Wood Chipping Agreement will need to be modified. If the tonnages set out in the Agreement are to be maintained more intense felling will be necessary in parts of the license area lying outside the Shannon Drainage Basin.

Recommendations

The Committee recommends:

1. That during the first license period of the Wood Chipping Industry Agreement Act, 1969-73, clear-felling should not be carried out in an area designated here the Shannon River Drainage Basin;

2. that precise boundaries of the area to be set aside as the Shannon River Drainage Basin be determined by the Environmental Protection Authority in consultation with the Conservator of Forests;

3. that all Crown land within the designated boundaries which is not at present incorporated in State Forests should be immediately reserved;

4. that, towards the end of the first license period when the effects of clear-felling in other areas can be assessed, a committee select, from within the Shannon River Drainage Basin, a sustantial area of wet sclerophyll forest to be conserved in perpetuity as natural forest; the Environmental Protection Authority, the Conservator of Forests, the Western Australian Wildlife Authority, and the National Parks Board of Western Australia should be represented on this committee;

5. that the Conservator of Forests be asked to manage the area selected for conservation as though it were a National Park;

6. that during the first license period of the Wood Chipping Agreement, the Environmental Protection Authority collaborate with the Forests Department in initiating a project to study in detail, and over a prolonged period, any aspects of the biology, hydrology, sedimentology, pedology and geology of the Shannon River Drainage Basin (including Broke Inlet) that appear relevant to assessment of the environmental effects of the woodchip industry and to the conservation of the wet sclerophyll forest.

2.5 TONE-PERUP RIVER AREA

Lying between the Tone and Perup Rivers about 50 km ENE of Manjimup, this area comprises State Forest No. 37 and Forest Act Timber Reserves F 103/25 and F 140/25. It covers approximately 38,000 ha.

The area is gently undulating with mainly lateritic soils; there are sandy or reddish clay loams in the valleys and occasional granite outcrops (Christensen, 1973). The predominant vegetation on the lateritic ridges is Jarrah (Eucalyptus marginata) open forest with some Marri (E. calophylla). The understorey is low and open in the east, often dominated by Bossiaea ornata, while in the western part it is denser and Bossiaea linophylla becomes dominant. Wandoo (Eucalyptus wandoo) woodlands occur on the sandy loams in lower areas. Blackboy (Xanthorrhoea sp.) flats are common and some swamps are found in the south. Heartleaf Poison (Gastrolobium bilobum) forms dense thickets especially in some lower lying areas while Prickly Moses (Acacia pulchella) forms thickets on the ridges.

The Tone-Perup Area is one of the best areas for wildlife in the South-West, and is exceptionally rich in native mammals. Thirteen species of marsupials, two of native rodents and seven species of bats have been recorded. Notable among the marsupials are the Woylie (Bettongia penicillata), Tammar (Macropus eugenii), Numbat (Myrmecobius fasciatus, Fig. 2.8) and Ring-tail Possum (Pseudocheirus peregrinus).

The Forests Department has designated this land a "Fauna Priority Area", and has indicated that it will be excluded from woodchipping. The major objectives of a Fauna Priority Area have been stated as:

"1. The conservation and management of the total forest environment with particular reference to the fauna.

2. To use the area as a centre of research aimed at establishing the basic principles for sound fauna management in forest areas." (Christensen, 1973).

The Committee considers that the research by the Forests Department towards these objectives is most desirable and considers that this area is very suitable for it.

Recommendations

The Committee recommends.

1. that on the understanding that the Forests Department intends to manage the area to the benefit of its fauna, the entire area delineated in Fig. 2.9 be classified State Forest and be managed by the Forests Department as though it were a reserve for flora and fauna;

2. that if at any time the area is relinquished by the Forests Department it be made a Class A Reserve for Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

Figure 2.8. A Numbat (Myrmecobius fasciatus).

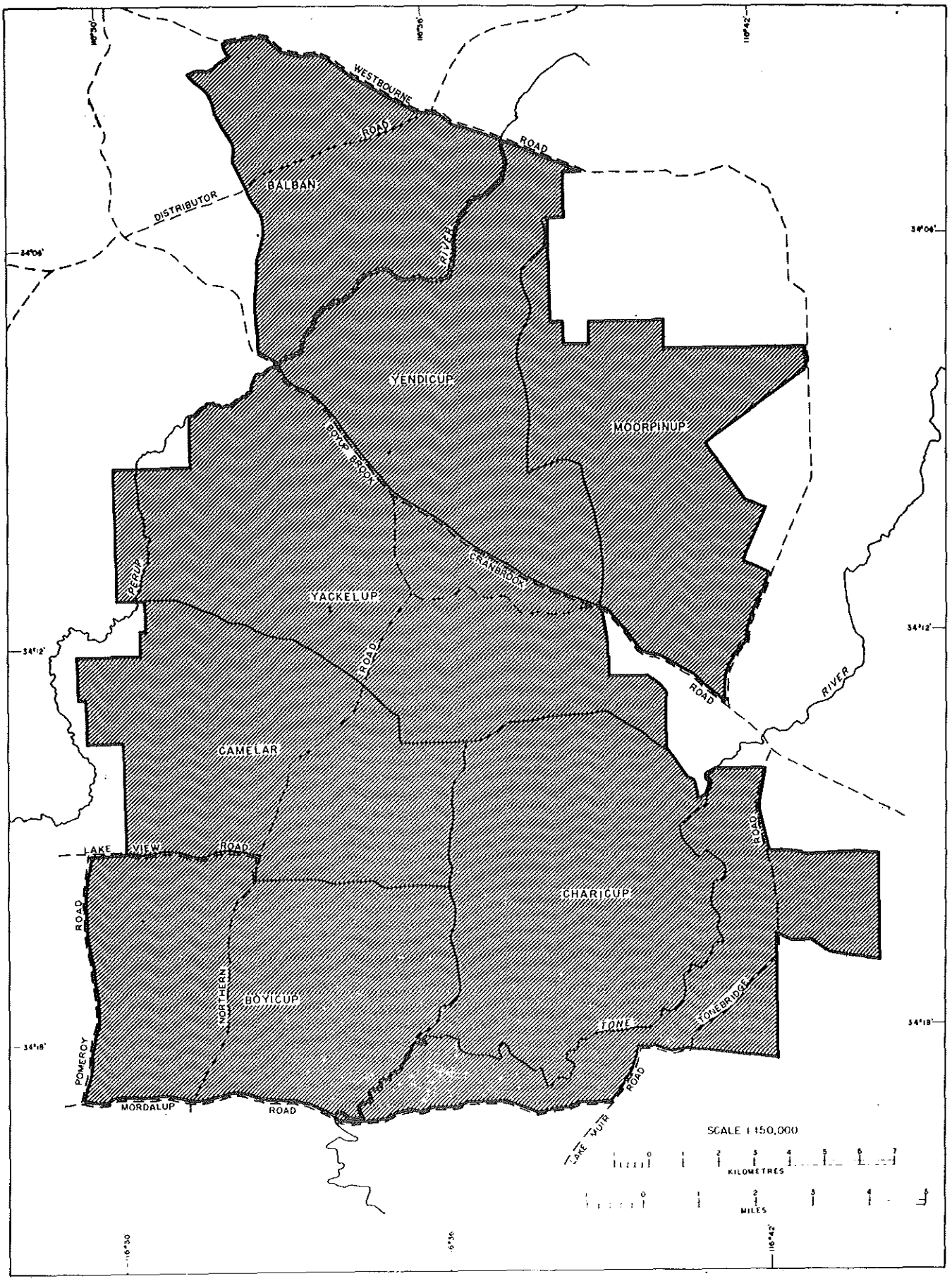

Figure 2.9 Area map of Tone - Perup River area

2.6 LAKE MUIR

This area (Fig. 2.10) comprises a number of small lakes, lagoons and swamps some of which drain into Lake Muir. Situated north and south of the Muir Highway, they lie between the Deep and Frankland Rivers. The complex is about 56 km east of Manjimup and 75 km west of Mt. Barker.

Lake Muir itself is a saline flat containing very little vegetation. A stonewort (Lamprothamnion sp.), one of the few salt-tolerant non-marine algae in WA, is found in shallow water but dies back as the lake dries during summer. Dense swards of Wilsonia backhousii grow on slightly higher ground, and salt-water paperbarks (Melaleuca cuticularis) occur in narrow belts around the shores, passing into Jarrah-Banksia woodland.

Fresh water and brackish lakes and swamps occur to the east and north of Lake Muir, e.g. Red Lake and Byenup Lagoon. Several of these lakes have permanent open water up to 2 m deep. The Jointed Rush (Baumea articulata), a common plant in peat deposits, grows in permanently wet areas but appears to be thinning out, probably because of the increasing salinity of the lakes. A tall closed heath of myrtaceous shrubs occurs in dense or open stands in the lakes. Typical species include Melaleuca lateritia and M. humulosa. Paperbarks, both Melaleuca rhaphiophylla and M. preissiana, are common, and sedges include Leptocarpus and Juncus species. Some permanently wet parts of the area are completely covered with a rush-heath association.

The margins of these swamps carry a woodland dominated by paperbarks, Flooded Gum (Eucalyptus rudis), Yate (E. cornuta) and Swamp Banksia (Banksia littoralis). Common understorey species are Native Willow (Oxylobium linearifolium) and Wattie (Agonis juniperina).

Although the species composing the vegetation of the Lake Muir area are mostly widespread, they occur here in formations which are not duplicated elsewhere.

The Lake Muir area is one of the most important waterfowl areas in the South-West. The presence of a large brackish lake where large numbers of birds can rest and feed without disturbance, close to a series of comparatively fresh lagoons where they can drink, is particularly effective. The area serves one of the largest Black Swan (Cygnus atratus) populations ever recorded - over 50,000 birds having been counted on one occasion. Many other species of waterbirds also occur abundantly.

Two main problems arise in connection with this area. One is the increasing salinity of the wetlands, which seems to be at least partly the result of clearing surrounding bushland. Records suggest that Lake Muir was comparatively fresh at the turn of the century.

The other problem is peat extraction. Applications have been made for Coal Mining leases covering the wetlands to the east of Lake Muir and an area on its western shore. The Committee

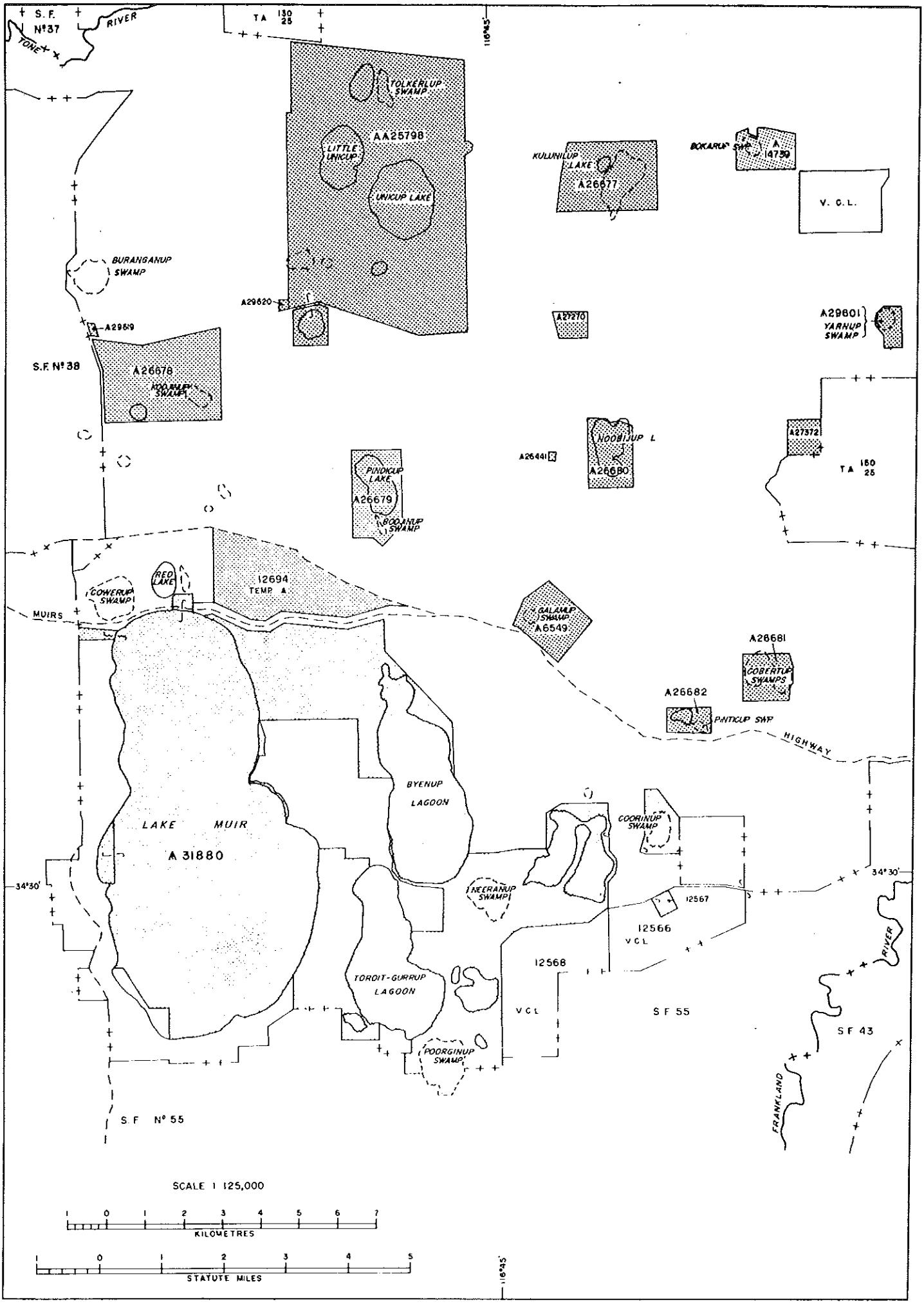

Figure 2-10 Area map of Lake Muir area

understands that negotiations between the company concerned and the Government have produced a set of conditions whereby the mining might take place without harming the long term use of the wetlands by waterfowl. Peat is already being excavated from Cowerup Swamp, to the north of Lake Muir, under a lease granted by the Department of Lands and Surveys.

The Lake Muir area contains a complex of reserves mostly for Conservation of Fauna and Flora and vested in the WA Wild Life Authority, although many swamps are on private land. The larger lakes and swamps north of Muir Highway are situated on reserves dispersed among farmland while to the south of the Highway a large reserve includes Lake Muir and its associated wetlands. To the west and south of Lake Muir most country is within State Forest No. 55, but to the north and east some Crown land remains. This should be reserved to prevent clearing and the consequent effects on salinity.

Recommendations

The Committee recommends that:

1. the following reserves, for the Conservation of Flora Fauna and vested in the WA Wild Life Authority, be declared Class A

26677	Kulunilup Lake
26678	Kodjinup Swamp
26679	Pindicup Lake and Bodginup Swamp
26680	Noobijup Lake
26681	Cobertup Swamps
26682	Pinticup Swamp;

2. reserve No. 29601 (Yarnup Swamp) for the Conservation of Flora and Fauna, not vested, be declared Class A and vested in the WA Wild Life Authority;

3. the purpose of reserves 6549 (Galamup Swamp) and 14739 (Bokarup Swamp) set aside for 'Water' and not vested, be amended to include Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

The Committee endorses the status, purpose and vesting of reserve No. 25798 (Lake Unicup and Little Unicup)

The Committee endorses the status, purpose and vesting of reserve No. 31880 (Class C, Conservation of Flora and Fauna, vested in the WA Wild Life Authority, including Lake Muir, Byenup Lagoon, Tordit-Gurrup Lagoon, Neeranup Swamp, Poorginup Swamp and Coorinup Swamp) and recommends the following be added to it:

1. the temporary reserve to the north-east of Lake Muir (Nelson Location 12694)

2. the vacant Crown land south-east of Neeranup and Coorinup Swamps (Nelson Locations 12566, 12567 and 12568).

Mining operations on this reserve should be subject to conditions laid down by the Environmental Protection Authority and designed to preserve the wetlands.

2.7 PORONGURUP NATIONAL PARK

The Porongurup National Park (Fig. 2.0) is an A Class reserve No. 18987 of about 2239 ha, for National Park, under the control of the National Parks Board of WA. It is a range of granite peaks up to 700 m high. In places the rocks are exposed as large boulders or bare slopes, but where soils are deep there is a tall forest. On the southern slopes and in the wetter gullies on the northern face, the forest is dominated by Karri (Eucalyptus diversicolor). Elsewhere, Marri (E. calophylla) and Jarrah (E. marginata) are dominant, while around the granite outcrops they are replaced by Bullich (E. megacarpa). Many shrubby species make up the understorey and in spring the wildflowers are attractive.

There are several access roads to the range, and paths have been developed to some of the scenic lookouts.

The Committee endorses the status, purpose and control of the Porongurup National Park.

2.8 MILLBROOK RESERVE

Millbrook reserve (Fig. 2.0) is a C Class reserve, No. 18739 of about 1497 ha for the Conservation of Flora and is not vested. It lies about 30 km north of Albany at the head of the Mill Brook. The brook here is a shallow, swampy depression, rising on each side to low hills with sandy or lateritic soil. The swamp contains a number of interesting plants, including Albany Pitcher Plant (Cephalotus follicularis), a club moss (Lycopodium carolinianum), orchids and bladderworts (Utricularia).

The hills carry a dense woodland dominated by Jarrah (Eucalyptus marginata) and Sheoak (Casuarina fraserana). The understorey is especially rich in Proteaceae and contains the last known population of a rare prostrate Banksia (B. goodii). Other species of restricted distribution which occur here include Banksia brownii, Dryandra squarrosa (Fig. 2.11), D. baxteri and Stirlingia tenuifolia.

Many birds including Wedge-tailed Eagles (Aquila audax) have been recorded in the reserve, as well as the Western Grey Kangaroo (Macropus fuliginosus).

Recommendations

The Committee recommends that the status and purpose of reserve No. 18739 be changed from C Class for "Conservation of Flora" to A Class for "Conservation of Flora and Fauna", and that it be vested in the WA Wild Life Authority.

Figure 2.11. Dryandra squarrosa, known only from the Millbrook reserve area.

Figure 2.12. West Cape Howe area - view across Lake William.

2.9 WEST CAPE HOWE

West Cape Howe (Fig. 2.0), the southernmost point of the Western Australian mainland, is a precipitous headland with cliffs rising abruptly from the sea. There are also exposures of granite, while Coastal Limestone forms superficial deposits in places. Derived soils in the area are sands and loams. Several small streams and Lake William add further variety to the landforms and habitats.

The vegetation includes forest, woodland, swamps, heathlands and granite associations (Fig. 2.12). Karri (Eucalyptus diversicolor) dominates the forest, with admixture around the margins of Yate (E. cornuta), Bullich (E. megacarpa) and Common Sheoak (Casuarina fraserana). Bullich occurs also as a mallee, on the coastal dunes.

A dense sedge - scrub association occurs around Lake William. A rare species of the Euphorbiaceae, Amperea volubilis, is found here, as well as an as yet unnamed paperbark (Melaleuca sp.). Albany Pitcher Plant (Cephalotus follicularis) grows on the swamp margins. On the northern margin of the Lake is a fine stand of Wattie (Agonis juniperina). Other species of interest in the area are Acacia tetragonocarpa, Hibbertia perfoliata and Veronica plebeia. The cushion-like heath Andersonia sprengelioides shows considerable variation on the coastal heaths.

This area is worthy of reservation both for its spectacular coastal scenery and for its varied vegetation and flora. It is at present a C Class reserve of about 3205 ha, No. 26177 for Common, controlled by the Shire of Albany.

Recommendations

The Committee recommends that the status and purpose of reserve No. 26177 be changed from C Class for Common to A Class for National Park, and that it be placed under the control of the National Parks Board of WA.

2.10 TORNDIRRUP NATIONAL PARK

This is an A Class reserve, No. 24258, of about 3594 ha, for National Park and Recreation, under the control of the National Parks Board of WA. It also includes C Class reserve No. 28232 of 10 ha for Tourist Lookout at the Gap and Natural Bridge.

The park (Fig. 2.0) includes one of the most scenic and popular sections of the south coast, including the Gap, the Natural Bridge and Jimmy Newell's Harbour. Massive granite cliffs and steep slopes rise sheer from the ocean, providing spectacular scenery. The vegetation is a low heath, often windswept, but it is rich in species, and wildflowers add to the attraction of the park. Here are the principal known populations of Albany Banksia, (B. verticillata) and the only known occurrence of Adenanthos cunninghamii. The Coastal Banksia (B. praemorsa) grows on steep sandy slopes near the seashore.

The Committee supports submissions proposing the addition of much of Vancouver Peninsula to the park. Most of the Peninsula is within reserve No. A 25295 which is for Public Recreation and is not vested. There is also a small reserve, No. 30360 for Recreation, vested in the Shire of Albany, where a youth camp has been developed (Camp Quaranup).

The Peninsula separates Princess Royal Harbour from King George Sound. In contrast to the rugged coast to Tornidirrup, it has sheltered sandy and rocky shores suitable for recreation. The vegetation is mainly coastal heath in the southern part with a few fresh swamps, while the northern part is hilly with granite outcrops and has a Jarrah-Marri woodland. Flora and fauna are typical of the region but include elements absent from Torndirrup. The peninsula has both recreational and conservational value, and is close to Albany.

The Committee endorses the status, purpose and control of reserve A 24258.

Recommendations

The Committee recommends:

1. that the status and purpose of reserve No. 28232 be changed from C Class for tourist lookout to A Class for National Park, and that it remain under the control of the National Parks Board of WA;
2. that the purpose of reserve No. A 25295 be changed from "Recreation" to "National Park" and that it be placed under the control of the National Parks Board of WA.

2.11 TWO PEOPLES BAY WILDLIFE SANCTUARY

Two Peoples Bay Wildlife Sanctuary (Figs. 2.0, 2.13) comprises Class A Reserve No. 27596 of 4638 ha., about 25 km east of Albany. The reserve was gazetted in 1966, its creation resulting primarily from the rediscovery of the Noisy Scrub Bird (Atrichornis clamosus) on the slopes of Mt. Gardner in 1961.

The Noisy Scrub Bird was recorded in the nineteenth century near Albany and in the Darling Range, and before rediscovery at Two Peoples Bay had been considered extinct (Webster, 1962).

At the time of rediscovery there wereplans for a townsite to be established in part of what is now reserve, but following representations by conservationists (including the Duke of Edinburgh) and the Department of Fisheries and Fauna the WA Government decided not to proceed with the town and the reserve was established.

The reserve includes four main vegetation types. The first covers the area south from Two Peoples Bay including Mt. Gardner. This consists of Precambrian granite-gneiss with derived sands and some Tertiary sediments. It is covered predominantly with a heath vegetation typical of much of the south coast but in the gullies the vegetation is extremely thick,

Figure 2.13. View of Mt. Gardner across Two Peoples Bay

with eucalypts (especially the Bullich, shrubs and sedges (Lepidosperma spp.). It is within these gullies that the Noisy Scrub Bird is found. West of Two Peoples Bay are heath-covered Quaternary limestones and sands. To the north of these are lateritic soils with a Jarrah (Eucalyptus marginata) woodland while between this and the Coastal Limestone are a series of swamps and lakes including Moates Lagoon and Lake Gardner.

As well as the Noisy Scrub Bird the sanctuary contains other rare bird species. Notable among these are the Western Whip Bird (Psophodes nigrogularis) and the Bristle Bird (Dasyornis brachypterus). The Southern Emu-Wren (Stipiturus malachurus) is common in the coastal heaths.

The Two Peoples Bay Wildlife Sanctuary is also important for the diversity of mammals, reptiles and frogs. Ten species of marsupial, two native rodents and two seals are known. Of especial interest are the Quokka (Setonix brachyurus) which is near the eastern end of its range, the Ring-tail Possum (Pseudocheirus peregrinus) and Water Rat (Hydromys chrysogaster), Two Peoples Bay being the easternmost locality for both species. Both the Australian Sea Lion (Neophoca cinerea) and the New Zealand Fur Seal (Arctocephalus forsteri) occur on Coffin Island and occasionally visit the mainland.

The reptiles and frogs are typical of those found in the wet south coastal part of WA. Sixteen species of reptiles and 7 species of frogs are known. The reserve is important in providing a permanent habitat for uncommon species such as the skinks Lerista microtis and Egernia luctuosa and the snake Elapognathus minor.

The Two Peoples Bay Wildlife Sanctuary is the subject of a management plan approved by the WA Wild Life Authority which allows visitors in some areas and prohibited entry to others. Access roads have been constructed and a picnic area established. A ranger is resident on the reserve.

Since 1963 the CSIRO Division of Wildlife Research has been carrying out investigations into the song and ecology of the Noisy Scrub Bird, Western Whip Bird and Bristle Bird. When this study is complete the information gained will be used to improve the reserve management plan.

The Committee endorses the purpose status and vesting of the Two Peoples Bay Wildlife Sanctuary

2.12 WETLANDS

Two major wetlands complex are recognised in System 2 (see Fig. 0.1).

WETLAND COMPLEX 6 - LAKE MUIR

The Lake Muir complex (discussed above under Area 2.6) includes a series of wetlands near the Muir Highway. They serve as a breeding and feeding area for waterfowl as well as a drought refuge for birds moving from the inland.

The principal wetlands are:

Already within Conservation Reserves	Not within Conservation Reserves
Byenup Lagoon	Lake Carabundup
Kulunilup Lake	Lake Poorarecup
Lake Muir	
Little Unicup Lake	
Noobijup Lake	
Pindicup Lake	
Tordit-Gurrup Lagoon	
Unicup Lake	

Recommendations concerning this complex are given under Area 2.6.

WETLAND COMPLEX 12 - AUGUSTA

These wetlands extend along the coast from Augusta to Wilsons Inlet. Surveys have shown that no single wetland contains a very large waterfowl population but that the total complex of swamps, lakes and estuaries does carry large populations, especially in the summer months when inland wetlands become dry. The reservation of areas in this complex would greatly benefit the Black Duck (Anas superciliosa) and Grey Teal (Anas gibberifrons), the two species which have suffered the greatest habitat losses on the Pinjarra Plain.

The major wetlands in the complex are:

Already within Conservation Reserves	Not within Conservation Reserves
Gingilup Swamps (part)	Broke Inlet
	Gingilup Swamps (part)
	Hardy Inlet
	Irwin Inlet
	Lake Jasper
	Lake Maringup
	Owingup Swamp
	Parry Inlet
	Quailaijup Lake
	Walpole Inlet
	Warren River
	Wilsons Inlet

Most of these wetlands are either estuaries which cannot be reserved under the Land Act or are included in the proposed South Coast National Park. (Area 2.3). Two areas are recommended for reservation by the Committee, the Gingilup Swamps and Owingup Swamp.

The Gingilup Swamps are a series of fresh water swamps which form the headwaters of the Scott River. As discussed under Area 2.1, the Scott Coastal Plain is a distinctive entity of the Western Australian landscape. Already most of it has been

cleared and it is important that representative areas be reserved. The Gingilup Swamps provide important waterfowl habitat especially for the Black Duck (Anas superciliosa) and Grey Teal (Anas gibberifrons). Part of the swamps are already reserved (reserve no. 30626, Conservation of Flora and Fauna, not vested, 2808 ha) but the Committee believes that the reserve should be enlarged and its status raised. Increasing salinity has been a problem with south coast rivers when their catchments are cleared and a larger reserve will help mitigate against this possibility as well as providing further habitat for waterfowl and other animal life.

Owingup Swamp lies between Walpole and Denmark. The Kent River runs into it from the north by a well defined channel and flows out into Irwin Inlet by a number of poorly defined channels to the west. Part of the "Swamp" is a lake containing permanent fresh water while the western section of about 800 ha is densely vegetated and low lying. The main upper storey of this area is of Wattle (Agonis juniperina) and Paperbark (Melaleuca preissiana). Where the watties are less dense other species such as Blister Bush (Phebalium anceps) Tea Tree (Astartea fascicularis), Agonis linearifolium, Native Willow (Oxylobium lanceolatum) and Loxocarya flexuosa are found. On the lake edge are areas of the Jointed Rush (Baumea articulata).

Swamp Banksia (B. littoralis) and Yate (Eucalyptus cornuta) are found on the fringes of the swamp. To the south west are areas of encroaching sand dunes, most of which are stable at present.

The open fresh water of the lake provides a refuge for large numbers of waterfowl which move to the coast during the summer. In addition the rushes and the vegetation around the lake are breeding habitat for a number of species. One feature of the area is the breeding colonies of the Black Cormorant (Phalacrocorax carbo) in trees along the edge of the Kent River near where it enters the swamp.

Owingup Swamp and surrounds are within reserves no. 10048 (Government Requirements, not vested) and 2009 (Government Requirements, not vested) Part is vacant Crown land.

Owingup Swamp has for sometime been proposed for agricultural use. A report by the Department of Agriculture (Malcom et al., 1969) indicated that much of the low lying area adjacent to Owingup Lake is suitable for vegetable growing. However, drainage may be costly.

Recommendations

The Committee recommends that:

1. reserve no. 30626 be increased in size as shown in Fig. 2.1 It should remain for the Conservation of Flora and Fauna, be declared Class A and vested in the WA Wild Life Authority.

2. a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, be created at Owingup Swamp. The reserve should include the open waters of Owingup Lake and part of the surrounding and adjoining swamps. Boundaries to be determined by the Environmental Protection Authority following consultation between the Departments of Agriculture, Fisheries and Fauna, and Lands and Surveys.

2.13 ISLANDS

Along the south coast from Cape Leeuwin to Hassell Beach there are scattered, usually small, offshore islands. They are basically pieces of the mainland cut off by rising sea levels in the Quaternary. Some have conservational importance.

The most important island in the System is Bald Island, 50 km east of Albany. This island is Class 'A' Reserve No. 25869 for the Conservation of Fauna, vested in the WA Wild Life Authority and is about 800 ha in extent.

Bald Island (Fig. 2.14) is a precipitous mass of granite-gneiss rising about 300 m above sea level. The vegetation has been classified into six types - succulent mat, tussock-land, heath, peppermint scrub, bushy yate forest and tea-tree forest (Storr, 1965).

The vegetation is especially interesting and contrasts with that of the adjacent mainland. The island is depauperate in terms of species typical of the sandplains of the south coast. It is probable that the vegetation of Bald Island is typical of the region at the time when it was joined to the mainland and that development of the sandheaths of the mainland has occurred since. In contrast to the mainland, the vegetation shows no obvious evidence of burning and suggests that the development and distribution of south coast heaths is very much dependent on fire-frequency.

The island is chiefly notable for containing the only insular population of the Quokka (Setonix brachyurus) apart from that on Rottnest Island which lives under very different conditions. It probably also contains a bandicoot but no specimens have been collected.

Breeding birds include the Little Penguin (Eudyptula minor) and the Great-winged Petrel (Pterodroma macroptera). Five species of lizard have been collected.

Several other islands in the System are important sea-bird breeding sites. These include St Alouarn and Seal Islands off Cape Leeuwin, Sandy Island near Point D'Entrecasteaux, Chatham Island near Cliffy Head, Saddle Island near Walpole, Eclipse Island south of Albany, Michaelmas, Breaksea, Mistaken and Seal Islands in King George Sound, Green Island in Oyster Harbour and Coffin Island at Two Peoples Bay.

Figure 2.14. Bald Island, with Mermaid Point and Mt. Manypeaks in the background.

Species of seabird breeding on these islands include the Little Penguin (Eudyptula minor), Fleshy-footed Shearwater (Puffinus carneipes), Little Shearwater (Puffinus assimilis), Great-winged Petrel (Pterodroma macroptera), White-faced Storm-Petrel (Pelagodroma marina) and Silver Gull (Larus novaehollandiae). All but one of these islands are already reserves although not all are of Class A. Eclipse Islands is controlled by the Australian Government as a lighthouse site.

Green Island, however, is a reserve for "Recreation", a purpose that conflicts with its use by the Silver Gull (Larus novaehollandiae) as a breeding site.

Recommendations

The Committee recommends

1. that the status of the following reserves be changed from Class C to Class A and that they remain for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority;

No. 144	- Mistaken Island
No. 27614	- Breaksea Island
No. 30049	- Michaelmas Island
No. 31904	- Chatham Island
No. 32199	- Seal Island (King George Sound)

2. that the purpose of Reserve No. A 24808 (Green Island) be changed from Recreation to Conservation of Fauna and Flora and that it be vested in the WA Wild Life Authority.

2.14 THE SOUTH COAST

Much of the south coast between Cape Leeuwin and Cape Arid (See also System 3) is included in various reserves for such purposes as 'Common', 'Recreation and Camping' and 'Excepted from Sale'. Some is vacant Crown land.

The coastline of the State, and of the southwest in particular, is the centre of population both for urban development and for recreation. Those parts of the south coast still controlled by the Crown are an important public resource for such values as;

1. Recreation - swimming, camping, picnicking, fishing and boating
2. Conservation - protection of flora and fauna
3. Coastal Protection - prevention of erosion by wind and water.

The Crown land includes many areas of scenic grandeur, e.g., Mt. Manypeaks and the Waychinicup River, Mermaid Point and Look-out Point near Cheynes Beach and Cape Knob and Point Hood near Bremer Bay.

The southern coastline with its sandy beaches alternating with rocky headlands and cliffs is much more variable than the west coast north of Geographe Bay. Behind the beach or cliffs the vegetation is usually a low sand heath although woodlands or forests may occur, especially around lakes, swamps and rivers.

Animal life is typical of the heaths and includes the Grey Kangaroo (Macropus fuliginosus), Honey Possum (Tarsipes spencerae), Marsupial Mice (Antechinus and Sminthopsis), Bush Rats (Rattus fuscipes) and a variety of birds and reptiles. One animal of interest is the Dibbler (Antechinus apicalis) which in recent times had been collected only at Cheynes Beach. Another is the rare Ground Parrot (Pezoporus wallicus), which in Western Australia is found only in the south coast heaths.

It is apparent that some of the coastal Crown lands are deteriorating. This is shown by increasing erosion and mobility of sand dunes, the multiplicity of vehicle tracks and the presence of squatters. The causes of erosion are complex but probably include the construction of tracks to beaches and fishing spots, the use of all-terrain vehicles, grazing by domestic stock and too frequent burning.

Some Crown lands along the south coast are included in National Parks and Wildlife Sanctuaries and additional reserves of these types are recommended in this report. However much vacant Crown land and reserved land is in relatively small parcels scattered between private property and does not lend itself to consolidation into National Parks. Nevertheless we consider that these scattered areas make an important contribution to the environment. The land needs to be controlled and managed to prevent further deterioration and to provide public access and facilities in suitable places.

Because of the large area involved and the complexity of the problem the Committee does not believe that existing local or State Government bodies on their own, can undertake the management of this important area. It therefore proposes that a special authority, combining expertise from both State and local government, be set up.

Initially, the Committee believes that a working group should be appointed by the Environmental Protection Authority to define the problem, determine the land to be controlled, how the authority should be financed, and what bodies should be represented on it. The Committee believes that this working group will not be able to complete its work quickly unless provision is made for a full time co-ordinator or secretary, preferably a person with training in town planning or a natural science.

Recommendation

The Committee recommends that a working group comprising representatives of relevant local authorities, State Government Departments and the public be set up by the Environmental Protection Authority. The terms of reference to be to make recommendations on:

1. the future control and management of Crown lands along the south coast between Capes Leeuwin and Arid, excepting
   a) the proposed South Coast National Park (Area 2.1)
   b) Walpole-Nornalup National Park (Area 2.1)
   c) William Bay National Park

d) proposed West Cape Howe National Park (Area 2.9)
e) Torndirrup National Park (Area 2.10)
f) Two Peoples Bay Wildlife Sanctuary (Area 2.10)
g) Fitzgerald River National Park (Area 3.2)
h) Cape le Grande National Park (Area 3.4)
i) Cape Arid National Park (Area 3.5)

2. the financial implications of creating a special authority to manage these Crown lands;

A list of land to be included in the study is as follows (see also System 3, Area 3.10).

SYSTEM 2 WEST TO EAST

19787 "C" class, Camfield, Camping area
15677 "A" class, near Irwin Inlet, Inspection of Flora
22975 "C" class, Irwin Inlet, Camping and protection of Flora
17734 "C" class, Irwin Inlet, Common
10224 "C" class, Foul Bay, Government Requirements
7723 "C" class, Boat Harbour, Government Requirements
2010 "C" class, Boat Harbour, Public Utility
2008 "C" class, Point Hillier, Public Utility
20928 "A" class, Parry Inlet, Recreation and Camping
24913 "A" class, Ratcliffe Bay, Park Lands and Recreation
30883 "A" class, near Youngs siding, Recreation
17464 "C" class, Tennessee siding, Common
24514 "A" class, Torbay, Recreation and Camping
20367 "C" class, Port Hughes, Common
2217 "C" class, Port Hughes, Public Utility and Camping
4732 "C" class, south of Lake Powell, Common
13773 "C" class, south of Cuthbert, Pine plantation
24547 "A" class, Port Harding, Camping and Recreation
24548 "A" class, Port Harding, Camping and Recreation
22998 "A" class, Port Harding, Camping and Recreation
2903 "C" class, west of Princess Royal Harbour, Quarantine station for stock
22698 "C" class, Emu Point, Residences Business area, Public Utility
27107 "A" class, Emu Point Townsite extension (Albany) and National Park.

All vacant Crown land on coastline.

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SYSTEM 3 - EASTERN SOUTH COAST

INTRODUCTION

Area and Physiographic Features

System 3 covers the region from the Stirling Range and Hassell Beach to Mt. Ragged and the coast near Israelite Bay (Figs. 3.1, 3.2). It is a region of sweeping plains, rugged hills and mountains, salt lakes, intermittent rivers and estuaries.

The System includes the eastern part of the Recherche continental shelf (Carrigy and Fairbridge, 1954). Numerous rocky islands of the Recherche Archipelago rise on the shelf from depths of 40 to 70 m and the coast consists of rugged headlands, cliffs and broad beach-lined bays. System 3 encompasses about 46,690 km^2.

Much of the region is underlain by Precambrian granitic and gneissic rocks. The higher hills are Middle Proterozoic sedimentary rocks, and some areas are covered by Eocene sediments - the Plantagenet Beds. Superficial deposits of sand or laterite cover large areas.

West of Culham Inlet the form of the coastline is essentially controlled by the regional southwesterly trend of the resistant Proterozoic crystalline rocks, and any irregularities result from marine erosion acting along foliation and joint planes (Sofoulis, 1958).

East of Culham Inlet the coastline trends generally east-west with no obvious structural control. Clarke and Phillips (1953) suggested that here the coastline is retreating.

In many places rock platforms, corresponding in level to winter high tides, are cut into the hard rocks or, in the western part, are building up offshore by consolidation of beach sand. These offshore platforms provide protected clear swimming places such as those as at Hopetoun and west of Esperance.

The sandy bays are usually backed by sand dunes fixed by light vegetation. Such dunes are vulnerable and may be rapidly remobilised if the vegetation is removed.

Immediately behind the dune sands there is generally a gently undulating sand plain within which occur small lakes and swamps. This plain is between 45 m and 60 m above sea level and in those areas which are underlain by the Upper Eocene Pallinup Siltstone has a thin grey sand cover over yellow clay.

Most rivers entering the sea are now at grade following a late Pleistocene rejuvenation which produced gorges near the coast and dissected earlier alluvial flood plains. The river mouths are often barred and numerous shallow inlets have developed.

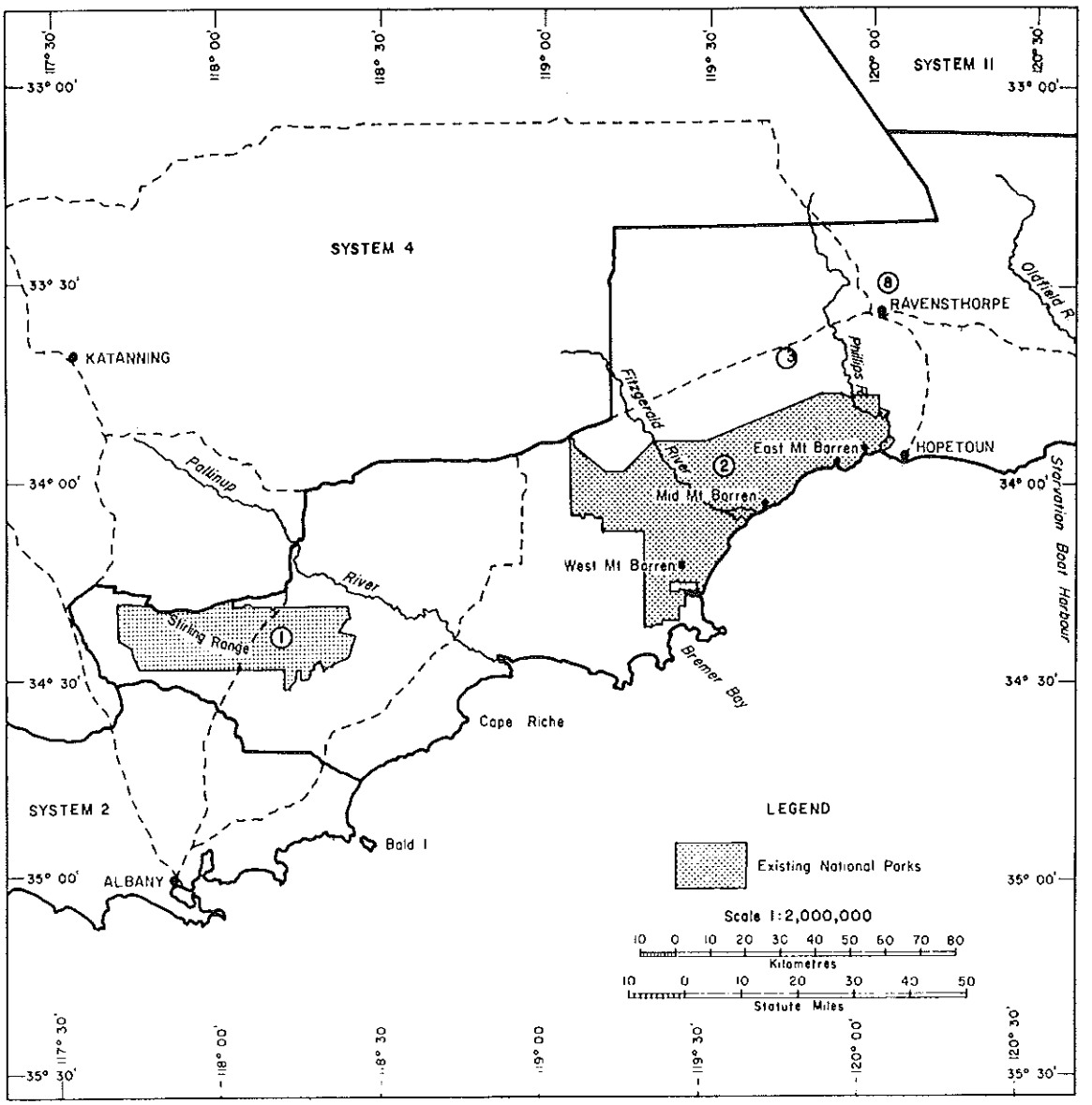

Figure 3·1 System map - 1 Circled numbers denote areas discussed

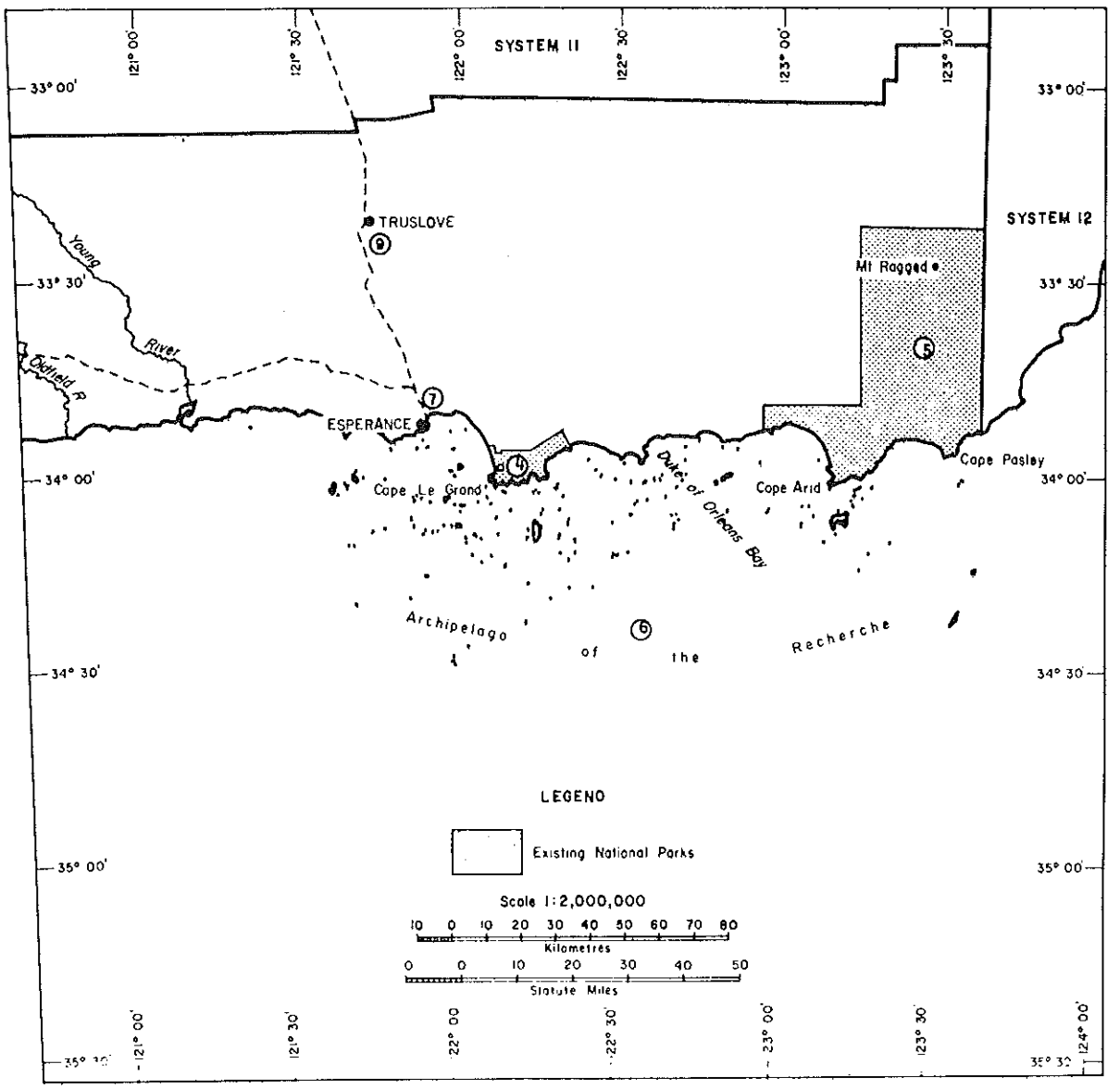

Figure 3·2 System map 2

South and east of Esperance the Archipelago of the Recherche comprises numerous small steep rocky islands and reefs which extend some 65 km offshore to the edge of the continental shelf. Some islands carry small deposits of guano or fringing limestone but most are relatively bare granitic prominences rising abruptly from sea-level.

Biology

The vegetation of the System is mainly heath of considerable diversity (Erickson et al., 1973). There are also woodlands, dense mallee thickets, halophytic formations and flora adapted to granite outcrops. In places wildflower displays are spectacular in spring, and near the coast flowers may be seen at any season. The flora is typically south-western with a high degree of endemism. In a few areas such as the Raventhorpe Range and the edges of the Fitzgerald River valley species more typical of drier inland areas occur as outliers.

Land Use

Land use in the System is mainly agricultural, and most of the sparse population is rural. There are several towns, but only Esperance, which serves the hinterland and the Goldfields to the north, is of appreciable size (pop. 4874, 1971 Census). Sporadic small-scale mining for copper and magnesite occurs in the Ravensthorpe area. Commercial fishing is conducted along the coast, and sport fishing is an important recreational activity.

Tourism

Tourism, based mainly on scenic attractions, wildlife (especially wildflowers) and sport fishing, is increasing in importance. Many transit visitors pass through the region including those using the "Leeuwin Way", en route to or from the Eastern States. Since the summer is relatively mild, and because the region is accessible to Albany, Perth and Kalgoorlie, pressure from tourism will increase, especially along the coast.

CONSERVATION RESERVES

The region already has several major conservation reserves. National Parks include the Stirling Range, Fitzgerald River, Cape le Grand and Cape Arid. Flora and fauna reserves throughout the System cover most of the region's scenic and biological diversity. The areas dealt with in this Report are:

1. Stirling Range National Park
2. Fitzgerald River National Park
3. Cocanarup Reserve National Park
4. Cape le Grande National Park
5. Cape Arid National Park

6. The Recherche Archipelago
7. Esperance Lakes
8. Ravensthorpe Range
9. Truslove area
10. The Coast
11. The Wetlands

3.1 STIRLING RANGE NATIONAL PARK

The Stirling Range, a series of peaks extending in an east-west direction for about 65 km, are the highest mountains in the southern half of the State, reaching 1109 m at Bluff Knoll. Consisting of hard sediments of Late Proterozoic age, the range has eroded into diverse forms (Figs. 3.3, 3.4). It includes many rock faces and is considered to be the best climbing area in the State. In addition to the scenery, the Range is famous for its wildflowers. Over 550 species of plants are recorded and many are endemic to the park. The Mountain Bells, Darwinia spp., some of which are confined to single peaks, are especially well-known.

While the mountains are covered with tall dense scrub, the lower slopes and plains mostly carry woodlands dominated by Jarrah (Eucalyptus marginata), Marri (E. calophylla) or Wandoo (E. wandoo). There is almost no permanent water in the Range; the creeks flow briefly only after rain.

The Range is served by the main road from Albany to Borden through Chester Pass; by a road from this Pass to Cranbrook along the northern edge of the park; and by a road through Red Gum Pass to Kendenup.

A scenic drive winds through the Range from Red Gum Pass to Chester Pass, and there are access roads to the base of some of the major peaks such as Bluff Knoll and Toolbrunup. Firebreaks allow some access by four-wheel drive vehicles to other areas, but movement otherwise must be on foot. This is one of the main attractions of the park which is popular with bushwalkers and climbers.

Because of its popularity, the park is already staffed by two permanent Rangers who are stationed at the Toolbrunup and Bluff Knoll turnoffs. Camping areas are provided at both locations.

The Park Reserve No. A 14792, is an A Class reserve for National Park. It was established in 1913 and is under the control of the National Parks Board of WA. It covers about 115,000 hectares.

The Committee endorses the purpose, status and vesting of the Stirling Range National Park.

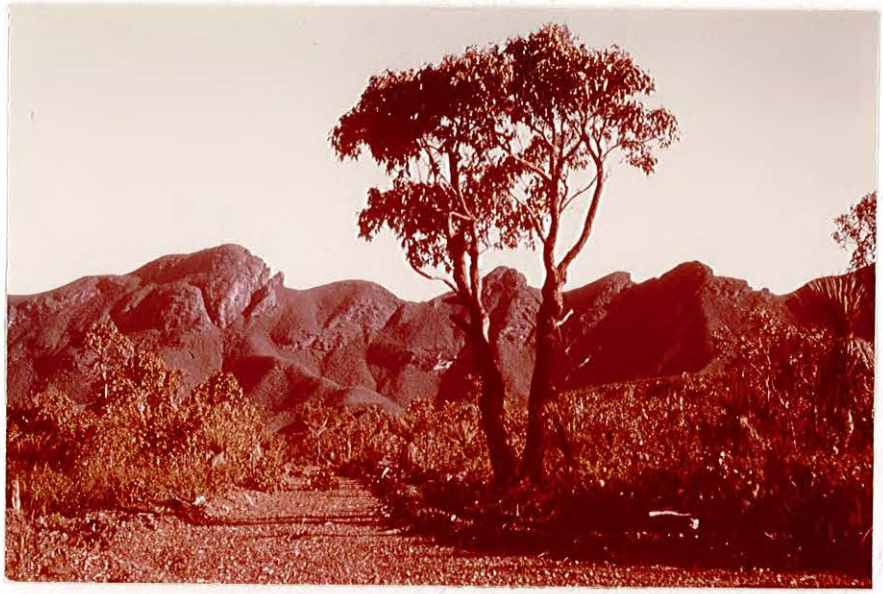

Figure 3.3. Stirling Range National Park: the Arrows towards the eastern end of the Range.

Figure 3.4. Stirling Range National Park: Ellen Peak from the Arrows.

3.2 FITZGERALD RIVER NATIONAL PARK

This park (Figs. 3.8, 3.9) of over 242,000 ha extends from Gordon Inlet to Culham Inlet and for some distance inland. It includes all of the Barren Ranges which are isolated peaks and small ranges of Proterozoic quartzites up to 530 m high (Figs. 3.5, 3.6). There are two major river systems, the Fitzgerald and the Hamersley, both of intermittent flow. Their valleys consist mainly of spongolites which are marine sediments deposited during the Eocene when the Barrens were offshore islands. The rivers have cut into these sediments and formed colourful cliffs (Fig. 3.7). These, the Barrens, and spectacular coastal cliffs make it an area of great scenic attraction.

Much of the park is sandheath, while the hills carry a dense scrub though with much exposed rock. Dense mallee tracts and Swamp Yate (Eucalyptus occidentalis) woodlands occur in the river valleys. There are some swamps, both fresh and saline. Over 600 species of plants have been recorded, of which about 60 are endemic to the park. Most of the others are typical of the south coastal region, but some represent species more common in drier inland regions. Wildflowers contribute greatly to the attractions of the park, because of either colourful flowers or striking and unusual growth forms.

Both the scenery and the flora are outstanding.

In 1954 the area was made a C Class reserve, No. 24048, for the conservation of flora and fauna, but was not vested. In 1973 following action by the Environmental Protection Council and the Environmental Protection Authority it was gazetted an A Class reserve for a National Park and placed under the control of the National Parks Board of WA. The park is in two sections; the major part being reserve A 31737, and a 1 km-wide coastal strip being reserve No. A 31738.

Along the northern boundary of the park is a large area of vacant Crown land. Much of it is sandheath, and it includes also the central valleys of the Fitzgerald and Hamersley Rivers. The western part is the upper watershed of Twertup Creek, a tributary of the Fitzgerald. Here erosion has exposed the underlying Precambrian granite, which is rarely seen elsewhere in the park. Different flora and fauna occur in this habitat.

Beyond the western end of the park is the valley of the Gairdner River, much of which is vacant Crown land. In physiography and flora this valley differs somewhat from the other river valleys of the park.

Within the boundaries of the park lie a number of reserves for purposes such as water and recreation. These should be incorporated into the park. The Department of Lands and Surveys has already acted towards achieving this.

Recommendations to add these and other areas to the park have previously been made both by the Reserves Advisory Council (1969) and by the Conservation Through Reserves Committee, acting in response to a resolution from the Environmental Protection Council in advance of this main report.

Figure 3.5. Fitzgerald River National Park: aerial view of East Mt. Barren and Culham Inlet.

Figure 3.6. East Mt. Barren, seen from the sand dunes which separate Culham Inlet from the sea.

Figure 3.7. Roes Rock on the Fitzgerald River: aerial view.

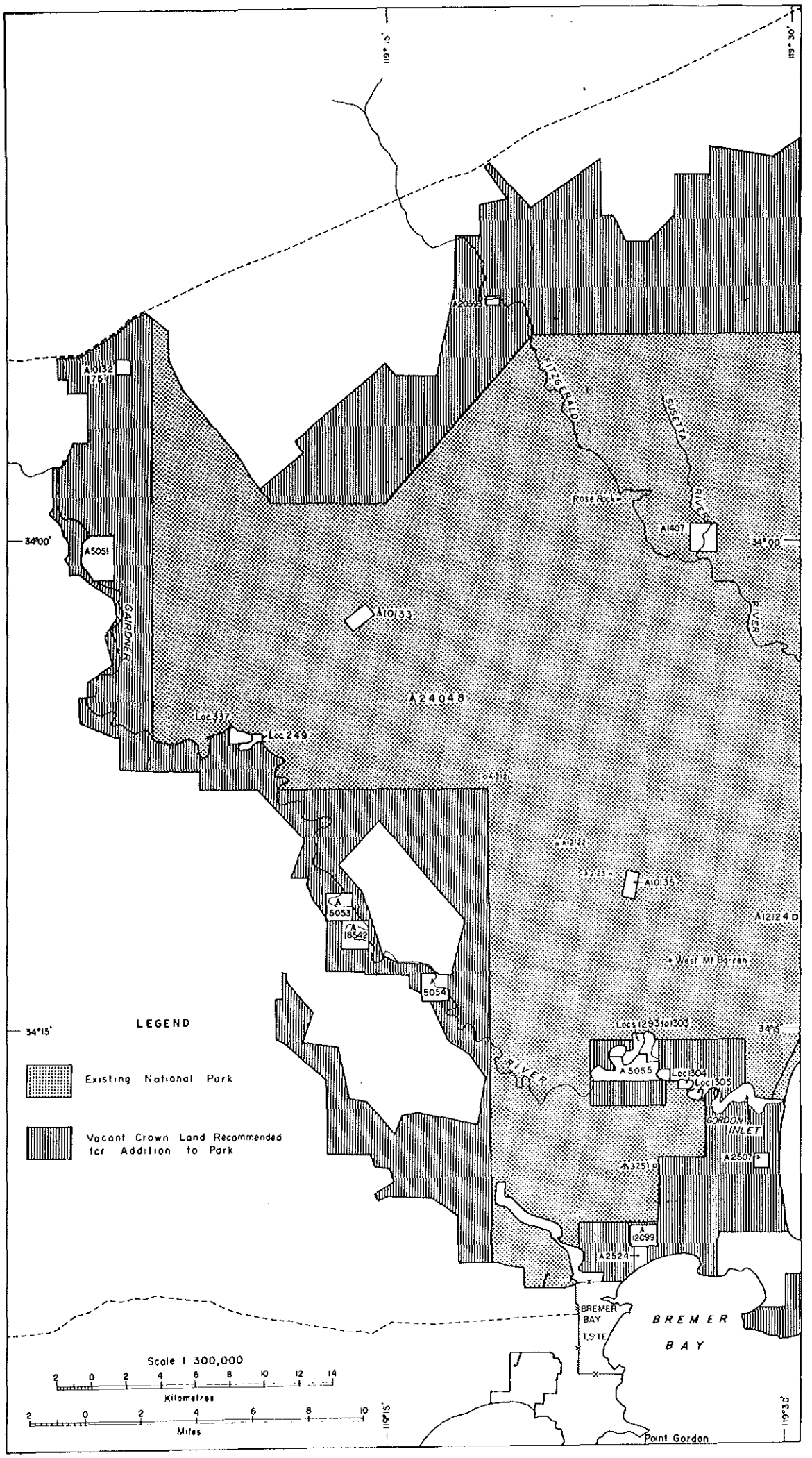

Figure 3 · 8 Area map of the Fitzgerald River National Park- Western Section

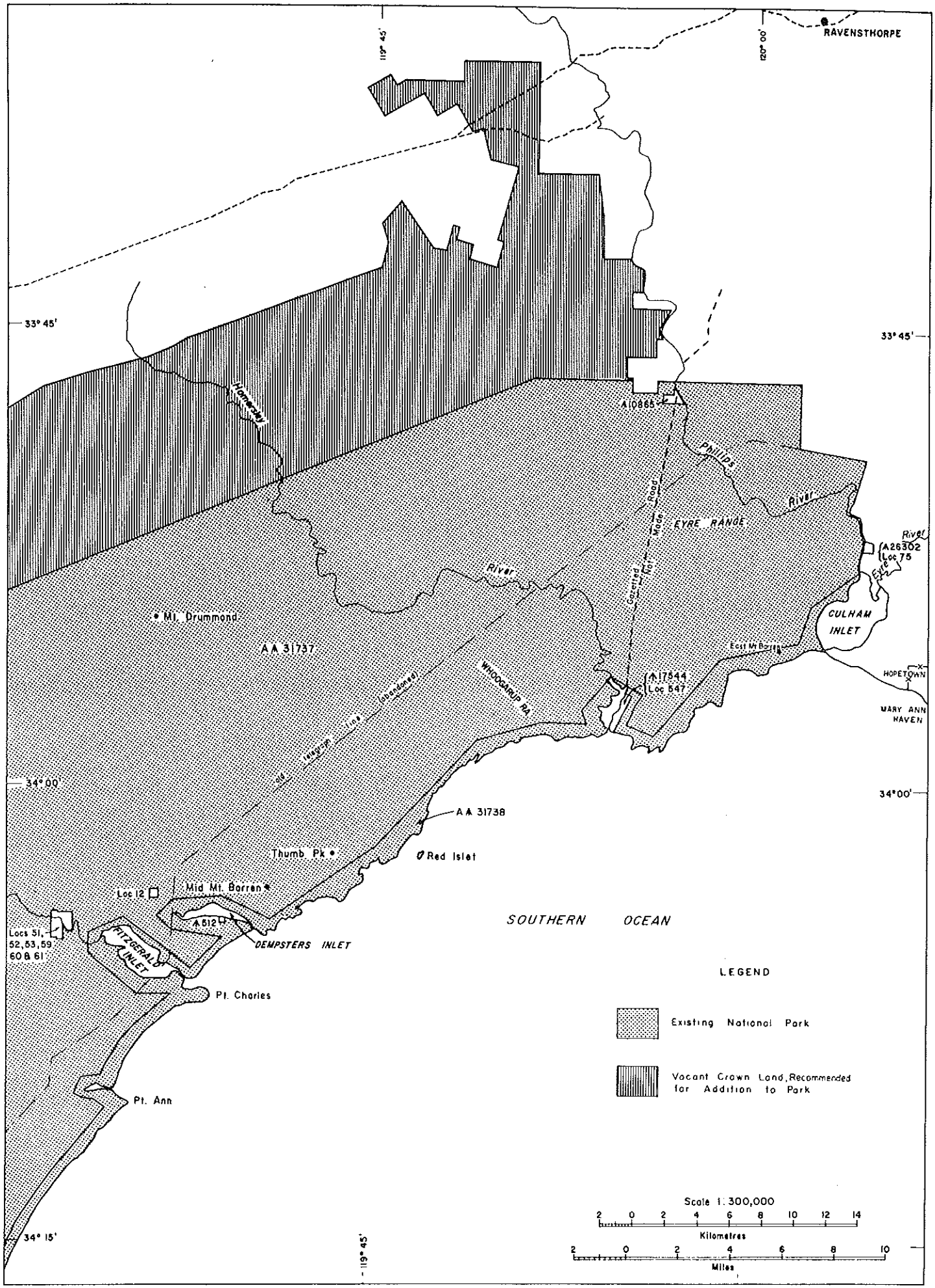

Figure 3.9 Area map of the Fitzgerald River National Park - Eastern Section

The CTRC resolutions were as follows:

1. Acting upon the resolution of the Environmental Protection Authority (May 31, 1972) the Conservation Through Reserves Committee has reviewed the boundaries of the Fitzgerald River Reserve as recommended by the Reserves Advisory Council on November 13, 1969 and considered by the Environmental Protection Authority and the Environmental Protection Council.

2. The Committee agreed with the Reserves Advisory Council that the northern boundary of Reserve 24048 should include a northward extension of vacant Crown land.

3. In view of the decline of agricultural development in the area and the danger of degradation, the Committee concluded that the argument, accepted by the Reserves Advisory Council, no longer held that part of the north west portion of the reserve should be excised for subdivision.

4. The Committee agreed with the Reserves Advisory Council that the south western boundary of Reserve 24048 should include more of the valleys of the Bremer and Gairdner Rivers.

5. The Committee agreed with the Reserves Advisory Council that the southern boundary of Reserve 24048 should include a southward extension to the coast.

6. Consideration was given to the "coastal strip" which the Reserves Advisory Council proposed to become a separate Class C reserve. The Committee considered the arguments concerning possible future demands for utilisation of portion of the coastline both for public use and possible professional fishing operations. The Reserves Advisory Council had accepted the argument that the creation of the coastal Class C reserve would enable development proposals to proceed without the necessity for parliamentary legislation to ammend the Class A reserve. At the same time the vesting of the Class C reserve (National Park) would ensure supervision by the National Parks Board's Ranger, thus assisting in curtailing squatter and litter problems which could arise on this fifty-odd mile length of coastline.

   The Conservation Through Reserves Committee concluded that it was important that this coastline should be reserved for the public as a Class A reserve (National Park) but that varied use in the public interest should be obtained through the management authority having the right, as part of its management function, to designate areas of the "coastal strip" to be used as recreation and fishing areas and to be empowered to lease part of them for these purposes.

7. The Committee also considered problems raised by freehold or alienated land close to or within parts of the boundary or Reserve 24048 and the presence, within the reserve, of smaller reserves set aside for other purposes.

Arising out of these deliberations the Committee resolved that
(Res. 33/72) a) All land lying within the boundary shown in colour brown on the attached plan be proclaimed as Class A Reserve for the purposes of "National Park" including part of Reserve 24048, and the Reserves nos. 1406, 2507, 2524, 5055, 10132, 10133, 10135, 10865, 12099, 12121-12124, 20393 and 22355.

b) It be vested in the National Parks Board of WA, without power to lease; and

c) That the following areas of freehold land within the boundary, Kent Locations 12, 51-53, 59-61, 249 and 1293-1305, be acquired and added to the National Park.

(Res. 34/72) a) The "coastal strip" shown in colour dark blue on the attached plan become a Class A Reserve to the low water mark for "National Park", including part of Reserve 24048 and Reserve nos. 512, 2507, 2524 and 17544; and

b) It be vested in the National Parks Board of WA; with power to lease limited areas to cover circumstances which may arise concerning commercial fishing and matters connected with the provision of facilities for public use.

(Res. 35/72) The Environmental Protection Authority be informed that the status of the blocks of land, Kent Locations 1910-1921, and Reserves 5051-5054 and 18542, be examined by the Authority with a view to their possible acquisition for subsequent inclusion within the proposed National Park delineated by the boundary coloured brown.

(Res. 36/72) That the Environmental Protection Authority be informed that the part of Reserve 24048 on Dillon Bay, lying outside of the proposed National Park area, be retained as a separate reserve for its present purpose and that its future be reviewed in due course by the Authority in relation to Common reserves to the west of it.

The Committee reports that its further investigations have shown the desirability of adding recommendations concerning the following areas to the park, as described below.

i) Culham Inlet

The estuary known as Culham Inlet, at the mouth of the Phillips and Steere Rivers, has been cut off from the sea for at least thirty years. A ridge of sand dunes stabilised by coastal vegetation now forms a barrier between it and the sea, and it can now be classified as a lake in the same way as the Jerdacuttup Lakes east of Hopetoun are permanently separated from the sea. Such development is typical of the south coastal estuaries.

Due to its isolation from the sea it is biologically different from the other estuaries within the park. It never dries up completely, and is always a haven for birds.

ii) East bank of Phillips River

At the eastern end of the park, on the east bank of the Phillips River, is reserve No. 26302, for Recreation and the Conservation of Flora, covering 41 hectares (Fig. 3.5).

iii) **Red Islet**

Red Islet lies about 1 km off the coast just east of Thumb Peak. It consists of Proterozoic crystalline rocks and carries a low shrubby vegetation. It is the only islet along this part of the coast and provides an important insular comparison with the adjacent mainland and should be incorporated in the park.

iv) Road reserve

A road no. 6284,, (Fig. 3.9) runs through the park from the Hamersley River estuary towards Ravensthorpe. To facilitate management, it should be added to the park. The Committee also draws attention to the fact that the park, at present extends to within 2 chains (40 m) of low water mark although the CTRC had earlier recommended (in Res. 34/72) the inclusion of this strip. To facilitate management of the park and to give adequate protection to the coast, the Committee reiterates its earlier recommendation that the strip to low water mark should be added to the park.

The Committee endorses the purpose, status and vesting of the park but recommends further amendments to its boundaries.

Recommendations

The Committee recommends

1. that the area of vacant Crown land as shown in Fig. 3.4 be added to the Fitzgerald River National Park;
2. that the portion of road reserve no. 6284 lying within the boundaries of the park be cancelled and its area added to the park;
3. that reserve No. 26302 be cancelled and its area added to the park;
4. that Culham Inlet be added to the park. The whole of the sand ridge between it and the sea to be included;
5. that Red Islet, down to low water mark, be added to reserve No. 31738, without power to lease.

3.3 COCANARUP RESERVE

To the west of Ravensthorpe, where the Phillips River crosses the road to Ongerup, is a C Class reserve for Timber, No. 30795 (Fig. 3.10). It covers about 9096 ha and is not vested. The reserve contrasts strongly with the Fitzgerald River National Park.

The area is underlain by Precambrian granite which outcrops in a few places and is also extensively exposed along the bed of the Philips River. The deep, wide valley of this river is the main landform, but the area south of the main roads is hilly.

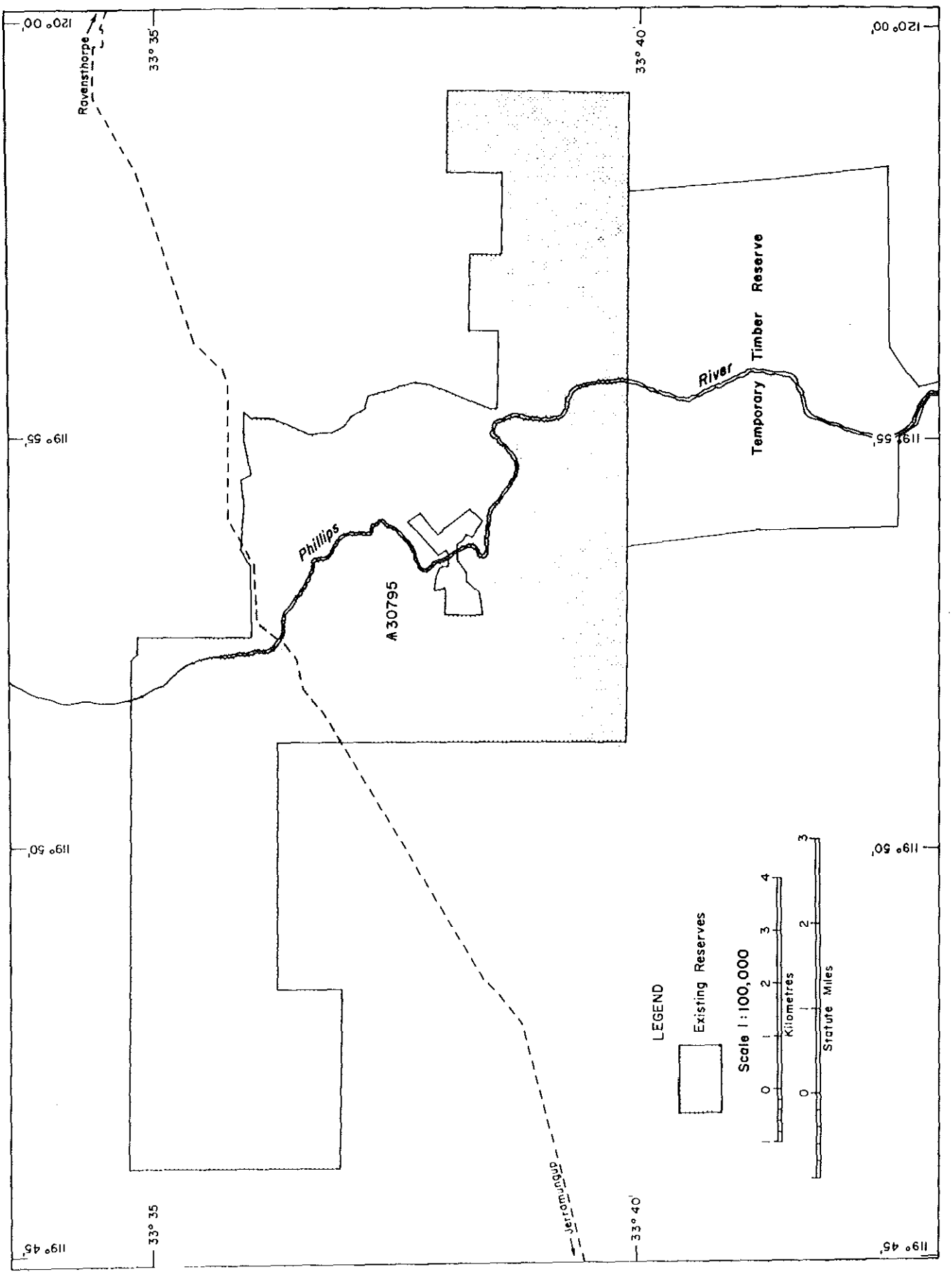

Figure 3.0 Area map of Cocundrup Reserve

Figure 3.11. Salmon Gum (Eucalyptus salmonophloia) woodland on Cocanarup Reserve

Figure 3.12. Jam (Acacia acuminata) woodland on Cocanarup Reserve

An outstanding feature of the reserve is a tall Salmon Gum (Eucalyptus salmonophloia) woodland towards the southern boundary (Fig 3.11). It covers almost 1000 ha of the reserve and is one of the southernmost populations of the species. This type of vegetation was once widespread throughout the Wheatbelt but has been extensively cleared for agriculture. Salmon Gums are also common in the Goldfields but in that region they are associated with a different understorey.

In other parts of the reserve a woodland of Jam (Acacia acuminata) is often associated with Salmon Gums (Fig. 3.12). The Jam Tree is another species once common in the Wheatbelt but now greatly reduced. In the reserve it covers some 1740 ha.

Neither Salmon Gum nor Jam is present in the Fitzgerald River National Park. The other common formation in the reserve is mallee which is tall and dense in places, low and open in others. As well as many Eucalyptus species there is often a rich association of other shrubs and perennial herbs typical of southern mallee regions.

Several small granite outcrops in the north-west part of the reserve carry a different vegetation, although the species are mostly typical of such outcrops. Granite exposures are rare in the Fitzgerald River National Park.

The reserve thus contains a variety of vegetation types, highlighted by the Salmon Gum and Jam formations.

The fauna of the reserve has not been studied in detail. An important occurrence is the small wallaby, the Tammar (Macropus eugenii); this being one of the easternmost populations on the mainland of WA. It does not occur in the Fitzgerald River National Park. The Grey Kangaroo (Macropus fuliginosus), two species of frogs and fourteen species of reptiles have been recorded, the latter including the skinks Morethia obscura, Hemiergis initialis and Tiliqua occipitalis, all of which are poorly represented in reserves elsewhere. Twenty three species of birds have been recorded.

The reserve is important for conserving ecotypes poorly represented in other reserves, and the area should be primarily a wildlife sanctuary. Protection of a large part of the valley of the Philips River would be obtained through this reserve and the Fitzgerald River National Park.

Recommendation

The Committee recommends that the purpose of reserve No. 30795 be amended from timber to Conservation of Flora and Fauna, that it be declared A Class and vested in the WA Wild Life Authority.

3.4 CAPE LE GRAND NATIONAL PARK

This park was created in 1948 as reserve A 22795, of about 16,000 ha but at that time was not vested. It was subsequently enlarged to over 22,000 ha and placed under the control of National Parks Board.

Extending from Esperance Bay almost to Duke of Orleans Bay, it contains several granitic peaks, the highest being Mt. le Grand at 345 m (Fig. 3.13). Nearby, Frenchman Peak rises to 261 m and has a natural tunnel through it just below the summit. Most of the hills are lower but are on the coast and are scenically attractive. There are sandy beaches as well, notably in Esperance Bay, Lucky Bay and Rossiter Bay. Offshore are the islands of the Recherche Archipelago.

The vegetation is mostly sandheath containing a wide variety of plants, a few of them endemic to the park, eg Lambertia echinata. Many unusual species occur on the granite hills, and some of these also are endemic to the region eg Leptospermum sericeum. Several freshwater swamps contain different plant associations and are noteworthy as harbouring species known otherwise only from the Albany district.

Eight species of native mammal have been recorded from the park, including the Short-nosed Bandicoot (Isoodon obesulus) and Honey Possum (Tarsipes spencerae). Over 118 species of birds have been recorded here, Bassian forms predominating. The park is also rich in reptiles, with 30 species so far known. Several are here at the eastern limit of their ranges (Kitchener et at., unpublished).

The Esperance area is historically important, as several early expeditions called there and made valuable scientific collections. It is the type locality for many plant species described by French and English botanists in the late 18th and early 19th Centuries. In 1801 Matthew Flinders spent some days at Lucky Bay and Thistle Cove, both now in the park.

The park is important both scenically and biologically. It is close to the growing town of Esperance and is served by a good access road.

To the north of the park is a C Class reserve, number 28170, for the use and requirements of the Government. The watershed supplying swamps and streams in the park is situated largely in this reserve. Parts of it contain vegetation different from that of the park, and the latter would be more representative of the area if it were enlarged to include this reserve. There is also a road No. 12710, through the western part of the park.

Within the present boundaries of the park are the following Crown grants:

Esperance	Loc.	340	52 ha
"	"	368	58 ha
"	"	371	64 ha
"	"	385 abt.	20 ha

Inclusion of these within the park would facilitate management, as well as prevent possible future problems which independent development of such enclaves within the park could cause.

Figure 3.13. Mt. le Grand: Pincushions (Borya nitida) in flower (white) on granite slopes.

Figure 3.15. Mt. Ragged from the south: low open mallee-heath in the foreground; wave-cut platform at base of mountain.

The Committee endorses the status, purpose and vesting of the park but recommends some amendment to its boundaries.

Recommendations

The Committee recommends:

1. that the park, reserve No. A 22795 be extended to low-water mark;
2. that Esperance Locations 340, 368, 371 and 385 be acquired and added to the park;
3. that the portion of road reserve No. 12710 within the park be cancelled and added to the park;
4. that reserve No. 28170 be incorporated within the boundaries of the park.

3.5 CAPE ARID NATIONAL PARK

Cape Arid is a park of almost 260,000 ha, situated between the Thomas River and Israelite Bay and extending inland for some distance (Fig. 3.14). On the coast are some granitic headlands the highest being Cape Arid which reaches 356 m. Between these are sandy beaches. There are some low granite hills inland, and in the north of the park is Mt. Ragged, a ridge of Precambrian quartzite rising to 585 m. Surrounding the hills and comprising the greater part of the park are extensive sandplains.

The area contains a rich flora, mostly typical of the southern sandheaths. There are also unusual species, especially on the hills. e.g. Rhadinothamnus euphemiae, Scaevola brookeana, Kunzea baxteri, Thysanotus spp., Boronia coriacea, Leucopogon sp., Beyeria latifolia, Dryandra sp., Kennedia beckxiana.

The southern sandheaths and mallee extend inland as far as Mt. Ragged, to the north of which there is a rapid transition to tall or low woodland dominated by species typical of inland areas. The ground storey here consists of saltbush (Atriplex), bluebush (Kochia), Geijera, etc. There are also small salt lakes, especially north west of Mt. Ragged.

Mt. Ragged (Figs. 3.15, 3.16) is the largest of several high hills which together comprise the Russell Range. It is a steep-sided, rocky ridge with a summit which is almost a razorback. Around the base is a wave-cut platform which corresponds geologically to similar benches around the Barrens of the Fitzgerald River National Park. There is an interesting botanical link also, since several species occur in both localities but not in the area between, e.g. Beyeria latifolia, but Mt. Ragged contains several species that are endemic to it. These include Scaevola brookeana, Monotoca oligarrhenoides, an as yet undescribed species of Dryandra, and Gastrolobium pycnostachym (Mt. Ragged Poison). Despite its relative aridity, a number of orchids and several ferns have been recorded from the mountain and its vicinity. A population here of Sticky Tail-flower (Anthocercis viscosa) is unusual in being the only inland occurrence of a species which is otherwise coastal.

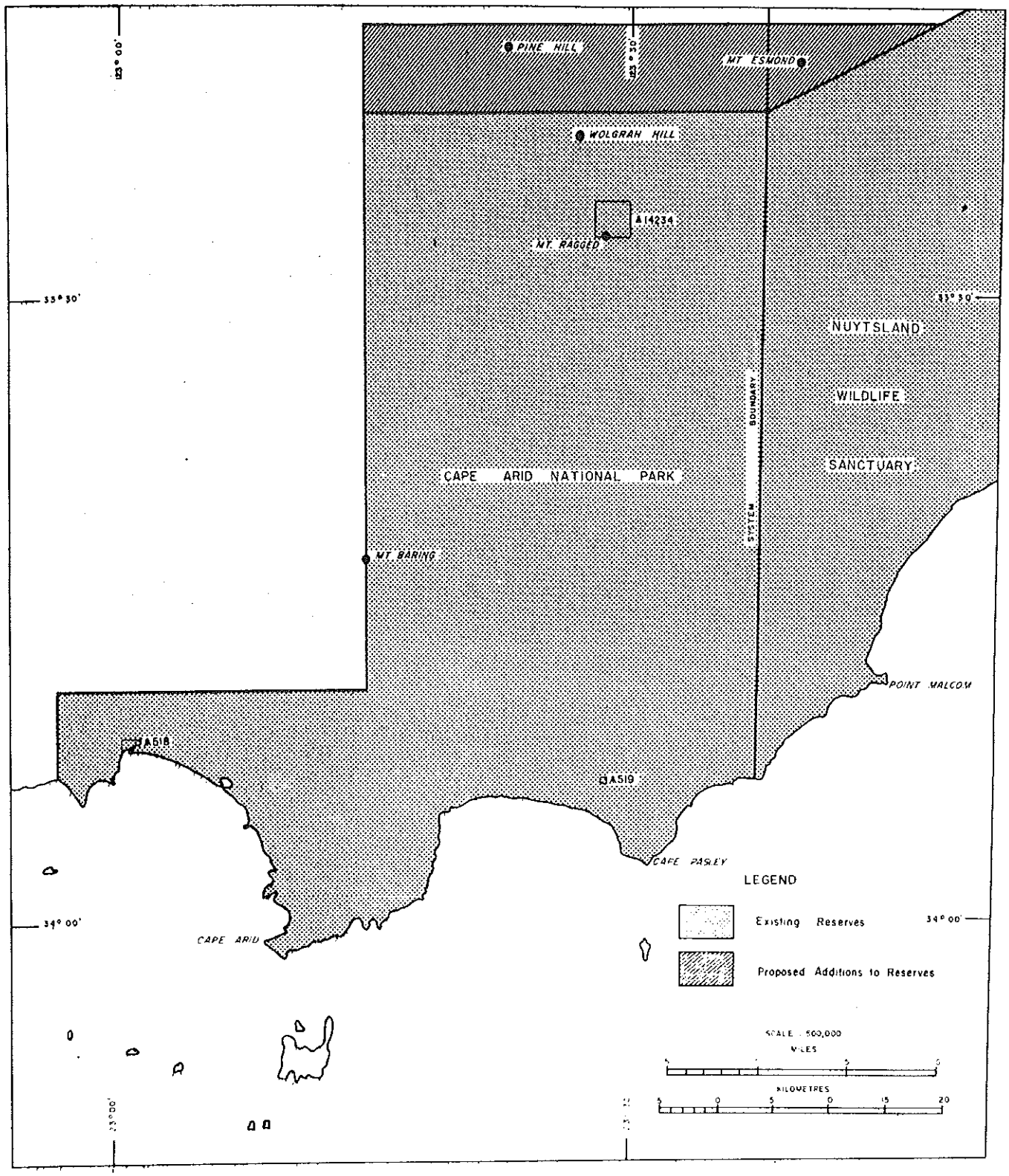

Figure 3-14 Cape Arid National Park

Figure 3.16. Mt. Ragged; upper slopes and ridge.

Figure 3.17. Pine Hill: rockhole full of water, with Water Milfoil (Myriophyllum sp.), Swamp Lily (Ottelia ovalifolia) and sedges.

Mt. Ragged, or the area immediately to the south of it, is thought to be the locality where Nothomyrmecia, the most primitive of all ants, was collected in 1930. This ant is considered even more primitive than known fossil ants, and there have since been several intensive but unsuccessful expeditions in search of it.

Mt. Ragged at present lies within a Water Reserve, No. 14234, of 1295 ha. It is one of the important physiographic and biological features of the region, and should be part of the National Park.

North of Mt. Ragged at Pine Hill, is a small permanent water-hole adjacent to a granite outcrop (Fig. 3.17). The "pines" after which the hill is named are Callitris preissii. Aquatic plants, rare in this region, include Ottelia ovalifolia, Myriophyllum sp. and Marsilea drummondii. Species on the granite include the fern Cheilanthes. The graves of three members of the Brooke family, pioneer settlers in the last century, lie here.

The park is Class A reserve No. 24047, under the control of the National Parks Board. Within its boundaries are the following smaller reserves and Crown grants:

Reserve	14234	Water	1295 hectares
Reserve	518	Public Purposes	101 hectares
Reserve	519	Public Purposes	40 hectares

Neridup Loc. Nos. 8 (40 ha), 9 (64 ha) and 10 (40 ha).

The Committee endorses the purpose, status and vesting of the park, but recommends some amendment to its boundaries.

Recommendations

The Committee recommends:

1. that the park be extended to low water mark;
2. that reserves 14234, 518 and 519 be cancelled and incorporated within the boundaries of the Park;
3. that Neridup Locations. 8, 9, and 10 be purchased and incorporated within the boundaries of the park.
4. that the park be extended northwards, as shown in Fig. 3.14 to include Pine Hill.

3.6 THE RECHERCHE ARCHIPELAGO

The many islands of the Recherche Archipelago together compose reserve No. A 22796, vested in the WA Wild Life Authority. They are granitic or gneissic rocks similar to the hills of the adjacent mainland. Some islands have Quaternary limestone fringing the granite. There are large expanses of bare rock, but vegetation occurs where soil has accumulated, and in places the vegetation is very dense.

Because of their steep margins and lack of beaches, access to most islands is difficult and can be attempted only in calm weather.

The biology was described as follows in the 1962 report of the Australian Academy of Science Committee on National Parks: "Although the islands are strikingly similar geologically and botanically to the granite peaks which are such a feature of the adjoining mainland, the distribution pattern of plants among the islands is remarkable. Few of the 240 species recorded for the Archipelago occur on all the islands so far visited and many species are known only from one island. Moreover, some 8 species which are common in South Australia are known in W.A. only from the islands of the Recherche Archipelago.

This general similarity to the mainland with a wide divergence between the individual islands, together with their affinities with South Australia, makes the islands important botanical reserves.

The fauna of the islands is also of great importance. They contain three species of marsupials, a Rock Wallaby (Petrogale penicillata), the Tammar (Macropus eugenii) and a Bandicoot (Isoodon obesulus) (which is believed to be closely related to a form found on islands at the eastern end of the Bight). As with the plants, the distribution of the animals is complex and not fully understood. For example, some of the islands carry one species of wallaby, while the others carry the other, and the interaction between animals and plants on these islands will repay close study. For example, Combe Island which is of only 97 ha supports a Rock Wallaby population and the interaction of nesting seabirds, vegetation, and the wallabies appears to be simple and stable ecological situation as has been described."

Two species of seals occur - the New Zealand Fur Seal (Arctocephalus forsteri) and the Australian Sea Lion (Neophoca cinerea). The Recherche is the stronghold of the Fur Seal in Western Australian although scattered groups may be found as far west as Albany and even to Cape Leeuwin. It also occurs off South Australia and in New Zealand.

The New Zealand Fur Seal was greatly affected by sealers in the last century. They have been legally protected since 1892 but an open season was declared in 1920 and 494 Fur Seals and 327 Sea Lions were taken in the Recherche that year (Serventy, 1953). The Fur Seal has been slow to increase its numbers since the sealing days and it is still not particularly common.

Near Barker Inlet is a small island, Red Island, which in geology, flora and fauna appears similar to the islands of the Recherche. It should be added to the reserve.

The Committee endorses the purpose, status and vesting of the reserve, but recommends an addition to it, as well as the extension of its boundaries to low water mark.

Recommendations

The Committee recommends:

1. that Red Island, near Barker Inlet, be added to the reserve A 22796;
2. that reserve A 22796 on all islands be extended to low water mark.

3.7 ESPERANCE LAKES RESERVES

Inland from the Esperance Bay is a series of reserves containing fresh-water and brackish lakes comprising Cheetup, Mullet, Woody and Warden Lakes. They are permanently wet, and water drains slowly from east to west through the lakes and to this extent they are a single interdependent complex. Other wetlands associated with them are discussed below under area 3.11.

The vegetation around the lakes is a marsh flora dominated by the paperbark Melaleuca cuticularis. Low shrubs include samphires such as Arthrocnemum bidens and saltbushes such as Atriplex exilifolia. Two species of samphire here are unnamed, as also is a sedge (Leptocarpus) common in the area. A small mat plant here, Wilsonia rotundifolia, is considered rare, since it is known from only one other locality 150 km to the west. Sandy rises between the lakes carry heath comprising many species, especially of the families Proteaceae, Myrtaceae and Leguminosae. Christmas Trees, Nuytsia floribunda, are common. Two wattles, (Acacia pulchella and an as yet unnamed species) are interesting isolated populations, since they occur otherwise only near Albany or further west.

The lakes are an important faunal habitat, especially for water birds. There are large resident populations, and in summer populations migrate here when inland lakes dry up.

Lake Warden is within a C Class reserve, No. 32257 for the Conservation of Flora and Fauna, and Recreation, vested in the West Australian Wild Life Authority. East of this is reserve 20664, C Class for Public Utility, not vested. The lake further east is within reserve A 15231, for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

Mullet Lake and the Lakes to the east of it. as well as the area down to Wylie Bay on the coast, comprise an A Class reserve, No. A 23825, for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

The lakes and their environs form an important wetland complex which should be preserved as a unit.

Recommendations

The Committee recommends that reserves 32257 and 20664 be cancelled and added to reserve A 15231, and that it and reserve No. A 23825 be consolidated into a single A Class reserve for the Conservation of Flora and Fauna, to remain vested in the West Australian Wild Life Authority.

3.8 RAVENSTHORPE RANGE

In this report the Ravensthorpe Range is taken to include all the hills from Mt. Desmond (south-east of Ravensthorpe) to Mt. Short (north of the town). It is a series of low hills of Precambrian granite, migmatite, gneiss and greenstones. They appear from a distance to be relatively rounded and gently sloping, but in fact have a very rocky surface dissected by many gullies. The vegetation varies from low woodland with a sparse understorey to dense mallee and scrub.

The flora of the range and its immediate vicinity is very rich and contains many species not known from the surrounding country. Some are endemic, others are common here but rare elsewhere. Endemic species include Eucalyptus megacornuta, E. desmondensis, E. stoatei, Boronia ternata var. elongata, Grevillea fulgens, Banksia laevigata subsp. nov. Guichenotia apetala and several as yet unnamed species of Acacia.

Rare species include Beaufortia orbifolia, Hybanthus floribundus subsp. adpressus, Scaevola myrtifolia and Hakea verrucosa.

There are many orchids, including such species as Caladenia caerulea, C. sigmoidea, Pterostylis allantoidea and undescribed species of Pterostylis.

More than 20 Eucalyptus species occur in the area. These are an important food source for jewel beetles (Buprestidae), of which many species are to be found during flowering periods.

Colourful plants common in the range include Qualup Bells, (Pimelea physodes), Bell-fruited Mallee (Eucalyptus preissiana), Nematolepis phebalioides, Banksia lemanniana, Hakea obtusa Boronia spp, Kunzea spp., etc.

The Warted Yate (Eucalyptus megacornuta) and the Desmond Mallee (E. desmondensis) are confined to a few hillsides, the former just north of the Ravensthorpe-Esperance road, and the latter on Mt. Desmond. Both species are in demand for horticulture, and the natural seed source should be preserved.

Near the Jerdacuttup River east of the southern end of the range is an area of dense mallee scrub where the colourful Eucalyptus stoatei grows. This is the only known locality for the species which is of great horticultural value, and it is essential to preserve its natural seed source also.

Two stretches of the Jerdacuttup River are included within the proposed reserve. Although it flows only after heavy rain, the river contains a number of permanent pools. Along two of its tributaries (Bonnymidgup and Woodenup Creeks) are fresh water pools. A different association of plants occurs along the river, including some aquatic plants such as Water Ribbons (Triglochin procerum).

The proposed reserve is very different from the Fitzgerald River National Park, and indeed is a unique biological niche in the State. Most of it is at present vacant Crown land. In the northern part there are two water reserves Nos. 17880 and 17384.

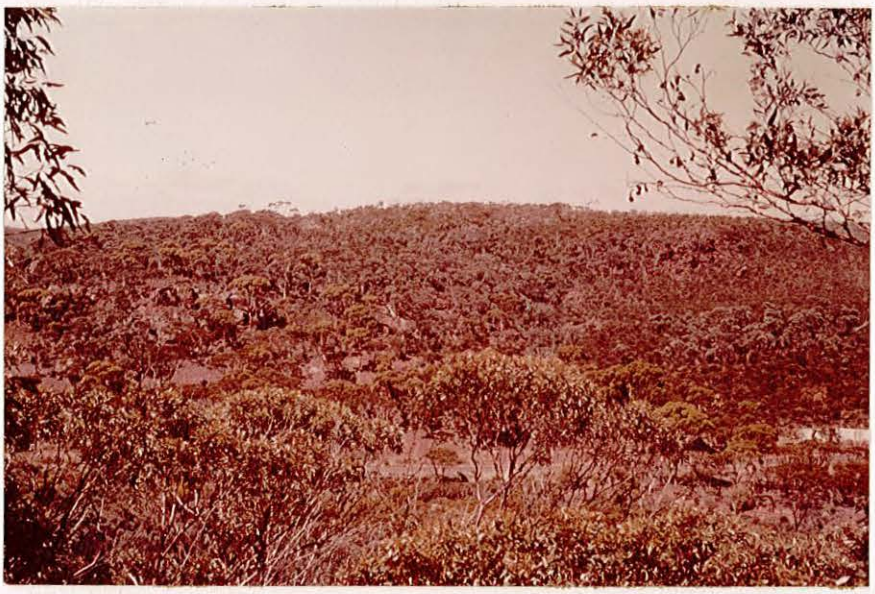

Figure 3.18. Ravensthorpe Range: rocky hills covered with woodland and mallee shrubland.

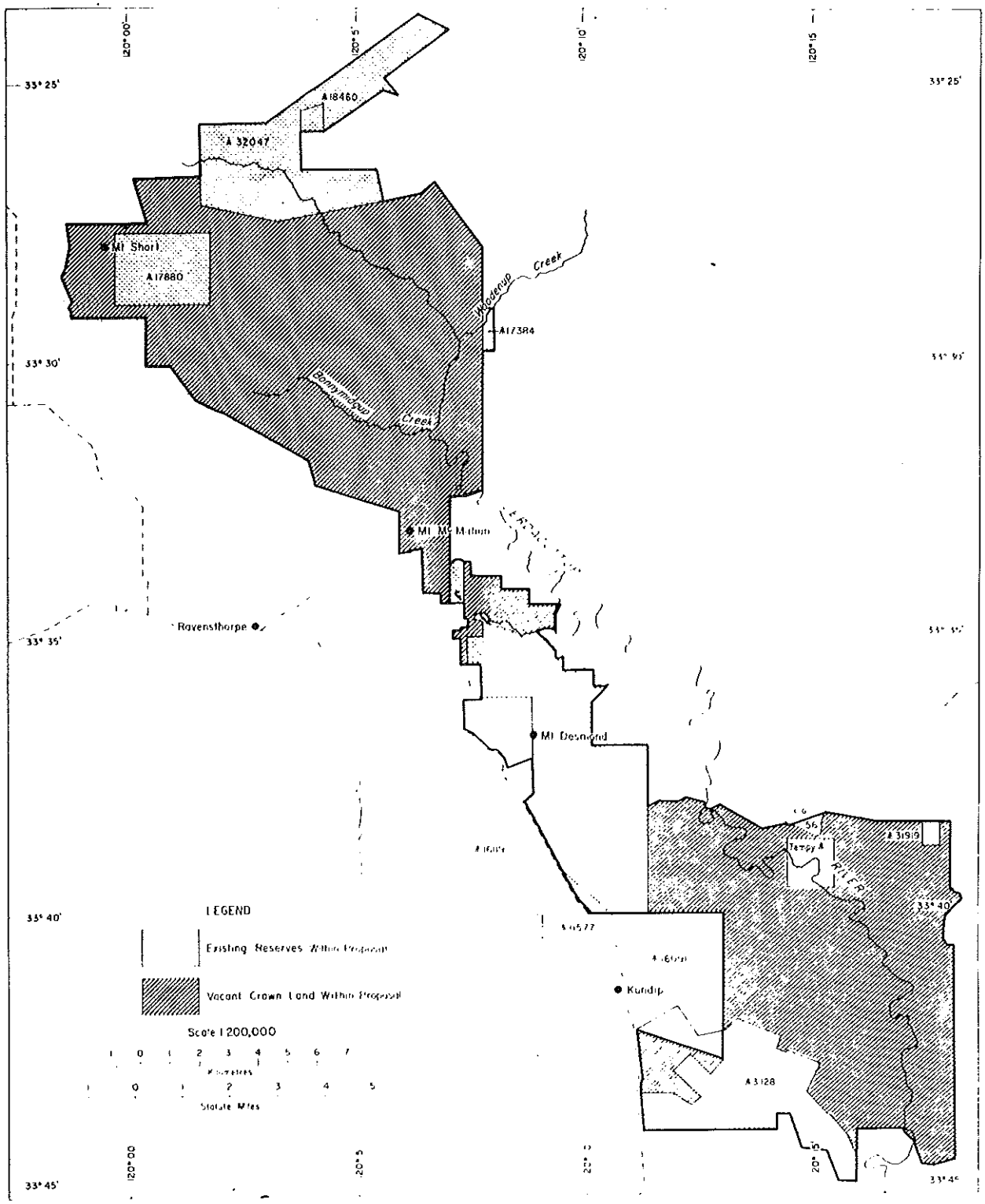

Figure 3-19 Area map of proposed Ravensthorpe Range Reserve

In the southern area there is already a reserve for flora and fauna, No. 31128, which is C Class and not vested. Part of reserve No. 16119 (Common, not vested) is included within the proposed reserve, as well as a temporary reserve, No. 5904. Biologically the area is worthy of A Class protection, but it contains areas prospective for minerals. Until these have been evaluated, the reserve should remain C Class.

Recommendations

The Committee recommends that the areas as shown in Fig. 3.19 be classified as a C Class reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority. The following existing reserves should be included: 17880 (Water), 17384 (Water), 31128 (Flora and Fauna), part of 16119 (Common).

3.9 TRUSLOVE AREA

A report received from the Forests Department (Anon., 1973) recommended an area between Truslove and Scaddan (north of Esperance) as a reserve for the conservation of flora, especially Fuchsia Gum (Eucalyptus forrestiana). This is one of many Eucalyptus species in the area where a tall mallee scrub is the dominant vegetation type.

The area is near the inland margin of the agricultural districts, with an annual rainfall of about 375 mm. The topography is relatively flat.

Eucalyptus forrestiana is a colourful species of great horticultural value and is already cultivated as an ornamental tree. It is important that a natural seed source be secured by reservation. Other Eucalypts in the area include E. occidentalis, E. goniantha, E. leptocalyx and E. eremophila.

The proposed area is currently part of reserve No. 24952 for natives, set apart for the use and benefits of aboriginies.

Just east of this reserve is a reserve of about 6070 ha., No. 27985, C Class for Flora and Fauna, vested in the WA Wild Life Authority. This reserve contains country similar to that of the proposed reserve, and in addition contains extensive areas of salt lakes which are typical of slight depressions in the region. The reserve has not been examined for the presence of a population of Fuchsia Gum adequate to ensure the seed source. If reserve No. 27985 is not adequate to provide this, surrounding country should be examined, and it may be necessary to negotiate with the Aboriginal Lands Trust to obtain some release of land by agreement.

Recommendation

The Committee recommends that the WA Wild Life Authority and the WA Herbarium examine reserve No. 27985 and make such recommendations to the Environmental Protection Authority as may be needed to secure populations of Eucalyptus forrestiana.

3.10 THE SOUTH COAST

The Committee believes that the working group discussed under Area 2.14 should also consider sections of the coast in System 3. A typical section of this coastline is shown in Fig. 3.20.

Recommendations

The Committee recommends that the working group proposed in System 2, Area 2.14, be also given control of certain sections of the coast in System 3. The sections are as follows (from west to east):

Reserve 31240, between Wilyanup Creek and Ledge Point, C Class for Government Requirements.
Reserve 14942, Cape Riche, C Class for Park and Recreation
Reserve 14943, Mt. Melville, C Class, for Park and Recreation
Reserve 14944, Cheyne Island, C Class for Park and Recreation
Reserve 31240, Mt. Melville to Mt. Groper; C Class, for Park and Recreation
Reserve 14987, Mt. Groper to Beaufort Inlet, C Class for Recreation and Camping
Reserve 14986, Pt. Irby, A Class. for Park Lands and Recreation
Reserve 22353, Pallinup River, C Class, for Recreation
Reserve 21647, Beaufort Inlet, C Class, for Recreation and Camping
Reserve 14988, north shore of Beaufort Inlet, C Class, for Recreation and Camping.
Reserve 27102. Beaufort Inlet to Cape Knob. C Class for Common and recreation
Reserve 26097, Dog Proof Fence, C Class
Reserve 28122 C Class for Recreation
Vacant Crown land at Dillon Bay
Reserve A 31737, part thereof, A Class for National Park
Reserve 3766 Pt. Henry, B Class for Govt. Requirements
Reserve 4121 Pt. Gordon. B Class " " "
Reserve 511, Bremer Bay, C Class, for Recreation
Vacant Crown land at Hood Point
Two-chain (40 metre) strip on coast between Culham Inlet and Hopetoun
Reserve 28438, east of Hopetoun, C Class, for Recreation
Vacant Crown land east of Hopetoun
Reserve 22761, east of Jerdacuttup Lakes, C Class. for Public Utility
Vacant Crown land west of Starvation Boat Harbour
Reserve 7580, Starvation Boat Harbour. C Class. for Rabbit Department

Figure 3.20. The South Coast. Cape Riche with Ledge Point and Haul-off-Rock in the background.

Vacant Crown land east of Starvation Boat Harbour
Reserve 3559, Fanny Cove, C Class, for National Park (not vested)
Reserve 27888, Barker Inlet, C Class, for Flora
Reserve 26885, West of Lake Gore, C Class, for Flora
Reserve 24486, Butty Harbour, C Class, for Flora
Reserve 4180, east of Butty Harbour, C Class for Common
Vacant Crown land between Wharton Townsite and Cape Arid National Park, under option to the Esperance Land Development Corporation; a strip 2 km wide (from low water mark) extending along the coast should be reserved.

In addition to the above, all those 2-chain (40 metres) strips between Crown grants or Pastoral Leases and low water mark.

3.11 WETLANDS

Two major wetland complexes (2 and 13) are recognised in System 3 (see Fig. 0.1 for the distribution and numbering of wetlands in WA).

WETLAND COMPLEX 2 - ESPERANCE

This wetland complex which extends through and beyond the Esperance Lakes Reserves, is second in importance only to that of the Swam Coastal Plain. The wetlands still retain much of their natural character and support large resident populations of waterfowl as well as forming an important refuge for birds during the summer drought. The principal lakes in the complex are

a) Already within Conservation Reserves (See area 3.7 above)

Lake Cheetup
Lake Warden
Mullet Lake
Woody Lake

b) Not within Conservation Reserves

Bannitup Lakes
Barkers Inlet
Lake Gidong
Lake Gore
Lake Kubitch
Lake Mortijimup
Lake Quallilup
Lake Tarblong
Pink Lake

Several of these lakes are recommended for immediate reservation as wildlife sanctuaries. These are:

i) Lake Gore

Lake Gore is the most important waterfowl area in the Esperance region. It is an important drought refuge for many species, including Black Swan (Cygnus atratus), Mountain Duck (Tadorna tadornoides), Black Duck (Anas superciliosa), Grey Teal (Anas gibberifrons) and Wood Duck (Chetonetta jubata). Other species of duck and other water birds have also been recorded from it. Both Black Swan and Mountain Duck use Lake Gore for moulting. During the moult these species are unable to fly and it is important to prevent disturbance of the population at that time. Lake Gore is at present vacant Crown land.

ii) Lake Mortijinup

This lake is between Lake Gore and Esperance and is at present part of Reserve No. 24486 for flora. Lake Gore is the most important waterfowl refuge in the Esperance area and Lake Mortijinup complements it; because of extensive belts of timber around the lake it is far more protected than Lake Gore in bad weather.

iii) Lakes Gidong, Kubitch and Carbul

Aerial surveys have shown that these lakes, which are immediately west of Lake Gore, harbour large populations of waterfowl, particularly Black Duck (Anas superciliosa) and Grey Teal (Anas gibberifrons). The reservation of these lakes would add significantly to the area of protected wetlands. Lakes Carbul and Kubitch are within Esperance Location 464 (Conditional purchase lease 347/11179) and Lake Gidong is partly within the same Esperance Location and partly within Reserve No. 26885 for the Conservation of Flora.

WETLAND COMPLEX 13 - HOPETOUN

The wetlands of this complex are confined to a narrow belt adjacent to the coast. They consist of a series of small estuaries and lakes fed by rivers from the hinterland. This area holds large concentrations of waterfowl during the dry summer months, the species being mainly Mountain Duck (Tadorna tadornoides) and Black Swan (Cygnus atratus).

The principal wetlands are

a) Already within Conservation Reserve	b) Not within Conservation Reserves
Lake Shaster	Culham Inlet
	Fitzgerald Inlet
	Jerdacuttup Lakes
	Margaret Cove Lake
	St. Mary River mouth

The reservation of estuaries is not possible under the Land Act. However, the Fitzgerald River National Park (Area 3.2) surrounds two of the above areas St. Mary River mouth and Fitzgerald Inlet - and the reservation of Culham Inlet, now considered a lake, is proposed under Area 3.2.

The Jerdacuttup Lakes are a drought refuge area, and aerial and ground surveys by the Department of Fisheries and Fauna have revealed large numbers of waterbirds present during the summer. Some birds remain to breed during the winter. These include a large colony of Black Swan (Cygnus atratus). The Jerdacuttup Lakes should be reserved as a wildlife sanctuary.

The Lakes are at present largely vacant Crown land although Reserve No. 28286 for the Conservation of Flora is located on one side of the main lake.

Recommendations

The Committee recommends:

1. that Lake Gore be declared a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority;

2. that Lake Mortijinup be declared a Class A reserve, for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, boundaries to include the lake and all adjoining land within 100 m of its shore excepting where this encroaches on private property;

3. that Lakes Carbul, Kubitch and Gidong, extending to 50 metres above their shoreline, be resumed from Conditional Purchase Lease 347/11179 and declared a Class A reserve for the Conservation of Flora and Fauna vested in the WA Wild Life Authority;

4. that the Jerdacuttup Lakes be declared a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority; the reserve to be all vacant Crown land and reserves between the eastern boundary of Oldfield Location 335 and the western boundary of Reserve 7580.

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SYSTEM 4 - WHEATBELT

INTRODUCTION

Area and Physiographic Features

The Wheatbelt System covers about 134,800 km^2 extending from Mullewa, south to Mt. Barker and Jerramungup and east to Lake King (Fig. 4.0).

Geologically it is part of the Yilgarn Block, a Precambrian crystal massif comprising granite and gneiss together with sinuous belts of metasedimentary metavolcanic rocks left as undigested remnants after extensive granitization. In the Wheatbelt System granite predominates and many of the townships originally relied on the availablity of shallow groundwater around the margins of bald granite hills.

Prolonged weathering and erosion have produced a peneplain about 300 m above sea level on which laterite developed and is now being eroded. Silica sand is often found as pockets above the laterite. In the absence of laterite sandy loams predominate as residual soils derived from granite.

Drainage in the western third is by rivers flowing to the Indian Ocean through the Darling Range. In the south some drainage is into the Southern Ocean. Drainage in the remainder of the system is into an unco-ordinated salt lake complex. Rainfall varies from about 400 to 600 mm, and mostly falls during winter.

Biology

Much of the original vegetation has been lost due to clearing for agriculture (Fig. 4.1). What remains can be loosely grouped into woodlands, mallee, scrub or heath (Erickson et al., 1973). Woodlands are common in the high rainfall areas and on heavy, valley soils in drier parts.

Wandoo (Eucalyptus wandoo) and York Gum (E. loxophleba) are common on better soils in the west, while Powder-bark Wandoo (E. accedens) occurs on gravelly hills. In the eastern part of the System, mallets (E. astringens, E. falcata and E. gardneri) occur on the hills. Salmon Gum (E. salmonophloia) is widespread on the heavy valley soils, but has been extensively cleared for agriculture.

Mallees are found over a wide area of the wheatbelt, particularly in the south and south-east. They commonly occur on sandy loam either as dense thickets composed of one or several species, or as isolated shrubs in heath. On poor sandy clays there is frequently a tall thicket formation known as wodgil. It is dominated by species of Acacia, especially A. neurophylla, but also has a mixture of other shrubs such as Casuarina, Hakea and Grevillea. Another common vegetation type is tamma scrub, dominated by Casuarina campestris.

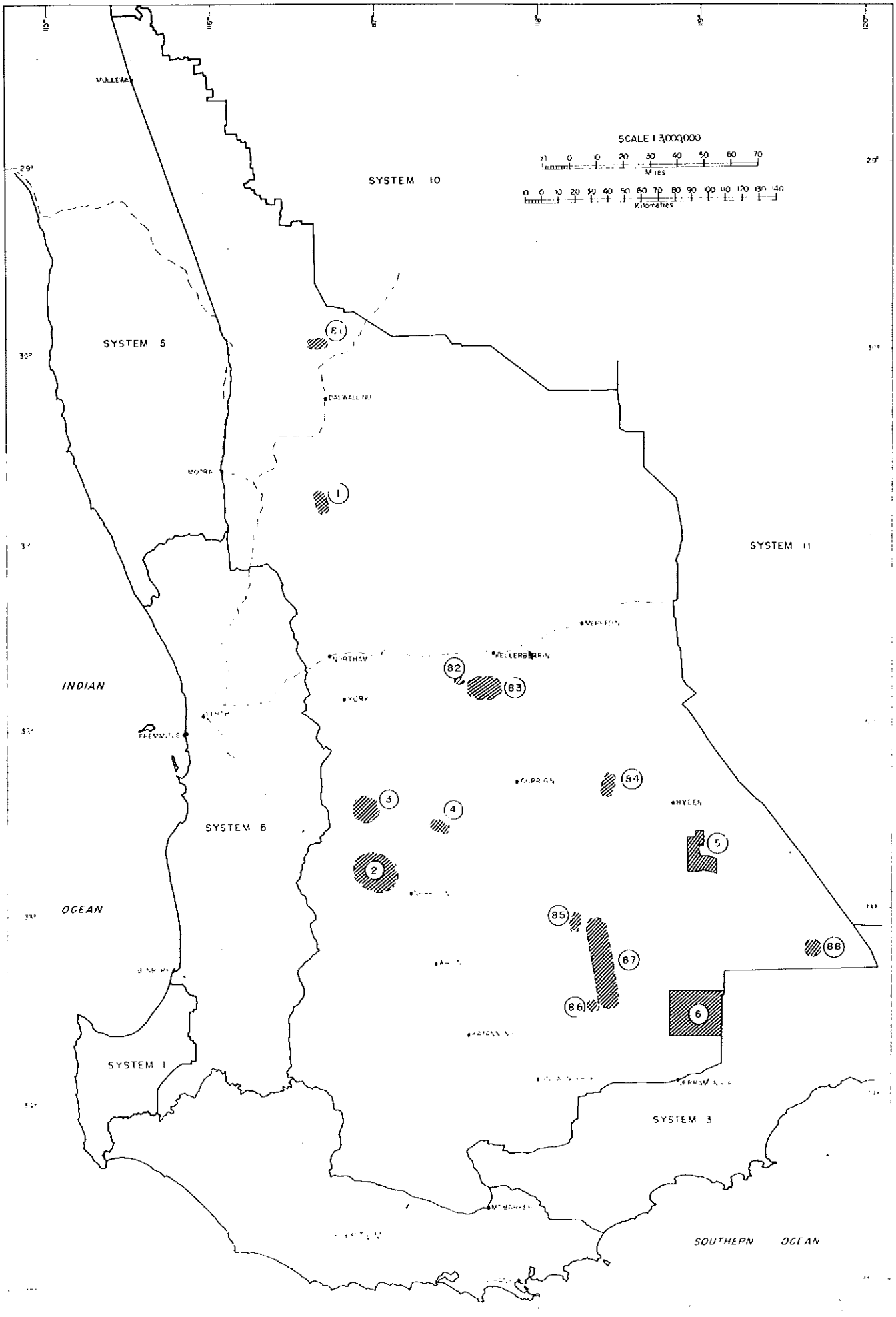

Figure 4.0 Wheatbelt System

Figure 4.1 Typical Wheatbelt scene: an area south of Perenjori viewed from the air.

The open heath and mallee heath of the wheatbelt support a wealth of wildflowers. Developed on deep white or yellow sand, or on shallow sand over laterite, these heaths are popularly known as "sandplains". The families Myrtaceae, Proteaceae and Epacridaceae are usually well represented. The number of species in some small areas of wheatbelt heath is remarkable; Tutanning Wildlife Sanctuary, for example, has over 400 species in an area of about 2,000 ha.

The fauna of the wheatbelt was once extremely rich but has been much reduced since European settlement. Of the 44 species of mammals originally recorded, 4 are probably extinct and a further 11 are no longer found in the region. The survival of another 10 species is in doubt (Kitchener, 1973). Birdlife is rich, the Honeyeaters being especially well represented. It is noteworthy that a number of bird species are migrants or nomads. Among the Honeyeaters there appear to be three groups (J. Dell, pers. comm.). These are firstly a group of mainly insectivorous and sedentary birds which include the Singing Honeyeater (Meliphaga virescens) and White-eared Honeyeater (Meliphaga leucotis). Secondly, there is a group of honeyeaters which are insectivorous, and nomadic within a restricted area. These include the Brown-headed Honeyeater (Melithreptus brevirostris). Finally there are birds which are mainly nectivorous and extensively nomadic, following the flowering sequence of eucalypts and other floriferous species. The group includes the Tawney-crowned Honeyeater (Gliciphila melanops) and Purple-gaped Honeyeater (Meliphaga cratita).

Increasing knowledge of bird movements in the wheatbelt emphasises the importance of a widespread system of reserves as well as the value of road verges as corridors between reserves. This is clear from the high proportion of trees parasitised by mistletoes (Amyema spp.) in road verges compared to larger areas of bush. Mistletoes are spread by the Mistletoe-bird (Dicaeum hirundinaceum) and the movements of the birds from one piece of bush to another are channelled along road verges.

Population

About 105,000 people reside in the wheatbelt, 10 towns being classified as urban (more than 1,000 persons) in the 1971 census. They are Gnowangerup, Katanning, Kellerberrin, Merredin, Moora, Mount Barker, Narrogin, Northam, Wagin and York. There are also many smaller towns.

Land Use

About 78% of the wheatbelt is taken up in rural holdings. Most of the remainder is reserved for various purposes, including roads and railways. Very little vacant Crown land remains, excepting an area south of Hyden near Dragon Rocks, and some land in the south east of the System.

Primary Industry

Cereal production and sheep grazing are by far the most important industries of the wheatbelt. Beef cattle numbers are increasing and oilseeds are assuming importance.

Mining and Secondary Industry

There is little known mineral wealth in the wheatbelt, but geological knowledge is at present inadequate for a confident assessment. Some bauxite deposits occur in the western part of the System but areas of greater potential in the Darling Range are more attractive to mining companies. Gypsum occurs in and on the margins of some lakes. There is little secondary industry and the towns mainly service agriculture.

Recreation and Tourism

Although most recreational and tourist activities in the South-West are coastal, an increasing number of people are visiting the wheatbelt, especially in spring when the wildflowers are at their best. There is an increasing demand from visitors to view natural bushland, particularly those areas with spectacular wildflowers and abundant bird life.

CONSERVATION RESERVES

A number of small conservation reserves exist in the wheatbelt. Only a few are large enough and/or contain a sufficient variety of land forms, plants and animals to be considered here. Only one existing reserve, Lake Magenta Wildlife Sanctuary, and one proposed reserve, the Dragon Rocks area, can be considered of adequate size for a representative regional conservation reserve.

However. in discussing only outstanding areas the Committee does not wish to detract from the value of retaining and indeed extending, the existing system of small conservation reserves. Important in maintaining the typical "Australian" character of the countryside, they also conserve a fairly diverse flora and a smaller variety of animals (especially birds) which are able to persist in small areas, in competition with European man, his agriculture and his domestic and feral animals. As discussed earlier the many small reserves and roadside verges are of particular importance to migratory or nomadic birds.

In the wheatbelt it is not possible to extend the conservation reserves system to any great extent because most land is already freehold. Thus only a few of the areas discussed below are not already reserved.

The areas the Committee wishes to report on are as follows:

AREAS

1. Wongan Hills
2. Dryandra Forest
3. Boyagin Wildlife Sanctuary
4. Tutanning Wildlife Sanctuary
5. Dragon Rocks area
6. Lake Magenta Wildlife Sanctuary
7. Wetlands
8. Other areas

4.1 WONGAN HILLS

The Wongan Hills are an interesting assemblage of rock types including sillimanite and cordierite schists, chert, quartzite, jaspilite and concordant ultramafic rocks and basalts. They trend generally northwesterly and dip towards the west. Lateritization masks much of the original rock and granite is evident on both flanks.

They are covered by a fairly dense woodland and tall shrubland. Eucalypts are the dominant trees and include such species as Salmon Gum (Eucalyptus salmonophloia), Wandoo (E. wandoo), White Mallee (E. erythronema) and Sandplain Mallee (E. ebbanoensis). Sheoaks (Casuarina) and Honey-myrtles (Melaleuca) make up much of the shrub layer but many other genera are represented, making a rich and interesting flora. Several species are restricted to this area, e.g. Dryandra comosa and Stylidium coroniforme.

The botanist James Drummond visited the Hills in 1842 and it is probable that they are the type locality for some plants he collected, e.g. the Winter Spider Orchid (Caladenia drummondii). It is also the type locality for the recently described Phebalium brachycalyx. Other interesting records include Pterostylis mutica, Hakea coriacea and H. petiolaris. Orchids are a feature of the ground flora and over 20 species have been recorded.

The fauna, at present being studied by a group from the West Australian Naturalists Club, includes a variety of birds. The Mallee-Fowl (Leipoa ocellata) is common, and there are many active mounds. The Southern Scrub-Robin, (Drymodes brunneopygia) and the Common Bronzewing (Phaps chalcoptera) also occur here. The ornithologist John Gilbert, who collected animals for John Gould, visited the Wongan Hills with the Drummonds in September 1842.

The central area of the Wongan Hills including Mt. Matilda and The Speakers Chair is a temporary (Land Act) reserve for minerals.

Copper was recorded in the Hills around the turn of the century but the exact location of the find is uncertain. Recent bauxite exploration has disclosed some anomalous nickel values. Further surface geological mapping and adequate subsurface exploration would be needed to evaluate the mineral potential.

To the north and south of the Crown land there are areas of freehold bush land. At the edge of the Hills, and adjacent to the Wongan-Ballidu railway, lies reserve No. 25808, for Ecological Purposes and the Conservation of Flora. This reserve has an interesting flora and is the only known locality for Dryandra comosa. Adjoining it is reserve No. 18672, for Experimental Farm, portions of which are still in their natural state.

The Wongan Hills have become an island of bush surrounded by agriculture. They are interesting both geologically and biologically and are a popular local picnic spot.

Recommendations

The Committee recommends that:

1. the temporary reserve for minerals and Reserve 25808 be declared a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority;
2. negotiations be opened with the owners of certain adjoining properties with a view to purchasing additional virgin country and adding it to the proposed Class A reserve. The location numbers are listed in a confidential appendix to this report;
3. the Department of Agriculture be approached with a view to obtaining the release of portions of Reserve 18762 (Experimental Farm) still in their natural state for addition to the Class A reserve.

4.2 DRYANDRA FOREST

The Dryandra area is a complex of State Forest and reserves lying about 25 km north-west of Narrogin. It is a series of discontinuous areas of bushland totalling about 25,000 ha. It was originally set aside as an area for developing plantations of the Brown Mallet (Eucalyptus astringens), some 8,100 ha being planted between 1927 and 1962. The remainder is in its natural state, although some has been cut over for Wandoo (Eucalyptus wandoo). With the declining commercial value of mallet as a source of tanbark, the importance of the forest now lies in its conservational and recreational assets.

The forest and its natural history are the subject of a book by Serventy (1970) which has brought the area before the public and increased its popularity

The biological features of the area have been studied by Dr. A. Burbidge. The vegetation falls into 4 main types:

1. Plateau. The high country is a lateritic plateau, with sand cover in places. The upper storey is dominated by Powder-bark Wandoo (Eucalyptus accedens) and Jarrah (E. marginata) with a few Marri (E. calophylla). The shrub layer is diverse and spectacular when in flower. It is dominated by various species of Dryandra, especially D. nobilis and D. armata. Other shrubs include Adenanthos cygnorum, Conospermum spp., Banksia sphaerocarpa, Isopogon spp. and Acacia pulchella. In some areas the mallee Eucalyptus drummondii occurs; occasionally in dense stands, especially on poorer soils where the upper storey is absent. There is little or no ground cover.

2. Slope. The plateau may give way to a slope either abruptly, i.e. in a breakaway, or gradually. Brown Mallet (Eucalyptus astringens) usually occurs just below breakaways. This rapidly changes into Powder-bark on the slope. Where no breakaway occurs the plateau vegetation changes gradually to Powder-bark slope. Here the dominant upper storey is Powder-bark and the shrub layer is usually mainly Sandplain Poison (Gastrolobium microcarpum) although in some areas it is replaced by Bossiaea eriocarpa. Further down the slope the upper storey changes to Wandoo (E. wandoo) with a shrub layer almost entirely of Sandplain Poison (Fig. 4.2).

3. Valley. The valley vegetation consists of an upper storey of Wandoo with no shrub layer and a ground cover of grasses and sedges. In heavier soils Jam (Acacia acuminata) occurs, while Rock Oak (Casuarina huegeliana) occurs on granitic soils.

4. Alluvial soils.

a) Marri. On areas of alluvial white sand the dominant upper storey member is Marri while the understorey contains much tea-tree (Leptospermum spp.) and myrtle (Hypocalymma sp.) as well as Sandplain Poison. In some areas Dryandra sessilis is an important part of the understorey.

b) Heath. Alluvial soils on the slopes are covered with a dense shrub layer with little or no upper storey. Shrubs are mainly myrtaceous and proteaceous species.

The mammalian fauna is outstanding and 20 native species including 13 marsupials have been recorded. Of especial interest are the Numbat (Myrmecobius fasciatus) which is plentiful, the Woylie (Bettongia penicillata), a rare and endangered species, and the Tammar (Macropus eugenii) which is not common on the mainland. Another species of interest is the Red-tailed Wambenger (Phascogale calura), considered by many authorities to be in danger of extinction.

Ninety seven species of birds have been recorded, and comparatively rare species such as the Mallee-Fowl (Leipoa ocellata) (Fig. 4.3) and the Bush Bronzewing (Phaps elegans) are quite common. A number of species occur here at the western extremity of their range; these include the Chestnut Quail-Thrush (Cinclosoma castanotum), the Gilbert Whistler (Pachycephala gilberti), the White-eared Honeyeater (Meliphaga leucotis) and White-fronted Honeyeater (Glicıphera albifrons); while the Red-capped Parrot (Purpureicephalus spurius) is at its eastern limit. A number of reptiles and frogs are known,

Figure 4.2 Dryandra Forest: Wandoo slope vegetation. The upper storey is Wandoo (Eucalyptus wandoo) and the shrub is Sandplain Poison (Gastrolobium microcarpum).

Figure 4.3 Dryandra Forest: a Mallee-Fowl (Leipoa ocellata) on its egg mound.

the most interesting being the Golden-flecked Burrowing Frog (Heleioporus barycragus) which is largely restricted to the western Darling Range and which occurs here as an outlier.

Dryandra Forest is becoming increasingly popular as a recreational area. The old forestry settlement has been converted to a camp for underpriviledged children by the Lions Clubs of WA.

Of the three areas in the Narrogin-Pingelly-Brookton region which contain a wide variety of mammals and which were included in the National Parks Report (1962) - Tutanning (East Pingelly), Boyagin (West Pingelly) and Dryandra - Dryandra provides the best chance of maintaining the full variety of flora and fauna of the region, because it is much larger and more varied physiographically. It is most important that the area be protected and managed for conservation.

At present the Dryandra complex includes State Forest Nos. 51 and 53 and a number of reserves. The most important reserve is number 16201 of 1740 ha, set aside for Water Supply and vested in the Minister for Water Supplies. This reserve is surrounded by State Forest 51 and includes some of the best wandoo forest and animal habitat at Dryandra. The Committee recognises the water catchment value of this reserve but believes that this should be second in importance to the preservation and management of the forest as an animal habitat. Many other reserves also occur on the edge of the State Forests and the Committee believes these should be consolidated with the Forest and placed under one management authority.

Recommendations

The Committee emphasises the outstanding value of the Dryandra area as wildlife habitat. This is due largely to the protection and management which the area has hitherto received from the Forests Department. In view of both the current specialised staff and the knowledge of forestry management possessed by the Forests Department, the Committee recommends:

1. that State Forests 51 and 53 remain dedicated to that purpose;

2. that the following reserves be included in the State Forest:

Reserve	Purpose	Vesting
16201	Water Supply	Minister for Water Supply
18856	Timber (Mallet)	not vested
25768	Timber (Mallet)	not vested
31670	Protection of Native Fauna	not vested
26643	Conservation of Flora and Fauna	WA Wild Life Authority
31378	Conservation of Flora and Fauna	not vested

3. that no further portions of Dryandra Forest be planted with pines or other exotic species;

4. that if any of the mallet plantations are felled they be regenerated to natural bush;

5. that the area be managed by the Forests Department as though it were a fauna and flora reserve and that if any time the area is relinquished by the Forests Department it be made a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority.

4.3 BOYAGIN WILDLIFE SANCTUARY

Boyagin Wildlife Sanctuary lies about 10 km south-west of Brookton and 16 km north-west of Pingelly. It includes Reserves 19128 and 20610 totalling 4860, ha both vested in the WA Wild Life Authority. Adjoining it, Reserve A 11144, of 122 ha set aside for Parklands and Picnic Grounds not vested, contains the spectacular Boyagin Rock.

The vegetation is similar to that found at Dryandra (Area 4.2) except that most is of plateau and Powder-bark slope types. The mammals are similar to those of Dryandra except that neither the Woylie (Bettongia penicillata) nor the Red-tailed Wambenger (Phascogale calura) has been recorded. However trapping and biological survey effort at Boyagin has been less intense than at either Dryandra or Tutanning (Area 4.4) and further species may be present. Even if they are not, Boyagin is an outstanding conservation area, especially as so little remains of the original landscape of the Wheatbelt.

The Boyagin Wildlife Sanctuary presents some problems, due mainly to its dissected shape. The reserves fall into three blocks, two major ones separated by freehold cleared land along Boyagin Creek, with a third small block to the east. Private lands make deep inroads into the two major blocks. There have been requests from adjoining landholders that they be permitted to straighten their boundaries by adding pieces of the reserve to their property. The WA Wild Life Authority wishes to realign the boundaries by eventual resumption, although it is willing to release the small eastern block of the Sanctuary (Avon Location 12102).

The presence of Reserve A 11144, which is surrounded on three sides by the Wildlife Sanctuary but which is not under the control of the Wild Life Authority, also creates a management problem. Boyagin Rock is a popular picnic place, especially for local people, and this use should both be encouraged and regulated. The Rock is an integral part of the wildlife sanctuary and needs to be managed as part of it.

Recommendation

The Committee endorses the purpose and vesting of the Reserves comprising the Boyagin Wildlife Sanctuary. It recommends:

1. that the eastern block of the reserves (Avon Location 12102) be excised;
2. that no further alienation be permitted;
3. that the remaining portions of Reserves 19128 and 20610 be amalgamated and declared Class A;
4. that the purpose of Reserve A11144 be changed from "Parkland" to "Recreation and the Conservation of Flora and Fauna" and that it be vested in the WA Wild Life Authority.

4.4 TUTANNING WILDLIFE SANCTUARY

Tutanning Wildlife Sanctuary lies about 20 km east of Pingelly. It is a small reserve (No. A 25555) of 2087 ha, for the Conservation of Fauna and Flora, vested in the WA Wild Life Authority and contains a remarkable diversity of animals and plants.

Over 400 species of plants have been recorded, some being rare or restricted to the reserve. Endemics include Boronia capitata subsp. capitata, two unnamed Dryandra species, Pomaderris bilocularis and an unnamed Tetratheca. Some rare species are Dryandra cynaroides, D. proteoides, Boronia busselliana and Brizula nutana.

Several sandplains occur within the reserve and each has a distinctive flora (Fig. 4.4). Other vegetation types are somewhat similar to those at Dryandra (Area 4.2) except that the understorey is of Box Poison (Oxylobium parviflorum) rather than Sandplain Poison. As at Boyagin (Area 4.3) there are few areas of lower slope or valley vegetation in the sanctuary. Areas of exposed granite and their associated plants (Fig. 4.5) are common.

Mammals are diverse and plentiful and include the same species as Dryandra except that the Native Cat (Dasyurus geoffroii) is absent, while the Ring-tail Possum (Pseudocheirus peregrinus) and Common Wambenger (Phascogale tapoatafa) are present.

Tutanning is also important because it is close to Woyerling Well, one of the localities at which the important British Museum collections were made by G.C. Shortridge during his stay in WA between 1904 and 1907. These collections give an insight into the changes which have occur in the native fauna since that time.

In 1964 the State Government constructed a Research Station at Tutanning and this has been used extensively, especially by personnel from the Department of Zoology, University of Western Australia, for studies on the animals and plants. Tutanning has been used by the Department of Fisheries and Fauna as an experimental area for developing management techniques for wildlife sanctuaries in Western Australia. Because some of the studies have shown that the reserve is too small, the Government, through the Department of Fisheries and Fauna, has purchased additional virgin land to add to the reserve.

Figure 4.4 Tutanning Wildlife Sanctuary: sandplain dominated by Blackboy (Xanthorrhoea reflexa), with woodland beyond.

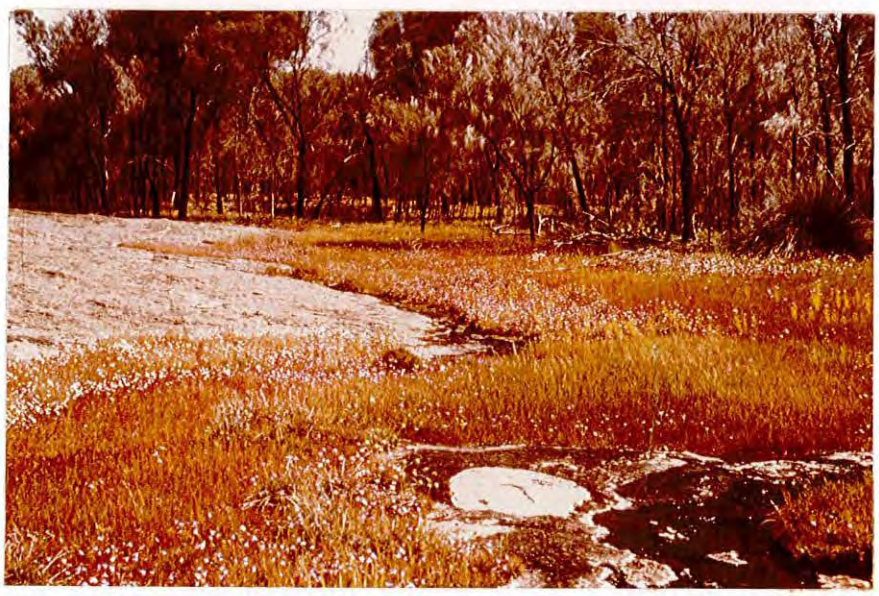

Figure 4.5 Tutanning Wildlife Sanctuary: Lithic complex. In the background is Rock Oak (Casuarina huegeliana) while the "meadow" around the granitic sheet is dominated by ephemerals, especially triggerplants (Stylidium) sundews (Drosera), and Pincushions (Borya nitida).

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

4.5 DRAGON ROCKS AREA

The Dragon Rocks Area lies about 30 km south-south-east of Hyden, and covers some 40,000 ha of vacant Crown land. The Department of Fisheries and Fauna, supported by some local farmers, has for some time sought a large reserve here and in 1972 and biological survey was made with the assistance of the Western Australian Herbarium. The report (McKenzie, et al., 1973) showed that the area is undoubtedly important and recommended a 30,000 ha reserve.

The vegetation falls into seven formations

1. Woodland. Salmon Gum (Eucalyptus salmonophloia) is dominant with some Morrel (E. longicornis)
2. Low Open Forest. Stands of White Mallet (E. falcata) and Blue Mallet (E. gardneri)
3. Open scrub. Characterised by dense mallees of which E. eremophila is the most common.
4. Tall Shrubland. Scattered mallees (E. eremophila, E. redunca, E. albida) with an understorey of Calytrix, Isopogon, Gastrolobium and Leptospermun (Fig. 4.6)
5. Tall Open Shrubland. Mallees are very scattered with a well-developed heath understorey.
6. Open Heath. A medium-dense heath of shrubs usually less than 2 m high. This is the richest of the formations and shows a mixture of Eremean (desert), central wheatbelt and southern species.
7. Lithic complex. Two types are found, the commonest being granite outcrops, the other on breakaways.

One species, a Grevillea, has not been found outside the area and a number of plants occuring on the Dragon Rocks area are not known to occur on any reserve.

The fauna of the Dragon Rocks area is outstanding. Fifteen native mammals have been recorded and another three probably occur. Rare species at present include the Red-tailed Wambenger (Phascogale calura) and the Western Mouse (Pseudomys occidentalis). The Numbat (Myrmecobius fasciatus) probably occurs there, and if confirmed this would extend its known range. Fifty-nine species of birds have been recorded. The reptiles and frogs are a mixture of Wheatbelt and south coastal species, some being at the inland limit of their range, e.g. Litoria cyclorhyncha (a tree frog), and the gecko Diplodactylus spinigerus.

It is clear that the Dragon Rocks area complements rather than duplicates existing reserves in the region.

Figure 4.6 Tall open shrubland in the Dragon Rocks Area.

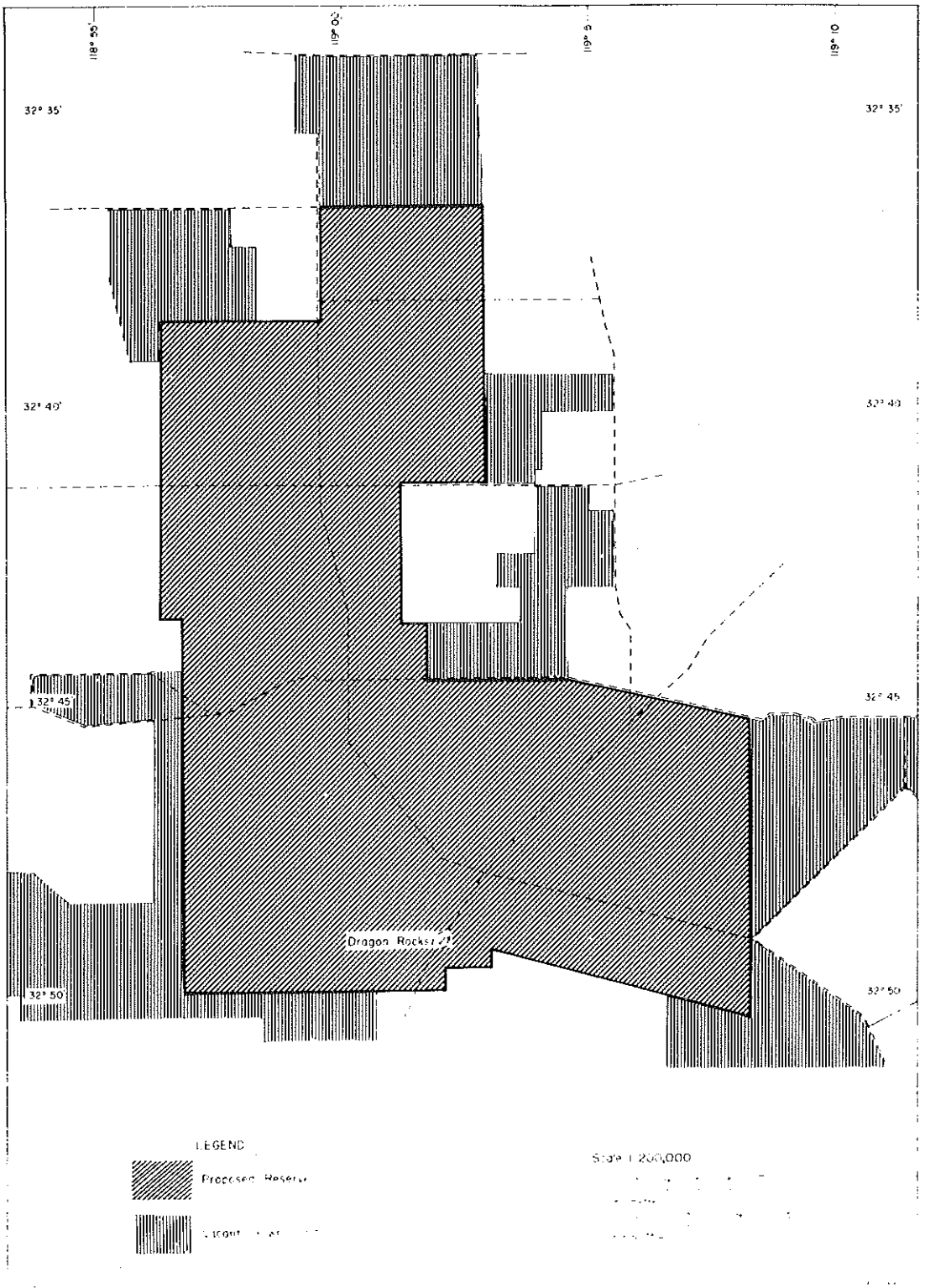

Figure 4·7 Proposed reserve, Dragon Rocks area

Recommendations

The Committee strongly endorses the recommendations of McKenzie et al. (1973), i.e.:

"1. that a Reserve of at least 30,000 ha, as in (Fig. 4.7) be set aside;

2. that the reserve be for the purpose of "Conservation of Flora and Fauna" and that it be vested in the WA Wild Life Authority;

3. that, because of the great importance of the area as a wildlife sanctuary, the reserve should be of Class "A"."

4.6 LAKE MAGENTA WILDLIFE SANCTUARY

Lake Magenta Wildlife Sanctuary is a Class A reserve for the Conservation of Fauna vested in the WA Wild Life Authority. It lies about 50 km east of Pingrup and has an area of 94 170 ha.

The reserve is representative of the south-eastern wheatbelt mallee country. It contains Lake Magenta, a chain of salt pans, and a series of fresh water swamps and lakes at the headwaters of the Fitzgerald River.

The reserve has been the subject of biological surveys by the WA Museum and the description below of the vegetation is from this report (Kitchener et al., unpublished). The vegetation may be classified into a number of formations.

1. Open Woodland. Two formations occur on heavy soils, one dominated by Salmon Gum (Eucalyptus salmonophloia) and the other by Swamp Mallet (E. spathulata).

2. Closed Woodland. Three separate formations occur. One, dominated by White Mallet (E. falcata), another dominated by E. incrassata and E. kondininensis, a third by E. wandoo. They are found on sandy soils associated with ironstone (laterite) ridges.

3. Open Scrub and Mallee. Several different formations are recognised.

4. Closed Scrub (Mallee). Three formations of this type have been described by Kitchener et al.; Moort (E. platypus) is common.

5. Closed Scrub. Two closed scrub formations are dominated by Melaleuca spp.

6. Closed Heath (Sandplain) on sandy soils.

7. Herbland (Samphire) in depressions adjoining Lake Magenta.

Mammals are not plentiful, in contrast to the Dragon Rocks Area (Area 4.5) further to the north, this possibly being due to the number of fires which have recently occurred in the reserve. Five native species have been recorded, the most notable being the Honey Possum (Tarsipes spencerae) and Mitchell's Hopping Mouse (Notomys mitchellii). Birds, on the other hand, are

plentiful and 98 species have been recorded, many more than at Dragon Rocks. Some of the additional species are found on the salt and fresh water lakes. Mallee-Fowl (Leipoa ocellata) occur in the reserve but are not common. Reptiles are plentiful, 31 species having been recorded, while 7 species of frogs occur. The reserve has representatives of south coast elements e.g. the frog Litoria cyclorhyncha, and eastern elements, e.g. the dragon lizards Amphibolurus salinarum and A. cristatus. It also has the most easterly inland records of the skink Lerista distinguenda and the legless lizard Aprasia repens.

Lake Magenta Wildlife Sanctuary is the largest of the wheatbelt reserves, and is one of the few south-western reserves considered large enough to retain its essential character in the face of peripheral development and natural catastrophes such as fire. Also, because of its size, the reserve can support large populations of birds and reptiles. It is particularly important as a refuge for nomadic or migratory birds such as the Purple-gaped Honeyeater (Meliphaga cratita), Yellow-plumed Honeyeater (Meliphaga ornata), Brown-headed Honeyeater (Melithreptus brevirostris), Tawny-crowned Honeyeater (Gliciphila melanops) and Spotted Pardalote (Pardalotus punctatus).

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

4.7 WETLANDS

A number of wetland complexes (see Introduction) occur within the Wheatbelt (Fig. 0.1). In order of importance, they are:

WETLAND COMPLEX 3 - WAGIN-KATANNING

These wetlands constitute the main breeding area for waterfowl in the South-West. Breeding species include the rare Freckled Duck (Stictonetta naevosa) and Chestnut-breasted Teal (Anas castanea). The lakes hold large resident populations of waterfowl and act also as a drought refuge and moulting ground for Black Swans (Cygnus atratus) and Mountain Duck (Tadorna tadornoides). The most important wetlands here are:

Already Within Conservation Reserves	Not Within Conservation Reserves
Coblinive River and Flats	Charling Lake
Lake Coyrecup	Flagstaff Lake
Lake Dumbleyung	Kwobrup Swamp
Lake Gundaring	Lake Ewlymartup
Lake Martinup	Lake Murdualhurrin
Muripin Lake	Lake Norring
Wagin Lake	Lake Parkyerring

Lake Quarbing
Little Lime Lake
Nuning Swamp
Sprats Lagoon
Wardering Lake

In recent years there has been rapid degeneration of the wetlands of the Wagin-Katanning complex as waterfowl habitat, principally as a result of increasing salinity of their waters. This makes protection of the remaining good waterfowl areas even more important. The Committee therefore recommends two lakes, Wardering and Parkyerring for reservation.

Wardering Lake is west of Woodanilling. Reserve 17258 (Public Utility, not vested) covers about 80% of the lake, the remainder being freehold. It is the main water-fowl sanctuary in the Wagin area, being one of the few remaining relatively fresh water lakes. Counts have shown concentrations of up to 20,000 Black Swans and many ducks.

Lake Parkyerring is south of Wagin and lies wholly within Reserve A 10733 (Recreation, not vested). Along its shore is Reserve 24792 for the Conservation of Flora, not vested, and to the south is an adjoining lake which is vacant Crown land. Lake Parkyerring is a most important waterfowl feeding and refuge area and when flooded carries large populations of waterfowl as well as many other birds such as waders. It is our information that the lake is not used for recreation to any extent.

WETLAND COMPLEX 8 - BEVERLEY

The Beverley wetland complex has as its focal point a lake system which is one of the sources of the Avon River. This has been dammed to form a series of lakes known as the Channel Lakes and Beverley Lakes on the Yenyening Flats. These are fed by the Cunderdin Salt Lakes flowing from the north-east. The Channel Lakes and Beverley Lakes are already conservation reserves.

WETLAND COMPLEX 9 - NARROGIN

This complex extends north-easterly along the Arthur River from the Great Southern Highway about 20 km south of Narrogin. For its size it is one of the most productive waterfowl areas in the south-west. However due to sporadic flooding and drying it cannot be counted on as an annual breeding area. Most important lakes are already conservation reserves, viz. Lake Toolibin, Lake Taarblin, Ibis Lake, Billy Lake, Nomans Lake, and White Lakes.

WETLAND COMPLEX 10 - WONGAN HILLS

This wetland complex extends from Dowerin through Wongan Hills and Lake Hinds and to the north east. The principal lakes are:

Already Within Conservation Reserves	Not Within Conservation Reserves
Lake Ninan (part only)	Damboring Lakes
Lake Walyormouring (Oak Park)	Lake Hinds
	Lake Koomberkine

These lakes are used for breeding, feeding and for staging during migration, and in wet years contain large waterfowl populations. In years when some or all the lakes are dry, their carrying capacity is much lower. If the more permanent lakes can be protected and improved by deepening or impounding further water, their carrying capacity could be greatly increased. This can probably be done in Lake Hinds which is included in Reserve 16305 (Common, not vested) and Reserve 11801 (Water, not vested). This lake is recommended for reservation.

Lake Hinds is an excellent place for waterfowl, especially in early summer when larger areas of surface water are usually present. The birds remain on the lake until the water becomes so low or stagnant that they are forced to move. Four times in recent years large concentrations of waterfowl have been seen on Lake Hinds prior to cyclonic rains in the Murchison and Gascoyne. After rain has fallen in the north the birds leave the lake, suggesting that one of its most important functions is as a staging area.

WETLAND COMPLEX 14 - LAKE GRACE

The Lake Grace complex is a series of salt lakes in the south-eastern wheatbelt. The principal lakes are:

Already Within Conservation Reserves	Not Within Conservation Reserves
Lake Magenta	Kondinin Lake
	Lake Buchan
	Lake Chinocup
	Lake Grace
	Lake Jilikin
	Lake Pingarnup

Although often dry these lakes are of major importance to waterfowl in the years when they contain water. Most lakes are so large when full that waterfowl using them cannot be disturbed to any extent. However, dispersed between the major lakes are smaller wetlands which are permanent or semi-permanent. These need protection, since waterfowl are concentrated on them when the large, shallow lakes dry up.

Kondinin Lake is one of these smaller wetlands which is known to hold large numbers of water birds during early summer, Kondinin Lake is Reserve No. 22519, for the purpose of Common and is controlled by the Kondinin Shire Council. It is used by local people for recreation and is recommended here for reservation as a joint wildlife sanctuary and recreation area.

The reservation of the Lake Grace - Lake Chinocup complex is recommended below (Area 4.8).

WETLANDS COMPLEX 15 - LAKE KING

The Lake King complex is a chain of salt lakes. The principal wetlands are:

Already Within Conservation Reserves	Not Within Conservation Reserves
Lake Hurlstone	Lake Camm
Lake Varley	Lake Carmody
Lake Pallarup	Lake Fox
	Lake Gulson
	Lake Kathleen
	Lake King

The values of these lakes in terms of waterfowl are similar to those described for wetland complex 14 - Lake Grace. They differ in having an interesting flora both on the lake foors and on adjacent granite rocks, e.g. Lily McCarthy Rock.

Lake King is an extensive salt lake with large areas of samphire flats, sand banks and islands. These support a wide variety of halophytic plants including at least 12 species of samphire, (Arthrocnemum spp.). Two of these are undescribed. A large spear grass (Stipa sp.) and an undescribed heath (Leucopogon sp.) are known only from this locality. An unnamed ephemeral herb (Hydrocotyle sp.) is known only from here and a locality near Norseman. It is one of the most unusual species of the genus. Other rare species on the lake are Chthonorephalus pygmaeus and Scaevola collaris.

Recommendations

The Committee recommends that:

1. reserve No. 17258 (Wardering Lake), C Class reserve for Public Utility, not vested, be reclassified a Class A reserve for the Conservation of Fauna and Flora, and vested in the WA Wild Life Authority;
2. the Environmental Protection Authority be asked to investigate the source of the fresh water in Wardering Lake and take any necessary measures to prevent it becoming salt;
3. the purpose of reserve No. A 10733 (Parkyerring Lake) be changed from Recreation to the Conservation of Fauna and Flora and be vested in the WA Wild Life Authority, and that the purpose of reserve No. 24792 be changed from Conservation of Flora to Conservation of Flora and Fauna, declared Class A and vested in the WA Wild Life Authority;
4. the vacant Crown land within the southern extension of Lake Parkyerring be added to reserve No. A 10733;
5. that the classification and purpose of reserves Nos. 16305 (C Class, for Common, not vested) and 1101 (C Class, for Water, not vested) at Lake Hinds be changed to A Class for the Conservation of Flora and Fauna. and vested in the WA Wild Life Authority;
6. the classification and purpose of reserve No. 22519 at Kondinin Lake (C Class, for Common) be changed to A Class for Recreation and the Conservation of Fauna and Flora and that it be vested jointly in the Shire of Kondinin and the WA Wild Life Authority;

7. a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, be declared, to include Lake Fox, Lake Camm, Lake Milarup, Lake Ronnerup and Lake King, plus existing vacant Crown land within 2 km of the edge of the lakes; and that Commander Rocks (reserve No. 19717 for Water, not vested) be included within the lakes reserve.

It should be noted that the enacting of these recommendations need have no effect on the current usage by duck shooters of some of the above areas. The Department of Fisheries and Fauna is empowered to permit duck shooting on both Crown and private land. It is the practice of the Department to maintain duck shooting in areas where it has occurred over many years, even when such areas are made reserves.

4.8 OTHER AREAS

As discussed previously there are many smaller reserves in the wheatbelt which are of conservational value. While many of these are mainly of local importance, a few are known to be of especial value because of the occurrence of outstanding or rare species of plants or animals.

In listing such reserves the Committee stresses that the present knowledge of plant and animal distributions in the wheatbelt, while much better than it was a few years ago, is still limited, and further areas will doubtless be found to be of similar importance as survey work continues.

1. Buntine Wildlife Sanctuary. Consists of Reserve No. A 26837 for Conservation of Flora and Fauna vested in the WA Wild Life Authority and Reserve No. 16379 for Water and Conservation of Flora and Fauna vested in the Minister for Water Supplies. These total 3147 ha. The area is important for its relatively large size, its diverse vegetation, and the presence of some small mammals and a wide variety of birds.

2. Charles Gardner Reserve. Consists of Reserve No. A 20041 (583 ha) for the Conservation of Flora, under the control of the National Parks Board. It is important for the variety of spectacular sandplain flora (Fig. 4.8) and the presence of rare plants such as Casuarina fibrosa. The Committee sees a certain anomoly in the present vesting and purpose of this small flora reserve but this no doubt has historical explanations. It suggests that the National Parks Board and the West Australian Wild Life Authority discuss a more appropriate purpose and vesting.

3. Mount Stirling Wildlife Sanctuary - Reserve No. 11048, 231 ha
Mount Caroline Wildlife Sanctuary - Reserve No. 11047, 352 ha (Fig. 4.9)
Nangeen Hill Wildlife Sanctuary - Reserve No. 23187, 176 ha

Figure 4.8 Charles Gardner National Park: sandplain with woodland beyond. The large pine-like shrub is Actinostrobus psammophilus.

Figure 4.9 Mt. Caroline Wildlife Sanctuary: habitat of the Brush-tailed Rock Wallaby (Petrogale penicillata).

These three reserves, which are vested in the WA Wild Life Authority, are important because they contain populations of the Brush-tailed Rock Wallaby (Petrogale penicillata). The range of this species was formerly much wider in the South-West but it is now known only from this area of the Wheatbelt. Two other populations occur nearby, one on private property and one on Reserve 11039 (127 ha) for "Water" at Tutakin Hill.

4. Bendering Wildlife Sanctuary. This is reserve No. A 20338, of 5119 ha. It is important because of its size and diversity as well as the rare species which it contains e.g. the White-tailed Dunnart (Sminthopsis granulipes) and the Western Mouse (Pseudomys occidentalis).

5. Tarin Rock Wildlife Sanctuary. Reserve No. A 25711 of 2015 ha for Conservation of Flora and Fauna. It contains a varied flora and a number of rare mammals, including the Tammar (Macropus eugenii), the Western Mouse (Pseudomys occidentalis) and the Honey Possum (Tarsipes spencerae). Nearby lies North Tarin Rock Wildlife Sanctuary (reserve No. 29857 of 1416 ha, C Class, for Conservation of Flora and Fauna, vested in the WA Wild Life Authority) which also contains the Tammar; as well as the Common Dunnart (Sminthopsis murina).

The vegetation is mostly a sandheath containing many outstanding wildflowers. The Proteaceae and Myrtaceae are well represented by species such as Banksia baueri, Conospermum ephedroides, Verticordia humilis, etc. The Compass Bush (Casuarina pinaster) and the lambstail Physopsis lachnostachya are localised species which are common here. A curious prostrate wattle, Acacia depressa, is known only from one hilltop in the reserve.

6. Chinocup Wildlife Sanctuary. Reserve No. 18803 of 979 ha for Water and the Conservation of Flora and Fauna, vested in the Minister for Water Supplies; it also contains a population of the Tammar (Macropus eugenii).

7. Lake Grace - Lake Chinocup Area. This includes reserve Nos. 28395 (7 174 ha) and 26802 (1559 ha) for the Conservation of Flora, not vested; and vacant Crown land within the salt lakes and the Chinocup Townsite. Recent surveys by the Department of Fisheries and Fauna have shown that the land surrounding the lakes contains a remarkable number of small mammals. These include the Western Mouse (Pseudomys occidentalis), Ashy-Grey Mouse (Pseudomys albocinereus), Mitchell's Hopping Mouse (Notomys mitchellii) and White-tailed Dunnart (Sminthopsis granulipes). The first and last are rare species while the Ashy-Grey Mouse, common in some coastal areas, has never before been recorded so far inland. As reported under Area 4.7 the lakes are of value to waterfowl (Fig. 4.10) and reservation of the whole area would create an important conservation reserve of about 20,000 ha.

8. Lake Pallarup - One Mile Rocks Wildlife Sanctuaries Consists of Reserves 29864 of 4113 ha vested in the WA Wild Life Authority. They are notable for the varied vegetation which includes the most south-westerly occurrence of a spinifex (Triodia scariosa). Little work has been done on the fauna of these reserves.

Figure 4.10 Black Swans (Cygnus atratus) on Lake Grace.

In addition to the areas specified above, the Committee draws attention to two types of reserve which, as a result of extensive clearing and the lack of conservation reserves in the Wheatbelt, are today important for the conservation of wildlife.

1. Country and Railway Water Supply Reserves

Many areas set aside as catchments retain the native vegetation and often a variety of animals as well. Some water supply reserves are outstanding conservation areas; well known examples include those at Quairading and Corrigin, but there are many others.

2. Townsites

In the early days of settlement when transport was slow, many townsite reserves were set aside. Often these have either been little developed or not developed at all. Often the unused portions of such undeveloped townsites contain important flora and fauna.

Recommendations

The Committee recommends that:

1. reserve No. 16379 (Buntine) be declared Class A and that its purpose and vesting remain unaltered;
2. reserves 11047, 11048 and 23187 for Conservation of Flora and Fauna be declared Class A and remain vested in the WA Wild Life Authority;
3. the classification and purpose of reserve 11039 be changed from C Class for Water to A Class for the Conservation of Fauna and Flora, and that it be vested in the WA Wild Life Authority;
4. reserve 29857 (North Tarin Rock) be declared Class A and that its purpose and vesting remain unaltered;
5. reserve 18803 (Chinocup) be declared Class A and that its purpose and vesting remain unaltered;
6. the following be included in one Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority;
   a) reserve 28395 and 26802
   b) Chinocup Townsite
   c) all vacant Crown land in and around the following: Lake Grace North, Lake Grace South, Lake Chinocup, Lake Pingrup and Lake Dorothy;
7. reserves 29860 and 29864 (Lake Pallarup) be declared Class A;
8. the Environmental Protection Authority approach the Railways Department and the Public Works Department to obtain an undertaking that reserves under their control be offered to the WA Wild Life Authority if they are no longer required for their original purpose;

9. townsite reserves containing significant areas of natural vegetation and no longer needed for their original purpose have their purpose changed to Conservation of Flora and Fauna, be made Class A and be vested in the WA Wild Life Authority.

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SYSTEM 5 - NORTHERN SANDHEATHS

INTRODUCTION

Area and Physiographic Features

System 5 extends along the coast from north of Gantheaume Bay to the vicinity of Guilderton and inland to a boundary joining Gingin, Coorow, Mullewa and Coolcalalaya (Fig. 5.0). The marine area of the System includes the northern part of the Rottnest Shelf and the southern Dirk Hartog Shelf (Carrigy and Fairbridge, 1957). It covers about 44,520 km^2.

Most of the System lies in the Perth Basin (McWhae et al., 1958) which contains thick sedimentary sequences of Palaeozoic and Mesozoic age. The eastern boundary of the System is virtually coincident with the Darling Fault, a major fracture that forms the boundary between the Precambrian Yilgarn Block and the Perth Basin. Sequences of younger Precambrian strata outcrop along the Darling Scarp between Moora and Coorow and at Billeranga Hills. Except near the Hill River, the Perth Basin displays little topographic relief. The north-northwest trending Dandaragan Scarp rises to elevations of 250 m and extends from Muchea to the vicinity of the Herschel Range. Jurassic and Cretaceous sediments outcrop along this scarp and extend eastward to the Darling Fault beneath superficial sands. The Urella Fault Scarp, a large Mesozoic dislocation, extends from the vicinity of Coorow, northward though Mingenew to near Tenindewa. The geology of the northern Perth Basin is dominated by the Northampton Block of Precambrian crystalline metamorphic rocks. This uplift is onlapped by the Silurian Tumblagooda Sandstone, and by Triassic, Jurassic and Cretaceous sediments. The Tumblagooda Sandstone is extensive; it outcrops along the coast and is exposed along the Murchison River gorge. Laterite is widely developed, particularly in eastern parts of the System.

It forms resistant cappings on most hills and high land, and secondary laterites occur at lower levels.

Sandplains are ubiquitous in the Perth Basin. They comprise superficial deposits of quartz sand, 1 to 5 m thick, that cover all older rocks including the widespread laterite. The sands occur in vast sheet-like bodies but dune forms are also developed in many places. A belt of quartzose dunes up to 20 km wide, termed the 'Bassendean Sands' by McArthur and Bettenay (1960), extends along the base of the Darling and Dandaragan Scarps and merges with broader sand sheets in northern parts of the System. The Bassendean Sands are probably decalcified aeolianite dunes and residual quartz sands remobilised from aeolianite.

The coastal area is a terrain of calcareous aeolianite dunes. These aeolianites form a multiple ridge system and probably represent high strandlines during the Quaternary. The youngest dune system (Quindalup Dunes, McArthur and Bettenay, 1960) consists of older, partly lithified dunes and of younger areas of unconsolidated mobile dunes and sand. Erosion and sand migration are problems in the coastal areas which are likely to increase with grazing, burning, and other human activities.

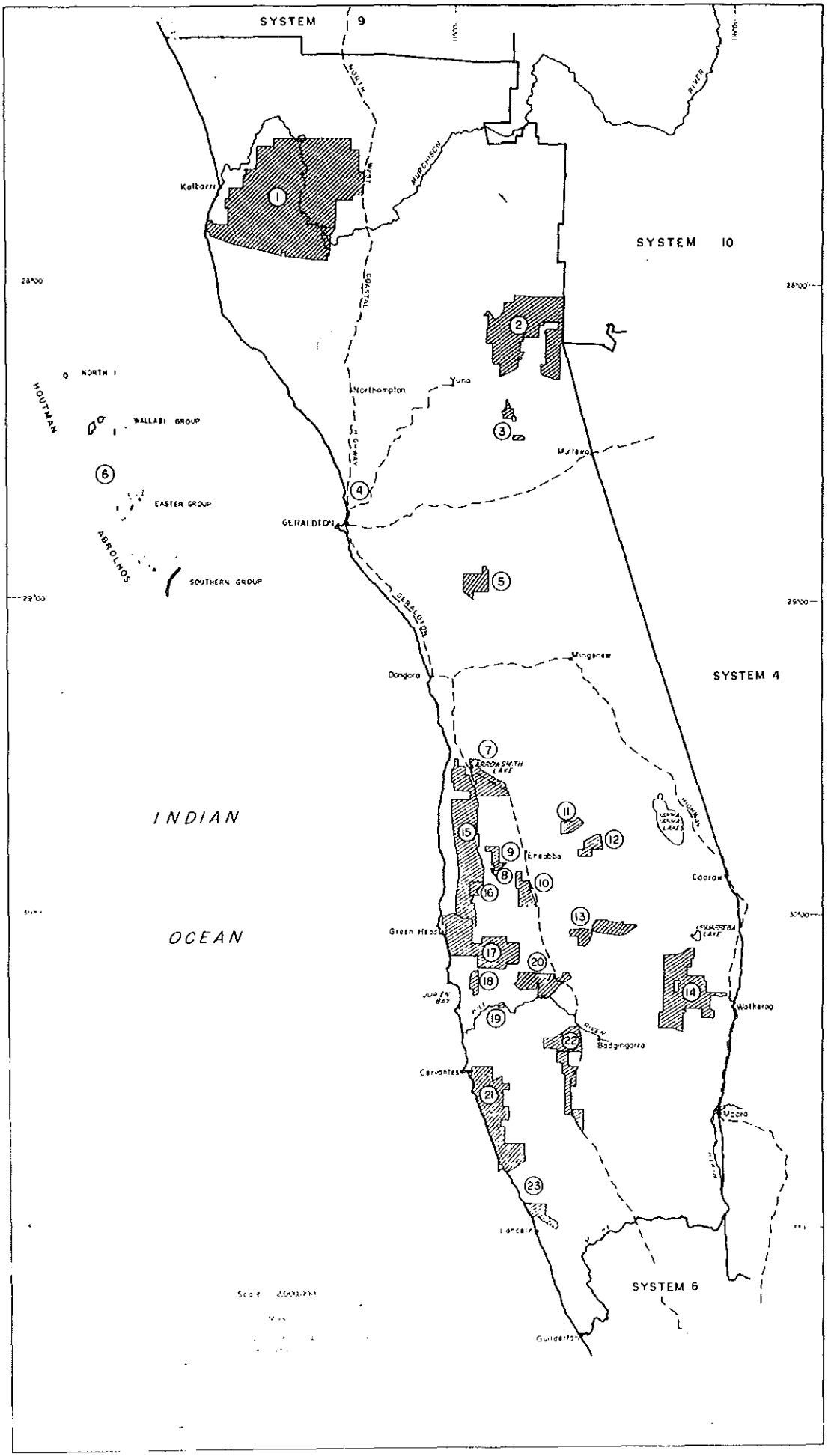


Figure 5·0 Map of System 5

Rivers in the region flow only after heavy winter rains or occasional summer cyclones. The Hutt, Bowes and Chapman Rivers rise in the Northampton Block. Drainage basins of the Murchison, Greenough, Irwin, Arrowsmith and Moore Rivers lie mainly on the Yilgarn Block east of the Darling Fault, and the Hill River rises in the Dandaragan Scarp. The Murchison is the largest river. It meanders through a majestic gorge incised in Tumblagooda Sandstone, and enters the Indian Ocean through a small estuary at Kalbarri. Other rivers traverse sandplains and aeolianite dune terrain and open directly to the ocean. Their mouths are usually blocked by sand-bays and there are no deltas because of the imbalance between high energy marine conditions and intermittent river discharge. River sands are transported along shore and thrown up into coastal dunes, but their contribution to the total aeolian build-up is relatively insignificant.

Sandplain and aeolianite terrains are poorly drained and often the groundwater table is close to the surface. Shallow lakes, swamps and soaks are therefore abundant, filling interdune depressions and low-lying areas. Many smaller lakes and swamps are seasonal, but large bodies retain water for most of the year and are important in the ecology of the region, particularly for nomadic and migratory birds. Some lakes are brackish and others such as the Yarra Yarra Lakes, south of Three Springs, contain brines.

The Rottnest Shelf is about 50 km wide in the south but it broadens northward to 80 km off Geraldton where it merges with the Dirk Hartog Shelf. High energy conditions prevail, for the shelf is incessantly swept by swells generated in the southern Indian Ocean. The average characteristics of the waves are height 6 m, length 100-200 m, period 8-12 sec. and there is added turbulence generated by prevailing strong southerly winds. Collins (1973) reports that the shelf floor is rock-covered with a veneer of Recent sediment about 1 cm thick consisting of rock fragments and skeletal debris of marine invertebrates. The only significant quantities of sediment are located in beaches and coastal dunes. These findings are important in coastal erosion problems because they imply that there is no possibility of sand replenishment from offshore deposits.

The inner shelf is dotted with shoals and small islands. Most of these shoals are "sandstone reefs" in that they are submerged aeolianite dune ridges, thinly encrusted with a specialised rock substrate biota of coralline algae, bryozoa and sponges. Coral reefs occur at Houtman Abrolhos where Recent corals have built structures on foundations of Pleistocene reefs (Teichert, 1947). Reefs are habitats for the rock lobster (Panulirus cygnus) on which a thriving commercial fishery is based.

The coast between Guilderton and Geraldton is characterised by sandy beaches, mobile dunes and resistant headlands of indurated aeolianite. Small anchorages offering limited protection have been established where larger headlands and associated offshore reefs modify the high-energy shelf regime. These include Port Gregory, Drummonds Cove, Geraldton, Port Denison, Green Head, Jurien Bay, Cervantes, Wedge Island, Lancelin and Guilderton. Geraldton has become a port through construction of artificial breakwaters but further port development here or elsewhere in the region will require major construction. The anchorages are centres for rock lobster industry and are also growing recreational resorts. Between Port Gregory and Gantheaume Bay

the coast comprises cliffs of aeolianite and Tumblagooda Sandstone.

Biology

Between Gingin and Shark Bay are extensive areas of sandheath where the soils are infertile yet support a low, dense scrub that is very rich in plant species. The myrtle, banksia and legume families are the dominant groups and provide much of the wildflower spectacle which has become a major springtime tourist attraction. The areas between the Hill River and Dongara, and along the lower Murchison River, are especially important in this respect. Many of the plants are endemic to the region.

Pockets of woodland occur throughout the System. They are usually dominated by either York Gum (Eucalyptus loxophleba) or Wandoo (E. wandoo), although there are areas of Jam Tree (Acacia acuminata) woodland towards the eastern boundary. Near the coast, sand dunes and limestone hills support a dense scrub in which some species are typical of coastal habitats while others are endemic to the area. Lakes support a characteristic flora.

The fauna of System 5 reflects its predominantly sandheath vegetation. The mammals, except for the Western Grey Kangaroo (Macropus fuliginosus), are mainly small and include both marsupials, such as the Honey Possum (Tarsipes spencerae) and Dunnarts (Sminthopsis crassicaudata, S. murina and S. granulipes), and rodents such as the Ashy-Grey Mouse (Pseudomys albocinereus) and Southern Bush Rat (Rattus fuscipes). Bird life is plentiful and nectivorous and insectivorous groups are well represented. Many species that avoid the forests and woodlands of the south-west penetrate southward along the coastal heaths. Two such species that reach their southern distribution limit in the System are the White-backed Swallow (Cheramoeca leucosternum) and the Blue-and-white Wren (Malurus leuconotus).

Reptiles, especially skinks, are common. A number of species are restricted to the System, including Lerista lineopunctulata, L. lineata, Ctenotus lesueurii, Morethia lineoocellata, and Hemiergis quadrilineatus. One skink, Lerista elegans, is known otherwise only from Barrow Island (G.M. Storr, pers. comm.).

The occasional wetlands support a typical south-western range of waterbirds although a northern influence is evident from the presence of species such as the Pink-eared Duck (Malcorhynchus membranaceus). Some offshore islands are important sea-bird breeding sites and also contain interesting reptilian faunas.

Population

System 5 has a population of about 30,000. Geraldton with about 15,000 people is the only urban centre in the region and over the 1966-71 intercensal period had a population growth of 26%, an increase similar to Perth's over the same period. Under the State Government's decentralisation policy, Geraldton has been designated a regional growth centre.

Between Kalbarri and Moore River there are numerous fishing and holiday settlements. Some of these are gazetted townsites, others occupied by squatters without legal tenure. Licensed rock lobster processing plants are located at Geraldton, Dongara, Jurien, Cervantes, Lancelin, Ledge Point and Seabird.

Inland towns within the System contain a total of about 4,400 people and serve agricultural districts. The remaining population is largely rural, as agriculture is important within the System. Most of the State's population is concentrated within ready vacation range of the System.

Land Use and Primary Industry

Farming is the main industry of System 5, chiefly cereal production and sheep grazing. Beef cattle are assuming importance. Much of the western part of the System, south of Dongara, remains under the control of the Crown, being land which is of little agricultural value.

Many of the coastal towns and settlements owe their origin to the rock lobster (Panulirus cygnus) fishery. This fishery, worth about $24,968,000 in export revenue in 1971/72, is centred in this system although significant catches are made further south. The Houtman Abrolhos is the most important area for the rock lobster fishery.

Secondary Industry

Secondary Industry is limited to service industries for agriculture and urban development.

Mining

To date the principal mineral resource of the system area is natural gas which is produced at 11 production wells, collected at Pell Bridge and pumped 415 km through a buried pipeline to Perth. The gas field has an estimated life of 15 years at the present day production rate of 2 million m^3/day.

Forty four petroleum exploration wells have been drilled into the Perth Basin sedimentary succession within the System but no commercial oil fields have been found. However it cannot yet be said that the area has been exhaustively tested for oil.

A number of heavy mineral sand deposits have been discovered along the foot of the Gingin Scarp which is the present day topographic expression of a Pleistocene coastline. These deposits extend intermittently from Gingin to Eneabba.

The principal deposits extend from 5 km northeast to Eneabba to 12 km south of Eneabba and are held by four companies, one of which has commenced open-cut mining operations. Ilmenite will be the principal product with rutile, zircon and kyanite as saleable by-products. The Companies have disclosed proved and probable reserves totalling 27.4 million tonnes of contained heavy minerals for the Eneabba deposit.

A smaller deposit (2 million tonnes contained heavy minerals) occur about 24 km east of Jurien townsite and two other small deposits exist immediately north of Gingin and near Regans Ford.

Development of all these deposits will be by open-cut mining methods.

Coal has been known to exist in the Perth Basin since the discovery of the Irwin River Coal measures in 1846. These Permian coal beds have been repeatedly been tested as a fuel source and hitherto discounted. However, they are not uniformly poor and recent investigations in the Green Head locality suggest that better grade coal might occur here at an uneconomical depth of some 600 metres. Investigations to locate shallower deposits at lesser depth are continuing.

Southwest of Eneabba, coal seams of the Early Jurassic Cattamarra Coal measures occur beneath 10 to 100 metres of overburden. Although this coal is of relatively poor quality, its proximity to the extensive heavy mineral sand deposits may render it economically viable for on-site power generation.

Diatomaceous earth has been found in the beds of the chain of lakes extending southwards from Irwin by Mallina Mining and Exploration N.L. Proved and probable reserves of over 1 million tonnes have been announced by the Company with a considerable part of their tenement area yet to be tested.

Bentonite, a variety of clay with applications in oil drilling and fluid classification, has been found in some lake beds near Marchagee.

Nodular phosphate is known in the vicinity of Dandaragan but has not been found as yet in commercial quantities.

Visitors and Tourism

The coastline provides the main potential for tourism in the System. Geraldton, and to a lesser extent Dongara and Kalbarri, attracts visitors during the cooler months of the year as well as during the summer, because of a milder winter climate than Perth. Coastal fishing settlements such as Lancelin, Jurien Bay and Cervantes are now developing as recreational areas for people from the Metropolitan area, as well as the adjacent agricultural districts.

In the late winter and spring wildflowers are an important attraction, many bus tours being specially organised to enable visitors to see them.

CONSERVATION RESERVES

There are numerous reserves in System 5 and for the most part these are adequate for the conservation of representative flora and fauna and growing recreational usage. The most urgent needs are for reclassification of some C Class reserves to A Class, redisignation of the purpose of others, and for adequate management. A reserve in the Moresby Range adjacent to Geraldton is also necessary.

As established, present reserves have a variety of purposes, some of which may be no longer relevant (e.g., No. 15018 for Horsebreeding). There is also a variety of vesting authorities, while some remain unvested. The largest reserve in the System is No. 24496 with an area of 71,498 ha, for the Protection of Flora. This large reserve is unvested and extends along the coast from Jurien Bay to the vicinity of Dongara (Fig. 5.4). Conservation of flora is to a large extent the practical current use of other reserves, notably 15018, 24275, 24276 and 29073, but they also are important for conservation of fauna.

Until the early sixties the area between Jurien Bay and Dongara was a virtual wilderness, with a few isolated fishing settlements and limited but increasing agricultural development. Since then there has been improved access with expansion of agriculture, development of large-scale mineral-sand mining and discoveries of natural gas. Many coastal settlements have grown from fishing camps to small towns, some with lobster processing works. There has been a rapid and considerable increase in recreational use of the coastal zone by people from Perth, Geraldton and inland rural centres. The expected completion of the Gingin-Eneabba-Dongara highway in 1975 as a main arterial route from Perth to Geraldton will further focus public attention on the area and lead to increased public usage and conflicting demands.

Wildflowers attract many visitors to the System, and conducted spring tours are an important source of revenue for the tourist industry. Extensive clearing for agriculture and mineral sand mining are yearly increasing the importance of existing reserves for the conservation of northern sandplain floras.

The areas reported on by the Committee are:

1. Kalbarri National Park
2. Vacant Crown land north-east of Yuna
3. East Yuna reserves
4. Moresby Range
5. Burma Road reserve
6. Houtman Abrolhos
7. Arrowsmith Lake area
8. Lake Indoon
9. Reserve 29073
10. Reserve 29806
11. South Eneabba reserve
12. Tathra National Park
13. Alexander Morrison National Park
14. Watheroo National Park
15. Beekeepers reserve
16. Stockyard Gully area
17. Mt. Lesueur reserves
18. Drovers Cave National Park
19. Hill River reserve
20. Coomallo area
21. Nambung National Park
22. Badgingarra National Park
23. Reserves 31675 and 31781
24. The West Coast
25. Wetlands
26. Islands between Dongara and Lancelin.

5.1 KALBARRI NATIONAL PARK

Kalbarri National Park is reserve A 27004 for National Park, approximately 152,700 ha in area, under the control of the National Parks Board of WA. The park is centred on the Murchison River gorge and adjacent sandheaths but it also includes picturesque coastal cliffs and gullies south of Red Bluff and Wittecarra Gully. The main purpose of the park is nature conservation but there is intensive public recreational usage from the town of Kalbarri located at the river mouth. The park is also of geological interest because of extensive exposures of the Lower Palaeozoic Tumblagooda Sandstone.

The park contains a rich flora, especially on the sandheaths lying each side of the Murchison gorge. Many genera and species occur here, and wildflower displays are outstanding from late winter to midsummer. A number of the plants endemic to the area occur in the park, including Lechenaultia chlorantha, Banksia lindleyana, Darwinia virescens, Melaleuca megacephala and Verticordia oculata. The gorge contains a different suite of plants, some again being endemic, e.g. Grevillea costata. It is also the only known locality in South-Western Australia for the primitive fern Psilotum nudum.

A survey of the fauna of the Park was made by the WA Museum in 1969 (Bannister, 1969) and 1970. It revealed 9 species of native mammals, 53 of reptiles, and some fish. The mammals include the Honey Possum (Tarsipes spencerae) which is at the northern extremity of its range. A small colony of the Brush-tailed Rock Wallaby (Petrogale penicillata) inhabits the Gorge. Since the survey, the Hairy-footed Dunnart (Sminthopsis hirtipes) has been discovered in the Park, this being a large extension from its previously known range - central Australia westward to the Canning Stock Route. The wide variety of reptiles includes a species of Blind Snake (Rhamphotyphlops leptosoma), which is known only from the Park, and other species with restricted distributions.

Unfortunately a large number of goats, pigs and other feral animals occur in the Park.

The Loop in the gorge of the lower Murchison River is one of the main scenic attractions in the area but it lies outside the boundaries of the park in vacant Crown land. The Committee endorses the status, purpose and control of the Kalbarri National Park.

It endorses the proposed action of the Department of Lands and Surveys that the boundaries of reserve No. A 27004 be amended to include all that land bordered red on Lands and Surveys Miscellaneous Plan 675.

5.2 VACANT CROWN LAND NORTH-EAST OF YUNA

North-east of Yuna is a large area of vacant Crown land. It contains extensive sandheaths rich in wildflowers of many families and genera. The area is farther inland than Kalbarri National Park and contains patches of country containing plants more typical of drier areas. It thus approaches the transitional zone between the South-West and Eremean Botanical Provinces, a zone of great biological interest. A reserve should be declared within it for the conservation of flora and fauna.

Information is insufficient at this stage for boundaries of a new reserve to be determined.

Recommendations

The Committee recommends that a Class A reserve for Conservation of Flora and Fauna, vested in the WA Wild Life Authority, be declared north-east of Yuna, the boundaries to be determined after the completion of a survey co-ordinated by the Department of Fisheries and Fauna.

Any proposal to alienate land here prior to the declaration of a reserve should be referred to the Environmental Protection Authority.

5.3 EAST YUNA RESERVES

The East Yuna Reserves are about 70 km north-east of Geraldton. Two adjoining Class C reserves, Nos. 28415 and 29231, total 1717 ha while a little to the south, at Bindoo Hill, lies Class C Reserve No. 30844 of 486 ha. All are for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

In 1973 and 1974 the WA Museum undertook surveys of these reserves for the Department of Fisheries and Fauna. Only preliminary results were avilable at the time of writing (Chapman and Dell, 1974).

The reserves occupy a tract of land which is generally higher than the surrounding country. A spectacular breakaway runs through the centre of the northern reserves. in places the breakaways are circular and resemble gorges. Above the breakaway the vegetation is low open scrub with such species as Acacia neurophylla, A. blakelyi, Melaleuca cordata and occasionally the native pine Actinostrobus arenarius. Below the breakaway is a tall scrub with such species as Acacia stereophylla, Melaleuca eleutherostachya, M. uncinata and Casuarina campestris while Melaleuca nematophylla is common on the steep breakaway slope. A conspicuous association which grows on both land surfaces is a mallee (Eucalyptus dongarraensis) with an unidentified spinifex (Plectrachne sp.) below it. Elsewhere on the reserves are areas of deep yellow/orange sands with a distinctive vegetation. Banksia sceptrum and B. ashbyi

are prominent with several Hakea and one Eremaea. A woody pear (Xylomelum angustifolium) is also present in places. Almost pure stands of Actinostrobus arenarius grow on white sand in lower areas. Another vegetation type present is York Gum (Eucalyptus loxopheba) woodland, which occurs in patches.

Both the Western Grey Kangaroo (Macropus fuliginosus) and Euro (M. robustus) occur on the reserves. Two species of native rodent have been collected - Mitchell's Hopping Mouse (Notomys mitchellii) and the Ashy-Grey Mouse (Pseudomys albocinereus). One interesting occurrence is the presence of abandoned nests of Stick-nest Rats (Leporillus sp.) under breakaways and mesas.' It is almost certain that Stick-nest Rats are extinct in the South-West.

Birds are plentiful and a wide variety has been recorded. The reserves have a dense population of the Splendid Blue Wren (Malurus splendens). This is important as it provides the only link between the coastal population and the inland population of these species. These reserves are the only ones in the wheatbelt known to maintain a population of this wren which presumably was widespread before agricultural clearing. The Western Yellow Robin (Eopsaltria griseogularis) and Spotted Scrub-Wren (Sericornis maculatus) are at their inland limit in the northern part of their range while the Little Wood-Swallow (Artamus minor), which breeds on the reserves, is at its southern limit.

The reptiles are a mixture of wheatbelt and desert speoies. Among the latter are Varanus eremius, Omolepida branchiale melanops, Egernia inornata and Morethia butleri, all of which are at their southern or western limit. The reptiles also include two rare species - the gecko Diplodactylus michaelseni, and the skink Ctenotus alleni. The latter species was known only from the two type specimens until seven were collected from the East Yuna reserves.

Recommendation

The Committee recommends that Reserves 28415, 29231, and 30844 remain for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, but be declared Class A.

5.4 MORESBY RANGE

The Moresby Range is a series of mesas and buttes that form a picturesque backdrop to the port of Geraldton. The Range which rises to about 200 m is composed mainly of flat-lying Mesozoic strata, capped by a laterite hardpan. Gneiss and granite of Precambrian age outcrop along the lower flanks of the range. These characteristic hills typify the unique landscape of the Geraldton district.

Besides their scenic and geological interest, these flat-topped hills carry a flora which in certain respects differs from that found elsewhere in the region or indeed in the State. The vegetation varies from a low to tall heath, with higher stands dominated by mallee eucalypts. In contrast to most Western Australian heath formations, the banksia and legume families are relatively poorly represented, and the myrtles are dominant. Besides the eucalypts, species of Melaleuca and Verticordia are common, sometimes within one or two species dominating particular areas and giving vivid splashes of colour when in flower. Among the species restricted to this area are Verticordia penicillata, Ricinocarpos psilocladus, Gastrolobium spinosum var. triangulare and Drummondita ericoides.

In saddles between the hills the soil is a deeper sand in which a taller shrubland has developed, including species typical of the region. There are also a few watercourses along which York Gum and River Gum (Eucalyptus loxophleba and E. camaldulensis respectively) occur, adding further variety to the area.

The lower slopes of the range have been developed for agriculture, but some higher parts have not been cleared. The Range is mostly in freehold land.

The area immediately surrounding Geraldton has few conservation and recreation reserves. Apart from the small Spalding Park on the outskirts of the town, the nearest are Kalbarri National Park on the lower Murchison River, and Burma Road Reserve south-east of the town.

A freehold property in the Moresby Range is currently for sale. It is mostly uncleared and would make a good national park.

Recommendation

The Committee recommends that the property listed in the Confidential Appendix be acquired by the State. It should then be designated an A Class reserve for National Park and placed under the control of the National Parks Board of WA.

5.5 BURMA ROAD RESERVE

Burma Road Reserve is Class C reserve No. 26663, for Conservation of Flora, vested in the Geraldton Tree Society; the area is about 6889 ha.

Situated south-east of Walkaway, this reserve consists of elevated sandheaths on which a rich flora has developed. The land is undulating with wide shallow valleys bordered in some places by low lateritic breakaways. Soils are deep sands in the valleys grading to shallow sand over laterite on the higher areas.

The vegetation is a low or tall shrubland containing many colourful wildflowers, especially of the myrtle, legume and banksia families. Black Kangaroo Paws (Macropidia fuliginosa) are common. Some plants are restricted to the area. These include Irwin Lechenaultia (L. longiloba) and as yet undescribed species of Grevillea, Banksia, and Scholtzia. Honeymyrtles, featherflowers, hakeas, dryandras, heaths, pea flowers and many others contribute to the colour and diversity of the bushland.

There is some overlap here of the floras of the "midlands" sandheaths and those of the Murchison-Shark Bay heaths, some species being at their northern limits and others at their southern limits.

This large reserve is an important part of the conservation reserve system of Western Australia. It has been enthusiastically protected and managed in recent years by the Geraldton Tree Society. The Committee believes that it should now be further protected by Class A designation and vested in a state management authority. We would hope, however, that because of their experience, the Geraldton Tree Society will be consulted concerning the form of management.

Recommendations

The Committee recommends:

1. that the status and purpose of reserve No. 26663 be changed from C Class for Conservation of Flora to A Class for Conservation of Flora and Fauna;
2. that the Geraldton Tree Society and the WA Wild Life Authority confer to arrange a timetable for the transfer of the vesting of the reserve to the Wild Life Authority;
3. that, so long as the Geraldton Tree Society remains active, the WA Wild Life Authority consult the Society concerning the management of the reserve.

5.6 HOUTMAN ABROLHOS RESERVE

Houtman Abrolhos are reserve No. A 20253 for Conservation of Flora and Fauna and Fishing vested in the Minister for Fisheries and Fauna. They are a group of low islands and coral reefs on the Rottnest Shelf margin about 50 km west of Geraldton (Fig. 5.0). The coral reefs are the southernmost in the eastern Indian Ocean (Fairbridge 1960) but little is known of the marine flora and fauna.

The islands of the Abrolhos group have an outstanding fauna. They are the most important breeding place for seabirds in the State, some 15 species breeding on Pelsart Island alone. Pelsart and Wooded Islands have the only breeding colonies of the Lesser Noddy (Anous tenuirostris) (Fig. 5.1) in Australia. The islands contain endemic subspecies of land birds including the Brush Bronzewing (Phaps elegans), the Spotted Scrub-Wren (Sericornis maculatus) and the Painted Quail (Turnix varia).

Two subspecies of native mammals restricted to the Wallabi Islands have been described. One, the Abrolhos Island Tammar (Macropus eugenii bynoe) was the first Australian marsupial recorded by Europeans (Pelsart in 1629). The other is a form of the Southern Bush Rat (Rattus fuscipes glauerti) found here to the north of its range on the mainland.

A number of species of reptile occur, West Wallabi with 18 species being particularly notable (Storr, 1965).

The Abrolhos are of considerable historic significance. They were discovered by Dutch mariners in the seventeenth century, and at least two East Indiamen were wrecked there. The best known is the 'Batavia' which was wrecked in the Wallabi Group in 1629. Following the wreck the captain and some of the crew sailed an open boat to the East Indies to obtain help. In their absence some crew members mutinied and massacred many of the survivors. This is probably the earliest fully documented Australian historical episode. Another early wreck was of the 'Zeewyck', wrecked in the Southern Group in 1727. The survivors reported seeing the remains of an earlier wreck on the reef. This may have been the 'Aagterkerke', a missing East Indiaman of the period.

The reefs around the Abrolhos are an important centre for the rock lobster industry and some of the islands are inhabited during the lobster season (March-August) by fishermen who anchor in the lagoons. Human habitation and limited tourism conflict with the role of the islands as fauna sanctuaries.

Human use of the islands has already had its effects. Large breeding colonies of the Sooty Tern (Sterna fuscata) and Common Noddy (Anous stolidous) have disappeared from Rat Island, and the Painted Quail (Turnix varia) seems to be no longer present on North Island (Storr, 1960). Rats (Rattus rattus) have become established on some islands and rabbits (Oryctolagus cuniculus) have been introduced to others. Both these species have damaging effects on the native vegetation and fauna, and ground or burrow-nesting sea birds are especially vulnerable.

Domestic pets such as cats and dogs have also been taken to some islands and in some cases cats have gone wild. The presence of fishermen has also led to a major rubbish and waste disposal problem.

Some of the islands inhabited by fishermen are of little conservational value. However, in other cases there must be cause for concern. For example, both the Wallabi Islands, the home of the Abrolhos Tammar, have been disturbed - a few fishermen live on West Wallabi and an airstrip has been constructed on East Wallabi.

Efforts are now being made by the managing authority to resolve these problems. Policies have been laid down to control rubbish and waste disposal, and occupation of some islands, including West Wallabi, is being phased out. The keeping of pets is being strictly controlled and programmes to eradicate cats, rabbits and rats are under way.

There has been some pressure for tourist development. Buildings erected by the British Phosphate Commission on Pelsart Island during World War II were used as a tourist camp for a short period after the war but the venture failed. Other attempts met a similar fate and recently the policy of the management authority has been against allowing the development of tourist facilities.

It seems inevitable, however, that tourist interest in the islands will increase, especially if Geraldton continues to develop as a major regional centre. Limited public use need not conflict with terrestrial or marine conservation, or the rock lobster industry in the Abrolhos, provided that access and facilities are planned and controlled with these primary purposes in view. One way of ensuring that this aim is implemented would be to restrict tourist development to an environmental studies centre which could be used by visitors from clubs, schools and research establishments as well as commercially operated tours. This concept would fit in with the existing reservation of the Houtman Abrolhos as a wildlife sanctuary much better than facilities which were for purely recreational purposes. Conservational management is in everybody's interest, as the principal tourist assets of the Abrolhos are their terrestrial and marine life and historical associations. Also the principal commercial value - the rock lobster industry - likewise depends on the maintenance of the reef communities.

It is not possible to make firm recommendation on aquatic reserves in the Houtman Abrolhos area because of the lack of detailed scientific knowledge of the reefs. That the reefs should be considered as aquatic reserves is suggested by

a) the vulnerability of reef communities to human pressures,
b) the probable value of the reefs for scientific research and education, and
c) the vital role of the reefs as the base for the rock lobster industry.

Research should be carried out with a view to delineating aquatic reserves, as the need for such reserves will become urgent if recreational development is contemplated.

Recommendations

The Committee recommends that:

1. the Houtman Abrolhos remain a Class A reserve for Conservation of Flora and Fauna, Tourism and Fishing, vested in the Minister for Fisheries and Fauna;
2. any future tourism be carefully planned and strictly controlled, and that no developments be permitted that conflict with the primary purpose of the islands as a wildlife sanctuary and commercial rock lobster fishing grounds;
3. a research programme on the biology of the reefs be carried out by the Estuarine and Marine Advisory Committee with the view of delineating an aquatic reserve or reserves in the Abrolhos area;

Figure 5.1. A Lesser Noddy (Anous tenuirostris), perched on White Mangrove (Avicennia marina) at the breeding colony on Pelsart Island, Houtman Abrolhos.

Figure 5.2. Arrowsmith Lake with Flooded Gums (Eucalyptus rudis) and paper barks (Melaleuca sp.).

4. reserve A 20253 be extended to low water mark.

5.7 ARROWSMITH LAKE AREA

Arrowsmith Lake (Fig. 5.2) is a wide, shallow depression on the north side of the new highway to Geraldton, about halfway between Eneabba and Dongara. During winter and spring it contains fresh water, but this may dry up in summer. Flooded Gums (Eucalyptus rudis) dominate the lake but there is a sparse vegetation otherwise on the lake floor which differs maredly from that of the surrounding heaths.

A tall shrubland containing species of such genera as Acacia, Jacksonia and Hakea surrounds the lake. Within this belt on the south side of the lake is a population of Emblingia calceoliflora, a strange and rare plant with oddly shaped flowers. It has intrigued botanists for many years, for it appears to have no close relatives.

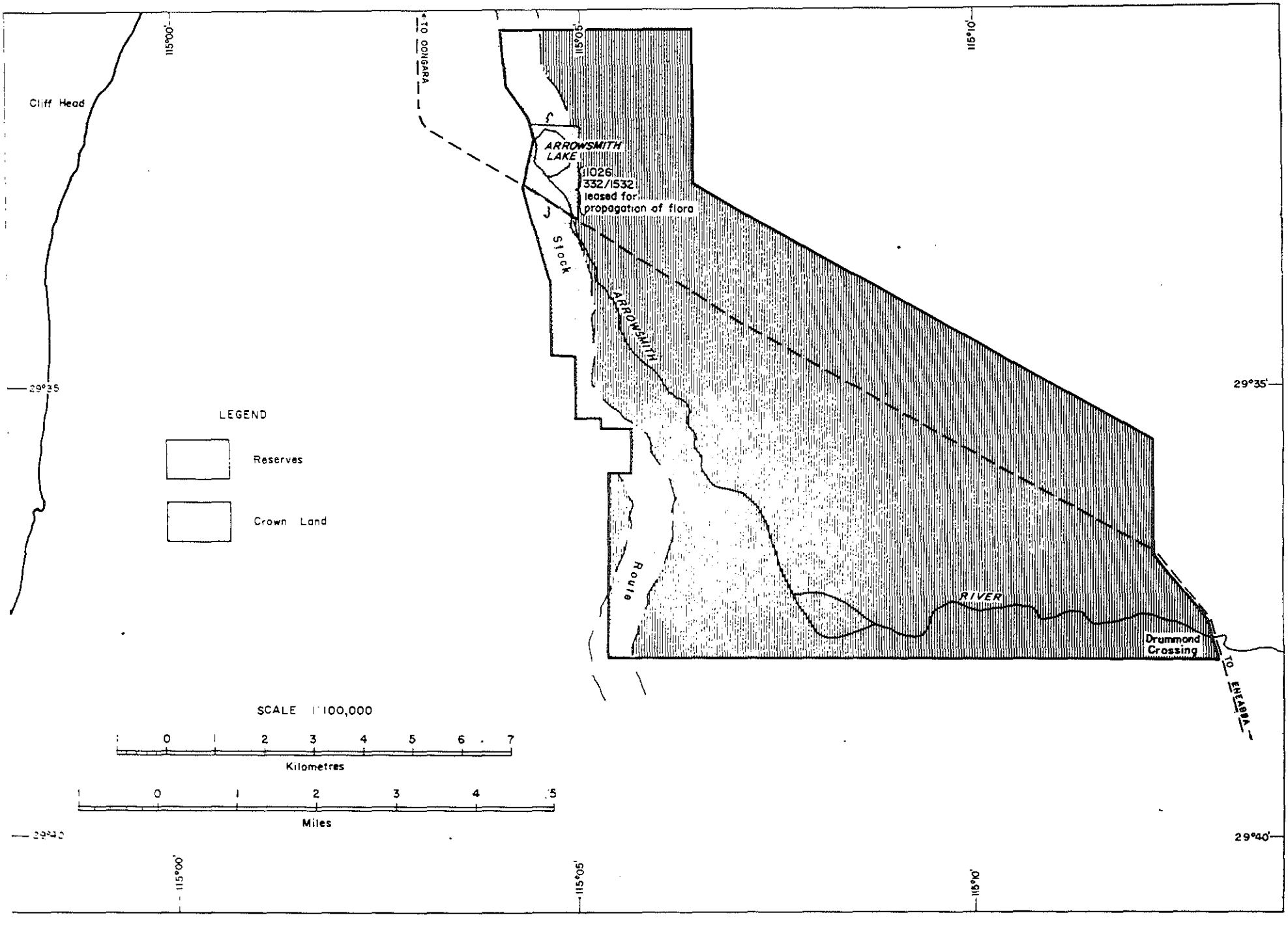
South and south-east of the lake are sandheaths dominated by Banksias. Banksia hookerana is common, and in spring displays its bright orange flowers. B. attenuata occurs here as a low-growing variant, and the uncommon B. elegans is also present. Species of featherflower (Verticordia), smokebush (Conospermum), bottlebrush (Calothamnus) and many others are colourful in spring. There are two as yet unnamed species of Lechenaultia.

Low-lying swamps to the north of the lake are dominated by paperbarks (Melaleuca spp.) and often have an open to dense lower storey of shrubs. In open areas there are many small ground herbs, some which are rare. These include undescribed species of Wilsonia and Lawrencia and undescribed small Compositae.

Forty four species of the birds, 8 of which are aquatic have been recorded on or adjacent to Arrowsmith Lake. These include Musk Duck (Biziura lobata) and Pink-eared Duck (Malacorhynchus membranaceus). Land birds include the White-breasted Robin (Eopsaltria georgiana), Black Honeyeater (Myzomela nigra), Little Wattle-bird (Anthochaera chrysoptera) and both the Variegated and Blue-breasted Wren (Malurus lamberti and M. pulcherrimus). The Spotted Scrub-Wren (Sericornis maculatus) in this area shows the transition from the southern yellow-bellied form to the northern white-bellied form.

The Arrowsmith River, an intermittent stream, flows into the Lake from the south and east. Like the lake itself it supports a suite of plants different from those of the surrounding plains.

This area is unlike the land to the west which is a higher limestone ridge supporting a different flora. It contains an excellent range of wildflowers, is an important sanctuary, especially for birds, and its reservation would make an important contribution to consorvation in the System.


Cliff Head
115°00'
115°05'
115°10'
TO GONGARA
ARROWSMITH LAKE
1026
332/1532
leased for propagation of flora
Stock
ARROWSMITH
RIVER
Roule
Drummond Crossing
TO ENEABBA
29°35'
29°40'
LEGEND
Reserves
Crown Land
SCALE 1:100,000
0 1 2 3 4 5 6 7
Kilometres
0 1 2 3 4 5
Miles

Recommendation

The Committee recommends that the area as shown in Fig. 5.3 be declared a Class A Reserve for the Conservation of Flora and Fauna, and vested in the WA Wild Life Authority.

5.8 LAKE INDOON RESERVE

Lake Indoon lies west-southwest of Eneabba in low sandplain country. It is semi-permanent, only slightly brackish and is an important habitat for waterfowl. It is unusual in that it has a white sandy beach with little vegetation along its shores. A few paperbarks (Melaleuca rhaphiophylla) grow at the water's edge. Above the beach is a fringe of fine Flooded Gum (Eucalyptus rudis), here showing intermediate characters transitional with those of the River Gum (E. camaldulensis). Banksia prionotes is common here, and an unusual feature is the giant zamia (Macrozamia riedlei) (Fig. 5.5) which is also frequent near the lake. The alga Lamprothamnium papulosum occurs in the lake.

The lake at present is within C Class Reserve number 29072 for Recreation, vested in the Shire of Carnamah. It has obvious recreational potential but should also be managed to safeguard the flora and fauna.

Recommendation

The Committee recommends that the Lake Indoon reserve be designated A Class for Recreation and the Conservation of Flora and Fauna and vested jointly in the Shire of Carnamah and the West Australian Wild Life Authority.

5.9 RESERVE 29073

Reserve 29073 is an unvested C Class reserve for the Conservation of Flora and Fauna, with an area of 3307 ha. It lies towards the western side of a wide shallow valley which is flanked on the west by a coastal limestone ridge and on the east by a high ridge of Mesozoic sandstone and shale. The soil is mostly deep sand and, although deficient in nutrients, supports a rich heath. The Proteaceae are prominent, being represented especially by many species of Banksia which flower at different times of the year. There are extensive populations of the rare B. elegans, a species which only occasionally sets seed and should be preserved for future study on pollination, seed production and propagation. Menzies Banksia (B. menziesii) occurs here as a low shrub, in contrast to its tree habit further south. Banksia hookerana, B. attenuata, B. prionotes and B. pinifolia are also common in the reserve.

Other members of the Proteaceae include Grevillea, Hakea, Dryandra, Petrophile and Xylomelum. The flowers of the last mentioned provide an important food source for jewel beetles (Buprestidae) in mid-summer.

The myrtle, legume and wattle families are also prominent in the flora of the reserve.

Recommendation

The Committee recommends that reserve 29073 be designated a Class A reserve for the Conservation of Flora and Fauna and vested in the WA Wild Life Authority.

5.10 RESERVE 29806

Reserve 29806 is a C Class reserve of 2,891 hectares on the Eneabba-Three Springs Road. It is set aside for the purpose of Conservation of Flora and is not vested.

The reserve lies in rolling lateritic sandplain country underlain by Jurassic sandstones and shales and has much similarity to the Tathra National Park described below.

It is close to the developing townsite of Eneabba, and if not managed properly is liable to degradation.

Recommendations

The Committee recommends that the purpose of reserve be changed to Conservation of Flora and Fauna and that it be vested in the WA Wild Life Authority.

5.11 SOUTH ENEABBA RESERVE

These reserves, Nos. 27886 and 31030, are adjacent C Class reserves for Conservation of Flora and Fauna, vested in the WA Wild Life Authority. Their total area is about 4946 ha.

The area is underlain by Palaeozoic and Mesozoic sedimentary rocks over which Cainozoic aeolian and alluvial sediments have been deposited. Lateritization and subsequent dissection of the younger sediments have resulted in a subdued topography of lateritic capped hills separated by valleys containing quartz sand.

Over much of the quartz-sand areas, heavy mineral sand deposits occur at shallow depths in a belt some 7 km wide extending south-south westerly from the existing mining operations near Eneabba. These deposits are now known to be more extensive than Lissiman and Oxenford (1973) indicated.

In the south western part of the reserve are possibly economic deposits of a sub-bituminous coal which occur beneath 10 to 100 m of overburden. This coal correlates with the early Middle Jurassic Cattamarra Coal Measures which elsewhere are too thin or deeply buried to be of economic interest (Lowry, 1972). The deposit has potential for on-site power generation.

The vegetation is a low heath - shrubland dominated by Coastal Blackbutt (Eucalyptus todtiana), Sandplain Pear (Xylomelum angustifolium) and species of Banksia.

The reserves lie in the mineral-sand mining belt that extends southward from Eneabba and has been extensively pegged by mining companies. Mining is already in progress, but will probably not affect the whole area of the reserves. The WA Wild Life Authority has decided to retain them in order to gain experience in rehabilitation techniques following mining. The Committee regards this work as having considerable importance.

Recommendations

The Committee recommends that the status of the reserves 27886 and 31030 remain unchanged. It further recommends:

1. that mining within the reserves be carried out under conditions laid down by the Environmental Protection Authority;
2. that the WA Wild Life Authority be given financial assistance to provide for monitoring and management studies in the reserves.

5.12 TATHRA NATIONAL PARK

Tathra National Park comprises two Class A Reserves (Nos A 29802, A 29805) totalling 4,355 ha for national park, controlled by the National Parks Board.

The park is set in rolling sandplain country on the Winchester-Eneabba road and is surrounded by farmland. The vegetation consists of low heath and provides a representative section of the flora in the area. The shallow valleys have sandy floors, changing to laterite on the slopes and hilltops and the heath varies in composition accordingly.

The park contains both typical and unusual plants. An undescribed Daviesia, notable for its large red flowers, is known only from the reserve, which also contains a rare undescribed species of Dryandra. Another Dryandra, D. speciosa is common on some lateritic rises. Public interest and usage is limited to observation of wildflowers in the winter and spring. Thus the reserve conforms more to the concept of a floral sanctuary than a national park.

It appears that it may be more appropriate for the purpose of this reserve to be changed from National Park to Conservation of Flora and Fauna. Under these circumstances the land could be vested in the WA Wild Life Authority rather than the National Parks Board as is the case at present.

Recommendation

The Committee recommends that the National Parks Board be asked to reconsider the purpose and vesting of reserves A 29802 and A 29805.

5.13 ALEXANDER MORRISON NATIONAL PARK

Alexander Morrison National Park comprises three A Class reserves (A 29800, A 29803, A 29804), totalling about 8405 hectares for National Park under the control of the National Parks Board. The park lies along the Green Head-Coorow road, adjacent to a large tract of vacant Crown land.

The park contains sandplain and low lateritic breakaways over sandstones and shales of the Lower Jurassic Cockleshell Gully Formation. Sand heaths are the dominant vegetation, but there are areas of low woodland amd mallee, especially along the breakaways in the western part of the park. Powder-bark Wandoo (Eucalyptus accedens) and Mallalie (E. eudesmoides) are prominent eucalypts.

The heaths are rich in species typical of the region and also include such rare species as Spirogardnera rubescens. The northern variant of Dryandra vestita is common.

On the south side of the Green Head - Coorow road is a large area of vacant Crown land. The addition of a broad strip of this would add to the park's value as a scenic area where travellers along the road can see wildflowers. With extensive clearing for agriculture, such reserves are becoming more important in preserving the wildflower spectacle.

Recommendation

The Committee endorses the status, purpose and control of Reserve A 29800, A 29803 and A 29804 and recommends that a strip of vacant Crown land 1 km wide along the south side of the Green Head - Coorow road where it adjoins the reserves be added to them.

5.14 WATHEROO NATIONAL PARK

Watheroo National Park consists of three reserves, Nos. A 24229, A 24450 and A 24491. All are A Class for the purpose of National Park, under the control of the National Parks Board of WA. Their total area is about 32,863 ha.

The reserves are generally within an area covered by quartz sand lying in a basin of internal drainage between the Dandaragan Plateau to the west and the Darling plateau to the east. There are a few small outcrops of Upper Cretaceous glauconitic sandstone which occasionally forms low hills capped with laterite.

There is no obvious economic mineral potential in the area of the reserves although some of the quartz sand may be pure enough for glass manufacture.

The reserve contains an excellent example of midland sandheath as well as a curious outlier of plants typically found much further east. The vegetation is mainly heath, but there are areas of woodland and tall scrub. The heaths contain a rich variety of plants including such rare species as Dryandra conferta, Hemiandra rubriflora, Hemiandra rutilans, Eriostemon pinoides and an undescribed genus of Myrtaceae. Two species are here isolated from their main populations: these are Hakea baxteri which is otherwise south-coastal and Conospermum eatoniae which has its maximum development in the central wheatbelt.

The woodlands are dominated by Powder-bark Wandoo (Eucalyptus accedens) or by York Gum (E. loxophleba), and the tall shrublands by Banksia prionotes and the Sandplain Cypress (Actinostrobus arenarius).

On the eastern side of the park is a rocky hill where species of Dodonaea and other genera more typical of the Goldfields and wheatbelt are found. The most unusual occurrence, however, is a population of the spinifex Triodia scariosa which typically occurs on the dry eastern Goldfields.

The Committee endorses the status, purpose and control of the Watheroo National Park.

5.15 BEEKEEPERS RESERVE

The name "Beekeepers Reserve" is applied to the inland part of existing Class C reserve No. 24496 between Green Head and Cliff Head (Fig. 5.4). It includes also parts of the adjoining Stock Route Reserve, No. 19219.

Reserve 24496 for Protection of Flora was declared in 1956 on the recommendation of the late C.A. Gardner, then Government Botanist, and the Farmers' Union of WA, as an area to be preserved in its natural state especially for the use of beekeepers. It is C Class and is not vested. It includes extensive tracts both of coastal plain and of the limestone ridge to the east of the plain. The ridge is extremely rugged and has abundant karst features. Access is difficult, but beekeepers have registered many apiary sites both on it and on the coastal plain.

The vegetation is mainly low or tall heath, and contains a wide range of plants typical of the lower central west coast. Parrot Bush (Dryandra sessilis), Silky Clawflower (Calothamnus sanguineus), Chenille Honeymyrtle (Melaleuca huegelii) and heaths (Leucopogon species) are typical plants. The flora is excellent for honey production. Especially in winter the combination of pollen and nectar-producing plants with the mild climate makes this one of the best areas in Australia for bee-keeping.

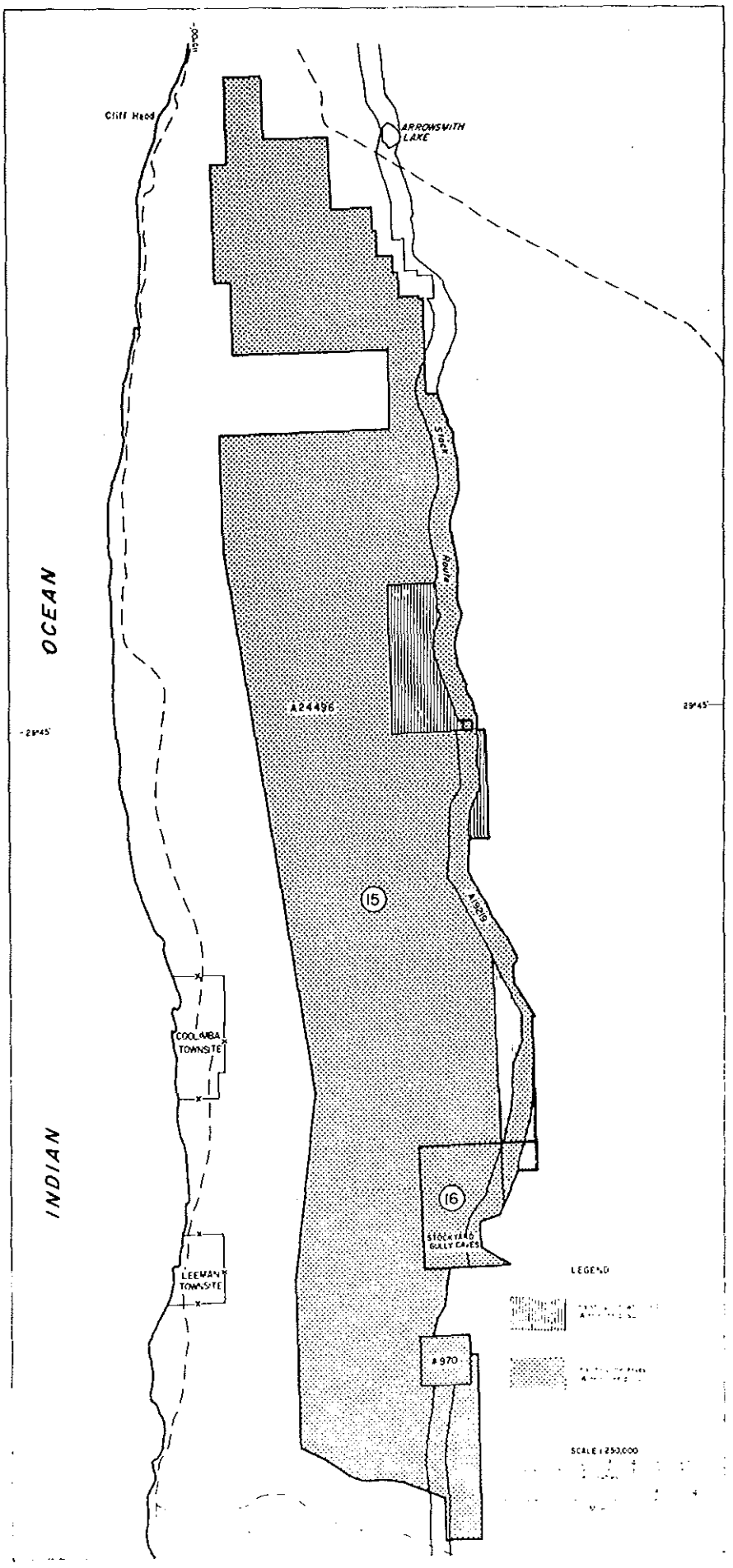


Figure 5.4 Land tenure map of proposed Beekeepers reserve and Stockyard Gully reserve

Most of this area should be consolidated into a reserve for beekeeping. Certain parts have been selected in this report for reservation as flora and fauna reserves or national parks (Areas 5.16, 5.17).

Recommendation

The Committee recommends that the purpose of those parts of Reserve No. 24496 (Protection of Flora) and Reserve No. 19219 (Stock Route) as shown in Figure 5.4 be changed to "Apiculture and Conservation of Flora" and that it be vested in the Minister for Agriculture. The reserve should be of Class C.

5.16 STOCKYARD GULLY

Stockyard Gully is a small stream that drains low sandplain country about 15 km southwest of Eneabba. The stream, which is intermittent, flows westward to the north-trending belt of Coastal Limestone and disappears into a series of subterranean caverns. Numerous caves occur in this area and some of them have collapsed to form a rocky gully bordered by steep aeolianite cliffs. The gully lies in the Stock Route Reserve (No. 19219) and was an overnight stopping place when the route was in use. The caves now attract numerous visitors, mainly speleological groups, who camp in the lightly timbered land surrounding the gully.

The gully lies mainly in rought karst country with limestone outcrop lightly clothed in a low heath. However the area immediately adjacent to the gully has loamy sandy soils and supports an interesting flora including Flooded Gums (Eucalyptus rudis), giant Macrozamia (Fig. 5.5) and Geraldton Wax (Chamelaucium uncinatum). There is a curious undescribed species of the family Gyrostemonaceae endemic to this area. It apparently represents a new genus.

Recommendations

The Committee recommends:

1. that part of Stock Route Reserve No. 19219 and part of C Class Reserve No. 24496 be cancelled and incorporated in a new reserve with boundaries as shown in Figure 5.4;
2. that the reserve be Class A for the Conservation of Flora and the Protection of Caves, and placed under the control of the National Parks Board of WA.

5.17 MT. LESUEUR RESERVES

A number of reserves termed "Mt. Lesueur Reserves" lie in the Mt. Lesueur - Cockleshell Gully - Green Head area (Fig. 5.7). All except one are C Class reserves and are not vested; these are:

Figure 5.5. Giant Zamia (Macrozamia riedlei) at Stockyard Gully.

Figure 5.6. Lesueur Hakea (Hakea megalosperma), endemic to the Mt. Lesueur area.

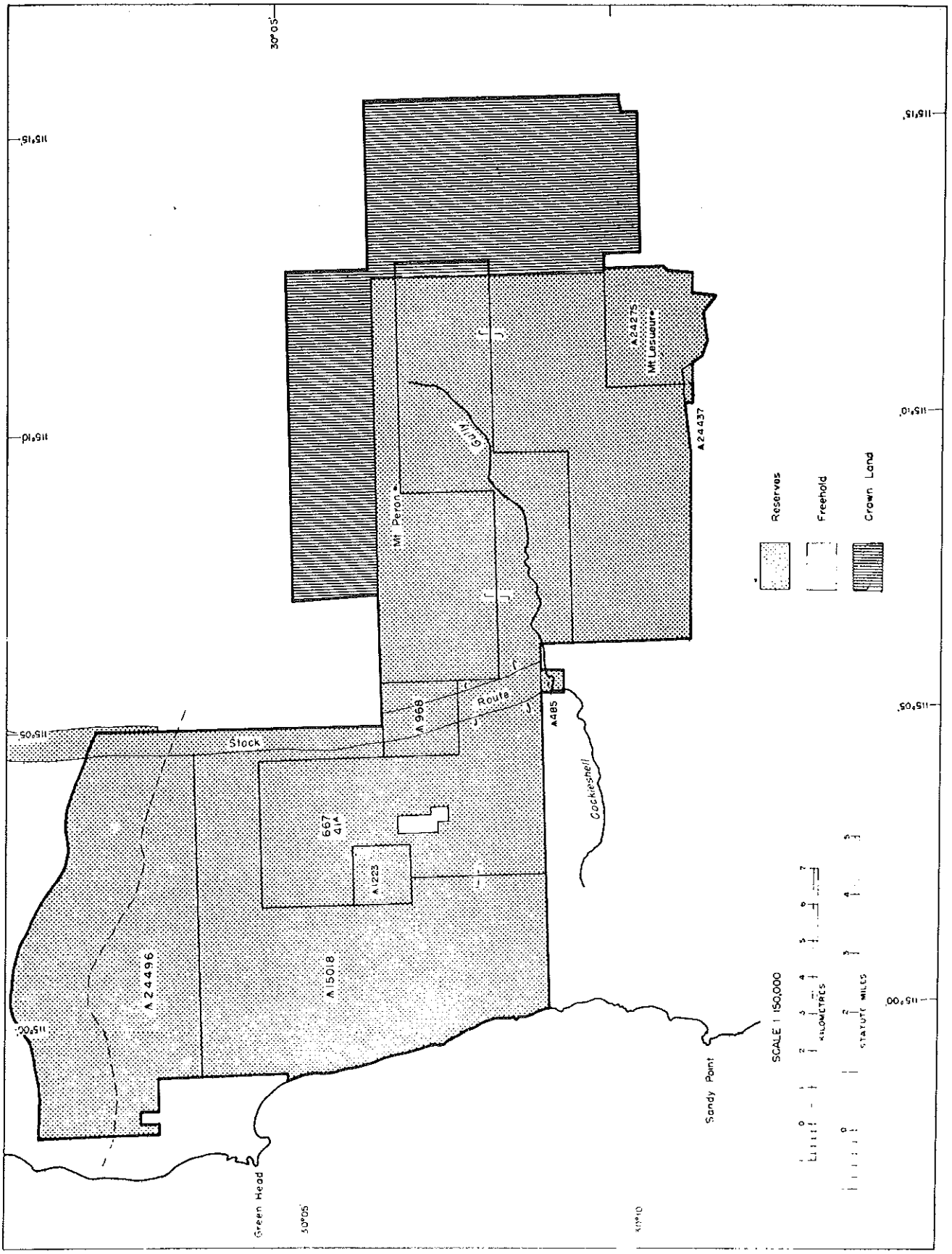


Figure 5.7 Mt. Lesueur area map

No. 485, for Public Purposes;
No. 1223, for Water and Stopping Place;
No. 15018, for Horse Breeding;
part of No. 19219, for Stock Route;
No. 24275, for Educational Purposes;
No. 24437, for Water and Camping;
part of No. 24496, for Protection of Flora.

There is also reserve No. 968, C Class for Travellers, vested in the Dandaragan Shire.

The reserves encompass coastal dunes and sandplains and extend inland to highly faulted areas underlain by Triassic and Jurassic rocks.

Mt. Lesueur itself is a lateritised tabletop hill reaching 311 m, while to the north west is Mt. Peron, a slightly lower peak. The slopes of the hills are gentle but the peaks and surrounding hills are bordered by steep breakaway edges separated by wide valleys. Cockleshell Gully, an intermittent stream, rises in the area and passes through the hills.

Mt. Lesueur is covered with a low heath containing many species, some typical of the region, others rare or restricted to this locality. The important botanical collector James Drummond visited this area in the 1840's and 50's and many plants from his collections were described as new species.

Among the rare species found on or close to Mt. Lesueur are Banksia tricuspis, Hakea megalosperma (Fig. 5.6) H. neurophylla, Daviesia epiphylla, Urocarpus phebalioides, Xanthosia tomentosa, Leucopogon crassiflorus, L. plumuliflorus, Isopogon tridentatus, and Darwinia helichrysoides.

Towards the coast the vegetation changes as the soil becomes more sandy. Some areas carry a low woodland of Banksia species and Eucalyptus todtiana. The Black Gin, Kingia australis, is found here as an isolated outlying population, its main occurence being from Perth to Albany. An undescribed genus of Restionaceae, a new species of Darwinia and other rare plants are confined to the area. North of Jurien Bay, low limestone hills near the coast are the only habitat of a recently-discovered Grevillea, G. olivacea. This area is also the southern limit of Illyarrie (Eucalyptus erythrocorys), a eucalypt with spectacular flowers.

Gully floors in the area contain narrow belts of woodland in which outliers occur of species generally more southern in distribution, e.g. Marri (Eucalyptus calophylla), Robin Redbreast Bush (Melaleuca lateritia) and Bossiaea eriocarpa.

A biological survey of the Mt. Lesueur area commissioned by the Department of Fisheries and Fauna and carried out by the WA Museum in 1973 revealed an interesting fauna (D.J. Kitchener, pers. comm.). Ten species of native mammals include the Common Dunnart (Sminthopsis murina), Fat-tailed Dunnart (S. crassicaudata), White-tailed Dunnart (S. granulipes), Honey Possum (Tarsipes spencerae), Southern Bush-Rat (Rattus fascipes) and Ashy-grey Mouse (Pseudomys albocinereus). The species of birds

observed numbered 78, three of which - the Western Thornbill (Acanthiza inornata), Scarlet Robin (Petroica multicolor) and Spinebill (Acanthorhynchus superciliosus) - are at their northern known limit. The Long-billed Corella (Kakatoe tenuirostris), which is a rare species, occurs in the area. Twenty-five species of reptiles have been collected.

The importance of the Mt. Lesueur reserves for conservation of flora and fauna was stressed in the National Parks Report (1962). They have added significance in view of probable development and population growth in the coastal zone.

In 1962 the National Parks Report made general recommendations that there be some consolidation of the Mt. Lesueur Reserves, that they be gazetted Class A and vested in an appropriate Authority. Further study by an expert committee leading to designation of areas for protection of flora and fauna and for public recreation also was recommended, but no action was taken.

Thus in 1974 there is an urgent need for consolidation of the Mt. Lesueur Reserves under the control of a single vesting authority and the implementation of a management programme.

In addition to the reserves listed there is an area of vacant Crown land to the east and north of Mt. Lesueur which should be incorporated within the proposed reserve. It includes the lower slopes of Mt. Lesueur and Mt. Peron, and is important for increasing the protection of the flora.

The area includes a temporary grazing lease, No. 667/14A, which is renewed annually. A small area of freehold land exists within the proposed reserve.

Recommendations

The Committee recommends

1. that the reserves and areas described above and shown in Fig. 5.7 be consolidated and declared an A Class reserve for the Conservation of Flora and Fauna vested in the WA Wild Life Authority;
2. that where it borders the coastline the reserve be extended to low water mark;
3. that grazing lease No. 667/14A be cancelled and Victoria Locations 1433 and 1730 be purchased and added to the reserve.

5.18 DROVERS CAVE NATIONAL PARK

This is reserve No. 31302, C Class for National Park, under the control of the National Parks Board of WA. Its area is about 2680 ha.

Important caves occur in the park. Drovers Cave has potential for development as a tourist site, due largely to spectacular stalactite formations. Hastings Cave and Moorba Cave are both significant palaeontological sites. Hastings Cave has a sandy floor rich in bone deposits up to 12,000 years old. About 40 species of mammals have been recorded here sofar. Moorba Cave

contains phosphatic deposits of palaeontological significance. There are also two very large caves east of Drovers Cave - Old River and Mystery Caves.

The Committee endorses the purpose and vesting of the Drovers Cave National Park.

Recommendation

The Committee recommends that the status of reserve No. 31302 be changed from C Class to A Class.

5.19 HILL RIVER RESERVE

The Hill River reserve of 405 ha is a C Class reserve No. 855 for the purposes of Camping and Conservation of Flora vested in the Shire of Dandaragan. The reserve is located where the Jurien-Cervantes road crosses the Hill River in a region that has been largely cleared for farming. The southern boundary passes through a small permanent lake. The reserve is used as an overnight camping stop by motorists and has value for conservation of flora and fauna.

The vegetation is mostly a woodland dominated by Marri (Eucalyptus calophylla). It is typical of the Hill River itself, most of which now lies within freehold land used for agriculture. Away from the river the sandy soil supports a lower woodland dominated by Banksia species and Coastal Blackbutt (Eucalyptus todtiana). The lower storey contains many shrubby species, including Beaufortia squarrosa and Calytrix fraseri; Yellow Kangaroo Paws (Anigozanthos pulcherrimus) and Winter Bell (Blancoa canescens) are frequent.

A tall sedge formation occurs around the lake margins.

Little of the Hill River is within conservation reserves. Although of intermittent flow, it is the largest river between the Moore and Irwin Rivers and along its bed there is a flora very different from that of the surrounding heaths.

Recommendations

The Committee recommends:

1. that the status of reserve No. 855 be changed from C Class to A Class;
2. that its purposes be changed to Parklands and Recreation;
3. that it be placed under the control of the National Parks Board of WA.

5.20 COOMALLO RESERVES

A series of reserves that lie along the Jurien Bay road from its junction with the arterial Gingin-Eneabba-Dongara road are here termed the Coomallo reserves. The area consists of Triassic and Jurassic sandstones and shales that have been dissected by Coomallo Creek and its tributaries to form a series of escarpments and hills. The escarpment and hill country contains reserves 24276 (C Class for educational purposes, not vested) 24113 (C Class, timber for settlers, not vested) and 28559 (C Class for government requirements and camping, not vested). There also is a large tract of vacant Crown land adjacent to the reserves (Fig. 5.8).

The flat-topped hills and gullied escarpments (Fig. 5.9) are an attractive contrast to the monotony of gently rolling farmlands along roads to the west and south. The hills and plains carry a rich flora, and this is an area frequently visited by wildflower tourists, especially in spring. The road from Coomallo to Jurien has been designed and constructed by the Main Roads Department to take advantage of the scenery.

The area should be consolidated into one reserve for the conservation of flora and fauna, so that these as well as the scenic beauty, may be preserved by being properly managed by a single authority.

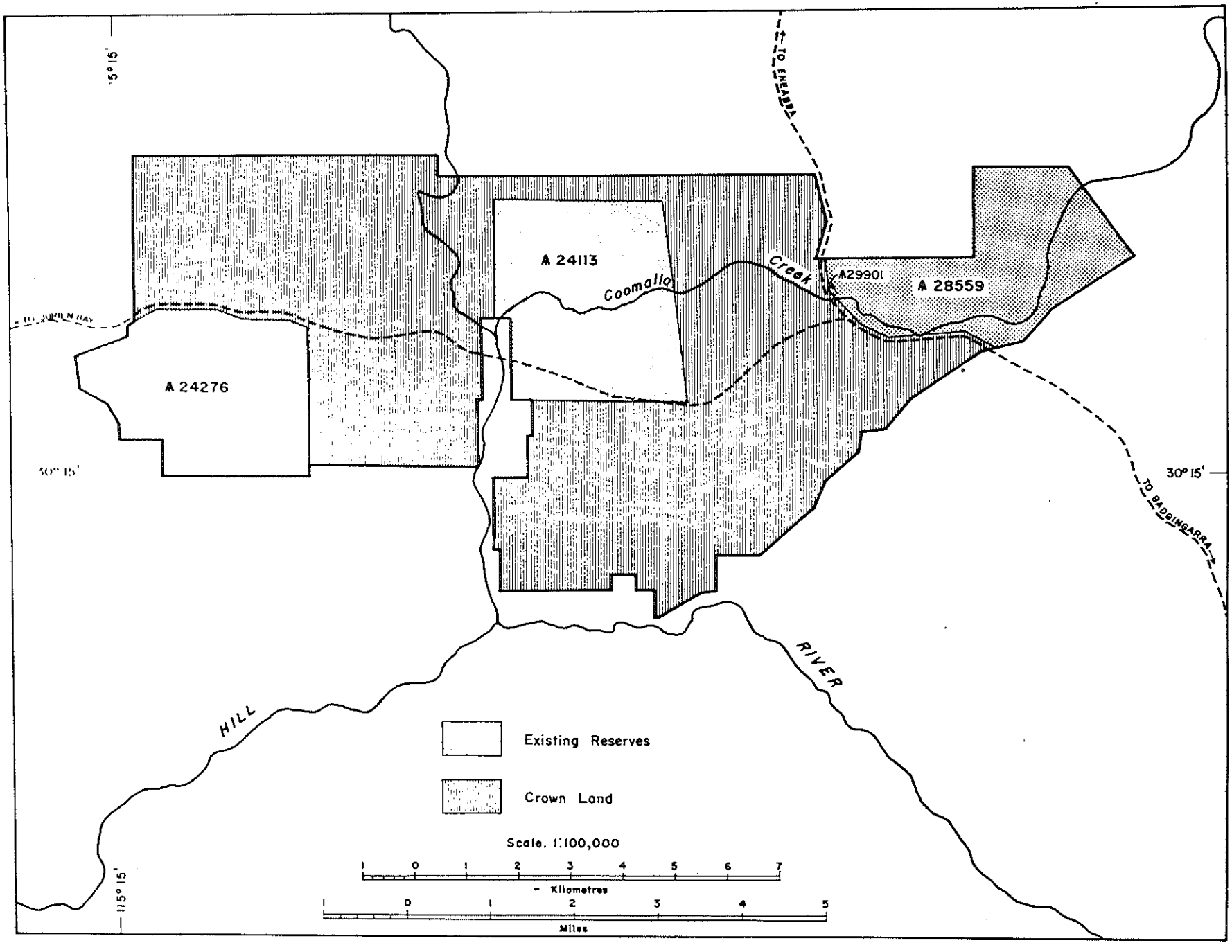
Recommendations

The Committee recommends that reserves 24276, 24113 and 28559 and vacant Crown land as shown in Fig 5.8 be designated an A Class reserve for the Conservation of Flora and Fauna and vested in the Western Australian Wild Life Authority.

5.21 NAMBUNG NATIONAL PARK

Nambung National Park comprises three reserves, all vested in the National Parks Board of WA. They are Class A Reserve No. 24522 for Preservation of Caves and National Park, Class C Reserve No. 28393 for Preservation of Natural Formations (Pinnacles) and Class C Reserve No. 29149 for National Park. They total about 17,332 ha. It consists largely of rolling dunes extending some distance inland from the coast. The vegetation is a low heath especially rich in myrtles, wattles and legumes which provide much colour in winter and spring.

The spectacular limestone pinnacles (Fig. 5.10) developed in the Tombstone Rocks area have been formed by groundwater movement of lime within unconsolidated sands. Plant root systems appear to have become preferred channels for downward percolations of rainwater, and lime leached from the calcareous sands, was redeposited as calcite along and around them. Later erosion of unconsolidated overlying sand by wind exposed the resistant columns so formed, and the abrasive action of windblown sand is constantly modifying their shape.


TO ENEABBA
A 24113
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A 28559
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TO BADGINGARRA
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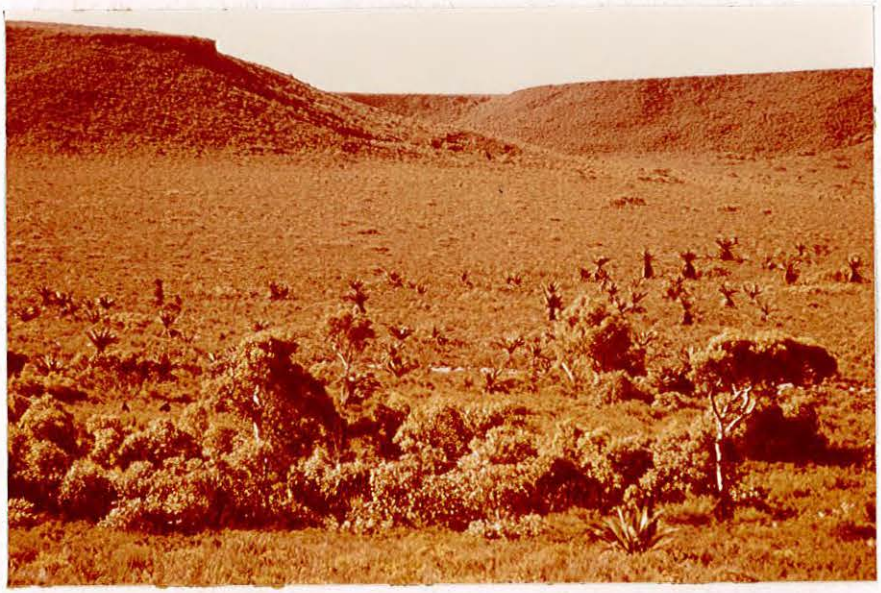

Figure 5.9. Coomallo area. Reserve 28559 with a vegetation of Powder-bark Wandoo (Eucalyptus accedens), Zamia Palms (Macrozamia riedlei) and heath.

Figure 5.10. The Pinnacles, Nambung National Park.

Within the boundaries of the Park are two pieces of freehold land and an area set aside for "protected road". Melbourne Location 2489 of about 154 ha contains permanent springs and several species of waterfowl frequent and breed in the region. Melbourne Location 2490 of about 654 ha includes the valley of the Nambung River. Mobile dunes are moving northerly from the White Desert into this Location and have blocked the Nambung River, which now flows underground through a cave system. The entrance to the cave is within Location 2490. Clearing of the vegetation in this area could lead to extensive erosion and further dune mobility. Apart from these reasons the existance of private land within a National Park could lead to management complications. Roads within a National Park should be constructed as part of the park management plan to blend both with the landscape and the aims of the Park Authority.

Recommendations

The Committee recommends that:

1. Reserves A 24522, 28393 and 29149 be consolidated into one Class A Reserve for National Park under the control of the National Parks Board of WA;
2. Mebourne Locations 2489 and 2490 be purchased and added to the National Park;
3. the protected road within the Park be closed and its area added to the Park;
4. the park be extended to the low water mark.

5.22 BADGINGARRA NATIONAL PARK

This park is an A Class reserve No. 31809, of about 8640 ha for National Park, under the control of the National Parks Board of WA. It consists of undulating lateritic hills and sandy valleys in one of the best wildflower areas in the State. The flora includes excellent populations of Black Kangaroo Paw (Macropidia fuliginosa), and their protection is an important purpose of the reserve.

However there are tracts of vacant Crown land as well as two reserves to the south of the park which should be added to it. This action would increase the representation of local flora (including rare species) and would provide an excellent opportunity for viewing extensive wildflower country. The proposed additions are shown in Fig. 5.11.

The banksia family, Proteaceae, is especially well represented here by many species of Banksia, Dryandra, Hakea, Grevillea, and other genera. One Banksia species is at present unnamed. Two species of unusual interest are Hakea flabellifolia and Strangea cynanchicarpa; the latter is one of two southwestern species of Strangea whose nearest relatives occur in north-eastern Queensland and New South Wales.

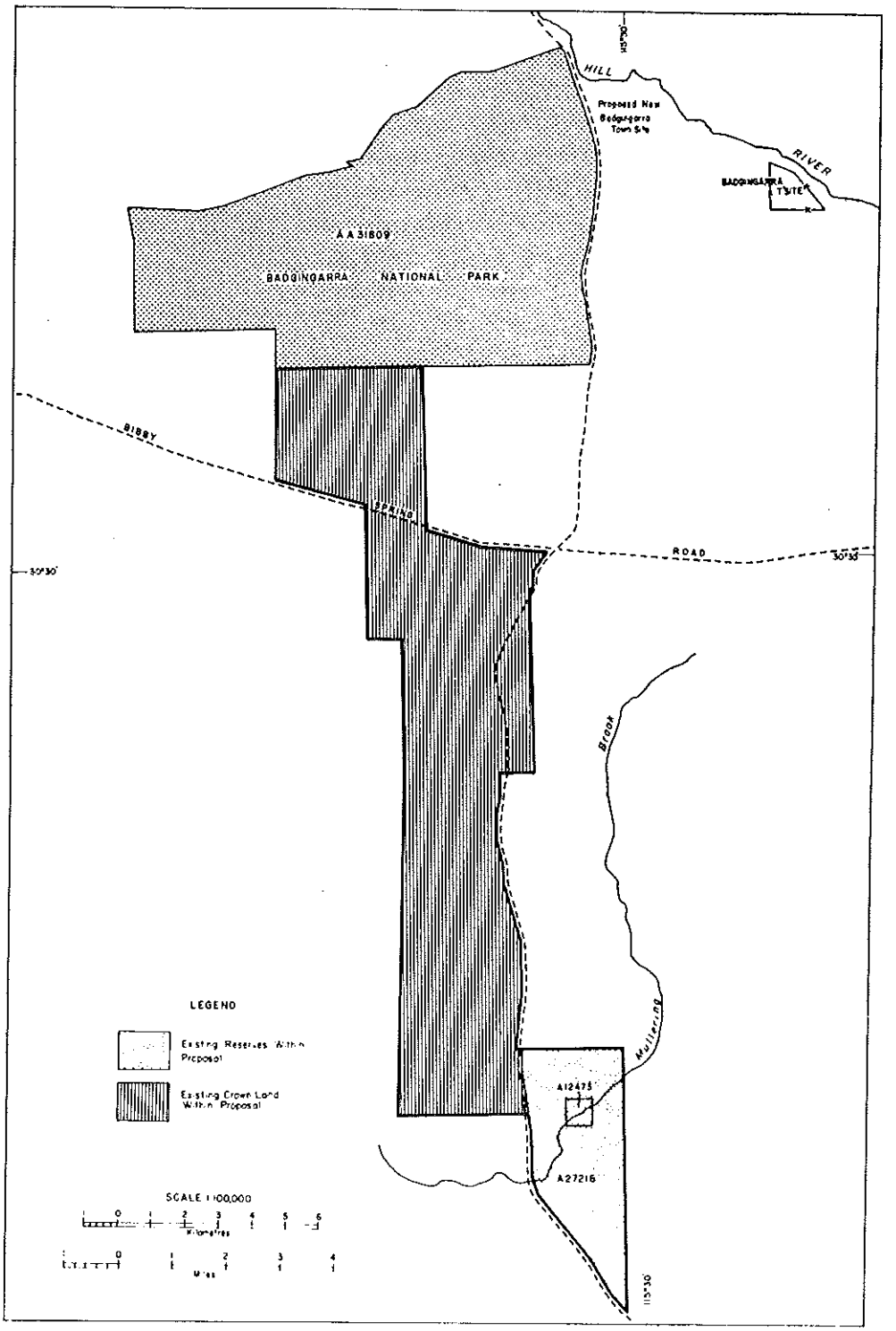

Figure 5·11 Badgingarra National Park and proposed additions

The flora includes the main population of a rare mallee, Eucalyptus pendens. This is a slender, graceful species very different from other eucalypts in the region and it is important that a natural seed source be preserved.

At the southern end of this area, on the east side of the highway, is reserve No. 27216 for Recreation, Camping and Conservation of Flora. Within it is a smaller reserve, No. 12473, for Water and Camping. Mullering Brook passes through both reserves. It is a shallow valley with a swampy floor rather than a distinct streamline, and contains swamp-loving species which do not occur on the surrounding higher ground. Among these is an isolated outlier of an as yet unnamed Banksia species, the northernmost record of the species.

The new highway from Perth through Eneabba to Geraldton passes through the area. The proposed additions to the Badgingarra National Park will provide almost 80 km of readily accessible and spectacular wildflower country along and near the highway. There may also be a need here for recreational facilities for travellers.

Recommendations

The Committee recommends:

1. that the vacant Crown land as shown in Fig. 5.11 be added to Badgingarra National Park (reserve No. A 31809);
2. that reserves 27216 and 12472 be cancelled and their areas added to reserve A 31809.

5.23 RESERVES 31675 AND 31781

These two reserves are C Class for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority. They consist chiefly of coastal heath on rolling sand dunes which in places are mobile. The vegetation is typical of the lower west coast of the State. It contains many species of the families Myrtaceae and Papilionaceae, but the Proteaceae are far less prominent than on heaths farther inland. Blackboys (Xanthorrhoea preissii) are common especially in the swales and often provide a picturesque landscape. Apart from these large areas, coastal heath now occurs only in a few small areas southwards in and near the Perth Metropolitan Region where it is threatened by developmental pressures. It is an important "typical" element of the landscapes of the South-West.

Recommendation

The Committee endorses the status, purpose and vesting of reserves 31675 and 31781 but recommends that they be extended to low water mark.

5.24 THE WEST COAST

Much of the west coast between the Moore River and Kalbarri is included in various reserves or is vacant Crown land.

As discussed in System 2 (Area 2.14) the coastline of the State, and of the south-west in particular, is the centre of population, both for urban development and for recreation. Those parts of the west coast still controlled by the Crown are an important public resource. The area is increasingly being used by people from Perth and the northern agricultural areas for recreation.

As is the case with south coast Crown land, some west coastal areas are deteriorating. Increasing mobility of dunes, the multiplication of tracks and too frequent fires are all causing concern. The land needs to be controlled and managed to prevent further deterioration, to rehabilitate the environment where necessary and to provide public access and facilities in suitable places.

Because of the large area of land involved and the complex nature of the problem the Committee does not believe that existing local or State Government bodies, on their own, can undertake the management of this important area. It therefore proposes that a special authority, combining expertise from both State and Local Government be set up.

The Committee believes that initially a working group should be appointed by the EPA to define the problem, the land to be controlled, how the authority should be financed and what bodies should be represented on it. As in the case of the south coast the Committee believes that this working group will not be able to complete its work quickly unless provision is made for a full time co-ordinator or secretary, preferably a person with training in town planning or a natural science.

Recommendations

The Committee recommends:

1. that a working group be set up by the EPA comprising representatives of, Local Authorities, State Government Departments, and the public;

2. that the terms of reference be to make recommendations on the future control and management of Crown lands on the west coast between the Moore River and Kalbarri, excepting

   a) Kalbarri National Park (Area 5.1)
   b) the proposed Mt. Lesueur Wildlife Sanctuary (Area 5.17)
   c) the Numbung National Park (Area 5.21)
   d) Reserves 31675 and 31781 (Area 5.23)
   e) Islands between Lancelin and Dongara (Area 5.26)

   and to report on the financial implications of creating a special authority to manage these Crown lands.

The land to be included in the study is as follows (from north to south):

12686 "C" class, near Hutt Lagoon, Camping.
12092 "C" class, near Pakington, salt deposit
15126 "C" class, north of Pakington, Camping
29151 "A" class, Horrocks, Camping and public recreation
32009 "C" class, Horrocks Beach, Recreation
24738 "C" class, Drummond Cove, Beach Camp resort
8613 "C" class, Coronation Beach, Park
7298 "C" class, South of Greenough River, Camping
28653 "C" class, near Greenough River, Recreation (Beach Cottages)
20995 "C" class, Bootenall, Recreation
7276 "A" class, near Cape Burney, Park land
24496 "C" class, strip of land centered near Jurien Bay, Protection of Flora.
12267 "C" class, near White Point, Camping
25581 "C" class, Public Utility, Bonniefield
23600 "C" class, Bonniefield, Flora
24829 "C" class, Dongarra, Water supply
17696 "C" class, Dennison, Lime Sands
23373 "C" class, South of Dennison, Lime Sands
137 "C" class, south of Dennison, Common
24496 "C" class, near Knobby Head, Protection of Flora (Only those parts not included in recommendations under Areas 5.15, and 5.17)
22521 "C" class, Greenhead, Camping and Water
22522 "C" class, Greenhead, Camping and Water
19759 "C" class, Sandy Point, Camping
18865 surrounds Jurien Townsite, Government requirements
25471 "C" class, Jurien Townsite, rubbish
29453 "C" class, Jurien, Water supply
29941 "C" class Jurien, abattiors and holding paddocks
19206 "C" class Jurien Bay, Public Utility
21760 "C" class Lancelin Townsite, Recreation Camping and Caravan Park.
28303 "C" class south of Lancelin Townsite, Government requirements, Protected for development of sand dunes for forestry
24408 "C" class south of Ledge Point Townsite, Public Utility
27215 "C" class East of Ledge Point, Recreation Picnic ground.

5.25 WETLANDS

Three wetland complexes are recognised within System 5 (See Fig. 0.1).

Wetland Complex 4 - Morawa

The Morawa Complex is of high value to waterfowl populations as it not only supports large populations but it is also the main area from which populations disperse into the north following cyclonic rains (see also Wetland Complex 10, Area 4.7). This is especially so in the case of Grey Teal (Anas gibberifrons) and Pink-eared Duck (Malacorhynchus membranaceous).

The principal wetlands are:

Already within Conservation Reserves	Not within Conservation Reserve
Lake Eganu	Lake Pinjarrega
	Yarra Yarra Lakes
	Three-Springs-Morawa Salt Flats
	Lake Nullewa

The Committee understands that the Department of Lands and Surveys has already decided to reserve Lake Pinjarrega and surrounds as a wildlife sanctuary. The Committee endorses this action and recommends that the Yarra Yarra Lakes also be reserved.

The Yarra Yarra Lakes are west of Three Springs and are a series of large salt pans. When containing water they provide a habitat for many species of salt-tolerant waterbirds, including Black Swan, (Cygnus atratus), various ducks, Banded Stilt (Cladorhynchus leucocephalus), White-headed Stilt (Himantopus himantopus) and many smaller wading birds. The lakes appear to be an important staging post for trans-equatorial migratory waders which inhabit the south-west coastal estuaries during the summer.

Yarra Yarra Lakes are at present vacant Crown land. A small reserve (No. 26442) for the Conservation of Flora has been declared at the Northern end of the main lake. Mineral claims for gypsum have been pegged in the main lake.

Wetland Complex 5 - Jurien Bay

The Jurien Bay Wetland Complex lies adjacent to the coast, northward from the Hill River. It serves the same function as the Morawa Complex.

The principal wetlands are:

Already within Conservation Reserves	Not within Conservation Reserves
None	Green Head Salt Lakes Snag Island Salt Lakes Lake Indoon Lake Logue Hill River Estuary

The Green Head Salt Lakes are recommended for reservation and are dealt with under Area 5.16. Recommendations are made on Lake Indoon under Area 5.7. Lake Logue is within pastoral lease 3114/874 and it is not available for reservation at present. Consideration should be given to reserving it when the lease expires.

Wetland Complex 7 - Wannamal

Although most of the wetlands in the Wannamal Complex are filled almost every year by the winter rains they have degenerated rapidly because of clearing and increased salinity.

The principal wetlands are:

Already within Conservation Reserves	Not within Conservation Reserves
Lake Wannamal	Moore River between Mogumber and Moora Moora Lakes.

The Moora Lakes are a group of wetlands to the NW of Moora and are on freehold property. They have been used as a research area by the Department of Fisheries and Fauna and more species of waterbirds have been recorded as continually inhabiting these lakes than any other in the South-West.

Recommendations

The Committee recommends:

1. that the status and purpose of Reserve No. 25210 at Lake Eganu be changed from C Class for Recreation and the Conservation of Flora and Fauna to A Class for Conservation of Flora and Fauna and that it remain vested in the WA Wild Life Authority;
2. that the area of vacant Crown land including Lake Pinjareega be declared a Class A reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority, the boundaries to be: Victoria Locations 10051, 10419, 7160, 7350, 10315 and all vacant Crown land between Road Nos. 13683 and 10433, east of Victoria Locations 10085, 10087 and 10090 and west of Victoria Locations 8578, 9895, 10500, 10502, 5866, 7308, and 10341 and including Lake Pinjareega.

3. that reserve No. 26442 (Conservation of Flora, not vested) and the Yarra Yarra Lakes (vacant Crown land) be declared a Class C reserve for the Conservation of Flora and Fauna, vested in the WA Wild Life Authority. Any extensions to mining in the reserve should be subject to conditions laid down by the Environmental Protection Authority;

4. that the Department of Fisheries and Fauna negotiate with the owners of the Moora Lakes with the view of having them declared a fauna sanctuary, either by purchase or by agreement as laid down in Section 13 of the Fauna Conservation Act.

5.26 ISLANDS BETWEEN DONGARA AND LANCELIN

Between Dongara and Lancelin and within 10 km of the shore lie some 35 small islands. They vary in size from a few square metres to about 25 ha. The fauna of these islands has been documented by Ford (1963).

The islands are important as breeding sites for seals and seabirds. They also contain an interesting variety of reptiles, and some mammals.

The Australian Sea Lion (Neophoca cinerea) breeds on a number of the islands, including the Beagle Islands, Fisherman Islands, North Essex Rock, Buller Island, Sandland Island and Cervantes Island. Ten species of seabirds are known to breed on the islands, including four species of Terns - the Caspian Tern (Hydroprogne caspia), Roseate Tern (Sterna dougallii), Crested Tern (Sterna bergii) and Bridled Tern (Sterna anaethetus). Sandland Island has the greatest variety of breeding seabirds in this group of islands - eight species on an island of only 1.5 ha.

Three species of gecko and 10 species of skink occur on various islands, the number of species apparently being related to the habitat diversity and size of the island. Boullanger and Lancelin Islands each have six species, the greatest number recorded.

The Common Dunnart (Sminthopsis murina) inhabits Boullanger and possibly Whitlock Island. The introduced House Mouse (Mus musculus) has become established on Boullanger while the European Rabbit (Oryctolagus cuniculus) has recently been unlawfully released on the Green Islets.

The islands are being increasingly visited by holiday-makers and fishermen from the coastal settlements.

All these islands are Class C reserves for the Conservation of Flora and Fauna vested in the WA Wild Life Authority.

Recommendation

The Committee endorses the purpose and vesting of the reserves including the islands between Dongara and Lancelin but recommends that their Class be changed from C Class to A Class, and their boundaries be extended to low water mark.

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SYSTEM 8 - THE PILBARA

INTRODUCTION

Area 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 km^2 in area, in which, in Lower Proterozoic time, dominantly iron-rich and silcia-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:

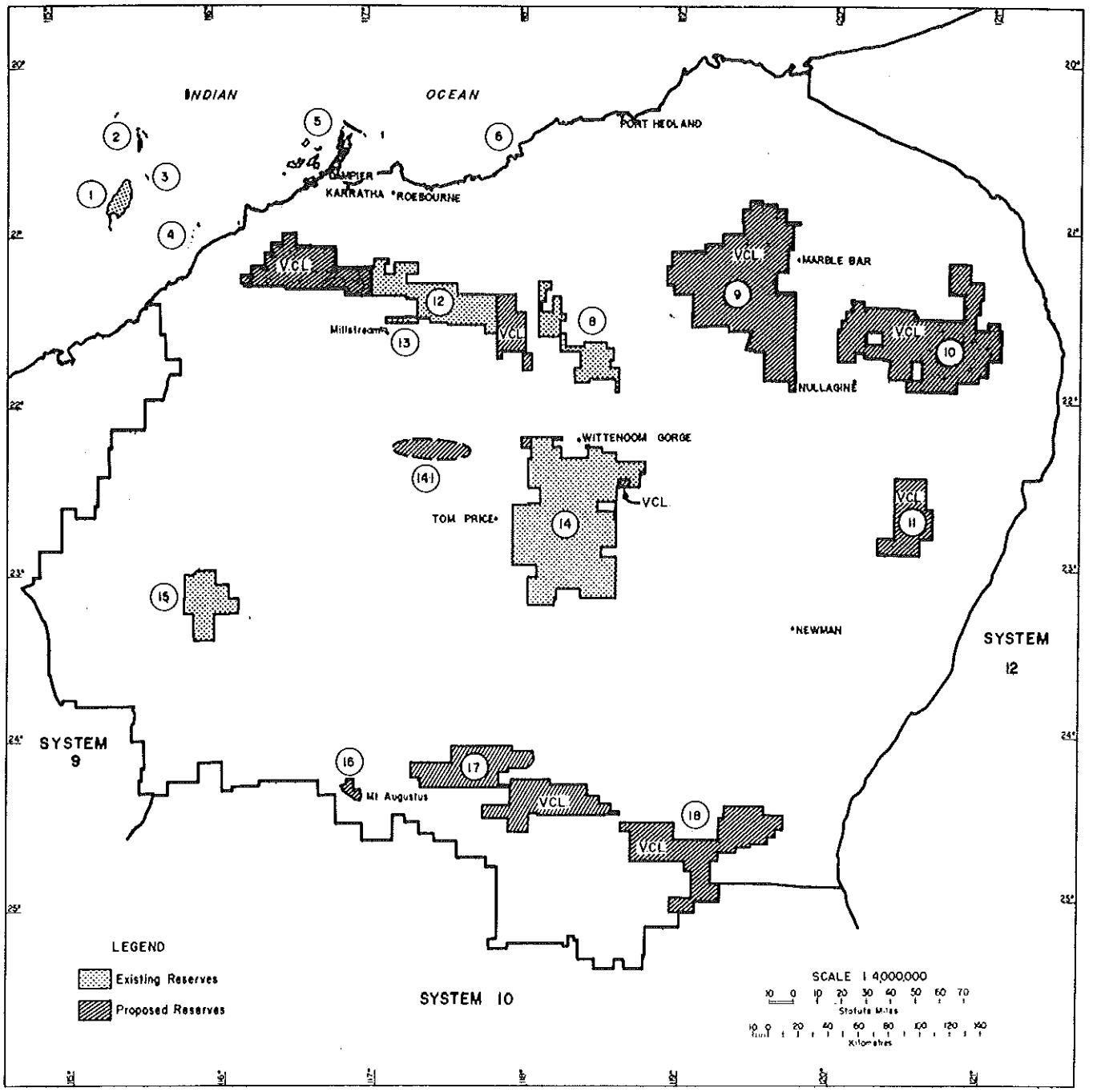

Figure 8·0 System map

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. Mungaroona 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.

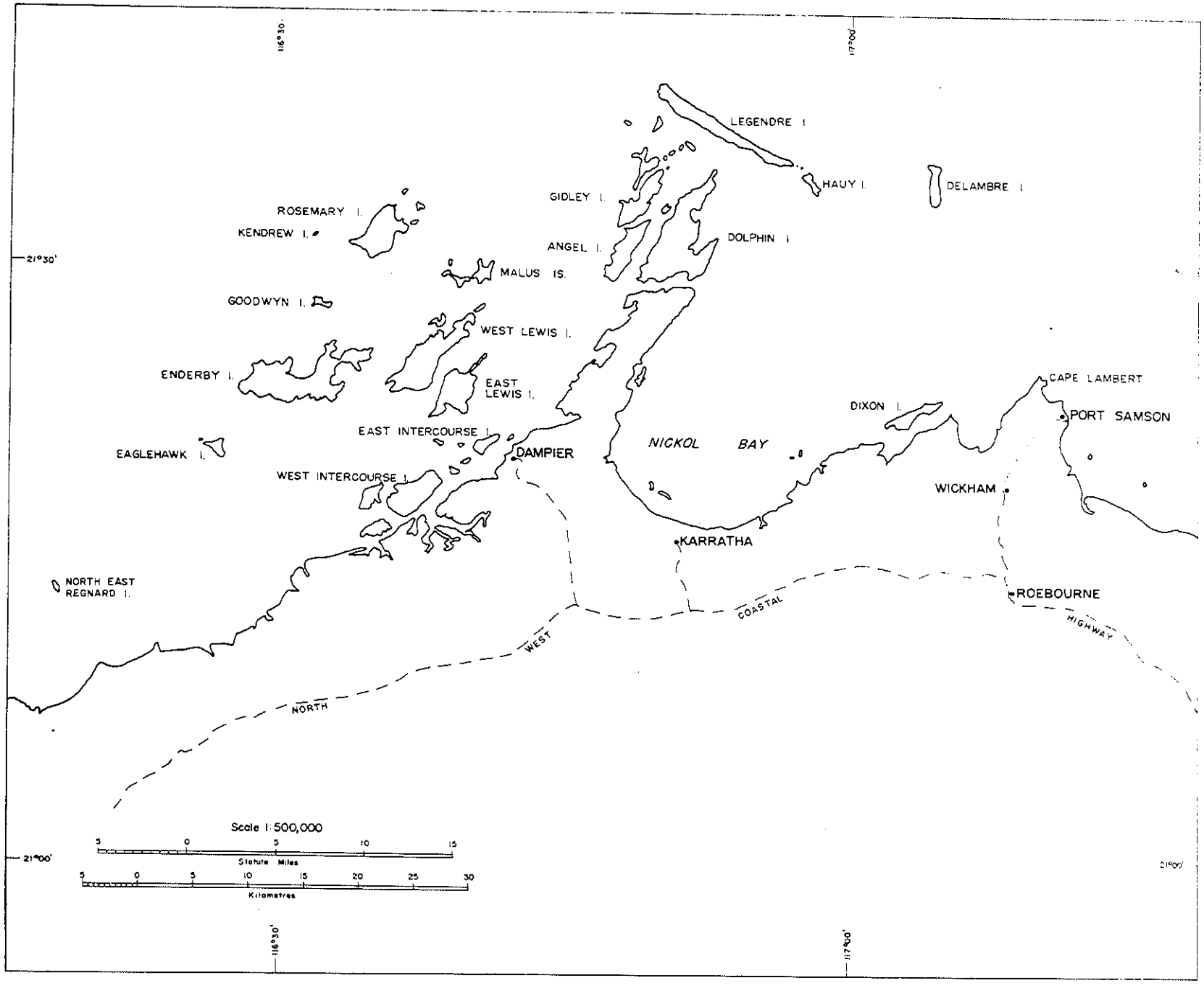

Figure 8·4 Area map of the Dampier Archipelago

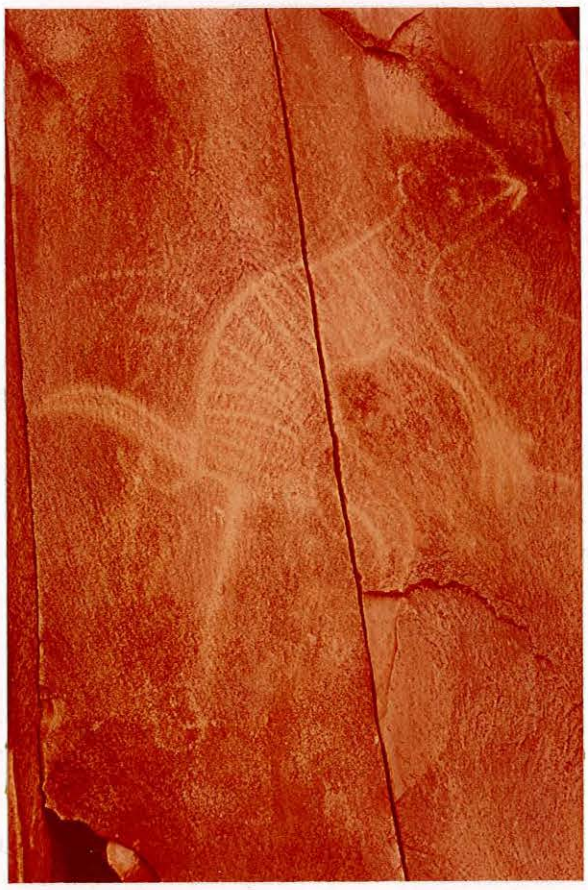

Figure 8.3. Aboriginal engraving, Angel Island, Dampier Archipelago.

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 follwoing 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 tablelandsto 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 representativ 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 damsel-flies, 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.

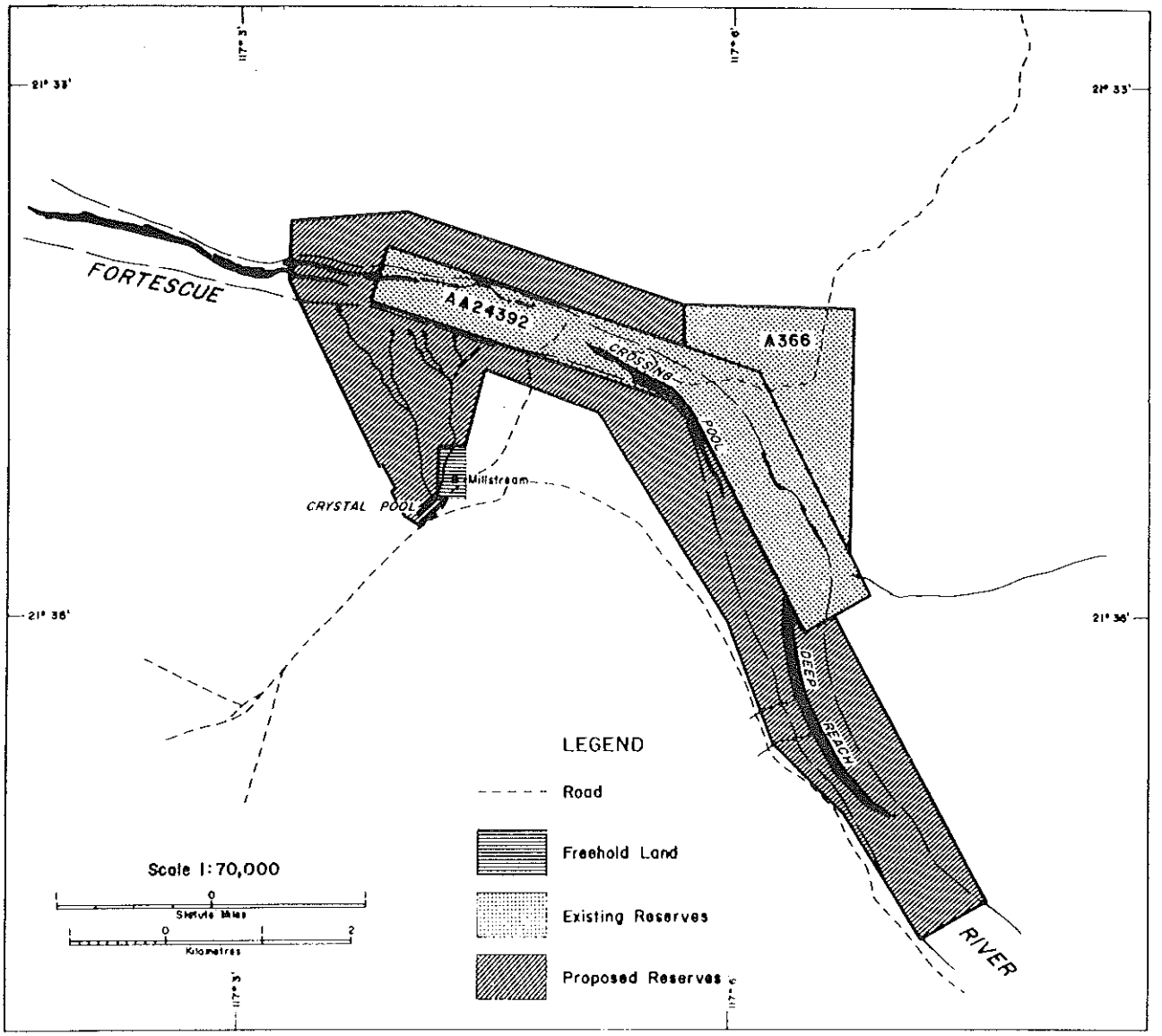

Figure 8·8 Area map of Millstream

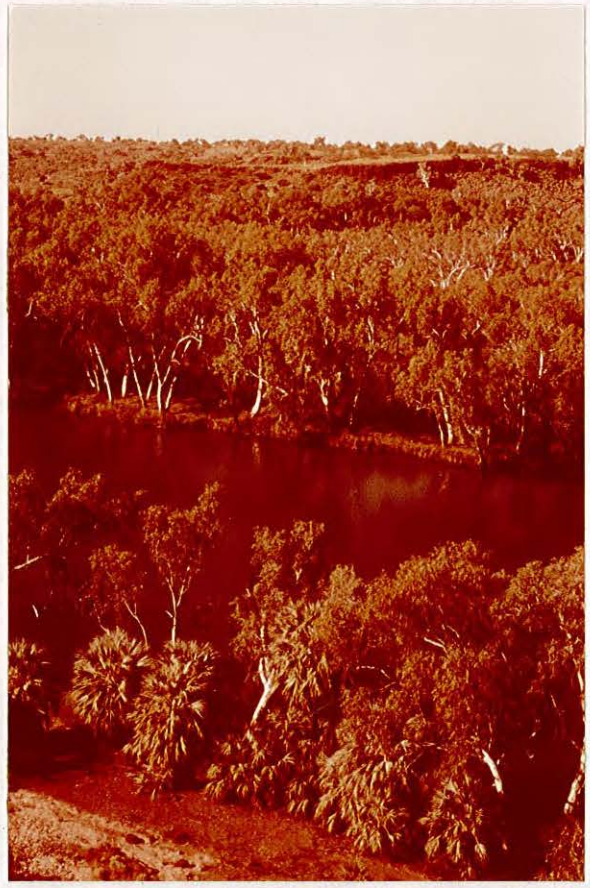

Figure 8.5. Millstream: Crossing Pool from "Cliff Scene", showing River Gums (Eucalyptus camaldulensis), Cadjeputs (Melaleuca leucadendron), and Millstream Palms (Livistona alfredii); dry hills beyond, with spinifex and Migum.

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

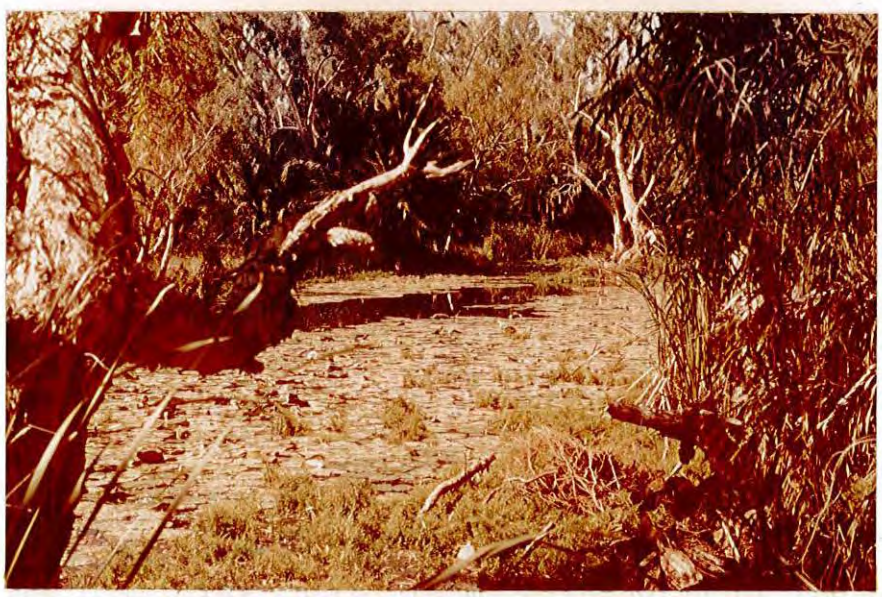

Figure 8.7. Millstream: Crystal Pool, with Cadjeputs (Melaleuca leucadendron), aquatic fern Ceratopteris thalictroides, and introduced date palms and water lilies.

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 in 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.

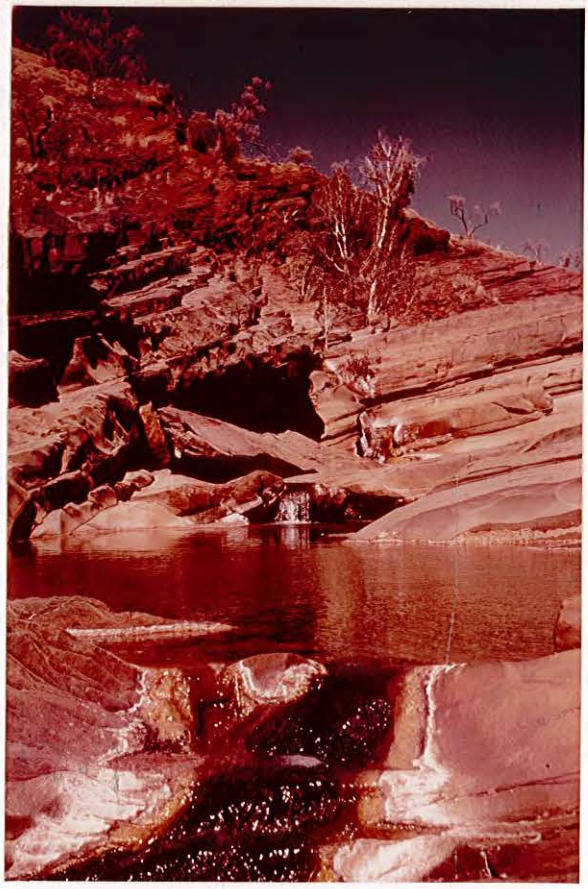

Figure 8.10. Hamersley Gorge.

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 occurence 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), hopbushes (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.

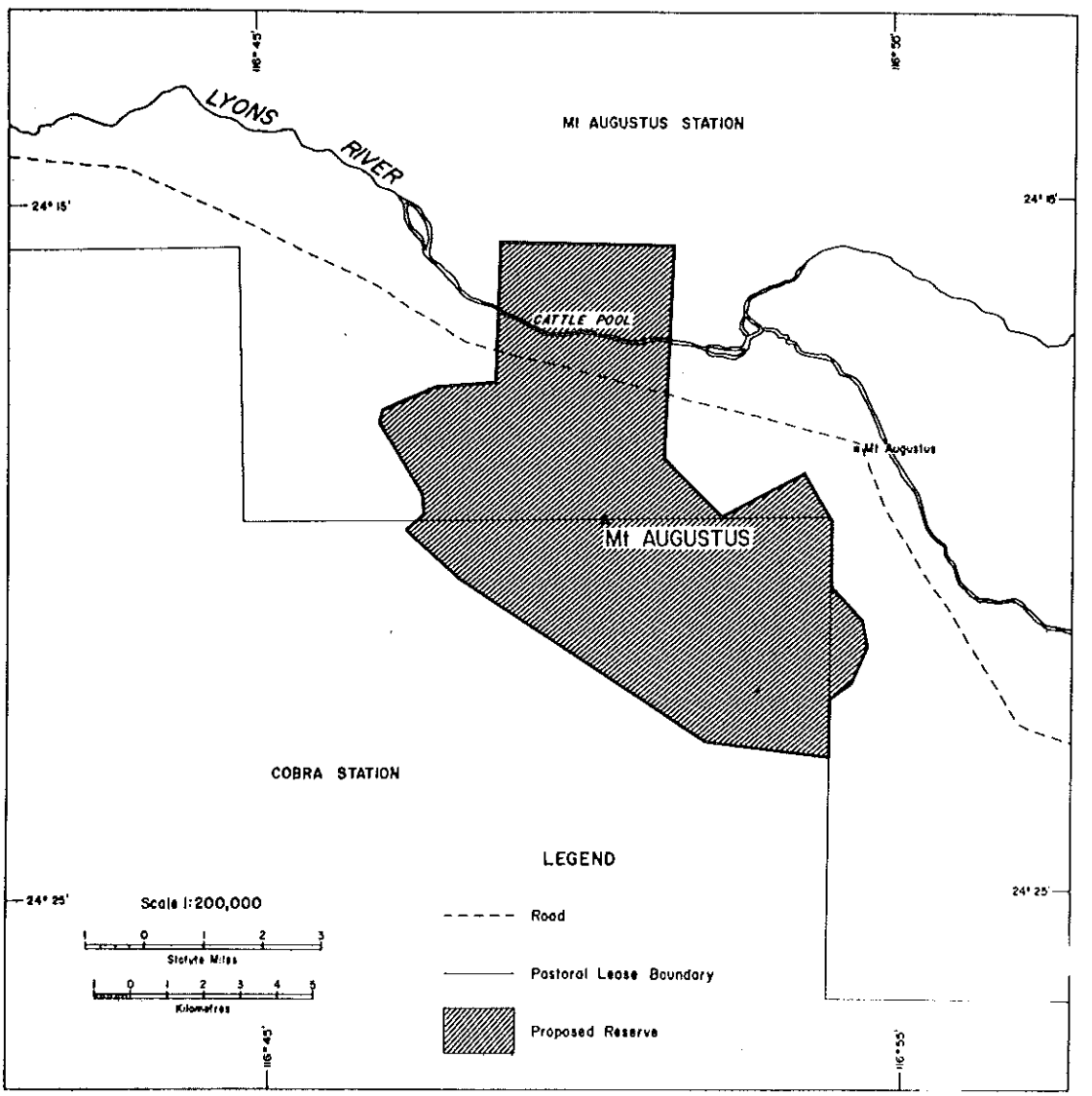

Figure 8 11 Area map of Mt Augustus

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 Wild-Life 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.

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SYSTEM 9 - CENTRAL WEST COAST

INTRODUCTION

Area 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 km^2 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 delinated 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 km^2 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. Acounts of major

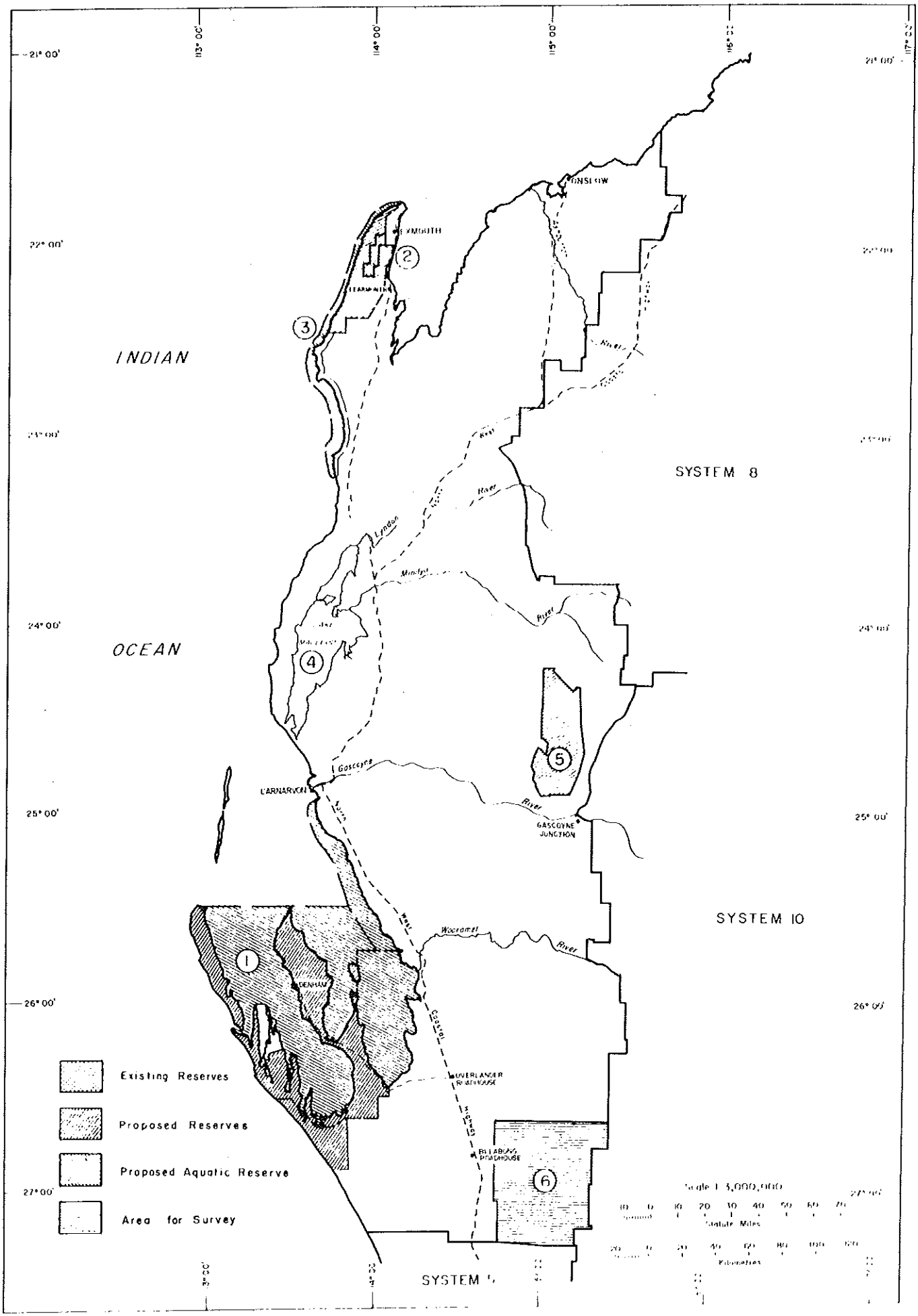

Figure 9.9 Map of system 9 showing boundaries, localities mentioned in text and existing and proposed reserves.

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 km^2 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 km^2. 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 km^2 special agreement lease.
2. Exmouth Gulf: Exmouth Salt Pty. Ltd.; temporary reserve under Mining Act, No. 5350; 1795 km^2.
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 santuaries, 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 propose 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 an 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 aeolianite 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 stablisation 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 uproductive 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:

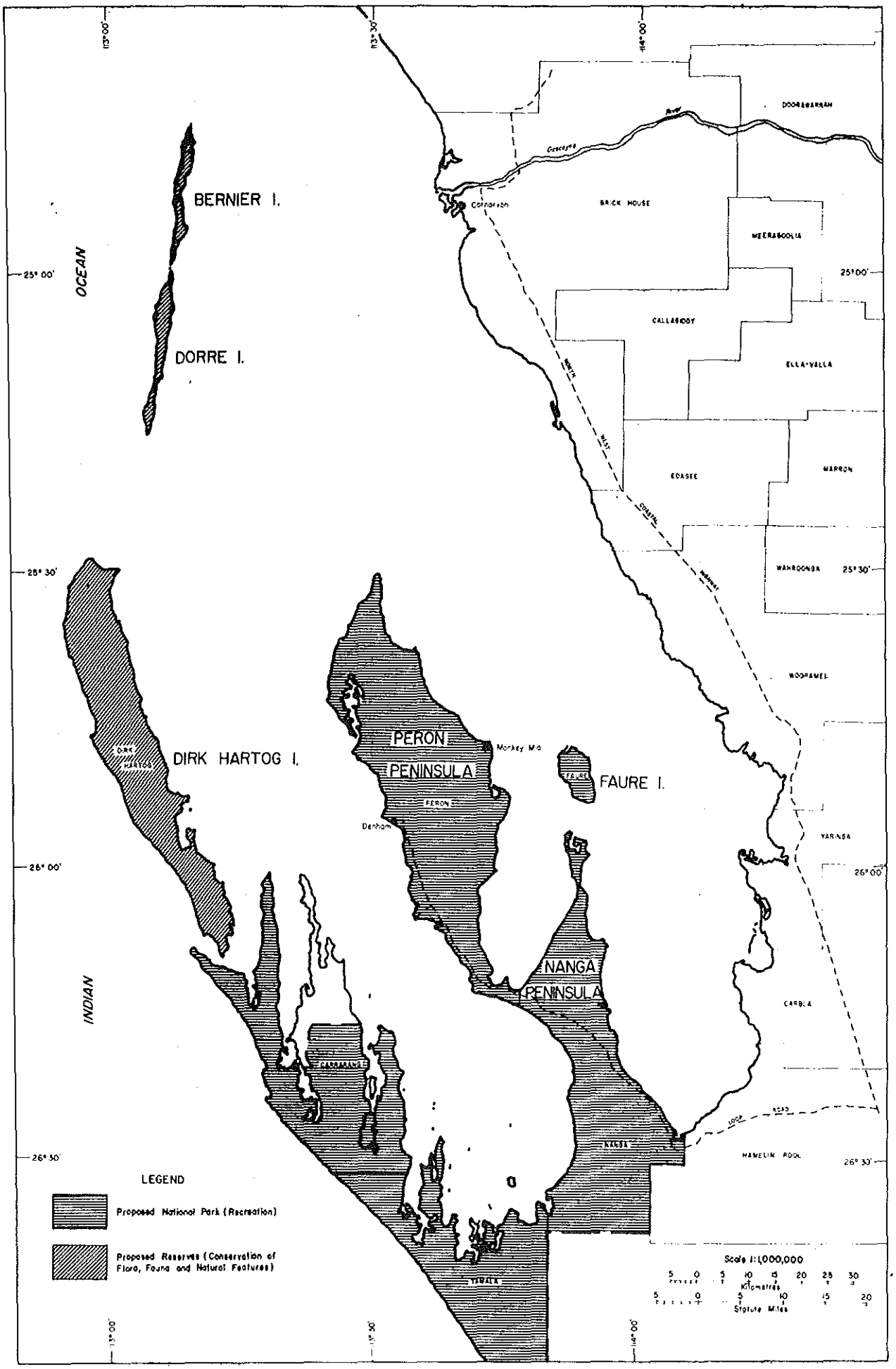

Figure 9 1 Shark Bay region, showing proposed reserves

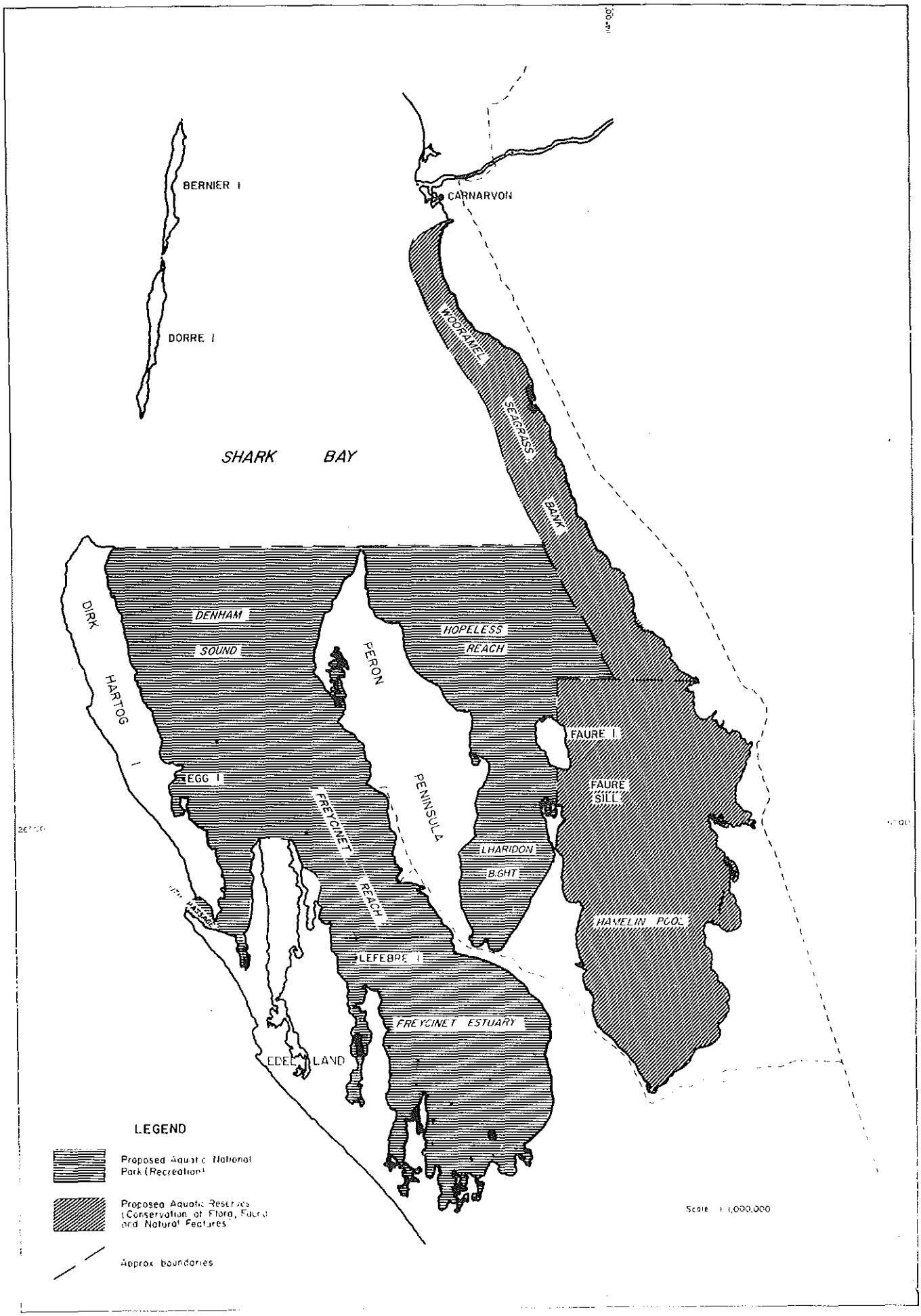

Figure 9·2 Shark Bay region, showing proposed aquatic reserves.

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 terrestial 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 inter-tidal 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 porposed 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 lead 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 lead 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 stomatolites, coquinas, ooid shoals and cemented sediments also requires measures which will prevent destruction by activities of man.

The Hamelin Pool stomatolites 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 endorese 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 km^2 and is 129 km long; average width is 8 km.

The bank structure is a widge-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 emphasised. 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 yatchting, 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 1964 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 adaption 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 comination of summer and winter rains, the floristic elements represent all three botanical provinces of Western Australia, the South-West, Eremean 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

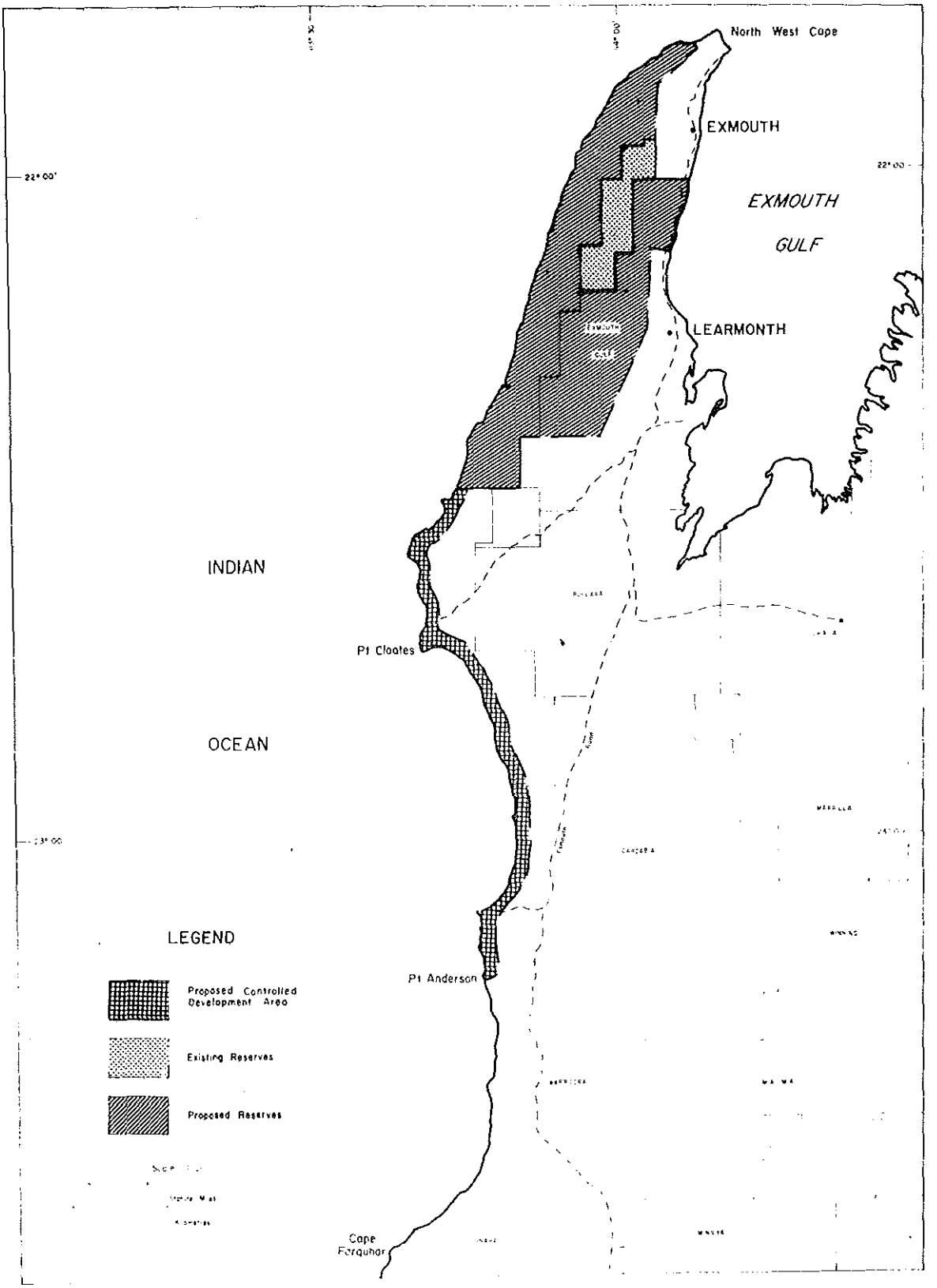

Figure 9·8 Area map of Cape Range National Park and proposed extensions.

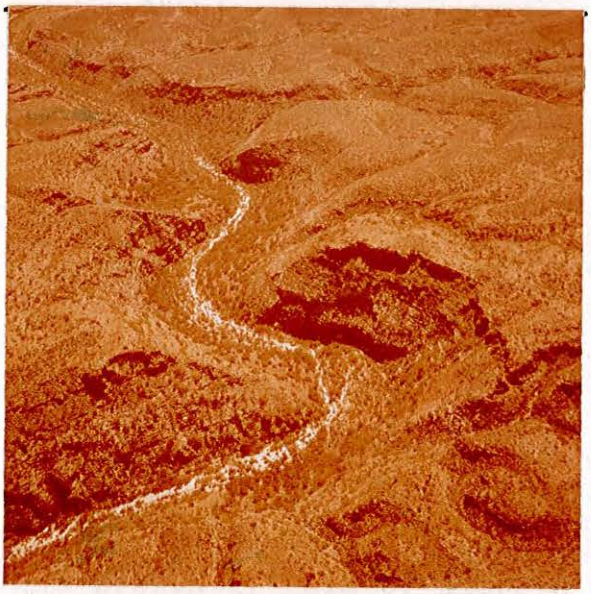

Figure 9.9. Canyon country, Cape Range.

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.

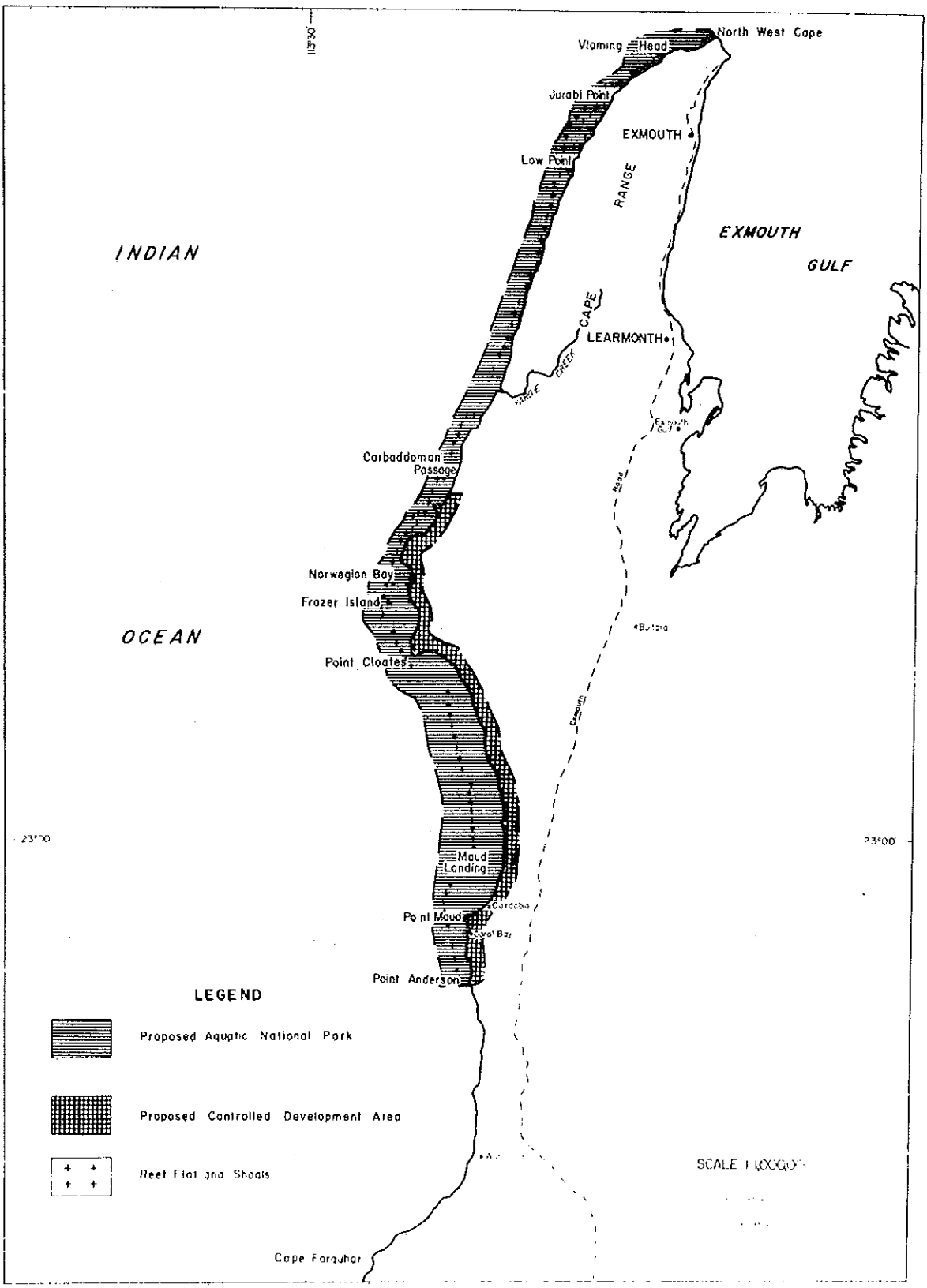

Figure 9·10 Area map of Ningaloo reef tract, showing proposed reserves.

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 Gnaraloo-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 km^2 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 lesseesif 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.

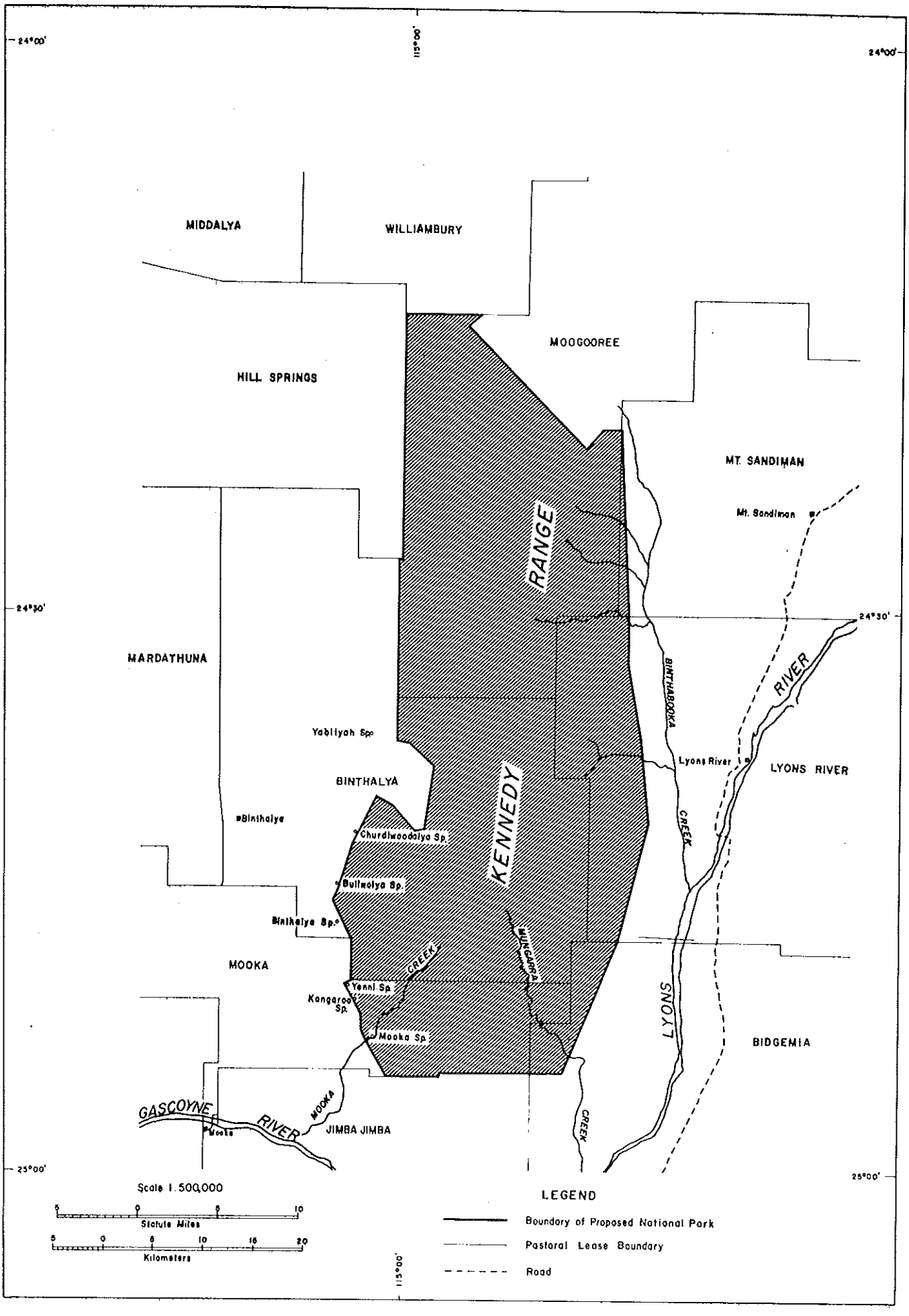

Figure 9 13 Area map showing boundaries of proposed Kennedy Range National Park.

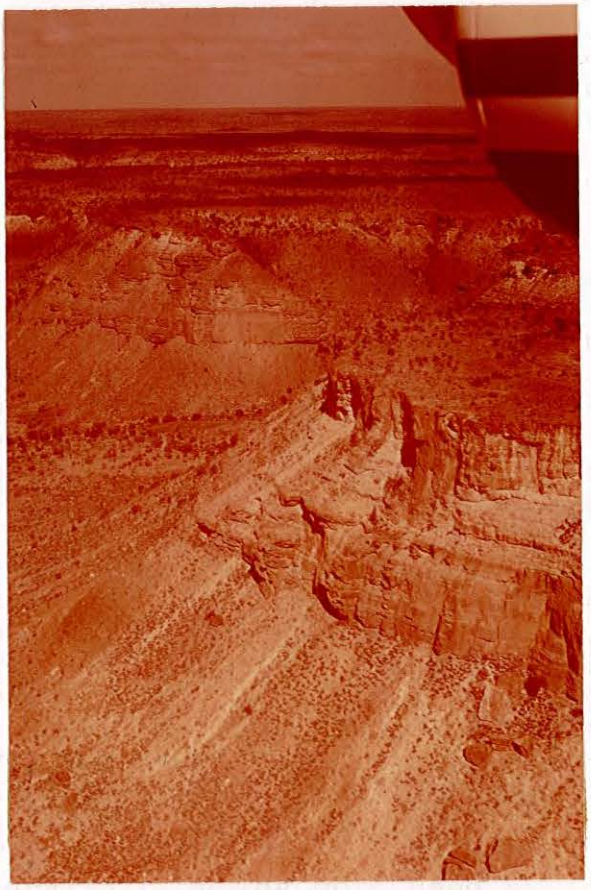

Figure 9.14. Kennedy Range - aerial view of the escarpment.

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.

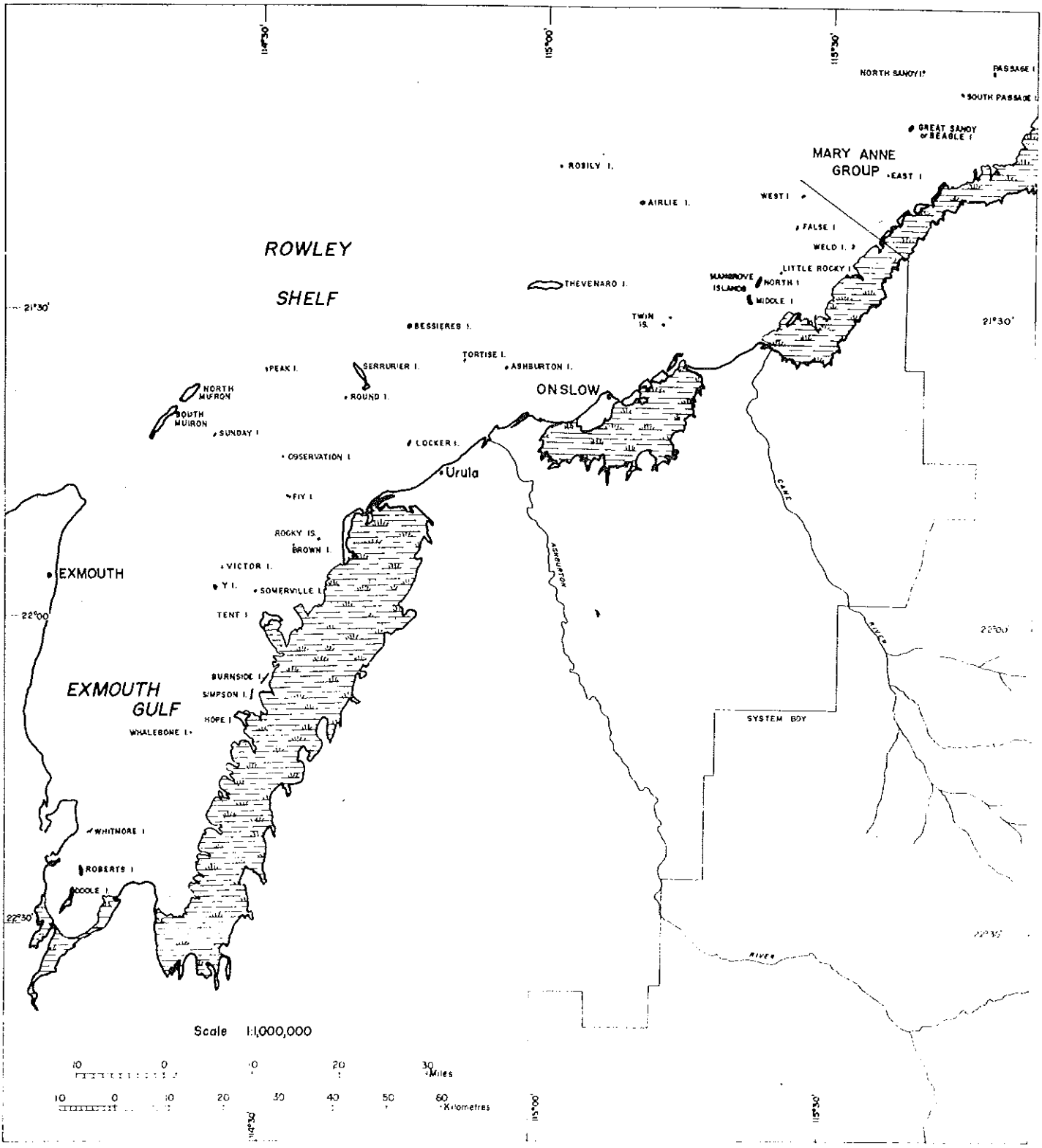

Figure 9·15 Area map of the Rowley Shelf showing offshore islands and tidal flats.

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.

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SYSTEM 10 - THE MURCHISON

INTRODUCTION

Area, Physiography and Biology

The Murchison System as delineated by the Committee includes about 208,370 km^2 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.

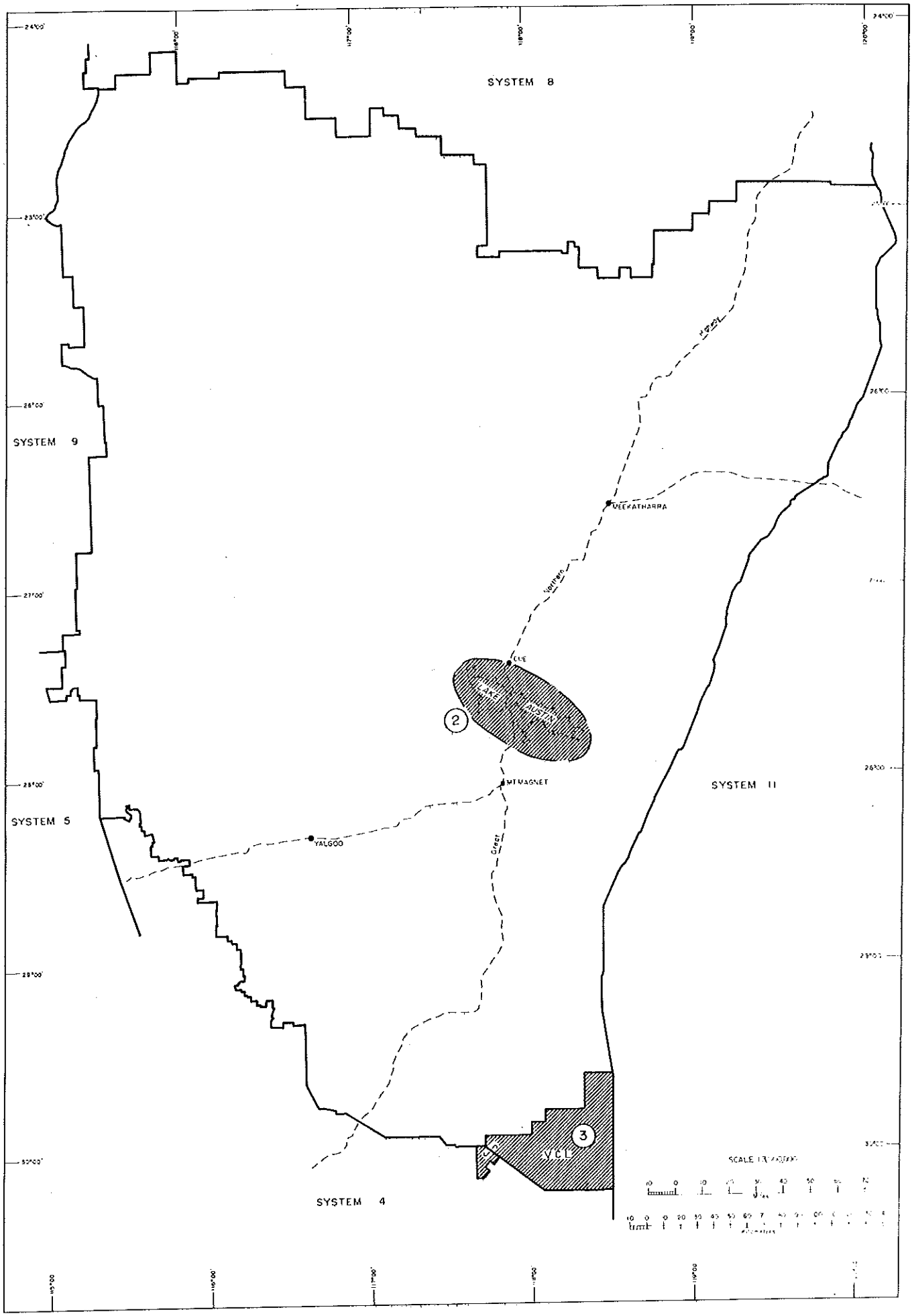

Figure 10·0 System map

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 hoofed 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.

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SYSTEM 11 - THE GOLDFIELDS *

INTRODUCTION

Area and Physiography

The Goldfields System (Fig. 11.0) covers about 295,100 km^2, 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

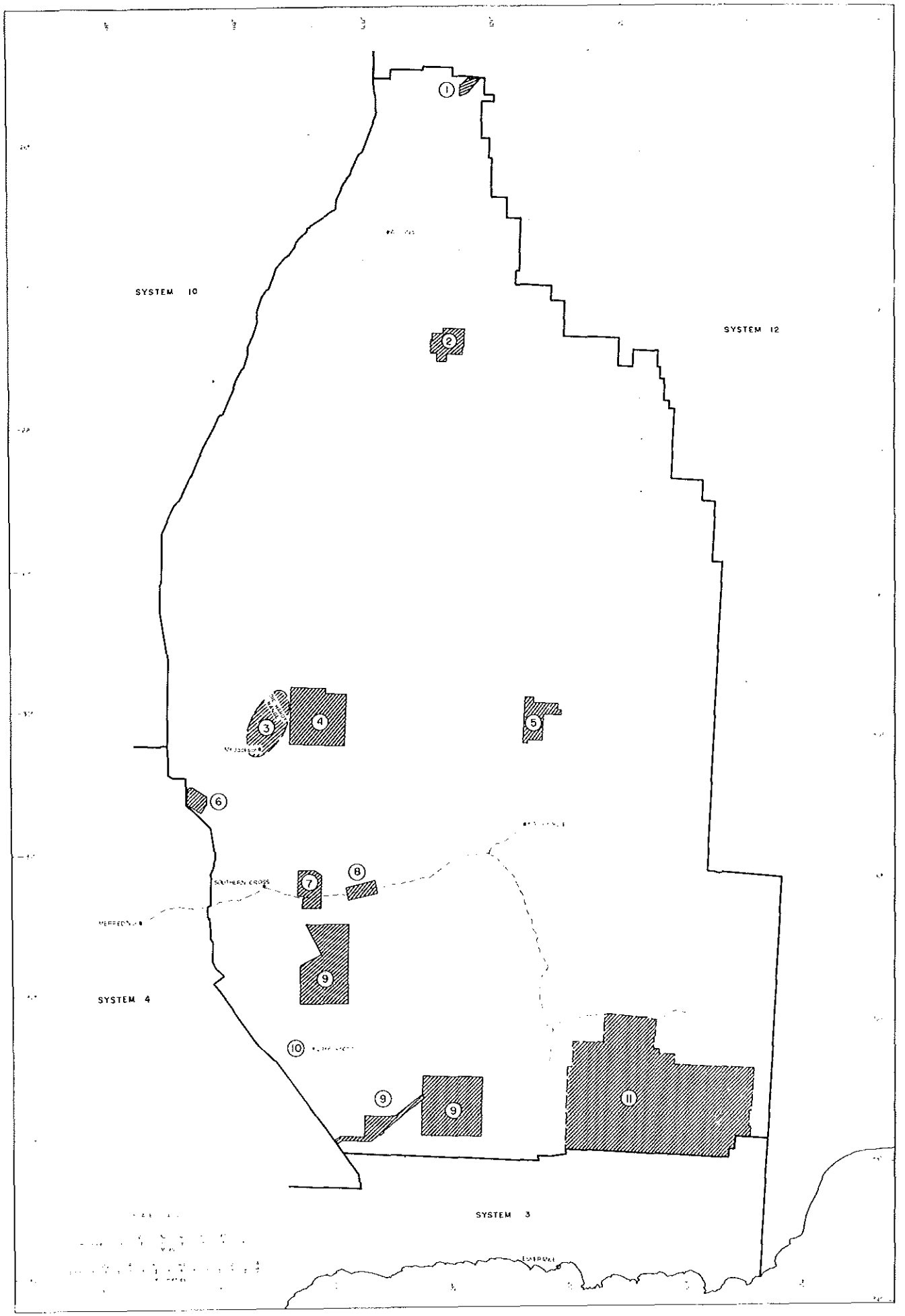

Figure II · O System map

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 occuring 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 understorey of mulga and Jam (Acacia acuminata) and a ground cover of mulla-mulla (Ptilotus obovatus) and everlastings (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 understorey 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.

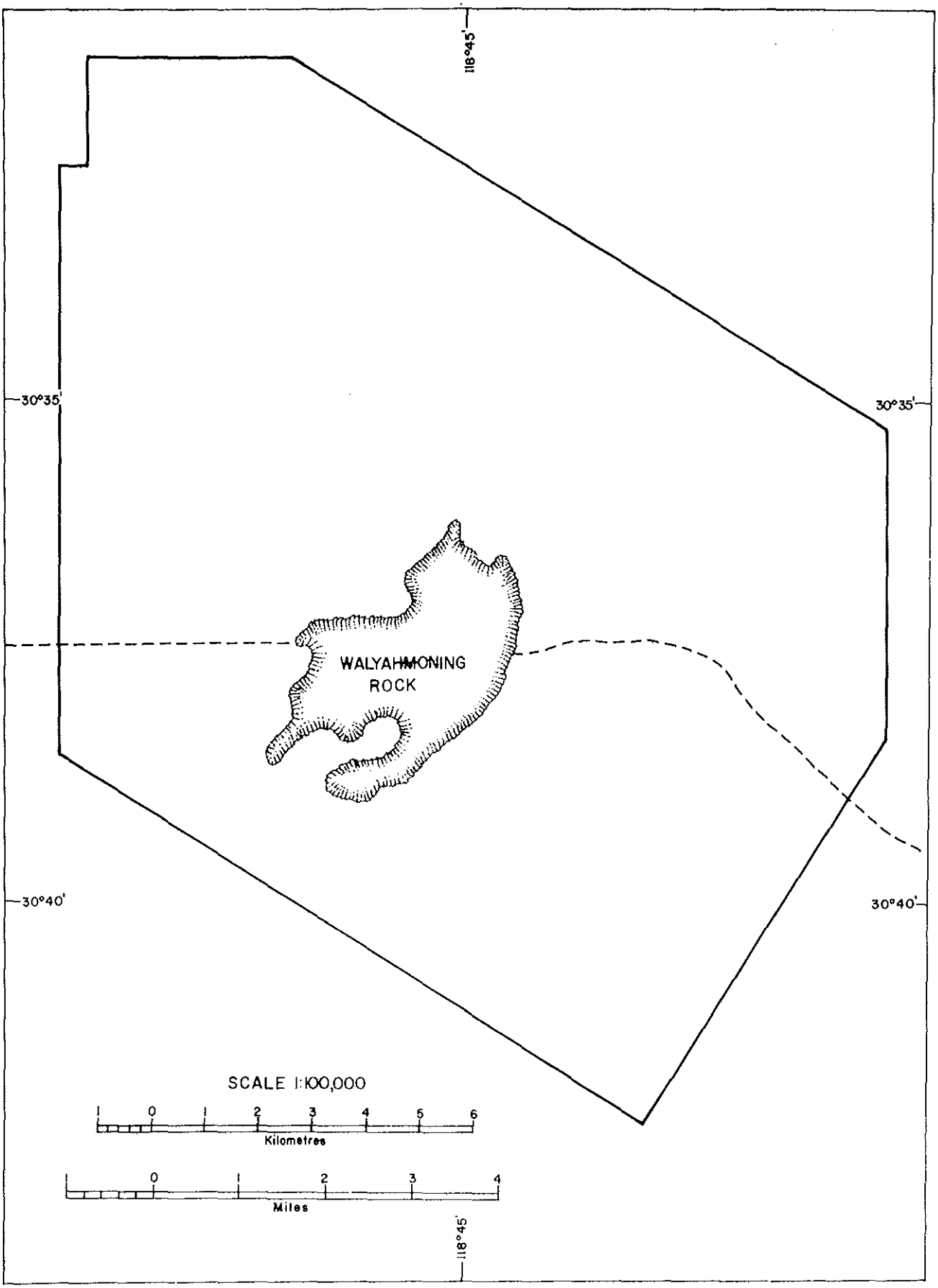

Figure 11·5 Area map of Walyahmoning Rock area

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.

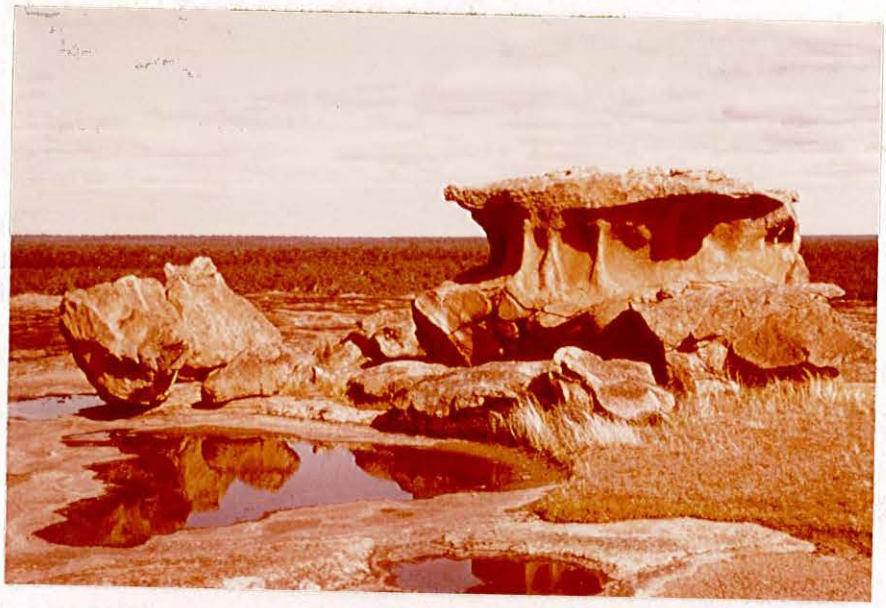

Figure 11.6. Weowanie Rock, north of Yellowdine.

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 relects 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.

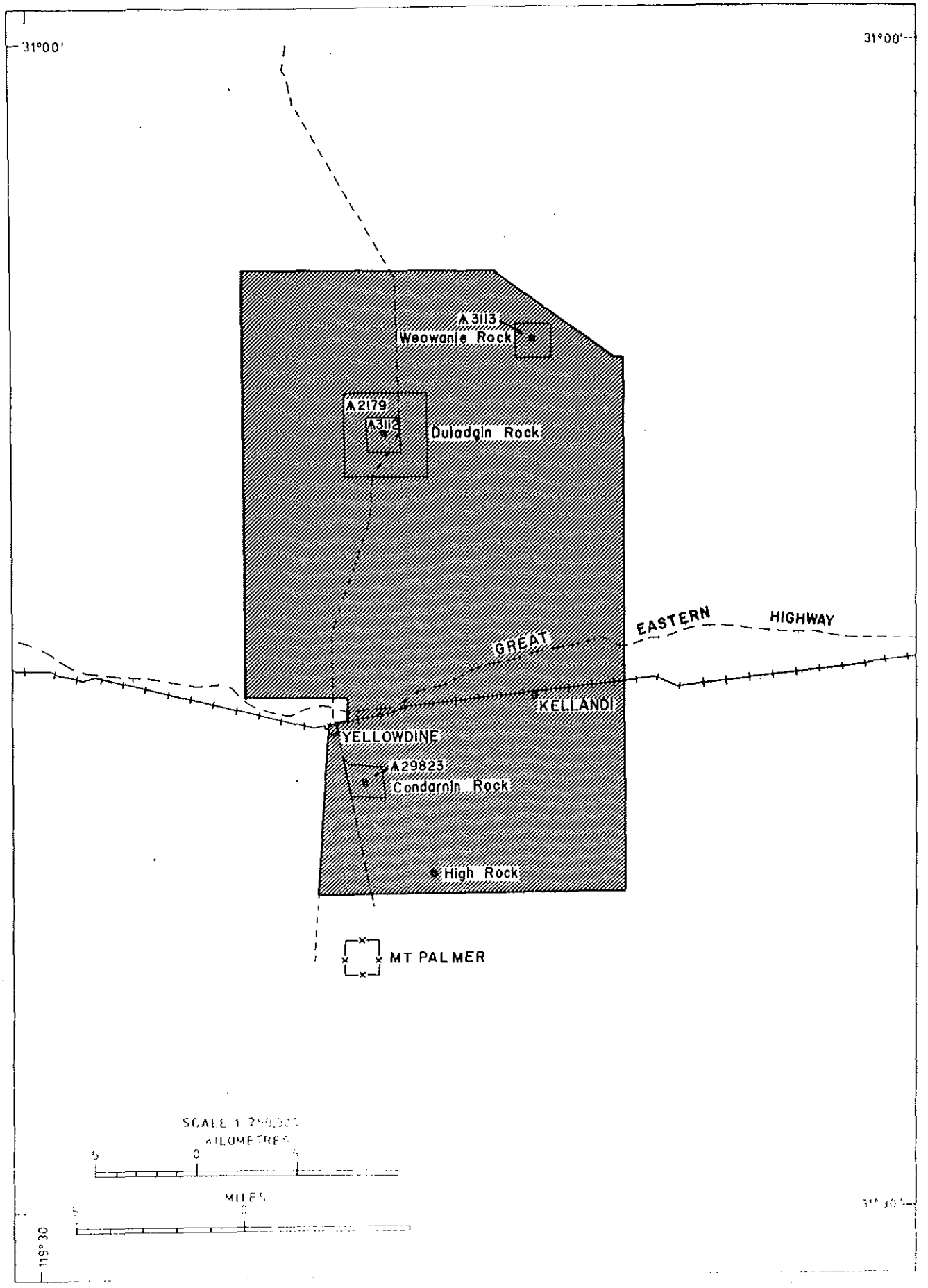

Figure II-7 Area map of Yellowdine area

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 tammar 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 cecilae), 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 mondnock 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 Eleanora, 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.

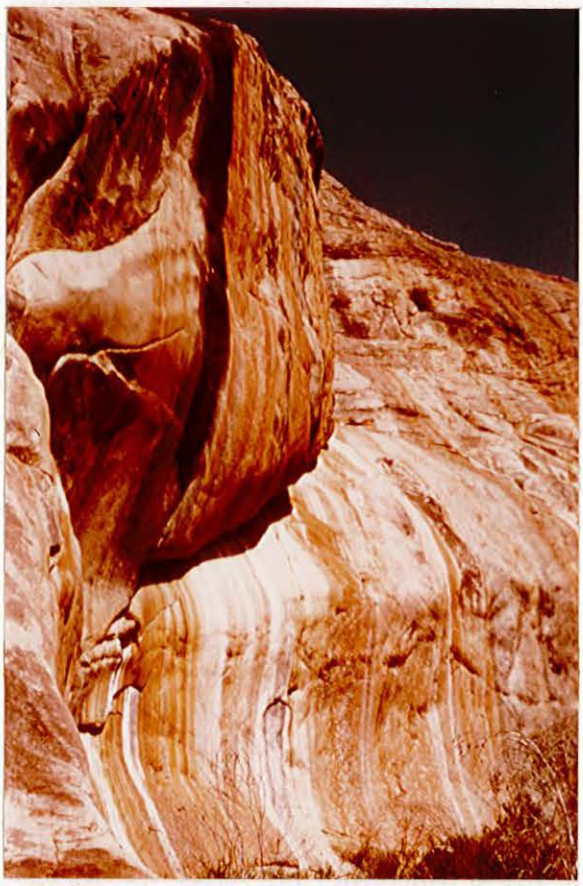

Figure 11.13. Wave rock formation, Peak Charles.

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 km^2) 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 occuring 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.

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SYSTEM 12 - THE DESERTS AND NULLARBOR PLAIN

INTRODUCTION

The desert regions of the State (including the Nullarbor Plain) and a few pastoral areas northeast of Wiluna make up System 12 (Fig. 12.C). It covers an area of about 947,280 km^2. 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 DESERTS

Area, 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 that 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.

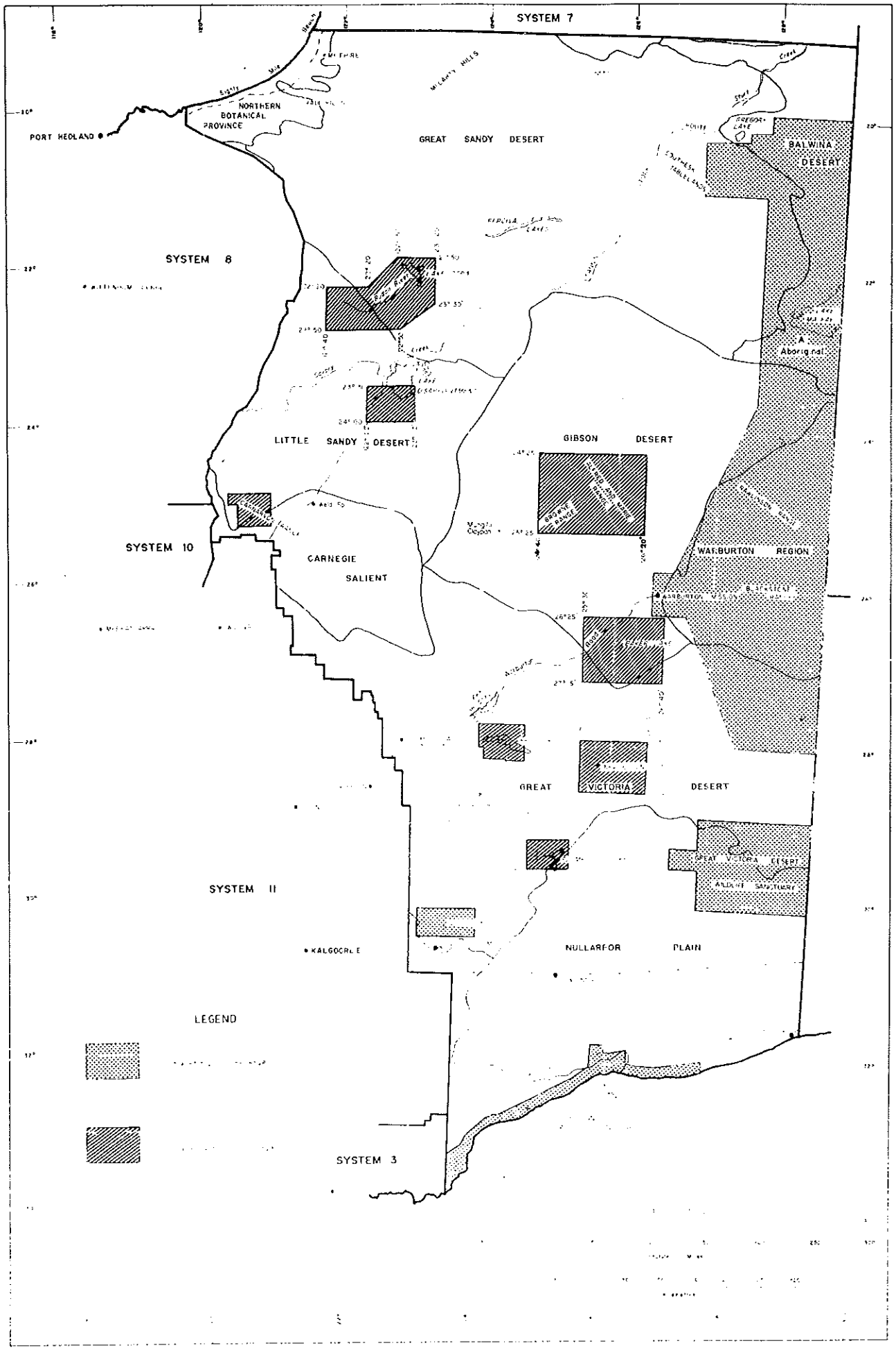

Figure 12-0 System map. Nomenclature of deserts after Beard (1969)

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 Aboriginals 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).

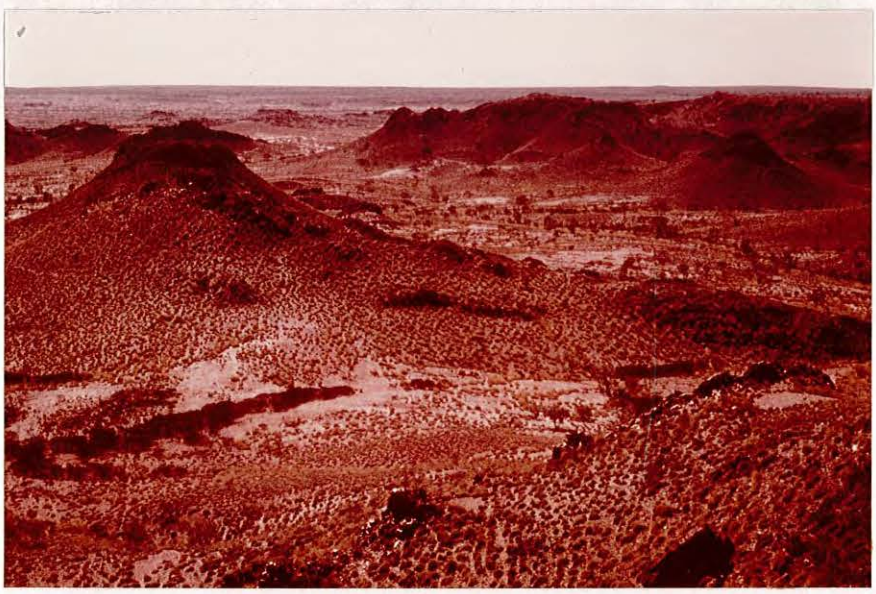

Figure 12.2. Rocky hills and valleys near the Rudall River: open spinifex (Triodia) steppe on the slopes, tall shrubs along creeklines.

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 km^2 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^{o} 20' S, 121^{o} 40' E, east to 122^{o} 20' E, then northeast to 122^{o} 50' E, east to 123^{o} 20' E, south to 22^{o} 30' S, southwest to 122^{o} 50' E, west to 121^{o} 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 km^2 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° 31' S, 123° 00' E, 24° 00' S, 122° 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 km^2. 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° 52' S, 120° 18' E) east to 120° 52' E,

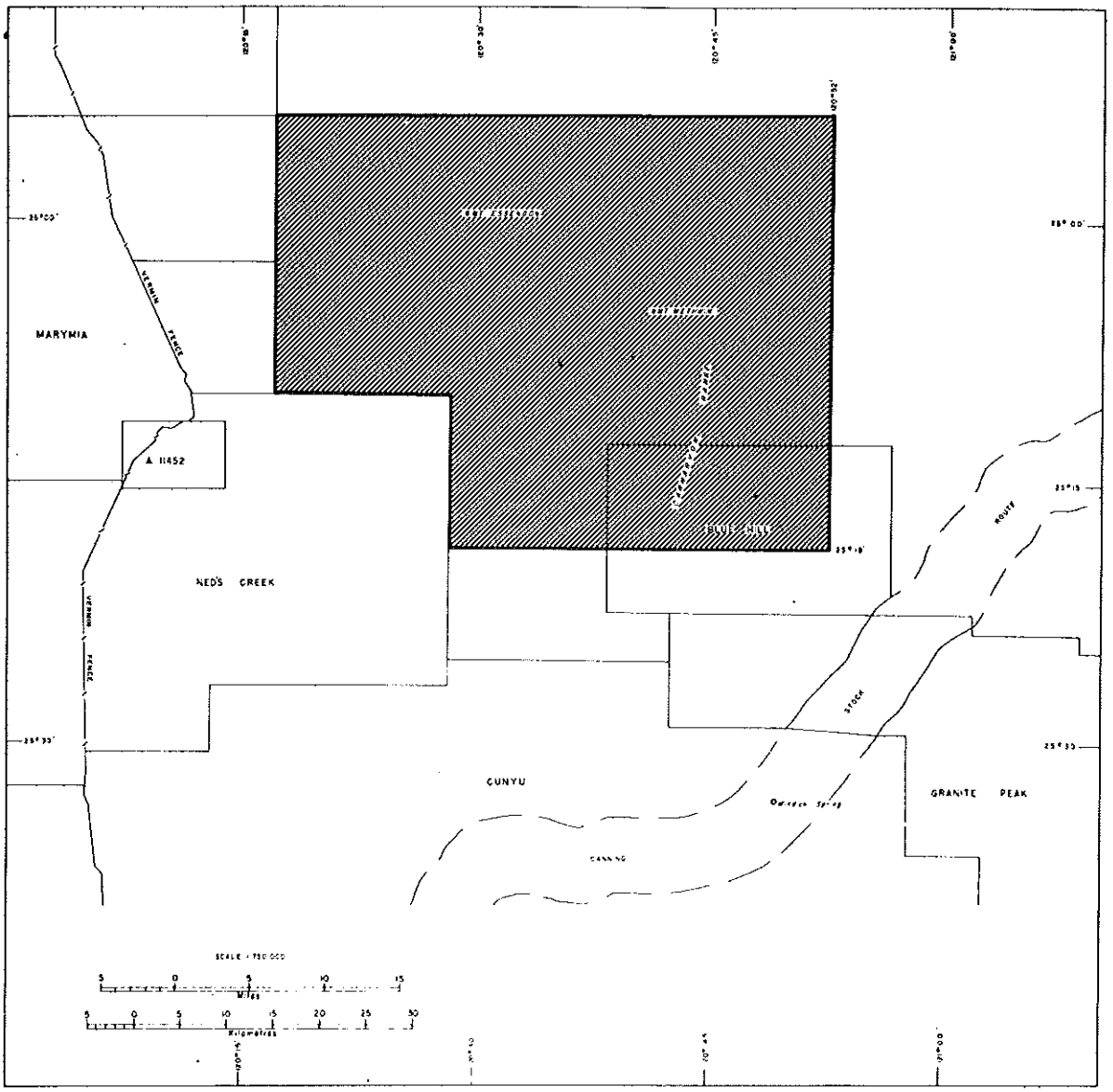

Figure 12·4 Area map of Carnarvon Range area

south to 25° 19' S, west to the boundary of Neds Creek pastoral lease (approximately 120° 28' E), north west to approximately 120° 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. breakaway 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 km^2 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 km^2 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 km^2.

Boundaries

The boundaries of the proposed reserve are as follows:
26° 25' S, 126° 40' E, 27° 15'S, 125° 30' E.

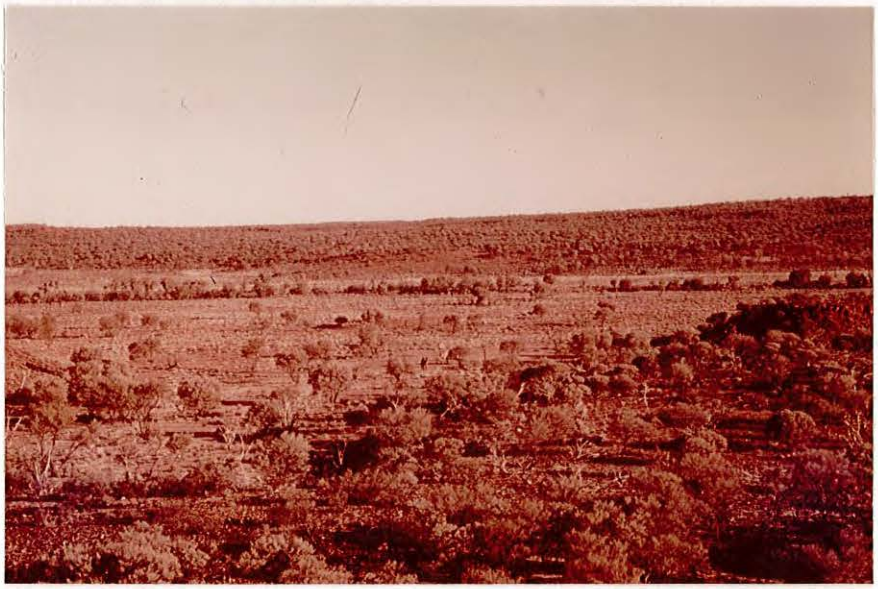

Figure 12.9. Low, lateritic hills near Point Watt, with mulga (Acacia aneura) and open steppe.

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 THROSSELL - 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 undifferentialted 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. Philotheca 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. striaticalyx.

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.

These 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.

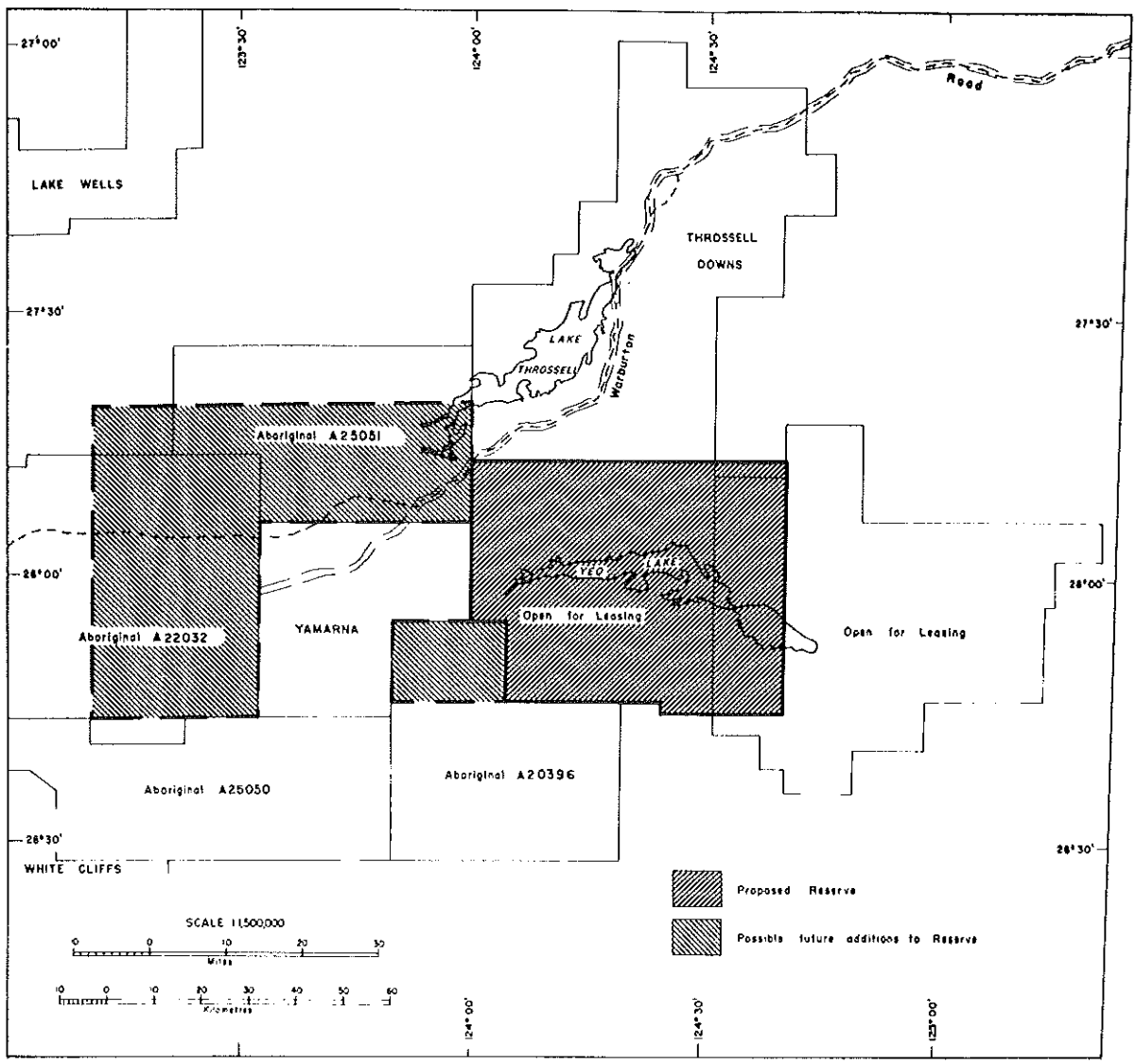

Figure 12 13 Area map of Lake Throssel – Yeo Lake area

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 macrediana, 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 km^2.

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.K. 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.

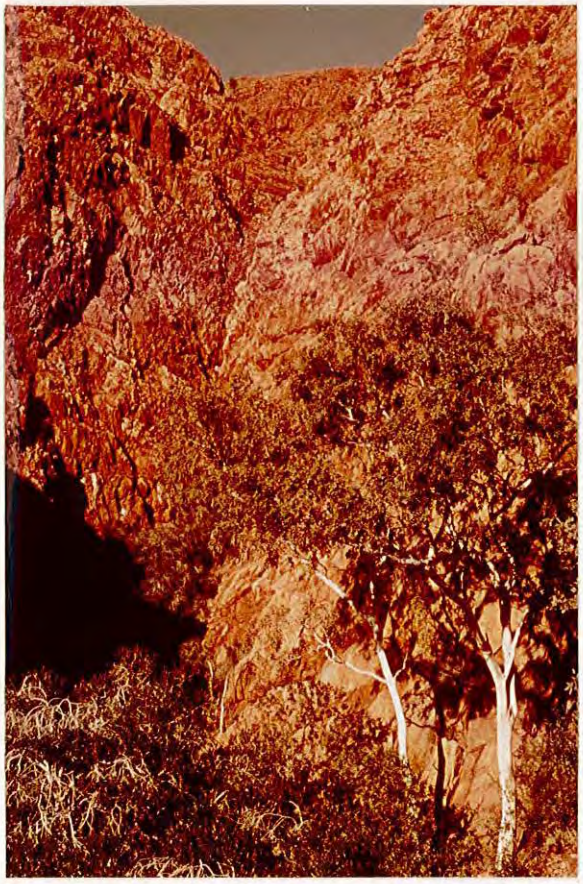

Figure 12.18. Bungabiddy Rockhole in the Walter James Range: Rock Figs (Ficus platypoda) and Ghost Gums (Eucalyptus papuana) at the base.

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 occurence, 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 km^2 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 Cocklebiddy 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 adaptions 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.

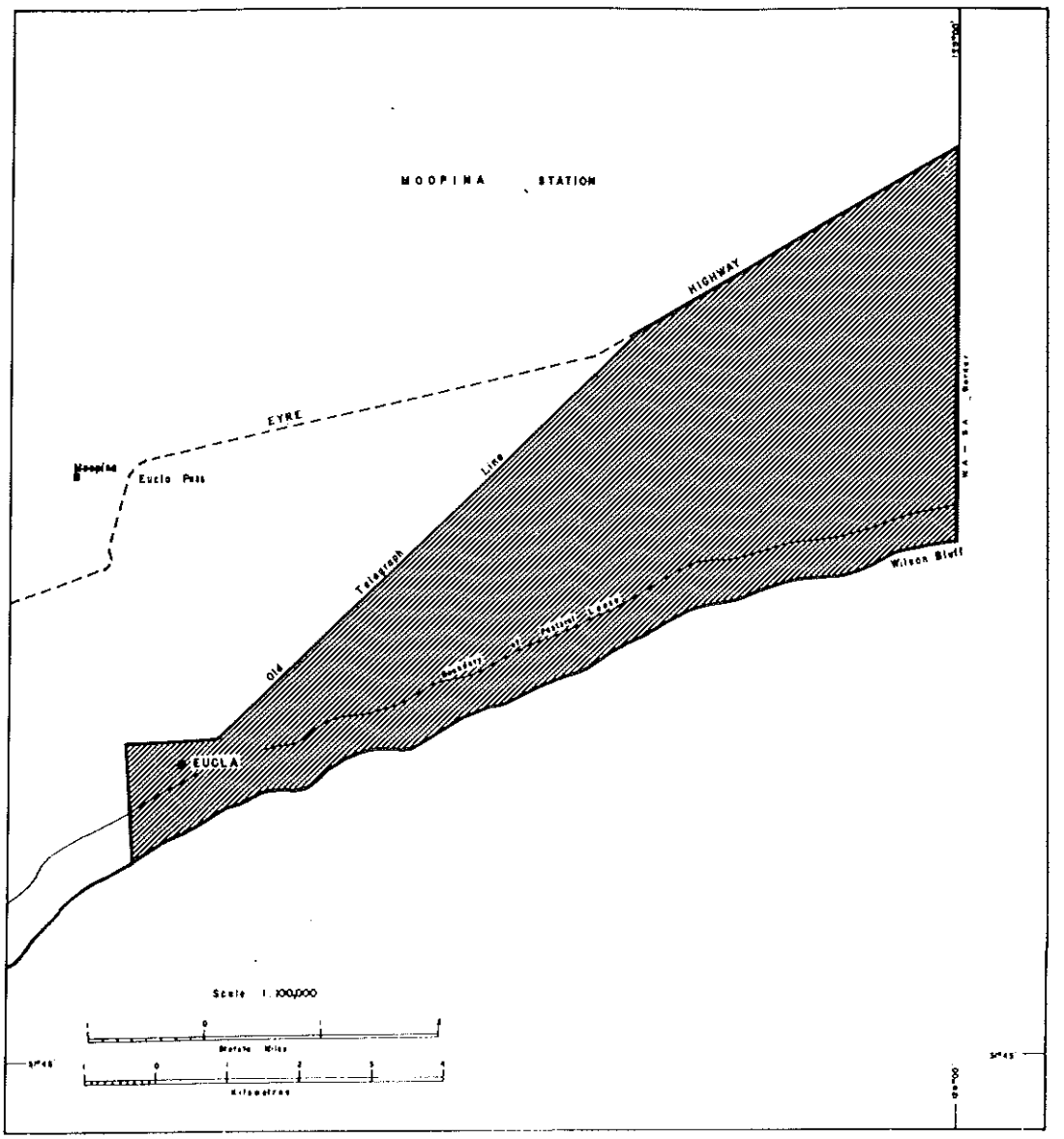

Figure 12·23 Area map of proposed Eucla reserve

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, Cocklebiddy, Weebubbie, Mullamullang, Murra-el-elevyn, Roaches Rest, Lynch and Thylacine.

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

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