Biodiversity Monitoring in the Gascoyne-Murchison Strategy Area: A Case Study

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Abstract
The recent adoption by the Western Australian Government of the Gascoyne-Murchison Strategy has paved the way for a wide range of additional values to be recognized in the use and management of this large area of the State rangelands. A major program of land acquisition for nature conservation is underway as part of the Strategy. In the course of this, the question is being asked, how can we be sure that the nature conservation values in the landscape will be protected in the long-term through this initiative? This paper sets out an initial response to the question. A biodiversity monitoring system is proposed – this builds on the existing rangelands monitoring system that considers pastoral values only. The rangelands monitoring system can be expanded to include additional site types, and the sampling program can be expanded to include biodiversity values. Data management through the Agriculture WA system would continue. The collection and collation of a range of additional data such as those collected in biogeographic surveys and from remote sensing is also proposed. The proposed biodiversity monitoring system conforms with the framework and indicators suggested by the rangelands biodiversity monitoring project undertaken by the Tropical Savannas CRC.

Introduction

This paper was prepared following discussions at the Workshop convened by the Tropical Savannas Cooperative Research Centre (TS CRC) in Darwin, 19-21 June 2000. The Workshop was organised as a part of a project entitled "Developing an adaptive framework for monitoring biodiversity in Australia's rangelands", a contribution to the National Land and Water Resources Audit. The discussion papers prepared for the Workshop are comprehensive, and provide the rationale for the proposals given in this Case Study *(reference when available – JW at al please)*.

The Gascoyne-Murchison Strategy Area covers about 34 million hectares, and includes 253 pastoral leases and areas of unallocated Crown land in the arid interior. It includes most of the Carnarvon, Gascoyne, Murchison, Yalgoo and Little Sandy Desert IBRA Regions and parts of the Avon Wheatbelt, Geraldton Sandplains, Gibson Desert, Great Vuictoria Desert and Pilbara Regions (Figure 1). Some of the most arid land in Western Australia is found in the east of the region. In the western two-thirds of the region, pastoralism has been the dominant land use over the past century: some has been considered the best wool-growing areas in Western Australia's rangelands.

Declining commodity prices and the declining productivity of the landscape were the major reasons for the review of activities on the region, which led to the development of the Gascoyne-Murchison Strategy. The strategy was adopted by the Western Australian Government in October 1998. It provides for the restructuring of the pastoral enterprises across the region, for introduction of innovative commercial activities including ecotourism, and for the establishment of a comprehensive, adequate and representative reserve (CAR) protected area system for nature conservation in the region.

The Gascoyne-Murchison region is known to have generally high biological diversity, but it is very poorly documented. The recent biological survey of the southern Carnarvon Basin, for example, which covers only about 15 % of the Gascoyne-Murchison region, recorded 144 species of indigenous reptiles, 59 species of mammals, 500 species of aquatic invertebrates, and more than 2000 species of vascular plants

Since December 1998, the Department of Conservation and Land Management (CALM) has purchased eight leases and part of nine other properties, a total of 1.9 million hectares. Negotiations with pastoralists over land acquisition are continuing.

The identification of land for acquisition or other form of protection is based, at least in part, on vegetation mapping at the scale of 1:250,000 by J. S. Beard and compiled into a digital database that can readily be interrogated. As leases are acquired or protected, information about each lease is added to the database so that further purchases do not duplicate vegetation units – to ensure that each new acquisition will add different ecosystems to the reserve system. The land acquired to date contains 24 vegetation types which were not previously within the reserve system, and many more vegetation types now have an improved level of representation.

Other data sets used for planning the protected areas system include the land system mapping, the geological mapping for the region, both at the scale of 1:250,000, the 1:100,000 scale topographical mapping and data on distribution of threatened species and communities.

The rangelands of the Gascoyne-Murchison region have undergone extensive changes as a result of almost 150 years of pastoral management combined with the introduction of feral animal and alien plant species and altered fire regimes. There are

now significant land conservation and range deterioration problems – in the Murchison region, for example, only about 21% of the land systems are considered to be in good or very good condition (Curry *et* al. 1994). These range deteoration problems are exacerbated by the widespread mining activities in the region. Important introduced animals (other than livestock) include cats and foxes, goats and camels. A major problem plant species from a nature conservation viewpoint is buffel grass.

The following environmental data sets useful for designing a biodiversity monitoring system for the region are available:

- cadastral data and pastoral property infrastructure (of varying quality) in the pastoral plans digital database;
- a derived land-use map that distinguishes leases running solely sheep from those running solely cattle from those running a mix of livestock. The map database also includes details of pastoral lease ownership and management e.g. mining companies, indigenous communities, CALM ;
- 1:250,000 land system mapping for most of the region, in 4 discrete projects that are not yet integrated;
- 1:250,000 vegetation mapping;
- 1:100,000 topographic maps for the entire area, with >70% being digital;
- 1:250,000 geological maps (hard copy only);
- 1:1,000,000 hydrogeology map;
- Landsat TM coverages;
- Coverages of processed NDVI data from 1992 to provide seasonal context
- Historic and current climatic surfaces through the SILO database;
- Fire history, extent and timing based on NOAA AVHRR data.

The results of the southern Carnarvon Basin biogeographic survey are now available. A total of 63 terrestrial sites were sampled during this survey for vascular plants, terrestrial vertebrates (mammals including bats, reptiles and amphibians, birds) and selected invertebrate groups.

The region includes approximately 416 active Western Australian Rangelands Monitoring System (WARMS) sites as well as about 30 fenced exclosures. There are some 2,800 inventory and condition which form part of the resource inventory and condition surveys. Vegetation and soil data were collected at these sites but they do not form part of the on-going re-assessment program.

The biodiversity monitoring proposal

Management Aim

The aim for the nature conservation program in the Gascoyne-Murchison Strategy area can be expressed as: *to maintain the full suite of organisms known to exist in the region.*

A related aim for the Gascoyne-Murchison Strategy is: *to achieve ecologically sustainable management of the rangelands so that the individual properties might receive accreditation as businesses meeting ecological sustainability standards.*

Hypothesis

For a variety of reasons, it is important to develop an hypothesis that might be tested through the monitoring program. The proposed hypothesis is: *that the new landscape configuration and management programs will not lead to further loss of biodiversity at the regional scale.*

Monitoring progress towards CAR

One of the major planned outcomes of the Gascoyne-Murchison Strategy is the establishment of a CAR protected areas system for the region. This reconfiguration of the landscape will have major implications for biodiversity conservation in the region. A major tool in the design of the protected areas system is the 1:250,000 vegetation map database e.g. see Hopkins *et al.* 1996). The gradual improvement of the protected areas system can be monitored using this database. In addition, the protection of entities such as Threatened Ecological Communities and populations of Threatened Species can be monitored. The progress towards CAR is consistent with Indicator 1 proposed by the Audit's rangelands biodiversity monitoring project (see below).

Site/Landscape monitoring

A package of measures that builds constructively on the existing site-based data sets and integrates the resulting data is proposed. The proposed package has the following elements:

- build on the work of the southern Carnarvon Basin biogeographic survey by expanding the coverage of comprehensively-sampled sites, and factoring in resampling at approximately 10 year intervals;
- enhance the WARMS sites by collecting additional (biodiversity-related) data types at all or selected sites (hereafter referred to as WARMS+ sites);
- enhance the WARMS system by adding additional sites in relatively undisturbed areas (reference sites) and in environmentally sensitive areas that may have been omitted to date. The field cost for establishment and assessment of WARMS sites is about $580 per site. An additional amount (of about $100 per site is required for data entry, database management, analysis and reporting;
- establish additional monitoring sites to address specific values in area with special biodiversity values eg Threatened Ecological Communities and areas where the WARMS methodologies are inappropriate e.g. dense riparian vegetation;
- consolidate data on feral animals (especially goat off-take) and kangaroo harvest so that these can be interpreted to give an indication of trends of threatening processes;
- livestock numbers and turn-off from pastoral leases, maintained by the Department of Land Administration (DOLA) as part of the Pastoral Lease Information System (confidential at the lease scale, but can be aggregated to district , catchment or IBRA scales for public release;

- establish monitoring sites on newly acquired conservation lands to study the effects of de-stocking, and recovery of biodiversity values (a pilot project is needed to develop methodology);
- establish monitoring sites to study other significant processes in the landscape eg rehabilitation (using a consistent methodology)
- continue to maintain coverages of NDVI data for seasonal context;
- continue to develop and test the use of NDVI for assessing the broad scale landscape i.e. trend in baseline and Water Use Efficiency products;
- progressively adopt the Landsat Cover Change Change Analysis (LCCA) technique within the region (processing and analysis of the Quobba scene is complete) This provided an estimate of landscape change across broad spatial areas. The cost is approximately $32,000 per scene to produce the basic mosaic,and to analyse the time sequence back to 1982. Once the baseline data sets are in place, the cost is about $10,000 to update the analyses at appropriate time intervals. Each scene covers an area of approximately 180 km by 180 km (~32,400km^2);
- examine the potential to use videography for specific areas of interest;
- Maintain access to weather data on a station-by-station basis and to the SILO climatic surfaces database. Maintain a capacity to model environmental responses.

There is an identified potential to use volunteers and to develop tertiary student programs to undertake some of the monitoring work listed above. There is a growing interest in ecotours in the Gascoyne-Murchison Strategy area, with many of the tour participants keen to contribute to well planned activities. There is also some potential to involve Aboriginal people from the region.

Data management and reporting

A most important and often overlooked component of any monitoring system is data management. A related issue is the reporting process and the necessity for ensuring that the outcomes of the monitoring program as a whole feed back into management.

Progress towards a CAR protected areas system will be reported on a 6-monthly basis for existing accountability requirements.

The existing WARMS database (in ORACLE) could be enhanced through the addition of tables incorporating the data on biodiversity attributes. It will be necessary to refine the reporting mechanisms to reflect the broadened scope of WARMS, and to ensure that the wider audience for the reporting is reached. It is proposed that annual reports will go to the nature conservation management agency (CALM) including the relevant regional management team from that agency, to the Gascoyne-Murchison Strategy Board, the Pastoral Lands Board, the Commissioner for Soil Conservation, the Environmental Protection Authority and other bodies as required, such as the proposed National Rangelands Monitoring Program and Commonwealth and Western Australian State of Environment Reporting.

Relationship to the framework proposed by the TS CRC biodiversity project

The Rangelands biodiversity monitoring project being run by the CRC for Tropical Savannas (TS CRC) has suggested that any useful biodiversity monitoring program in

Australia's rangelands will need to include a number of elements (see below). Briefly, we consider how consistent our proposal biodiversity monitoring in the G-MS area would be:

- *elements of the State and Territory pastoral monitoring programs.* The WARMS network would comprise an important part of the proposed system
- *increased application of remote sensing and improved linkage to both landscape function and biodiversity monitoring.* The proposed system would use NDVI for seasonal context, evaluate the use of NDVI for a crude assessment of landscape function and would progressively use the Land Cover Change Analysis technique for more detailed assessment of land cover and landscape function. Tertiary students would be encouraged to investigate many of the linkages between landscape function and currently collected indicators, as suggested by the TS CRC proposal.
- *additional wildlife (flora and fauna diversity) surveys designed to repeat "landmark" surveys and validate surrogates or indicators.* The proposal would expand the work of the Carnarvon Basin biogeographic survey as well as endeavour to set up a resampling program.
- *regular surveys of populations of a range of selected species, emphasising those most sensitive to prevailing adverse processes.* The proposal suggests that regular monitoring of one or two guilds of birds will indicate trends in biodiversity values as a whole.
- *improved capability to regularly review and use a wide range of biodiversity studies in the rangelands to identify important trends.* The proposal provides a sound, scientific framework and knowledge base to test hypotheses about biodiversity and disturbance. The framework and knowledge base would be marketed within scientific and educational institutions as an attractive starting point for future studies.
- *meta-analysis of existing surveys of exploited, pest and endangered species to enhance early detection of broad scale adverse trends.* These analyses will be carried out as resources permit. The present authors believe, however, that priority should be given to controlling foxes and feral cats in the region.
- *explicit linkage of monitoring programs for Parks and Reserves to their equivalents on lands used for primary production.* The proposal allows for additional WARMS or WARMS+ sites to be established more widely on the conservation estate. Such linkages would be further enhanced by the collection of additional biodiversity information at the existing (and new) sites.
- *surveys or other studies to fill critical gaps for taxa and sites where there is already evidence for significant adverse change.* Threatened species and communities will be monitored as part of the proposed program.
- *influence on plans for enhanced or expanded environmental mapping in the rangelands to agreed standards.* There is a close cooperation between the State agencies involved in developing and maintaining the key environmental data sets for the region. The agencies will be responsive to needs for additional mapping where it will enhance management and biodiversity conservation.

The TS CRC project also makes strong recommendations for the need to validate many of the assumed linkages between the indicators already collected, landscape

function, threatening processes, the area and type of land conserved for nature conservation and change in biodiversity. Such work will require careful investigation, yet is unlikely to be directly funded by state agencies. However, the proposal outlined in this document will enable collaboration between universities and other organisations with a focus on research. The proposed biodiversity monitoring program will provide a useful test bed for external validation work.

The TS CRC project has recommended nine measures or indicators that should make up the biodiversity component of an Australia wide rangeland monitoring system. Here we consider whether (and how) these nine suggested indicators are congruent with the system proposed for the Gascoyne Murchison area.

1) Progress to CAR - Key component of proposed system.

2) Extent of clearing - Not applicable for the most part. If any areas were cleared (legally), data would be avaialable through the Commissioner of Soil Conservation and the Pastoral Lands Board (also Department of Minerals and Energy if cleared for mining).

3) Landscape functionality - Landscape functionality is assessed at the plot scale as part of WARMS (Tongway's LFA technique) and at the broad scale through the prototype NDVI products change in baseline and Water Use Efficiency. It is also inferred through the Land Cover Change Analysis (Landsat) work.

4) Native perennial grass species cover – The G-MS area is primarily a shrubland grazing situation. Perennial grass frequency and shrub population dynamics are assessed directly, at the plot scale, by WARMS (and WARMS+) sites. Perennial cover is assessed using the LCCA technique.

5) Exotic plant species cover – This is assessed at WARMS and WARMS+ sites but this does not provide sufficient spatial coverage to map. Additional observations will be required.

6) Fire sensitive plants and communities - Fire is uncommon throughout much of the Gascoyne-Murchison (except in the limited spinifex grasslands). Current DOLA SRSS fire mapping (using NOAA AVHRR) will indicate the area burnt and timing of fire. Specific, targetted on ground work will be needed to investigate the effects of fire on fire sensitive communities - unless they happen to have WARMS and WARMS+ sites already on them.

7) "Ice-cream" plants - These can be readily monitored on WARMS and WARMS+ sites. Where spatially explicit mapping is required, additional survey work will be required. Existing resource inventory and condition sites (~2,800) would be available for revisiting if required

8) Susceptible vertebrates - 1. mammals – data on the critical weight range mammals will be collated in the course of the program, and a decision made on the need for further survey and monitoring.

9) Susceptible vertebrates - 2. birds - The proposal suggests that regular monitoring of one or two guilds of birds will indicate trends in biodiversity values as a whole. This would be done on selected WARMS and WARMS+ sites.

Concluding remarks

The proposal outlined here is conceptual only. It was prepared in response to presentations at the biodiversity monitoring workshop during the course of the

workshop as a case study to test the monitoring options. Clearly, the implementation of such a proposal will require considerable consultation, and considerable design work to ensure that it is achievable and that it will provide relevant data. Nevertheless, the Gascoyne-Murchison Strategy provides an solid opportunity to trial such a system.

There remains a substantial, unanswered question in the package of measures outlined. What are the additional organisms that might be monitored that will provide a reliable indication of the trends of the biodiversity as a whole? More work will be required to answer this question. However, it our view that one or two guilds of birds may be suitable organisms. One thing is clear, though. There is now a considerable body of evidence that shows that foxes and feral cats are having a very serious impact on the terrestrial fauna. This in a phenomenon that does not require further monitoring. It requires control measures to be implemented as a matter of priority.

References

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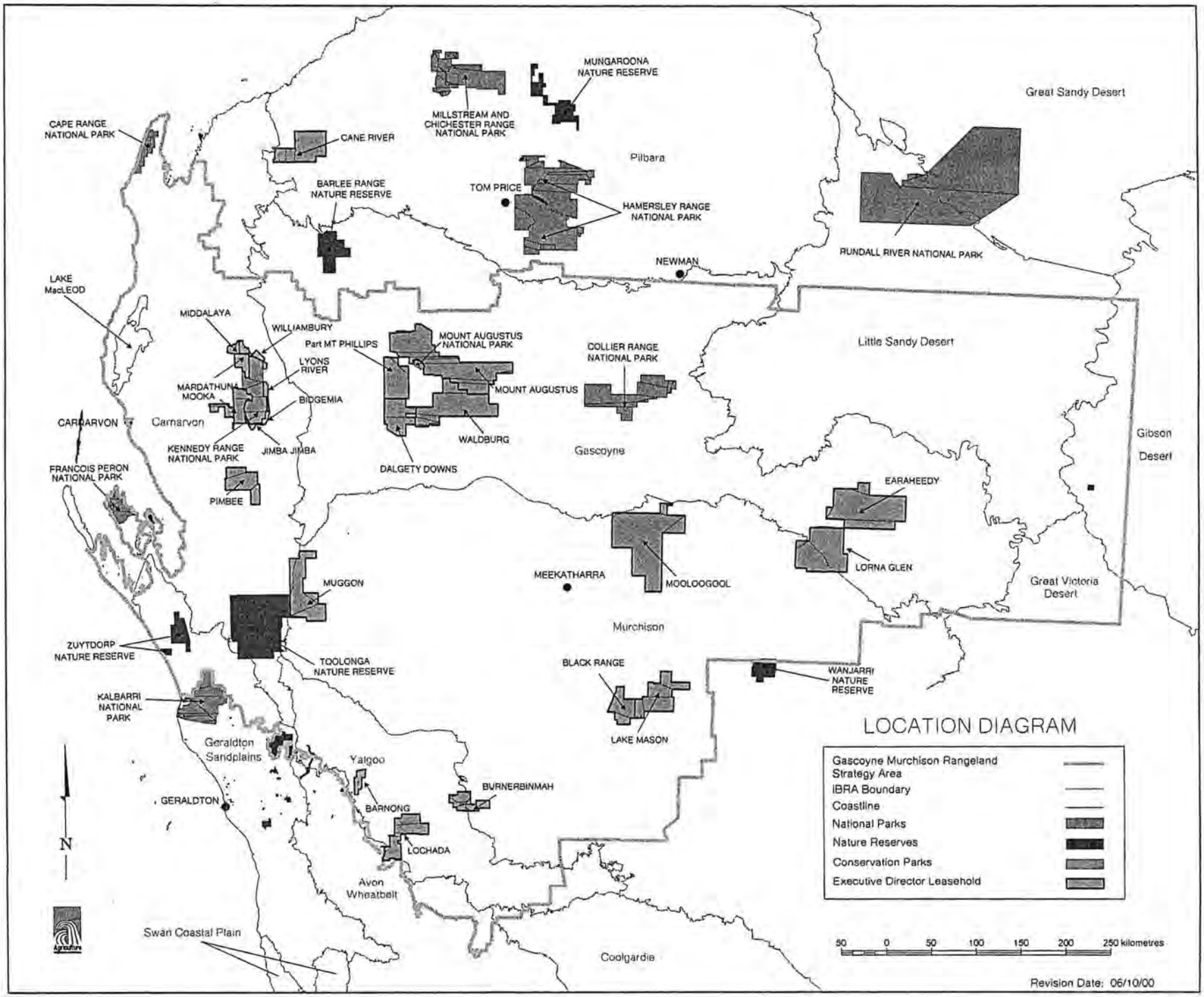
MUNGAROONA NATURE RESERVE
MILLSTREAM AND CHICHESTER RANGE NATIONAL PARK
CAPE RANGE NATIONAL PARK
CANE RIVER
Pilbara
BARLEE RANGE NATURE RESERVE
TOM PRICE
HAMERSLEY RANGE NATIONAL PARK
Great Sandy Desert
RUNDALL RIVER NATIONAL PARK
NEWMAN
LAKE MacLEOD
MIDDALAYA
WILLIAMBURY
Part MT PHILLIPS
MOUNT AUGUSTUS NATIONAL PARK
COLLIER RANGE NATIONAL PARK
Little Sandy Desert
LYONS RIVER
MARDATHUNA MOOKA
BIDGEMIA
MOUNT AUGUSTUS
CARNARVON
Carnarvon
KENNEDY RANGE NATIONAL PARK
JIMBA JIMBA
WALDBURG
Gascoyne
Gibson Desert
DALGETY DOWNS
FRANCOIS PERON NATIONAL PARK
PIMBEE
EARAHEEDY
MEEKATHARRA
MOOLOOGOOL
LORNA GLEN
Great Victoria Desert
MUGGON
Murchison
ZUYTDORP NATURE RESERVE
TOOLONGA NATURE RESERVE
BLACK RANGE
WANJARRI NATURE RESERVE
KALBARRI NATIONAL PARK
LAKE MASON
Geraldton Sandplains
Yalgoo
BURNERBINMAH
GERALDTON
BARNONG
LOCHADA
Avon Wheatbelt
Swan Coastal Plain
Coolgardie
LOCATION DIAGRAM
Gascoyne Murchison Rangeland Strategy Area
IBRA Boundary
Coastline
National Parks
Nature Reserves
Conservation Parks
Executive Director Leasehold
50 0 50 100 150 200 250 kilometres
Revision Date: 06/10/00