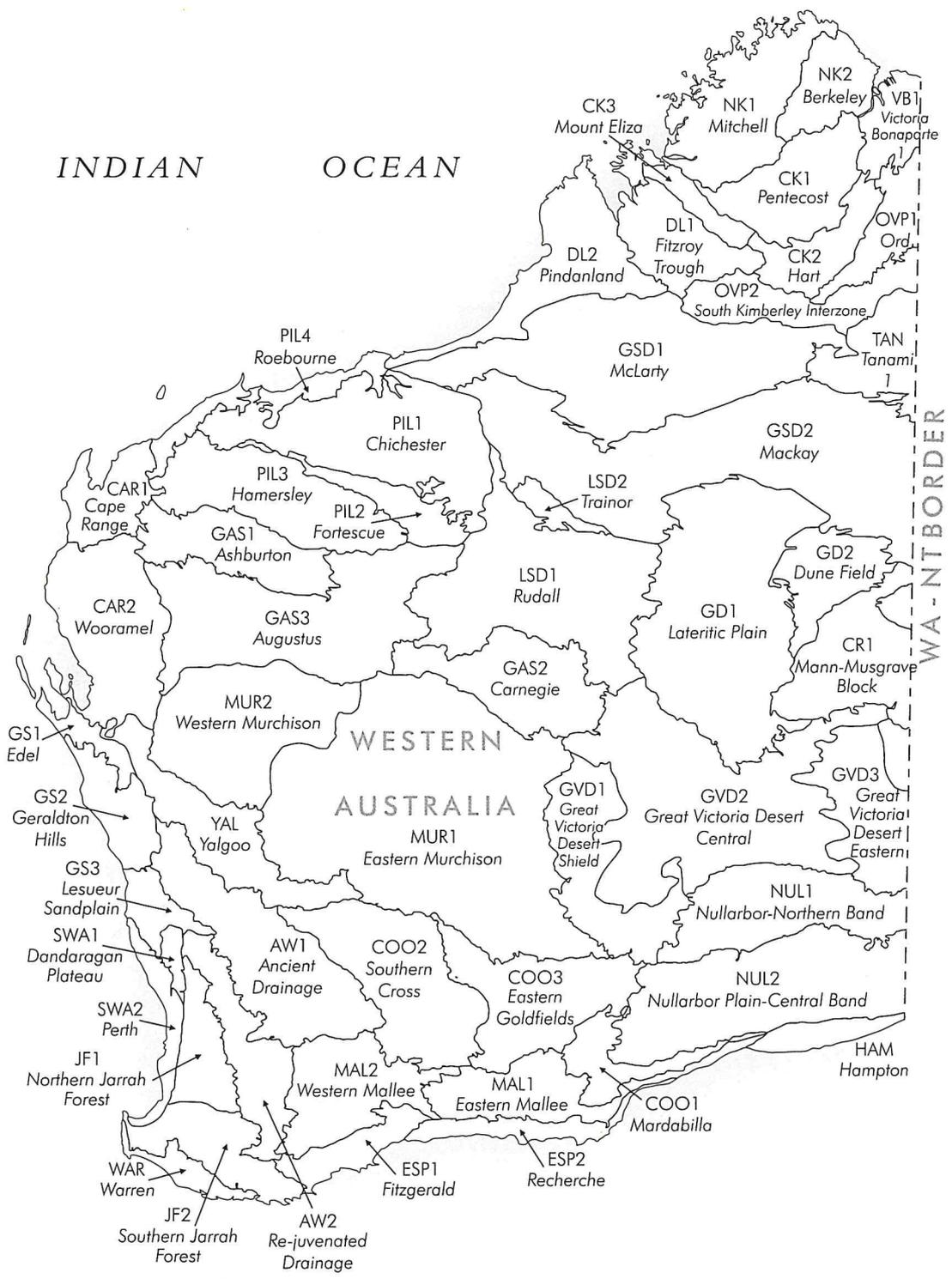


A Biodiversity Audit  
of Western Australia's  
**53** Biogeographical  
Subregions in 2002



*A contribution to the development of Western Australia's  
biodiversity conservation strategy*





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of Western Australia's  
Biogeographical  
Subregions in 2002.

Edited by J.E. May and N.L. McKenzie



Front cover photo: Jewelled gecko by Babs & Bert Wells/CALM.

Back cover photo: Ephemeral waterfall and wetland along Nunyerry Creek in the Chichester Range, Pilbara. Photo by Peter Kendrick.

# Foreword

Western Australia is recognised internationally for the incredible diversity of its native plants, animals and ecosystems. The south-west of the State, for example, is one of the world's 25 biodiversity 'hotspots'. This is because of the large number of species, the fact that a high proportion of them are endemic, and that they face significant threats to their continued survival. But threats to biodiversity are not confined to the south-west – they exist across all the bioregions of the State.

In recognition of this, the State Government is preparing new legislation that will provide a framework for biodiversity conservation and protection for the 21<sup>st</sup> Century. This is part of an integrated approach that also will involve the development of a Biodiversity Conservation Strategy for Western Australia.

In 2001-02, the Department of Conservation and Land Management undertook an extensive audit of the State's terrestrial biodiversity as part of the National Land and Water Resources Audit Biodiversity Assessment. This was undertaken to provide a basis from which to determine the priorities for conservation action and has been published by the National Land and Water Resources Audit in summary form.

This document – A Biodiversity Audit of WA's 53 Biogeographical Subregions 2002 – provides the far more detailed information gathered for each of these subregions during preparation of the national audit. A companion volume – Bioregional Summary of the 2002 Biodiversity Audit for Western Australia – provides a summary of the findings for each of the biogeographic regions. Both volumes are an important contribution to the development of the State's proposed Biodiversity Conservation Strategy and will be significant references for Government agencies, other research institutions, landowners, natural resource management groups, community organisations and people generally interested in conserving the State's natural biodiversity.

Although the 2002 Biodiversity Audit is a 'snapshot in time', over the next few years, gaps in the information will be addressed and the audit will be updated. It is therefore a dynamic process that will continue to add to our knowledge and, combined with sound science, will assist in conserving the State's biodiversity for its intrinsic value and for the benefit of present and future generations.

The State Government acknowledges the contribution of staff of the Department of Conservation and Land Management and the WA Museum to this audit. It also acknowledges the Commonwealth Government for its assistance with funding for the audit through the National Land and Water Resources Audit of the Natural Heritage Trust.

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September 2003

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# Introduction

This report reviews the nature conservation issues that each of Western Australia's 53 biogeographical subregions faced in 2002 (map inside front cover).

The data and interpretations presented are based on first-hand experience, being compiled by the Department of Conservation and Land Management's regional nature conservation staff between July 2001 and January 2002.

By providing an overview of the status of the species and ecosystems in each subregion's lands and waterways in terms of a consistent set of criteria, this report provides a detailed, systematic basis for assessing conservation priorities among different parts of Western Australia. It also indicates the likely consequences for biodiversity if no action is taken.

There are a range of gaps and omissions in this initial edition. For instance, no information is included for subregions that are predominantly in the Northern Territory or South Australia. Information will become more extensive as data continues to be gathered and nature conservation work in Western Australia progresses.

In many instances, the reader will become aware that a subregion or area is under ecological threat from forces ranging from grazing, to salinity, to weed control. Some of these problems are challenging, and in some places they are not being well managed. Where feasible, potential solutions have been outlined. These solutions need to become part of the day-to-day management of our lands and waters if the environment is to improve.

The report was originally compiled as Western Australia's contribution to an audit of nature conservation issues Australia-wide. The project was implemented and managed by the editors, with assistance from Gordon Graham, Terry Rose, Angas Hopkins and Damian Shepherd.

Western Australia signed contracts to complete this statewide biodiversity audit after meeting with representatives from State, Territory and Commonwealth environmental agencies April 2001.

A broader Australia-wide project was defined, carried out and published under the auspices of the Natural Heritage Trust's National Land and Water Resources Audit (Australian Terrestrial Biodiversity Audit 2002). The Australia-wide project was managed by Paul Sattler, Colin Creighton, Rochelle Lawson and Jim Tate (NLWRA), with general direction from an Audit Biodiversity Assessment Advisory Committee comprising Keiran McNamara (Chair, CALM), Gus McGown (Agforce), Ray Nias (WWF), Hugh Possingham (BDAC), Denis Saunders (CSIRO), Christine Schweizer (EA), Geoff Barrett (Birds Australia), Cynthia Maher (NFF), Stephen Hunter (Audit Advisory Council) and Phil Pritchard (AFFA). The regional boundaries are modified from the phytogeographical regionalisation devised by John Beard for Western Australia.

The Western Australian component of the project was funded by NLWRA (below) and CALM. For contributing data and providing helpful assessments of the drafts, the editors and authors thank Western Australian Museum, Perth Herbarium, Western Australian Threatened Species and Communities Unit (WATSCU), Sally Black, David Blood, Jenna Brooker, Andy Chapman, Mike Clarke, Gary Connell, John Dell, Alex George, Stuart Halse, Sheila Hamilton-Brown, Marg Wilke, Bronwen Keighery, Greg Keighery, Kevin Kenneally, Michi Maier, Libby Mattiske, Jelena May, Nathan McQuoid, Shaun Molloy, Alan Payne, David Pearson, Jeff Richardson, Tony Robinson, Geoff Stoneman, John Stretch, Roy Teale, Klaus Tiedemann, John Woinarski, Gordon Wyre and many others.

The editors and authors invite all interested people to make use of the information. We encourage robust discussion on its usages, and invite candid recommendations for improvement. We hope that it will provide a framework for the State biodiversity strategy, and for setting priorities among nature conservation activities 'on the ground'.

Jelena May and Norm McKenzie  
Science Division  
Department of Conservation and Land Management  
Western Australia

# Structure

The synopses follow a standardised structure which was supplied by the National Land and Water Resources Audit (a program funded by the Natural Heritage Trust). A report summarising the results and background to this Australia-wide programme was published in December 2002 (National Land and Water Resources Audit 2002).

*The structure and the categorisations used in the synopses are detailed below.*

## Subregional description and biodiversity values

### Description and area

Area of subregion and an integrated description of geology, landforms, soils and dominant vegetation types.

### Dominant land use

List from one or more of 15 land-use categories in Key b of Appendix B. These include land-uses such as grazing, forestry and conservation.

### Continental Stress Class

Continental Stress Class (Morgan 2001a, Morgan 2001b) values range from 1 (extremely high stress) to 6 (no stress). If the Continental Stress Class value seems inappropriate authors commented on why and what the number should be.

### Known special values in relation to landscape, ecosystem, species and genetic values

Examples include high species or ecosystem diversity, rare features (e.g. volcanic plugs), rare ecosystems (e.g. ironstone range flora), rare species, centres of endemism, and refugia. In each case describe and/or list species or taxonomic groups present.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

Provide information on available sources of information, including databases, results of scientific studies, previous surveys and regional management plans if they exist.

## Ecosystems at risk

### Threatened ecological communities (TECs)

The ecosystems listed here are listed by WATSCU as Threatened Ecological Communities (TECs) AND endorsed by the West Australian Environment Minister. Status data in the synopses are Western Australian.

Identify each threatened ecosystems (based on status across its geographical range), describe it in terms such as its vegetation, dominant species, preferred substrate and landform. For each, list a reliability rank (Rank 1 of Appendix C), relate the identified threatened ecosystem

## Wetlands

### Wetlands of national significance (DIWA listings)

Assess wetlands of national significance including information on wetland name and Directory of Important Wetlands of Australia (Environment Australia 2001) 'code', condition (Rank 2 of Appendix C), trend in condition (Rank 3 of Appendix C), threatening processes (Key e of Appendix B) and reliability of assessment (Rank 1 of Appendix C).

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Assess wetlands of subregional significance (in addition to nationally significant wetlands, above), including information on wetland name, location (grid reference or latitude and longitude), description (Key d of Appendix B), special values (Key c of Appendix B), condition (Rank 2 of Appendix C), trend in condition (Rank 3 of Appendix C), threatening processes (Key e of Appendix B) and reliability of assessment (Rank 1 of Appendix B).

### Riparian zone vegetation

The riparian zone is the area which has a functional influence on watercourses and their biota. Provide information on condition (Rank 2 of Appendix C), trend (Rank 3 of Appendix C), threatening processes (Key e of Appendix B) and reliability of the assessment (Rank 1 of Appendix C).

to NVIS Major Vegetation Sub Groups (Key f of Appendix B), identify its West Australian status (CR = Critically Endangered, E = Endangered, V = Vulnerable, P = Priority), condition (Rank 2 of Appendix C), trend in condition (Rank 3 of Appendix C), and threatening processes (Key e of Appendix B).

### Other ecosystems at risk

Describe any other ecosystems considered at risk by regional ecologists and others, as well as TECs that are not yet formally approved by the Minister for the Environment. The required information for each is the same as for "Threatened Ecological Communities" above.

## Species at risk

### Fauna species at risk

From Commonwealth and State listings of threatened species of fauna (including invertebrates), list species name, status (most recent listing of the Western Australian Wildlife Conservation Act (1950) - CR = Critically Endangered, E = Endangered, V = Vulnerable and P = Priority), condition (Rank 2 of Appendix C), trend in condition (Rank 3), reliability of assessment (Rank 1) and threatening processes (Key e of Appendix B).

### Declared rare and priority flora

For each declared species of plant, list species name, status (most recent listing of the Western Australian Wildlife Conservation Act (1950) - CR = Critically Endangered, E = Endangered, V = Vulnerable and P = Priority), condition (Rank 2 of Appendix C), trend in condition (Rank 3 of Appendix C), reliability of assessment (Rank 1 of Appendix C) and threatening processes (Key e of Appendix B).

Due to constraints of space, time and knowledge, only priority 1 and 2 species are listed in this document so far. Many other priority species, particularly 'priority 4' species in the forest subregions, are considered to be threatened. These have not been included at this stage to maintain consistency with the other WA subregions.

## Analysis of appropriate management scenarios

### Ecosystem reservation priorities

Although most regional ecologists in Western Australia carried this analysis out at the IBRA subregional level, NLWRA requested, for each IBRA V bioregion (Environment Australia 2000; Thackway and Cresswell 1995), a list of: threatened ecological communities, other ecosystems at risk and vegetation associations (Hopkins *et al.* 1996; Shepherd *et al.* 2000) according to their reservation status (IUCN I-IV, V-VI, CALM leasehold or other) and priority for acquisition (L = low, M = medium, H = high).

Although more detailed vegetation mapping is available for some WA subregions, the 1:250 000 scale maps (Hopkins *et al.* 1996; Shepherd *et al.* 2000) which cover the entire State allow consistent inter-regional comparisons.

### Constraints on reservation

List the subregional constraints on the reservation of poorly reserved ecosystem (Key g of Appendix B).

### Bioregional and subregional priority for reserve consolidation

Bioregional NRS Priority based on reservation extent and vegetation cover only (Cummings and Hardy 2001) is

listed in Appendix D, values between 1 and 5. Regional ecologists were asked to examine the value that has been allocated to their bioregion and comment on whether or not this is appropriate. Sometimes other prioritisation is listed (Rank 4i of Appendix C)

### Reserve management standard

Assessment of reserve management, as individual reserves or groups of reserves (Rank 5 of Appendix C).

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species or priority groups of threatened species found off CALM reserve and any relevant recovery plans.

### Appropriate species recovery actions

Specific recovery actions that would or do apply to species or groups identified (Key h of Appendix B). Describing major constraints if necessary.

### Ecosystems and existing recovery plans

Identify specific threatened ecosystems found off CALM reserve and any relevant recovery plans.

### Appropriate ecosystems recovery actions

Specific recovery actions that would or do apply to species or groups identified (Key h of Appendix B). Describing major constraints if necessary.

While these actions have been recommended for the recovery of the particular species or ecosystem, further research may reveal more effective alternatives in some cases. The listing should not be interpreted as an intent by CALM to undertake all these actions.

### Subregion priority for off reserve conservation

Off reserve conservation priority for component subregions for (Rank 6 of Appendix C).

## Conservation actions as an integral part of Natural Resource Management

### Existing NRM actions

Identify existing NRM actions (Key i of Appendix B) in place that contribute significantly to biodiversity conservation and describe type of action and effectiveness.

### Feasible opportunities for NRM

Identify feasible opportunities for NRM actions to specifically address biodiversity (Key i of Appendix B) and describe type of action and effectiveness.

### **Impediments or constraints to opportunities**

Discuss impediments or constraints where opportunities are identified.

### **Subregions where specific NRM actions are a priority to pursue**

Allocate subregions with an NRM priority (Rank 7 of Appendix C).

### **Data gaps**

Gaps in data needed for the identification of biodiversity values and management responses

Identify priority data gaps in knowledge of biodiversity values and management responses (Key a of Appendix B).

### **Sources**

#### **References cited**

Table of references that appear within the text.

#### **Other relevant publications**

Numbers refer to other publications that are relevant to the subregion but are not referred to in the text (see Appendix A).

# Foreword

Western Australia is recognised internationally for the incredible diversity of its native plants, animals and ecosystems. The south-west of the State, for example, is one of the world's 25 biodiversity 'hotspots'. This is because of the large number of species, the fact that a high proportion of them are endemic, and that they face significant threats to their continued survival. But threats to biodiversity are not confined to the south-west – they exist across all the bioregions of the State.

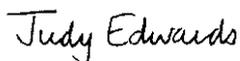
In recognition of this, the State Government is preparing new legislation that will provide a framework for biodiversity conservation and protection for the 21<sup>st</sup> Century. This is part of an integrated approach that also will involve the development of a Biodiversity Conservation Strategy for Western Australia.

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Dr Judy Edwards MLA  
Minister for the Environment



Keiran McNamara  
Executive Director  
Department of Conservation  
and Land Management

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# Avon Wheatbelt 1 (AW1 - Ancient Drainage subregion)

BRETT BEECHAM  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

The Avon Wheatbelt is an area of active drainage dissecting a Tertiary plateau in Yilgarn Craton. Gently undulating landscape of low relief. Proteaceous scrub-heaths, rich in endemics, on residual lateritic uplands and derived sandplains; mixed eucalypt, *Allocasuarina huegeliana* and Jam-York Gum woodlands on Quaternary alluvials and eluvials. Within this bioregion, AW1 is an ancient peneplain with low relief, gently undulating landscape. There is no connected drainage; salt lake chains occur as remnants of ancient drainage systems that now only function in very wet years. Lateritic uplands are dominated by yellow sandplain. Climate is Semi-arid (Dry) Warm Mediterranean. Total area is 6,566,022 ha.

## Dominant land use

Mainly a mixture of (iv) Cultivation – dryland agriculture and (viii) Grazing – Improved pastures, dryland, with lesser areas of (xi) UCL and Crown reserves, (xiii) Conservation, (ii) Rural residential and (vii) Mining (see Appendix B, key b).

## Continental Stress Class

The Continental Stress Class for AW1 is 1.

Known special values in relation to landscape, ecosystem, species and genetic values

**Critical Weight Range Mammals:** 35-7 000 g weight range mammals are threatened by fox predation. Two species are now totally extinct; the Pig-footed Bandicoot and Crescent Nailtail Wallaby. Several species are locally extinct, and some are still extant.

Species	Current Conservation Status (WA)	Status in AW1 Subregion
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Locally Extinct
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Threatened (Endangered)	Locally Extinct
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Locally Extinct
Numbat ( <i>Myrmecobius fasciatus</i> )	Threatened (Vulnerable)	Locally Extinct
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Locally Extinct
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Locally Extinct
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	Threatened (Vulnerable)	Locally Extinct
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Locally Extinct
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Locally Extinct
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Locally Extinct
Quenda ( <i>Isodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Locally Extinct
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent

**Yorkrakine Rock:** A refuge for aquatic invertebrate species that are confined to the scattered granite rock pools of inland south-western Australia. Aquatic plants occur in the pools and mosses and ferns occur at the pool edges and in seepage areas on the rock. The rock outcrop is otherwise mostly bare and surrounding land is mostly cleared. A good example of the granite outcrop pools that occur patchily but broadly across inland south-western Australia, providing "islands" of freshwater habitat in a region dominated by salinised wetlands. A declared rare plant *Myriophyllum petraeum* (Sr) occurs in rock pools on outcrops east of the site. Plants that typically occur in silt in the floor of rock pools such as those at Yorkrakine include quillworts *Isoetes* spp. (six of the eight species in WA granite rock pools are endemic), mudmats *Glossostigma* spp., *Crassula crassula* spp., mudworts *Limosella australis* and waterworts *Elatine gratioloides*. Edges and seepage areas typically support moss pillows, sundews *Drosera* spp., bladderworts

*Utricularia* and *Polypompholyx* spp. and ferns *Ophioglossum* and *Phylloglossum* spp., some of which have special adaptations to their environment.

In the inland of the south-west, the aquatic and mat plant communities are generally confined to rock pools (McComb and Lake 1990; Bayly 1992). Ducks or herons may use the pools for drinking and/or feeding on occasions. The site is the type locality of the frog *Crinia pseudinsignifera* (Main) and other frogs such as *Limnodynastes dorsalis* and *Pseudophryne guentheri* also occur. A substantial diversity of aquatic invertebrates occurs, e.g. *Limnadia* and *Allotrissocladus* spp. Larval stages of the flies *Archaeochlus brundini* and *Archaeochlus* sp. (undescribed), which have their closest relatives in southern Africa, occur in seepages at the site. The black 'water flea' *Daphnia jollyi*, red calanoid copepod *Boeckella opaqua* and fairy shrimp *Branchinella longirostris*, which are endemic to granite rock pools of

WA, also occur at the site's wetlands (McComb and Lake 1990; Bayly 1992). The pseudoscorpion *Synsphyronus elegans* is known only from Yorkkrakine Rock (Harvey 1987, cited in Main 2000). The threatened Yorkkrakine Trapdoor Spider (*Idiosoma nigrum*) is also found in the reserve.

**Granite Outcrops:** Important as seasonal resources and temporary refuge for fauna of surrounding habitats; Black-flanked Rock Wallaby, 4 species of reptiles are restricted to granite outcrops; at least 1320, and possibly 2000 plant species occur on Western Australian granite outcrops – most diverse in the southwest with individual outcrops having up to 200 species, including many endemics; non-vascular flora – for example Yilliminning Rock (AW2) has 36 recorded lichen species, including two restricted to this rock (*Paraparmelia sammyi*, *P. sargentii*); the mygalomorph genus *Teyl* shows extensive radiation in the southern half of WA (Harvey and Main undated), is a Gondwanan relic of “wet” habitats (Main 1996). They occur in meadows on many granite outcrops (Main 2000) and are restricted to granite outcrops as are the larvae chironomid fly *Archaeochlus* (Withers and Edward 1997); recent surveys in the wheatbelt have identified at least 230 species of aquatic invertebrates from granite pools, they contribute significantly to endemism of aquatic fauna of the inland south-west and have particular conservation value for about 50 species restricted to them (Pinder *et al.* 2000).

**Gypsum Dunes:** Plant species are generally unique to each IBRA Region and often smaller scales; several DRF and Priority flora species are restricted to gypsiferous habitats, and at least 80 species are likely to be gypsiphyllic (Mattiske Consulting 1995a).

**Durokoppin Nature Reserve:** High species richness and local endemism of mygalomorph trapdoor spiders. 23 species from 6 families and 12 genera, including several relictual species of “wet” Gondwanan (Mesozoic/Tertiary) heritage.

**Mallee Eucalypts and Melaleuca for Oil Production:** It is seen as vital to identify local *Eucalyptus* and *Melaleuca* species that can be introduced in commercial quantities to develop a plantation based oil mallee industry in the south west of Western Australia. The use of locally endemic species is seen as preferable to minimise the risk of eastern Australian species hybridising with local species and becoming environmental weeds. The use of local species is also seen as providing some fauna habitat benefits as well. Populations of numerous mallee *Eucalyptus* species (Series: Oleosae, Cneoripholiae, Ovulares, Erythronemae, Loxophlebae, Calycogonae and the Spathulata Groups) and *Melaleuca uncinata* sens. lat. and *M. lateriflora* contain individuals that produce higher than average quantities of cineole oil. Identifying these individuals in native vegetation, and introducing their genetic material into breeding programs is critical to the success of this program. The subregion supports significant populations of many of these species.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

There has been no comprehensive subregional or regional biodiversity planning process or systematic review of biodiversity or threats. Several publications have reviewed specific elements of biota at this scale, but not necessarily using IBRA boundaries:

- Beard's Vegetation Mapping at a scale of 1:250 000 – broad structural vegetation types covers all of the subregion (Beard 1972a, Beard 1972e, Beard 1976d, Beard 1979a, Beard 1980b, Beard 1980d, Beard 1980e)
- Conservation status of vegetation types throughout Western Australia. (Hopkins *et al.* 1996) – based on modified Beard vegetation mapping at 1:250 000.
- Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna (Saunders and Ingram 1995)
- Salinity Action Plan (SAP) Biodiversity Survey of the Agricultural Zone (unpublished data; Frost *et al.* 2001) – a systematic, broadscale biogeographic survey of the biota (aquatic invertebrates, waterbirds, terrestrial vascular flora, ground-dwelling arachnids, scorpions, centipedes, small mammals, reptiles and frogs) occurring low in the landscape and under threat from salinity.
- Salinity Risk Mapping completed for the agricultural zone by the Land Monitor project showing both current and predicted extent (Frost *et al.* 2001).
- The Wheatbelt Region of the Department of Conservation and Land Management is currently drafting a Regional Plan that includes a broad analysis of biodiversity values, threatening processes and management priorities (unpublished).

Several other surveys have reviewed elements of the biota and threatening processes at smaller scales within the subregion, or have reviewed the biota of a selection of reserves within the subregion (but not necessarily using IBRA boundaries). This list does not include the numerous surveys that have been completed for individual reserves or single species:

- Botanical values of gypsum dunes in the wheatbelt (Mattiske Consulting 1995a)
- Biological Survey of the Western Australian Wheatbelt Parts 6 (Muir *et al.* 1978), Parts 8 and 9 (Dell *et al.* 1979), Part 10 (Kitchener *et al.* 1979), Parts 11 and 12 (Chapman *et al.* 1980).
- Wallatin Creek (CSIRO) – numerous studies of elements of the biota and threatening processes within the Wallatin Creek catchment. See Saunders (1995) for a brief overview, however there are numerous other references to work from the study area.
- Conservation values of small reserves in the wheatbelt of Western Australia (Safstrom 1995; Safstrom *et al.* 1996; Ecoscape 2000) - brief survey of biological and human use values of numerous reserves using a standard methodology to assist with land use planning.
- Management of Granite Outcrops Symposium, Hyden, April 16-18, 1999 (Withers and Hopper 2000)
- Regional Assessment of the Wheatbelt of Western Australia: Central Wheatbelt (Wooller and Moore 2000) (part of AW1)
- A review of grassy woodlands in the Western Australian Wheatbelt (Mattiske Consulting 1995b) –

literature review, survey of possible sites to document flora and a report detailing location and describing floristics.

- Production of habitat hollows by wheatbelt eucalypts (Rose 1993) – survey of tree diameter, age and hollow formation of wandoo and salmon gum from across the major east-west rainfall gradient.
- Some nature reserves of the Western Australian wheatbelt Part 1-28 (Muir 1978-1979) – brief surveys of various reserves providing a vegetation

map and description, and list of fauna, human uses and other values.

- “Native Vegetation Handbook” series for various Shires in the Avon Basin (eg. Weaving 1995) – contain basic information on and lists of native vegetation, wetlands, fauna and flora, land resources and land management and land degradation issues.

## Wetlands

### Wetlands of National Significance (DIWA Listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Yorakine Rock Pools, WA005	B10	i	iii	iii	x (water diversion via low walls to water storage tanks; interest in further walling), xii (excessive human disturbance - damage by off-road vehicles to vegetation mats; vandalism), xi (fouling by stock and rabbits), vi (bridal creeper <i>Asparagus asparagoides</i> ), ix

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Process <sup>6</sup>
Mollerin Lake System	553000E 6627000N Zone 50	B8 (An area of lowland woodlands and northern gypsophilous communities in very good condition).	i	iii	iii	iii	x
Buntine to Marchagee Braided Saline Drainage Line	465000E 6681000N Zone 50	B8 (Covers the northern gypsophilous communities of these drainage systems).	i	ii	iii	iii	ix, x
Cowcowing Lake	531000E 6567000N Zone 50	B8 (Best area of extensive Atriplex shrublands with associated lowland woodland communities of the large lakes of this region).	i	ii	iii	iii	ix, x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

According to the State of the Environment Report 1998, virtually all "fringing vegetation" along substantial streamlines (defined as any stream shown on a 1:50 000 topographic map) is in "very poor"

condition (land cleared of virtually all natural vegetation) (Wallis and Higham 1998).

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	i	iii	iii	ii, iv, vi, viii, ix, x, i, v, xi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Plant Assemblages of the Billeranga System - <i>Melaleuca fillifolia</i> – <i>Allocasuarina campestris</i> thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes; <i>Eucalyptus loxophleba</i> woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by <i>Dodonaea inaequifolia</i> over red/brown loamy soils on the slopes and ridges.	V	15	iii	iii	iii	iv, vi
Plant assemblages of the Inering System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over chert and granite; <i>Allocasuarina campestris</i> thicket with scattered <i>Acacia acuminata</i> and <i>Allocasuarina huegeliana</i> over brown sandy loam over stony and lateritic summits and slopes; <i>Acacia</i> spp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; <i>Melaleuca cardiophylla</i> thicket with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus salmonophloia</i> over granite on the lower slopes and foothills; and <i>Eucalyptus loxophleba</i> woodland over clay loam on the foothills.	V	26	ii	iii	iii	i, iv, vi, ii
Plant assemblages of the Koolanooka System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over red loam on hill slopes; Shrubs and emergent mallees on shallow loam red over massive ironstone on steep rocky slopes; <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> spp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the upper slopes and summits; <i>Eucalyptus loxophleba</i> woodland over scrub on the footslopes; and mixed <i>Acacia</i> spp. scrub on granite.	V	26	ii	iii	iii	i, iv, vi, vii, xii (mining)
Plant assemblages of the Moonagin System (Beard 1976d) - <i>Acacia</i> scrub on red soil on hills; <i>Acacia</i> scrub with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus oleosa</i> on red loam flats on the foothills.	V	14	iii	iii	iii	i, iv, vi
Perched fresh-water wetlands of the northern Wheatbelt dominated by extensive stands of living <i>Eucalyptus camaldulensis</i> (River Red Gum) across the lake floor.	X	42	i	i	iii	i, vi, ix, x
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	CR	42	ii	ii	iii	v, vi, ix, x, i
Ferricrete floristic community (Rocky Springs type) - Tall shrublands on seasonally inundated red brown sandy loams over ironstone dominated by <i>Dryandra stricta</i> , <i>Allocasuarina campestris</i> , <i>Labichea lanceolata</i> and <i>Acacia blakelyi</i> on the Eneabba Plain. It also comprises a rich herbaceous layer.	EN	28	ii	iii	iii	viii, x, i, v, vi, vii
Assemblages of the organic mound springs of the Three Springs region	EN	N/A	ii	iii	iii	i, iv, vi, v, vii, ix, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk\*

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Perched clay wetlands of the Wheatbelt region dominated by <i>Eragrostis australasica</i> and <i>Melaleuca strobophylla</i> across the lake floor	DD	42	ii	iii	iii	vi, ix, x, v, i
Dense thickets of <i>Melaleuca</i> spp. with emergent <i>Eucalyptus erythronema</i> var. <i>marginata</i> and <i>Eucalyptus transcontinentalis</i> .	P	15	ii	iii	iii	vi, ix, x, xii (recreation), v
Tall emergent <i>Eucalyptus salmonophloia</i> over <i>Allocasuarina huegeliana</i> tall closed forest over <i>Acacia acuminata</i> mid high	P	16	iii	iii	iii	x, v, vi

isolated trees over <i>Alyxia buxifolia</i> tall sparse shrubland over <i>Pteridium esculentum</i> very tall closed fernland over various sparse forbland. Occurs in a drainage line near the base of a granite inselberg.						
Microbial, invertebrate and plant assemblages of natural saline seeps.	V	N/A	ii	iii	iii	vii, ix, x, vi

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

\*Specific communities are listed in the tables above, however vegetation types on dissection valley floors and lower slopes are more than 90% cleared for agriculture and comprise about 1/3 of the total number of the vegetation types in the subregion. The remaining areas of valley floor woodlands are subject to secondary salinity. Therefore, a further 20 to 30 vegetation types in this subregion should be treated as being "at risk"

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Phascogale calura</i>	E	ii	iv	iii	v, i, ii
<i>Petrogale lateralis lateralis</i>	V	ii	v	iii	v, i, ii
<b>Schedule 1: Rare/likely to become extinct, Div 2 (Birds)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, ix, x, vi
<i>Leipoa ocellata</i>	V	ii	iii	iii	i, ii, vii, vi, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia stokesii badia</i>	V	ii	iii	iii	i, ii, iv, v
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 7 (ARACHNIDS)</b>					
<i>Idiosoma nigrum</i>	V	ii	iii	iii	i, ii, iv, vii
<i>Kwonkan eboracum</i>	CR	ii	vi	iii	i, ii
<i>Teyl</i> sp. (BY Main 195312683, 1984/13)	CR	i	ii	iii	iv, v, vii, x, xii (gravel extraction)
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	ii	iv	iii	i, ii,
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i> (south west population)	SP	i	ii	iii	i, iv, v
<i>Morelia spilota imbricata</i>	SP	ii	iii	iii	i, iv, v
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Acanthiza iredalei iredalei</i>		ii	iv	iii	iv
<i>Platycercus icterotis xanthogenys</i>	2	ii	iii	iii	i, iv
<i>Ninox connivens connivens</i>	2	ii	iii	iii	i, ii,
<i>Lerista viduata</i>	1	ii	vi	ii	i, ii, iv, v, vii
<i>Daphnia jollyi</i>	1	ii	vi	iii	ix, x
<i>Limnocythere porphyretica</i>	1	ii	vi	iii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Flora

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Acacia aprica</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia ataxiphylla</i> subsp. <i>magna</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia lobulata</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia sciophanes</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia subflexuosa</i> subsp. <i>capillata</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia vassalii</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia volubilis</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Banksia cuneata</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Caladenia drakeoides</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Caladenia hoffmanii</i> subsp. <i>hoffmanii</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Chorizema humile</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Cyphanthera odgersii</i> subsp. <i>occidentalis</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Daviesia bursarioides</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Daviesia cunderdin</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Daviesia euphorbioides</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila nivea</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila pinnatifida</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila resinosa</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila veneta</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila viscida</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea pythara</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea scapigera</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Hemiandra gardneri</i>	CR	ii	iii	iii	i, ii, iv, vi, vii
<i>Hemiandra rutilans</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Myriophyllum lapidicola</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Philotheca basistyla</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Symonanthus bancroftii</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Tetralochea deltoidea</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Thelymitra manginii</i> ms	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia albida</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia spicata</i> subsp. <i>squamosa</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia lanuginophylla</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Caladenia wanosa</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis wonganensis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Darwinia acerosa</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Darwinia masonii</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Darwinia</i> sp. Carnamah (J.Coleby-Williams 148)	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila virens</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus brevipes</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus crispata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus crucis</i> subsp. <i>crucis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus pruiniramis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Gastrolobium glaucum</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Glyceria drummondii</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea christineae</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea murex</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Hakea aculeata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Jacksonia quairading</i> ms	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Leucopogon marginatus</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Melaleuca sciotostyla</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Philotheca wonganensis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Rhizanthella gardneri</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Stylidium coroniforme</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia huqhanii</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia denticulosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia recurvata</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Acacia semicircularis</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Allocasuarina fibrosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Boronia adamsiana</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Calectasia pignattiana</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis dielsii</i> subsp. <i>teres</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Darwinia chapmaniana</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus synandra</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x

<i>Halosarcia bulbosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Hensmania chapmanii</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Microcorys eremophiloides</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Pityrodia scabra</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Rhagodia acicularis</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Roycea pycnophylloides</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Styloidium merrallii</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Thomasia glabripetala</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Wurmbea tubulosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<b>PRIORITY 1</b>					
<i>Acacia caesariata</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia cochlocarpa</i> subsp. <i>velutinos</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia sclerophylla</i> var. <i>tereliuscula</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia tetraeneura</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dampiera scaevolina</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus myriadena</i> subsp. <i>parviflora</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Frankenia glomerata</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Gastrolobium diablophyllum</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Guichenotia seorsiflora</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Verticordia huegellii</i> var. <i>tridens</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia caesariata</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>PRIORITY 2</b>					
<i>Acacia cowaniana</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia sclerophylla</i> var. <i>pilosa</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Boronia ericifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus recta</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Fitzwillia axilliflora</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>Other Species at Risk</b>					
<i>Boronia rhomboidea</i>		ii	iii	iii	i, ii, iv, vi, vii, ix, x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
	Plant Associations of the Billeranga System - <i>Melaleuca filifolia</i> - <i>Allocasuarina campestris</i> thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes; <i>Eucalyptus loxophleba</i> woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by <i>Dodonaea inaequifolia</i> over red/brown loamy soils on the slopes and ridges.	100	1897	4	0	4	H
	Perched clay wetlands of the Wheatbelt region dominated by <i>Eragrostis australasica</i> and <i>Melaleuca strobophylla</i> across the lake floor	100	40	0	0	0	H

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
	Plant assemblages of the Inering System (Beard 1976d) <i>Allocasuarina campestris</i> scrub over chert and granite; <i>Allocasuarina campestris</i> thicket with scattered <i>Acacia acuminata</i> and <i>Allocasuarina huegeliana</i> over brown sandy loam over stony and lateritic summits and slopes; <i>Acacia</i> sp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; <i>Melaleuca cardiophylla</i> thicket with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus salmonophloia</i> over granite on the lower slopes and foothills; and <i>Eucalyptus loxophleba</i> woodland over clay loam on the foothills.	100	650	0	0	0	H
	Plant assemblages of the Koolanooka System (Beard 1976d) <i>Allocasuarina campestris</i> scrub over red loam on hill slopes; Shrubs and emergent mallees on shallow loam red over massive ironstone on steep rocky slopes; <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> sp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the	100	5444	0	0	0	H

	upper slopes and summits; <i>Eucalyptus loxophleba</i> woodland over scrub on the footslopes; and mixed <i>Acacia</i> sp. scrub on granite.						
	Dense thickets of <i>Melaleuca</i> spp. with emergent <i>Eucalyptus erythronema</i> var. <i>marginata</i> and <i>Eucalyptus transcontinentalis</i> .	100	15	0	15 (100%)	0	H
	Plant assemblages of the Moonagin System (Beard 1976d) <i>Acacia</i> scrub on red soil on hills; <i>Acacia</i> scrub with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus oleosa</i> on red loam flats on the foothills.	100	1435	0	0.4 (<1%)	0	H
	Perched fresh-water wetlands of the northern Wheatbelt dominated by extensive stands of living <i>Eucalyptus camaldulensis</i> (River Red Gum) across the lake floor.	100	28	0	0	0	H
	Assemblages of the organic mound springs of the Three Springs region	100	11.97	0	0.049	0	H
	Tall emergent <i>Eucalyptus salmonophloia</i> over <i>Allocasuarina huegeliana</i> tall closed forest over <i>Acacia acuminata</i> mid high isolated trees over <i>Alyxia buxifolia</i> tall sparse shrubland over <i>Pteridium esculentum</i> very tall closed fernland over various sparse forbland. Occurs in a drainage line near the base of a granite inselberg.	100	0.125	0	0.125 (100%)	0	M
	Microbial, invertebrate and plant assemblages of natural saline seeps.	100	25	0	0	0	H
	Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	97	421	100	0	100	H
2048	Shrublands; scrub-heath in the Mallee Region	0.0	4.1	0.0	0.0	0.0	L
37	Shrublands; teatree thicket	0.0	10.6	0.0	0.0	0.0	L
365	Shrublands; bowgada & jam scrub with scattered York gum & red mallee	0.0	14.2	0.0	0.0	0.0	L
949	Low woodland; banksia	0.0	14.6	0.0	0.0	0.0	L
1059	Mosaic: Medium woodland; salmon gum & gimlet/Shrublands; mallee <i>Eucalyptus longicornis</i> & <i>E. sheathiana</i> scrub	100.0	15.7	0.0	0.0	0.0	H
1164	Mosaic: Shrublands; scrub-heath on sandplain (banksia-xylomelum alliance) in the Geraldton Sandplain & Avon-Wheatbelt Regions/Shrublands; <i>Allocasuarina campestris</i> thicket	100.0	22.6	0.0	0.0	0.0	H
<b>Beard Veg Assoc</b>	<b>Vegetation Association Description</b>	<b>% of total extent in IBRA subregion</b>	<b>Area in IBRA subregion (ha)</b>	<b>% in IUCN Reserve</b>	<b>% in Non-IUCN Reserve</b>	<b>Total % Area in CALM Estate</b>	<b>Priority</b>
412	Succulent steppe with scrub; teatree ( <i>Melaleuca thyioides</i> ?) over samphire	0.4	24.5	0.0	0.0	0.0	L
1025	Mosaic: Medium woodland; York gum, salmon gum & morrel/Succulent steppe; saltbush & samphire	81.8	34.5	0.0	0.0	0.0	H
1080	Succulent steppe with mallee & thickets; Mallee and <i>Melaleuca uncinata</i> thickets on salt flats	54.1	49.9	0.0	0.0	0.0	H
695	Shrublands; <i>Allocasuarina campestris</i> scrub	100.0	52.3	0.0	0.0	0.0	H
538	Shrublands; <i>Acacia brachystachya</i> scrub	0.0	57.5	0.0	0.0	0.0	L
392	Shrublands; <i>Melaleuca thyioides</i> thicket	7.4	115.4	0.0	0.0	0.0	M
438	Shrublands; dodonaea scrub	100.0	178.1	0.0	0.0	0.0	H
1156	Shrublands; <i>Allocasuarina campestris</i> thickets with scattered jam & casuarina	100.0	197.0	0.0	0.0	0.0	H
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges	0.3	197.3	0.0	0.0	0.0	L
936	Medium woodland; salmon gum	0.0	236.0	0.0	0.0	0.0	L
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	0.1	282.6	0.0	0.0	0.0	L
1058	Shrublands; York gum & <i>Eucalyptus gonglocarpa</i> mallee scrub	100.0	296.4	0.0	0.0	0.0	H
385	Shrublands; bowgada & jam scrub with scattered York gum	0.9	321.9	0.0	0.0	0.0	L
516	Shrublands; mallee scrub, black marlock	0.1	350.8	0.0	0.0	0.0	L

1063	Medium-Low woodland; York gum & cypress pine ( <i>Callitris columellaris</i> )	0.3	387.1	0.0	0.0	0.0	L
145	Mosaic: Medium woodland; York gum & salmon gum/Shrublands; thicket, acacia-casuarina-melaleuca alliance	100.0	402.1	0.0	0.0	0.0	H
2081	Shrublands; bowgada and associated spp. scrub	0.0	715.8	0.0	0.0	0.0	L
40	Shrublands; acacia scrub, various species	0.2	723.7	0.0	0.0	0.0	L
691	Shrublands; <i>Dryandra quercifolia</i> & <i>Eucalyptus</i> spp. thicket	1.7	736.1	0.0	0.0	0.0	L
1271	Bare areas; claypans	1.0	984.8	0.0	0.0	0.0	L
960	Shrublands; mallee scrub, redwood & black marlock	6.4	1,033.6	0.0	0.0	0.0	M
314	Succulent steppe with open woodland; York gum over saltbush	16.8	1,448.5	0.0	0.0	0.0	M
1155	Mosaic: Medium woodland; York gum /Shrublands; <i>Allocasuarina campestris</i> thicket	100.0	3,300.2	0.0	0.0	0.0	H
693	Mosaic: Low woodland: <i>Allocasuarina huegelliana</i> over mallee and acacia scrub/ <i>Allocasuarina campestris</i> thicket	100.0	3,494.0	0.0	0.0	0.0	H
325	Succulent steppe; saltbush & samphire	6.2	3,795.9	0.0	0.0	0.0	L
355	Shrublands; bowgada & jam scrub with scattered York gum & red mallee	6.5	4,266.0	0.0	0.0	0.0	L
1067	Medium woodland; salmon gum, morrel, gimlet & rough fruited mallee	30.9	4,849.1	0.0	0.0	0.0	M
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>	0.4	5,226.5	0.0	0.0	0.0	L
419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket	2.0	6,580.5	0.0	0.0	0.0	L
1198	Mosaic: Succulent steppe with thicket; <i>Melaleuca thyioides</i> over samphire/Shrublands; bowgada open scrub	52.8	9,705.8	0.0	0.0	0.0	M
495	Shrublands; thicket, Jam & <i>Allocasuarina acutivalvus</i> on ironstone	100.0	9,774.2	0.0	0.0	0.0	M
Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
552	Shrublands; <i>Casuarina acutivalvus</i> & calothamnus (also melaleuca) thicket on greenstone hills	35.6	13,450.6	0.0	0.0	0.0	L

### Subregional constraints in order of priority (see Appendix B, key g)

**Irreplacibility and Limited Opportunity to Meet CAR Criteria:** The majority of ecosystems have been extensively cleared well below CAR thresholds. Within the agricultural zone virtually all remnants are important for biodiversity conservation and building towards CAR thresholds.

**Other:** Many ecosystems low in the landscape are under threat from rising watertables. Most lowland communities, including tall woodlands, mallee and *Melaleuca* shrublands, freshwater and naturally saline wetland systems will be lost. These systems support over 1,500 plant species, of which 450 are endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.

**Economic Constraints:** Insufficient resources to acquire and manage an increased conservation estate.

**Competing Land Uses:** Whilst some opportunities exist to add to the conservation estate through the vesting of unallocated Crown land and the re-vesting of other

Crown reserves, there is some competition with other government agencies and local government for these areas. The process is also lengthy and somewhat ad hoc.

**Other:** Inadequate systematic knowledge of biodiversity values at an appropriately fine scale.

### Bioregional and subregional priority for reserve consolidation

Category 1 IBRA Reservation Class 1 (<2% and <30% of native vegetation cover remaining – see Appendix D. AW1 – 1a (Appendix C, rank 4: clearing has been extensive, and rising saline groundwater threatens up to 30% of the landscape).

## Reserve management standard

The Reserve Management Standard for the bioregion is poor. A significant threatening process i.e. rising saline groundwater, is not managed (except in very localised circumstances) and is currently and projected to cause major declines and extinctions in lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems. Several reserves are routinely fox baited (part of Dryandra Woodland, Tutanning Nature Reserve, Boyagin Nature Reserve, Mt Caroline Nature Reserve, Mt Stirling Nature Reserve, Nangeen Hill Nature Reserve, Dongolocking Nature Reserve, Gundaring Nature Reserve, East Yornanning Nature Reserve, Weam

Nature Reserve, Pingeculling Nature Reserve, Jalaran Nature Reserve – approximately 9.7% (17 600 ha) of the conservation estate is baited). Biodiversity values are poorly identified. The recent Salinity Action Plan Biodiversity Survey project represents the first systematic overview of the region's biota, and is due for publication in late 2002. However there is no systematic fine scale vegetation mapping (1:25 000 or better); the best available is Beard's at 1:250 000. Some reserves have had vegetation maps prepared, but there is little consistency between methodologies. Inappropriate fire regimes are also a major threat to biodiversity, but little is known of the response of individual species to fire. Fire histories for all reserves are also poorly known and documented.

## Off reserve conservation

### Priority species or groups

CWR mammal Species	Current Conservation Status (WA)	Status in AW1 Subregion	Recovery Plan
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Locally Extinct	No
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)	No
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Threatened (Endangered)	Locally Extinct	National
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Locally Extinct	State
Numbat ( <i>Myrmecobius fasciatus</i> )		Locally Extinct	National & State
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Locally Extinct	National
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Locally Extinct	No

CWR mammal Species	Current Conservation Status (WA)	Status in AW1 Subregion	Recovery Plan
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	Threatened (Vulnerable)	Locally Extinct	No
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)	No
Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> )	Threatened (Vulnerable)	Locally Extinct	No
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Locally Extinct	No
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Quenda ( <i>Isodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent	No

### Coordinated Conservation Plan – Western Wheatbelt (Action Plan for Australian Birds 2000)

Species	Status
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	Locally Extinct
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Endangered
Malleefowl ( <i>Leipoa ocellata</i> )	Vulnerable
Australian Bustard ( <i>Ardeotis australis</i> )	Near Threatened
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	Near Threatened
Hooded Plover (western) ( <i>Thinornis rubricollis tregellasi</i> )	Near Threatened
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	Near Threatened
Barking Owl (southern) ( <i>Ninox connivens connivens</i> )	Near Threatened
Shy Heathwren (western) ( <i>Hylacola cauta whitlocki</i> )	Near Threatened
Rufous Fieldwren (western wheatbelt) ( <i>Calamanthus campestris montanellus</i> )	Near Threatened
White-browed Babbler (western wheatbelt) ( <i>Pomatostomus superciliosus ashbyi</i> )	Near Threatened
Crested Shrike-tit (western) ( <i>Falcunculus frontatus leucogaster</i> )	Near Threatened
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis oberon</i> )	Near Threatened
Crested Bellbird (southern) ( <i>Oreoica gutturalis gutturalis</i> )	Near Threatened

Other priority groups and action plans include:

Western Wheatbelt Coordinated Conservation Plan for 14 bird species (Garnett and Crowley 2000)

Flora and fauna of granite outcrops – numerous species including Black-flanked Rock-wallaby, *Tyl* spp.,

*Caladenia hoffmanii* subsp. *graniticola*, and *Daphnia jollyi*.

District Threatened Flora Recovery Team – the Moora, Merredin and Katanning District TFRT already cover the following species with IRPs - *Acacia aprica*, *Acacia sciophanes*, *Chorizema humile*, *Cyphanthera odgersii* subsp. *occidentalis*, *Daviesia cunderdin*, *Daviesia euphorbioides*, *Drakonorchis drakeoides*, *Eremophila nivea*, *Eremophila veneta*, *Grevillea curviloba* subsp. *incurva*, *Grevillea dryandroides* subsp. *Dryandroides*, *Grevillea scapigera*,

*Hemiandra gardneri*, *Symonanthus bancroftii*, and *Tetratheca deltoidea*.

Threatened flora of roadsides – for example *Boronia adamsiana* and *Acacia volubilis*.

Threatened flora of lowland communities - including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems e.g. *Eremophila viscida*, *E. resinosa*.

Threatened Flora Species	Status EPBC Act	Status WA
<i>Acacia aprica</i>	E	CR
<i>Acacia ataxiphylla</i> subsp. <i>magna</i>	E	CR
<i>Acacia denticulosa</i>	V	V
<i>Acacia lanuginophylla</i>	E	E
<i>Acacia lobulata</i>	E	CR
<i>Acacia recurvata</i>	E	-
<i>Acacia sciophanes</i>	E	CR
Threatened Flora Species	Status EPBC Act	Status WA
<i>Acacia semicircularis</i>	V	V
<i>Acacia subflexuosa</i> subsp. <i>capillata</i>	E	CR
<i>Acacia vassalii</i>	E	CR
<i>Acacia volubilis</i>	E	CR
<i>Allocasuarina fibrosa</i>	V	V
<i>Banksia cuneata</i>	E	CR
<i>Boronia adamsiana</i>	V	V
<i>Boronia rhomboidea</i>	NO STAT	-
<i>Caladenia hoffmanii</i>	E	CR
<i>Caladenia wanosa</i>	V	-
<i>Calectasia arnoldii</i>	V	-
<i>Chorizema humile</i>	E	-
<i>Conostylis dielsii</i> subsp. <i>teres</i>	E	-
<i>Conostylis wonganensis</i>	E	E
<i>Cyphanthera odgersii</i> subsp. <i>occidentalis</i>	E	CR
<i>Darwinia acerosa</i>	E	-
<i>Darwinia chapmaniana</i>	E	-
<i>Darwinia masonii</i>	V	-
<i>Darwinia</i> sp. Carnamah (J.Coleby-Williams 148)	E	-
<i>Daviesia bursarioides</i>	E	-
<i>Daviesia cunderdin</i>	E	CR
<i>Daviesia euphorbioides</i>	E	CR
<i>Drakonorchis drakeoides</i>	E	-
<i>Eremophila nivea</i>	E	-
<i>Eremophila pinnatifida</i>	E	CR
<i>Eremophila resinosa</i>	E	CR
<i>Eremophila veneta</i>	E	CR
<i>Eremophila virens</i>	E	E
<i>Eremophila viscida</i>	E	CR
<i>Eucalyptus brevipes</i>	E	E
<i>Eucalyptus crispata</i>	V	-
<i>Eucalyptus crucis</i> subsp. <i>crucis</i>	V	-

<i>Eucalyptus pruiniramis</i>	E	-
<i>Eucalyptus rhodantha</i> var. <i>petiolaris</i>	E	-
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	V	-
<i>Eucalyptus synandra</i>	V	V
<i>Gastrolobium glaucum</i>	E	E
<i>Glyceria drummondii</i>	E	-
<i>Grevillea christineae</i>	E	E
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	E	-
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	E	CR
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	E
<i>Grevillea murex</i>	E	-
<i>Grevillea pythara</i>	E	CR
<i>Grevillea scapigera</i>	E	CR
<i>Hakea aculeata</i>	V	E
<i>Halosarcia bulbosa</i>	V	-
<i>Hemiandra gardneri</i>	E	CR
<i>Hemiandra rutilans</i>	E	CR
<b>Threatened Flora Species</b>	<b>Status EPBC Act</b>	<b>Status WA</b>
<i>Hemigenia viscida</i>	V	-
<i>Hensmania chapmanii</i>	V	-
<i>Jacksonia quairading</i>	E	
<i>Leucopogon marginatus</i>	E	E
<i>Melaleuca sciotostyla</i>	E	E
<i>Microcorys eremophiloides</i>	V	V
<i>Myriophyllum lapidicola</i>	E	CR
<i>Philotheca basistyla</i>	E	CR
<i>Philotheca wonganensis</i>	E	E
<i>Pityrodia scabra</i>	E	V
<i>Rhagodia acicularis</i>	V	V
<i>Rhizanthella gardneri</i>	E	E
<i>Roycea pycnophylloides</i>	E	-
<i>Stylidium coroniforme</i>	E	-
<i>Stylidium merrallii</i>	V	V
<i>Symonanthus bancroftii</i>	E	CR
<i>Tetralthea deltoidea</i>	E	CR
<i>Thelymitra manginii</i>	E	-
<i>Thomasia glabripetala</i>	V	-
<i>Verticordia albida</i>	E	-
<i>Verticordia hughanii</i>	E	E
<i>Verticordia spicata</i> subsp. <i>squamosa</i>	E	-
<i>Wurmbea tubulosa</i>	E	-

Priority 1 and 2 flora species	Priority
<i>Acacia caesariata</i>	1
<i>Acacia cochlocarpa</i> subsp. <i>velutinos</i>	1
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	1
<i>Acacia tetraeneura</i>	1
<i>Dampiera scaevolina</i>	1
<i>Eucalyptus myriadena</i> subsp. <i>parviflora</i>	1
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	1

<i>Frankenia glomerata</i>	1
<i>Gastrolobium diablophyllum</i>	1
<i>Guichenotia seorsiflora</i>	1
<i>Verticordia huegelii</i> var. <i>tridens</i>	1
<i>Acacia cowaniana</i>	2
<i>Acacia sclerophylla</i> var. <i>pilosa</i>	2
<i>Boronia ericifolia</i>	2
<i>Eucalyptus recta</i>	2
<i>Fitzwillia axilliflora</i>	2

## Priority species or groups and existing recovery plans

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Yes – unpublished IRP	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Chuditch ( <i>Dasyurus geoffroi</i> )	Yes – State	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Numbat ( <i>Myrmecobius fasciatus</i> )	Yes – National (unpublished)	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Bilby ( <i>Macrotis lagotis</i> )	Yes – National	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Boodie ( <i>Bettongia lesueur lesueur</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> )	Yes – Interim Recovery Plan	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Not in WA	No	Western Shield Fauna Recovery Program
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Yes – RP (now out of date)	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	No (old draft)	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Quenda ( <i>Isodon obesulus fusciventer</i> )	No	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Mala ( <i>Lagorchestes hirsutus</i> )	Yes – National (unpublished)	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Red-tailed Phascogale ( <i>Phascogale calura</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Heath Mouse ( <i>Pseudomys shorridgei</i> )	No	Action Plan for Australian Rodents	No
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	Yes – Interim Recovery Plan	Action Plan for Australian Birds - Coordinated Conservation Plan for the Western Wheatbelt & Taxon Summary	No
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Yes - State	Action Plan for Australian Birds - Coordinated Conservation Plan for the Western Wheatbelt & Recovery Outline	No
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis</i> )	No	Action Plan for Australian Birds - Taxon Summary	Research Plan for the Western Ground Parrot, Western Whipbird and Western Bristlebird.
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	No	Action Plan for Australian Birds - Taxon Summary	No
Barking Owl (southern) ( <i>Ninox connivens</i> )	No	Action Plan for Australian Birds - Taxon Summary	No

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Malleefowl ( <i>Leipoa ocellata</i> )	National Recovery Plan for Malleefowl	Action Plan for Australian Birds - Coordinated Conservation Plan for the Western Wheatbelt & Recovery Outline	Malleefowl Preservation Society
Western Wheatbelt Birds	Some	Action Plan for Australian Birds - Coordinated Conservation Plan for the Western Wheatbelt and individual Action Plans	No
<i>Egernia stokesii badia</i>	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Aspidites ramsayi</i> (south west population)	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Lerista viduata</i>	No	No	No
<i>Idiosoma nigrum</i>	No	No	No
<i>Kwonkan eboracum</i>	No	No	No
<i>Teyl</i> sp. (BY Main 195312683, 1984/13)	Yes – Interim Recovery	N/A	No

	Plan		
<i>Cyphanthera odgersii</i> subsp. <i>occidentalis</i>	Yes – IRP	N/A	No
<i>Daviesia cunderdin</i>	Yes – IRP	N/A	No
<i>Daviesia euphorbioides</i>	Yes – IRP	N/A	No
<i>Drakonorchis drakeoides</i>	Yes – IRP	N/A	No
<i>Eremophila nivea</i>	Yes – IRP	N/A	No
<i>Eremophila veneta</i>	Yes – IRP	N/A	No
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Yes – IRP	N/A	No
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	Yes – IRP	N/A	No
<i>Grevillea scapigera</i>	No – draft RP	N/A	No
<i>Hemiandra gardneri</i>	Yes – IRP	N/A	No
<i>Symonanthus bancroftii</i>	Yes – IRP	N/A	No
<i>Tetralthea deltoidea</i>	Yes – IRP	N/A	No

### Appropriate species recovery actions

Species or Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Chuditch ( <i>Dasyurus geoffroi</i> )	vii, i, x, xiv, ix	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – monitoring; Fire management.	Locally extinct?, lack of survey data, lack of suitably large habitat areas, predator control
Numbat ( <i>Myrmecobius fasciatus</i> )	vii, i, x, xiv, xii, ix	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Research; Fire management.	Locally extinct, lack of suitably large habitat areas, predator control
Bilby ( <i>Macrotis lagotis</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Boodie ( <i>Bettongia lesueur lesueur</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	vii, i, ii, x, xiv	Feral animal control (particularly predators); Habitat retention through reserves and on private lands; Translocation; Other – monitoring.	Lack of suitably large habitat areas, predator control

Species or Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> )	vii, x, i	Feral animal control (particularly predators); Translocation; Habitat retention through reserves.	Locally extinct, lack of suitably large habitat areas, predator control
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	vii, x, i	Feral animal control (particularly predators); Translocation; Habitat retention through reserves.	Locally extinct, lack of suitably large habitat areas, predator control
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	vii, i	Feral animal control (particularly predators); Habitat retention through reserves.	Locally extinct, lack of suitably large habitat areas, predator control
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	vii, i, x, xiv, ix	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – monitoring; Fire management.	Locally extinct?, lack of survey data, lack of suitably large habitat areas, predator control
Quenda ( <i>Isodon obesulus fusciventer</i> )	vii, i, ii, x	Feral animal control (particularly predators); Habitat retention through reserves and on private lands; Translocation.	Locally extinct, lack of suitably large habitat areas, predator control
Mala ( <i>Lagorchestes hirsutus</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Red-tailed Phascogale ( <i>Phascogale calura</i> )	i, ii, vii, ix, x	Habitat retention through reserves and on private lands; Feral animal control (particularly predators); Fire management; Translocation.	Locally extinct?, lack of survey data, lack of suitably large habitat areas, predator control
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	vii, i	Feral animal control (particularly predators); Habitat retention through reserves;	Locally extinct?, lack of suitably large habitat areas, predator control
Heath Mouse <i>Pseudomys shortridgei</i>	vii, i, xiv, ix	Feral animal control (particularly predators); Habitat retention through reserves; Other - survey and monitoring; Fire management.	Lack of knowledge of distribution.
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	x, i, iii, vii, xiv	Translocation; Habitat retention through reserves and on other state lands; Feral animal control (particularly predators); Other - survey and monitoring.	Locally extinct
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	i, ii, iii, xiv, xii	Habitat retention through reserves, on private lands and on other state lands; Other - Protect known nesting trees and breeding areas, survey work, captive breeding and public awareness programme; Research.	Lack of survey data on breeding and habitat areas
Western Whipbird (western mallee) ( <i>Psophodes nigroquararis</i> )	i, iii, ii, viii, xiv, xii	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Other – monitoring; Research.	Lack of survey data
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	xiv, xii, i, ii, iii	Other – monitoring, promote community nestbox program, and mitigate food limitations; Research; Habitat retention through reserves, on private lands and on other state lands.	Lack of knowledge on habitat requirements
Barking Owl (southern) ( <i>Ninox connivens</i> )	i, iii, ii, xii, xiv, xiii, viii, vii	Habitat retention through reserves, other state lands and on private lands; Research; Other – survey work; Capacity building - extension to promote habitat management; Revegetation; Feral animal control (particularly predators).	Lack of survey data
Malleefowl ( <i>Leipoa ocellata</i> )	ix, vii, i, iii, ii, xiv	Fire management; Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly predators); Other – survey, monitoring and captive breeding.	Lack of survey data, lack of resources to manage fire regimes
Western Wheatbelt Birds	i, iii, ii, viii, vii, v, vi, xi, xiv	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Feral animal control (particularly predators); Fencing; Weed control; Reinstatement of hydrology; Other – tree hollow protection and monitoring.	Lack of survey data
Western Spinytailed Skink ( <i>Egernia stokesii badia</i> )	i, iii, ii, vii, v, xiv	Habitat retention through reserves, other state lands and on private lands; Feral animal control (particularly predators); Fencing; Other – Survey and monitoring.	

Species or Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
<i>Aspidites ramsayi</i> (south west population)	i, iii, ii, xiv, vii, xiii, x	Habitat retention through reserves, on other state lands and on private lands; Other – survey and captive breeding; Feral animal control (particularly predators); Capacity building - develop guidelines and incentives to manage population outside reserves; Translocation.	Possibly locally extinct, lack of survey data
<i>Morelia spilota imbricata</i>	i, iii, ii, xiv, vii, xiii, x	Habitat retention through reserves, on other state lands and on private lands; Other – survey and captive breeding; Feral animal control (particularly predators); Capacity building - develop guidelines and incentives to manage population outside reserves; Translocation.	Lack of survey data
<i>Lerista viduata</i>	Unknown	Unknown	Lack of knowledge and data
<i>Idiosoma nigrum</i>	i, iii, vii, xiv, vi, ix	Habitat retention through reserves and on other state lands; Feral animal control (particularly predators); Other - minimise soil disturbance and survey; Weed control; Fire management.	Lack of survey data
<i>Kwonkan eboracum</i>	Unknown	Unknown	Lack of survey data
<i>Teyl</i> sp. (BY Main 195312683, 1984/13)	iii, i, vii, xiv, v, xi, ix	Habitat retention through reserves and other state lands; Feral animal control (particularly predators); Other - management of competing land uses and survey work; Fencing; Reinstatement of hydrology; Fire management.	Lack of survey data
Threatened Flora on roadsides e.g. <i>Boronia adamsiana</i> , <i>Acacia volubilis</i>	iii, xiii, vi, v, x, viii	Habitat protection on other state lands; Capacity building - Shire officers; Weed control; Translocation; Revegetation.	Competing land use; loss of permanent staff and increased use of contractors makes the education process more difficult
Flora and fauna of granite outcrops e.g. <i>Teyl</i> spp., <i>Caladenia hoffmanii</i> subsp. <i>graniticola</i> , <i>Daphnia jollyi</i>	i, iii, ii, xi, vi, vii, ix, xiii, xii	Habitat retention through reserves, other state lands and on private lands; Reinstatement of hydrology; Weed control; Feral animal control (particularly predators); Fire management; Capacity building with landholders; Research.	Competing use of water for supply purposes; loss of fringing vegetation in many instances.
Threatened flora of lowland communities, including tall woodlands, mallee and <i>Melaleuca</i> shrublands, freshwater and naturally saline wetland systems. e.g. <i>Eremophila viscida</i> , <i>E. resinosa</i> .	xi, xiii, viii, x, xiv	Reinstatement of hydrology; Capacity building with landholders; Revegetation; Translocation; Other - germplasm storage.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	xi, x, xiv, i, iii, ii	Reinstatement of hydrology; Translocation; Other - germplasm storage; Habitat retention through reserves, other state lands and on private lands.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Priority 1 and 2 flora	xiv	Other - additional survey to locate new populations.	Insufficient numbers of suitably qualified and experienced staff to undertake the extensive fieldwork required.
Declared Rare Flora (general)	xiv	Other – additional survey work to locate new populations.	Insufficient numbers of suitably qualified and experienced staff to undertake the extensive fieldwork required for survey, monitoring and management actions

Species or Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
<i>Acacia aprica</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Acacia sciophanes</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Chorizema humile</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Cyphanthera odgersii</i> subsp. <i>occidentalis</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Daviesia cunderdin</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Daviesia euphorbioides</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Drakonorchis drakeoides</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Eremophila nivea</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Eremophila veneta</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Grevillea scapigera</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above

Species or Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
<i>Hemiandra gardneri</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Symonanthus bancroftii</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above
<i>Tetralthea deltoidea</i>	i, iii, ii, vii, v, vi, xiv (survey), x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (particularly herbivores); Fencing; Weed control; Other – survey; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer to DRF General above

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Community	Specific Recovery Plan	General Recovery Plan
Plant Associations of the Billeranga System - <i>Melaleuca filifolia</i> – <i>Allocasuarina campestris</i> thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes; <i>Eucalyptus loxophleba</i> woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by <i>Dodonaea inaequifolia</i> over red/brown loamy soils on the slopes and ridges	Yes - IRP	Wheatbelt Management Plan (draft)
Perched clay wetlands of the Wheatbelt region dominated by <i>Eragrostis australasica</i> and <i>Melaleuca strobophylla</i> across the lake floor	No	Wheatbelt Management Plan (draft)
Plant assemblages of the Inering System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over chert and granite; <i>Allocasuarina campestris</i> thicket with scattered <i>Acacia acuminata</i> and <i>Allocasuarina huegeliana</i> over brown sandy loam over stony and lateritic summits and slopes; <i>Acacia</i> sp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; <i>Melaleuca cardiophylla</i> thicket with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus salmonophloia</i> over granite on the lower slopes and foothills; and <i>Eucalyptus loxophleba</i> woodland over clay loam on the foothills.	Yes - IRP	Wheatbelt Management Plan (draft)
Plant assemblages of the Koolanooka System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over red loam on hill slopes; Shrubs and emergent mallees on shallow loam red over massive ironstone on steep rocky slopes; <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> sp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the upper slopes and summits; <i>Eucalyptus loxophleba</i> woodland over scrub on the footslopes; and mixed <i>Acacia</i> sp. scrub on granite.	Yes - IRP	Wheatbelt Management Plan (draft)
Melaleuca thicket - Dense thickets of <i>Melaleuca</i> spp. with emergent <i>Eucalyptus erythronema</i> var. <i>marginata</i> and <i>Eucalyptus transcontinentalis</i> .	No	Wheatbelt Management Plan (draft)
Plant assemblages of the Moonagin System (Beard 1976d) - <i>Acacia</i> scrub on red soil on hills; <i>Acacia</i> scrub with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus oleosa</i> on red loam flats on the foothills.	Yes - IRP	Wheatbelt Management Plan (draft)
Perched fresh-water wetlands of the northern Wheatbelt dominated by extensive stands of living <i>Eucalyptus camaldulensis</i> (River Red Gum) across the lake floor.	No	Wheatbelt Management Plan (draft)
Tall emergent <i>Eucalyptus salmonophloia</i> over <i>Allocasuarina huegeliana</i> tall closed forest over <i>Acacia acuminata</i> mid high isolated trees over <i>Alyxia buxifolia</i> tall sparse shrubland over <i>Pteridium esculentum</i> very tall closed fernland over various sparse formland. Occurs in a drainage line near the base of a granite inselberg.	No	Wheatbelt Management Plan (draft)
Microbial, invertebrate and plant assemblages of natural saline seeps.	No	Wheatbelt Management Plan (draft)

Community	Specific Recovery Plan	General Recovery Plan
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor. (occurrences other than Toolibin Lake).	Yes - IRP	Wheatbelt Management Plan (draft)
Ferricrete Floristic Community (Rocky Springs type)	No – draft IRP	Wheatbelt Management Plan (draft)
Assemblages of the organic mound springs of the Three Springs region	No	Wheatbelt Management Plan (draft)

### Appropriate ecosystem recovery actions

Community	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Constraints
Plant Associations of the Billeranga System - <i>Melaleuca filifolia</i> – <i>Allocasuarina campestris</i> thicket on clay sands over laterite on slopes and ridges; open mallee over mixed scrub on yellow sand over gravel on western slopes; <i>Eucalyptus loxophleba</i> woodland over sandy clay loam or rocky clay on lower slopes and creeklines; and mixed scrub or scrub dominated by <i>Dodonaea inaequifolia</i> over red/brown loamy soils on the slopes and ridges	i, ii, vi, vii, v, ix, xiv, xiii, xiv	Habitat retention through reserves and on private lands; Weed control; Revegetation; Fencing; Fire management; Other - survey, monitoring, mapping and land acquisition; Capacity building using incentives for landholders to conserve the community.	Further research needs to undertaken
Perched clay wetlands of the Wheatbelt region dominated by <i>Eragrostis australasica</i> and <i>Melaleuca strobophylla</i> across the lake floor	Unknown	Unknown	Further research needs to undertaken
Plant assemblages of the Inering System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over chert and granite; <i>Allocasuarina campestris</i> thicket with scattered <i>Acacia acuminata</i> and <i>Allocasuarina huegeliana</i> over brown sandy loam over stony and lateritic summits and slopes; <i>Acacia</i> spp. mixed low woodland on red/brown sandy loam over granite on summits and slopes; <i>Melaleuca cardiophylla</i> thicket with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus salmonophloia</i> over granite on the lower slopes and foothills; and <i>Eucalyptus loxophleba</i> woodland over clay loam on the foothills.	ii, xiv, xiii, vii, v, i, vi, viii, ix, xii	Habitat protection on private lands; Other – survey work; Capacity building using incentives for landholders to conserve the community; Feral animal control; Fencing; Habitat retention through reserves; Weed control; Revegetation; Fire management; Research.	Further research needs to undertaken
Plant assemblages of the Koolanooka System (Beard 1976d) - <i>Allocasuarina campestris</i> scrub over red loam on hill slopes; Shrubs and emergent mallees on shallow loam red over massive ironstone on steep rocky slopes; <i>Eucalyptus ebbanoensis</i> subsp. <i>ebbanoensis</i> mallee and <i>Acacia</i> spp. scrub with scattered <i>Allocasuarina huegeliana</i> over red loam and ironstone on the upper slopes and summits; <i>Eucalyptus loxophleba</i> woodland over scrub on the footslopes; and mixed <i>Acacia</i> spp. scrub on granite.	i, ii, iii, vi, vii, v, ix, xiv, xiii	Habitat retention through reserves, on private lands and on other state lands; Weed control; Feral animal control; Fencing; Fire management; Other - survey, monitoring, mapping and land acquisition; Capacity building using incentives for landholders to conserve the community.	Further research needs to undertaken
Melaleuca thicket - Dense thickets of <i>Melaleuca</i> spp. with emergent <i>Eucalyptus erythronema</i> var. <i>marginata</i> and <i>Eucalyptus transcintentalis</i> .	xiv	Other - survey for additional occurrences.	Further research needs to undertaken
Plant assemblages of the Moonagin System (Beard 1976d) - <i>Acacia</i> scrub on red soil on hills; <i>Acacia</i> scrub with scattered <i>Eucalyptus loxophleba</i> and <i>Eucalyptus oleosa</i> on red loam flats on the foothills.	i, ii, xiii, v, xiv, vi, viii	Habitat retention through reserves and on private lands; Capacity building using incentives for landholders to conserve the community; Fencing; Other - survey and monitoring; Weed control; Revegetation.	Further research needs to undertaken
Perched fresh-water wetlands of the northern Wheatbelt dominated by extensive stands of living <i>Eucalyptus camaldulensis</i> (River Red Gum) across the lake floor.	xiv	Other - survey for occurrences.	Presumed totally destroyed.

Community	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Constraints
Tall emergent <i>Eucalyptus salmonophloia</i> over <i>Allocasuarina huegeliana</i> tall closed forest over <i>Acacia acuminata</i> mid high isolated trees over <i>Alyxia buxifolia</i> tall sparse shrubland over <i>Pteridium esculentum</i> very tall closed fernland over various sparse forbland. Occurs in a drainage line near the base of a granite inselberg.	xiv	Other - survey for any additional occurrences.	Need to determine if <i>P. esculentum</i> is a natural component of the community
Microbial, invertebrate and plant assemblages of natural saline seeps.	xiv, xii	Other - surveys for additional occurrences; Research.	Further research needs to undertaken
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor (occurrences other than Toolibin Lake).	ii, xi, xiv, vi, viii	Habitat protection on private lands; Reinstatement of hydrology; Other - survey and monitoring of flora, surface water and groundwater; Weed control; Revegetation.	Further research needs to undertaken
Ferricrete Floristic Community (Rocky Springs type)	i, vi, ix, xii, xiv	Habitat retention through reserves; Weed control; Fire management; Research; Other - hydrological investment; dieback disease prevention.	Further research needs to undertaken
Assemblages of the organic mound springs of the Three Springs region	ii, v, xii	Habitat protection on private lands; Fencing; Research.	Further research needs to undertaken

<sup>1</sup>Appendix B, key h

For all the unreserved vegetation types listed (pages 14-16), the following recovery actions would generally apply: i, iii, ii, xi, vii, vi, ix, xiii – landholders.

### Subregion priority for off reserve conservation

There are major constraints (see Appendix C, Rank 6, rank = 1) to achieve conservation outcomes due to the level of habitat loss and degree of fragmentation leaving insufficient resources across most of the landscape to support viable populations of many species, significant landscape scale threatening processes such as salinity (affecting up to 30% of the landscape) and fox/cat predation, and competing land uses i.e. broadacre cropping and grazing.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** There are incentives for a range of on-ground actions through State, Federal and some other programs. These incentives generally involve revegetation and remnant vegetation fencing, but in some cases (State government in particular) may involve earthworks. Examples include:

- State funding through recovery catchments and other components of the Salinity Program, such as the Crown Reserves Program (refer to Wallace 2001 for summary);
- Land for Wildlife Program (managed by Department of Conservation & Land Management);
- Bushcare funding, through joint projects with State government (who contribute significant dollars) projects and regional NRM groups;
- The Search Project (State-Federal program), for example, significant funding of commercially prospective native species of regional provenance;

- Other NHT programs (National Landcare, Endangered Species).

Three main options also exist to derive a financial benefit from on-farm remnant vegetation:

- Land purchase by government agencies, Australian Bush Heritage fund, interested individuals through the Bush Brokers scheme etc.
- Land revaluation as unproductive, or differential rating by covenanting, and
- Gifting of the land to a tax conservation body for taxation deductions.

**Legislation:** Most relevant legislation is Wildlife Conservation Act and Conservation and Land Management Act. There is no “duty of care” legislation, and no evidence that such legislation is practicable.

**Institutional Reform:** The purchase of bushland by CALM is a very real contribution to helping to re-align land use and free up money for landholders. This is a form of new tenure. Operation of regional NRM groups in a state of flux, but represents an on-going case of institutional reform. (See also recommendations in Frost *et al.* 2001 and Wallace 2000). Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

**Capacity Building with Landholders:** In September 1999 Bush Brokers was established with a formal Memorandum of Understanding by all partners. The MOU sets out a range of projects to be undertaken within the next twelve months. These include:

- A united base for promoting improvements to government policies, particularly subdivision policies and procedures so as to streamline the separation of bush from agricultural titles and placement on a separate title.
- A web site register of properties/ blocks currently for sale, and buyers seeking bushland.
- Research on the size of the bushland market, and the most cost-effective measures to stimulate that market.
- A case studies handbook of individuals and groups who have already bought bush.
- "Marketing Bushland" Information Seminars for rural agents.
- A "Marketing Bushland" component included in the accredited REIWA course.

**Other Planning Opportunities (with Local Government):** Draft Statement of Planning Policy made under Section 5AA of the *Town Planning and Development Act* (1928). This policy may be cited as the Draft Statement of Planning Policy: Environment and Natural Resources Policy. The purpose of this policy is to inform local governments and the Town Planning Appeals Tribunal of those aspects of State-level planning policy concerning the environment and natural resources which should be taken into account in planning decision-making. The policy will also guide the WAPC in undertaking its planning responsibilities, and in integrating and coordinating the activities of the many State agencies who influence the use and development of land. This policy includes a section on biodiversity.

**Valuing Ecosystem Services & Tradable Rights:** Testing of these NRM methods is currently being undertaken in other states, and results will be examined for their relevance in Western Australia.

**Threat Abatement Planning:** Actual action is largely through CALM, and there are internal reports and policies on threats such as dieback, feral animal control, fire, etc. However, note also:

- CALM's salinity review (Wallace 2001).
- State Salinity Strategy (State Salinity Council 2000).
- Report of the Salinity Taskforce (Frost *et al.* 2001).
- Weed management strategies (Department of Conservation and Land Management 1999b; Department of Agriculture 2001; Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2000a; Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2000b; and Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2001).
- Local government dieback guidelines document (Lewis and Colquhoun 2000).

Also, specialist plans, for example, those related to management of locust control and interaction of control measures on conservation lands.

**Industry Codes of Practice:** Such as the following:

- Environmental Code of Practice – Extractive Industries (Environmental Protection Authority 1991).
- Environmental Management in the WA Mining Industry (Chamber of Mines and Energy of Western Australia 1993).
- Code of Practice for Timber Plantations in Western Australia
- Roadside Conservation Committee – Code of Practice for Roadside Conservation in Road Construction and Road Maintenance. The aim of this code is to balance road design and road safety requirements with all other values associated with roadsides in each Shire.

**Environmental Management Systems & Ecologically Sustainable Product Marketing:** The Wheatbelt Region of CALM is preparing an EMS to identify values, threats, goals and prioritise management across the landscape.

**Capacity Building:** There is significant interaction between State agencies, regional NRM groups (eg. Avon Catchment Network), Greening Australia (WA) (for example, Living Landscapes) and Worldwide Fund for Nature (through Woodland Watch in particular). These groups are also interacting jointly and independently to contribute to capacity building amongst landholders. Other groups such as the Threatened Species Network and Malleefowl Preservation Society also make significant contributions to capacity building in the community.

**Other Planning Opportunities:** Examples include:

- Department for Planning and Infrastructure is developing relevant rural land use plans.
- Some local governments are acting together to produce joint programs – for example, Kondinin Bush Heritage Committee.
- Regional NRM planning processes continue.
- CALM's Wheatbelt Regional Plan in development.
- National Action Plan for Water Quality and Salinity in development.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Integration occurring in various ways. Examples include:

- Contribution to property planning by Land for Wildlife;
- Agwest Land Management (Department of Agriculture) includes soil survey, land capability assessment and farm planning.
- Catchment planning through recovery catchments (natural diversity, water resources and rural towns);
- Rapid Catchment Appraisal process managed by Department of Agriculture.
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

**Other:** Actual on-ground actions by Department of Conservation and Land Management represent the most significant single, focussed contribution to biodiversity conservation in the subregion.

## Feasible opportunities for NRM

**Incentives:** Potential changes in the taxation laws for philanthropy exist. It is important to note that in many important cases – such as salinity – it is not an incentive that is required, but technical solutions that are economically viable to implement. While the lack of technical solutions is a barrier, it is also an opportunity. CALM is, particularly in the case of revegetation, working hard to find economically viable technical solutions. Resources are an impediment to doing this faster. It is also essential to note that, if we do not develop economically viable solutions using regional plants and animals, there is a severe risk that new invasive weeds and pest animals (eg, through aquaculture and more aggressive grazing animals) will be introduced.

**Legislation:** Proposed re-writing of the Wildlife Conservation Act is a key opportunity for change. More effective legislation and regulation in relation to land clearing and drainage would assist to combat some existing threats. This is both an opportunity and a barrier. Note the existing MOU is being reviewed.

**Institutional Reform:** While institutional reform is an issue, even greater opportunities for progress lie in improving the current institutions and ensuring that they are staffed at a sufficient level and with appropriate people. Put simply, bad operators will still be bad irrespective of institutional reform, good operators will generally do comparatively well despite institutional structures. This does not deny the need for institutional reform in some cases. However, it has become clear that the recruitment, training and management of an effective NRM “group” is a far more significant impediment to progress than institutional structures and arrangements. Institutional reforms that would help include:

- To minimise institutional change, and certainly to avoid more frequent structural change to organisations than 8-10 year timeframes without very good reason. Significant structural changes cause organisational inefficiencies that last for a minimum of three years.
- Only implement institutional reform where there is a clearly articulated and convincing case that there is a well-identified problem to be fixed and that the proposed reform has a high probability of success.
- Wherever practicable, appoint contract officers to minimum terms of five years.
- Reverse the current trend of increasing duplication of service delivery in the NRM area.

**Valuing Ecosystem Services & Tradable Rights:** Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

**Threat Abatement Planning as Part of NRM:** The environmental management system being developed by CALM for the subregions should, for these areas, provide a greatly improved platform for threat abatement planning. Wallace and Beecham (submitted for publication) present the generalised framework for this.

**Environmental Management Systems & Ecologically Sustainable Product Marketing:** See comment above under threat abatement.

**Capacity Building:** The most important opportunity here is the need to re-define capacity building, and to more clearly state goals, objectives and strategies.

**Other planning opportunities:** To date there has been a tendency to over-plan, for example, there are a series of over-lapping planning processes for biodiversity conservation in the south-west. This has, and remains, a barrier. A key opportunity is to proceed implement plans and monitor their value in a more strictly “adaptive management” style than has been the practice to date.

**Integration with property management planning, catchment planning and Landcare:** See comment under Other Planning above.

## Impediments or constraints to opportunities

Given opportunities and impediments/constraints are often different sides of the same issue, both are covered in this section.

A key constraint overall is the lack of resources – including human and infrastructure resources – for implementation. This point reflects the relative importance of biodiversity conservation and environmental issues in general in the public and political mind. Unless there is much wider recognition that biodiversity conservation makes a vital contribution to each individual’s quality of life, this situation is unlikely to change. See Burbidge and Wallace (1995) for a discussion of some of the relevant issues.

A second generic issue is that NRM is variously and poorly defined. This is a significant impediment to progress, and reflects a much wider lack of rigour in the NRM area, and the generally very poor understanding of the relevant socio-political processes. One example of these issues is documented in Wallace (submitted for publication).

A range of problems, opportunities and constraints in relation to salinity are dealt with in Wallace (2001). Many of these are relevant to the broader field of NRM.

## Subregions where specific NRM actions are a priority to pursue

AW1 has a subregional NRM priority of (i), indicating that the subregion faces major constraints to implement effective NRM actions to achieve biodiversity outcomes (see Appendix C, rank 7).

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

#### **Vegetation and Regional Ecosystem Mapping:**

Systematic vegetation mapping of all vegetation remnants is required to the sub-association level. At present little mapping has been done at this scale. To compliment this approach we also require equivalent scale mapping of soil-landscape units to facilitate revegetation of cleared lands, and to provide an alternative biodiversity surrogate, particularly for small terrestrial vertebrates and invertebrates. A standardised database and GIS application is also essential for data querying and management.

**Ecological and Life History Data:** It is critical to identify priorities and appropriate management responses in the fragmented and largely cleared landscape of the subregion. Data on various population demographic parameters, resource requirements and landscape variables are required to model population viability for a range of species with different life history strategies. This is essential to ensure that management actions are of an appropriate magnitude to achieve the desired biodiversity conservation goals.

**Systematic Fauna Surveys:** Required for birds, small terrestrial mammals, reptiles and select invertebrate groups across the landscape; also measures of various habitat and landscape variables. A standardised database and GIS application is also essential for data querying and

management. The assumption that vegetation characteristics can be used as habitat surrogates for fauna needs to be investigated more thoroughly in conjunction with vegetation and ecosystem mapping above. The continued use of the focal species approach (Lambeck 1997; Lambeck 1999) and a modified version (Lambeck 1998) for biodiversity conservation planning across the subregion requires further research and survey data to address the following:

- the validity of vegetation as a habitat surrogates for all fauna,
- the validity of using birds as indicators for all fauna,
- what constitutes a viable population (Lambeck 1998) and an understanding of metapopulation dynamics for various flora and fauna species in a fragmented landscape

**Floristic Data:** Need for the structural vegetation mapping above. Whilst structural units are easiest to map, it is important to also document the floristic variation within and between vegetation sub-associations, particularly for management purposes

#### **Other Priority Data Gaps Include:**

Fire – A knowledge of fire regimes and histories for reserves and areas of remnant vegetation, and data on the effects of fire on flora and fauna based on their life history attributes. This information is essential if the role of altered fire regimes in biodiversity conservation is to be understood and managed.

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762	Rossetto, M., Dixon, K., Atkins, K. and Coates, D.J. for the Corrigin Grevillea Recovery Team	(undated).	Draft Recovery Plan for the Corrigin Grevillea ( <i>Grevillea scapigera</i> )	Department of Conservation and Land Management	O
574	Safstrom, R.	(1995).	Conservation values of small reserves in the central wheatbelt of Western Australia: A framework for evaluating the conservation values of small reserves.	Prepared for the Western Australian Department of Conservation and Land Management by Environs Consulting, Perth.	R
576	Safstrom, R., True, D. and Coates, A.	(1996).	Conservation and other values of selected Agricultural Area dams in the central wheatbelt of Western Australia.	Prepared for the Western Australian Department of Conservation and Land Management by Environs Consulting, Perth.	R
583	Saunders, D.A.	(1995).	Setting the scene - research on remnants during the past decade. Pp. 5-9 in K.J. Wallace (ed) Remnant Native Vegetation Ten Years On: A decade of research and management. Proceedings of the Dryandra workshop September 1993.	Department of Conservation and Land Management, Western Australia.	B
587	Saunders, D.A. and Ingram, J.A.	(1995).	Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna.	Surrey Beatty and Sons, Chipping Norton, NSW.	B
600	Short, J.	(1995).	Interim Recovery Plan for the Western Barred Bandicoot ( <i>Perameles bougainville</i> ) (unpublished).		R
616	Stack, G. and English, V.	(1999).	Blunt Wattle ( <i>Acacia aprica</i> ms) Interim Recovery Plan 1999-2002.	Department of Conservation and Land Management, Western Australia.	R
731	Stack, G. and English, V.	(1999).	Prostrate Flame Flower ( <i>Chorizema humile</i> ) Interim Recovery Plan 1999-2002 (IRP No 31)	Department of Conservation and Land Management	O
759	Start, T., Burbidge, A. and Armstrong, D. for the Woylie Recovery Team	(1995).	Recovery Plan for the Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Department of Conservation and Land Management	O
622	State Salinity Council	(2000).	Natural Resource Management in	Government of Western Australia,	R

			Western Australia: Salinity.	Perth.	
653	Wallace, K.J. (compiler).	(2001).	State Salinity Action Plan 1996: Review of the Department of Conservation and Land Management's programs: January 1997 to June 2000.	Department of Conservation and Land Management, Perth.	R
654	Wallace, K.J. and Beecham, B.C.	(undated).	Planning nature conservation in agricultural landscapes - a land manager's perspective.	Submitted to Ecological Management and Restoration.	O
655	Wallis, R. and Higham, A.	(1998).	Environment Western Australia 1998 State of the Environment Report.	Department of Environmental Protection, Western Australia.	R
681	Weaving, S.	(1995).	Native vegetation handbook for the Shire of Bruce Rock.	Western Australian Department of Agriculture.	B
700	Withers, P.C. and Edward, D.H.	(1997).	Terrestrial fauna of granite outcrops in Western Australia.	Journal of the Royal Society of Western Australia 80(3):159-166.	J
701	Withers, P.C. and Hopper, S.D. (eds)	(2000).	Management of Granite Outcrops Symposium.	Journal of the Royal Society of Western Australia 83(3).	J
704	Wooler S.J. and Moore S.A.	(2000).	Regional assessment of the wheatbelt of Western Australia: Central Wheatbelt.	Prepared for the Australian Heritage Commission, Murdoch University, Perth	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 014, 020, 046, 101, 102, 139, 146, 193, 259, 268, 341, 373, 376, 378, 380, 381, 382,

388, 423, 444, 449, 464, 466, 468, 509, 554, 562, 615, 652 and 707 in Appendix A.

# Avon Wheatbelt 2 (AW2 - Rejuvenated Drainage subregion)

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## Subregional description and biodiversity values

### Description and area

The Avon Wheatbelt is an area of active drainage dissecting a Tertiary plateau in Yilgarn Craton. Gently undulating landscape of low relief. Proteaceous scrub-heaths, rich in endemics, on residual lateritic uplands and derived sandplains; mixed eucalypt, *Allocasuarina huegeliana* and Jam-York Gum woodlands on Quaternary alluvials and eluvials. Within this, AW2 is the erosional surface of gently undulating rises to low hills with abrupt breakaways. Continuous stream channels that flow in most years. Colluvial processes are active. Soil formed in colluvium or in-situ weathered rock. Includes woodland of Wandoo, York Gum and Salmon Gum with Jam and Casuarina. The climate is Semi-arid (Dry) Warm Mediterranean, and area is 3, 012, 977 ha.

### Dominant land use

Mainly a mixture of (iv) Cultivation – dry land agriculture and (viii) Grazing – Improved pastures, dryland, with lesser areas of (xiii) Conservation (x) Crown reserves, (vi), (v) and (ii) Rural residential and (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class for AW1 is 1.

Known special values in relation to landscape, ecosystem, species and genetic values

**Critical Weight Range mammals:** 35-7 000 g weight range mammals threatened by fox predation. Two species are now totally extinct; the Pig-footed Bandicoot and Crescent Nailtail Wallaby. Several species are subregionally extinct, and some are still extant.

Species	Current Conservation Status (WA)	Status in AW2 Subregion
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Subregionally Extinct
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Threatened (Endangered)	Subregionally Extinct
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Subregionally Extinct
Numbat ( <i>Myrmecobius fasciatus</i> )	Threatened (Vulnerable)	Subregionally Extinct
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Subregionally Extinct
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Subregionally Extinct
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	Threatened (Vulnerable)	Subregionally Extinct
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Subregionally Extinct
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Quenda ( <i>Isoodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent
Brush-tailed Phascogale ( <i>Phascogale tapoatafa</i> )	Priority 4, Conservation Dependent	Threatened
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent

**Toolibin Lake:** The principal breeding area for colonial waterbirds in the inland drainage systems of south-western Australia; a major breeding area for Freckled Duck *Stictonetta naevosa*; also an increasingly important breeding area for other waterbirds. The lake has been identified as a Critically Endangered Threatened Ecological Community.

**Pingelly (Boyagin-Tutanning Reserves):** High density of rare and geographically restricted flora (Fig. 12.1, Hopper and Muir 1984); supports populations of several Critical Weight Range (fox predation) marsupials (Numbat, Quenda, Woylie, Tammar, Red-tailed Phascogale, Brushtail Possum) that had disappeared from most of the Australian or Western Australian mainland.

**Dryandra Woodland:** Supports extant populations of several Critical Weight Range (fox predation) marsupials (Numbat, Woylie, Tammar, Red-tailed Phascogale, Brushtail Possum) that had disappeared from most of the Australian or Western Australian mainland. Dryandra State Forest has a vascular flora of at least 850 species, more than Mt Lesueur (a well recognised area of high species richness) (Keighery and Lyons 2001b).

**South West Botanical Province** (includes AW2): High species richness and endemism; Proteaceae (632 spp, 99% endemic; 16 genera, 5 endemic) (Cowling and Lamont 1998);

**Transitional Rainfall Zone** (equivalent to the Mallee, Avon Wheatbelt and Geraldton Sandplains IBRA Regions): This zone contains the most species-rich areas, including the lateritic uplands of the western edge of the wheatbelt (Hopper 1992).

- *Acacia* and *Verticordia* (Hopper *et al.* 1996)
- *Lhotskya*, *Eriostemon*, *Wehliia*, *Baeckea*, *Melaleuca*, *Chamelaucium*, *Micromyrtus* and *Thryptomene* (Hopper 1979)

**Eucalyptus Woodlands:** High floristic diversity (Table 4; Yates *et al.* 2000), they contain a high proportion of Declared Rare Flora (around 25%) (Yates *et al.* 2000; Hopper *et al.* 1990).

**Mallee eucalypts and *Melaleuca* for oil production:** It is seen as vital to identify local *Eucalyptus* and *Melaleuca* species that can be introduced in commercial quantities to develop a plantation based oil mallee industry in the south west of Western Australia. The use of locally endemic species is seen as preferable to minimise the risk of eastern Australian species hybridising with local species and becoming environmental weeds. The use of local species is also seen as providing some fauna habitat benefits as well. Populations of mallee *Eucalyptus* species (Spathulata Group) contain individuals that produce higher than average quantities of cineole oil. Identifying these individuals in with natural populations, and introducing their genetic material into breeding programs is critical to the success of this program. The subregion supports significant populations of many of these species.

**Wongan Hills Greenstone Belt and Associated Laterite-Capped Mesas:** The Wongan Hills are a range of flat topped hills situated some 194km north-east of Perth in the northern wheat belt region of Western Australia. Mount Matilda (434m) and Mount Rupert (419m) are the highest points in the hills. The place has terrain typical of the Wongan Hills which comprise a series of laterite capped mesas generally trending north-south, dissected by numerous steep gullies in which exposures of greenstone and granite can be seen. The Wongan Hills Area is underlain by the Archaean rock of the Darling Plateau which is part of the Yilgarn Block, a stable nucleus composed mainly of granite and gneisses with some altered volcanics and sediments known as greenstone belts. The hills are formed on infolded beds of the altered volcanics and sediments which are more resistant to erosion than the country rock. The rocks at one time were eroded into low, rounded hills and became thickly crusted with laterite. Subsequently the laterite has been breached to form mesas bounded by breakaways and scarp slopes. The place is within the Avon botanical district of the South West Botanic Province. The Wongan Hills support a vegetation system which forms a small enclave within the Guangan Vegetation System.

The Wongan Hills Area is significant in maintaining ecological processes in the wheat belt region of south-western Australia. There is no other area of intact breakaway country of comparable size in the wheat belt region and the vegetated portion of Wongan Hills is the largest single area of natural vegetation remaining in the northern wheat belt. The place is one of the few pockets

of uncleared land that is large and varied enough to continue to provide a habitat for the remaining species of the wheat belt. It therefore plays a critical role in the maintenance of the biodiversity in the wheat belt region. The place is important for maintaining a large number of bird species that have undergone major population declines throughout the wheat belt region. The Wongan Hills Area has remained a stable refuge for a number of bird species that are totally reliant on mallee and woodland habitats. This is of considerable importance as 53% of the bird species using woodlands and 63% of those in mallee habitats have declined since European settlement. The place is also important as a refuge for wheatbelt migrant and nomadic species. A number of plant species that are either Declared Rare Flora or Priority Flora in Western Australia have been collected in the Wongan Hills. These include *Acacia botrydion*, *Acacia cochlocarpa* subsp. *velutinoso*, *Acacia congesta* subsp. *Wonganensis*, *Acacia denticulosa*, *Acacia pharangites*, *Acacia pygmaea*, *Acacia semicircularis*, *Calothamnus accedens*, *Conostylis wonganensis*, *Dampiera glabrescens*, *Daviesia spiralis*, *Dryandra comosa*, *Dryandra pulchella*, *Dryandra wonganensis*, *Eremophila ternifolia*, *Eucalyptus recta*, *Gastrolobium glaucum*, *Grevillea dryandroides* subsp. *Dryandroides*, *Grevillea kenneallyi*, *Hemigenia conferta*, *Loxocarya albipes*, *Lysiosepalum abollatum* ms, *Melaleuca sciotostyla*, *Microcorys eremophiloides*, *Philotheca wonganensis*, *Rhagodia acicularis*, *Stylidium coroniforme*, *Verticordia staminosa* subsp. *staminosa*, and *Verticordia wonganensis*.

With the exception of bats, the mammal fauna of the Wongan Hills is depauperate. The wheat belt region of Western Australia has suffered a considerable loss of faunal diversity in a relatively short period. In the last 100 years the Wongan Hills have probably lost at least ten mammal species. In recent times only nine species of native mammals have been collected in or near the Wongan Hills. Unlike mammals, however, the bird fauna is very rich, ninety species have been recorded in the Wongan Hills including several rare, threatened and regionally uncommon fauna species such as the Malleefowl (*Leipoa ocellata*), Peregrine Falcon (*Falco peregrinus*), and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). Four species of frog and twenty-two species of reptile have been collected in the Wongan Hills. Most species of reptiles and frog recorded here are within their known range. The fauna is of interest as it contains *Diplodactylus pulcher*, *Underwoodisaura milii*, *Ctenophorus ornatus* and *Demansia psammophis* which are infrequently recorded on wheat belt reserves. Wongan Hill also contains an interesting assemblage of spiders, including the Shield-backed Trapdoor spider and the endemic Wongan Hills Wishbone Spider (*Dekana wonganensis*). Forty species from twenty-eight genera have been recorded in total, and includes both widely distributed species and species with a more restricted range. The Hills include vegetation types that have become rare and uncommon in the wheat belt of Western Australia. The salmon gum, York gum, gimlet and *Eucalyptus falcata* woodlands and *Acacia acuminata* low forest are rare woodland/forest types. Some 97% of York gum/jam woodlands and 78% of salmon gum/gimlet woodlands have been cleared in the south-west Botanic Province.

The Wongan Hills Area is of biogeographical importance as it contains a high number of endemic, disjunct species of fauna and flora and a number of species at their limits of distribution. Plant species endemic to the Wongan Hills include *Acacia botrydion*, *A. pharangites*, *A. pygmaea*, *Calytrix stowardii*, *Clematis aff. microphylla*, *Dryandra pulchella*, *Eremophila ternifolia*, *Eriostemon wonganensis* and *Rhagodia acicularis*. Although the Wongan Hills do not constitute a natural barrier to birds a number of species have distributional limits in or close to the Hills. The place is therefore of biogeographical interest as it contains species of both the arid zone and south-west. Of particular biogeographical interest is that Wongan Hills is one of the few areas in the wheat belt where the Splendid Fairy-wren and Blue-breasted Fairy-wren occur sympatically. The place maintains an assemblage of reptiles on laterite hill country that is not represented anywhere else in the central wheat belt. It has a diverse bird fauna, with ninety species being recorded, compared with the average of about seventy-five species of birds recorded on most wheat belt reserves and bush remnants. The place is considered to be an excellent and intact representation of the landforms and vegetation characteristic of the breakaway country in the northern/central wheat belt. The Wongan Hills Area is important in contributing to a wider understanding of the ecology of the northern wheat belt and the place is the type for two species of spider and a number of plant species. Data gathered here serves as a base line for monitoring on-going ecological change within the region.

References for this section on Wongan Hills are Beard (1981), Beard and Sprenger (1984), Burbidge and McKenzie (1989), Carter and Lippie (1982), Chinnock (1982), Coates (1988), Conservation Through Reserves Committee (1974), Curry (1994), Dell and Harold (1977), Hobbs (1991), Kenneally (1977a; 1977b; 1977c; 1977d; 1982), Morris and Dell (1977), de Rebeira and de Rebeira (1977), Saunders and de Rebeira (1991), Saunders and Ingram (1987), Saunders, *et al.* (1985), Saunders *et al.* (1982), Smith (1987), Watkins (1993) and Main (1987).

**Granite outcrops:** important as seasonal resources and temporary refuge for fauna of surrounding habitats; 4 species of reptiles are restricted to granite outcrops; at least 1320, and possibly 2000 plant species occur on Western Australian granite outcrops – most diverse in the southwest with individual outcrops having up to 200 species, including many endemics; *Eucalyptus caesia* (Boyagin Nature Reserve); Yilliminning Rock has 36 recorded lichen species, including two restricted to this rock (*Paraparmelia sammyi*, *P. sargentii*); the mygalomorph genus *Teyl* shows extensive radiation in the southern half of WA (Harvey and Main, undated), is a Gondwanan relic of “wet” habitats (Main 1996). They occur in meadows on many granite outcrops (Main 2000) and are restricted to granite outcrops as are the larvae chironomid fly *Archaeochlus* (Withers and Edward 1997); recent surveys in the wheatbelt have identified at least 230 species of aquatic invertebrates from granite pools, they contribute significantly to endemism of aquatic fauna of the inland south-west and have particular conservation value for about 50 species restricted to them (Pinder *et al.* 2000).

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

There has been no comprehensive subregional or regional biodiversity planning process or systematic review of biodiversity or threats. Several publications have reviewed specific elements of biota at this scale, but not necessarily using IBRA boundaries:

- Beard's Vegetation Mapping at a scale of 1:250 000 – broad structural vegetation types covers all of the subregion (Beard 1979a, Beard 1979b, Beard 1979c, Beard 1979d, Beard 1980c, Beard 1980d, Beard 1980e)
- Conservation status of vegetation types throughout Western Australia. (Hopkins *et al.* 1996) – based on modified Beard vegetation mapping at 1:250 000.
- Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna (Saunders and Ingram 1995)
- SAP Biodiversity Survey of the Agricultural Zone (unpublished data; Frost *et al.* 2001) – a systematic, broadscale biogeographic survey of the biota (aquatic invertebrates, waterbirds, terrestrial vascular flora, ground-dwelling arachnids, scorpions, centipedes, small mammals, reptiles and frogs) occurring low in the landscape and under threat from salinity.
- Salinity Risk Mapping completed for the agricultural zone by the Land Monitor project showing both current and predicted extent (Frost *et al.* 2001).
- The Wheatbelt Region of the Department of Conservation and Land Management is currently drafting a Regional Plan that includes a broad analysis of biodiversity values, threatening processes and management priorities (unpublished).

Several other surveys have reviewed elements of the biota and threatening processes at smaller scales within the subregion, or have reviewed the biota of a selection of reserves within the subregion (but not necessarily using IBRA boundaries). This list does not include the numerous surveys that have been completed for individual reserves or single species:

- Biological Survey of the Western Australian Wheatbelt Part 5 (Chapman *et al.* 1978), and Part 7 (Dell *et al.* 1979).
- Conservation values of small reserves in the wheatbelt of Western Australia (Safstrom 1995; Safstrom *et al.* 1996; Ecoscape 2000) - brief survey of biological and human use values of numerous reserves using a standard methodology to assist with land use planning.
- Management of Granite Outcrops Symposium, Hyden, April 16-18, 1999 (Withers and Hopper 2000).
- Regional Assessment of the Wheatbelt of Western Australia: Central Wheatbelt (Wooller and Moore 2000) Part of AW2
- A review of grassy woodlands in the Western Australian Wheatbelt (Mattiske Consulting 1995) – literature review, survey of possible sites to document flora and a report detailing location and describing floristics.
- Production of habitat hollows by wheatbelt eucalypts (Rose 1993) – survey of tree diameter, age

- and hollow formation of wandoo and salmon gum from across the major east-west rainfall gradient.
- Some nature reserves of the Western Australian wheatbelt Part 1-28 (Muir 1978-1979) – brief surveys of various reserves providing a vegetation map and description, and list of fauna, human uses and other values.

- “Native Vegetation Handbook” series for various Shires in the Avon and Blackwood Basins (eg. Weaving 1995) – contain basic information on and lists of native vegetation, wetlands, fauna and flora, land resources and land management and land degradation issues.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Coyrecup Lake, WA001	B7, B12	ii	iii	iii	ix, x (salinisation from surface inflow and rising water table in addition to excessive inundation, are killing the remaining live trees in the lake), xiii (siltation), xi (eutrophication from agricultural fertilisers)
Dumbleyung Lake, WA002	B7	ii	iii	iii	xi (eutrophication leading to algal blooms; increased siltation) ix (increased salt loads due to drainage and groundwater pumping in catchment), xii (excessive human disturbance, e.g. water-skiing among moulting shelducks in spring-summer)
Toolibin Lake, WA003	B14	ii	iii	iii	ix, x (salinisation has caused the loss of the Eucalypt component of the overstorey; increased inundation due to drainage of agricultural land (by earthworks construction) in the catchment; remaining lake vegetation, predominantly <i>C. obesa</i> and <i>M. strobophylla</i> , is showing signs of salt stress; loss of fringing vegetation, particularly rushes, appears to have reduced the numbers of the secretive species Australasian Bittern <i>Botaurus poiciloptilus</i> and Purple Swamphen <i>Porphyrio porphyrio</i> ; numbers of Freckled Duck <i>Sictonetta naevosa</i> appear to be declining), xi (eutrophication due to agricultural fertilisers)
Yealering Lakes System, WA004	B8	ii	iii	iii	ix, x (salinisation and excessive inundation), xi (eutrophication)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Process <sup>6</sup>
Mortlock River System	477000E 6526000N Zone 50	B8 System appears to be less driven by gypsophilous soils, hence a very different flora. Many rare and potentially rare flora species. Largely freehold land. Has lost some fresh components, but much of the edging woodlands of Casuarina and York Gum are still relatively intact.	i	ii	iii	iii	ix, x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

All major watercourses within the AW2 are categorised as “very poor – land cleared of virtually all natural vegetation.” (Fig. 18, Wallace and Higham 1998).

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	i	ii	iii	ii, iv, vi, ix, x, i, v, xi, iii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Heath dominated by one or more of <i>Regelia megacephala</i> ,	E	30	ii	iii	iii	i, iv, vi, vii, xii (mining;

<i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region.						recreation), ii
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	CR	42	ii	ii	iii	v, vi, ix, x, ii
Herbaceous plant assemblages on bentonite Lakes	E	42	ii	iii	iii	iv, v, vi, ix, x, xii (mining)
Salt Flats Plant Assemblages of the Mortlock River (East Branch)	E		ii	ii	iii	i, iv, v, vi, ix, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other Ecosystems at risk\*

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Deep pools and natural braided sections of fresh to brackish rivers of the Avon Botanical District	P	N/A	i	iii	iii	iv, vi ix, x, xii (siltation), ii
Wheatbelt Mottlecah ( <i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i> ) dominated heathland on deep white sands.	-	29	ii	iii	ii	iv, vii, vii, ii
Plant assemblages of the Wongan Hills System - Mallee over <i>Petrophile shuttleworthiana</i> / <i>Allocasuarina campestris</i> thicket on shallow gravelly soils over ironstone on summit and slopes; Shrub mallee on slopes of lateritic hills; Mallee over <i>Allocasuarina campestris</i> thicket on the slopes of the laterite plateaus; Mallee over <i>Melaleuca</i> thicket on red brown loam over gravel on slopes below the plateau; Mallee over <i>Melaleuca coroncarpa</i> heath on shallow red soil on scarp slopes; <i>A. campestris</i> / <i>Calothamnus asper</i> thicket over red-brown clay/ironstone/greenstone on scree slopes; and in lower areas: <i>Eucalyptus longicornis</i> / <i>E. salubris</i> woodland, <i>E. salmonophloia</i> and <i>E. loxophleba</i> woodlands; <i>Acacia acuminata</i> low forest; <i>E. ebbanoensis</i> mallee over scrub; and open mallee of <i>E. drummondii</i> .	P	29	ii	iii	iii	iv, vi, vii, xii (mining), ii

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Brown Mallet Communities in the western Wheatbelt on brown or grey clays on low slopes and valleys. Near York and on the Arthur River on grey clays the understorey is dominated by <i>Melaleuca viminea</i> over sedges ( <i>Gahnia trifida</i> ) and bunch grasses. At Kojonup and near Tambellup on brown clays sparse shrubs and succulent shrubs ( <i>Disphyma crassifolium</i> ) dominate the understorey (G. Keighery, pers. comm.)	-	8	ii	iii	ii	i, ii, ix, x, iv, vi, vii
Red Morrell woodland communities of the western wheatbelt. There appear to be at least three variants; the "normal" on calcareous clays in the valleys, another on dune rises around saline lakes, and a rare variant on massive laterites (Dongolocking and Brookton) (G. Keighery, pers. comm.)	-	8	ii	iii	ii	i, ii, iv, vi, ix, x, vii
<i>Banksia prionotes</i> and <i>Xylomelum angustifolium</i> on low level sandplains	-		iv	iv	iii	i, ii, iv, v, vi, vii, viii
Tamma-Dryandra-Eremaea shrubland on cream sands of the Ulva landform unit	-		iv	iv	iii	i, ii, iv, v, vi, vii, viii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

\*Specific communities are listed in the tables above, however vegetation types on dissection valley floors and lower slopes are more than 90% cleared for agriculture and comprise about 1/3 of the total number of the vegetation types in the subregion. The remaining areas of valley floor woodlands are subject to secondary salinity. Therefore, a further 20 to 30 vegetation types in this subregion should be treated as being "at risk".

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i>	V	ii	v	iii	v, i, ii
<i>Myrmecobius fasciatus</i>	V	ii	iv	iii	v, i, ii
<i>Petrogale lateralis lateralis</i>	V	ii	v	iii	v, i, ii
<i>Phascogale calura</i>	E	ii	iv	iii	v, i, ii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, ix, x, vi
<i>Calyptorhynchus baudinii</i>	V	ii	iii	iii	i, ii, ix, x, vi
<i>Leipoa ocellata</i>	V	ii	iii	iii	i, ii, vii, vi, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia stokesii badia</i>	V	ii	iii	iii	i, ii, iv, v
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	ii	iv	iii	i, ii,
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	1	i	ii	iii	i, iv, v
<i>Morella spilota imbricata</i>	SP	ii	iii	iii	i, iv, v
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Psophodes nigrogularis oregon</i>	Near threatened	ii	iii	iii	i, ii, vii
<i>Acanthiza iredalei iredalei</i>		ii	iv	iii	iv
<i>Platycercus icterotis xanthogenys</i>	2	ii	iii	iii	i, iv,
<i>Lerista viduata</i>	1	ii	vi	ii	i, ii, iv, v, vii
<i>Bothriembryon bradshawi</i>	1	ii	vi	ii	i, ii
<i>Parartemia contracta</i>	1	ii	vi	ii	ix
<i>Daphnia jollyi</i>	1	ii	vi	ii	ix, x
<i>Limnocythere porphyretica</i>	1	ii	vi	ii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Acacia prismifolia</i>	X	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia aphylla</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia ataxiphylloides</i> subsp. <i>magna</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia insolita</i> subsp. <i>recurva</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia pharangites</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia subflexuosa</i> subsp. <i>capillata</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia vassalii</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x, vii ( <i>Phytophthora</i> sp.)
<i>Banksia cuneata</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x, vii ( <i>Phytophthora</i> sp.)
<i>Caladenia drakeoides</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Darwinia carnea</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Daviesia euphorbioides</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila pinnatifida</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila resinosa</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila scaberula</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila veneta</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Gastrolobium hamulosum</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea pythara</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea scapigera</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Roycea pycnophylloides</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Synaphea quartzitica</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Thomasia</i> sp. Green Hill (S. Paust 1322)	CR	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	CR	ii	ii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia aristulata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia brachypoda</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia lanuginophylla</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia pygmaea</i>	E	ii	iii	iii	i, ii, iv, vi, vii
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x, vii ( <i>Phytophthora</i> sp.)
<i>Banksia oligantha</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x, vii ( <i>Phytophthora</i> sp.)
<i>Boronia capitata</i> subsp. <i>capitata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis drummondii</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis wonganensis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Daviesia dielsii</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eremophila ternifolia</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Gastrolobium appressum</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Gastrolobium glaucum</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea christineae</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea involucreata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Hakea aculeata</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Lasiopetalum rotundifolium</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Lechenaultia pulvinaris</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Melaleuca sciostyla</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Orthrosanthus muelleri</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Philotheca wonganensis</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Rhizanthella gardneri</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Stylidium coroniforme</i>	E	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Acacia denticulosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Acacia semicircularis</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Allocasuarina fibrosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Asterolasia nivea</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Calectasia pignattiana</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Conostylis misera</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus olivacea</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Grevillea flexuosa</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x

<i>Microcorys eremophiloides</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Pultenaea pauciflora</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Rhagodia acicularis</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Stylidium merrallii</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Thomasia glabripetala</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia carinata</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<i>Verticordia hughanii</i>	V	ii	iii	iii	i, ii, iv, vi, vii, ix, x
<b>PRIORITY 1</b>					
<i>Acacia cochlocarpa</i> subsp. <i>velutinosa</i>	1	ii	vi	unknown	Unknown threatening processes
<i>Acacia microneura</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia trinalis</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dampiera glabrescens</i>	1	ii	vi	unknown	Unknown threatening processes
<i>Dryandra lepidorhiza</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Guichenotia seorsiflora</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Lysiosepalum abollatum</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Paraparmelia sammyii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Paraparmelia sargentii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thomasia dielsii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thomasia</i> sp. Arthur River (H.F. & M. Broadbent 1409)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thysanotus sabulosus</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Verticordia huegellii</i> var. <i>tridens</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>PRIORITY 2</b>					
<i>Acacia congesta</i> subsp. <i>wonganensis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia drewiana</i> subsp. <i>minor</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia gemina</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia sclerophylla</i> var. <i>pilosa</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia tuberculata</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Andersonia carinata</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Boronia ericifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Caladenia luteola</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Chordifex ornatus</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Chordifex ornatus</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Conostylis seorsiflora</i> subsp. Nyabing (A. Coates s.n.)	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra acanthopoda</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra rufistylis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus recta</i>	2	ii	vi	unknown	Unknown threatening processes
<i>Eucalyptus sparsicoma</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Grevillea kenneallyi</i>	2	ii	vi	unknown	Unknown threatening processes
<i>Lasiopetalum cardiophyllum</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Leucopogon denticulatus</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Leucopogon florulentus</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Melaleuca ordinifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Melaleuca pritzellii</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Persoonia hakeiformis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Phyllangium palustre</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Pimelea neokyrea</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea platyphylla</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thysanotus acerosifolius</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Verticordia wonganensis</i>	2	ii	vi	unknown	Unknown threatening processes
<b>OTHER SPECIES AT RISK</b>					
<i>Boronia rhomboidea</i>		ii	iii	iii	i, ii, iv, vi, vii, ix, x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
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	Deep pools and natural braided sections of fresh to brackish rivers of the Avon Botanical District	100	17	0	0	0	H
	Heath community on chert hills of the Coomberdale Floristic Region - Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region.	100	630	45 (7%)	0	7	M
	Wheatbelt Mottlecah ( <i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i> ) dominated heathland on deep white sands.	100	2	0	0	0	H
	Plant assemblages of the Wongan Hills System - Mallee over <i>Petrophile shuttleworthiana</i> / <i>Allocasuarina campestris</i> thicket on shallow gravelly soils over ironstone on summit and slopes; Shrub mallee on slopes of lateritic hills; Mallee over <i>Allocasuarina campestris</i> thicket on the slopes of the laterite plateaus; Mallee over Melaleuca thicket on red brown loam over gravel on slopes below the plateau; Mallee over <i>Melaleuca coronicarpa</i> heath on shallow red soil on scarp slopes; <i>A. campestris</i> / <i>Calothamnus asper</i> thicket over red-brown clay/ironstone/greenstone on scree slopes; and in lower areas: <i>Eucalyptus longicornis</i> / <i>E. salubris</i> woodland, <i>E. salmonophloia</i> and <i>E. loxophleba</i> woodlands; <i>Acacia acuminata</i> low forest; <i>E. ebbanoensis</i> mallee over scrub; and open mallee of <i>E. drummondii</i> .	100	2410	759 (32%)	0	32	M
	Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	3	13	0	0	0	H
	Herbaceous plant assemblages on bentonite Lakes	100	65.25	0	65.25 (100%)	0	H
	Salt Flats Plant Assemblages of the Mortlock River (East Branch)	100	6310.2	0	438.86 (6.9%)	0.05	H
	<i>Banksia prionotes</i> and <i>Xylomelum angustifolium</i> on low level sandplains	100	58.38	0	58.38 (100%)	0	H
Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
	Tamma-Dryandra-Eremaea shrubland on cream sands of the Ulva landform unit	100	93	8.1	60.2 (64.7%)	19.46	H
49	Shrublands; mixed heath	0.2	55.8	0.0	0.0	0.0	L
392	Shrublands; <i>Melaleuca thyioides</i> thicket	0.2	3.3	0.0	0.0	0.0	M
551	Shrublands; <i>Allocasuarina campestris</i> thicket	0.8	807.7	0.0	0.0	0.0	M
631	Succulent steppe with woodland and thicket; York gum over <i>Melaleuca thyioides</i> & samphire	0.7	303.4	0.0	0.0	0.0	M
948	Medium woodland; York gum & river gum	100.0	138.8	0.0	0.0	0.0	H
950	Medium woodland; <i>Casuarina obesa</i>	98.8	222.2	0.0	0.0	0.0	H
954	Shrublands; thicket, Jam & <i>Allocasuarina huegelliana</i>	0.5	5.4	0.0	0.0	0.0	M
962	Medium woodland; mallet ( <i>E. astringens</i> )	83.8	208.0	0.0	0.0	0.0	H
1022	Succulent steppe with woodland; <i>Casuarina obesa</i> & samphire	100.0	211.7	0.0	0.0	0.0	H
1025	Mosaic: Medium woodland; York gum, salmon gum & morrel/Succulent steppe; saltbush & samphire	18.0	7.6	0.0	0.0	0.0	H
1040	Medium woodland; York gum & <i>Casuarina obesa</i>	0.7	5.0	0.0	0.0	0.0	M
1042	Succulent steppe with low woodland; sheoak over samphire	100.0	13.5	0.0	0.0	0.0	H
1044	Mosaic: Medium woodland; York gum & salmon gum/Shrublands; <i>Melaleuca thyioides</i> thicket	6.7	9.2	0.0	0.0	0.0	H
1046	Succulent steppe with woodland; York gum & samphire	100.0	65.0	0.0	0.0	0.0	H
1048	Mosaic: Shrublands; melaleuca patchy scrub/Succulent steppe; samphire	0.4	9.6	0.0	0.0	0.0	M
1077	Medium woodland; jarrah & river gum	50.0	718.8	0.0	0.0	0.0	M
1080	Succulent steppe with mallee & thickets; Mallee and <i>Melaleuca uncinata</i> thickets on salt flats	45.9	42.3	0.0	0.0	0.0	H

1088	Medium woodland; mallet & blue mallet	82.8	158.8	0.0	0.0	0.0	H
1094	Mosaic: Medium woodland; York gum & salmon gum/Shrublands; mallee scrub <i>Eucalyptus eremophila</i> & black marlock	5.1	251.6	0.0	0.0	0.0	L
1095	Medium woodland; York gum, yate & salmon gum	10.0	34.2	0.0	0.0	0.0	M
1149	Shrublands; scrub-heath Acacia-Ecdeiocolia association in the south-east Geraldton Sandplain Region	1.3	7.5	0.0	0.0	0.0	M

## Subregional constraints in order of priority

(see Appendix B, key g)

### Irreplacibility and Limited Opportunity to Meet CAR Criteria:

The majority of ecosystems have been extensively cleared well below CAR thresholds, generally below 10%. Within the agricultural zone virtually all remnants are important for biodiversity conservation and building towards CAR thresholds.

**Other:** Many ecosystems low in the landscape are under threat from rising watertables. Most lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems will be lost. These systems support over 1500 plant species, of which 450 are endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.

**Economic Constraints:** Insufficient resources to acquire and manage an increased conservation estate.

**Competing Land Uses:** Whilst some opportunities exist to add to the conservation estate through the vesting of unallocated Crown land and the re-vesting of other Crown reserves, there is some competition with other government agencies and local government for these areas. The process is also lengthy and somewhat ad hoc.

**Other:** Inadequate systematic knowledge of biodiversity values at an appropriately fine scale.

## Bioregional and subregional priority for reserve consolidation

Avon Wheatbelt

Category 1 IBRA Reservation Class 1 (<2% and <30% of native vegetation cover remaining (all subregions)

(Appendix D). There is no change recommended for this class.

AW2 – 1b (Appendix C, rank 4) Clearing has been extensive, and rising saline groundwater threatens up to 30% of the landscape.

## Reserve management standard

The Reserve Management Standard is Poor (see Appendix C, rank 5). A significant threatening process i.e. rising saline groundwater, is not managed (except in very localised circumstances) and is currently and projected to cause major declines and extinctions in lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems. Several reserves are routinely fox baited (part of Dryandra Woodland, Tutanning Nature Reserve, Boyagin Nature Reserve, Mt Caroline Nature Reserve, Mt Stirling Nature Reserve, Nangeen Hill Nature Reserve, Dongolocking Nature Reserve, Gundaring Nature Reserve, East Yornanning Nature Reserve, Weam Nature Reserve, Pingeculling Nature Reserve, Jaloran Nature Reserve – approximately 9.7% (17 600 ha) of the conservation estate is baited). Biodiversity values are poorly identified. The recent Salinity Action Plan Biodiversity Survey project represents the first systematic overview of the region's biota, and is due for publication in late 2002. However there is no systematic fine scale vegetation mapping (1:25 000 or better); the best available is Beard's at 1:250 000. Some reserves have had vegetation maps prepared, but there is little consistency between methodologies. Inappropriate fire regimes are also a major threat to biodiversity, but little is known of the response of individual species to fire. Fire histories for all reserves are also poorly known and documented.

## Off reserve conservation

### Priority species or groups

CWR mammals

Species	Current Conservation Status (WA)	Status in AW2 Subregion	Recovery Plan
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Locally Extinct	No
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)	No
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Threatened (Endangered)	Locally Extinct	National?
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Locally Extinct	State
Numbat ( <i>Myrmecobius fasciatus</i> )	Threatened (Vulnerable)	Locally Extinct	National & State
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Locally Extinct	National
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Locally Extinct	No
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	Threatened (Vulnerable)	Locally Extinct	No
Black-flanked Rock-wallaby ( <i>Petrogale lateralis lateralis</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)	No
Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> )	Threatened (Vulnerable)	Locally Extinct	No

Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Locally Extinct	No
Woylie ( <i>Beetongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Quenda ( <i>Isoodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Locally Extinct	No
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent	No

Western Wheatbelt Coordinated Conservation Plan for 14 bird species (Garnett and Crowley 2000) – only 11 of these occur in the AW2 and one is subregionally extinct.

Species	Status
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	Locally Extinct
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Endangered
Malleefowl ( <i>Leipoa ocellata</i> )	Vulnerable
Australian Bustard ( <i>Ardeotis australis</i> )	Near Threatened
Bush Stone-curlew ( <i>Burhinus grallarius</i> )	Near Threatened
Hooded Plover (western) ( <i>Thinornis rubricollis tregellasi</i> )	Near Threatened
Western Rosella (wheatbelt) ( <i>Platycercus icterotis xanthogenys</i> )	Near Threatened
Barking Owl (southern) ( <i>Ninox connivens connivens</i> )	Near Threatened
Shy Heathwren (western) ( <i>Hylacola cauta whitlocki</i> )	Near Threatened
Rufous Fieldwren (western wheatbelt) ( <i>Calamanthus campestris montanellus</i> )	Near Threatened
White-browed Babbler (western wheatbelt) ( <i>Pomatostomus superciliosus ashbyi</i> )	Near Threatened
Crested Shrike-tit (western) ( <i>Falcunculus frontatus leucogaster</i> )	Near Threatened

Other groups at risk include:

Flora and fauna of granite outcrops – for example *Eucalyptus rhodantha* var. *rhodantha*, *Verticordia staminosa* subsp. *staminosa*

District Threatened Flora Recovery Teams – the Katanning, Narrogin, Merredin and Moora District TFRT, and the Swan Regional TFRT cover the following species with IRPs - *Acacia pharangites*, *Acacia pygmaea*,

*Adenanthos pungens* subsp. *effusus*, *Darwinia carnea*, *Daviesia euphorbioides*, *Drakonorchis drakeoides*, *Eremophila scaberula*, *Eremophila veneta*, *Grevillea curviloba* subsp. *incurva*, *Grevillea dryandroides* subsp. *dryandroides*, *Grevillea scapigera*, *Orthrosanthus muelleri*, *Sphenotoma drummondii*, *Synaphea quartzitica*, *Thomasia* sp. Green Hill (S.Paust 1322), *Verticordia staminosa* subsp. *staminosa*.

Wongan-Ballidu Threatened Flora Management Program

- covers the following 28 flora taxa:

Species	Status EPBC Act	Status WA
<i>Acacia botrydion</i>	-	P 4
<i>Acacia cochlocarpa</i> subsp. <i>velutinos</i>	-	P 1
<i>Acacia congesta</i> subsp. <i>wonganensis</i>	-	P 2
<i>Acacia pharangites</i>	CR	CR
<i>Acacia pygmaea</i>	E	E
<i>Acacia semicircularis</i>	V	V
<i>Calothamnus accedens</i>	X	X
<i>Conostylis wonganensis</i>	E	E
<i>Dampiera glabrescens</i>	-	P 1
<i>Daviesia spiralis</i>	-	P 4
<i>Dryandra comosa</i>	-	P 4
<i>Dryandra pulchella</i>	-	P 4
<i>Dryandra wonganensis</i>	-	P 4
<i>Eremophila ternifolia</i>	E	V
<i>Eucalyptus recta</i>	-	P 2
<i>Gastrolobium glaucum</i>	E	CR
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	CR	CR
<i>Grevillea kenneallyi</i>	-	P 1
<i>Hemigenia conferta</i>	-	P 4
<i>Loxocarya albipes</i>	-	P 4
<i>Lysiosepalum abollatum</i> ms	-	P 1
<i>Melaleuca sciotostyla</i>	E	E
<i>Microcorys eremophiloides</i>	V	V

Species	Status EPBC Act	Status WA
<i>Philothea wonganensis</i>	E	E
<i>Rhagodia acicularis</i>	V	V
<i>Stylidium coroniforme</i>	E	E
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	CR	CR
<i>Verticordia wonganensis</i>	-	P 2

Threatened flora of roadsides – for example *Banksia cuneata* and *Hakea aculeata*.

Threatened flora of lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater

and naturally saline wetland systems. Eg. *Drakonorchis drakeoides*.

Declared Threatened Flora Species	Status EPBC Act	Status WA
<i>Acacia aphylla</i>	V	CR
<i>Acacia aristulata</i>	E	-
<i>Acacia ataxiphylla</i> subsp. <i>magna</i>	E	CR
<i>Acacia brachypoda</i>	E	E
<i>Acacia denticulosa</i>	V	V
<i>Acacia insolita</i> subsp. <i>recurva</i>	E	CR
<i>Acacia lanuginophylla</i>	E	E
<i>Acacia pharangites</i>	E	CR
<i>Acacia prismifolia</i>	NO STAT	-
<i>Acacia pygmaea</i>	E	E
<i>Acacia semicircularis</i>	V	V
<i>Acacia subflexuosa</i> subsp. <i>capillata</i>	E	CR
<i>Acacia vassalii</i>	E	CR
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	E	CR
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	V	E
<i>Allocasuarina fibrosa</i>	V	V
<i>Asterolasia nivea</i>	V	-
<i>Banksia cuneata</i>	E	CR
<i>Banksia oligantha</i>	E	-
<i>Boronia capitata</i> subsp. <i>capitata</i>	E	E
<i>Boronia rhomboidea</i>	NO STAT	-
<i>Calectasia arnoldii</i>	V	-
<i>Chordifex chaunocoleus</i>	V	-
<i>Conostylis drummondii</i>	E	E
<i>Conostylis misera</i>	E	
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	E	CR
<i>Conostylis wonganensis</i>	E	E
<i>Darwinia carnea</i>	E	CR
<i>Darwinia macrostegia</i>	V	-
<i>Darwinia meeboldii</i>	V	-
<i>Darwinia oxylepis</i>	E	-
<i>Daviesia dielsii</i>	V	-
<i>Daviesia euphorbioides</i>	E	CR
<i>Daviesia spiralis</i>	V	-
<i>Drakonorchis drakeoides</i>	E	-
<i>Eremophila pinnatifida</i>	E	CR
<i>Eremophila resinosa</i>	E	CR

Declared Threatened Flora Species	Status EPBC Act	Status WA
<i>Eremophila scaberula</i>	E	-
<i>Eremophila ternifolia</i>	E	E
<i>Eremophila veneta</i>	E	CR
<i>Eucalyptus olivacea</i>	V	V
<i>Eucalyptus rhodantha</i> var. <i>petiolaris</i>	E	-
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	V	-
<i>Gastrolobium appressum</i>	V	-
<i>Gastrolobium glaucum</i>	E	E
<i>Gastrolobium hamulosum</i>	E	CR
<i>Grevillea christineae</i>	E	E
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	E	-
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	E	CR
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	E
<i>Grevillea flexuosa</i>	V	-
<i>Grevillea involucrata</i>	E	E
<i>Grevillea pythara</i>	E	CR
<i>Grevillea scapigera</i>	E	CR
<i>Hakea aculeata</i>	V	E
<i>Hemigenia viscida</i>	V	-
<i>Lasiopetalum rotundifolium</i>	E	E
<i>Lechenaultia pulvinaris</i>	E	E
<i>Melaleuca sciotostyla</i>	E	E
<i>Microcorys eremophiloides</i>	V	V
<i>Orthrosanthus muelleri</i>	E	-
<i>Philotheca wonganensis</i>	E	E
<i>Pultenaea pauciflora</i>	V	V
<i>Rhagodia acicularis</i>	V	V
<i>Rhizanthella gardneri</i>	E	E
<i>Roycea pycnophylloides</i>	E	CR
<i>Sphenotoma drummondii</i>	E	-
<i>Stylidium coroniforme</i>	E	E
<i>Stylidium merrallii</i>	V	V
<i>Synaphea quartzitica</i>	E	-
<i>Thomasia glabripetala</i>	V	-
<i>Thomasia</i> sp. Green Hill (S.Paust 1322)	E	-
<i>Verticordia carinata</i>	V	-
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	E	CR
<i>Verticordia hughanii</i>	E	V
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	E	CR

## Priority 1 and 2 flora

Species	Priority
<i>Acacia cochlocarpa</i> subsp. <i>velutinosa</i>	1
<i>Acacia congesta</i> subsp. <i>wonganensis</i>	2
<i>Acacia drewiana</i> subsp. <i>minor</i>	2
<i>Acacia gemina</i>	2
<i>Acacia microneura</i>	1
<i>Acacia sclerophylla</i> var. <i>pilosa</i>	2
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	1
<i>Acacia trinalis</i>	1

Species	Priority
<i>Acacia tuberculata</i>	2
<i>Andersonia carinata</i>	2
<i>Boronia ericifolia</i>	2
<i>Caladenia luteola</i>	2
<i>Chordifex ornatus</i>	2
<i>Chordifex ornatus</i>	2
<i>Conostylis seorsiflora</i> subsp. Nyabing (A. Coates s.n.)	2
<i>Dampiera glabrescens</i>	1
<i>Dryandra acanthopoda</i>	2
<i>Dryandra lepidorhiza</i>	1
<i>Dryandra rufistylis</i>	2
<i>Eucalyptus recta</i>	2
<i>Eucalyptus sparsicoma</i>	2
<i>Grevillea kenneallyi</i>	2
<i>Guichenotia seorsiflora</i>	1
<i>Lasiopetalum cardiophyllum</i>	2
<i>Leucopogon denticulatus</i>	2
<i>Leucopogon florulentus</i>	2
<i>Lysiosepalum abollatum</i>	1
<i>Melaleuca ordinifolia</i>	2
<i>Melaleuca pritzelii</i>	2
<i>Paraparmelia sammyii</i>	1
<i>Paraparmelia sargentii</i>	1
<i>Persoonia hakeiformis</i>	2
<i>Phyllangium palustre</i>	2
<i>Pimelea neokyrea</i>	2
<i>Synaphea platyphylla</i>	2
<i>Thomasia dielsii</i>	1
<i>Thomasia</i> sp. Arthur River (H.F. & M. Broadbent 1409)	1
<i>Thysanotus acerosifolius</i>	2
<i>Thysanotus sabulosus</i>	1
<i>Verticordia huegellii</i> var. <i>tridens</i>	1
<i>Verticordia wonganensis</i>	2

## Existing recovery plans

Species/Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Yes – unpublished IRP	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Chuditch ( <i>Dasyurus geoffroi</i> )	Yes – State	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Numbat ( <i>Myrmecobius fasciatus</i> )	Yes – National unpublished	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Bilby ( <i>Macrotis lagotis</i> )	Yes – National	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Boodie ( <i>Bettongia lesueur lesueur</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Not in WA	No	Western Shield Fauna Recovery Program
Species/Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Yes – RP (now out of	Action Plan for Australian Marsupials and	Western Shield Fauna

	date)	Monotremes - Taxon Summary	Recovery Program
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	No (old draft)	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Quenda ( <i>Isodon obesulus fusciventer</i> )	No	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Mala ( <i>Lagorchestes hirsutus</i> )	Yes – National (unpublished)	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Red-tailed Phascogale ( <i>Phascogale calura</i> )	No	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No	Action Plan for Australian Marsupials and Monotremes - Taxon Summary	Western Shield Fauna Recovery Program
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	Yes – Interim Recovery Plan	Action Plan for Australian Birds - Coordinated Conservation Plan & Taxon Summary	No
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Yes - State	Action Plan for Australian Birds - Coordinated Conservation Plan & Recovery Outline	No
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis</i> )	No	Action Plan for Australian Birds – Taxon Summary	Research Plan for the Western Ground Parrot, Western Whipbird and Western Bristlebird.
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	No	Action Plan for Australian Birds – Taxon Summary	No
Barking Owl (southern) ( <i>Ninox connivens</i> )	No	Action Plan for Australian Birds - Coordinated Conservation Plan & Taxon Summary	No
Western Wheatbelt Birds	Some	Action Plan for Australian Birds - Coordinated Conservation Plans and individual Action Plans	No
Western Spinytailed Skink ( <i>Egernia stokesii badia</i> )	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Aspidites ramsayi</i> (south west population)	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles - Recovery Outline	No
<i>Lerista viduata</i>	No	No	No
<i>Idiosoma nigrum</i>	No	No	No
<i>Kwonkan eboracum</i>	No	No	No
Threatened Flora on roadsides e.g. <i>Boronia adamsiana</i> , <i>Acacia volubilis</i>	Few	N/A	Roadside Conservation Strategies (Roadside Conservation Committee and Shires)
Flora and fauna of granite outcrops e.g. <i>Eucalyptus rhodantha</i> var. <i>rhodantha</i> , <i>Verticordia staminosa</i> subsp. <i>staminosa</i>	Few	N/A	No
Threatened flora of lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems.	Few	N/A	Eg. Buntine-Marchagee Recovery Catchment
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	No	N/A	Salinity Action Plan Biological Survey of the Agricultural Zone
Wongan-Ballidu Threatened Flora Management Program	Draft in prep.	N/A	No
Priority 1 and 2 flora (41 species)	No	N/A	No

Species/Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
General Declared Rare Flora without an IRP (60 species)	No	N/A	No
<i>Acacia pharangites</i>	Yes - IRP	N/A	No
<i>Acacia pygmaea</i>	Yes - IRP	N/A	No
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	Yes - IRP	N/A	No
<i>Darwinia carnea</i>	Yes - IRP	N/A	No
<i>Daviesia euphorbioides</i>	Yes - IRP	N/A	No
<i>Drakonorchis drakeoides</i>	Yes - IRP	N/A	No
<i>Eremophila scaberula</i>	Yes - IRP	N/A	No
<i>Eremophila veneta</i>	Yes - IRP	N/A	No
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	Yes - IRP	N/A	No
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	Yes - IRP	N/A	No
<i>Grevillea scapigera</i>	No – draft RP	N/A	No
<i>Orthrosanthus muelleri</i>	Yes - IRP	N/A	No
<i>Sphenotoma drummondii</i>	Yes - IRP	N/A	No
<i>Synaphea quartzitica</i>	Yes - IRP	N/A	No
<i>Thomasia</i> sp. Green Hill (S.Paust 1322)	Yes - IRP	N/A	No
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	Yes - IRP	N/A	No

### Appropriate species recovery actions

Species/Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Chuditch ( <i>Dasyurus geoffroi</i> )	vii, i, x, xiv, ix	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – monitoring; Fire management.	Lack of survey data, lack of suitably large habitat areas, predator control
Numbat ( <i>Myrmecobius fasciatus</i> )	vii, i, x, xiv, xii, ix	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Research; Fire management.	Lack of suitably large habitat areas, predator control
Bilby ( <i>Macrotis lagotis</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Boodie ( <i>Bettongia lesueur lesueur</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	vii, i, x, xiv, ix, xii	Feral animal control (particularly predators); Habitat retention through reserves; Translocation; Other – Captive breeding and monitoring; Fire management; Research.	Locally extinct, lack of suitably large habitat areas, predator control
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	vii, x, i	Feral animal control (particularly predators); Translocation; Habitat retention through reserves.	Locally extinct, lack of suitably large habitat areas, predator control
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	vii, i	Feral animal control (particularly predators); Habitat retention through reserves.	Lack of suitably large habitat areas, predator control

Species/Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	vii, i	Feral animal control (particularly predators); Habitat retention through reserves;	Lack of suitably large habitat areas, predator control
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	x, i, iii, vii, xiv	Translocation; Habitat retention through reserves and on other state lands; Feral animal control (particularly predators); Other - survey and monitoring.	Locally extinct
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	i, ii, iii, xiv, xii	Habitat retention through reserves, on private lands and on other state lands; Other - Protect known nesting trees and breeding areas, survey work, captive breeding and public awareness	Lack of survey data on breeding and habitat areas

		programme; Research.	
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis</i> )	i, iii, ii, viii, xiv, xii	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Other – monitoring; Research.	Lack of knowledge on habitat requirements
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	xiv, xii, i, ii, iii	Other – monitoring, promote community nestbox program, and mitigate food limitations; Research; Habitat retention through reserves, on private lands and on other state lands.	Lack of survey data
Barking Owl (southern) ( <i>Ninox connivens</i> )	i, iii, ii, xii, xiv, xiii, viii, vii	Habitat retention through reserves, other state lands and on private lands; Research; Other – survey work; Capacity building - extension to promote habitat management; Revegetation; Feral animal control (particularly predators).	Lack of survey data, lack of resources to manage fire regimes
Western Wheatbelt Birds	i, iii, ii, viii, vii, v, vi, xi, xiv	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Feral animal control (particularly predators); Fencing; Weed control; Reinstatement of hydrology; Other – tree hollow protection and monitoring.	Lack of survey data, lack of knowledge on causes of declines
Western Spinytailed Skink ( <i>Egernia stokesii badia</i> )	i, iii, ii, vii, v, xiv	Habitat retention through reserves, other state lands and on private lands; Feral animal control (particularly predators); Fencing; Other – Survey and monitoring.	Lack of survey data, lack of knowledge on causes of declines
<i>Aspidites ramsayi</i> (south west population)	i, iii, ii, xiv, vii, xiii, x	Habitat retention through reserves, on other state lands and on private lands; Other – survey and captive breeding; Feral animal control (particularly predators); Capacity building - develop guidelines and incentives to manage population outside reserves; Translocation.	Possibly locally extinct, lack of survey data
<i>Morelia spilota imbricata</i>	i, iii, ii, xiv, vii, xiii, x	Habitat retention through reserves, on other state lands and on private lands; Other – survey and captive breeding; Feral animal control (particularly predators); Capacity building - develop guidelines and incentives to manage population outside reserves; Translocation.	Lack of survey data
<i>Lerista viduata</i>	Unknown	Unknown	Lack of knowledge and data
<i>Idiosoma nigrum</i>	i, iii, vii, xiv, vi, ix	Habitat retention through reserves and on other state lands; Feral animal control (particularly predators); Other - minimise soil disturbance and survey; Weed control; Fire management.	Lack of survey data
<i>Kwonkan eboracum</i>	Unknown	Unknown	Lack of survey data
Threatened Flora on roadsides e.g. <i>Boronia adamsiana</i> , <i>Acacia volubilis</i>	iii, xiii, vi, v, x, viii	Habitat protection on other state lands; Capacity building - Shire officers; Weed control; Translocation; Revegetation.	Competing land use; loss of permanent staff and increased use of contractors makes the education process more difficult

Species/Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Flora and fauna of granite outcrops e.g. <i>Eucalyptus rhodantha</i> var. <i>rhodantha</i> , <i>Verticordia staminosa</i> subsp. <i>staminosa</i>	i, iii, ii, xi, vi, vii, ix, xiii, xii	Habitat retention through reserves, other state lands and on private lands; Reinstatement of hydrology; Weed control; Feral animal control (particularly predators); Fire management; Capacity building with landholders; Research.	Competing use of water for supply purposes; loss of fringing vegetation in many instances.
Threatened flora of lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems.	xi, xiii, viii, x, xiv	Reinstatement of hydrology; Capacity building with landholders; Revegetation; Translocation; Other - germplasm storage.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	xi, x, xiv, i, iii, ii	Reinstatement of hydrology; Translocation; Other - germplasm storage; Habitat retention through reserves, other state lands and on private lands.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Wongan-Ballidu Threatened Flora Management Program	i, iii, ii, vii, v, vi, xiv, x, ix, xii	Habitat retention through reserves, on private land and on other state lands; Feral animal control; Fencing; Weed control; Other - survey work; Translocation; Fire management; Research.	
Priority 1 and 2 flora (41 species)	xiv (additional survey to locate new populations)	Other - additional survey to locate new populations.	Insufficient number of qualified staff to undertake the extensive fieldwork required.
General Declared Rare Flora without an IRP (60 species)	General – iii, ii, i, vi, xi, v, viii, ix, xiii (Shires, landholders, Utilities), xiv (additional survey work to locate new populations), x	Other – additional survey work to locate new populations.	General - Insufficient qualified staff and resources to undertake the extensive fieldwork required for survey, monitoring and management actions
<i>Acacia pharangites</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control; Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Acacia pygmaea</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, on other state lands and on private lands; Feral animal control; Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	i, xiv, x, xi, xiv	Habitat retention through reserves; Other - protect from mining, disease management <i>Phytophthora</i> sp. and seed collection; Translocation; Reinstatement of hydrology.	Refer DRF General above
<i>Darwinia carnea</i>	ii, iii, v, vii, x, xii, xiv	Habitat protection on private lands and on other state lands; Fencing; Feral animal control; Translocation; Research; Other - survey and monitoring.	Refer DRF General above
<i>Daviesia euphorbioides</i>	iii, i, ix, x, xiii, xii, xiv	Habitat protection on other state lands and through reserves; Fire management; Capacity building with the Shire and Westrail; Research; Other - survey and monitoring.	Refer DRF General above

Species/Group	Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
<i>Drakonorchis drakeoides</i>	ii, i, xi, ix, vi, vii, xiv, xiii	Habitat protection on private lands and through reserves; Reinstatement of hydrology; Fire management; Weed control; Revegetation; Other - survey and monitoring; Capacity building with land holders.	Refer DRF General above
<i>Eremophila scaberula</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Eremophila veneta</i>	i, iii, xiii, ix	Habitat retention through reserves and on other state lands; Capacity building with Westrail; Fire management.	Refer DRF General above
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Grevillea scapigera</i>	iii, x, vi, xii	Habitat protection on other state lands; Translocation; Weed control; Capacity building with local community groups.	Refer DRF General above
<i>Orthrosanthus muelleri</i>	iii	Habitat protection on other state lands.	Refer DRF General above
<i>Sphenotoma drummondii</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Synaphea quartzitica</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Thomasia</i> sp. Green Hill (S.Paust 1322)	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	i, iii, ii, vii, v, vi, xiv, x, ix, xi, xii	Habitat retention through reserves, other state lands and private lands; Revegetation, Fencing; Weed control; Other – survey work; Translocation; Fire management; Reinstatement of hydrology; Research.	Refer DRF General above

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Community	Specific Recovery Plan	General Recovery Plan
Deep pools and natural braided sections of fresh to brackish rivers of the Avon Botanical District	No	Wheatbelt Management Plan (draft)
Heath community on chert hills of the Coomberdale Floristic Region - Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region.	Yes - IRP	Wheatbelt Management Plan (draft)

Community	Specific Recovery Plan	General Recovery Plan
Plant assemblages of the Wongan Hills System - Mallee over <i>Petrophile shuttleworthiana</i> / <i>Allocasuarina campestris</i> thicket on shallow gravelly soils over ironstone on summit and slopes; Shrub mallee on slopes of lateritic hills; Mallee over <i>Allocasuarina campestris</i> thicket on the slopes of the laterite plateaus; Mallee over <i>Melaleuca</i> thicket on red brown loam over gravel on slopes below the plateau; Mallee over <i>Melaleuca coronicarpa</i> heath on shallow red soil on scarp slopes; <i>A. campestris</i> / <i>Calothamnus asper</i> thicket over red-brown clay/ironstone/greenstone on scree slopes; and in lower areas: <i>Eucalyptus longicornis</i> / <i>E. salubris</i> woodland, <i>E. salmonophloia</i> and <i>E. loxophleba</i> woodlands; <i>Acacia acuminata</i> low forest; <i>E. ebbanoensis</i> mallee over scrub; and open mallee of <i>E. drummondii</i> .	No	Wheatbelt Management Plan (draft)
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	Yes	Wheatbelt Management Plan (draft)
Herbaceous plant assemblages on bentonite Lakes	Yes - IRP	Wheatbelt Management Plan (draft)
Salt Flats Plant Assemblages of the Mortlock River (East Branch)	No	Wheatbelt Management Plan (draft)

### Appropriate ecosystem recovery actions

Community	Ecosystem Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
Deep pools and natural braided sections of fresh to brackish rivers of the Avon Botanical District	xi, vi, vii, xii	Reinstatement of hydrology; Weed control; Feral animal control (stock); Research.	The extent of hydrological reinstatement required
Heath community on chert hills of the Coomberdale Floristic Region - Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region.	ii, i, iii, xiii, v, vi, xiv, ix, xii, viii	Habitat protection on private lands, through reserves and on other state lands; Capacity building with landholders, Water Corporation; Fencing; Weed control; Other - survey and monitoring; Fire management; Research; Revegetation.	Further research needs to undertaken
Wheatbelt Mottlecah ( <i>Eucalyptus macrocarpa</i> subsp. <i>macrocarpa</i> ) dominated heathland on deep white sands.	iii, vii, ix, xiv, xiv	Habitat protection on other state lands; Feral animals control (control); Fire management; Other - survey work and prevention of the introduction of <i>Phytophthora</i> sp	Further research needs to undertaken
Plant assemblages of the Wongan Hills System - Mallee over <i>Petrophile shuttleworthiana</i> / <i>Allocasuarina campestris</i> thicket on shallow gravelly soils over ironstone on summit and slopes; Shrub mallee on slopes of lateritic hills; Mallee over <i>Allocasuarina campestris</i> thicket on the slopes of the laterite plateaus; Mallee over <i>Melaleuca</i> thicket on red brown loam over gravel on slopes below the plateau; Mallee over <i>Melaleuca coronicarpa</i> heath on shallow red soil on scarp slopes; <i>A. campestris</i> / <i>Calothamnus asper</i> thicket over red-brown clay/ironstone/greenstone on scree slopes; and in lower areas: <i>Eucalyptus longicornis</i> / <i>E. salubris</i> woodland, <i>E. salmonophloia</i> and <i>E. loxophleba</i> woodlands; <i>Acacia acuminata</i> low forest; <i>E. ebbanoensis</i> mallee over scrub; and open mallee of <i>E. drummondii</i> .	i, iii, ii, vii, ix, vi, xiv	Habitat retention through reserves, on other state lands and on private lands; Feral animal control (stock); Fire management; Weed control; Other - controls on mining activities.	Further research needs to undertaken

Community	Ecosystem Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
Perched wetlands of the Wheatbelt region with extensive stands of living Swamp Sheoak ( <i>Casuarina obesa</i> ) and Paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor.	xi, i, xiii, viii, xii, xiv	Reinstatement of hydrology; Habitat retention through reserves; Capacity building with landholders; Revegetation; Research; Other - groundwater pumping.	Extent of revegetation required to manage groundwater in the long-term
Herbaceous plant assemblages on bentonite Lakes	i, ii, v, vi, xii	Habitat retention through reserves and on private lands; Fencing; Weed control; Research.	Further research needs to undertaken
Salt Flats Plant Assemblages of the Mortlock River (East Branch)	i, ii, v, vi, vii, x, xi, xii, xiii	Habitat retention through reserves and on private lands; Fencing; Weed control; Feral animal control; Translocations; Reinstatement of hydrology; Research; Capacity building.	Further research needs to undertaken

<sup>1</sup>Appendix B, key h

For all the unreserved vegetation types listed (page 45), the following recovery actions would generally apply: i, iii, ii, xi, vii, vi, ix, xiii (landholders).

### Subregion priority for off reserve conservation

There are major constraints (see Appendix C, rank 6) to achieve conservation outcomes due to the level of habitat loss and degree of fragmentation leaving insufficient resources across most of the landscape to support viable populations of many species, significant landscape scale threatening processes such as salinity (affecting up to 30% of the landscape) and fox/cat predation, and competing land uses i.e. broadacre cropping and grazing.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** There are incentives for a range of on-ground actions through State, Federal and some other programs. These incentives generally involve revegetation and remnant vegetation fencing, but in some cases (State government in particular) may involve earthworks. Examples include:

- State funding through recovery catchments and other components of the Salinity Program, such as the Crown Reserves Program (refer to Wallace 2001 for summary);
- Land for Wildlife Program (managed by Department of Conservation and Land Management);
- Bushcare funding, through joint projects with State government (who contribute significant dollars) projects and regional NRM groups;
- The Search Project (State-Federal program), for example, significant funding of commercially prospective native species of regional provenance;
- Other NHT programs (National Landcare, Endangered Species).

Three main options also exist to derive a financial benefit from on-farm remnant vegetation:

- Land purchase by government agencies, Australian Bush Heritage fund, interested individuals through the Bush Brokers scheme etc.
- Land revaluation as unproductive, or differential rating by covenanting, and
- Gifting of the land to a tax conservation body for taxation deductions.

**Legislation:** Most relevant legislation is Wildlife Conservation Act and Conservation and Land Management Act. There is no "duty of care" legislation, and no evidence that such legislation is practicable.

**Institutional Reform:** The purchase of bushland by CALM is a very real contribution to helping to re-align land use and free up money for landholders. This is a form of new tenure. Operation of regional NRM groups in a state of flux, but represents an on-going case of institutional reform. (See also recommendations in Frost *et al.* 2001 and Wallace 2001). Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

**Capacity Building with Landholders:** In September 1999 Bush Brokers was established with a formal Memorandum of Understanding by all partners. The MOU sets out a range of projects to be undertaken within the next twelve months. These include:

- A united base for promoting improvements to government policies, particularly subdivision policies and procedures so as to streamline the separation of bush from agricultural titles and placement on a separate title.
- A web site register of properties/ blocks currently for sale, and buyers seeking bushland.
- Research on the size of the bushland market, and the most cost-effective measures to stimulate that market.
- A case studies handbook of individuals and groups who have already bought bush.
- "Marketing Bushland" Information Seminars for rural agents.
- A "Marketing Bushland" component included in the accredited REIWA course.

**Other Planning Opportunities (with Local Government):** Draft Statement of Planning Policy made under Section 5AA of the *Town Planning and Development Act* (1928). This policy may be cited as the

Draft Statement of Planning Policy: Environment and Natural Resources Policy. The purpose of this policy is to inform local governments and the Town Planning Appeals Tribunal of those aspects of State-level planning policy concerning the environment and natural resources which should be taken into account in planning decision-making. The policy will also guide the WAPC in undertaking its planning responsibilities, and in integrating and coordinating the activities of the many State agencies which influence the use and development of land. This policy includes a section on biodiversity

**Valuing Ecosystem Services & Tradable Rights:** Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

**Threat Abatement Planning:** Actual action is largely through CALM, and there are internal reports and policies on threats such as dieback, feral animal control, fire, etc. However, note also:

- CALM's salinity review (Wallace 2001).
- State Salinity Strategy (State Salinity Council 2000).
- Report of the Salinity Taskforce (Frost *et al.* 2001).
- Weed management strategies (Department of Conservation and Land Management 1999b; Department of Agriculture 2001; Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2000a; Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2000b; and Agriculture & Resource Management Council of Australia & New Zealand *et al.* 2001).
- Local government dieback guidelines document (Lewis and Colquhoun 2000).
- Local government dieback guidelines document (Lewis and Colquhoun, 2000).

Also, specialist plans, for example, those related to management of locust control and interaction of control measures on conservation lands.

**Industry Codes of Practice:** Such as the following:

- Environmental Code of Practice – Extractive Industries (Environmental Protection Authority 1991).
- Environmental Management in the WA Mining Industry (Chamber of Mines and Energy of Western Australia 1993).
- Code of Practice for Timber Plantations in Western Australia
- Roadside Conservation Committee – Code of Practice for Roadside Conservation in Road Construction and Road Maintenance. The aim of this code is to balance road design and road safety requirements with all other values associated with roadsides in each Shire.

**Environmental Management Systems & Ecological Sustainable Product Marketing:** The Wheatbelt Region of CALM is preparing an EMS to identify values, threats, goals and prioritise management across the landscape.

**Capacity Building:** There is significant interaction between State agencies, regional NRM groups (eg. Avon Catchment Network), Greening Australia (WA) (for example, Living Landscapes) and Worldwide Fund for Nature (through Woodland Watch in particular). These groups are also interacting jointly and independently to

contribute to capacity building amongst landholders. Other groups such as the Threatened Species Network and Malleefowl Preservation Society also make significant contributions to capacity building in the community.

**Other Planning Opportunities:** Examples include:

- Department for Planning and Infrastructure is developing relevant rural land use plans.
- Some local governments are acting together to produce joint programs – for example, Kondinin Bush Heritage Committee.
- Regional NRM planning processes continue.
- CALM's Wheatbelt Regional Plan in development.
- National Action Plan for Water Quality and Salinity in development.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Integration occurring in various ways. Examples include:

- Contribution to property planning by Land for Wildlife;
- Aglets Land Management (Department of Agriculture) includes soil survey, land capability assessment and farm planning.
- Catchment planning through recovery catchments (natural diversity, water resources and rural towns);
- Rapid Catchment Appraisal process managed by Department of Agriculture.
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

**Other:** Actual on-ground actions by Department of Conservation and Land Management represent the most significant single, focussed contribution to biodiversity conservation in the subregions. One of the most significant aspects of this is in developing new industries based on native biota, particularly plants, that ameliorate threats without jeopardising conservation values. This includes the oil mallees, melaleucas, and a range of other species being investigated as part of the Department's Search program. This is a vital element of success in NRM.

Feasible opportunities for NRM and impediments or constraints to opportunities

Given opportunities and impediments/constraints are often different sides of the same issue, both are covered in this section.

A key constraint overall is the lack of resources – including human and infrastructure resources – for implementation. This point reflects the relative importance of biodiversity conservation and environmental issues in general in the public and political mind. Unless there is much wider recognition that biodiversity conservation makes a vital contribution to each individual's quality of life, this situation is unlikely to change. See Burbidge and Wallace (1995) for a discussion of some of the relevant issues.

A second generic issue is that NRM is variously and poorly defined. This is a significant impediment to

progress, and reflects a much wider lack of rigour in the NRM area, and the generally very poor understanding of the relevant Soc-political processes. One example of these issues is documented in Wallace (submitted for publication). A range of problems, opportunities and constraints in relation to salinity are dealt with in Wallace (2001). Many of these are relevant to the broader field of NRM.

**Incentives:** Potential changes in the taxation laws for philanthropy exist. It is important to note that in many important cases – such as salinity – it is not an incentive that is required, but technical solutions that are economically viable to implement. While the lack of technical solutions is a barrier, it is also an opportunity. CALM is, particularly in the case of revegetation, working hard to find economically viable technical solutions. Resources are an impediment to doing this faster. It is also essential to note that, if we do not develop economically viable solutions using regional plants and animals, there is a severe risk that new invasive weeds and pest animals (eg, through aquaculture and more aggressive grazing animals) will be introduced. Financial measures are a significant issue; Priority 1-5 years.

**Legislation:** The Proposed re-writing of the Wildlife Conservation Act is a key opportunity for change. More effective legislation and regulation in relation to land clearing and drainage would assist to combat some existing threats. This is both an opportunity and a barrier. Note the existing MOU is being reviewed. Financial measures are a significant issue (enforcement); Priority 1-20 years.

**Institutional Reform:** While institutional reform is an issue, even greater opportunities for progress lie in improving the current institutions and ensuring that they are staffed at a sufficient level and with appropriate people. Put simply, bad operators will still be bad irrespective of institutional reform, good operators will generally do comparatively well despite institutional structures. This does not deny the need for institutional reform in some cases. However, it has become clear that the recruitment, training and management of an effective NRM “group” is a far more significant impediment to progress than institutional structures and arrangements. Institutional reforms that would help include:

- To minimise institutional change, and certainly to avoid more frequent structural change to organisations than 8-10 year timeframes without very good reason. Significant structural changes cause organisational inefficiencies that last for a minimum of three years.
- Only implement institutional reform where there is a clearly articulated and convincing case that there is a well-identified problem to be fixed and that the proposed reform has a high probability of success.
- Wherever practicable, appoint contract officers to minimum terms of five years.
- Reverse the current trend of increasing duplication of service delivery in the NRM area.

Financial measures are a significant issue; Priority 1-20 years.

**Valuing Ecosystem Services & Tradable Rights:** Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

**Threat Abatement Planning as Part of NRM:** The environmental management system being developed by CALM for the subregions should, for these areas, provide a greatly improved platform for threat abatement planning. Wallace and Beecham (submitted for publication) presents the generalised framework for this.

**Environmental Management Systems & Ecologically Sustainable Product Marketing:** See comment above under threat abatement.

**Capacity Building:** The most important opportunity here is the need to re-define capacity building, and to more clearly state goals, objectives and strategies.

**Other Planning Opportunities:** To date there has been a tendency to over-plan, for example, there are a series of over-lapping planning processes for biodiversity conservation in the south-west. This has, and remains, a barrier. A key opportunity is to proceed implement plans and monitor their value in a more strictly “adaptive management” style than has been the practice to date.

**Integration with Property Management Planning, Catchment Planning and Landcare:** See comment under Other Planning above.

**Other:** One of the most significant aspects of this is in developing new industries based on native biota, particularly plants, that ameliorate threats without jeopardising conservation values. This includes the oil mallees, melaleucas, and a range of other species being investigated as part of the Department’s Search program. This is a vital element of success in NRM.

Subregions where specific NRM actions are a priority to pursue

There are major constraints (see Appendix C, rank 7) to implement effective NRM actions to achieve biodiversity outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** At present little mapping has been done of vegetation remnants to the sub-association level at this scale. To compliment this approach we also require equivalent scale mapping of soil-landscape units to facilitate revegetation of cleared lands, and to provide an alternative biodiversity surrogate, particularly for small terrestrial vertebrates and invertebrates. A standardised database and GIS application is also essential for data querying and management.

**Ecological and Life History Data:** It is critical to identify priorities and appropriate management responses in the fragmented and largely cleared landscape of the subregion. Data on various population demographic parameters, resource requirements and landscape variables are required to model population viability for a range of species with different life history strategies. This is essential to ensure that management actions are of an appropriate magnitude to achieve the desired biodiversity conservation goals.

**Systematic Fauna Surveys:** Required for birds, small terrestrial mammals, reptiles and select invertebrate groups across the landscape; also measures of various

habitat and landscape variables. A standardised database and GIS application is also essential for data querying and management. The assumption that vegetation characteristics can be used as habitat surrogates for fauna needs to be investigated more thoroughly in conjunction with vegetation and ecosystem mapping above. The continued use of the focal species approach (Lambeck 1997; Lambeck 1999) and a modified version (Lambeck 1998) for biodiversity conservation planning across the subregion requires further research and survey data to address the following:

- the validity of vegetation as a habitat surrogates for all fauna,
- the validity of using birds as indicators for all fauna,
- what constitutes a viable population (Lambeck 1998) and an understanding of metapopulation dynamics for various flora and fauna species in a fragmented landscape

#### Other Priority Data Gaps Include:

Fire – A knowledge of fire regimes and histories for reserves and areas of remnant vegetation, and data on the effects of fire on flora and fauna based on their life history attributes. This information is essential if the role of altered fire regimes in biodiversity conservation is to be understood and managed.

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R = Report; J = Journal article; O = Other.

### Other Relevant Publications

See reference numbers 014, 020, 045, 046, 090, 101, 102, 125, 139, 146, 160, 259, 265, 268, 341, 373, 388,

413, 416, 423, 449, 466, 470, 483, 509, 554, 562, 568, 575, 583 and 606 in Appendix A.

# Carnarvon 1 (*CAR1 - Cape Range subregion*)

PETER KENDRICK AND ROLAND MAU  
OCTOBER 2002

## Subregional description and biodiversity values

### Description and area

The Carnarvon bioregion is composed of quaternary alluvial, aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia stuartii* or *A. bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal.

Cape Range and Giralia dunefields form the northern part of Carnarvon Basin. Rugged tertiary limestone ranges and extensive areas of red aeolian dunefield, Quaternary coastal beach dunes and mud flats. Acacia shrublands over *Triodia* on limestone (*Acacia stuartii* or *A. bivenosa*) and red dunefields, *Triodia* hummock grasslands with sparse *Eucalyptus* trees and shrubs on the Cape Range. Extensive hummock grasslands (*Triodia*) on the Cape Range and eastern dune-fields. Tidal mudflats of sheltered embayments of Exmouth Gulf support extensive mangroves. Beach dunes with *Spinifex* communities. An extensive mosaic of saline alluvial plains with samphire and saltbush low shrublands along the eastern hinterland of Exmouth Gulf. Islands of the Muiron, Barrow, Lowendal and Montebello groups are limestone-based. Climate is arid, semi-desert to sub-tropical climate, with variable summer and winter rainfall. Cyclonic activity can be significant, and cyclonic systems may affect the coast and hinterland annually. Subregional area for CAR1 is 2, 547, 911ha.

### Dominant land use

Dominant land uses are grazing – native pastures (ix) (see Appendix B, key b), conservation (xiii), mining leases (vii), and urban (i).

### Continental Stress Class

The Continental Stress Class for CAR1 is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Off-Shore Islands:

Offshore islands of CAR1 are considered in the following groups; islands of Exmouth Gulf, the Muiron group (North and South Muiron Islands), the Lowendal group (Varanus and others), the Barrow group (Barrow, Middle, Boodie and associated smaller islands), and the Montebello group (Hermite, Trimouille and many other smaller islands, islets and rocks).

- Islands of Exmouth Gulf (including Doole, Roberts, Hope, Whitmore, Whalebone, Simpson, Burnside, Tent, Y, Gnderoo, Somerville, Eva, Brown, Fly and Observation Islands, and the Islam Islets). Geologically uniform (sand and limestone). Vegetation generally *Spinifex longifolius* near beaches, and *Triodia* hummock grasslands inland on larger islands. Scattered *Acacia coriacea*, *A. bivenosa* and *A. pyrifolia*. Extensive mangal occur on larger islands in the east of the Gulf. Sea turtles (details of species unknown) breed on these islands. Smaller islands support breeding seabirds, including Caspian Tern (*Sterna caspia*), Fairy Tern (*Sterna nereis*), Pied Oystercatcher (*Haematopus longirostris*), Osprey (*Pandion haliaetus*), Eastern Reef Heron (*Egretta sacra sacra*) and Pelican (Gnderoo) (*Pelecanus conspicillatus*). Significant mangal occurs around Doole and Tent Islands. A population of Shark Bay Mice (*Pseudomys fieldi*) has been reintroduced to Doole Island - 43 mice in June and September 1993, 8 in September 1995, 26 in November 1995, 30 in June 1997, 41 in August 1998, and 75 in November 2001 (to restore population after cyclonic activity). The first individuals released on Doole Island in 1993 and 1995 were sourced from Bernier Island, but animals translocated after 1995 were from Perth Zoo.
- Islands of the Muiron group (including North Muiron, South Muiron, and Sunday Island. Sandy, with a limestone base. Vegetation of typical coastal species (*Spinifex longifolius*, *Acacia coriacea* etc). Seabird nesting records include Wedge-tailed Shearwaters (*Puffinus pacificus*) and Osprey (*Pandion haliaetus*). South Muiron is an important Loggerhead (*Caretta caretta*) and Green Sea Turtle (*Chelonia mydas*) nesting island. Also some Hawksbill (*Eretmochelys imbricata bissa*) and occasionally Flatbacks (*Natator depressus*) visit the islands but numbers may not be significant; there is good coral cover and diversity on reefs surrounding island.
- Islands of the Lowendal group (including Varanus, Abutilon, Bridled, and Parakeelya Islands). Most are limestone, with small beaches. Vegetation of typical coastal species (*Spinifex longifolius* and *Acacia coriacea*), with some *Triodia angusta*, *Ficus platypoda* and *Pittosporum phylliraeoides* inland on Varanus Island. Seabird nesting records include Wedge-tailed Shearwater (*Puffinus pacificus*), Osprey (*Pandion haliaetus*), White-bellied Sea Eagle (*Haliaeetus leucogaster*), Caspian Tern (*Sterna caspia*), Crested Tern (*Sterna bergii*), Lesser Crested Tern (*Sterna bengalensis*), Roseate Tern (*Sterna dougallii*), Bridled Tern (*Sterna anaethetus*), Silver Gull (*Larus novaehollandiae*), Pied Cormorant (*Phalacrocorax varius*), Beach Stone Curlew (*Esacus neglectus*) and Pied Oystercatcher (*Haematopus*

*longirostris*). The islands are particularly important for tern breeding. House mice (*Mus musculus*) were introduced onto Varanus Island in 1993, but have been eradicated. Important sea turtle nesting occurs throughout the Lowendal group. Hawksbills (*Eretmochelys imbricata bissa*) and Greens Turtles (*Chelonia mydas*) nest on Varanus, Abutilon and Bridled Islands. Flatbacks Turtles (*Natator depressus*) are known to also nest on Varanus, in low numbers and occasional nesting by loggerheads has been recorded. Dugongs (*Dugong dugon*) are present in surrounding waters.

- Islands of the Barrow group, comprising Barrow, Boodie, Middle, Pascoe, Double, Boomerang. Islands are either limestone (some of which contain significant fossil deposits) or sand over limestone. Vegetation varies from entirely coastal species on small islands, to extensive hummock grasslands on Barrow Island. Stands of eucalypt and *Erythrina vespertilio* are also present, though restricted. The Barrow group supports 15 species of native terrestrial mammal. Several of these are listed as endangered: Golden Bandicoot (*Isodon auratus barrowensis*), Barrow Island Euro (*Macropus robustus isabellinus*), Spectacled Hare-wallaby (*Lagorchestes conspicillatus conspicillatus*), Black-footed Rock Wallaby (*Petrogale lateralis lateralis*) and Burrowing Bettong (*Bettongia lesueur*). Dugong (*Dugong dugon*) are common in nearby waters, and a large number of dolphin and whale species have been recorded. Over 100 bird species are known from Barrow Island, including a black and white variant of the White-winged Fairy-wren (*Malurus leucopterus leucopterus*). The island supports a large reptile fauna, including an apparently troglobitic snake (*Ramphotyphlops longissimus*; Aplin 1998). Significant sea turtle nesting, particularly Green (*Chelonia mydas*) and Flatback Turtles (*Natator depressus*), occurs on Barrow and Middle Islands. An internationally significant troglofauna, comprising terrestrial and stygofaunal elements is known from Barrow Island, and is unlikely to be fully documented.
- Islands of the Montebello group, including Hermite, Trimouille, North West, Bluebell, Alpha, Ah Chong, Crocus and Primrose, and a large number of smaller islands, islets and rocks throughout the archipelago. The islands are sandy on a limestone base, often with extensive vertical limestone shores and large areas of exposed limestone pavements outcropping on the island surfaces. Vegetation is typically coastal species (*Spinifex longifolius* and *Acacia coriacea*) along the beaches and on sandy areas, and hummock grasslands on areas of exposed limestone. Local mammal species became extinct in historical times. Recent translocations have resulted in the introduction of Mala (*Lagorchestes hirsutus*) to Trimouille Island, and *Pseudomys fieldi* on North West Island. *Aprasia rostrata* has not been recorded from Hermite Island since 1952. Many seabirds nest within the group, including Wedge-tailed shearwater, bridled tern, caspian tern, roseate tern, crested tern, fairy tern, white-bellied Sea Eagle

(*Haliaeetus leucogaster*), Osprey (*Pandion haliaetus*), Brahminy Kite (*Haliastur indus*), Silver Gull (*Larus novaehollandiae*), Reef Heron (*Egretta sacra*), Pied Oystercatcher (*Haematopus longirostris*). Significant sea turtle nesting occurs on sandy beaches. Shallow marine environments support Dugong (*Dugong dugon*). Highly diverse and abundant fish and coral reef fauna. Diverse range of marine habitats. Mangals are furthest from mainland in state.

#### **Karst System of Cape Range:**

Elevated limestone range, with deeply dissected rugged topography. Extensive karst features within range, with over 600 karst features described (Darren Brooks, pers. comm.). Contains a large troglobitic fauna of international significance, including both terrestrial and stygofaunal elements. Fauna includes fish (*Ophisternon candidum* and *Milyeringa veritas*), shrimps (*Stygiocaris* spp., ostracods (*Danielopolona*), amphipods (*Liagoceradocus*, *Halosbaena*), Remipedes (*Lasionectes*), plus many other families and orders of terrestrial and aquatic species.

The flora of the Cape Range has a very rich flora for an arid area (Keighery and Gibson 1993). The tertiary limestones of Cape Range are vegetated by shrublands comprising *Acacia tetragonophylla*, *A. bivenosa*, *Grevillea variifolia* subsp. *variifolia*, *G. calcicola*, *Melaleuca cardiophylla* (or terraces north of Yardie Creek by *Ipomoea yardiensis*) (Keighery and Gibson 1993). Yardie Creek represents the northern extent of range for many southern taxa, and the creek system and permanent wetlands in the area provide refugia for these species at the extremities of their ranges (Keighery and Gibson 1993). Hummock grasses of the Cape Range include *Triodia wiseana* and *T. pungens*, and there are a whole suite of less common herbs and shrubs restricted to the community (such as *Ipomoea costata*, *Acacia arida*, *Centaurium spicatum* and *Portulaca conspicua*) (Keighery and Gibson 1993).

The younger limestones of the western coastal plain and the Rough Ranges display a different community type, which is dominated by *Melaleuca cardiophylla* and/or *Hibbertia spicata* low heaths over *Triodia* spp, occasionally also containing *Acacia* low heaths (Keighery and Gibson 1993). Less common characteristic species include *Dysphania plantaginella*, *Hibiscus sturtii* and *Threlkeldia diffusa* (Keighery and Gibson 1993).

#### **Bundera Sinkhole:**

Anchialine sinkhole south of Yardie Creek, on coastal plain. Only known example of Remipede (*Lasionectes exleyi*) community in southern hemisphere, and is characterised by a complex stratified hydrological environment. The sinkhole contains a rich stygobitic fauna, including fish, hadziid amphipods, gammarid amphipods, copepods and ostracods. The aquifer adjacent contains other species which may also live within the sinkhole; atyid shrimp, thermosbaenaceans, diverse amphipods and *Ophisternon* (the blind eel). The stratification of water layers within the water column of the sinkhole is important to the wellbeing of the resident fauna, as many species are found only below thermo-halocline. For this reason, investigation of the site is

difficult, as diving destroys the thermo-halocline (at least temporarily). Local management includes signage and vehicle barriers.

#### **Camerons Cave:**

A cave system near Exmouth townsite that contains a unique assemblage of terrestrial and aquatic troglofauna. These include 4 threatened fauna (*Milyeringa veritas*, *Draculoides bramstokeri*, *Hyella* sp., and *Stygiochiropus peculiaris*). Other aquatic fauna include copepods. The terrestrial troglomorphic fauna is diverse, containing, in addition to those listed above, an undescribed Opilionida (harvestman), four undescribed spiders (Araneae; one Hahniidae, one Pholcidae, one Ctenidae), an undescribed Hemiptera (*Phaconura* sp. nov.), as well as undescribed species of Isopoda, Hemiptera, Coleoptera, Blattodea, Collembola and Calanoida. This is the most diverse troglomorphic fauna known from the Cape Range karst province.

#### **Ningaloo Reef Complex:**

An extensive fringing barrier reef system, extending approximately 300 km southward from the tip of North West Cape to Quobba. Very diverse coral and fish communities.

#### **Mangroves of eastern Exmouth Gulf:**

Extensive mangal along the entire eastern coast of Exmouth Gulf, and including pockets on the western side such as Bay of Rest. Very significant nursery areas for economic and recreational fishing species, including prawns. Important habitat for immature sea turtles.

#### **Centres of Endemism:**

- Cape Range - Large group of troglobitic species endemic to karst system, including fish, amphipods, isopods, remipedes, insects.
- Barrow Island - Large group of troglobitic species endemic to karst system, including blind snakes, amphipods, isopods, insects.
- Ningaloo Reef - Corals, fish, molluscs, other invertebrates, algae.
- Bundera Sinkhole - Anchialine sinkhole south of Yardie Creek, on coastal plain. Only known example of Remipede community in southern hemisphere. Also contains other species of stygofauna.

#### **Refugia:**

The following refugia are listed in Morton *et al* (1995) as being valuable for their isolation from the mainland and it's associated threatening processes:

- Montebello Islands group - mammals, sea turtles, and seabirds.
- Barrow Island group - marsupials, troglofauna, and sea turtles.

- Islands of Exmouth Gulf - mammals, and seabirds.
- Caves and landforms provide unique habitats, or shelter from threatening processes.
- Cape Range caves and gorges - mammals, troglofauna and relictual plants.

#### **High Species and Ecosystem Diversity:**

- Cape Range caves and gorges (mammals, troglofauna and relictual plants).
- Ningaloo Reef (corals, fish, crustaceans, molluscs, algae, etc.).
- Barrow Island (troglobitic species, including blind vertebrates), mammals.
- Montebellos (marine species).

#### **Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats**

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 9; Recommendations 9.2, 9.3, 9.7 and 9.8), in the 'Red Book' reports of 1975. Reserve recommendations in System 9 (including CAR1) included extensions to the Cape Range National Park, (9.2), the creation of the Ningaloo Marine Park (9.3), many reserve proposals for island reserves in Exmouth Gulf and as far up the coast as Onslow (9.7; including Serrurier and Thevenard, treated within the PIL4 synopsis) and that studies be implemented on the biophysical characteristics of the tidal and supra-tidal flats of the Exmouth Gulf and Onslow coasts, and that industrial developments be restricted to occurring landward of mangal communities (9.8). In 1993, the 'Red Book Status Report' reviewed the implementation of these recommendations.

Recommendations have been partially implemented, as indicated below.

- Recommendation 9.2. Extensions to the Cape Range National Park are only partially complete, due to mineral extraction and commercial development possibilities.
- Recommendation 9.3. Ningaloo Marine Park is established, but acquisition of Ningaloo is stalled, and large residential developments are proposed for sites adjacent to the Ningaloo Marine Park.
- Recommendation 9.7. Some Island reservations are complete, others stalled.
- Recommendation 9.8. Small amount of work on coast of the Gulf, but not much. No current salt production proposals.

No other subregional or bioregional planning for biodiversity conservation has been attempted.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name & Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Cape Range subterranean waterways (includes Bundera sinkhole and other karst feature waterways) CAR001WA	B19	iii	iv	iii	iv (goats), v (pollution of cave entrances), ix (increased salinity caused by water abstraction), xi (pollution from townsite).
Exmouth Gulf East CAR002WA	A2, A7, A9, A8	iii	iv	ii	iv (goats), v (pollution of cave entrances), vi (buffel grass)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Yardie Creek	iii	iv	iii	xii (visitor impacts), iv, v (rabbits & goats)
Mangrove Bay	iv	iv	ii	xii (visitor impacts)
Bay of Rest	iii	iv	ii	No known threatening processes
Ningaloo Reef	iii	iii	iii	xii (visitor impacts such as anchors, fishing, shell collecting in the past, fauna interactions especially with whales, turtles, whale sharks, and dugongs), xii (coral bleaching and sporadic <i>Drupella</i> infestation)
Subterranean waterways of Barrow Island	ii	iii	iii	xi (leakage from infrastructure, deliberate disposal to shallow aquifers)
Intertidal Communities of the Montebellos	iii - iv	iv	ii	xii (visitor impacts - fishing)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Riparian Zone Vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Lyndon – Minglya Rivers	i	iii	ii	iv, v (cattle, sheep and goats), vi (buffel grass), vii
Permanent and semi-permanent pools	i	iii	ii	iv (grazing pressure), v (cattle, sheep, horse), vi (buffel grass)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Cape Range Remipede Community	CR	N/A	iii	iv	iii	xii (visitor impacts), xi (pollution)
Camerons Cave Troglodytic Community	CR	N/A	iii	iv	iii	xi (pollution), xii (unique community so a once off-event can lead to extinction), xii (visitor impacts)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other Ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Stygofauna communities on Barrow Island	unknown	N/A	ii	iii - vi	iii	xi
Terrestrial troglodytes on Barrow Island	unknown	N/A	iii	iii	iii	xi, xii (human visitation)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Stygofauna communities on North West Cape	unknown	N/A	iii	iii	iii	xi, ix, xii (mining)
Marine environments generally (including Ningaloo reef, Exmouth Gulf, Shallow marine areas around Barrow Island and Montebellos)	unknown	40, + marine	iii	iii	iii	xi
Sea turtle nesting areas	unknown	41	i - ii	iii - iv	iii	v (fox, cat), xii (vehicles on beaches)
Ephemeral creekline drainage communities	unknown	37	i - ii	iii	iii	xii (mining, gravel extraction), vii, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Petrogale lateralis</i>	E	islands: iii mainland: i	iv - iii	iii	v (fox, cat), iv, xii (human disturbance)
<i>Bettongia lesueur</i>	E	islands: iii mainland: EX	iv	iv	Possibly viii, no current threatening processes
<i>Isoodon auratus auratus</i>	E	islands: iii mainland: EX	iv	iv	Possibly viii, no current threatening processes
<i>Lagorchestes conspicillatus conspicillatus</i>	E	islands: iii mainland: EX	iv	iv	Possibly viii, no current threatening processes
<i>Lagorchestes hirsutus</i>	E	islands: iii mainland: EX	v	iv	Possibly viii, no current threatening processes
<i>Macropus robustus isabellinus</i>	E	iii	iv	iv	Possibly viii, no current threatening processes
<i>Pseudomys fieldi</i>	E	islands: iii mainland: EX	v	iv	Possibly viii, no current threatening processes
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Amytornis textilis textilis</i>	E	iii	vi	ii	v (fox, cat)
<i>Malurus leucopterus edouardi</i>	E	iii	iv	ii	Possibly viii, no current threatening processes
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Aprasia rostrata rostrata</i>	E	unknown	vi	ii	v (rats)
<i>Caretta caretta</i>	E	ii	iii - iv	iv	xii (human disturbance), v (fox)
<i>Dermochelys coriacea</i>	V	unknown	vi	ii	xii (fishing and shipping)
<i>Chelonia mydas</i>	V	ii	vi	iii	xii (human interference)
<i>Natator depressor</i>	V	ii	vi	iii	xii (human interference)
<i>Eretmochelys imbricata</i>	V	iii	vi	iii	xii (human interference)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 5 (FISH)</b>					
<i>Ophisternon candidum</i>	E	iii	vi	ii	xi, xii (mining), v (feral fish)
<i>Milyeringa veritas</i>	E	iii	vi	ii	xi, xii (mining), v (feral fish)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 7 (ARACHNIDS)</b>					
<i>Bamazomus</i> sp. Nov. (WAM #95/748)	E	iii	vi	ii	xi, xii (mining)
<i>Draculoides bramstokeri</i>	E	iii	vi	ii	xi, xii (mining)
<i>Draculoides</i> sp. Nov (WAM # 96/1 15 1)	E	iii	vi	ii	xi, xii (mining)
<i>Hylla</i> sp. nov. (BES 1154.2525.2546.2554)	E	iii	vi	ii	xi, xii (mining)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 8 (CRUSTACEANS)</b>					
<i>Bogidoma australis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Lasionectes exleyi</i>	E	iii	vi	iii	xi, xii (human disturbance via cave diving)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 9 (MILLIPEDES)</b>					
<i>Speleostrophus nesiotis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Stygiochiropus isolatus</i>	E	iii	vi	ii	xi, xii (mining)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 10 (MAMMALS)</b>					
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Liagoceradocus branchialis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Liagoceradocus subthalassicus</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia fragilis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia humphreysi</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia hurlberti</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia marosculptilis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia sulptilis</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia straskraba</i>	E	iii	vi	ii	xi, xii (mining)
<i>Nedsia urifimbriata</i>	E	iii	vi	ii	xi, xii (mining)
<i>Stygiocaris lancifera</i>	E	iii	vi	ii	xi, xii (mining)

<i>Stygirochirus peculiaris</i>	E	iii	vi	ii	xi, xii (mining)
<i>Stygirochirus sympatricus</i>	E	iii	vi	ii	xi, xii (mining)
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Dugong dugon</i>	SP	iii	iii - iv	iii	xii (human disturbance)
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iv	vi	ii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Rhinocodon thypus</i>		iii	vi	vi	xii (human interference)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Ptilotus stipitatus</i>	1	iii	vi	ii	vi, vii
<b>PRIORITY 2</b>					
<i>Abutilon</i> sp. (Cape Range AS George 1312)	2	iii	vi	i - ii	vi, vii
<i>Acanthocarpus rupestris</i>	2	iii	vi	ii	vi, vii
<i>Daviesia pleurophylla</i>	2	iii	vi	ii	vi, vii
<i>Eremophila occidentalis</i> ms	2	unknown	vi	ii	vi, vii
<i>Harnieria kempeana</i> subsp. <i>rhadinophylla</i>	2	iii	vi	ii	vi, vii
<i>Verticordia serotina</i>	2	iii	vi	ii	vi, vii
<b>OTHER SPECIES AT RISK</b>					
<i>Livistona alfredii</i>	4	i	iii	iv	v (goats), xii (natural processes such as cyclones and fire)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )	0.0	0.0	0.0	H
43	Low forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)	1,535.1	0.0	0.0	H
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	0.0	0.0	0.0	M
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	316.8	0.0	54,725.4	L
103	Hummock grasslands, shrub steppe; snakewood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	M
117	Hummock grasslands, grass steppe; soft spinifex	32.5	1,522.5	0.0	M
127	Bare areas; mudflats	0.0	0.0	0.0	H

Beard Veg Assoc	Vegetation Association Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
151	Sedgeland; sedges with open low trees; coolibah over various sedges	0.0	0.0	0.0	H
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	0.0	0.0	0.0	M
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>	0.0	0.0	0.0	M
162	Shrublands; snakewood scrub	0.0	0.0	0.0	H
244	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> scrub	0.0	0.0	0.0	M
264	Low woodland; <i>Acacia victoriae</i> & snakewood	0.0	0.0	0.0	M
267	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush	0.0	0.0	0.0	H
307	Low woodland; bowgada & <i>Acacia subtessarogona</i>	0.0	0.0	0.0	H
345	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> patchy scrub, barren/Succulent steppe; saltbush & bluebush	0.0	0.0	0.0	M
585	Mosaic: Shrublands; snakewood & <i>Acacia victoriae</i> scrub/Hummock grasslands, shrub-steppe; kanji over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.6	M
589	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; soft spinifex soft spinifex	0.0	0.0	0.0	H
606	Hummock grasslands, shrub steppe; <i>Acacia victoriae</i> & snakewood over soft spinifex	0.0	0.0	0.0	M
608	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches/Short bunch grassland - savannah /grass plain (Pilbara)	0.0	0.0	2,224.7	L
641	Medium woodland; coolibah & river gum	0.0	0.0	0.0	H
658	Shrublands; <i>Acacia sclerosperma</i> & snakewood scrub (also with some waterwood)	0.0	0.0	0.0	M
662	Hummock grassland; shrub steppe; mixed acacia scrub & dwarf scrub with soft spinifex & <i>T. basedowii</i>	7,136.4	63.8	0.0	L
663	Hummock grasslands, shrub steppe; waterwood over soft spinifex	7,051.2	1,460.0	0.0	L
664	Hummock grasslands, sparse tree-steppe; scattered bloodwood over soft spinifex & <i>T. sp. indet. aff. angusta</i>	37,528.0	21.3	0.0	L
670	Hummock grasslands, shrub steppe; scattered shrubs over <i>Triodia basedowii</i>	0.0	0.0	3,023.1	L
674	Hummock grasslands, shrub steppe; bowgada & snakewood over <i>Triodia basedowii</i>	0.0	0.0	0.0	M
676	Succulent steppe; samphire	40.1	51.4	0.0	H
678	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex	0.0	0.0	0.0	M
680	Hummock grasslands, shrub steppe; <i>Acacia bivenosa</i> over <i>Triodia basedowii</i>	3,009.3	0.0	0.0	L
681	Shrublands; open dwarf scrub, waterwood ( <i>Acacia coriacea</i> ) on recent dunes	267.3	0.0	0.0	H
1162	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i> & <i>T. basedowii</i>	0.0	0.0	0.0	M
1271	Bare areas; claypans	0.0	0.0	0.0	H
1322	Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub	0.0	0.0	0.0	H
1325	Succulent steppe with very open low trees; coolibah over saltbush & samphire	0.0	0.0	0.0	H
1601	Mosaic: Shrublands; snakewood & <i>A. victoriae</i> scrub/Hummock grasslands; grass steppe, hard spinifex <i>Triodia basedowii</i>	0.0	0.0	0.0	H
1684	Succulent steppe with open scrub; scattered snakewood over bluebush	0.0	0.0	0.0	H
2675	Hummock grasslands, low tree & shrub steppe; scattered eucalypts, kanji over <i>Triodia pungens</i> & <i>T. basedowii</i>	0.0	0.0	0.0	H
2685	Shrublands; <i>Acacia quadrimarginea</i> & jam scrub on greenstone	0.0	0.0	0.0	H

## Subregional constraints in order of priority

(see Appendix B, key g)

**Irreplacibility:** Karst systems of Cape Range and Barrow Island are unique. Ningaloo Reef is unique.

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and relatively productive. Aboriginal lands are probably not available for reservation, but pastoral leases should be acquired, due to poor management and high conservation values. Turtle nesting management will require baiting on pastoral leases.

**Competing Land Uses:** In particular prospective mining interests (limestone and oil) over karst, and pastoral production.

**Other:** Inappropriate recreation developments (marina resorts) are also proposed

## Bioregional and subregional priority for reserve consolidation

CAR is reservation class 3 (see Appendix D, and Appendix C, rank 4) with only 3.45% of area in conservation reserve (IUCN I-IV). At the subregional level CAR1 has 2.2% in reserve (IUCN I-IV) while CAR2 has 3.9% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 2 with possibility of changing to a higher primary classification is appropriate.

## Reserve management standard

In CAR1, have one national park (Cape Range National Park), one marine park (Ningaloo Marine Park), two conservation parks (Bundegi and Jurabi Conservation Parks), one large island nature reserve (Barrow Island) and many smaller island nature reserves (Gulf islands, Muiron Islands, and Lowendal, Barrow and Montebellos groups). Cape Range National Park has resident staff (one ranger). Ningaloo Marine Park has one resident staff (at Coral Bay). Other areas have no resident staff. Barrow Island has a large resident oilfield workforce (between 200-400 people). Lowendal has a small resident oilfield workforce (30-50 people). Montebellos have a pearl farming operation with a resident staff of 5-30 people.

CAR2 reserves are generally large and with little access; management resources are hampered by the logistics of travel etc; wildfire management facilities are limited by resources, with no strategic fire breaks or prescribed burning; feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made a observable difference to rabbit numbers, goats are common throughout), and feral predator control systems are not in place in any area. Reserve Management Rank is (i) (see Appendix C, rank 5).

**National Park:** Rank (ii), fair. Cape Range National Park has a management plan, but this is now due for revision (in 2002). Currently has a minimal goat control program,

but foxes are baited effectively. There is no fire management, as prescribed in the existing management plan. However, weed issues (buffel grass) will be impossible to resolve.

**Marine Park:** Rank (iii), good. Ningaloo has two staff, and management funds. Has an operational management plan. Recreational and commercial fishing is managed. Effective management of whale shark watching industry is required. Limited monitoring of sea turtles, and fox control in some parts of marine park shore.

**Conservation Parks:** Rank (ii), fair. Jurabi and Bundegi Conservation Parks have interim management guidelines. No current fox control, despite high turtle nesting values, constrained due to public use.

**Montebellos Islands Conservation Park:** Rank (ii), fair. CALM has an accommodation facility on the island, which is used sporadically. Major management operations have included the terrestrial fauna survey, eradication of rats and cats, marine biodiversity and monitoring surveys, and introductions of endangered (non-local) fauna (*Pseudomys fieldi* and *Lagorchestes hirsutus*). Rat control is currently still ongoing (last baiting in October 2001). No current plans to control weeds (major infestations of buffel and kapok on most, if not all major islands of group). No current Management Plan, or Interim Management Guidelines, but planning for surrounding Marine reserve is underway.

**Barrow Island Nature Reserve (BINR):** Rank (ii/iii), fair to good. CALM has Interim Management Guidelines, drafted in cooperation with the oilfield operator. Access to BINR is restricted to third parties, as it is within a Petroleum Act lease. Fire management is restricted to suppression. Quarantine breaches have resulted in various vertebrate (rat, house mouse), invertebrate (bees, wasp nests and possibly others) and weed (buffel grass, kapok bush, and possibly other) invasions, but these have been generally promptly managed (usually with CALM assistance). The exceptions are weeds on minor islands (kapok on Middle Island and buffel grass on Boodie Island). Oilfield operations are a potential threat to biodiversity, particularly from continuing shallow well disposal of produced (oil-contaminated) water, but Chevron (the operator) does have comprehensive environmental management procedures. Access to the island for researchers and CALM staff is facilitated, and generally relations are highly cooperative. CALM, DEP and Conservation Commission visit Barrow annually, or otherwise for specific purposes. Planning for surrounding Marine reserve is underway.

**Lowendal Islands Nature Reserve:** Rank (ii/iii), fair to good. Generally as above. Apache (the operator) and CALM have a similarly cooperative relationship regarding biodiversity and conservation management on these islands. CALM, DEP and Conservation Commission visit Lowendal annually, or otherwise for specific purposes. Presence of oil base is a negative influence for nature conservation, through potential for weed and feral animal introduction, pollution and land disturbance. Industrial lighting and flares may affect nesting turtles and

hatchlings. Planning for surrounding Marine reserve is underway.

**Exmouth Gulf Islands:** Rank (ii), fair. No management plan. Episodic management visits. No control of weeds. Near-coastal islands have feral animals (fox, goat, and possibly rats).

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of fauna and flora & Recreation.	Cape Range National Park	National Park	ii
A	Conservation of marine fauna and flora & Recreation.	Ningaloo Marine Park	Marine Park	iii
	Conservation Park	Jurabi Conservation Park	Conservation Park	ii
	Conservation Park	Bundegi Conservation Park	Conservation Park	ii
A	Conservation of fauna and flora	Barrow Island group	Nature Reserve	ii/iii
C	Conservation of fauna and flora	Lowendal Islands	Nature Reserve	iii
A and C	Conservation of fauna and flora	Montebello Islands	Conservation Park	ii
	Conservation of fauna and flora	Exmouth Gulf Islands	Nature Reserves	ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

Species Name	Ecosystem Type or Status	Location	Threatening Processes <sup>1</sup>
<i>Petrogale lateralis</i>		Present in gorges of Cape Range, more common on the west side than the east	v (foxes), v (goats), xii (human disturbance at Yardie Creek)
<i>Bettongia lesueur</i>		Secure and abundant on Barrow Island, and a smaller secure population on Boodie Island	No current threats, possibly vulnerable to disease.
<i>Isoodon auratus auratus</i>		Secure and abundant on Barrow Island, and a smaller secure population on Middle Island. Plan to re-introduce <i>I. auratus</i> back onto Hermite Island, Montebellos	No current threats, possibly vulnerable to disease.
<i>Lagorchestes conspicillatus conspicillatus</i>		Secure and abundant on Barrow Island, and a smaller secure population on Middle Island. Plan to re-introduce <i>L. conspicillatus</i> back onto Hermite Island, Montebellos.	No current threats, possibly vulnerable to disease.
<i>Lagorchestes hirsutus</i>		Population (sourced from Tanami Desert) released recently onto Trimouille Island, apparently now secure	No current threats, possibly vulnerable to disease.
<i>Macropus robustus isabellinus</i>		Secure and abundant on Barrow Island	No current threats, possibly vulnerable to disease.
<i>Pseudomys fieldi</i>		Populations released onto North West Island recently are apparently now secure. Population also been released onto Doole Island between 1993 and 2001	No current threats, possibly vulnerable to disease.
<i>Amytornis textilis textilis</i>		Appears to be a rare species around Exmouth Gulf	v (cat), iv (changes to vegetation structure)
<i>Malurus leucopterus edouardi</i>		Secure and abundant on Barrow Island	No current threats, possibly vulnerable to disease.
<i>Aprasia rostrata rostrata</i>		Was collected from Hermite Island (Montebellos) in 1950's, but has not been recorded since	v (rats)

Species Name	Ecosystem Type or Status	Location	Threatening Processes <sup>1</sup>
<i>Caretta caretta</i>		Loggerheads usually nest further south, in Shark Bay. Some nesting on South Muiron Island, and nesting on mainland e.g. just to north of Coral Bay. Occasional recordings of loggerheads are made in other islands of CAR1.	
<i>Chelonia mydas</i>	Beaches, foredunes, mangroves	Green turtles nest on islands throughout CAR1 (Barrow, Montebellos, Lowendals), as well as mainland beaches of Ningaloo Marine Park and Jurabi Conservation Park.	Mainland populations: v (foxes & cats take eggs and hatchlings), xii (some hunting of adults during nesting time by Aboriginal people at Cardabia; beaches are disrupted by vehicles, which destroy nests; Ecotourism needs to be managed closely). Island populations: xii (human interference; industrial lighting and flares is a significant issue for islands with oil bases; prawn fishery in Exmouth Gulf), viii ('floating turtle syndrome' possibly caused by heavy parasite loads and bacterial infection producing large gas bubbles in the organ cavity)
<i>Eretmochelys imbricata</i>	Beaches, foredunes, mangroves	Hawksbill turtle known to nest on the Lowendals and Montebello Islands.	Island populations: xii (industrial lighting and flares associated with oil bases; prawn fishery in Exmouth Gulf)
<i>Natator depressus</i>	Beaches, foredunes, mangroves	Flatback turtle known to nest on mainland beaches of CAR1, and islands, including Barrow and Montebellos.	Mainland breeding: v (foxes & cats take eggs and hatchlings). Island populations: xii (industrial lighting and flares on islands with oil bases; prawn fishery in Exmouth Gulf).
<i>Dermochelys coriacea</i>		An occasional visitor	xii (fishing and shipping). Reports of this species are very occasional, and there is no data on local threats of mortality.
<i>Ophisternon candidum</i>	Karst	Restricted to karst waters of North West Cape.	xi (townsite; chemical; sedimentation), xii (mining), v (feral fish found in cave systems near Exmouth)
<i>Milyeringa veritas</i>	Karst	Restricted to karst waters of North West Cape and Barrow Island.	xi (townsite; chemical; sedimentation; shallow aquifer disposal of oily produced water at Barrow Island), xii (mining), v (feral fish found in cave systems near Exmouth)
<i>Rhincodon typus</i>	Marine	Whale Sharks visit waters of Ningaloo Reef, subject to intensive eco-tourism whale watching industry.	xii (human interference)
<i>Bamazomus</i> sp. nov. (WAM #95/748)	Karst	Western Cape Range <i>Bamazomus</i> (Arachnida). Restricted to terrestrial karst of western North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Draculoides bramstokeri</i>	Karst	Restricted to terrestrial karst of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Draculoides</i> sp. Nov (WAM # 96/1 15 1)	Karst	Restricted to terrestrial karst of western North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Hyella</i> sp. nov. (BES 1154.2525.2546.2554)	Karst	Restricted to terrestrial karst of eastern North West Cape (Camerons Cave; full distribution unknown).	xi (townsite; industrial), xii (mining)
Species Name	Ecosystem Type or Status	Location	Threatening Processes <sup>1</sup>
<i>Bogidoma australis</i>	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Lasionectes exleyi</i>	Karst	Restricted to karst waters of western North West Cape (Bundera sinkhole; full distribution unknown).	xi (townsite; industrial), xii (mining; Camerons Cave has been visited by recreational cave divers)
<i>Liagoceradocus branchialis</i>	Karst	Restricted to terrestrial karst of North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Liagoceradocus subthalassicus</i>	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia fragilis</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia humphreysi</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)

<i>Nedsia hurlberti</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown)	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia marosculptilis</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia sulptilis</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia straskraba</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Nedsia urifimbriata</i> (Barrow Island amphipod)	Karst	Restricted to karst waters of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining)
<i>Stygiocaris lancifera</i> (Exmouth cave shrimp)	Karst	Restricted to karst waters of western North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Speleostrophus nesiotus</i> (Barrow Island millipede)	Karst	Restricted to terrestrial karst of Barrow Island (full distribution unknown).	xi (townsite; industrial; shallow aquifer disposal of oily produced water is at Barrow Island), xii (mining; recreational visitation to the only cave it occurs in has recently been stopped by Chevron)
<i>Stygiochiropus isolatus</i> (Cape Range millipede)	Karst	Restricted to terrestrial karst of North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Stygiochiropus peculiaris</i> (Cape Range millipede)	Karst	Restricted to terrestrial karst of North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Stygiochiropus sympatricus</i> (Cape Range millipede)	Karst	Restricted to terrestrial karst of North West Cape (full distribution unknown).	xi (townsite; industrial), xii (mining)
<i>Dugong dugon</i> (Dugong)		Relatively common in inshore waters around islands, and within Exmouth Gulf. Ecosystem types: shallow marine, over seagrass.	xii (some mortality from shipping, possibly also trawl fishery)
<i>Falco peregrinus</i> (Peregrine falcon)		Appears to be a rare visitor to CAR1. No recent breeding records known.	Unknown
<i>Abutilon</i> sp. (Cape Range AS George 1312).	P1		No other data
<b>Species Name</b>	<b>Ecosystem Type or Status</b>	<b>Location</b>	<b>Threatening Processes<sup>1</sup></b>
<i>Ptilotus stipitatus</i>	P1	Known from Peedamulla Rd, Onslow	Unknown
<i>Acanthocarpus rupestris</i>	P1	Known from shallow soils over limestone and on foothill slopes of the Cape Range. Localities: 5.5 km S Exmouth; 6 km along old Shothole Canyon Rd; W of No. 2 oil well site.	Unknown
<i>Daviesia pleurophylla</i>	P2	Known from the Cape Range. Localities: 11 km N of Yardie Creek; 7.5 km SE of Sandy Point, at gate into inner part of bombing range; 200m W of 'Ningaloo no. 1'.	Unknown
<i>Eremophila occidentens</i> ms	P2		No other data
<i>Harnieria kempeana</i> subsp. <i>rhadinophylla</i>	P2		No other data
<i>Verticordia serotina</i>	P2		No other data
<i>Livistona alfredii</i>	P4	A tiny relictual population (several trees) in a very atypical habitat (on top of Cape Range)	iv, v (goats), xii (fire and cyclones appear to be main threat. Recently, Cyclone Vance destroyed the tree with Thomas Carter's initials engraved in the trunk)

<sup>1</sup>Appendix, key e.

## Existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Petrogale lateralis</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Bettongia lesueur</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Isodon auratus auratus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Lagorchestes conspicillatus conspicillatus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Lagorchestes hirsutus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Macropus robustus isabellinus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Pseudomys fieldi</i>	Yes - IRP	Action Plan for Australian Rodents
<i>Dugong dugon</i>	No	No
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds
<i>Amytornis textilis textilis</i>	Yes - IRP	Action Plan for Australian Birds
<i>Malurus leucopterus edouardi</i>	No	Action Plan for Australian Birds
<i>Aprasia rostrata rostrata</i>	No	Action Plan for Australian Reptiles

<i>Caretta caretta</i>	No	Action Plan for Australian Reptiles
<i>Ophisternon candidum</i>	No	Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003
<i>Milyeringa veritas</i>	No	Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003; Camerons Cave Troglitic Community, Camerons Cave and Camerons Cave Pseudoscorpion Interim Recovery Plan 2000-2003
<i>Rhincodon typus</i>	No	unknown
<i>Bamazomus</i> sp. Nov. (WAM #95/748)	No	No
<i>Draculoides bramstokeri</i>	No	Camerons Cave Troglitic Community, Camerons Cave and Camerons Cave Pseudoscorpion Interim Recovery Plan 2000-2003
<i>Draculoides</i> sp. Nov (WAM # 96/1 15 1)	No	No
<i>Hyella</i> sp. nov. (BES 1154.2525.2546.2554)	Yes - IRP	Camerons Cave Troglitic Community, Camerons Cave and Camerons Cave Pseudoscorpion Interim Recovery Plan 2000-2003
<i>Bogidoma australis</i>	No	No
<i>Lasionectes exleyi</i>	Yes - IRP	Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003
<b>Species</b>	<b>Specific Recovery Plan</b>	<b>General Recovery Plan</b>
<i>Liagoceradocus branchialis</i>	No	Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003
<i>Liagoceradocus subthalassicus</i>	No	No
<i>Nedsia fragilis</i>	No	No
<i>Nedsia humphreysi</i>	No	No
<i>Nedsia hurlberti</i>	No	No
<i>Nedsia marosculptilis</i>	No	No
<i>Nedsia sulptilis</i>	No	No
<i>Nedsia straskraba</i>	No	No
<i>Nedsia urifimbriata</i>	No	No
<i>Stygiocaris lancifera</i>	No	Cape Range Remipede Community (Bundera Sinkhole) and Cape Range Remipede Interim Recovery Plan 2000-2003
<i>Speleostrophus nesiotus</i>	No	No
<i>Stygiochiropus isolatus</i>	No	No
<i>Stygiochiropus peculiaris</i>	No	No
<i>Stygiochiropus sympatricus</i>	No	No
<i>Abutilon</i> sp. (Cape Range AS George 1312)	No	No
<i>Ptilotus stipitatus</i>	No	No
<i>Acanthocarpus rupestris</i>	No	No
<i>Daviesia pleurophylla</i>	No	No
<i>Eremophila occidentalis</i> ms	No	No
<i>Harnieria kempeana</i> subsp. <i>rhadinophylla</i>	No	No
<i>Verticordia serotina</i>	No	No

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Petrogale lateralis</i>	vii	Control of goats, foxes.
<i>Bettongia lesueur</i>	x, xiv	Translocation to Boodie Island, Monitoring
<i>Isoodon auratus auratus</i>	x, xiv	Translocation to Hermite Island, Monitoring
<i>Lagorchestes conspicillatus conspicillatus</i>	x, xiv	Translocation to Hermite Island, Monitoring
<i>Lagorchestes hirsutus</i>	xiv	Monitoring
<i>Macropus robustus isabellinus</i>	xiv	Monitoring
<i>Pseudomys fieldi</i>	xiv	Monitoring
<i>Dugong dugon</i>	xiv	Monitoring
<i>Falco peregrinus</i>	xiv	Monitoring
<i>Amytornis textilis textilis</i>	xiv	Monitoring
<i>Malurus leucopterus edouardi</i>	xiv	Monitoring
<i>Aprasia rostrata rostrata</i>	xii	Relocate on Hermite island, then monitor.
<i>Caretta caretta</i>	x, xiv, vii	Further research into nesting distribution and requirements, then Monitoring; control of fox if on mainland, restrict human use of nesting beaches
<i>Ophisternon candidum</i>	xiv	Monitoring
<i>Milyeringa veritas</i>	xiv	Monitoring (on Barrow as well)
<i>Rhincodon typus</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Bamazomus</i> sp. Nov. (WAM #95/748)	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Draculoides bramstokeri</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring

<i>Draculoides</i> sp. Nov (WAM # 96/1 15 1)	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Hyella</i> sp. nov. (BES 1154.2525.2546.2554)	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Bogidoma australis</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Lasionectes exleyi</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Liagoceradocus branchialis</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Liagoceradocus subthalassicus</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Nedsia fragilis</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia humphreysi</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia hurlberti</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia marosculptilis</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia sulphilis</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia straskraba</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Nedsia urifimbriata</i>	x, xiv, xiii	Further research on distribution and habitat requirements; Monitoring; Raise awareness in oil industry about oil and other pollution
<i>Stygiocaris lancifera</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Speleostrophus nesiotis</i>	x, xiv,	Further research on distribution and habitat requirements, Monitoring
<i>Stygiochiropus isolatus</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Stygiochiropus peculiaris</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Stygiochiropus sympatricus</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Abutilon</i> sp. (Cape Range AS George 1312)	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Ptilotus stipitatus</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Acanthocarpus rupestris</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Daviesia pleurophylla</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Eremophila occidentalis</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Harnieria kempeana</i> subsp. <i>rhadinophylla</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring
<i>Verticordia serotina</i>	x, xiv	Further research on distribution and habitat requirements, Monitoring

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Beard Veg Assoc	Vegetation Association or Community Description	Specific Recovery Plan	General Recovery Plan
	Cape Range Remipede Community	Yes - IRP	Cape Range National Park Management Plan
	Camerons Cave Troglotic Community	Yes - IRP	Cape Range National Park Management Plan
11	Stygofauna communities on Barrow Island	No	Interim Management Guidelines for Necessary Operations, Barrow Island Group

Beard Veg Assoc	Vegetation Association or Community Description	Specific Recovery Plan	General Recovery Plan
43	Terrestrial troglodytes on Barrow Island	No	Interim Management Guidelines for Necessary Operations, Barrow Island Group
127	Stygofauna communities on North West Cape	No	No
151	Marine environments generally (including Ningaloo reef, Exmouth Gulf, Shallow marine areas around Barrow Island and Montebellos)	No	Ningaloo Marine Park Management Plan
162	Sea turtle nesting areas	No	Turtle and Dugong Management Plan for Western Australia
267	Ephemeral creekline drainage communities	No	No

### Appropriate ecosystem recovery actions

Beard Veg Assoc	Vegetation Association Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
	Cape Range Remipede Community	i, ii, iii, xii, xiii	Habitat retention through reserves, private lands or on other State lands; Research into all aspects of troglofauna species, particularly distribution and requirements; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
	Camerons Cave Troglotic Community	i, ii, iii, xii, xiii	Habitat retention through reserves, private lands or on other State lands; Research into all aspects of troglofauna species, particularly distribution and requirements; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
11	Stygofauna communities on Barrow Island	i, ii, iii, xii, xiii	Habitat retention through reserves, private lands or on other State lands; Research into all aspects of troglofauna species, particularly distribution and requirements; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
43	Terrestrial troglodytes on Barrow Island	i, ii, iii, xii, xiii	Habitat retention through reserves, private lands or on other State lands; Research into all aspects of troglofauna species, particularly distribution and requirements; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
127	Stygofauna communities on North West Cape	i, ii, iii, xii, xiii	Habitat retention through reserves, private lands or on other State lands; Research into all aspects of troglofauna species, particularly distribution and requirements; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
151	Marine environments generally (including Ningaloo reef, Exmouth Gulf, Shallow marine areas around Barrow Island and Montebellos)	i, vii, xiii	Habitat retention through reserves; Feral predator control, mainly fox; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
162	Sea turtle nesting areas	i, ii, iii, vi, vii, xiii	Habitat retention through reserves, private lands or on other State lands; Weed control on islands; Feral predator control, mainly fox; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control
267	Ephemeral creekline drainage communities	i, ii, iii, vi, vii, xiii	Habitat retention through reserves, private lands or on other State lands; Weed control; Feral predator control, mainly fox; Building capacity of industry and landholders (pastoral) to contribute, especially to marine and troglofauna, and to feral animal control

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation in CAR1 is (ii) (see Appendix C, rank 6), indicating that large off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning:** Pastoral management of feral animals is currently very poor.

**Industry Codes of Practice:** Oil industry has some codes of practice that are improving with time, however further improvement is still needed.

**Capacity Building:** Some capacity in oil industry, however this could also be improved.

### Feasible opportunities for NRM

**Legislation:** Legislative control over pastoral management for controlling feral animals.

**Institutional Reform:** Review of pastoral production on State lands within CAR1.

**Threat Abatement Planning:** Control of goat, fox and island weeds.

**Industry Codes of Practice:** Needs to be developed within the oil industry with particular reference to troglofauna and other operations (sea turtles and lighting).

**Capacity Building:** Within oil industry and pastoral industry for conservation.

**Other Planning Opportunities:** Planning for CAR reserve system, to be acquired in 2015.

### Impediments or constraints to opportunities

- Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, let alone any further acquisitions. Lack of long-term planning in pastoral acquisition for CAR reserve system, particularly with reference to 2015 lease surrender.
- Impediments exist in operations of the Pastoral Lands Board (need to re-structure unviable leases after reserve areas are removed);
- High value conservation areas are still targeted by industry (Cape Range, offshore islands) for either raw materials, or processing sites;
- Need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general.
- Limited financial resources are also a major constraint.

- High value conservation areas are held under pastoral leases, and we can't afford to purchase them, therefore resumption is the only option.
- Weed control is limited to a few species, in a few places – broad scale control of buffel grass on offshore islands looks possible, but appears too expensive for our resources.
- Lack of basic research into troglofauna – distributions, basic habitat requirements.

### Subregions where specific NRM actions are a priority to pursue

CAR1 has a NRM rank of (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of a production/development system. This mainly applies to pastoral and oil industry.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology or regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Quantitative Fauna Survey:** Subregional survey of fauna has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists, usually for industrial development. Quadrat-based floristic data is available from only a few localities. Inventory sites were surveyed by the Departments of Agriculture and Land Administration in the Carnarvon Basin rangelands providing limited plant identification.

**Ecological and Life History Data:** There are few detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species (e.g., native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush and ruby dock).

### Other Data Gaps Include:

- Troglobitic fauna is not well understood. The fauna is known to be highly significant, yet many species are known from few or single localities.
- No estimate available of impact that recreational access to cave systems has on troglofauna.
- No understanding of impacts of shallow-aquifer disposal of oil-contaminated produced water on Barrow Island.
- No understanding of impacts of gravel extraction on Barrow Island.

- No knowledge of desirability or otherwise of fire and fire management (including suppression) on island ecosystems.
- No quantitative data on the impact of exotic herbivores on aquatic systems, or subterranean systems, especially effects of heavy loads of goat dung in cave inflows.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No assessment of the impact of global warming upon coastal and island communities, including increasing sea levels and possible increases in frequency and intensity of cyclonic events.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on coastal and island communities, particularly upon recruitment of perennial flora species, and consequent effects on invertebrate, vertebrate communities and other plants.
- Inventory survey has been undertaken for many islands within CAR1 (Exmouth Gulf, Barrow, Lowendal and Montebello groups). However, some islands within the Gulf are still poorly known.
- Poor state of knowledge of sea turtle nesting away from locations where monitoring and/or tagging occurs. Many islands and mainland beaches are known to support nesting, but numbers and species are unknown.
- Poor state of knowledge of sea bird nesting on islands of Exmouth Gulf.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
023	Aplin, K.P.	(1998).	Three new blindsnakes (Squamata, Typhlopidae) from northwestern Australia.	Records of the Western Australian Museum 19: 1-12.	J
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
242	Department of Conservation and Land Management	(in prep).	Turtle and Dugong Management Plan for Western Australia.	Department of Conservation and Land Management, Perth.	R
246	Department of Conservation and Land Management	(1999).	Interim Management Guidelines for Necessary Operations, Barrow Island Group.	Unpublished IMG, Department of Conservation and Land Management, Karratha.	R
228	Department of Conservation and Land Management	(1989).	Ningaloo Marine Park Management Plan, 1989 - 1999. Management Plan No. 12.	Western Australian Department of Conservation and Land Management.	R
243	Department of Conservation and Land Management	(1987).	Cape Range National Park Management Plan, 1987 - 1997. Management Plan No. 8.	Western Australian Department of Conservation and Land Management.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
810	Keighery, G. and Gibson, N.	(1993).	Biogeography and composition of the flora of the Cape Range Peninsula, Western Australia. In The Biogeography of the Cape Range Western Australia, W.F. Humphreys (Ed)	Records of the Western Australian Museum, Supplement No 45.	B

483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

### Other Relevant Publications

See reference numbers 011, 022, 025, 026, 031, 036, 037, 038, 039, 048, 092, 093, 094, 118, 148, 150, 173, 182, 245, 258, 268, 268, 280, 281, 282, 342, 350, 383, 387, 392, 393, 396, 397, 398, 399, 400, 401, 403, 407,

418, 419, 421, 422, 430, 443, 443, 462, 493, 515, 518, 533, 557, 591, 595, 601, 625, 634, 635, 636, 637, 638, 648, 656, 682, 684, 687, 688, 694, 699, 705 and 706 in Appendix A.

# Carnarvon 2 (CAR2 – Wooramel subregion)

ANTHONY DESMOND AND ALANNA CHANT  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

The Carnarvon bioregion is composed of quaternary alluvial, aeolian and marine sediments overlying Cretaceous strata. A mosaic of saline alluvial plains with samphire and saltbush low shrublands, Bowgada low woodland on sandy ridges and plains, Snakewood scrub on clay flats, and tree to shrub steppe over hummock grasslands on and between red sand dune fields. Limestone strata with *Acacia stuartii* or *A. bivenosa* shrubland outcrop in the north, where extensive tidal flats in sheltered embayments support mangal.

The Wooramel Subregion is the southern and central parts of the Carnarvon Basin. Alluvial plains associated with downstream sections and deltas of Gascoyne, Minilya and Wooramel Rivers. Includes Lake MacLeod and Kennedy Range. Tree to shrub steppe over hummock grasslands on and between aeolian red sand dunefields are extensive in the north and east as well as on top of Kennedy Range. Permian sediments are common in northern parts. Southern areas comprise limestone plateaux overlain by red sand plains. *Acacia* shrublands (Mulga, Bowgada and *A. coriacea*) over bunch grasses on red sandy ridges and plains. Mangroves confined to small areas around Lake MacLeod and near Carnarvon. Saline alluvial plains with samphire and saltbush low shrublands in near-coastal areas. A seasonal

arid climate, tending towards bimodal rainfall. Includes the northern section of the Peron Peninsula. The subregional area is 6, 667, 540 ha.

### Dominant land use

Mainly (ix) (see Appendix B, key b) grazing- native pastures, (90.37%) with lesser areas of (xi) UCL and Crown reserves (4.36%) and (xiii) Conservation (3.63%) although a significant proportion of conservation estate in the subregion falls outside the IUCN I-IV categories.

### Continental Stress Class

The Continental Stress Class is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Vertebrates:

Including: Peregrine Falcon (*Falco peregrinus*), Malleefowl (*Leipoa ocellata*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Mulgara (*Dasyercus cristicauda*), Kultarr (*Antechinomys laniger*), and *Ctenotus zastictus*.

#### Rare Flora:

The subregion has a number of rare flora.

### Ecosystem Types That Have at Least 85% of Their Total Extent Confined to CAR2

Beard Veg Assoc	Description
200	Mosaic: Low woodland over scrub; mulga over bowgada scrub/Shrublands; bowgada & grevillea scrub on sandhills
205	Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub
208	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Shrublands; bowgada & grevillea scrub
209	Shrublands; <i>Acacia sclerosperma</i> & minnieritchie scrub
224	Shrublands; waterwood & <i>Acacia victoriae</i> scrub
226	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Succulent steppe; samphire
229	Mosaic: Shrublands; bowgada and associated spp scrub/Shrublands; bowgada & grevillea scrub
242	Succulent steppe with scrub; snakewood over saltbush
244	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> scrub
245	Mosaic: Shrublands; bowgada & minnieritchie scrub/Succulent steppe; saltbush & bluebush
246	Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i>
265	Low woodland; <i>Acacia sclerosperma</i> & <i>A. victoriae</i>
281	Shrublands; mulga & bowgada open scrub
282	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> sparse scrub
283	Shrublands; <i>Acacia sclerosperma</i> , bowgada & <i>A. victoriae</i> scrub
Beard Veg Assoc	Description

284	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Shrublands; snakewood & <i>A. victoriae</i> scrub
301	Hummock grassland; shrub steppe; mixed scrub, hard spinifex ( <i>Triodia basedowii</i> ) with dwarf shrubs
303	Sparse succulent steppe; bluebush with very sparse snakewood shrubs
304	Sparse low woodland; <i>Acacia victoriae</i> & snakewood in scattered groups
307	Low woodland; bowgada & <i>Acacia subtessarogona</i>
308	Mosaic: Shrublands; <i>Acacia sclerosperma</i> sparse scrub/Succulent steppe; saltbush & bluebush
320	Shrublands; bowgada & <i>Acacia victoriae</i> scrub
321	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Succulent steppe; saltbush & bluebush
323	Shrublands; <i>Acacia sclerosperma</i> , bowgada & snakewood scrub
325	Succulent steppe; saltbush & samphire
328	Succulent steppe with scrub; waterwood & <i>Acacia sclerosperma</i> over saltbush & samphire
329	Shrublands; dwarf waterwood ( <i>Acacia coriacea</i> ) shrubs on recent dunes
342	Mosaic: Low woodland; waterwood/Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub
344	Mosaic: Shrublands; bowgada scrub and associated sp/Shrublands; <i>Acacia sclerosperma</i> , bowgada & <i>A. victoriae</i> scrub
346	Mosaic: Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub/Shrublands; patches of low mixed scrub
347	Mosaic: Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub patches/Succulent steppe; bluebush
349	Mosaic: Shrublands; bowgada scrub with scattered mulga/Shrublands; bowgada & grevillea scrub
1101	Shrublands; <i>Acacia ligulata</i> x <i>rostellifera</i> thicket
1103	Shrublands; <i>Acacia</i> & <i>lamarchea</i> thicket
1105	Hummock grasslands, grass steppe; spinifex <i>Triodia plurinervata</i>
1325	Succulent steppe with very open low trees; coolibah over saltbush & samphire
3432	Mosaic: Low woodland; waterwood/Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & <i>A. subtessarogona</i> scrub

#### Centres of endemism:

The *Lerista* group exhibits significant endemism in the subregion. The following species are endemic to the subregion:

- *Lerista gascoynensis*
- *Lerista kennedyensis*
- *Lerista lineata* (isolated population)
- *Lerista haroldi*

#### Refugia:

Lake MacLeod wetland is a major migration stopover and drought refuge for shorebirds

#### High Species and Ecosystem Diversity:

The *Lerista* group of lizards displays high species diversity, as listed above.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the System 9 in the CTRC Green Book. Some but not all of these recommendations (with modification) were implemented over the following ten years.

In 2000 a report on the Biodiversity of the Southern Carnarvon Basin was published. This included a paper on reserve system gaps, McKenzie, Halse and Gibson (2000).

The State Government's policy statement (Managing the Rangelands) broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation.

An unpublished report by Department of Conservation and Land Management - "Gascoyne - Murchison Strategy, Establishment and Management of a Conservation Reserve System" outlines the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in the article *Filling the Gaps* (McNamara *et al.* 2000).

Although no systematic assessment of biodiversity was undertaken recommendations on reserve status of the Shark Bay area are included in the Shark Bay Terrestrial Reserves management Plan (Department of Conservation and Land Management 2000).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Lake MacLeod, WA009 (CAR004WA)	iii	iv	iii	xii (mining for salt and gypsum), iv
McNeill Claypan, WA010 (CAR005WA)	ii	ii	iii	iv, xii (urban and light commercial development; inappropriate use by adjacent speedway and off road vehicles), xi (rubbish tip, sewage disposal and oil waste disposal)
Hamelin Pool, WA008 (CAR003WA)	iii-iv	iv	iii	xii (inappropriate tourism)
East Shark Bay, WA011 (CAR006WA)	iii-iv	iv	iii	xii (fishing, boating), xi (Monkey Mia sewerage)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Wooramel River	25° 45' S 114° 30' E	B2	Principal drainage, regional alluvial process-control, biological refuge, riverine ecosystems	i	iii	iii	x (floods, massive bed-load), vi (buffel grass, Athel Pine), iv (cattle), v (foxes, cats, rabbits, goats)
Gascoyne River	24° 50' S 114° 30' E	B2	Principal drainage, regional alluvial process-control, biological refuge, riverine ecosystems	i	iii	iii	x (floods, massive bed-load), vi (buffel grass, Athel Pine), iv (cattle), v (foxes, cats, rabbits, goats)
Minilya River	23° 45' S 114° 30' E	B2	Principal drainage, regional alluvial process-control, biological refuge, riverine ecosystems	i	iii	iii	x (floods, massive bed-load), vi (buffel grass), iv (cattle), v (foxes, cats, rabbits, goats)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Gascoyne River	i	iii	iii	iv, v (goats, rabbits), vi (Buffel grass, Athel pine), ii, x
Wooramel River	i	iii	iii	iv, v (goats, rabbits), vi (Buffel grass, Athel pine), ii, x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Hypersaline microbial community number 2 (Hamelin stomatolite)	V	16	iii	iii	i	xii (recreation; climate change leading to change in sea level; nutrient enrichment)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Permanent water soaks and wetlands on western edge of the Kennedy Ranges (B. Barton pers. comm.). Not distinct floristically but are geologically, flora highly variable, classified same as Callytharra claypans (G. Keighery pers. comm.).	V	16	i-ii	iii	i	iv, v (goats)
Invertebrate assemblages of Mooka Springs (-245253S, 1145827E). Spring in the Kennedy Range threatened by feral goats. Has rich representative invertebrate community (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.).	V	16	i-ii	iii	i	v (goats), iv

Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	V	Various	ii	iii	i	v (cats, foxes, goats), iv, vii
Invertebrate assemblages of Callytharra Spring, Wooramel River (-255232S, 1153007E). Permanent Spring on the Wooramel river. High aquatic invertebrate diversity (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.)	V	16	i	iii	i	iv (cattle), v (goats)
Plant assemblages dominated by <i>Acacia sibilans</i> (Myall) occurs. The number of trees is estimated to be very few, occurs on Yaringa Station and possibly Carbla and Woodleigh (J. Stretch pers. comm.)	V	21	ii	iii	i	iv, v (goats, rabbits)
Plant assemblages (spinifex dominated) of sand dune mesa topping the Kennedy Range National Park (B. Barton pers. comm.)	V	33	iii	iii	i	v (goats)
Flora and fauna assemblages of the gorges of Wooramel River (B. Barton pers. comm., T. Brandis pers. comm.)	V	16	i	vi	i	iv, v (goats)
Mangrove communities dominated by <i>Avicennia</i> (Shark Bay) (B. Barton pers. comm.)	V	40	iii	vi	i	i (through industry), x (siltation), xii (fishing)
Floodplains of the Carnarvon Basin, Wooramel and Gascoyne Rivers (Burbidge and McKenzie 1995; Wilcox and McKinnon 1992). Not in reserve system, is widespread but highly modified. Is a major break in floristics between tropics and south (G. Keighery pers. comm.)	V	?21, 27	i	iii	ii	iv, v (goats, rabbits)
<i>Acacia drephanophylla</i> (Hamelin Wattle) on calcareous substrates. Regionally restricted. From Carnarvon Basin Land Systems >800km <sup>2</sup> .	V	21	ii	vi	ii	iv, v (goats, rabbits)
Inland Mangrove assemblage ( <i>Avicennia marina</i> ) of Lake MacLeod. Western shore, photograph in (Burbidge and McKenzie 1995).	V	40	ii-iii	iv	i	x (inflows to lake due to degradation of catchment), xii (mining activities)
Lake MacLeod invertebrate assemblages. Saline aquatic community with strong marine affinities with particularly rich copepod element, is effectively a well developed, very rich birrida community with strong marine and terrestrial components with especially rich hypactacoid community (Halse <i>et al.</i> 2000). (A. Storey pers. comm.)	V	41	ii-iii	v	i	x (potential inflows to lake due to degradation of catchment), xii (mining activities)
Fish assemblages of Blue Holes, Lake MacLeod. (Fish have been collected by Andrew Storey.)	V	41	Unknown	v	i	x (inflows to lake due to degradation of catchment), xii (mining activities)
Samphire communities of Lake MacLeod (Burbidge and McKenzie 1995)	V	40	ii	iv	i	x (inflows to lake due to degradation of catchment), xii (mining activities)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Assemblages of the Gascoyne Delta system (T. Brandis pers. comm.).	V	Variou s	i	vi	i	iv, v (goats, rabbits), vi (athel pine), xii (development)
River Land System vegetation on Gascoyne River in Carnarvon. (J. Stretch pers. comm.)	V	Variou s	i	vi	i	xii (development), iv, v (goats, rabbits), vi (athel pine)
Specific Seagrass Communities, Shark Bay and elsewhere. (Walker 1990, Walker 1989).	V	Marine	ii-iii	vi	i	xii (boating, pearling, aquaculture, trawling)
Sponge community at Shark Bay. (R.I.T. Prince pers. comm.).	V	Marine	ii-iii	vi	i	xii (dredging, boating, pearling, aquaculture, trawling)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Pseudomys fieldi</i>	E	islands: iii mainland: extinct	v	iv	v
<i>Dasyercus cristicauda</i>	V	ii	iii	ii	vii, iv, v (foxes, cats)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Leipoa ocellata</i>	V	ii	v	iii	v (foxes, cats), ii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Caretta caretta</i>	E	ii	iii	ii	v (foxes, cats) xi
<i>Chelonia mydas</i>	E	ii	iii	ii	v (foxes, cats) xi
<i>Dermochelys coriacea</i>	E	ii	iii	ii	v (foxes, cats) xi
<i>Egernia stokesii badia</i>	E	ii	iii	ii	v (foxes, cats) ii
<i>Ctenotus zastictus</i>	V	iii	iv	ii	iv
<i>Egernia stokesii aethiops</i>	V	iii	iv	ii	v (foxes, cats) ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA, DIV 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	SP	ii	iii	ii	v (foxes, cats) ii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Acanthiza iredalei</i>		ii	iv	iii	iv, v (goats, rabbits, foxes, cats)
<i>Malurus lamberti</i>		ii	iv	iii	v (foxes, cats), ii, iv

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Thryptomene wittweri</i>	V	ii	iii	iii	v (goats), iv
<b>PRIORITY 1</b>					
<i>Chthonocephalus oldfieldianus</i>	1	ii	iii	ii	v (goats), iv, vi
<i>Chthonocephalus spathulatus</i>	1	ii	iv	ii	v (goats), iv, vi
<i>Chthonocephalus tomentellus</i>	1	iii	iv	ii	v (goats), iv, vi
<i>Gnephosis</i> sp. Billabong (B Nordenstam and A Anderberg 203)	1	i	iii	ii	v (goats), iv, vi, vii
<i>Rhodanthe ascendens</i>	1	ii	iii	ii	iv, v (goats), vi, vii
<i>Rhodanthe</i> sp. Overlander (PS Short 2096)	1	ii	iii	ii	iv, v (goats)
<i>Sclerolaena stylosa</i>	1	ii	iii	ii	iv, ii, v (goats)
<i>Tetragonia coronata</i>	1	ii	iii	ii	iv, vi, x
<b>PRIORITY 2</b>					
<i>Abutilon</i> sp. Hamelin (AM Ashby 2196)	2	iii	iv	ii	v (goats), iv, vi
<i>Abutilon</i> sp. Quobba (H Demarz 3858)	2	iii	iv	ii	v (goats), iv, vi
<i>Acacia ryaniana</i>	2	iii	iii	ii	v (goats), iv, vi
<i>Chthonocephalus muellerianus</i>	2	iii	iv	ii	v (goats), iv, vi
<i>Platysace</i> sp. Kennedy (PG Wilson 8450)	2	ii	vi	ii	iv, v (goats), vi, vii
<i>Ptilotus alexandri</i>	2	iii	iv	ii	v (goats), iv, vii, vi
<i>Rumex crystallinus</i>	2	ii	iii	ii	iv, v (goats), vii
<i>Scaevola chrysopogon</i>	2	iii	iv	ii	iv, v (goats), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )				L
21	Low woodland; waterwood				M
39	Shrublands; mulga scrub				M
43	Low forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)	X	X		L
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>			X	H
112	Hummock grasslands, shrub steppe; <i>Acacia ligulata</i> over <i>Triodia plurinervata</i>	X			H
125	Bare areas; salt lakes				L
127	Bare areas; mudflats	X			L
129	Bare areas; drift sand	X			L
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>			X	H
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub	X		X	L
162	Shrublands; snakewood scrub				L
163	Shrublands; eremophila and cassia dwarf scrub				L
166	Low woodland; mulga & <i>Acacia victoriae</i>				L
167	Shrublands; <i>Acacia victoriae</i> & snakewood open scrub				L
168	Shrublands; mulga, <i>Acacia victoriae</i> & snakewood scrub				H
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )			X	H
184	Shrublands; mulga & bowgada scrub			X	M
186	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> open scrub				H
200	Mosaic: Low woodland over scrub; mulga over bowgada scrub/Shrublands; bowgada & grevillea scrub on sandhills				H
205	Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub		X	X	H
206	Shrublands; bowgada & grevillea scrub				M
208	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Shrublands; bowgada & grevillea scrub				L
209	Shrublands; <i>Acacia sclerosperma</i> & minnieritchie scrub	X	X		H
221	Succulent steppe; saltbush	X	X		L
224	Shrublands; waterwood & <i>Acacia victoriae</i> scrub	X	X		H
226	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Succulent steppe; samphire				H
229	Mosaic: Shrublands; bowgada and associated spp scrub/Shrublands; bowgada & grevillea scrub			X	H
242	Succulent steppe with scrub; snakewood over saltbush				H
243	Shrublands; bowgada & minnieritchie scrub	X	X		H
244	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> scrub			X	H
245	Mosaic: Shrublands; bowgada & minnieritchie scrub/Succulent steppe; saltbush & bluebush				H

Beard Veg Assoc	Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
246	Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i>				H
248	Shrublands; bowgada scrub with scattered red mallee & <i>Eucalyptus</i> sp.				L
264	Low woodland; <i>Acacia victoriae</i> & snakewood	X		X	H
265	Low woodland; <i>Acacia sclerosperma</i> & <i>A. victoriae</i>				H
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe; saltbush & bluebush				H
267	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush				H
269	Low woodland over scrub; mulga over bowgada scrub				H
281	Shrublands; mulga & bowgada open scrub				H
282	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> sparse scrub				H
283	Shrublands; <i>Acacia sclerosperma</i> , bowgada & <i>A. victoriae</i> scrub			X	M
284	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Shrublands; snakewood & <i>A. victoriae</i> scrub				H
301	Hummock grassland; shrub steppe; mixed scrub, hard spinifex ( <i>Triodia basedowii</i> ) with dwarf shrubs	X		X	L
303	Sparse succulent steppe; bluebush with very sparse snakewood shrubs			X	H
304	Sparse low woodland; <i>Acacia victoriae</i> & snakewood in scattered groups				H
307	Low woodland; bowgada & <i>Acacia subtessarogona</i>			X	M
308	Mosaic: Shrublands; <i>Acacia sclerosperma</i> sparse scrub/Succulent steppe; saltbush & bluebush				H
320	Shrublands; bowgada & <i>Acacia victoriae</i> scrub				H
321	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Succulent steppe; saltbush & bluebush				H
323	Shrublands; <i>Acacia sclerosperma</i> , bowgada & snakewood scrub				H
325	Succulent steppe; saltbush & samphire				H
328	Succulent steppe with scrub; waterwood & <i>Acacia sclerosperma</i> over saltbush & samphire				H
329	Shrublands; dwarf waterwood ( <i>Acacia coriacea</i> ) shrubs on recent dunes				H
342	Mosaic: Low woodland; waterwood/Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub			X	L
344	Mosaic: Shrublands; bowgada scrub and associated sp/Shrublands; <i>Acacia sclerosperma</i> , bowgada & <i>A. victoriae</i> scrub	X			H
345	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> patchy scrub, barren/Succulent steppe; saltbush & bluebush				H
346	Mosaic: Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub / Shrublands; patches of low mixed scrub	X			H
347	Mosaic: Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub patches/Succulent steppe; bluebush	X			H
349	Mosaic: Shrublands; bowgada scrub with scattered mulga/Shrublands; bowgada & grevillea scrub			X	H
360	Shrublands; bowgada scrub with scattered mulga				H
363	Shrublands; bowgada scrub with scattered cypress pine	X			L
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine				L
368	Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee		X		L
658	Shrublands; <i>Acacia sclerosperma</i> & snakewood scrub (also with some waterwood)				H
662	Hummock grassland; shrub steppe; mixed acacia scrub & dwarf scrub with soft spinifex & <i>T. basedowii</i>	X			L
676	Succulent steppe; samphire	X	X	X	L
1101	Shrublands; <i>Acacia ligulata</i> x <i>rostellifera</i> thicket	X	X		L

Beard Veg Assoc	Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
1103	Shrublands; <i>Acacia</i> & <i>Lamarchea</i> thicket	X			L
1105	Hummock grasslands, grass steppe; spinifex <i>Triodia plurinervata</i>	X			L
1271	Bare areas; claypans			X	L
1322	Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub				H
1325	Succulent steppe with very open low trees; coolibah over saltbush & samphire				H
2081	Shrublands; bowgada and associated spp. scrub	X	X	X	M
2675	Hummock grasslands, low tree & shrub steppe; scattered eucalypts,				L

	kanji over <i>Triodia pungens</i> & <i>T. basedowii</i>				
2685	Shrublands; <i>Acacia quadrimarginea</i> & jam scrub on greenstone	X			H
3432	Mosaic: Low woodland; waterwood/Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & <i>A. subtessarogona</i> scrub				H
	Permanent water soaks and wetlands on western edge of the Kennedy Ranges (B. Barton pers. comm.). Not distinct floristically but are geologically, flora highly variable, classified same as Callytharra claypans (G. Keighery pers. comm.).	X		X	H
	Invertebrate assemblages of Mooka Springs (-245253.S, 1145827E). Spring in the Kennedy Range threatened by feral goats. Has rich representative invertebrate community (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.).				H
	Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	X		X	H
	Invertebrate assemblages of Callytharra Spring, Wooramel River (-255232S, 1153007E). Permanent Spring on the Wooramel river. High aquatic invertebrate diversity threatened by cattle (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.).				H
	Plant assemblages dominated by <i>Acacia sibilans</i> (Myall) occurs. The number of trees is estimated to be very few, occurs on Yaringa Station and possibly Carbla and Woodleigh (J. Stretch pers. comm.).				H
	Plant assemblages (spinifex dominated) of sand dune mesa topping the Kennedy Range National Park (B. Barton pers. comm.)	X			L
	Flora and fauna assemblages of the gorges of Wooramel River (B. Barton pers. comm., T. Brandis pers. comm.)				H
	Mangrove communities dominated by <i>Avicennia</i> (Shark Bay) (B. Barton pers. comm.).	X			L-M
	Hypersaline community number 2. Stromatolites of Hamelin Pool (Burne 1991/92; P. Brown pers. comm.).	X			L
	<i>Acacia drephanophylla</i> (Hamelin Wattle) on calcareous substrates. Regionally restricted. From Carnarvon Basin Land Systems >800km <sup>2</sup> .				H
	Inland Mangrove assemblage ( <i>Avicennia marina</i> ) of Lake MacLeod Western shore, photograph in Landscape article by Burbidge and McKenzie (1995).				H
	Lake MacLeod invertebrate assemblages. Saline aquatic community with strong marine affinities with particularly rich copepod element, is effectively a well developed, very rich birrida community with strong marine and terrestrial components with especially rich hypactacoid community (Halse <i>et al.</i> 2000). (A. Storey pers. comm.)				H
	Fish assemblages of Blue Holes, Lake MacLeod. (Fish have been collected by Andrew Storey)				H
	Samphire communities of Lake MacLeod (Burbidge and McKenzie 1995)				H
	Assemblages of the Gascoyne Delta system (T. Brandis pers. comm.).				H
Beard Veg Assoc	Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
	River Land System vegetation on Gascoyne River in Carnarvon. (J. Stretch pers. comm.)				H
	Specific Seagrass Communities. Shark Bay and elsewhere (Walker 1990, Walker 1989).	X?			H
	Sponge community at Shark Bay. (R.I.T. Prince pers. comm.).	X?			H

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Use:** This is the primary issue in that pastoralism occupies greater than 90% of the region and mining has interests in areas.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data; level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores.

### Bioregional and subregional priority for reserve consolidation

CAR is reservation class 3 (see Appendix D, and Appendix C, rank 4) with only 3.45% of area in conservation reserve (IUCN I-IV). At the subregional level CAR1 has 2.2% in reserve (IUCN I-IV) while CAR2 has 3.9% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 2 with possibility of changing to a higher primary classification is appropriate.

### Reserve management standard

CAR2 reserves are generally large and with little access. Management resources are hampered by the logistics of travel etc. Wildfire management facilities are limited by resources, with no strategic firebreaks or prescribed burning. Feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made an observable difference to rabbit numbers, goats are common throughout), and feral predator control systems are not in place in any area. The overall reserve management rank for CAR2 is poor(i) (see Appendix C, rank 5).

**Francis Peron National Park:** Feral control in place (Callicivirus hasn't made an observable difference to rabbit numbers), and re-introduction of mammal species and mallee fowl has been done. There is a number of dedicated staff on site. Wildfire management facilities are limited by resources, with no strategic firebreaks or prescribed burning in the past five years. The Park has a management plan in place, but actions are not necessarily funded so may not be undertaken.

**Shark Bay Marine Park:** Dedicated staff and equipment, Park management plan in place. The Park has a management plan in place, but actions are not necessarily funded so may not be undertaken. The reserve management standard is good (iii) but needs further resourcing.

**Hamelin Pool Marine Reserve:** Low impacts, Park has a management plan in place, but actions are not necessarily funded so may not be undertaken.

**South Peron (5h reserve):** Feral control in place (Callicivirus hasn't made an observable difference to rabbit numbers), harvesting of sandalwood, wildfire management facilities are limited by resources, with no strategic fire breaks or prescribed burning. The Park has a management plan in place, but actions are not necessarily funded so may not be undertaken.

**Kennedy Range National Park (and adjacent ex - Stations):** Large area with little access. Management resources are hampered by the logistics of travel etc. Wildfire management facilities are limited by resources, with no strategic firebreaks or prescribed burning. Feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made an observable difference to rabbit numbers, goats are found throughout), and feral predator control systems are not in place. The Park has a management plan in place, but actions are not necessarily funded so may not be undertaken.

**Pimbee (ex station):** Large area with little access. Management resources are hampered by the logistics of travel etc. Wildfire management facilities are limited by resources, with no strategic firebreaks or prescribed burning. Feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made an observable difference to rabbit numbers, goats are common throughout), and feral predator control systems are not in place. Interim Management Guidelines in place, but actions are not necessarily funded so may not be undertaken.

## Off reserve conservation

## Priority species or groups and existing recovery plans

Species	Beard Vegetation Association/Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Pseudomys fieldi</i>	1100 – Hummock grassland: dwarf steppe, mixed ericoid shrubs & spinifex	Yes - RP	Action Plan for Australian Marsupials and Monotremes
<i>Leipoa ocellata</i>	17 – Shrublands: <i>Acacia rostellifera</i> thicket; 260 – Mosaic: Shrublands tree-heath between sandhills, <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee/Shrublands scrub-heath; 246 – Hummock grasslands: low tree steppe, <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i> ; 365 – Shrublands: bowgada & jam scrub with scattered York and red mallee; 368 – Shrublands: tree-heath between sandhills, <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee.	Malleefowl Preservation Society has current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Acanthiza iredalei</i>	676 – Succulent steppe: samphire; 984 – Mosaic: Shrublands, acacia and melaleuca scrub/Succulent steppe, saltbush	No	Action Plan for Australian Birds
<i>Malurus lamberti</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	No	Action Plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.
<i>Caretta caretta</i>	Beaches for breeding	No	Action Plan for Australian Reptiles
<i>Chelonia mydas</i>	Beaches for breeding	No	Action Plan for Australian Reptiles
<i>Dermochelys coriacea</i>	Beaches for breeding	No	Action Plan for Australian Reptiles
<i>Egernia stokesii badia</i>	205 Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub; 243 Shrublands; bowgada & minnieritchie scrub	No	Action Plan for Australian Reptiles
<i>Egernia stokesii aethiops</i>	205 Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub; 243 Shrublands; bowgada & minnieritchie scrub	No	Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	112 Hummock grasslands, shrub steppe; <i>Acacia ligulata</i> over <i>Triodia plurinervata</i> ; 205 Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub; 243 Shrublands; bowgada & minnieritchie scrub, 246 Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i> ,	No	Action Plan for Australian Reptiles
<i>Dasyercus cristicauda</i>	301 Hummock grassland; shrub steppe; mixed scrub, hard spinifex ( <i>Triodia basedowii</i> ) with dwarf shrubs	No	Action Plan for Australian Marsupials and Monotremes
<i>Ctenopus zasticus</i>	246 Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i>	No	Action Plan for Australian Reptiles

Species	Beard Vegetation Association/Ecosystem	Specific Recovery Plan	General Recovery Plan
Threatened flora of CAR2	Various	No	No recovery plan exists for threatened flora in the CAR2 subregion. Although no Endangered flora occurs further research into the status of vulnerable species and management requirement is needed

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Pseudomys fieldi</i>	i, ii, iii, vii, ix, xii	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs reintroduction to create new mainland populations.
<i>Leipoa ocellata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of feral predators and herbivores (goats) required. Reduction of grazing intensity may be required.
<i>Acanthiza iredalei</i>	i, ii, iii, vii, xii	Habitat retention through reserves or on other State lands or on private lands.
<i>Malurus lamberti</i>	xii, vii	Control of herbivores such as rabbits and goats may be required. Monitoring of existing populations.
<i>Caretta caretta</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Chelonia mydas</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Dermochelys coriacea</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Egernia stokesii badia</i>	x, xii, i	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
<i>Egernia stokesii aethiops</i>	x, i	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Aspidites ramsayi</i>	x, vii, xii, i	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
<i>Dasyercus cristicauda</i>	x, xii, i	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Ctenotus zasticus</i>	x, xii, i	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Abutilon</i> sp. Hamelin (AM Ashby 2196)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Abutilon</i> sp. Quobba (H Demar 3858)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia ryaniana</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Chthonocephalus muellerianus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chthonocephalus oldfieldianus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chthonocephalus spathulatus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chthonocephalus tomentellus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Gnephosis</i> sp. Billabong (B Nordenstam and A Anderberg 203)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Platysace</i> sp. Kennedy (PG Wilson 8450)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptilotus alexandri</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rhodanthe ascendens</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rhodanthe</i> sp. Overlander (PS Short 2096)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rumex crystallinus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scaevola chrysopogon</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Sclerolaena stylosa</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Sondottia glabrata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Tetragonia coronata</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Thryptomene witweri</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.

<sup>1</sup>Appendix B, key h

## Ecosystems and appropriate recovery actions

Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
Permanent water soaks and wetlands on western edge of the Kennedy Ranges (B. Barton pers. comm.). Not distinct floristically but are geologically, flora highly variable, classified same as Callytharra claypans (G. Keighery pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management, especially of mulgara habitat at Kennedy Range National Park.
Invertebrate assemblages of Mooka Springs (-245253,S, 1145827E). Spring in the Kennedy Range threatened by feral goats. Has rich representative invertebrate community (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.

Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Invertebrate assemblages of Callytharra Spring, Wooramel River (-255232S, 1153007E). Permanent Spring on the Wooramel river. High aquatic invertebrate diversity threatened by cattle (W. Kay, M. Smith, M. Scanlon, S. Halse pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Plant assemblages dominated by <i>Acacia sibilans</i> (Myall) occurs. The number of trees is estimated to be very few, occurs on Yaringa Station and possibly Carbla and Woodleigh (J. Stretch pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Plant assemblages (spinifex dominated) of sand dune mesa topping the Kennedy Range National Park (B. Barton pers. comm.)	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management, especially of mulgara habitat at Kennedy Range National Park.
Flora and fauna assemblages of the gorges of Wooramel River (B. Barton pers. comm., T. Brandis pers. comm.)	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Mangrove communities dominated by <i>Avicennia</i> (Shark Bay) (B. Barton pers. comm.).	i, iii	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases).
Hypersaline community number 2. Stromatolites of Hamelin Pool (Burne 1991-1992; P. Brown pers. comm.).	i, iii	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases).
<i>Acacia drephanophylla</i> (Hamelin Wattle) on calcareous substrates. Regionally restricted. From Carnarvon Basin Land Systems >800km <sup>2</sup> .	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats. Fire management, especially of mulgara habitat at Kennedy Range National Park.
Inland Mangrove assemblage ( <i>Avicennia marina</i> ) of Lake MacLeod. Western shore, photograph (Burbidge and McKenzie 1995).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Lake MacLeod invertebrate assemblages. Saline aquatic community with strong marine affinities with particularly rich copepod element is effectively a well developed, very rich birrida community with strong marine and terrestrial components with especially rich hypactacoid community (Halse <i>et al.</i> 2002). (A. Storey pers. comm.)	i, iii	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases).
Fish assemblages of Blue Holes, Lake MacLeod. (Fish have been collected by Andrew Storey).	i, iii	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases).
Samphire communities of Lake MacLeod (Burbidge and McKenzie 1995)	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Assemblages of the Gascoyne Delta system (T. Brandis pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
River Land System vegetation on Gascoyne River in Carnarvon. (J. Stretch pers. comm.)	i, iii, v, vi, vii, ix	Habitat protection through reserves, more reservation needed of high priority areas, habitat protection on state lands (pastoral leases). Fencing of sensitive areas as exclosures where there are heavy goat numbers. Weed control for critical habitats. Feral animal control, especially of goats and foxes. Fire management.
Specific Seagrass Communities. Shark Bay and elsewhere (Walker 1990, Walker 1989).	N/A	N/A
Sponge community at Shark Bay. (R.I.T. Prince pers. comm.).	N/A	N/A

<sup>1</sup>Appendix B, key h

## Existing ecosystem recovery plans

There are no recovery plans currently written for any of the ecosystems at risk in CAR2.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that a large off-park effort is required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Through the Gascoyne Murchison Strategy, including purchase of leases for conservation estate.

**Threat Abatement Planning:** Including vegetation management plans, and pest management.

**Industry Codes of Practice:** Particularly in relation to pastoral, mining and exploration activities

### **Environmental Management Systems and Ecologically Sustainable Product Marketing**

**Integration With Property Management Planning, Catchment Planning and Landcare:** Through Land Care District committees through the region.

## Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** Including rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by the Rangelands Environmental Management Program of GMS. Requires a greater level of support to be successful.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. CTR is limited by the presence of mining leases and tenements. There is a need to increase awareness of conservation values through

education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

## Subregions where specific NRM actions are a priority to pursue

CAR2 has an NRM priority of (i) (see Appendix C, rank 7), indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of CAR is severely degraded through past agricultural practices (primarily sheep & cattle grazing) and feral herbivores. Under the Land Administration Act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes. Similar situation to MUR1 & MUR2.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regolith mapping available at scale of 1:250 000. Vegetation map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** Regional survey of fauna has been completed, but it was confined to vertebrates and selected invertebrate taxa. Also, sampling was sparse (ca. 40 terrestrial quadrats and 10 wetland quadrats across subregion), with quadrats positioned only on the most widespread surface-types, only 2-3 quadrats per surface-type, and few quadrats were sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence even for vertebrates.

**Floristic Data:** Regional survey of flora has been completed, but it was based on sparse sampling (about 170 quadrats across subregion), with quadrats positioned on only the most widespread surface-types. Additional Herbarium collections have been made elsewhere in the subregion, however these were mainly for taxonomic purposes. Inventory sites were surveyed by the Departments of Agriculture and Land Administration in

the Carnarvon Basin rangelands providing limited plant identification.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of most species, including CWR mammals and introduced pests such as rabbits, goats, cats and foxes.

**Other Priority Data Gaps Include:**

No quantitative data on the affect of exotic predators, weed colonisation, fire, introduced herbivores, mineral-extraction on gypsum surfaces of Lake MacLeod.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
712	Burbidge, A. and McKenzie, N.	(1995).	Patterns in nature: the biodiversity of the Carnarvon Basin.	Landscape 11(2), 15-20	J
713	Burne, Robert V.	(1991-1992)	Lilliput's castles: stromatolites of Hamelin Pool	Landscape. - Vol. 7 (2)	J
181	Cogger, H., Cameron, E., Sadlier, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
254	Department of Conservation and Land Management and National Parks and Nature Conservation Authority	(2000).	Shark Bay Terrestrial Reserves Management Plan 2000-2009, Management Plan No. 45.	Department of Conservation and Land Management.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
711	Halse, S.A., Shiel, R.J., Storey, A.W., Edward, D.H.D., Lansbury, I., Cale, D.J. and Harvey, M.S.	(2000).	Aquatic invertebrates and waterbirds of wetlands and rivers of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement 61, 217-267	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
710	McKenzie, N.L., Halse, S.A. and Gibson, N.	(2000).	Some gaps in the reserve system of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement No. 61: 511-546.	R
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscape. 15 (4) 43 - 49.	J
540	Payne, A.L., Curry, P.J., Spencer, G.F.	(1987).	An inventory and condition survey of rangelands in the Carnarvon Basin, Western Australia No. 73.	Western Australian Department of Agriculture.	R
631	Storr, G.M. and Harold, G.	(1990).	Amphibians and reptiles of the Shark Bay area, Western Australia. In Research in Shark Bay (Eds) P.F. Berry, S.D. Bradshaw, B.R. Wilson.	Western Australian Museum, Perth.	B

808	Walker, D.I.	(1990).	Seagrass in Shark Bay, Western Australia. In: "Research in Shark Bay: Report of the France-Australe Bicentenary Expedition Committee." (Eds. P.F. Berry, S.D. Bradshaw, B.R. Wilson)	Western Australian Museum, Perth. p.101-6	B
809	Walker, D.I.	(1989).	Regional studies - seagrass in Shark Bay, the foundations of an ecosystem. In: "Biology of Seagrasses. A treatise on the biology of seagrasses with special reference to the Australian region." (Eds. A.W.D. Larkum, A.J. McComb, S.A. Shepherd) (Aquatic Plant Studies 2)	Elsevier, Amsterdam. p.182-210	B
695	Wilcox, D.G. and McKinnon, E.A.	(1992).	A Report on the Condition of the Gascoyne Catchment.	Department of Agriculture, Western Australia.	R

R = Report; J = Journal article; O = Other.

### Other Relevant Publications

See reference numbers 026, 047, 065, 066, 075, 090, 097, 101, 114, 117, 118, 137, 241, 253, 267, 268, 270, 273, 274, 277, 278, 279, 299, 372, 387, 405, 406, 419,

425, 429, 450, 459, 505, 506, 513, 519, 526, 540, 584, 603, 630, 646, 647 and 708 in Appendix A.

# Central Kimberley 1 (CK1 – *Pentecost* subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

This is hilly to mountainous country with parallel siliceous ranges of Proterozoic sedimentary rocks with skeletal sandy soils supporting *Triodia* spp. hummock grasses with scattered trees, and with earths on Proterozoic volcanics in valleys supporting ribbon grass (*Chrysopogon* spp.) with scattered trees. Open forests of river red gum (*Eucalyptus camaldulensis*) and *Pandanus* spp. occur along drainage lines. The climate is dry hot tropical and sub-humid to semi-arid with summer rainfall.

The Pentecost subregion is predominantly middle Pentecosts sandstone, with King Leopold and Warton sandstone ranges along its southern peripheries. Large areas are mantled by Cainozoic soils. There is moderate dissection by several rivers (Durack, Chamberlain and Fitzroy). This is the true central Kimberley. Average annual rainfall ranges from 750 mm to 1000 mm. The dominant vegetation is savannah woodlands of eucalypts over *Triodia* spp.

Broad scale vegetation mapping of the area describes the following components;

- *Eucalyptus microtheca* (coolibah) and/or *Eucalyptus* spp. +/- *Excoecaria parvifolia* (gutta percha) grassy low woodland.
- *Adansonia gregorii* (boab), *Bauhinia cunninghamii* (bauhinia) and *Grevillea striata* (beefwood) grassy low open-woodland.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia* spp. (spinifex) hummock grasses or sometimes a hummock grassland without trees.
- *Eucalyptus tectifera* (Darwin Box) +/- *Eucalyptus grandifolia* (large-leaved cabbage gum) +/- *Eucalyptus byrnesii* (fan-leaved bloodwood) woodland with *Sorghum* spp. (sorghum) and *Sehima nervosum* (white grass) tall grasses.
- *Astrelba* spp. (Mitchell grass) and/or *Dichanthium* spp. (bluegrass) tussock grassland sparsely wooded with low trees.
- *Astrelba lappacea* (curly Mitchell grass) and/or *Astrelba pectinata* (barley Mitchell grass) tussock grassland sparsely wooded with *Acacia* spp. low trees.
- *Eucalyptus phoenicea* (scarlet gum) and *Corymbia ferruginea* subsp. *stypophylla* (rusty bloodwood) low woodland with *Triodia bitextura* (curly spinifex) hummock grassland understorey.
- *Eucalyptus dichromophloia*, *Eucalyptus miniata* (Darwin woollybutt) +/- *Eucalyptus tetradonta* (Darwin stringybark) open-woodland with *Triodia*

*bitextura* (curly spinifex) and *Sorghum* spp. (sorghum) grasses.

- *Eucalyptus grandifolia* (large-leaved cabbage gum) +/- *Eucalyptus greeniana* (broad-leaved bloodwood) +/- *Eucalyptus polycarpa* (long-fruited bloodwood) low open-woodland with *Triodia bitextura* (curly spinifex) hummock grasses or *Chrysopogon* spp. (ribbon grass) and *Dichanthium* spp. (blue grass) tussock grasses.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia bitextura* (curly spinifex) hummock grasses and/or tussock grasses.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia bitextura* (curly spinifex) hummock grasses +/- *Enneapogon* spp. (nine-awn grass) short-tussock grasses or sometimes a grassland without trees.

### Dominant land use

(see Appendix B, key b)

- (ix) Grazing – Native pastures
- (xi) UCL and Crown reserves

### Continental Stress Class

The Continental Stress Class for CK1 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- The subregion is fox and rabbit free and essentially uninhabited.
- The circular, freshwater Lake Gladstone.

#### Centres of Endemism:

Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

The nature of this aspect is poorly known. 'Dry' rainforest patches provide dry season refuges along with riparian zones. Further research is required to define the extent to which this aspect may apply to sandstone country because of its ability to provide fire protection.

#### High Species and Ecosystem Diversity:

Sandstone communities may provide areas of high species and ecosystem diversity. Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to

rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the

scale of subregion or even bioregion. Previous rainforest studies are applicable (McKenzie *et al* 1991).

There has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Gladstone Lake WA111	17° 11'S 126° 14'E	B5	ii, iii, iv	iii	iii	iii	iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of subregional significance in CK1.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) listed in CK1.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	ii	iii	iii	vii
Flora and fauna assemblages of Gladstone Lake near Mt House Station	V	42	Unknown	iii	iii	iv
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	Unknown	iv, vii
Herbfields of sandstone pavements of NW Kimberley.	V	38	Unknown	vi	Unknown	iv, vii

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Assemblages of spring-fed wetlands on organic substrates perched on sandstone hill-slopes in the Central Kimberley bioregion (Kachana Springs)		N/A	i-ii	iii	iii	iv, xii (soil compaction and erosion by cattle), vii, vi

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii.	ii	vii
<i>Erythrorichis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Rhinonictes aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<i>Tadorna radjah</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Common, widespread	iv	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Lagorchestes conspicillatus</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes, possibly feral predators
<i>Dasyurus hallucatus</i>	Near threatened	Unknown	iii	ii	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Acacia gloeotricha</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Acacia manipularis</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Echinochloa kimberleyensis</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Triumfetta hapala</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Eucalyptus ordiana</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Grevillea latifolia</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Jacksonia remota</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Livistona victoriae</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Olax spartea</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Central Kimberley vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
12	Medium woodland-tropical; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ).	1,675
39	Shrublands; mulga scrub.	47
43	Low forest; mangroves.	141
53	Mosaic: Grasslands/pindan; Medium woodland with mixed tree scrub over ?tall upland grass and <i>Plectrachne</i> spp.	20,665
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	89,854
61	Grasslands, tall bunch grass savannah woodland, coolabah over ribbon grass ( <i>Chrysopogon</i> spp.)	37,682
75	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> ).	1,793,559
77	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ).	424,117
116	Hummock grasslands, sparse low tree steppe; mixed low trees over <i>Triodia wiseana</i> .	789
126	Bare areas; freshwater lakes.	406
127	Bare areas; mudflats.	1,693
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) on sandplain.	6,950
709	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ) on stony laterite.	1,144
726	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over Mitchell ( <i>Astrebla</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	16,266
735	Hummock grasslands, sparse medium tree steppe; boab ( <i>Adansonia gregorii</i> ) over open <i>Triodia wiseana</i> on limestone.	104
742	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp.	2,844
743	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) and bauhinia ( <i>Bauhinia cunninghamii</i> ) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	15,798
754	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> )	525
759	Grasslands, tall bunch grass savannah woodland, coolabah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.)	115
774	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) over Mitchell grass ( <i>Astrebla</i> spp.) on black soil	26,840
802	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ) on basalt and dolerite.	204,242
804	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	77,959
805	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ) on limestone plateau.	6,334
807	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia</i> spp. over grass on black soil	689
809	Grasslands, tall bunch grass savannah woodland, longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over <i>Aristida</i> spp., riverine.	12,733
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	51,044
812	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	6,168
814	Hummock grasslands, low steppe woodland; silverleaf box ( <i>Eucalyptus pruinosa</i> ) and <i>Melaleuca</i> spp. over <i>Plectrachne</i> spp.	1,476
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	1,087
Beard Veg Assoc	Description	Area (Ha.)
829	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. arid short grass / Grasslands; high grass savannah, white grass ( <i>Sehima nervosum</i> ).	12,574
834	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrebla</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.)	25,220
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	56,869
837	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over arid short grass on plains.	160,181
838	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over spinifex and tall upland grass.	7,677
839	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over upland tall grass.	9,370
840	Grasslands, tall bunch grass savannah, ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.)	2,807
842	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. short grass/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ).	103,036
852	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over arid short grass on plains.	6,834
855	Grasslands, tall bunch grass savannah low tree; mixed low trees over Mitchell ( <i>Astrebla</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil	4,425
856	Grasslands, tall bunch grass savannah low tree; mixed low trees over ribbon/blue grass ( <i>Chrysopogon</i>	3,602

	spp./ <i>Bothriochloa</i> spp.) on black soil.	
858	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> )/grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ) on sandstone.	332,894
864	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	23,478
866	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil.	21,548
867	Grasslands, high grass savannah low woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	116,204
868	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	231,787
869	Grasslands, tall bunch grass savannah low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil	10,349
870	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	11,639
871	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> )/ Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	246,090
877	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	50,687
883	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ).	27,988
884	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.) on sandy plains	45,113
887	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ).	46,244
888	Grasslands, tall bunch grass savannah low woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	169,955
901	Grasslands, high grass savannah woodland; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	1,893
905	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and ghost gum ( <i>Eucalyptus bella</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ), riverine.	3,350
906	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.), Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over white grass ( <i>Sehima nervosum</i> ) and tall upland grass on sandstone.	1,488
914	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over kangaroo grass ( <i>Themeda australis</i> ) and white grass ( <i>Sehima nervosum</i> ).	4,578

#### Poorly represented ecosystems subject to threat:

Savannah communities of which <i>Callitris intratropica</i> is a component.
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Plant assemblages of sand plain seepage areas between/near sandstone ridges.
Herbfields of sandstone pavements.
Perched spring-fed peat-based swamps on hill slopes of the Durack Range area.
Naturally protected valley systems of the Saw and Durack Ranges.
Flora and fauna assemblages of Lake Gladstone.

Note: the lack of study in some areas precludes statements about the level of reservation required.

#### Subregional constraints in order of priority

(see Appendix B, key g)

**Economic Constraints:** Land prices for pastoral leases.

**Competing Land Uses:** Pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

#### Bioregional and subregional priority for reserve consolidation

The Central Kimberley bioregion has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). However this may need to be reviewed in light of the declaration of the King Leopold Ranges Conservation Park. It can also be

argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity). The ranking between the three subregions is the Hart subregion having the highest priority for investigation of possible reservation options and then the Pentecost subregion followed by the Mt Eliza subregion.

#### Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial burning prescribed. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks.

Conservation Estate	Rank <sup>1</sup>	Issues
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Conservation Parks		
King Leopold Range (Part)	ii	Location makes the park accessible. Full extent of threatening processes (fire, weeds, feral animals) need to be documented. Stock impact occurring.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Pentecost subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.

### Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Feral Animal Control:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

### Existing ecosystem recovery plans

There are no recovery plans for Ecosystems at Risk in CK1.

- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes.  
Gouldian Finch Recovery Plan.  
Draft Kimberley Region Management Plan (various strategies).

### Subregion priority for off reserve conservation

The priority for off park conservation in CK1 is (ii) (see Appendix C, rank 6), indicating that there is a large off park effort needed, resource constraints and limited community capacity.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Research is needed on the mechanism and impacts of threatening

processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committees.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management such as making national parks accessible.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be to give priority to the Hart subregion and given

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 551, 556, 626, 634, 635, 636, 637, 648, 692 and 693 in Appendix A.

the relatively small number of stakeholders could be achieved in the short term. The Mt Eliza subregion would be more complex followed by the Pentecost subregion. The rank for all subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production or development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Lacking on the habitat requirements of fauna species.

### Other Priority Data Gaps Include:

Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

# Central Kimberley 2 (CK2 – Hart subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

This is hilly to mountainous country with parallel siliceous ranges of Proterozoic sedimentary rocks with skeletal sandy soils supporting *Triodia* spp. hummock grasses with scattered trees, and with earths on Proterozoic volcanics in valleys supporting ribbon grass (*Chrysopogon* spp.) with scattered trees. Open forests of river gum (*Eucalyptus camaldulensis*) and *Pandanus* spp. occur along drainage lines. The climate is dry hot tropical and sub-humid to semi-arid with summer rainfall.

The subregion has a rugged topography dominated by Hart dolerite exposed along the eastern edge of the Kimberley Craton, where its basement members are folded and exposed. The basement rocks are volcanics, plutonics and sedimentary rocks. This is the driest part of Central Kimberley bioregion with an annual rainfall of 600 mm to 700 mm. The vegetation is primarily savannah woodland over *Triodia* spp. and/or bunch grasses. In this subregion are found the headwaters of the Ord, Dunham and Fitzroy Rivers. The subregional area is 2, 456, 607 ha.

Broad scale vegetation mapping of the area describes the following components;

- *Astrelba pectinata* (barley Mitchell grass) closed-tussock grassland +/- low trees.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia bitextura* hummock grasses or sometimes a *Triodia intermedia* (lobed spinifex) hummock grassland.
- *Eucalyptus tectifica* (Darwin Box) +/- *Corymbia grandifolia* (large-leaf cabbage gum) +/- *Corymbia byrnesii* woodland with *Sorghum* spp. (sorghum) and *Sehima nervosum* (whitegrass) tall grasses.
- *Corymbia opaca* low open-woodland with *Sehima nervosum* (whitegrass) and *Chrysopogon fallax* (golden beard grass) tussock grasses +/- *Triodia* spp. (spinifex).
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia bitextura* hummock grasses and/or tussock grasses.
- *Triodia wiseana* (limestone spinifex) and *Triodia intermedia* (lobed spinifex) hummock grassland sparsely wooded with *Eucalyptus brevifolia* (snappy gum) low trees.
- *Eucalyptus tectifica* (Darwin box) +/- *Eucalyptus* spp. woodland with *Chrysopogon* spp. (ribbon grass), *Sorghum* spp. (sorghum) and *Triodia bitextura* grassy understorey.
- *Cochlospermum fraseri* (kapok bush), *Erythrophleum chlorostachys* (ironwood) and *Terminalia aridicola?* (arid peach) +/- *Acacia* spp. +/- *Eucalyptus* spp.

deciduous low open-woodland with sparse-tussock grasses.

- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia bitextura* hummock grasses +/- *Enneapogon* spp. (nineawn grass) short-tussock grasses or sometimes a grassland without trees.

### Dominant land use

(see Appendix B, key b)

- (ix) Grazing – Native pastures
- (xi) UCL and Crown reserves

### Continental Stress Class

The Continental Stress Class for CK2 is 5.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- The subregion is fox and rabbit free and essentially uninhabited.
- Two of the Kimberley region's major rivers originate in this subregion.
- Extensive areas of dolerite outcropping is a particular feature.

#### Centres of Endemism:

There are a small number rainforest patches in the northern section of the subregion, however most species are on the edge of their tolerance limits. Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

The nature of this aspect is poorly known. Small 'Dry' rainforest patches provide dry season refuges along with riparian zones. Further research is required to define the extent to which this aspect may apply to sandstone country because of its ability to provide fire protection.

#### High Species and Ecosystem Diversity:

Sandstone communities may provide areas of high species and ecosystem diversity. Small rainforest patches are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Example fruit pigeons and flying foxes.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. Previous rainforest studies are applicable (McKenzie *et al* 1991).

There has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of

changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no wetlands of National Significance in CK2.

### Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of Subregional Significance in CK2.

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in CK2.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	ii	ii	iii	vii
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	Unknown	iv, vii
Herbfields of sandstone pavements	V	38	Unknown	vi	Unknown	iv, vii
Assemblages of spring-fed wetlands on organic substrates perched on sandstone hill-slopes in the Central Kimberley bioregion.	V	43	i-ii	ii-iii	ii	iv, vii
<i>Eucalyptus brevifolia</i> (snappy gum) woodlands to the west of Halls Creek.	V	9	Unknown	iii	i	iv, vii
Naturally protected valley systems of the Saw and Durack Ranges.	V	9	iii	iv	i	iv, vii, x
Rainforest patches of the Kimberley region	V	2	Variable	iii	iii	iv, vii, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Rhinonicteris aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<i>Tadorna radjah</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Acacia gloeotricha</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Boronia jucunda</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Cullen candidum</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Echinochloa kimberleyensis</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Goodenia durackiana</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Triumfetta saccata</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Olax spartea</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Central Kimberley vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
12	Medium woodland-tropical; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ).	1,675
39	Shrublands; mulga scrub.	47
43	Low forest; mangroves.	141
53	Mosaic; Grasslands/pindan; Medium woodland with mixed tree scrub over? tall upland grass and <i>Plectrachne</i> spp.	20,665

Beard Veg Assoc	Description	Area (Ha.)
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	89,854
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	37,682
75	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> ).	1,793,559
77	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ).	424,117
116	Hummock grasslands, sparse low tree steppe; mixed low trees over <i>Triodia wiseana</i> .	789
126	Bare areas; freshwater lakes.	406
127	Bare areas; mudflats.	1,693
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) on sandplain.	6,950
709	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ) on stony laterite.	1,144
726	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over Mitchell ( <i>Astrebla</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	16,266
735	Hummock grasslands, sparse medium tree steppe; boab ( <i>Adansonia gregorii</i> ) over open <i>Triodia wiseana</i> on limestone.	104
742	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp.	2,844
743	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) and bauhinia ( <i>Bauhinia cunninghamii</i> ) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	15,798
754	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> )	525
759	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	115
774	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) over Mitchell grass ( <i>Astrebla</i> spp.) on black soil	26,840
802	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ) on basalt and dolerite.	204,242
804	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	77,959
805	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ) on limestone plateau.	6,334
807	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia</i> spp. over grass on black soil	689
809	Grasslands, tall bunch grass savannah woodland, longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over <i>Aristida</i> spp., riverine.	12,733
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	51,044
812	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	6,168
814	Hummock grasslands, low steppe woodland; silverleaf box ( <i>Eucalyptus pruinosa</i> ) and <i>Melaleuca</i> spp. over <i>Plectrachne</i> spp.	1,476
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	1,087
829	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. arid short grass/Grasslands; high grass savannah, white grass ( <i>Sehima nervosum</i> ).	12,574
834	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrebla</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.).	25,220
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	56,869
837	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over arid short grass on plains.	160,181
838	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over spinifex and tall upland grass.	7,677
839	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over upland tall grass.	9,370
840	Grasslands, tall bunch grass savannah, ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	2,807

Beard Veg Assoc	Description	Area (Ha.)
842	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. short grass/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ).	103,036
852	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over arid short grass on plains.	6,834
855	Grasslands, tall bunch grass savannah low tree; mixed low trees over Mitchell ( <i>Astrebla</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil	4,425
856	Grasslands, tall bunch grass savannah low tree; mixed low trees over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	3,602
858	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> )/grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ) on sandstone.	332,894
864	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	23,478
866	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil.	21,548
867	Grasslands, high grass savannah low woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	116,204
868	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	231,787
869	Grasslands, tall bunch grass savannah low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil	10,349
870	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	11,639
871	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> )/ Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	246,090
877	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	50,687
883	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ).	27,988
884	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.) on sandy plains	45,113
887	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ).	46,244
888	Grasslands, tall bunch grass savannah low woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	169,955
901	Grasslands, high grass savannah woodland; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	1,893
905	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and ghost gum ( <i>Eucalyptus bella</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ), riverine.	3,350
906	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.), Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over white grass ( <i>Sehima nervosum</i> ) and tall upland grass on sandstone.	1,488
914	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over kangaroo grass ( <i>Themeda australis</i> ) and white grass ( <i>Sehima nervosum</i> ).	4,578

#### Poorly represented ecosystems subject to threat:

Savannah communities of which <i>Callitris intratropica</i> is a component.
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Plant assemblages of sand plain seepage areas between/near sandstone ridges.
Herbfields of sandstone pavements.
Perched spring-fed peat-based swamps on hill slopes of the Durack Range area.
Naturally protected valley systems of the Saw and Durack Ranges.
Flora and fauna assemblages of Lake Gladstone.

Note: the lack of study in some areas precludes statements about the level of reservation required.

#### Subregional constraints in order of priority

(see Appendix B, key g)

**Economic Constraints:** Land prices for pastoral leases.

**Competing Land Uses:** Pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

#### Bioregional and subregional priority for reserve consolidation

The Central Kimberley bioregion has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). However this may need to be reviewed in light of the declaration of the King Leopold Ranges Conservation Park. It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being

grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity). The ranking between the three subregions is the Hart subregion having the highest priority for investigation of possible reservation options and then the Pentecost subregion followed by the Mt Eliza subregion.

### Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial burning prescribed. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks.

There are no reserves within the Hart subregion.

### Off reserve conservation

#### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes.  
Gouldian Finch Recovery Plan.  
Draft Kimberley Region Management Plan (various strategies).

### Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Environmental Management Systems:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

## Existing ecosystem recovery plans

There are no recovery plans relevant to CK2.

## Subregion priority for off reserve conservation

Subregional priority for off park is (ii) (see Appendix C, rank 6), indicating that a large off park effort is needed, but resource constraints and limited community capacity exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Environmental Management Systems:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committees.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management such as making national parks accessible.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be to give priority to the Hart subregion and given the relatively small number of stakeholders could be achieved in the short term. The Mt Eliza subregion would be more complex followed by the Pentecost subregion. The rank for all subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production or development system.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Lacking on the habitat requirements of fauna species.

**Other:** Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

## Sources

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 551, 556, 626, 634, 635, 636, 648, 692 and 693 in Appendix A.

# Central Kimberley 3 (CK3 – Mount Eliza subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The bioregion is hilly to mountainous country with parallel siliceous ranges of Proterozoic sedimentary rocks with skeletal sandy soils supporting *Triodia* spp. hummock grasses with scattered trees, and with earths on Proterozoic volcanics in valleys supporting ribbon grass (*Chrysopogon* spp.) with scattered trees. Open forests of river red gum (*Eucalyptus camaldulensis*) and *Pandanus* spp. occur along drainage lines. The climate is dry hot tropical and sub-humid to semi-arid with summer rainfall.

The Mount Eliza subregion is the Southwestern periphery of the Kimberley Craton. It is very rugged with intense folding and exposure of basement strata. The geology includes shales, granites, sandstones, dolerites and volcanics. The vegetation is primarily savannah woodland and there are scattered vine thickets towards western end. Annual rainfall is approximately 800 mm. Subregional area is 1, 003, 969 ha.

Broad-scale vegetation mapping of the area describes the following components:

- *Bauhinia cunninghamii* (bauhinia) and/or deciduous species grassy low open-woodland.
- *Astrelba lappacea* (curly Mitchell grass) and/or *Astrelba pectinata* (barley Mitchell grass) tussock grassland sparsely wooded with *Acacia* spp. low trees.
- *Eucalyptus tectifica* (Darwin Box), *Eucalyptus flavescens* (wrinkle-leaved ghost gum) woodland with *Chrysopogon* spp. (ribbon grass) tussock grasses.
- *Eucalyptus brevifolia* (snappy gum), *Eucalyptus cadophora* subsp. *cadophora* (twin-leaved bloodwood low open-woodland with a *Triodia bitextura* ((curly spinifex) hummock grass ground layer.
- *Cochlospermum fraseri* (kapok), *Erythrophleum chlorostachys* (ironwood) and *Terminalia aridicola* (arid peach) +/- *Acacia* spp. +/- *Eucalyptus* spp. deciduous low open-woodland with sparse-tussock grasses.

### Dominant land use

(see Appendix B, key b)

- (ix) Grazing – Native pastures
- (xiii) Conservation
- (xi) UCL and Crown reserves

### Continental Stress Class

The Continental Stress Class for CK3 is 6, however further assessment of the condition of the subregion may warrant it becoming class 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- The subregion is fox and rabbit free and essentially uninhabited.
- The exposed folding of the rock strata within the King Leopold Ranges is of particular note.

#### Centres of Endemism:

- The Declared Rare Flora *Eucalyptus mooreana* is found within this subregion.
- Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

The nature of this aspect is poorly known. 'Dry' rainforest patches provide dry season refuges along with riparian zones. Further research is required to define the extent to which this aspect may apply to sandstone country because of its ability to provide fire protection.

#### High Species and Ecosystem Diversity:

Sandstone community, Laterite rainforests. Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. Previous rainforest studies are applicable (McKenzie *et al* 1991).

There has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer),

composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment,

vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance in CK3.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Windjana Gorge	17° 24' S, 124° 57' E	B2	ii.	iv	iv	ii	iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in CK3.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Rainforest patches of the Kimberley region	V	2	Variable	iii	iii	iv, vii, x
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	ii	ii	iii	vii
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	Unknown	iv, vii
Herbfields of sandstone pavements.	V	38	Unknown	vi	Unknown	iv, vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Petrophassa smithii blaaui</i>	V	Unknown	vi	Unknown	vii
<i>Erythrorchis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Rhinonicteris aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Dasyurus hallucatus</i>	Near threatened	Unknown	iii	ii	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Wyulda squamicaudata</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Phaps histrionica</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Eucalyptus mooreana</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 1</b>					
<i>Erpodium australiense</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Fimbristylis pilifera</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Minuria macrorhiza</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Central Kimberley ecosystems are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
12	Medium woodland-tropical; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ).	1,675
39	Shrublands; mulga scrub.	47
43	Low forest; mangroves.	141
53	Mosaic: Grasslands/pindan; Medium woodland with mixed tree scrub over? tall upland grass and <i>Plectrachne</i> spp.	20,665
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	89,854
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	37,682
75	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> ).	1,793,559
77	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ).	424,117
116	Hummock grasslands, sparse low tree steppe; mixed low trees over <i>Triodia wiseana</i> .	789
126	Bare areas; freshwater lakes.	406
127	Bare areas; mudflats.	1,693
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) on sandplain.	6,950
709	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ) on stony laterite.	1,144
726	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over Mitchell ( <i>Astrelba</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	16,266
735	Hummock grasslands, sparse medium tree steppe; boab ( <i>Adansonia gregorii</i> ) over open <i>Triodia wiseana</i> on limestone.	104
742	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp.	2,844
743	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) and bauhinia ( <i>Bauhinia cunninghamii</i> ) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	15,798
754	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> )	525
759	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	115
774	Grasslands, tall bunch grass savannah sparse low tree; corkybark wattle ( <i>Acacia suberosa</i> ) over Mitchell grass ( <i>Astrelba</i> spp.) on black soil	26,840
802	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ) on basalt and dolerite.	204,242
804	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	77,959
805	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ) on limestone plateau.	6,334
807	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia</i> spp. over grass on black soil	689
809	Grasslands, tall bunch grass savannah woodland, longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over <i>Aristida</i> spp., riverine.	12,733
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	51,044
812	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	6,168
814	Hummock grasslands, low steppe woodland; silverleaf box ( <i>Eucalyptus pruinosa</i> ) and <i>Melaleuca</i> spp. over <i>Plectrachne</i> spp.	1,476
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	1,087
Beard Veg Assoc	Description	Area (Ha.)
829	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. arid short grass/Grasslands; high grass savannah, white grass ( <i>Sehima nervosum</i> ).	12,574
834	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrelba</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.).	25,220
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	56,869
837	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over arid short grass on plains.	160,181
838	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over spinifex and tall upland grass.	7,677
839	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over upland tall grass.	9,370
840	Grasslands, tall bunch grass savannah, ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	2,807
842	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood	103,036

	( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. short grass/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ).	
852	Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over arid short grass on plains.	6,834
855	Grasslands, tall bunch grass savannah low tree; mixed low trees over Mitchell ( <i>Astrelba</i> spp.) and ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil	4,425
856	Grasslands, tall bunch grass savannah low tree; mixed low trees over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	3,602
858	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over curly spinifex ( <i>Triodia bitextura</i> )/grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah woodland; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ) on sandstone.	332,894
864	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	23,478
866	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil.	21,548
867	Grasslands, high grass savannah low woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	116,204
868	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	231,787
869	Grasslands, tall bunch grass savannah low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil	10,349
870	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)	11,639
871	Mosaic: Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> )/Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	246,090
877	Grasslands, tall bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	50,687
883	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus</i> spp.) over curly spinifex ( <i>Triodia bitextura</i> ).	27,988
884	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and longfruit bloodwood ( <i>Eucalyptus polycarpa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.) on sandy plains	45,113
887	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ).	46,244
888	Grasslands, tall bunch grass savannah low woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	169,955
901	Grasslands, high grass savannah woodland; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	1,893
905	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and ghost gum ( <i>Eucalyptus bella</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ), riverine.	3,350
906	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus</i> spp.), Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over white grass ( <i>Sehima nervosum</i> ) and tall upland grass on sandstone.	1,488
914	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over kangaroo grass ( <i>Themeda australis</i> ) and white grass ( <i>Sehima nervosum</i> ).	4,578

#### Poorly represented ecosystems subject to threat:

Savannah communities of which <i>Callitris intratropica</i> is a component.
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Plant assemblages of sand plain seepage areas between/near sandstone ridges.
Herbfields of sandstone pavements.
Perched spring-fed peat-based swamps on hill slopes of the Durack Range area.
Naturally protected valley systems of the Saw and Durack Ranges.
Flora and fauna assemblages of Lake Gladstone.

Note: the lack of study in some areas precludes statements about the level of reservation required.

#### Subregional constraints in order of priority

(see Appendix B, key g)

**Economic Constraints:** Land prices for pastoral leases.

**Competing Land Uses:** Pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

Bioregional and subregional priority for reserve consolidation

The Central Kimberley bioregion has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). However this may need to be reviewed in light of the declaration of the King Leopold Ranges Conservation Park. It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity). The ranking between the three subregions is the Hart subregion having the highest priority for investigation of possible reservation options and then the Pentecost subregion followed by the Mt Eliza subregion.

Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial

prescribed. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks.

Conservation Estate	Rank <sup>1</sup>	Issues
Conservation Parks		
King Leopold Range (Part)	ii	Location makes the park accessible. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Mount Eliza subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing recovery plans

**Other Planning Opportunities:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Environmental Management Systems:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Appropriate species recovery actions

The Action Plan for Australian Bats.

The Action Plan for Australian Birds 2000.

Action Plan for Australian Marsupials and Monotremes.

Gouldian Finch Recovery Plan.

Draft Kimberley Region Management Plan (various strategies).

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

### Existing ecosystem recovery plans

There are no existing recovery plans relevant to Ecosystems at Risk in CK3.

### Subregion priority for off reserve conservation

The priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that a large off park effort needed, and resource constraints and limited community capacity exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible Opportunities for NRM

**Environmental Management Systems:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committee.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an

acknowledgement of the worth of the natural environment e.g. tourism including the cost of management such as making national parks accessible.

**Integration with Property Management Planning, Catchment Planning and Landcare:**

Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be to give priority to the Hart subregion and given the relatively small number of stakeholders could be achieved in the short term. The Mt Eliza subregion would be more complex followed by the Pentecost subregion. The rank for all subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the

subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

**Other Priority Data Gaps:**

Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such as exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 551, 556, 626, 634, 635, 636, 637, 648, 692 and 693 in Appendix A.

# Central Ranges 1 (CR1 – Mann-Musgrave Block subregion)

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Information from Western Australia and the Northern Territory has been listed separately in this synopsis as a result of different vegetation mapping protocols that have been used in the two jurisdictions and the associated difficulties in combining that information.

## Subregional description and biodiversity values

### Description and area

#### Western Australia:

High proportion of Proterozoic ranges including both volcanic and quartzites and derived soil plains, interspersed with red Quaternary sandplains with some permian exposure. Described as the 'Giles Botanical District', the sandplains support low open woodlands of either Desert Oak or Mulga over *Triodia basedowii* hummock grasslands. Low open woodlands of Ironwood (*Acacia estrophiolata*) and Corkwoods (*Hakea* spp.) over tussock and hummock grasses often fringe ranges. The ranges support mixed wattle scrub or *Callitris glaucophylla* woodlands over hummock and tussock grasslands. The climate is Arid, with a mean rainfall of 200mm comprising summer and winter rain.

#### Northern Territory:

The Mann-Musgrave Block subregion lies in the south west corner of the Northern Territory. The Mann and Musgrave Ranges occur just south of the border in South Australia. Elevation in the subregion is generally above 500m, ranging up to 1000m along the South Australian border. The area lies over the Musgrave Block and small areas of the Amadeus Basin. Soils in the subregion are mainly shallow sands and massive earths. The climate is arid with annual rainfall below 300mm. Vegetation is hummock grassland (*Triodia* spp.) and sparse Acacia shrubland. Minor drainage occurs around the Petermann Ranges, including Docker and Hull Rivers.

### Dominant land use

#### Western Australia:

Dominant landuses include Aboriginal Reserve (94.33% of subregion area), Grazing – Freehold (0.03%), Grazing – Leasehold (1.36%), Unallocated Crown Land and Crown Reserves (4.28%).

#### Northern Territory:

No information supplied.

### Continental stress class

The Continental Stress Class for both the West Australian and Northern Territory components of CR1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Western Australia:

##### Rock Pools of the Walter James Range:

Two permanent freshwater pools with each being approximately 9m wide and 4m deep. The area is a permanent breeding site for the frog *Cyclorana maini* and a permanent source of water for birds. Provides a good example of the few permanent rock pools in the Central Ranges Bioregion. The social and cultural values of the pools are significant. They form part of a song line which extends from Broome through to Kings Canyon, NT to Pukura WA. The upper pool is used for drinking while the lower one is also used for swimming by local communities (WA014).

##### Rare and Priority Flora:

Includes: *Acacia auricoma*, *A. calcicola*, *Calotis latiuscula*, *Comesperma viscidulum*, *Dicrastylis gilesii*, *Eucalyptus sparsa*, *Fuirena nudiflora*, *Grevillea* sp. Rawlinson Range, *Isotropis winneckeii*, *Menkea lutea*, *Neurachne lanigera*, *Prostanthera centralis* and *Schoenus centralis*.

##### Rare and Specially Protected Fauna:

Includes birds such as Peregrine Falcon (*Falco peregrinus*), Grey Falcon (*Falco hypoleucos*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Princess Parrot (*Polytelis alexandrae*), Scarlet-chested Parrot (*Neophema splendida*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Malleefowl (*Leipoa ocellata*), and Night Parrot (*Pezoporus occidentalis*). Mammals include Bilby (*Macrotis lagotis*), Southern Marsupial Mole (Notoryctes typhlops), Mulgara (*Dasyercus cristicauda*), and Black-footed Rock Wallaby (*Petrogale lateralis* (the Townsend Ridges population of this species has a unique chromosome number)). Reptiles include Great Desert Skink (*Egernia kintorei*) and Woma (*Aspidites ramsayi*).

## Ecosystems That Have More Than 80% of Their Total Extent Confined CR1:

Beard Veg Assoc	Description	% Extent
92	Hummock grasslands, sparse tree steppe; bloodwood over hard spinifex <i>Triodia basedowii</i>	81.8
233	Shrublands; <i>Acacia bivenosa</i>	83.8
234	Shrublands; <i>Acacia ?cyperophylla</i> scrub	100.0

**Refugia:**

- There are no identified true known refugia in CR1, however the Rock Pools of the Walter James Range and Lake Christopher have the potential to provide such refuge during periods of drought, or as breeding locations during seasonal rainfalls.
- Some river and creek systems and gorges may also provide temporary refugia, but may be only seasonal.

**High Species and Ecosystem Diversity:**

The subregion is rich and diverse in both its flora and fauna however most species are wide ranging and usually occur in at least one, and often several, adjoining subregions.

*Northern Territory:*

No information supplied.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

*Western Australia:*

The CR1 subregion is covered by a CALM Regional Management Plan, that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. Issues in relation to joint management of IPAs (Indigenous Protected Areas) are flagged in this document, but not addressed in detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually (Department of Conservation and Land Management 1994b).

*Northern Territory:*

No planning process in place.

## Wetlands

## Wetlands of National significance (DIWA listings)

*Western Australia:*

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Rock Pools of the Walter James Range WA 014	B17	iii	iii-iv	iii	v (feral animals attracted to water source), x (changed hydrology due to grazing pressure around rockholes and 'upstream' by feral animals), vi (exotic weeds introduced by animals accessing water), xi (pollution by faeces and dead animals in waterholes)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

*Northern Territory:*

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Amadeus	Not stated	iii	vi	Not stated	v (camels)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

*Western Australia:*

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Christopher	127.32 E, 24.45 S	B6	i, iii, cultural values	iv	iv	ii	vii (altered fire regimes in fringing flora), v (feral animal grazing pressure including camels, goats, rabbits)
Rawlinson Range Springs (Yirrirra)	127.54 E, 24.49 S	B17	i, iii, cultural values	iv	iv	ii	v (feral animals attracted to water source), x (changed hydrology due to grazing pressure around springs and 'upstream' by feral animals), vi (exotic weeds introduced by animals accessing water), xi (pollution by faeces and eutrophication of dead animals).
Rebecca and Giles Creek systems	128.40-55 E, 24.47-25.10 S	B2	i, iii, cultural values	iv	iv	ii-iii	v (feral animals attracted to water source), x (changed hydrology due to grazing pressure around springs and 'upstream' by feral animals), vi (exotic weeds introduced by animals accessing water), vii (altered fire regimes around fringing vegetation), xi (pollution by faeces and eutrophication of dead animals)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

*Northern Territory:*

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Armstrong Creek	Not stated	B2	Not stated	iii	vi	Not stated	Not stated
Britten Jones Creek	Not stated	B2	ii	iii	vi	Not stated	xii
Hull River	Not stated	B2	Not stated	iii	vi	Not stated	Not stated

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

*Western Australia:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral creek lines	iii - iv	iv	i - ii	vi (grazing pressure from camels, goats and rabbits), vii, v (camels, goats, rabbits cats and foxes)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

*Northern Territory:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral creek lines	iii	iii	Unknown	vii, vi, v

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

*Western Australia:*

There are no Threatened Ecological Communities (TECs) in CR1.

*Northern Territory:*

No information supplied.

## Other ecosystems at risk

*Western Australia:*

No ecosystems at risk have been identified in CR1, although, in general, altered fire regimes and the potential for intense wildfires pose the greatest risk to ecosystems of this region. Introduced grazers and predators pose the next greatest risk to flora and fauna. Introduction of weeds along roadsides and water courses also threaten pristine ecosystems of the region.

*Northern Territory:*

No information supplied.

## Species at risk

## Fauna

*Western Australia:*

Species	WA Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	Unknown	vi	ii	v (foxes, cats)
<i>Notoryctes typhlops</i>	E	Unknown	vi	i-ii	v (foxes, cats)
<i>Dasyercus cristicauda</i>	V	Unknown	vi	ii	v (foxes, cats)
<i>Petrogale lateralis</i> MacDonnell Ranges race	V	Unknown	vi	iii	v (foxes and dingoes), ii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	V	Unknown	vi		vii
<i>Acanthiza iredalei</i> <i>iredalei</i>		Unknown	vi	ii	vii
<i>Leipoa ocellata</i>	V	Unknown	vi	ii	v (foxes, cats), vii
<i>Pezoporus occidentalis</i>	CR	Unknown	vi	ii	v (foxes, cats), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	Unknown	vi	iii	v (foxes, cats), vii
<b>Schedule 4; Other specially protected fauna. Division 2 (Birds)</b>					
<i>Falco peregrinus</i>	SP	Unknown	vi	ii	ii
<i>Cacatua leadbeateri</i>	SP	Unknown	vi	ii	ii, vij
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Falco hypoleucos</i>	P4	Unknown	vi	ii	ii
<i>Neophema splendida</i>	P4	Unknown	vi	ii	ii
<i>Aspidites ramsayi</i>	P1	Unknown	vi	ii	v (foxes, cats), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Northern Territory:

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Trichosurus vulpecula</i>	E	ii	ii	vi	vii (habitat change through increased incidence of hot extensive fires), vi (change through broad-scale weed invasion), iv (camels, donkeys, cattle), v (foxes, cats).

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

## Western Australia:

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Dicrasyllis gilesii</i>	1	Unknown	vi	ii	vii
<i>Fuirena nudiflora</i>	1	Unknown	vi	ii	vii
<i>Grevillea</i> sp. Rawlinson Range		Unknown	vi	ii	vii
<i>Isotropis winneckeii</i>	1	Unknown	vi	ii	vii
<i>Menkea lutea</i>	1	Unknown	vi	ii	iv, vii
<i>Neurachne lanigera</i>	1	Unknown	vi	ii	vii
<i>Prostanthera centralis</i>	1	Unknown	vi	ii	iv, vii
<i>Schoenus centralis</i>	1	Unknown	vi	ii	vii
<b>PRIORITY 2</b>					
<i>Comesperma viscidulum</i>	2	Unknown	vi	ii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Northern Territory:

No information supplied.

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

## Western Australia:

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges				H
125	Bare areas; salt lakes				H
676	Succulent steppe; samphire				H
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				H
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>				H
18	Low woodland; mulga ( <i>Acacia aneura</i> )				H
45	Shrublands; mallee scrub (Great Victoria Desert)				H
39	Shrublands; mulga scrub				H
2175	Grass savannah on clay plains (Tanami)				H
19	Low woodland; mulga between sandridges				H
252	Hummock grasslands, shrub steppe; mulga and mallee over soft spinifex				H
219	Hummock grasslands, grass steppe; soft & hard spinifex & <i>T. basedowii</i>				H

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				H
230	Mosaic: Medium sparse woodland; desert oak between sand dunes/Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				H
92	Hummock grasslands, sparse tree steppe; bloodwood over hard spinifex <i>Triodia basedowii</i>				H
233	Shrublands; <i>Acacia bivenosa</i>				H
234	Shrublands; <i>Acacia ?cyperophylla</i> scrub				H

*Northern Territory:*

Veg Number	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
65	<i>A. aneura</i> (Mulga) tall open-shrubland with <i>Eragrostis eriopoda</i> (Woollybutt) open-grassland understorey.	0	0	0	
73	<i>A. tetragonophylla</i> (Dead Finish), <i>A. kempeana</i> (Witchetty Bush) sparse-shrubland with herb/grassland understorey.	0	0	0	
78	<i>Triodia spicata</i> (Spike Flowered Spinifex) hummock grassland with <i>Grevillea wickhamii</i> (Holly Grevillea), <i>Acacia</i> sparse-shrubland overstorey.	0	0	0	
79	<i>Plectrachne melvillei</i> (Spinifex) hummock grassland with <i>A. aneura</i> (Mulga), <i>A. kempeana</i> (Witchetty Bush) tall open-shrubland overstorey.	0	0	0	
82	<i>Triodia basedowii</i> hummock grassland with <i>A. aneura</i> (Mulga) tall sparse-shrubland overstorey between dunes.	0	0	0	
84	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>E. gamophylla</i> (Blue Mallee) tall sparse-shrubland overstorey.	0	0	0	
86	<i>Triodia pungens</i> (Soft Spinifex) or <i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>Acacia</i> tall sparse-shrubland overstorey between dunes	0	0	0	
90	<i>Triodia irritans</i> (Porcupine Grass) open-hummock grassland.	0	0	0	
92	<i>Triodia clelandii</i> (Weeping Spinifex) hummock grassland with mixed species low open-woodland overstorey.	0	0	0	
93	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>Allocasuarina decaisneana</i> (Desert Oak) open-woodland overstorey between dunes.	0	0	0	
94	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>Allocasuarina decaisneana</i> (Desert Oak) low open-woodland or <i>Acacia</i> tall sparse-shrubland overstorey.	0	0	0	

Subregional constraints in order of priority  
(see Appendix B, key g)

*Western Australia:*

**Competing Landuses:** This subregion is almost entirely Aboriginal Reserve with no IUCN conservation reserve. Any establishment of conservation reserve will require negotiation with traditional owners. Other competing land uses are not currently a major issue although there are some significant prospective mineral deposits within the Central Ranges with associated Mining company interests that will need to be addressed in the near future. The region has numerous cultural sites, many of extreme importance, consultation with traditional owners in relation to land management in this region is paramount. Joint management strategies for lands (as outlined in the CALM Regional Management Plan) address issues in relation to cultural protection and/or development.

**Other:** There is considerable difficulty in identifying biodiversity values as there has been little work done in the area and most data is of a resolution that is too coarse.

*Northern Territory:*

No information supplied.

Bioregional and subregional priority for reserve consolidation

*Western Australia:*

CR1 is reservation Class 1 (see Appendix D, and Appendix C, rank 4). There are no reserves within the subregion at all, indicating a highly inadequate representation in terms of CAR criteria at not only the subregional level but also at the bioregional level.

*Northern Territory:*

There are no reserves in CR1.

Reserve management standard

*Western Australia:*

In CR1, no feral predator programs are in place other than for the protection of the Townsend Ridges Rock Wallaby population. Wildfire management facilities are limited by resources. Mining activities (exploration) are supervised, but feral herbivore grazing activities still pose a conservation risk in some areas. Reserve management standard is not applicable as there are no reserves, however the management rank for all tenures across the bioregion is (ii) (see Appendix C, rank 5). This indicates that biodiversity values and management issues are poorly identified and resource degradation is occurring (due to the lack of feral predator control), though the situation is retrievable.

There are no reserves in CR1.

*Northern Territory:*

## Off reserve conservation

### Priority species or groups and existing recovery plans

*Western Australia:*

Species	Specific Recovery Plan	General Recovery Plan
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds
<i>Falco hypoleucos</i>	No	Action Plan for Australian Birds
<i>Cacatua leadbeateri</i>	No	Action Plan for Australian Birds
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Neophema splendida</i>	No	Action Plan for Australian Birds
<i>Acanthiza iredalei iredalei</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Pezoporus occidentalis</i>	Yes - IRP	Action Plan for Australian Birds
<i>Macrotis lagotis</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes typhlops</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Dasymercus cristicauda</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Petrogale lateralis</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Egernia kintorei</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	No	Action Plan for Australian Reptiles

*Northern Territory:*

No information supplied.

### Appropriate species recovery actions

*Western Australia:*

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral animal control to restore habitat and CWR native fauna. Fire management.
<i>Falco hypoleucos</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral animal control to restore habitat and CWR native fauna. Fire management.
<i>Cacatua leadbeateri</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Fire management.
<i>Polytelis alexandrae</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Fire management.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Neophema splendida</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Fire management.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Fire management.
<i>Leipoa ocellata</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Fire management.
<i>Pezoporus occidentalis</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Fire management.
<i>Macrotis lagotis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Translocation from secure populations. Fire management.
<i>Notoryctes typhlops</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Fire management.
<i>Dasyercus cristicauda</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Fire management.
<i>Petrogale lateralis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Translocation from secure populations. Fire management.
<i>Egernia kintorei</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Feral predator control. Fire management.
<i>Aspidites ramsayi</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, Feral predator control. Fire management.

<sup>1</sup>Appendix B, key h.

*Northern Territory:*

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Trichosurus vulpecula</i>	v, vii, ix	Fencing is possibly useful in some areas to exclude stock, in order to protect habitat. Feral animal control include control of foxes, cats, camels and donkeys. Fire management including reduction in incidence of extensive hot fires.

<sup>1</sup>Appendix B, key h.

## Ecosystems

*Western Australia:*

There are no ecosystems at risk listed for CR1.

*Northern Territory:*

No information supplied.

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that significant off park effort is needed, resource constraints, and limited community capacity exist.

*Northern Territory:*

No information supplied.

## Conservation actions as an integral part of NRM

### Existing NRM actions

*Western Australia:*

**Industry Codes of Practice**

*Northern Territory:*

**Threat Abatement Planning:** Some regional fire management, monitoring and control through regional offices of Bushfires Council.

## Existing ecosystem recovery plans

*Western Australia:*

There are no ecosystems at risk listed for CR1.

*Northern Territory:*

No information supplied.

## Appropriate recovery actions

*Western Australia:*

There are no ecosystems at risk listed for CR1.

*Northern Territory:*

No information supplied.

## Subregion priority for off reserve conservation

*Western Australia:*

## Feasible opportunities for NRM

### *Western Australia:*

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation and threatened species management plans, pest management, and fire management plans.

**Capacity Building Required with Community, Landholders, Industry and Institutions:** Particularly developing relationships with Aboriginal communities.

### *Northern Territory:*

**Capacity Building Required with Community, Landholders, Industry and Institutions:** There is a need to expand resources to, and capability of, Aboriginal landowners for conservation management.

**Threat Abatement Planning:** There is scope for greater capacity for broad-scale management of fire, ferals, and weeds.

## Impediments or constraints to opportunities

### *Western Australia:*

Developing association with Aboriginal communities is essential. Conservation Through Reserves could be limited through mining leases and tenements, although this is not currently a major factor. There is a need to increase awareness of conservation values through education of various industry (mining) and the public in general. Limited financial resources are also a major constraint.

### *Northern Territory:*

No information supplied.

Subregions where specific NRM actions are a priority to pursue

The NRM priority for CR1 (ii) (see Appendix C, rank 7), indicating that there are significant constraints to implement NRM, primarily due to the subregions

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Ergernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
778	Blyth, J.	(1996).	Night parrot ( <i>Pezoporus occidentalis</i> ) Interim Recovery Plan for Western Australia 1996 to 1998 (IRP No 4)	Department of Conservation and Land Management, Perth.	O
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission	R

isolation and resource requirements to implement NRM in both Western Australia and the Northern Territory.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

### *Western Australia:*

**Vegetation and Regional Ecosystem Mapping:** There has been no systematic regional survey on flora or fauna.

**Systematic Fauna Survey:** Fauna survey data is confined to vertebrates and is sparse, and mostly site specific.

**Floristic Data:** There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species.

**Ecological and Life History Data:** No quantitative data present on the affect of exotic predators/herbivores, weed invasion, fire, mineral extraction or other threatening processes.

### **Other Priority Data Gaps:**

- Ethnoecological research in relation to flora and fauna is of a high priority for future work.

### *Northern Territory:*

### **Other Priority Data Gaps:**

- Monitoring to assess trends and responses to landscape-wide disturbance

### **Ecological and Life History Data**

**Systematic Fauna Survey:** Survey information required.

**Vegetation and Regional Ecosystem Mapping:** Survey information required.

				of the Northern Territory, Alice Springs	
546	Pearson, D.J.	(1992).	Past and present distribution and abundance of the Black-Footed Rock Wallaby in the Warburton region of Western Australia.	Wildlife Research 19: 605-622.	J

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 053, 061, 075, 081, 086, 104, 105, 115, 116, 119, 131, 268, 321, 420, 486, 497, 517,

545, 548, 607, 627, 628, 638, 685 and 686 in Appendix A.

# Coolgardie 1 (COO1 – Mardabilla subregion)

MAL GRANT, SARAH COMER, SANDRA GILFILLAN, KLAUS TIEDEMANN AND SARAH BARRETT  
JANUARY 2002

## Subregional description and biodiversity values

### Description and area

The Coolgardie Bioregion is comprised of granite strata of the Yilgarn Craton with Archaean Greenstone intrusions in parallel belts. Drainage is occluded. Mallees and shrublands on sandplains are associated with lateritised uplands, playas and granite outcrops. Diverse woodlands are rich in endemic eucalypts, on low greenstone hills, valley alluvials and broad plains of calcareous earths. In the west, the shrublands are rich in endemic Proteaceae, in the east they are rich in endemic acacias. The climate is arid to semi-arid Warm Mediterranean.

The Mardabilla subregion is an Eocene marine limestone plain, on a granite basement in its western parts. Red-brown loams and aeolian sands over sheet and nodular kankar. *Eucalyptus* woodland over broomebush/greybush, bluebush and saltbush. The climate is arid, with 250-300 mm of rainfall during winter and subregional area is 2, 190, 244 ha.

### Dominant land use

Mainly (vii) grazing - improved pasture (see Appendix B, key b) & (iv) cultivation - dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves, (xiv) roads and other easements, (v) forestry plantation.

### Continental Stress Class

The Continental Stress Class for COO1 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- Vertebrates include Malleefowl (*Leipoa ocellata*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*) and the Crested Shrike-tit (*Falcunculus frontatus*).
- Some threatened flora persist in COO1, including *Eremophila denticulata*.

#### Centres of Endemism:

- Areas in northern half of Cape Arid National Park and Dundas Nature Reserve may be described as centres of endemism.
- Caves are likely to be centres of endemism.

#### Refugia:

Caves are likely to be refugia for invertebrates.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Wheatbelt in the CTRC Green Book. Some, but not all of these recommendations (with modification) were implemented over the following ten years. The subregion is covered by the Department of Conservation and Land Management South Coast Regional Management Plan (1992) that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail and there is little information on the biota of COO1 contained within. Therefore, the reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion. The South Coast Macro Corridor Project (Watson and Wilkins 1999) identifies areas in COO1 where improved landscape connectivity will benefit biodiversity conservation.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no wetlands of national significance listed in COO1.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no known wetlands of subregional significance in COO1.

### Riparian zone vegetation

There are no riparian zones in COO1.

## Ecosystems at risk

### Threatened Ecological Communities (TECs)

There are no Threatened Ecological Communities (TECs) in COO1.

### Other ecosystems at risk

Beard Veg Assoc	Ecosystem Description	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
467	Mosaic: Medium woodland; salmon gum & gimlet/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>		18	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
514	Shrublands; mallee scrub, white mallee ( <i>Eucalyptus cooperiana</i> )		27	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
214	Mosaic: Medium woodland; goldfield eucalypts/Succulent steppe with open low woodland; myoporum over saltbush		8	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
4641	Succulent steppe with open woodland; salmon gum & gimlet over bluebush		31, 8	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )		27	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
925	Shrublands; mallee scrub, red mallee		27	Unknown	vi	Unknown	Unknown threatening processes though grazing is likely.
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush,		22	ii	ii	iii	v (rabbits), vii, iv
500	Mosaic: Medium woodland; merrit & red mallee/Shrublands; dodonaea scrub		29	i	iii	iii	vi, iv, vii
1241	Succulent steppe; bluebush		39	ii	iii	iii	v (rabbits), vii, iv
221	Succulent steppe; saltbush		39	ii	iii	iii	v (rabbits), vii, iv

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	V	Unknown	vi	iii	iv, ii
<i>Leipoa ocellata</i>	V	Unknown	vi	ii	v (foxes, cats rabbits)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Eremophila denticulata</i>	V	Unknown	vi	ii	vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN Reserves	Non-IUCN Reserves	Priority
10	Medium woodland; red mallee group			
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush,			
125	Bare areas; salt lakes	X		
214	Mosaic: Medium woodland; goldfield eucalypts/Succulent steppe with open low woodland; myoporum over saltbush			
221	Succulent steppe; saltbush			
467	Mosaic: Medium woodland; salmon gum & gimlet/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>			
482	Medium woodland; merrit & red mallee	X		
487	Medium woodland; redwood & red mallee ( <i>E. oleosa</i> )	X		
500	Mosaic: Medium woodland; merrit & red mallee/Shrublands; dodonaea scrub			
514	Shrublands; mallee scrub, white mallee ( <i>Eucalyptus cooperiana</i> )	X?		
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )	X		
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>			
925	Shrublands; mallee scrub, red mallee	X		
1241	Succulent steppe; bluebush	X		
4641	Succulent steppe with open woodland; salmon gum & gimlet over bluebush			

### Subregional constraints in order of priority

(see Appendix B, key g)

#### Irreplacibility, Economic Constraints and Competing

**Land Uses:** Major components of the landscape are covered by mines, mining tenements or exploration leases and to a lesser extent grazing.

#### Bioregional and subregional priority for reserve consolidation

COO1 is Reservation Class 3 (> 30% of native vegetation cover remaining) (see Appendix D, and Appendix C, rank 4).

### Reserve management standard

Many COO1 reserves are becoming saline. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks that are installed and maintained. Feral herbivore grazing activities are now minimal (e.g. Callicivirus has reduced rabbit populations, and there are few goats in the subregion), and feral predator controls are not carried out. The overall Reserve Management Standard Rank is (i) poor (see Appendix C, rank 5).

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	National Park	Cape Arid National Park	National Park	ii – iii
A	Primitive Area for the Preservation and Study of Flora, Fauna, Geological and Anthropological Features	Nuytsland Nature Reserve	Nature Reserve	i – ii
B	Conservation of Flora & Fauna	Dundas Nature Reserve	Nature Reserve	ii – iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plans	General Recovery Plans	Prioritise for Subregion
<i>Eremophila denticulata</i>	No	Goldfields Regional Management Plan	iii
<i>Acanthiza iredalei iredalei</i>	No (This species is known to associate with chenopod shrubland)	Action Plan for Australian Birds; Goldfields Regional Management Plan	
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Group have current Action Plan and ongoing research	Action Plan for Australian Birds; Goldfields Regional Management Plan	

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eremophila denticulata</i>	iii, ix, xiv	Habitat protection on other state lands. Fire Management. Other – Installation of roadside markers.
<i>Acanthiza iredalei iredalei</i>	xii, xiii	Research to determine the effects of sheep and rabbits; the ability of the subspecies to recolonise isolated habitats; determine past and present distribution. Capacity building to develop management guidelines for preferred habitat; Maintain and or establish habitat corridors between patches of suitable habitat; Conduct public education program among land managers to encourage the adoption of management guidelines.
<i>Leipoa ocellata</i>	vii, v, xi, ix, xii, x, xiii, xiv	Feral animal control (foxes, sheep, goats, rabbits). Fencing of habitat remnants to exclude stock. Support initiatives to reduce further salinisation. Fire management to reduce the incidence of large fires and discourage broadscale burning for agricultural purposes. Research –Population size and distribution, breeding, longevity, and survey techniques. Translocations and captive breeding. Capacity building with community groups, schools and farmers; Maintain and or establish habitat corridors between patches of suitable habitat. Other – Prepare regional conservation plans and manage the recovery process.

<sup>1</sup>Appendix B, key h.

### Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plans	General Recovery Plans
Banded ironstone range plant communities	No	Goldfields Regional Management Plan

### Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Banded ironstone range plant communities	i, ii, iii, xiii	Habitat retention through reserves or on other State lands or by on private lands. Capacity building required with industry.

<sup>1</sup>Appendix B, key h.

## Subregion Priority for Off Reserve Conservation

The subregional priority for off reserve conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required.

## Conservation actions as an integral Part of NRM

### Existing NRM actions

**Incentives:** Tax deductions for fencing on pastoral leases

**Legislation:** Pastoral Act has regulations on stocking rates, Wildlife Conservation Act, Sandalwood Act, Mining Act, Soil Conservation Act, Right to Water and Irrigation Act, Bush Fires Act, Agricultural and Related Resources Protection Act and the Environmental Protection Act.

**Threat Abatement Planning:** Vegetation management plans; pest management; feral animal control; Kangaroo shooting; Dingo baits; Callicivirus control of rabbit populations

**Environmental Management Systems:** Interim Management Guidelines only.

**Capacity Building:** The Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** e.g. South Coast Regional Integrated Planning Team (SCRIPT); Bushfire control program.

### Feasible opportunities for NRM

**Legislation:** Review of Wildlife Conservation Act necessary to strengthen protection of biodiversity in relation to mining, pastoral or other activities.

**Institutional Reform:** Industry reconstruction – pastoral activities in arid woodlands and savannah areas are of marginal value compared to their potential environmental impacts and should be critically reviewed.

**Environmental Management Systems:** Marginal woodlands and transitional areas need greater representation in the conservation estate through the creation of large nature reserves in this sub-division.

**Capacity Building:** Closer liaisons need to be developed with community groups and land holders on issues, e.g. pastoral industry. The Macro Corridor project can be used as a tool to identify strategic landscape level connectivity. Responses to bushfires need to be better coordinated.

**Other Planning Opportunities:** The Department of Conservation and Land Management South Coast Regional Management Plan N° 24 (1992-2002) recommends that two major extensions of Nuytsland nature Reserve be made, between the northern boundary of the reserve and the Eyre Highway. One block is

centered north of Point Culver; the other is north and west of Red Rocks Point and south of Madura (draft proposal DS9). These proposals resulted from the recommendations of the Biological Survey of the Nullarbor Region South and Western Australia in 1984 (McKenzie and Robinson 1987).

## Impediments or constraints to opportunities

The remoteness and absence of infrastructure in much of the subregion will add to costs of implementation an ongoing management of any NRM initiatives however this should not be a deterrent to their implementation. The terms of Native Title agreements (and future settlements) are likely to have profound implications for NRM actions in the future and the legal and administration issues are likely to be complex.

## Subregions where specific NRM actions are a priority to pursue

Significant constraints exist to integrate conservation as part of a production or development system apply in particular to the pastoral industry and protection of flora communities. Effective rabbit control also remains a challenge to natural land managers as numbers have received only a temporary check from Rabbit Callicivirus.

NRM rank is 3 (see Appendix C, rank 7) indicating that instruments are in place with some achieved biodiversity outcomes. A more coordinated approach between the agencies responsible for conservation, pastoral and mining activities on land use proposals to minimise environmental impacts would be highly desirable.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Vegetation map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** Sparse point-based fauna survey focusing on vertebrates and flora of the main landform units has been carried out. Additional points in the landscape, as well as an array of invertebrate taxa, need to be sampled. The sparsity of data applies both on and off nature conservation estate.

**Floristic Data:** Systematic quadrat-based flora survey. Most reserves don't have long-term survey data on species presence or absence; data is confined to specific threatened flora, and a few large reserves. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants (except some DRF), persisting Endangered or Vulnerable birds and uncommon vertebrate and plant species. There is no data to provide a regional context on life history (including

population-trend) of most species.

- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, fire, and potential affects of mining (currently exploration) on undisturbed native vegetation.

**Other Priority Data Gaps Include:**

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
230	Department of Conservation and Land Management	(1992).	South Coast Region Regional Management Plan 1992-2002. Management Plan No. 24.	Department of Conservation and Land Management.	O
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
489	McKenzie, N.L. and Robinson, A.C. (eds)	(1987).	A Biological Survey of the Nullarbor Region South and Western Australia in 1984.	South Australian Department of Environment and Planning, Western Australian Department of Conservation and Land Management and Australian National Parks and Wildlife Service.	B
675	Watson, J and Wilkins, P.J.	(1999).	The Western Australian South Coast Macro Corridor Project - A bioregional Strategy for Nature Conservation.	Parks 9(3): 7-16.	J

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 005, 014, 045, 046, 101, 118, 272, 273, 278, 307, 331, 340, 354, 409, 410, 485, 587 and 696 in Appendix A.

## Coolgardie 2 (COO2 – Southern Cross subregion)

MARK COWAN, GORDON GRAHAM & NORM MCKENZIE  
AUGUST 2001

### Subregional description and biodiversity values

#### Description and area

The subregion has subdued relief, comprising gently undulating uplands dissected by broad valleys with bands of low greenstone hills. It lies on the 'Southern Cross Terrains' of the Yilgarn Craton. The granite strata of Yilgarn Craton are interrupted by parallel intrusions of Archaean Greenstone. Drainage is occluded. It has an arid to semi-arid Warm Mediterranean climate with 250-300 mm of mainly winter rainfall.

Valleys have Quaternary duplex and gradational soils, and include chains of saline playa-lakes. Diverse Eucalyptus woodlands (*Eucalyptus salmonophloia*, *E. salubris*, *E. transcontinentalis*, *E. longicornis*) rich in endemic eucalypts occur around these salt lakes, on the low greenstone hills, valley alluvials and broad plains of calcareous earths. The salt lake surfaces support dwarf shrublands of samphire. The granite basement outcrops at mid-levels in the landscape and supports swards of *Borya constricta*, with stands of *Acacia acuminata* and *Eucalyptus loxophleba*. Upper levels in the landscape are the eroded remnants of a lateritic duricrust yielding yellow sandplains, gravelly sandplains and laterite breakaways. Mallees (*Eucalyptus leptopoda*, *E. platycoryx* and *E. scyphocalyx*) and scrub-heaths (*Allocasuarina corniculata*, *Callitris preissii*, *Melaleuca uncinata* and *Acacia beauverdiana*) occur on these uplands, as well as

on sand lunettes associated with playas along the broad valley floors, and sand sheets around the granite outcrops. The scrubs are rich in endemic acacias and Myrtaceae. The subregional area is 7, 041, 232 ha.

#### Dominant land use

The dominant land uses are (ix) Grazing – native pastures (17%) (see Appendix B, key b), (xi) UCL & Crown Reserves (66.74%), Cultivation -Dry Land agriculture (2.27%), Conservation reserves (11.53%).

#### Continental Stress Class

The Continental Stress Class for COO2 is 4.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- Arid woodlands include rare plants such as *Tetradlea harperi*, *T. aphylla*, *T. paynteri*, *Gastrolobium graniticum*, *Eremophila virens*, *Myriophyllum lapidicola*, etc;
- Rare vertebrates such as the Chuditch (*Dasyurus geoffroyi*), Slender-Billed Thornbill (*Acanthiza iredalei*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Malleefowl (*Leipoa ocellata*), Carpet Python (*Morelia spilota imbricata*), Major Mitchell's Cockatoo (*Cacatua leadbeateri*), and Red-tailed Black Cockatoo (*Calyptorhynchus banksii*).

#### The Following Ecosystems Have Greater Than 85% of Their Total Extent Within The Coolgardie 2 Subregion:

Beard Veg Code	Description
144	Medium woodland; wandoo, salmon gum, morrel, gimlet & rough fruited mallee
147	Succulent steppe with scrub; acacia species over saltbush
148	Medium woodland; gimlet
435	Shrublands; <i>Acacia neurophylla</i> , <i>A. beauverdiana</i> & <i>A. resinomarginea</i> thicket
436	Shrublands; <i>Acacia sp.</i>
535	Medium woodland; rough fruited mallee on greenstone hills
537	Medium woodland; morrel ( <i>E. longicornis</i> )
554	Low woodland over scrub; <i>Casuarina pauper</i> over bowgada scrub
1063	Medium-Low woodland; York gum & cypress pine ( <i>Callitris glaucophylla</i> )
1071	Succulent steppe with scrub; acacia species over saltbush & bluebush
1078	Medium woodland; salmon gum, redwood, merrit, gimlet & <i>Eucalyptus sheathiana</i>

**Centres of Endemism:**

- Fauna: sandplain *Ctenotus* (*Ctenotus xenopleura*), *Nephrurus stellatus*
- Flora: Banded-ironstone hill flora, sandplain acacias & myrtaceae, goldfields woodlands (mainly for eucalypts).

**High Species and Ecosystem Diversity:**

Banded ironstone ranges, ephemeral flora communities of Tertiary sandplain scrubs and of valley floor woodlands (up to 60 species per quadrat). The subregion is itself a biogeographic interzone.

**Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats**

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern Goldfields (System 11) in the CTRC Green Book. Some, but not all of these recommendations (with modification) were implemented over the following two

years. A review of outstanding recommendations was initiated in 1988 and culminated in the production of the report Nature Conservation Reserves in the Eastern Goldfields, Western Australia (Henry-Hall *et al* 1990). This report made recommendations on a nature conservation reserve system for the southern and central Goldfields, which incorporates COO2. The subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually (Department of Conservation and Land Management 1994b).

**Wetlands****Wetlands of National significance (DIWA listings)**

No nationally significant wetlands are known in COO2.

**Wetlands of subregional significance (in addition to the DIWA listed wetlands)**

Name	Location (Grid reference)	Description	Special Values <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Wallagne Soak	220000 E 6599000 N zone 51	C1. Artificial wetland at foot of large granite tor.	ii, iii	iv	iv	ii	v (foxes, cats & rabbits), vi, vii. The entire regional bat fauna recorded at dam which is surrounded by uncleared vegetation)
Lake Deborah East	151287 E 6601828 N zone 51	B8. Saltlake with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii, xii (salt mining)
Lake Deborah West	125207 E 6588022 N zone 51	B8. Saltlake with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii, xii (salt mining)
Johnston Lakes	289090 E 6429841 N zone 51	B8. Part of a large saltlake chain with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii
Eva Lake	193864 E 6563452 N zone 51	B8. Part of a large saltlake chain with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii

Name	Location (Grid reference)	Description	Special Values <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Unnamed Lake South of Boondine Hill	148953 E 6626679 N zone 51	B8. Part of a large saltlake chain with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii
Lake Walton	216726 E 6576050 N zone 51	B8. Part of a large saltlake chain with samphire and peripheral lunettes, kopi dunes & woodlands.	ii	iii	iv	ii	v (foxes, cats & rabbits), vi, vii

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iv	ii	vi, vii, v (foxes, cats & rabbits)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) are listed in COO2.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Banded Ironstone Hills with <i>Dryandra arborea</i> . (A. Brown pers. comm.).	V	21	iv	iii	ii	iv, v (goats, rabbits), vii
Flora and fauna assemblages of granite rock pools (J. Davis and S. Halse pers. comm.) (Pinder <i>et al.</i> 2000).	V	41	iii	iii-iv	ii	x, xi (faecal deposits from feral animals), v (goats, rabbits, stock)
Goldfields granite outcrop assemblages rocks east of Lake Johnson (Henry-Hall <i>et al.</i> 1990; J. Angas pers. comm.) (Mt Bevan telecom tower – A. Brown pers. comm.).	V	41	iii	iii	iii	xii (recreation; proposal to mine), v (goats), vi
Granite moss sheet communities (S. Halse pers. comm. 2000).	V	43	iii	iii	iii	xii (recreation), v (trampling by goats)
Duladgin Ridge vegetation complex (G. Keighery and N. Gibson pers comm.; Beard 1972d)	V	27, 21	iii	iv	iii	v (rabbits), vi, vii
Helena and Aurora Range vegetation complexes (Beard 1972b; Dell <i>et al.</i> 1985; Henry-Hall <i>et al.</i> 1990; Gibson <i>et al.</i> 1997; Lyons and Chapman 1997). Subject to imminent exploration programs for iron ore mining (Portman mining Co.) (R. Thomas pers. comm. 2000).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Koolyanobbing vegetation complexes (G. Keighery and N. Gibson pers comm.; Beard 1972b) Subject to imminent exploration programs for iron ore mining (Portman mining Co.) (R. Thomas pers. comm. 2000).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Highclere Hills vegetation complex (Beard 1972b; Newbey and Hnatiuk 1985; Dell <i>et al.</i> 1985; Henry-Hall 1990; Gibson and Lyons 1997a)	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Hunt Range vegetation complex (Gibson and Lyons 1997a; Beard 1972b; Beard 1978; Dell <i>et al.</i> 1985; Newbey & Hnatiuk 1985; Department of Conservation and Land Management 1994b).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Mount Dimer vegetation complex (Beard 1972b; N. Gibson and G. Keighery pers. comm.)	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Diehardy Range vegetation complex (G. Keighery and N. Gibson pers comm.; Henry-Hall <i>et al.</i> 1990; Beard 1972b). Subject to imminent exploration programs for iron ore mining (Portman mining Co.) (R. Thomas pers. comm. 2000).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Mount Manning Range vegetation complex (Beard 1972b; Beard 1990; Henry-Hall <i>et al.</i> 1990; Keighery <i>et al.</i> 1995; Gibson and Lyons 1997c). Subject to imminent exploration programs for iron ore mining (Portman mining Co.) (R. Thomas pers. comm. 2000).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Mount Jackson Range vegetation complex (Henry-Hall <i>et al.</i> 1990; G. Keighery and N. Gibson pers comm.; Beard 1972b). Subject to imminent exploration programs for iron ore mining (Portman mining Co.) (R. Thomas pers. comm. 2000).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Yilgarn Hills vegetation complex (G. Keighery and N. Gibson pers comm.; Newbey <i>et al.</i> 1995; Beard 1972b).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Ironcap Hills complexes (Mt Holland, Mid, North and South Ironcap Hills and Hatters Hill) (sufficient data may be available from Hopkins <i>et al.</i> (1996) to allow assessment against criteria for TECs) (Newbey <i>et al.</i> 1984; G. Keighery and N. Gibson pers. comm.; Beard 1972b).	V	27, 21	iii	iv	iii	xii (mining), vii, v (rabbits), vi?
Acacia - Casuarina - Melaleuca Thicket. 80% alienated (Beard and Sprenger 1984) Wheatbelt, Southern Goldfields, Darling, Northern Sandplain, Eastern South Coast, Southwest Interzone (Hopkins <i>et al.</i> 1996).	V	26, 28	ii	iv	iii	ii, iv, vii, v
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated (Beard and Sprenger 1984) Wheatbelt, Southern Goldfields, Southwest Interzone (Hopkins <i>et al.</i> 1996).	V	8, 31	ii	iv	ii-iii	ii, iv, vii, v
<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland (Beard and Sprenger 1984) Darling, Wheatbelt, Southern Goldfields, Eastern South Coast, Northern Sandplain, South West Interzone (Hopkins <i>et al.</i> 1996).	V	8	ii	iv	ii-iii	ii, iv, vii, v
Plant Assemblages of the Bremer Range		43	ii	unknown	ii	xii (mining)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i>	V	i	i	iii	v (foxes, cats), ii, iv, vii; likely to be extinct in subregion
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	i	iii	iii	ii, vii
<i>Acanthiza iredalei iredalei</i>	V	ii	iii	ii	iv
<i>Leipoa ocellata</i>	V	i	iii	iii	v (foxes & cats), vii, iv, ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	ii	iii	iii	v (foxes & cats), iii, ii, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Eremophila virens</i>	E	ii-iii	iv	iii	iv,
<i>Tetradlea paynterae</i>	E	iii	iv	iii	xii (mining), iv
<i>Gastrolobium graniticum</i>	V	ii-iii	iv	iii	vii, ii
<i>Myriophyllum lapidicola</i>	V	ii-iii	vi	iii	x, xii (aquatic plant that grows in

					granite pools after rain)
<i>Pityrodia scabra</i>	V	ii-iii	iv	iii	vii, ii, v, iv
<i>Tetralthea aphylla</i>	V	iii	iv	iii	xii (mining), iv
<i>Tetralthea harperi</i>	V	iii	iv	iii	xii (mining), iv
<b>PRIORITY 1</b>					
<i>Acacia adinophylla</i>	1	Unknown	Unknown	ii	iv, vii
<i>Acacia ependunculata</i>	1	Unknown	Unknown	ii	iv, vii
<i>Calothamnus superbus</i>	1	Unknown	Unknown	ii	iv, vii
<i>Calytrix cresswellii</i>	1	Unknown	Unknown	ii	iv, vii
<i>Chamelaucium paynteri</i>	1	Unknown	Unknown	ii	iv, vii
<i>Diocirea microphylla</i>	1	Unknown	Unknown	ii	iv, vii
<i>Gnephosis intonsa</i>	1	Unknown	Unknown	ii	iv, vii
<i>Grevillea phillipsiana</i>	1	Unknown	Unknown	ii	iv, vii
<i>Homalocalyx grandiflorus</i>	1	Unknown	Unknown	ii	iv, vii
<i>Lepidium merrallii</i>	1	Unknown	Unknown	ii	iv, vii
<i>Leptospermum macgillivrayi</i>	1	Unknown	Unknown	ii	iv, vii
<i>Persoonia leucopogon</i>	1	Unknown	Unknown	ii	iv, vii
<i>Ricinocarpos brevis</i> ms	1	Unknown	Unknown	ii	iv, vii
<i>Stenanthemum newbeyi</i>	1	Unknown	Unknown	ii	iv, vii
<b>PRIORITY 2</b>					
<i>Acacia kerryana</i>	2	Unknown	Unknown	ii	iv, vii
<i>Acacia subrigida</i>	2	Unknown	Unknown	ii	iv, vii
<i>Dampiera orchardii</i>	2	Unknown	Unknown	ii	iv, vii
<i>Elachanthus pusillus</i>	2	Unknown	Unknown	ii	iv, vii
<i>Frankenia brachyphylla</i>	2	Unknown	Unknown	ii	iv, vii
<i>Haegiela tatei</i>	2	Unknown	Unknown	ii	iv, vii
<i>Hakea rigida</i>	2	Unknown	Unknown	ii	iv, vii
<i>Jacksonia jackson</i>	2	ii-iii	iv	ii	iv, vii, xii (mining)
<i>Lepidium genistoides</i>	2	Unknown	Unknown	ii	iv, vii
<i>Leucopogon breviflorus</i>	2	Unknown	Unknown	ii	iv, vii
<i>Malleostemon</i> sp Adelong	2	Unknown	Unknown	ii	iv, vii
<i>Phebalium clavatum.</i>	2	Unknown	Unknown	ii	iv, vii
<i>Phlegmatospermum eremaeum</i>	2	Unknown	Unknown	ii	iv, vii
<i>Stylidium choreanthum</i>	2	Unknown	Unknown	ii	iv, vii
<i>Trachymene moorei</i> subsp <i>moorei</i> ms	2	Unknown	Unknown	ii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
8	Medium woodland; salmon gum & gimlet	X	X		L
9	Medium woodland; coral gum ( <i>E. torquata</i> ) & goldfields blackbutt ( <i>E. le souefii</i> ) (also some e10,11)				L
18	Low woodland; mulga ( <i>Acacia aneura</i> )				L
19	Low woodland; mulga between sandridges				L
20	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & Eucalyptus sp (e6?)				L
24	Low woodland; <i>Allocasuarina cristata</i>	X			L
36	Shrublands; thicket, acacia-casuarina alliance ?species				L
39	Shrublands; mulga scrub				L
40	Shrublands; acacia scrub, various species				L
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	X			L
123	Succulent steppe with open low woodland; sheoak over saltbush & bluebush				L
125	Bare areas; salt lakes	X	X		L
127	Bare areas; mudflats				L
128	Bare areas; rock outcrops	X	X		L
141	Medium woodland; York gum, salmon gum & gimlet	X			L
142	Medium woodland; York gum & salmon gum	X			L
143	Medium woodland; York gum, salmon gum & <i>Casuarina pauper</i>	X			L
144	Medium woodland; wandoo, salmon gum, morrel, gimlet & rough fruited mallee	X			L
147	Succulent steppe with scrub; acacia species over saltbush	X			M
148	Medium woodland; gimlet	X			H
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub	X			M
221	Succulent steppe; saltbush				L
256	Low woodland; York gum, and cypress pine (adjacent to e6pMLi)	X			L
314	Succulent steppe with open woodland; york gum over saltbush	X			L
352	Medium woodland; York gum				L
357	Medium woodland over scrub; York gum over bowgada & jam ( <i>Acacia acuminata</i> )				L
408	Shrublands; scrub-heath on coastal association, yellow sandplain	X			M
420	Shrublands; bowgada & jam scrub				L
435	Shrublands; <i>Acacia neurophylla</i> , <i>A. beauverdiana</i> & <i>A. resinomarginea</i> thicket	X	X		L
436	Shrublands; Acacia sp.		X		L
437	Shrublands; Mixed acacia thicket on sandplain	X	X		L
468	Medium woodland; salmon gum & goldfields blackbutt				L
483	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex; red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>				L
484	Shrublands; jam thicket				M
491	Medium woodland; morrel & Dundas blackbutt ( <i>E. dundasii</i> )				H
501	Medium woodland; goldfields blackbutt				M
504	Low woodland; mulga & red mallee				M
507	Succulent steppe with woodland; salmon gum & saltbush				H
508	Succulent steppe with open scrub; scattered mulga over saltbush	X			L
511	Medium woodland; salmon gum & morrel	X			L
516	Shrublands; mallee scrub, black marlock	X			L
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>	X			L
520	Shrublands; <i>Acacia quadrimarginea</i> thicket	X	X		L
521	Medium woodland; salmon gum & red mallee				M
522	Medium woodland; redwood ( <i>E. transcontinentalis</i> ) & merrit ( <i>E. flocktoniae</i> )	X	X		H

535	Medium woodland; rough fruited mallee on greenstone hills				H
536	Medium woodland; morrell & rough fruited mallee ( <i>E. corrugata</i> )				H
537	Medium woodland; morrel ( <i>E. longicornis</i> )				H
538	Shrublands; <i>Acacia brachystachya</i> scrub	X	X		L
551	Shrublands; <i>Allocasuarina campestris</i> thicket	X			L
552	Shrublands; <i>Casuarina acutivalvus</i> & <i>calothamnus</i> (also <i>melaleuca</i> ) thicket on greenstone hills				H
554	Low woodland over scrub; <i>Allocasuarina cristata</i> over bowgada scrub	X			L
555	Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>	X	X		L
676	Succulent steppe; samphire				L
936	Medium woodland; salmon gum	X	X		M
941	Mosaic: Medium woodland: salmon gum & morrel/Shrublands: mallee scrub, redwood				H
946	Medium woodland; wandoo				M
1024	Shrublands; mallee & casuarina thicket	X			L
1063	Medium-Low woodland; York gum & cypress pine ( <i>Callitris columellaris</i> )	X			L
1067	Medium woodland; salmon gum, morrel, gimlet & rough fruited mallee	X			L
1068	Medium woodland; salmon gum, morrel, gimlet & <i>Eucalyptus sheathiana</i>	X			L
1071	Succulent steppe with scrub; acacia species over saltbush & bluebush	X	X		L
1078	Medium woodland; salmon gum, redwood, merrit, gimlet & <i>Eucalyptus sheathiana</i>	X			L
1148	Shrublands; scrub-heath in the Coolgardie Region	X	X		L
1271	Bare areas; claypans				M
1413	Shrublands; acacia, casuarina & melaleuca thicket	X	X		L
2009	Medium woodland; redwood & goldfields blackbutt				M
2048	Shrublands; scrub-heath in the Mallee Region				L
2904	Medium woodland; York gum, goldfield blackbutt, gimlet & <i>Allocasuarina cristata</i>				H
	Banded Ironstone Hills with <i>Dryandra arborea</i> . (A. Brown pers. comm.).				H
	Flora and fauna assemblages of granite rock pools				H
	Goldfields granite outcrop assemblages, rocks east of Lake Johnson				H
	Granite moss sheet communities				H
	Duladgin Ridge vegetation complex				M
	Helena and Aurora Range vegetation complexes				H
	Koolyanobbing vegetation complexes				H
	Highclere Hills vegetation complex				M
	Hunt Range vegetation complex				M
	Mount Dimer vegetation complex				M
	Diehardy Range vegetation complex				H
	Mount Manning Range vegetation complex				H
	Mount Jackson Range vegetation complex				H
	Yilgarn Hills vegetation complex				M
	Ironcap Hills complexes (Mt Holland, Mid, North and South Ironcap Hills and Hatters Hill)				H

## Subregional constraints in order of priority

(see Appendix B, key g)

Competing Land Uses: Major components of the landscape are covered by mines, mining tenements, exploration leases and to a lesser extent grazing.

### Bioregional and subregional priority for reserve consolidation

Coolgardie Bioregion is IBRA Reservation Class 3 (11.3 % of its area reserved in IUCN I-IV) (see Appendix D, and Appendix C, rank 4). COO2 is listed as reservation Class 4 because 14.18 % of its area is reserved (IUCN I-IV), however, the south-western parts have been cleared for wheat fields and salinity problems are emerging so Class 3 is more appropriate.

### Reserve management standard

In COO, no feral predator programs are in place yet. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained in all reserves. Mining activities (exploration) are supervised (except for old exploration drill holes which often remain open), and feral herbivore grazing activities now minimal (e.g. Callicivirus has reduced rabbit populations; there are still relatively few goats). Therefore, the overall management rank is (ii) (see Appendix C, rank 5), due to the lack of feral predator control although vegetation and soils probably stable or regenerating from light grazing and timber removal early in the 20th century.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
		Mt. Elvire	Leasehold	ii-iii
		Jaurdi Station	Leasehold	ii-iii
A	Conservation Park	Goldfields Woodlands Conservation Park	Conservation Park	ii-iii
A	National Park	Goldfields Woodlands National Park	National Park	ii-iii
A	National Park	Boorabbin National Park	National Park	ii-iii
A	Conservation Of Flora And Fauna	Victoria Rock Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Wockallarry Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Walyahmoning Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Lake Cronin Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Karroun Hill Nature Reserve	Nature Reserve	ii-iii
A	Water And Conservation Of Flora And Fauna	Geeraning Nature Reserve	Nature Reserve	ii-iii
A	Water And Conservation Of Flora And Fauna	Yanneymoon Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Duladgin Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Jilbadji Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Condarnin Rock Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Biljahnjie Rock Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Mount Manning Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Yellowdine Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Dordie Rock Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Burra Rock Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Cave Hill Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Baladjie Lake Nature Reserve	Nature Reserve	ii-iii
C	Timber	Scahill Timber Reserve	Section 5(g) reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plans
<i>Acanthiza iredalei iredalei</i>	No	Action Plan for Australian Birds; Goldfields Regional Management Plan.
<i>Calyptorhynchus latirostris</i>	Yes – Draft RP	Action Plan for Australian Birds; Goldfields Regional Management Plan.
<i>Dasyurus geoffroii</i>	Yes – IRP	Action Plan for Australian Marsupials and Monotremes; Goldfields Regional Management Plan.
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles; Goldfields Regional Management Plan.
<i>Leipoa ocellata</i>	Yes - National Recovery Plan for Malleefowl	Action Plan for Australian Birds; Goldfields Regional Management Plan.
<i>Eremophila virens</i>	No	Goldfields Regional Management Plan
<i>Gastrolobium graniticum</i>	No	Goldfields Regional Management Plan
<i>Myriophyllum lapidicola</i>	No	Goldfields Regional Management Plan
<i>Pityrodia scabra</i>	Yes - IRP	Goldfields Regional Management Plan
<i>Tetralthea aphylla</i> .	No existing recovery plans. Probably a genuinely rare species limited by suitable habitat.	Goldfields Regional Management Plan
<i>Tetralthea harperi</i>	No existing recovery plans. Probably a genuinely rare species limited by suitable habitat.	Goldfields Regional Management Plan
<i>Tetralthea paynterae</i>	No existing recovery plans. Probably a genuinely rare species limited by suitable habitat.	Goldfields Regional Management Plan

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Acanthiza iredalei iredalei</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Calyptorhynchus latirostris</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Dasyurus geoffroii</i>	i, ii, iii, vii, x	Habitat retention through reserves or on other State lands or on private lands. Translocation from secure population would be required. Control of foxes and cats would be necessary
<i>Morelia spilota imbricata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Likely that control of foxes and cats would contribute to recovery
<i>Leipoa ocellata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands on private lands. Likely that control of foxes and cats would contribute to recovery
<i>Eremophila virens</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Gastrolobium graniticum</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Myriophyllum lapidicola</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Pityrodia scabra</i>	i, ii, iii, v, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands.
<i>Tetralthea aphylla</i> .	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Tetralthea harperi</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Tetralthea paynterae</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.

<sup>1</sup>Appendix A, key h.

### Ecosystems

Ecosystem	Specific Recovery Plan	General Recovery
Banded Ironstone <i>Tetralthea</i> spp communities threatened by proposed mining activities	No existing recovery plans. Probably genuinely rare species limited by suitable habitat.	Goldfields Regional Management Plan
CWR mammal habitats	Yes – RP for Chuditch	Goldfields Regional Management Plan
Johnston Lakes	No	South Coast Management Plan
Eva Lake	No	Goldfields Regional Management Plan
Unnamed Lake South of Boondine Hill	No	Goldfields Regional Management Plan

Lake Walton	No	Goldfields Regional Management Plan
Flora and fauna assemblages of granite rock pools	No	
Goldfields granite outcrop assemblages rocks east of Lake Johnson	No	South Coast Management Plan
Duladgin Ridge vegetation complex	No	Goldfields Regional Management Plan
Helena and Aurora Range vegetation complexes	No	Goldfields Regional Management Plan
Highclere Hills vegetation complex	No	Goldfields Regional Management Plan
Hunt Range vegetation complex	No	Goldfields Regional Management Plan
Mount Dimer vegetation complex	No	Goldfields Regional Management Plan
Diehardy Range vegetation complex	No	Goldfields Regional Management Plan
Mount Manning Range vegetation complex	No	Goldfields Regional Management Plan
Mount Jackson Range vegetation complex	No	Goldfields Regional Management Plan
Ironcap Hills complexes (Mt Holland, Mid, North and South Ironcap Hills and Hatters Hill)	No	South Coast Management Plan
Acacia - Casuarina - Melaleuca Thicket. 80% alienated	No	Goldfields Regional Management Plan
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated	No	Goldfields Regional Management Plan
<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland	No	Goldfields Regional Management Plan

### Existing ecosystem recovery plans and appropriate recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Banded Ironstone <i>Tetratheca</i> spp communities threatened by proposed mining activities	i, ii, iii, xiii	All identified vegetation complexes would require habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry.
CWR mammal habitats	i, ii, iii, ix, v	Habitat retention through reserves or on other State lands or on private lands. Appropriate fire management. Stock exclusion from habitats.
Lake Deborah East	iii	Habitat protection on other state lands.
Lake Deborah West	iii	Habitat protection on other state lands.
Johnston Lakes	i	Habitat retention through reserves.
Flora and fauna assemblages of granite rock pools	i, ii, iii	Habitat retention and protection through reserves, on private land and on other state lands.
Goldfields granite outcrop assemblages rocks east of Lake Johnson	i	Habitat retention through reserves.
Granite moss sheet communities	i, ii, iii	Habitat retention and protection through reserves, on private land and on other state lands.
Duladgin Ridge vegetation complex	i	Habitat retention through reserves.
Helena and Aurora Range vegetation complexes	i	Habitat retention through reserves.
Koolyanobbing vegetation complexes	iii, xiii	Habitat protection on other state lands. Capacity building with mining companies.
Highclere Hills vegetation complex	iii, xiii	Habitat protection on other state lands. Capacity building with the pastoral industry.
Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Mount Dimer vegetation complex	i	Habitat retention through reserves.
Diehardy Range vegetation complex	i	Habitat retention through reserves, included in proposed reserve extension.
Mount Manning Range vegetation complex	i	Habitat retention through reserves, included in proposed reserve extension.
Mount Jackson Range vegetation complex	i	Habitat retention through reserves, included in proposed reserve extension.
Ironcap Hills complexes (Mt Holland, Mid, North and South Ironcap Hills and Hatters Hill)	i	Habitat retention through reserves, included in proposed reserve extension.
Acacia - Casuarina - Melaleuca Thicket. 80% alienated	i, iii, ix, xii	Habitat retention through reserves and on other state lands. Fire management. Research.
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated	i, iii, ix, xii	Habitat retention through reserves and on other state lands. Fire management. Research.
<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland	i, iii	Habitat retention through reserves and on other state lands.
Plant Assemblages of the Bremer Range	iii	Habitat retention on other state lands.

<sup>1</sup>Appendix A, key h.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. vegetation management plans, and pest management.

**Industry Codes of Practice.**

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Include Local Government Planning and National Action Plan for Water Quality and Salinity.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, so Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for COO2 is (iii) (see Appendix C, rank 7), indicating that NRM instruments in place with some achieved biodiversity outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available and, although regional survey of flora and vertebrate fauna has been published, it is based on very sparse sampling.

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse (60 quadrats across subregion), quadrats only positioned on widespread surface-types, and only 3 – 4 quadrats per surface-type, few quadrats have been sampled on more than three occasions. The Western Australian Biological Surveys Committee conducted extensive surveys in the Eastern Goldfields, see

Dell *et al.* 1985, Keighery *et al.* 1995, Newbey *et al.* 1984 and McKenzie and Hall 1982.

**Floristic Data:** Data is sparse (about 130 quadrats across subregion), quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. The Western Australian Biological Surveys Committee conducted extensive surveys in the Eastern Goldfields, see Dell *et al.* 1985, Keighery *et al.* 1995, Newbey *et al.* 1984 and McKenzie and Hall 1982.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of any species, even rabbits.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, weed colonisation, fire, mineral-extraction on greenstone surfaces (particularly banded ironstones).

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R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 055, 057, 075, 080, 098, 101, 103, 106, 118, 164, 166, 182, 211, 232, 241, 258, 260,

268, 278, 287, 313, 370, 390, 406, 459, 519, 526, 577, 597, 647, 685, 686 and 709 in Appendix A.

# Coolgardie 3 (COO3 – Eastern Goldfields subregion)

MARK COWAN  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

Coolgardie 3 lies on the Yilgarn Craton's 'Eastern Goldfields Terrains'. The relief is subdued and comprises of gently undulating plains interrupted in the west with low hills and ridges of Archaean greenstones and in the east by a horst of Proterozoic basic granulite. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half are the remnants of an ancient major drainage line.

The vegetation is of Mallees, Acacia thickets and shrub-heaths on sandplains. Diverse *Eucalyptus* woodlands occur around salt lakes, on ranges, and in valleys. Salt lake support dwarf shrublands of samphire. Woodlands and *Dodonaea* shrubland occur on basic granitoides of the Fraser Range. The area is rich in endemic Acacias. The climate is Arid to Semi-arid with 200-300 mm of rainfall, sometimes in summer but usually in winter. The subregional area is 5, 102, 428 ha.

### Dominant land use

The dominant land uses are (xi) UCL and Crown reserves (see Appendix B, key b), (ix) Grazing-Native pastures-leasehold (37.8%) freehold (7.15%), (xiii) conservation, (vii) Mining leases.

### Continental Stress Class

The Continental Stress Class for COO3 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

**Rowles Lagoon, Clear and Muddy Lakes:** This system of wetlands is the largest semi-permanent freshwater complex in the region and as such plays an important ecological role. With 41 species of waterbird, including

eight protected by international treaty, it has more species than any other southern arid zone wetland in WA.

**Plant assemblages of the Fraser Range Vegetation Complex:** *Allocasuarina huegeliana* and *Pittosporum phylliraeoides* open woodland over *Beyeria lechenaultii* and *Dodonaea microzyga* Scrub and *Aristida contorta* bunch grasses (granite complex), on the slopes and summits of hills; *Acacia acuminata* Tall Shrubland dominated by *Melaleuca uncinata* and *Triodia scariosa* on uplands with shallow loamy sands; *Eucalyptus* aff. *uncinata* over *Cassia helmsii*, *Cryptandra miliaris*, *Dodonaea boroniifolia*, *D. stenozyga* and *Triodia scariosa* (*Eucalyptus effusa* Mallee) on colluvial flats with loamy clay sands, and; *E. oleosa*, *E. transcontinentalis*, *E. urna* Woodland on flats. Fraser Range is a unique landform that supports distinctive vegetation associations of mallees and low woodlands interspersed with herblands (Newbey *et al.* 1984). A number of plant species that occur there have restricted distributions (*Lasioptalum ogilvieanum*, *Eucalyptus balladoniensis*, *Geococcus pusillus* etc.) while several other species are at the limit of their range (*Prostanthera serpyllifolia*, *Eucalyptus lesouefii*).

**Plant assemblages of the Woodline Hills:** *Baeckea recurva* Tall Shrubland on Proterozoic quartzite ridges on the Woodline Hills located 95 km south-east of Widgiemooltha and 100 km north-east of Norseman.

**Swan Lake:** A semi permanent freshwater lake that often persists when other water bodies have dried up in drought conditions and as such performs an important ecological function in addition to supporting at least 9 species of waterbirds.

**Plant and Community Special Values Include:** Declared rare flora *Gastrolobium graniticum*, *Pityrodia scabra*, *Daviesia microcarpa*, and *Eucalyptus platydisca*. Communities include arid zone eucalypt woodlands.

**Fauna Special Values Include:** Vulnerable and specially protected fauna Malleefowl (*Leipoa ocellata*), Carpet Python (*Morelia spilota imbricata*), Peregrine Falcon (*Falco peregrinus*), Chuditch (*Dasyurus geoffroyi*) and the Freckled Duck (*Stictonetta naevosa*).

### Ecosystems That Have Greater Than 85% of Their Total Extent Within Coolgardie 3 Subregion:

Beard Veg Code	Description
9	Medium woodland; coral gum ( <i>E. torquata</i> ) & goldfields blackbutt ( <i>E. lesouefii</i> ) (also some e10, 11)
123	Succulent steppe with open low woodland; sheoak over saltbush & bluebush
467	Mosaic: Medium woodland; salmon gum & gimlet/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>
468	Medium woodland; salmon gum & goldfields blackbutt
481	Mosaic: Medium woodland; salmon gum & red mallee/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>
488	Mosaic: Medium woodland; gimlet/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>
489	Mosaic: Medium woodland; goldfields blackbutt & <i>Dundas blackbutt</i> /Shrublands; dodonaea scrub
500	Mosaic: Medium woodland; merrit & red mallee/Shrublands; dodonaea scrub
505	Low woodland; <i>Allocasuarina cristata</i> & eucalypts
506	Succulent steppe with woodland; salmon gum & bluebush
509	Succulent steppe with woodland; gimlet & saltbush
513	Mosaic: Medium woodland; salmon gum & Dundas blackbutt/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>
525	Mosaic: Medium woodland; salmon gum & gimlet/Medium woodland; merrit & red mallee
542	Shrublands; mallee scrub marble gum ( <i>Eucalyptus gongylocarpa</i> )
1294	Medium woodland; coral gum
2901	Mosaic: Medium woodland; <i>Allocasuarina cristata</i> & goldfields blackbutt Shrublands; <i>Acacia quadrimarginea</i> thicket

#### Centres of Endemism:

- Goldfields Woodlands- Exceptionally high diversity of Eucalyptus species with as many as 170 species occurring in the bioregion

#### High Species and Ecosystem Diversity:

- Eucalyptus Woodlands
- Subregion has high diversity in Acacia species
- Ephemeral flora communities of tertiary sandplain shrublands and of valley floor woodlands.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern Goldfields (System 11) in the CTRC Green Book. Some but not all of these recommendations (with modification) were implemented over the following two

years. A review of outstanding recommendations was initiated in 1988 and culminated in the production of a report – Nature Conservation Reserves in the Eastern Goldfields (Henry-Hall *et al.* 1990). This report made recommendations on a nature conservation reserve system for the southern and central Goldfields which incorporates COO3. Most of the subregion is covered by a CALM Regional Management Plan (Department of Conservation and Land Management 1994b), that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually (Department of Conservation and Land Management 1994b).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Rowles Lagoon System (WA015)	B6, B10, B13	ii	iv	iii	v (rabbits, goats, foxes, cats, stray stock), vi (Saffron Thistle, Bathurst Burr, Brome Grass, Southern Liquorice), iv (grazing by stock which may also lead to siltation), xii (uncontrolled recreational use; and eutrophication)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Swan Lake	434832 E, 6559102 N, zone 51  30° 41' S 122° 40' E	B6 (area of wetland is 125 ha)	ii (one of very few freshwater wetlands that are usually inundated), iii (Due to the persistence in dry conditions this site may act as an important refuge for waterbirds. Site proposed as an important waterbird area in the eastern Goldfields by the RAOU).	i (the lake is situated in the middle of a sheep grazing paddock)	Currently vi, although likely to be iii or iv	ii	iv, vi (species unknown), v (rabbits, foxes, cats)
Lake Cowan	31° 42' S 121° 54' E	B12	iii, v (potential)	iii-iv	iv	iii	xii (possibly mining) but no known threats,
Lake Arrow	30° 32' S 121° 24' E	B8	ii, iii, iv (nomadic species)	iii	iv	iii	xii (possibly mining and roadworks)
Canegrass Swamp	30° 32' S 122° 01' E	B10	ii (freshwater), iii, iv (nomadic species)	iii	iv	iii	x (water extraction for mining or roadworks)
King of the West Lake	30° 30' S 121° 27' E	B8	ii, iii, iv (nomadic species)	iii	iv	iii	xii (recreation, urban proximity), iv
Lignum Swamp	30° 12' S 121° 30' E	B13	ii, iii, iv (nomadic species), v	iii	iv	iii	iv
Black Flag Lake	30° 34' S 121° 18' E	B8	ii, iii, iv (nomadic species)	iii	iv	iii	xii (mining, recreation), iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian Zone Vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iv	ii	iv, vi, vii, v (foxes, cats, rabbits, goats), iii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) listed in COO3.

## Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Fraser Range vegetation complex Plant assemblages of the Fraser Range Vegetation Complex: <i>Allocasuarina huegeliana</i> and <i>Pittosporum phylliraeoides</i> open woodland over <i>Beyeria lechenaultii</i> and <i>Dodonaea microzyga</i> Shrublands and <i>Aristida contorta</i> bunch grasses (granite complex), on the slopes and summits of hills; <i>Acacia acuminata</i> Tall Shrubland dominated by <i>Melaleuca uncinata</i> and <i>Triodia scariosa</i> on uplands with shallow loamy sands; <i>Eucalyptus</i> aff. <i>uncinata</i> (KRN 7854) over <i>Cassia helmsii</i> , <i>Cryptandra miliaris</i> , <i>Dodonaea boroniifolia</i> , <i>D. stenozyga</i> and <i>Triodia scariosa</i> ( <i>Eucalyptus effusa</i> Mallee) on colluvial flats with loamy clay sands, and; <i>E. oleosa</i> , <i>E. transcontinentalis</i> , <i>E. urna</i> Woodland on flats.	V	26, 28	ii-ii	iii	iii	iv (grazing), vi, vii, xii (mining)
Woodline Hills vegetation complexes ( <i>Baeckea recurva</i> shrubland) (Newbey <i>et al.</i> 1984; Henry-Hall 1990) (N. Gibson, G. Keighery pers comm.).	V	32	ii-iii	iii	iii	xii (mining)
Southern Hills Vegetation Complex		43	ii	unknown	ii	iv, xii (soil compaction and erosion), vi
Flora and fauna assemblages of granite rock pools (J. Davis and S. Halse pers. comm.) (Pinder <i>et al.</i> in press).	V	41	iii	iii	ii	x, xi (fecal deposits from feral animals), v (goats, rabbits, stock), vi
Goldfields granite outcrop assemblages (Eranyinia Hill - Cowarna Downs Station) (Henry-Hall, 1990; J. Angas pers. comm.) (Mt Bevan telecom tower – A. Brown pers. comm.).	V	41	iii	iii	iii	xii (recreation; proposal to mine), v (goats), vi
Granite moss sheet communities (S. Halse pers. comm. 2000).	V	43	iii	iii	iii	xii (recreation), vi
Permanent to semi-permanent brackish to freshwater wetlands with belts of Samphire and <i>Melaleuca</i> around the perimeter, Goldfields region. Swan Lake - Cowarna Downs Station; Cane Grass Lagoon - east of Rowles Lagoon (Henry-Hall 1990; J. Angas, A. Chapman pers. comm.).	V	39	ii-iii	iv	ii	iv, v, vii, x
Mt Belches <i>Acacia quadrimarginea</i> / <i>Ptilotus obovatus</i> banded ironstone community. On Randell Timber Reserve. Has grazing coexistence with the reserve. (R. Thomas pers. comm.).	V	21	ii-iii	iv	ii	iv, v, xii (mining)
Halophytic communities of salt lake systems of the goldfields Lake Lefroy; Madoonia Downs Station (Handley 1991; J. Angas pers. comm.)	V	41	ii-iii	iv	ii	xii (mining)
Assemblages of the lignum Swamps of the Goldfields Region eg. Sheehan Swamp - Cowarna Downs; Brown Lagoon - east of Rowles Lagoon; Lignum Swamp - Mt Vettors Station) (I. Kealley, A. Chapman pers. comm.).	V	42	ii	iii	ii	xii (mining), iv
Peripheral claypans surrounding salt lakes (Lake Wannaway, Madoonia Downs; unnamed lake at 30 km peg north of Norseman) (J. Angas, A. Chapman pers. comm.)	V	43	ii-iii	iii	ii	xii (mining), iv
Rich ephemeral communities of outcrops and bottomlands in the Kurnalpi-Kalgoorlie area (McKenzie and Hall 1992)	V	43	ii-iii	iii	ii	iv, v (rabbits, goats), vi

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Mixed low woodlands of <i>Eucalyptus oleosa</i> , <i>Casuarina cristata</i> and <i>Acacia aneura</i> in the Kurnalpi-Kalgoorlie area (McKenzie and Hall 1992)	V	8	ii-iii	iii	ii	iv, v (goats, rabbits), vii, xii (mining)
Vegetation complexes of the Greenstone/ banded ironstone ranges of the goldfields (J. Angas pers. comm.).	V	32	ii-iii	iii	iii	vii, xii (mining)
Melaleuca spp. Shrublands. 70% alienated (Beard and Sprenger 1984) Southern Goldfields, Darling, Eastern South Coast (Hopkins <i>et al.</i> 1996)	V	28	ii	iii	iii	vii
Acacia - Casuarina - Melaleuca Thicket. 80% alienated (Beard and Sprenger 1984) Wheatbelt, Southern Goldfields, Darling, Northern Sandplain, Eastern South Coast, Southwest Interzone (Hopkins <i>et al.</i> 1996)	V	15	ii	iii	iii	vii
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated (Beard and Sprenger 1984) Wheatbelt, Southern Goldfields, Southwest Interzone (Hopkins <i>et al.</i> 1996)	V	29	ii	iii	iii	vii
<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland (Beard and Sprenger, 1984) Darling, Wheatbelt, Southern Goldfields, Eastern South Coast, Northern Sandplain, South West Interzone (Hopkins <i>et al.</i> 1996)	V	8	ii	iii	iii	vii, iii (woodland was extensively cut over for fuel and pit-tunnel props from 1890 to 1950 but is now regenerating), iv (goats)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1 <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i>	V	i	i	iii	v (foxes, cats)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Leipoa ocellata</i>	V	i	iii	iii	v (foxes, cats), vii, iv, ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	ii	vi	ii	ii, iv, vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	ii	iii	iii	v (foxes, cats), iii, ii, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Conospermum toddii</i>	CR	ii	iii-iv	iii	vii
<i>Daviesia microcarpa</i>	CR	Unknown	Unknown	ii	ii, vii, x, xii (low numbers, few populations)
<i>Eucalyptus merrickiae</i>	V	Unknown	Unknown	ii	vii
<i>Eucalyptus platydisca</i>	V	Unknown	Unknown	ii	vii, ii, xii (mining; limited distribution; close proximity to road)
<i>Gastrolobium graniticum</i>	V	Unknown	Unknown	iii	vii, ii, vi
<i>Pityrodia scabra</i>	V	Unknown	Unknown	iii	vii, ii, v, iv?

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Boronia revoluta</i>	V	Unknown	Unknown		vii, ii, xii (mining, limited distribution)
<b>PRIORITY 1</b>					
<i>Acacia websteri</i>	1	Unknown	Unknown	ii	ii, vii
<i>Dampiera plumosa</i>	1	Unknown	Unknown	ii	iv, vii
<i>Diocirea microphylla</i>	1	Unknown	Unknown	ii	iv, vii
<i>Eremophila perglandulosa</i> ms	1	Unknown	Unknown	ii	iv, vii
<i>Eremophila praecox</i> ms	1	Unknown	Unknown	ii	vii
<i>Eucalyptus griffithsii</i> subsp Widgiemooltha	1	Unknown	Unknown	ii	vii
<i>Gnephosis intonsa</i>	1	Unknown	Unknown	ii	iv, vii
<i>Grevillea phillipsiana</i>	1	Unknown	Unknown	ii	iv, vii
<i>Halosarcia flabelliformis</i>	1	Unknown	Unknown	ii	iv
<i>Jacksonia</i> sp Cundeelee	1	Unknown	Unknown	ii	vii
<i>Lepidium fasciculatum</i>	1	Unknown	Unknown	ii	iv, vii
<i>Phebalium appressum</i>	1	Unknown	Unknown	ii	vii, iv
<i>Prostanthera splendens</i>	1	Unknown	Unknown	ii	v (goats)
<i>Ptilotus procumbens</i>	1	Unknown	Unknown	ii	iv
<b>PRIORITY 2</b>					
<i>Acacia kerryana</i>	2	Unknown	Unknown	ii	vii, v (goats, rabbits)
<i>Elachanthus pusillus</i>	2	Unknown	Unknown	ii	iv
<i>Eucalyptus jutsonii</i>	2	Unknown	Unknown	ii	vii
<i>Grevillea secunda</i>	2	Unknown	Unknown	ii	iv
<i>Hakea rigida</i>	2	Unknown	Unknown	ii	vii, iv, v (rabbits, goats)
<i>Micromyrtus serrulata</i>	2	Unknown	Unknown	ii	vii, iv
<i>Micromyrtus stenocalyx</i>	2	Unknown	Unknown	ii	vii, iv
<i>Phebalium clavatum</i>	2	Unknown	Unknown	ii	vii, iv
<i>Phlegmatospermum eremaeum</i>	2	Unknown	Unknown	ii	iv, vi
<i>Rumex crystallinus</i>	2	Unknown	Unknown	ii	iv, vi
<i>Stylidium choreanthum</i>	2	Unknown	Unknown	ii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
8	Medium woodland; salmon gum & gimlet	X			L
9	Medium woodland; coral gum ( <i>E. torquata</i> ) & goldfields blackbutt ( <i>E. lesouefii</i> ) (also some e10,11)	X	X		L
10	Medium woodland; red mallee group				H
20	Low woodland; mulga mixed with <i>Casuarina pauper</i> & <i>Eucalyptus</i> sp (e6?)				M
24	Low woodland; <i>Casuarina pauper</i>		X		L
40	Shrublands; acacia scrub, various species				L
85	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex on sandplain				L
109	Hummock grasslands, shrub steppe; <i>Eucalyptus youngiana</i> over hard spinifex		X		L
110	Hummock grasslands, shrub steppe; red mallee over spinifex <i>Triodia scariosa</i>				M
123	Succulent steppe with open low woodland; sheoak over saltbush & bluebush				L
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
125	Bare areas; salt lakes	X	X		L

128	Bare areas; rock outcrops	X	X		L
221	Succulent steppe; saltbush	X			L
435	Shrublands; <i>Acacia neurophylla</i> , <i>A. beauverdiana</i> & <i>A. resinomarginea</i> thicket				L
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush		X		L
460	Succulent steppe; bluebush with saltbush in depressions				H
461	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over bluebush				M
467	Mosaic: Medium woodland; salmon gum & gimlet/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>				H
468	Medium woodland; salmon gum & goldfields blackbutt	X	X		L
480	Succulent steppe with open low woodland; mulga & sheoak over salt bush				H
481	Mosaic: Medium woodland; salmon gum & red mallee/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>		X		M
482	Medium woodland; merrit & red mallee				L
484	Shrublands; jam thicket				L
486	Mosaic: Medium woodland; salmon gum & red mallee/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>				H
487	Medium woodland; redwood & red mallee ( <i>E. oleosa</i> )				L
488	Mosaic: Medium woodland; gimlet/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>				H
489	Mosaic: Medium woodland; goldfields blackbutt & Dundas blackbutt/Shrublands; dodonaea scrub				H
500	Mosaic: Medium woodland; merrit & red mallee/Shrublands; dodonaea scrub	X			L
501	Medium woodland; goldfields blackbutt		X		L
502	Medium woodland; goldfields blackbutt & red mallee				H
505	Low woodland; <i>Allocasuarina cristata</i> & eucalypts				H
506	Succulent steppe with woodland; salmon gum & bluebush	X	X		L
507	Succulent steppe with woodland; salmon gum & saltbush				H
508	Succulent steppe with open scrub; scattered mulga over saltbush		X		M
509	Succulent steppe with woodland; gimlet & saltbush	X			L
513	Mosaic: Medium woodland; salmon gum & Dundas blackbutt/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>	X			L
518	Mosaic: Medium woodland; merrit & coral gum/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>		X		L
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>				L
520	Shrublands; <i>Acacia quadrimarginea</i> thicket				H
521	Medium woodland; salmon gum & red mallee				H
522	Medium woodland; redwood ( <i>E. transcontinentalis</i> ) & merrit ( <i>E. urna</i> )	X?	X		M
524	Medium woodland; Dundas blackbutt & red mallee	X	X		L
525	Mosaic: Medium woodland; salmon gum & gimlet/Medium woodland; merrit & red mallee				H
529	Succulent steppe with open low woodland; mulga & sheoak over bluebush		X		L
538	Shrublands; <i>Acacia brachystachya</i> scrub				L
540	Succulent steppe with open low woodland; sheoak over saltbush				M
542	Shrublands; mallee scrub marble gum ( <i>Eucalyptus gongylocarpa</i> )		X		L
551	Shrublands; <i>Allocasuarina campestris</i> thicket				H
555	Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>				M
676	Succulent steppe; samphire				M
936	Medium woodland; salmon gum	X	X		L
<b>Beard Veg Assoc</b>	<b>Ecosystem Description</b>	<b>IUCN I-IV</b>	<b>Non-IUCN Reserve</b>	<b>CALM-Purchased Lease</b>	<b>Priority</b>
1241	Succulent steppe; bluebush				L
1294	Medium woodland; coral gum	X	X		L
1413	Shrublands; acacia, casuarina & melaleuca thicket		X		L
2009	Medium woodland; redwood & goldfields blackbutt		X		L
2901	Mosaic: Medium woodland; <i>Allocasuarina cristata</i> & goldfields blackbutt Shrublands; <i>Acacia quadrimarginea</i> thicket				H
2903	Medium woodland; Salmon gum, goldfield blackbutt, gimlet & Casuarina pauper				L
2904	Medium woodland; York gum, goldfield blackbutt, gimlet & Casuarina pauper				M
4641	Succulent steppe with open woodland; salmon gum & gimlet over bluebush				L
	Fraser Range vegetation complex Plant assemblages of the Fraser Range Vegetation Complex: <i>Allocasuarina huegeliana</i> and <i>Pittosporum phylliraeoides</i> open woodland over <i>Beyeria lechenaultii</i> and <i>Dodonaea</i>				H

	<i>microzyga</i> Shrublands and <i>Aristida contorta</i> bunch grasses (granite complex), on the slopes and summits of hills; <i>Acacia acuminata</i> Tall Shrubland dominated by <i>Melaleuca uncinata</i> and <i>Triodia scariosa</i> on uplands with shallow loamy sands; <i>Eucalyptus</i> aff. <i>uncinata</i> (KRN 7854) over <i>Cassia helmsii</i> , <i>Cryptandra milliaris</i> , <i>Dodonaea boroniifolia</i> , <i>D. stenozya</i> and <i>Triodia scariosa</i> ( <i>Eucalyptus effusa</i> Mallee) on colluvial flats with loamy clay sands, and; <i>E. oleosa</i> , <i>E. transcontinentalis</i> , <i>E. urna</i> Woodland on flats.				
	Woodline Hills vegetation complexes ( <i>Baeckea recurva</i> shrubland)				H
	Flora and fauna assemblages of granite rock pools				H
	Goldfields granite outcrop assemblages (Eranyinia Hill - Cowarna Downs Station)				H
	Granite moss sheet communities				
	Permanent to semi-permanent brackish to freshwater wetlands with belts of Samphire and Melaleuca around the perimeter, Goldfields region. Swan Lake - Cowarna Downs Station; Cane Grass Lagoon - east of Rowles Lagoon				H
	Mt Belches <i>Acacia quadrimarginea</i> / <i>Ptilotus obovatus</i> banded ironstone community. On Randell Timber Reserve.		X		H
	Halophytic communities of salt lake systems of the goldfields Lake Lefroy Madoonia Downs Station				H
	Assemblages of the lignum Swamps of the Goldfields Region eg. Sheehan Swamp - Cowarna Downs; Brown Lagoon - east of Rowles Lagoon; Lignum Swamp - Mt Vettors Station)				H
	Peripheral claypans surrounding salt lakes (Lake Wannaway, Madoonia Downs; unnamed lake at 30 km peg north of Norseman) (J. Angas, A. Chapman pers. comm.)				H
	Rich ephemeral communities of outcrops and bottomlands in the Kurnalpi-Kalgoorlie area				H
	Mixed low woodlands of <i>Eucalyptus oleosa</i> , <i>Casuarina cristata</i> and <i>Acacia aneura</i> in the Kurnalpi-Kalgoorlie area				H
	Vegetation complexes of the Greenstone/banded ironstone ranges of the goldfields				H
	Melaleuca spp. Scrub. 70% alienated (Beard and Sprenger, 1984) Southern Goldfields, Darling, Eastern South Coast				H
	Acacia - Casuarina - Melaleuca Thicket. 80% alienated (Beard and Sprenger, 1984) Wheatbelt, Southern Goldfields, Darling, Northern Sandplain, Eastern South Coast, Southwest Interzone		X		M
	Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated (Beard and Sprenger 1984) Wheatbelt, Southern Goldfields, Southwest Interzone				M
	<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland 97% alienated (Beard and Sprenger, 1984) Darling, Wheatbelt, Southern Goldfields, Eastern South Coast, Northern Sandplain, South West Interzone				M

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Uses:** In particular prospective mining interests and to a lesser extent pastoral values.

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management.

**Other:** We do not have fine enough resolution of biodiversity values in some areas e.g. greenstone communities to identify priorities for acquisition.

### Bioregional and subregional priority for reserve consolidation

COO is reservation Class 3 (see Appendix D, and Appendix C, rank 4) with 11.3% of area in conservation reserve which is probably adequate at the bioregional level, however there is considerable bias at the subregional level with only 4.35% of COO3 (COO1 = 20.3% and COO2 = 14.8%) in reserve system so

reservation class 2 is more appropriate. The subregional priority for reserve consolidation in COO3 is (ii) (IUCN I-IV). The reserve system is highly biased in terms of CAR criteria at the subregional level and is not comprehensive or representative in terms of ecosystem representation.

### Reserve management standard

In COO, no feral predator programs are in place yet. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained in all reserves. Mining activities (exploration) are supervised (except for old exploration drill holes which often remain open), and feral herbivore grazing activities now minimal (e.g. Callicivirus has reduced rabbit populations; there are still relatively few goats). The overall reserve management rank is (ii) (see Appendix C, rank 5) because no feral predator control exist, although vegetation and soils are probably stable or regenerating from light grazing and timber removal early in the 20th century.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation Of Flora And Fauna	Victoria Rock Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Cardunia Rocks Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Unnamed Nature Reserve	Nature Reserve	ii-iii
A		Karamindie Forest	State Forest	ii-iii
B	Conservation Of Flora And Fauna	Dundas Nature Reserve	Nature Reserve	ii-iii
C	Conservation Park	Rowles Lagoon Conservation Park	Conservation Park	iii
C	Conservation Of Flora And Fauna	Clear And Muddy Lakes Nature Reserve	Nature Reserve	iii
C	Conservation Of Flora And Fauna	Binaronca Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Kambalda Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Kurrawang Nature Reserve	Nature Reserve	ii-iii
C	Timber	Brockway Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber	Kangaroo Hills Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber	Yallari Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber	Lakeside Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber	Scahill Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber-Sandalwood	Coonana Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber-Sandalwood	Emu Rocks Timber Reserve	Section 5(g) reserve	ii-iii
C	Timber-Sandalwood	Wallaby Rocks Timber Reserve	Section 5(g) reserve	ii-iii
C		Majestic Timber Reserve	Timber Reserve	ii-iii
C		Randell Timber Reserve	Timber Reserve	ii-iii
C		Kambalda Timber Reserve	Timber Reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Group have current Action Plan and ongoing research	Action Plan for Australian Birds; Goldfields Regional Management Plan.
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles; Goldfields Regional Management Plan.
<i>Dasyurus geoffroii</i>	Yes - RP	Action Plan for Australian Marsupials and Monotremes; Goldfields Regional Management Plan.
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds; Goldfields Regional Management Plan.
<i>Conospermum toddii</i>	No	Goldfields Regional Management Plan.
<i>Gastrolobium graniticum</i>	No	Goldfields Regional Management Plan.
<i>Pityrodia scabra</i>	Yes – Interim Working Management Guidelines	Goldfields Regional Management Plan.

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Leipoa ocellata</i>	i, ii, iii, vii, xiv	Habitat retention through reserves or on other State lands or on private lands. Likely that control of foxes and cats would contribute to recovery. Other – reduction of sheep numbers on pastoral lands.
<i>Morelia spilota imbricata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Likely that control of foxes and cats would contribute to recovery.
<i>Dasyurus geoffroii</i>	i, ii, iii, vii, x	Habitat retention through reserves or on other State lands or on private lands. Translocation from secure population would be required. Control of foxes and cats would be necessary.
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Conospermum toddii</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required and if identified as an issue. Fencing could be an alternative to feral predator control. Understanding of life history requirements of all rare flora very limited and needs additional work. Capacity building required with industry.
<i>Gastrolobium graniticum</i>	i, ii, iii, xiii	Habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry.
<i>Pityrodia scabra</i>	i, ii, iii, v, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements of all rare flora very limited and needs additional work. Capacity building required with industry.

<sup>1</sup>Appendix B, key h.

### Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Fraser Range	No	Goldfields Regional Management Plan.
Woodline Hills	No	Goldfields Regional Management Plan.
Swan Lake	No	No
Lake Cowan	No	No
Lake Arrow	No	No
Canegrass Swamp		Goldfields Regional Management Plan.
King of the West Lake	No	No
Lignum Swamp	No	No
Black Flag Lake	No	No
Ecosystem	Specific Recovery Plan	General Recovery Plan
Southern Hills Vegetation Complex	No	No
Flora and fauna assemblages of granite rock pools	No	No
Goldfields granite outcrop assemblages (Eranyinia Hill - Cowarna Downs Station)		Goldfields Regional Management Plan.
Granite moss sheet communities	No	No
Permanent to semi-permanent brackish to freshwater wetlands with belts of <i>Samphire</i> and <i>Melaleuca</i> around the perimeter, Goldfields region. Swan Lake - Cowarna Downs Station; Cane Grass Lagoon -		Goldfields Regional Management Plan.

east of Rowles Lagoon		
Mt Belches <i>Acacia quadrimarginea</i> / <i>Ptilotus obovatus</i> banded ironstone community.	No	No
Halophytic communities of salt lake systems of the goldfields Lake Lefroy; Madoonia Downs Station	No	No
Assemblages of the lignum Swamps of the Goldfields Region eg. Sheehan Swamp - Cowarna Downs; Brown Lagoon - east of Rowles Lagoon; Lignum Swamp - Mt Veters Station)	No	No
Peripheral claypans surrounding salt lakes (Lake Wannaway, Madoonia Downs; unnamed lake at 30 km peg north of Norseman) (J. Angas, A. Chapman pers. comm.)	No	No
Rich ephemeral communities of outcrops and bottomlands in the Kurnalpi-Kalgoorlie area	No	No
Mixed low woodlands of <i>Eucalyptus oleosa</i> , <i>Casuarina cristata</i> and <i>Acacia aneura</i> in the Kurnalpi-Kalgoorlie area	No	No
Vegetation complexes of the Greenstone/ banded ironstone ranges of the goldfields	No	No
Melaleuca spp. Shrublands. 70% alienated	No	No
Acacia - Casuarina - Melaleuca Thicket. 80% alienated	No	No
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated	No	No
<i>Eucalyptus loxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland	No	No

### Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Fraser Range	i, iii, vi, vii	Habitat retention through reserves or on other State lands or on private lands. Destocking and feral animal control required to negate any further degradation of area
Woodline Hills	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
Lake Arrow	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building required with mining industry.
Canegrass Swamp	i	Habitat protection through reserves
King of the West Lake	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building required with pastoral industry.
Lignum Swamp	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building required with pastoral industry.
Black Flag Lake	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building required with pastoral industry.
Southern Hills Vegetation Complex	i, iii, vi	Habitat protection through reserves and on other state lands. Weed control.
Flora and fauna assemblages of granite rock pools	i, ii, iii	Habitat protection and retention through reserves, on private land and on other state land.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Assemblages of the lignum Swamps of the Goldfields Region eg. Sheehan Swamp - Cowarna Downs; Brown Lagoon - east of Rowles Lagoon; Lignum Swamp - Mt Veters Station)	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building with pastoral & mining industries.
Peripheral claypans surrounding salt lakes (Lake Wannaway, Madoonia Downs; unnamed lake at 30 km peg north of Norseman) (J. Angas, A. Chapman pers. comm.)	iii, v, xiii	Habitat protection on other state lands. Fencing. Capacity building with pastoral & mining industries.
Rich ephemeral communities of outcrops and bottomlands in the Kurnalpi-Kalgoorlie area	i, ii, iii	Habitat retention and protection in reserves, on private lands and on other state lands.
Mixed low woodlands of <i>Eucalyptus oleosa</i> , <i>Casuarina cristata</i> and <i>Acacia aneura</i> in the Kurnalpi-Kalgoorlie area	i, iii	Habitat retention and protection in reserves and on other state lands.
Vegetation complexes of the Greenstone/ banded ironstone ranges of the goldfields	i, iii, vii, ix	Habitat retention and protection in reserves and on other state lands. Feral animal control. Fire management.
Melaleuca spp. Shrublands. 70% alienated	i, iii	Habitat retention and protection in reserves and on other state lands.
Acacia - Casuarina - Melaleuca Thicket. 80% alienated	i, iii	Habitat retention and protection in reserves and on other state lands.
Eucalyptus, Acacia, Atriplex, Halosarcia Wooded Succulent Steppe 87% alienated	i, iii	Habitat retention and protection in reserves and on other state lands.
<i>Eucalyptus toxophleba</i> , <i>E. wandoo</i> , <i>E. salmonophloia</i> Woodland	i, iii	Habitat retention and protection in reserves and on other state lands.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to mining and exploration activities.

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements.

## Other Planning Opportunities Including Local Government Planning and National Action Plan for Water Quality and Salinity.

**Capacity Building with Industry:** Partnerships with the mining industry, e.g. for the management of rare flora and fauna.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas already attempting to identify and implement ecologically sustainable practices through the EMU process developed by AgWA. Needs a greater level of support to be successful.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

## Subregions where specific NRM actions are a priority to pursue

The subregional priority for NRM in COO3 is (ii) (see Appendix C, rank 7), indicating that there are significant

constraints to integrate conservation as part of a production or development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regional survey of flora and vertebrate fauna has been published, but is based on very sparse sampling.

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse (60 quadrats across subregion), quadrats only positioned on widespread surface-types, and only 3 – 4 quadrats per surface-type, few quadrats have been sampled on more than three occasions. The Western Australian Biological Surveys Committee conducted extensive surveys in the Eastern Goldfields, see McKenzie and Hall 1992 and Newbey *et al.* 1984.

**Floristic Data:** Data is sparse (about 130 quadrats across subregion), quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. The Western Australian Biological Surveys Committee conducted extensive surveys in the Eastern Goldfields, see McKenzie and Hall 1992 and Newbey *et al.* 1984.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting Critical Weight Range mammals, and uncommon vertebrate and plant species. There is no data to provide a regional context on life-history (including population-trend) of any species, even rabbits.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, weed colonisation, fire, mineral-extraction on greenstone surfaces etc.

## Sources

### References cited

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084	Beard, J.S. and Sprenger, B.S.	(1984).	Geographical data from the vegetation survey of Western Australia. Vegetation Survey of Western Australia. Occasional Paper No 2.	Vegmap Publications, Applecross.	O
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
343	Handley, M.A.	(1991).	The biota of inland salt lakes of the Kambalda region, and coastal salt lakes of Esperance, Western Australia. A comparative study.	Honours thesis. Curtin University of Technology	O
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483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
491	McKenzie, N.L. and Hall, N.J. (eds.)	(1992).	The biological survey of the eastern Goldfields of Western Australia. Part 8. Kurnalpi-Kalgoorlie Study Area.	Records of the Western Australian Museum Supplement No. 41, 1-125. Perth, WA.	J
530	Newbey, K.R., Dell, J., How, R.A. and Hnatiuk, R.J.	(1984).	The biological survey of the eastern Goldfields of Western Australia. Part 2. Widgiemooltha-Zanthus Study Area.	Records of the Western Australian Museum Supplement No. 18, 21-158. Perth, WA.	R
532	Orell, P., and Morris, K.	(1994).	Chuditch Recovery Plan 1992-2001. WA Wildlife Management Program No. 13.	Department of Conservation and Land Management, Perth.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 035, 041, 057, 064, 075, 080, 098, 101, 118, 164, 166, 182, 211, 217, 232, 240, 241, 258, 260, 268, 272, 278, 287, 313, 330, 390, 406, 415,

428, 459, 519, 544, 562, 577, 597, 647, 685 and 686 in Appendix A.

# Dampierland 1 (*DL1 – Fitzroy Trough subregion*)

GORDON GRAHAM  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

There are four basic components to the subregion. These comprise;

- Quaternary sandplain overlying Jurassic and Mesozoic sandstones with Pindan. There are hummock grasslands on hills.
- Quaternary marine deposits on coastal plains, with mangal, samphire – *Sporobolus* spp. grasslands, *Melaleuca alcephila* low forests, and *Spinifex* spp. – *Crotalaria* spp. strand communities.
- Quaternary alluvial plains associated with the Permian and Mesozoic sediments of Fitzroy Trough support tree savannahs of ribbon grass (*Chrysopogon* spp.), bluegrass (*Dichanthium* spp.) and Mitchell grass (*Astrelba* spp.) scattered coolibah (*Eucalyptus microtheca*) – *Bauhinia cunninghamii*. There are riparian forests of river red gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca* spp.) fringe drainages.
- Devonian reef limestones in the north and east support sparse tree steppe over lobed spinifex (*Triodia intermedia*) and limestone spinifex (*T. wiseana*) hummock grasses.

The climate is described as dry hot tropical and semi-arid with summer rainfall. The average annual rainfall is between 500 – 800 mm. The subregional area of DL1 is 3, 614, 096 ha.

The Fitzroy Trough is the semi-arid northern periphery of Canning Basin containing the middle and lower catchments of the Fitzroy River. It includes the alluvial plains associated with this river (mainly erosional products from the Central Kimberley, but also from the South Kimberley Interzone via Christmas Creek), and areas of sandplain and eroded dune surfaces derived from the Canning Basin. Extensive coastal mud flats are associated with the Fitzroy delta. Devonian limestone barrier reef structures are preserved along its northern and eastern peripheries. There are woodlands of Pindan, Boab (*Adansonia gregorii*) and Eucalyptus. Rainforest patches and hummock grassland occur on limestone.

Broad scale vegetation mapping of the area describes the following components;

- Mangroves.
- Saline tidal mudflats +/- samphire.
- *Eucalyptus microtheca* (coolibah) and/or *Eucalyptus* spp. +/- *Excoecaria parvifolia* (guttapercha tree) grassy low woodland.
- *Astrelba pectinata* (barley Mitchell grass) closed-tussock grassland +/- low trees.
- *Dichanthium fecundum* (curly bluegrass) and *Chrysopogon fallax* (golden beard grass) tussock grassland sparsely wooded with low trees.

- Swamps, lakes and lagoons, frequently ephemeral +/- fringing woodlands, shrublands, herblands and sedgeland.
- *Eucalyptus tetradonta* (Darwin stringybark), *Eucalyptus miniata* (Darwin woollybutt) +/- *Eucalyptus* spp. +/- *Livistona* spp. (fan palms) woodland with a ground layer of tussock grasses and *Triodia bitextura*.
- *Adansonia gregorii* (boab), *Bauhinia cunninghamii* and *Grevillea striata* (beefwood) grassy low open-woodland.
- *Corymbia dampieri* low open-woodland with *Acacia* spp. Shrubs and *Triodia pungens* (soft spinifex) and *Triodia bitextura* hummock grasses.
- *Corymbia dampieri* and *Corymbia zygophylla* low open-woodland with *Acacia eriopoda* (Broome pindan wattle) shrubs and *Triodia* spp. (spinifex) hummock grasses or *Adansonia gregorii* (boab), *Grevillea striata* (beefwood) and *Bauhinia cunninghamii* low open-woodland.
- *Acacia ancistrocarpa* (Fitzroy wattle) and/or *Acacia eriopoda* (Broome pindan wattle) and/or *Acacia monticola* (Gawar) tall shrubland with *Triodia intermedia* (lobed spinifex) and *Triodia pungens* (soft spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (lobed spinifex) and/or *Triodia bitextura* hummock grassland wooded with *Eucalyptus* spp or *Bauhinia cunninghamii* low trees.
- *Triodia wiseana* (limestone spinifex) open-hummock grassland wooded with low trees of *Terminalia* spp. or *Adansonia gregorii* (boab).
- *Astrelba lappacea* (wheat Mitchell) and/or *Astrelba pectinata* (barley Mitchell grass) tussock grassland sparsely wooded with *Acacia* spp. low trees.
- *Corymbia dampieri* low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (lobed spinifex) hummock grasses.
- *Acacia ancistrocarpa* (Fitzroy Wattle) and/or *Acacia eriopoda* (Broome pindan wattle) open-shrubland with *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (lobed spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (lobed spinifex) hummock grassland sparsely wooded with low trees.
- *Eucalyptus tectifera* (Darwin Box), *Corymbia flavescens* woodland with *Chrysopogon* spp. (ribbon grass) tussock grasses.

### Dominant land use

(see Appendix B, key b)

- (ix) Grazing – Native pastures
- (xi) UCL and Crown reserves
- (xiii) Conservation

### Continental Stress Class

The Continental Stress Class for DL1 is 4.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- Devonian reef system.
- Tunnel Creek, with it being the only known example in WA of a river passing through a range via a cave.
- Tunnel Creek is an important location for bat colonies, most notably a ghost bat (*Macroderma gigas*) colony.
- Rivers passing through Devonian reef such as in the formation of Windjana and Geikie gorges.
- Mound springs on coastal mudflats associated with the Big Springs complex with rainforest patches found on several larger ones.
- Extensive cave system of the Lawford Ranges (Mimbi Caves).
- Camballin Floodplain being one of the few large floodplains of the Kimberley region.

#### Centres of Endemism:

Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

The nature of this aspect is poorly known. 'Dry' rainforest patches, (as well as swamp rainforests), Mangroves, and Riparian zones provide dry season refuges. Further research of the cave systems associated with Devonian reef systems is warranted.

#### High Species and Ecosystem Diversity:

Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 (System 7) formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. Previous rainforest studies are applicable (McKenzie *et al* 1991).

Apart from specific survey work there has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Tunnel Creek WA012	B1	iv	vi	ii	Limited information. xii (human impact through use)
Windjana Gorge WA013	B1	iii	iii	ii	xii (siltation due to degradation in the catchment; potential for human impact pollution and general degradation)
Big Springs WA114	B17	iii	iii	ii	iv
Camballin Floodplain (Le Lievre Swamp System) WA017		ii	iii	ii	x, v (pigs), iv
Geikie Gorge WA 019	B1	ii	iii	ii	xii (siltation due to degradation in the catchment; potential for human impact pollution and general degradation)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Wollamor Claypan	17°06'00"S 124°05'00"E	B6	ii	ii	iii	ii	iv
Subterranean soak and creek systems of the Lawford Ranges	18° 40' S 126° 04' E	B19	ii	iv	vi	i	xii (possible increased human impacts)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x, vi, xii (potential for human impacts from tourism in certain locations)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Organic mound spring communities of Big Springs	V	43	ii - iii	iii	iii	iv

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

There are many widespread vegetation types across this subregion that are threatened by changed fire regimes.

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Dampierland region.	V	15, 38, 42	Variable	iii	ii	iv, vii
Vine thickets of limestone ranges: Napier Range, and Jeremiah hills.	V	2	Unknown	iii	ii	iv, vii
Invertebrate community of Napier Range Cave on Old Napier Downs.	V	43	Unknown	vi	iii	Unknown threatening processes
Invertebrate assemblages of the cliff foot springs around Devonian reef system. Black soils. Springs drying up due to dewatering of karst systems	V	43	Unknown	vi	iii	x
Invertebrate community of Tunnel Creek	V	43	Unknown	vi	iii	Limited information, though xii (human impact through use) is likely
Landsnail communities of limestone reefs		N/A	Unknown	vi	Unknown	vii, iv (stock), vi

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Erythrorichis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Rhinonictes aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<i>Phaps histrionica</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Cullen candidum</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Blumea pungens</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Goodenia sepalosa</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Nymphoides beaglensis</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Dampierland vegetation associations are not reserved within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
32	Shrublands, pindan; Acacia shrubland with scattered low trees over <i>Plectrachne</i> spp. and <i>Triodia</i> spp.	35,672
37	Shrublands; teatree ( <i>Melaleuca</i> spp.) thicket.	14,505
41	Shrublands; teatree ( <i>Melaleuca</i> spp.) scrub.	11,680
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	36,558
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	81,828

Beard Veg Assoc	Description	Area (Ha.)
64	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	460,411
67	Grasslands, tall bunch grass savannah, sparse low tree; ribbon grass ( <i>Chrysopogon</i> spp.) paperbarks ( <i>Melaleuca</i> spp.).	28779
73	Grasslands, short bunch grass savannah, grass; salt water couch ( <i>Sporobolus virginicus</i> ).	242,046
93	Hummock grasslands, shrub steppe; Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	1,030
101	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over soft spinifex ( <i>Triodia pungens</i> ).	13
104	Hummock grasslands, shrub steppe; silverleaf grevillea ( <i>Grevillea refracta</i> ) and <i>Hakea</i> spp. over soft spinifex ( <i>Triodia pungens</i> ).	90,204
117	Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ).	27,410
125	Bare areas; salt lakes.	2,285
126	Bare areas; freshwater lakes.	259
175	Short bunch grassland - savannah/grass plain.	18,549
676	Succulent steppe; samphire.	207
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) on sandplain.	1,885,682
700	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) between dunes.	1,046,019
701	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. and <i>Grevillea</i> spp. over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ) on sandy plateau.	115,505
702	Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	25,551
704	Grasslands, short bunch grass savannah low tree and sparse shrubs; bauhinia ( <i>Bauhinia cunninghamii</i> ), <i>Acacia eriopoda</i> and <i>Acacia</i> spp. over <i>Aristida</i> spp. short grasses on river flats.	65,444
705	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	19,218
707	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	215,223
710	Mosaic: Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)/hummock grasslands, grass steppe soft spinifex ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ).	27,073
712	Mosaic: Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> )/Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	258,457
716	Mosaic: Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	12,276
721	Hummock grasslands, sparse tree steppe; eucalypt and bauhinia ( <i>Bauhinia cunninghamii</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	55,049
722	Shrublands, pindan; <i>Acacia</i> spp. and <i>Acacia eriopoda</i> shrubland with sparse low bauhinia ( <i>Bauhinia cunninghamii</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	14,652
724	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ).	154
737	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	38,160
742	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp.	11
743	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia suberosa</i> and bauhinia ( <i>Bauhinia cunninghamii</i> ) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	4108
745	Shrublands, pindan; <i>Acacia</i> spp. shrubland with scattered low trees over spinifex.	246
751	Shrublands, pindan; <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low <i>Eucalyptus confertiflora</i> over curly spinifex ( <i>Triodia bitextura</i> ).	13,411
752	Hummock grasslands, shrub steppe; pindan wattle ( <i>Acacia tumida</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	7,129
Beard Veg Assoc	Description	Area (Ha.)
754	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	195,258
755	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) and <i>Acacia</i> spp. shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	19,881
756	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp. mixed with coolibah and ghost gum ( <i>Eucalyptus bella</i> ).	2,838
757	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) and <i>Acacia</i> spp. shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	16,926
759	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	55,395
761	Hummock grasslands, shrub steppe; <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) over <i>Triodia</i> spp. and winged spinifex ( <i>Triodia intermedia</i> ) sandplain	27,575

762	Hummock grasslands, shrub steppe; <i>Acacia eriopoda</i> over soft spinifex ( <i>Triodia pungens</i> ).	7,939
764	Shrublands, pindan; <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	581,958
765	Shrublands, pindan.	185,199
767	Hummock grasslands, shrub steppe; silverleaf grevillea ( <i>Grevillea refracta</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	599
770	Shrublands; Wattle thicket near Broome.	878
771	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with ghost gum ( <i>Eucalyptus bella</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) medium woodland over curly spinifex ( <i>Triodia bitextura</i> ).	36,173
840	Grasslands, tall bunch grass savannah, ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	36,663
854	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.).	5,975
864	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	2,424
866	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil.	7,152
867	Grasslands, high grass savannah low woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	5,239
1271	Bare areas; claypans.	1,745
2041	Succulent steppe with scrub; teatree ( <i>Melaleuca</i> spp.) over saltflats.	153
7001	Shrublands, pindan; <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low cabbage gum ( <i>Eucalyptus grandifolia</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	110,505
8003	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ).	123,265

Poorly represented ecosystems subject to threat:

Savannah communities of which <i>Callitris intratropica</i> is a component.
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Dampierland region.
Organic mound spring communities of Big Springs
Vine thickets of limestone ranges: Napier Range, and Jeremiah hills.
Invertebrate community of Napier Range Cave on Old Napier Downs.
Landsnail communities of limestone reefs.

Note: the lack of study in some areas precludes statements about the level of reservation required.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Competing Land Uses:** Pastoral production, mining.

**Economic:** Land prices for pastoral leases.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

## Bioregional and subregional priority for reserve consolidation

The Dampierland has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). However this may need to be increased because of the creation of several conservation parks within the Fitzroy Trough subregion. There continue to be problems with the continued impact of inappropriate fire regimes and uncontrolled

stock grazing. The fire issue is becoming particularly relevant for the Pindanland subregion. It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity). In terms of priority the Pindanland subregion would have a higher priority than the Fitzroy Trough subregion.

## Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial prescribed burning along with some opportunistic hand burns with the latter being confined to very small areas of the Fitzroy Trough subregion. The extent of other threatening processes, for example weeds, is yet to be determined. Due to uncontrolled stock access, changes are occurring within parks particularly in valley systems.

Estate	Rank <sup>1</sup>	Issues
<b>National Parks</b>		
Windjana Gorge	ii	Ranger presence during the tourist season. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
Geikie Gorge	ii	Full time ranger presence. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
<b>Conservation Parks</b>		
Brooking Gorge	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
Devonian Reef	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
<b>Nature Reserves</b>		
Point Coulomb	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Fitzroy Trough subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.

- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes  
Gouldian Finch Recovery Plan.  
Draft Kimberley Region Management Plan (various strategies).

### Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Environmental Management Systems:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

## Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, traditional owners and the broader community. For example with mound springs the recovery actions would be (ix) fire management, (vii) feral animal control and (vi) weed control.

## Existing ecosystem recovery plans

There are no existing recovery plans relevant to ecosystems at risk in DL1.

## Subregion priority for off reserve conservation

For much of the subregion, (ii) (see Appendix C, rank 6), where a large off park effort is needed, and resource constraints and limited community capacity exist. However for some focused areas (iv), limited off park measures will result in significant conservation gains.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

## Feasible opportunities for NRM

**Capacity Building:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) co-ordinated through Land Conservation District Committee.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management, such as making national parks accessible.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

## Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

## Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be necessary for both subregions however due to the continuing and growing impacts within the Pindanland subregion this may have higher priority than the Fitzroy Trough. The rank for both subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development system.

## Data gaps

### Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Surveys:** No systematic quadrat based fauna and/or flora sampling programme across the

subregion to provide a basis for modelling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

**Other:** Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 258, 268, 298, 418, 437, 483, 492, 495, 551, 556, 592,

626, 634, 635, 636, 637, 648, 692, 693 and 714 in Appendix A.

# Dampierland 2 (*DL2 – Pindanland subregion*)

GORDON GRAHAM  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

There are four basic components to the subregion. These comprise;

- Quaternary sandplain overlying Jurassic and Mesozoic sandstones with Pindan. There are hummock grasslands on hills.
- Quaternary marine deposits on coastal plains, with mangal, samphire – *Sporobolus* spp. grasslands, *Melaleuca alsophila* low forests, and *Spinifex* spp. – *Crotalaria* spp. strand communities.
- Quaternary alluvial plains associated with the Permian and Mesozoic sediments of Fitzroy Trough support tree savannahs of ribbon grass (*Chrysopogon* spp.) – bluegrass (*Dichanthium* spp.) grasses with scattered coolibah (*Eucalyptus microtheca*) – *Bauhinia cunninghamii*. There are riparian forests of river red gum (*Eucalyptus camaldulensis*) and Cadjeput (*Melaleuca* spp.) fringe drainages.

The climate is described as dry hot tropical and semi-arid with summer rainfall. The average annual rainfall is between 450 – 700 mm, slightly lower than the Fitzroy Trough subregion. The area of DL2 is 5, 198, 904 ha.

The Pindanland subregion comprises sandplains of the Dampier Peninsular and western part of Dampier Land, including the hinterland of the Eighty Mile Beach. It is a fine-textured sand-sheet with subdued dunes and includes the paleodelta of the Fitzroy River. The vegetation is described primarily as pindan. This is the coastal, semi-arid, north-western margin of the Canning Basin.

Broad scale vegetation mapping of the area describes the following components;

- Mangroves.
- Coastal dune communities.
- Ephemeral herblands and/or grasslands with scattered low trees.
- Mixed species tussock grasslands or sedgelandes +/- emergent *Pandanus* spp. (screw palm).
- *Eucalyptus tectifera* (Darwin box), *Corymbia flavescens* woodland with *Acacia tumida* (pindan wattle) open-scrub and *Chrysopogon* spp. (ribbon grass) and *Triodia bitextura* grasses.
- *Eucalyptus tetradonta* (Darwin stringybark), *Eucalyptus miniata* (Darwin woollybutt) +/- *Eucalyptus* spp. +/- *Livistona* spp. (fan palms) woodland with a ground layer of tussock grasses and *Triodia bitextura*.
- *Melaleuca citrolens* (lemon-scented teatree) and *Melaleuca* spp. (paperbark) low woodland with sparse *Chrysopogon fallax* (golden beard grass) tussock grasses.

- *Adansonia gregorii* (boab), *Bauhinia cunninghamii* and *Grevillea striata* (beefwood) grassy low open-woodland.
- *Corymbia dampieri* low open-woodland with *Acacia* spp. Shrubs and *Triodia pungens* (soft spinifex) and *Triodia bitextura* hummock grasses.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia* spp. (spinifex) hummock grasses or sometimes a hummock grassland without trees.
- *Acacia ancistrocarpa* (Fitzroy wattle) and/or *Acacia eriopoda* (Broome pindan wattle) and/or *Acacia monticola* (Gawar) tall shrubland with *Triodia intermedia* (lobed spinifex) and *Triodia pungens* (soft spinifex) hummock grasses.
- *Grevillea refracta* +/- *Hakea lorea* corkwood open-shrubland with *Triodia pungens* (soft spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia schinzii* hummock grassland wooded with low trees and *Acacia* spp. Shrubs.

### Dominant land use

(see Appendix B, key b)

- (ix) Grazing – Native pastures
- (xi) UCL and Crown reserves

### Continental Stress Class

The Continental Stress Class for DL2 is currently 6, however, given the continuing impacts of landscape scale threatening processes this may need to be reviewed.

Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

- Numerous patches of rainforest found mainly behind the coastal primary dune system with a structure unique to the Dampier Peninsula.
- The extensive mudflats of Roebuck Bay and Eighty Mile Beach resulting from two major paleoriver systems.
- The enormous numbers of migratory birds found at Roebuck Bay and Eighty Mile Beach.
- *Keraudrenia exastia* and *Pandanus spiralis* var. *flammeus* are both declared rare species.
- The vast grasslands of the Roebuck Plains.
- Coastal swamps adjacent to Eighty Mile Beach.
- Claypans support populations the uncommon aquatic plant *Nymphaea indica* (G. Keighery pers. comm.).

### Centres of Endemism:

Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic

species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

The nature of this aspect is poorly known. 'Dry' rainforest patches, (as well as swamp rainforests), Mangroves, Riparian zones and Springs (particularly associated with the Edgar Ranges area) provide dry season refuges.

#### High Species and Ecosystem Diversity:

Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Bunda-Bunda Mound Springs WA016	B17	iii	iii	ii	iv, vii
Eighty Mile Beach System WA018	A5	iv	vi	ii	iv, xii (excessive human disturbance, potential for irrigated agriculture using groundwater inland), xi (pollution is a potential threat)
Roebuck Bay WA020	A7	Terrestrial ii, Marine iv	Terrestrial iii, Marine vi	ii	xii (excessive human disturbance, non sustainable hunting of dugong), xi (pollution is a potential threat)
Roebuck Plains System WA021	A7	iii	iii	ii	iv, vii
Willie Creek Wetlands WA022		iii	iii		x (groundwater extraction, causeway construction), v (feral animals), xii (expansion of the town of Broome)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

No wetlands of subregional significance have been identified in DL2.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula	V	2	ii	iii	iii	iv, vii, ii
Species-rich faunal community of the intertidal mudflats of Roebuck Bay.	V	40	iii	vi	iii	xii (human impact), xi (possible pollution)
Disaster Bay organic mound spring communities.		N/A	ii-iii	vi	iii	iv, xii (soil compaction by cattle; potential changes in sea level due to

The CTRC report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. Previous rainforest studies are applicable (McKenzie *et al* 1991).

Apart from specific survey work there has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

						climate change)
Bunda Bunda organic mound spring communities	V	N/A	ii	iii-iv	iii	iv, vi, xii (soil compaction and erosion)
Assemblages of the organic springs and mound springs of Mandora Marsh area	V	N/A	i-ii	iii	iii	iv (cattle), xii (soil compaction and erosion)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

There are many widespread vegetation types across this subregion that are threatened by changed fire regimes.

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Dampierland region.	V	15, 38, 42	Variable	iii	ii	iv, vii, v
Organic mound spring communities of Lolly Well spring.	P1	N/A	iii	iv	iii	x (ground water abstraction), vii, xii (road construction is affecting salt inflow and fresh water outflows; litter), vi
Nimalaica clay pan community. Inland from Willie Creek.	P4	42	Unknown	iii	iii	x (groundwater extraction, causeway construction), v (feral animals), xii (expansion of the town of Broome)
Saline grasslands on tidal flats above high-water mark ( <i>Sporobolus virginicus</i> dominated) on Dampier Peninsula/Broome area.	P1	37	Unknown	vi	ii	vii
Vine thickets on heavily ferruginised Emeriau sandstone on Dampier Peninsula.		2	Unknown	vi	ii	vii, v
Flora and fauna assemblages of spring communities Logues Spring, south-west Kimberley Edgar Range near Dampier Downs.		43	ii	iii	iii	iv
Assemblages of Culla Culla Creek – unusual spring site in Dampierland.			Unknown	vi	ii	Unknown threatening processes
Assemblages of Taylors Lagoon, Lake Champion, and Lake Eda.	V	42	Unknown	vi	iii	Unknown threatening processes

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	Unknown	vi	ii	vii, v (predators)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Erythrorchis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Caretta caretta</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Lepidochelys olivacea</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Chelonia mydas</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Dermochelys coriacea</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Eretmochelys imbricata</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Natator depressus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<i>Crocodylus porosus</i>	S4	Unknown	v	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Rhinonictis aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda subclarescens</i>	Near threatened	Unknown	iii	iii	vii
<i>Phaps histrionica</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Keraudrenia exastia</i>	CR	Unknown	iv	iii	xii (urban impacts; potential land clearing)
<i>Pandanus spiralis</i> var. <i>flammeus</i>	E	Unknown	v	iii	iv, vi
<b>PRIORITY 1</b>					
<i>Cullen candidum</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Glycine pindanica</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Nicotiana heterantha</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Sauropus salignus</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Gomphrena pusilla</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Goodenia sepalosa</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Nymphoides beaglensis</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Olax spartea</i>	2	Unknown	vi	Unknown	No known threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

The following Dampierland vegetation associations are not reserved within the bioregion:

Beard Veg Assoc.	Description	Area (Ha)
32	Shrublands, pindan; Acacia shrubland with scattered low trees over <i>Plectrachne</i> spp. and <i>Triodia</i> spp.	35,672
37	Shrublands; teatree ( <i>Melaleuca</i> spp.) thicket.	14,505
41	Shrublands; teatree ( <i>Melaleuca</i> spp.) scrub.	11,680
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	36,558
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	81,828
64	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	460,411
67	Grasslands, tall bunch grass savannah, sparse low tree; ribbon grass ( <i>Chrysopogon</i> spp.) paperbarks ( <i>Melaleuca</i> spp.).	28779
73	Grasslands, short bunch grass savannah, grass; salt watermarine couch ( <i>Sporobolus virginicus</i> ).	242,046
93	Hummock grasslands, shrub steppe; Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	1,030
101	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over soft spinifex ( <i>Triodia pungens</i> ).	13
104	Hummock grasslands, shrub steppe; silverleaf grevillea ( <i>Grevillea refracta</i> ) and <i>Hakea</i> spp. over soft spinifex ( <i>Triodia pungens</i> ).	90,204
117	Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ).	27,410
125	Bare areas; salt lakes.	2,285
126	Bare areas; freshwater lakes.	259
175	Short bunch grassland - savannah/grass plain.	18,549
676	Succulent steppe; samphire.	207
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and <i>Eucalyptus setosa</i> over soft ( <i>Triodia pungens</i> ) and <i>Triodia bitextura</i> on sandplain.	1,885,682
700	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and <i>Eucalyptus setosa</i> over soft ( <i>Triodia pungens</i> ) and <i>Triodia bitextura</i> between dunes.	1,046,019
701	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. and <i>Grevillea</i> spp. over soft spinifex ( <i>Triodia pungens</i> ) and winged lobed spinifex ( <i>Triodia intermedia</i> ) on sandy plateau.	115,505
702	Hummock grasslands, grass steppe; winged lobed spinifex ( <i>Triodia intermedia</i> ).	25,551
704	Grasslands, short bunch grass savannah low tree and sparse shrubs; bauhinia ( <i>Bauhinia cunninghamii</i> ), Broome pindan wattle ( <i>Acacia eriopoda</i> ) and <i>Acacia</i> spp. over <i>Aristida</i> spp. short grasses on river flats.	65,444
705	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over lobed spinifex ( <i>Triodia intermedia</i> ).	19,218
707	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	215,223
710	Mosaic: Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)/hummock grasslands, grass steppe soft spinifex ( <i>Triodia pungens</i> ) and <i>Triodia bitextura</i> .	27,073
712	Mosaic: Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and <i>Eucalyptus setosa</i> over soft ( <i>Triodia pungens</i> ) and <i>Triodia bitextura</i> /Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), <i>Bauhinia cunninghamii</i> and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.).	258,457
716	Mosaic: Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.)/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and lobed spinifex ( <i>Triodia intermedia</i> ).	12,276
721	Hummock grasslands, sparse tree steppe; eucalypt and bauhinia ( <i>Bauhinia cunninghamii</i> ) over lobed spinifex ( <i>Triodia intermedia</i> ).	55,049
722	Shrublands, pindan; <i>Acacia</i> spp. and <i>Acacia eriopoda</i> shrubland with sparse low <i>Bauhinia cunninghamii</i> and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	14,652
724	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged lobed spinifex ( <i>Triodia intermedia</i> ).	154
737	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over <i>Triodia bitextura</i> .	38,160
742	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp.	11

Beard Veg Assoc.	Description	Area (Ha)
743	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia suberosa</i> and bauhinia ( <i>Bauhinia cunninghamii</i> ) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	4108
745	Shrublands, pindan; <i>Acacia</i> spp. shrubland with scattered low trees over spinifex.	246
751	Shrublands, pindan; <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low <i>Eucalyptus confertiflora</i> over <i>Triodia bitextura</i> .	13,411
752	Hummock grasslands, shrub steppe; pindan wattle ( <i>Acacia tumida</i> ) over winged lobed spinifex ( <i>Triodia intermedia</i> ).	7,129
754	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	195,258
755	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) and <i>Acacia</i> spp. shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	19,881
756	Medium woodland; river red gum ( <i>Eucalyptus camaldulensis</i> ) and <i>Terminalia</i> spp. mixed with coolibah and ghost gum ( <i>Eucalyptus bella</i> ).	2,838
757	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) and <i>Acacia</i> spp. shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	16,926
759	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	55,395

761	Hummock grasslands, shrub steppe: <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) over <i>Triodia</i> spp. and spinifex ( <i>Triodia intermedia</i> ) sandplain	27,575
762	Hummock grasslands, shrub steppe: <i>Acacia eriopoda</i> over soft spinifex ( <i>Triodia pungens</i> ).	7,939
764	Shrublands, pindan: <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and <i>Eucalyptus setosa</i> over ribbon grass ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	581,958
765	Shrublands, pindan.	185,199
767	Hummock grasslands, shrub steppe: silverleaf grevillea ( <i>Grevillea refracta</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	599
770	Shrublands; Wattle thicket near Broome.	878
771	Shrublands, pindan; pindan wattle ( <i>Acacia tumida</i> ) shrubland with ghost gum ( <i>Eucalyptus bella</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) medium woodland over <i>Triodia bitextura</i> .	36,173
840	Grasslands, tall bunch grass savannah, ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	36,663
854	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.).	5,975
864	Grasslands, tall bunch grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.).	2,424
866	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over ribbon grass ( <i>Chrysopogon</i> spp.) on black soil.	7,152
867	Grasslands, high grass savannah low woodland: Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	5,239
1271	Bare areas; claypans.	1,745
2041	Succulent steppe with scrub; teatree ( <i>Melaleuca</i> spp.) over saltflats.	153
7001	Shrublands, pindan: <i>Acacia eriopoda</i> and pindan wattle ( <i>Acacia tumida</i> ) shrubland with scattered low <i>Eucalyptus grandifolia</i> and <i>Eucalyptus setosa</i> over ribbon ( <i>Chrysopogon</i> spp.) and <i>Triodia bitextura</i> .	110,505
8003	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ).	123,265

#### Poorly represented ecosystems subject to threat:

Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Dampierland region.
Species-rich faunal community of the intertidal mudflats of Roebuck Bay.
Monsoon (vine) thickets on coastal sand dunes of the Dampier Peninsula.
Disaster Bay organic mound spring communities.
Organic mound spring communities of Lolly Well spring.
Nimalaica clay pan community. Inland from Willie Creek.
Saline grasslands on tidal flats above high-water mark ( <i>Sporobolus virginicus</i> dominated) on Dampier Peninsula/Broome area.
Roebuck Bay freshwater seepage (sponges) community.
Vine thickets on heavily ferruginised Emeriau sandstone on Dampier Peninsula.
Flora and fauna assemblages of spring communities Logues Spring, south-west Kimberley Edgar Range near Dampier Downs.
Assemblages of Culla Culla Creek – unusual spring site in Dampierland.
Assemblages of Taylors Lagoon, Lake Champion, and Lake Eda.
Assemblages of the ephemeral Claypan at Cape Borda

Note: the lack of study in some areas precludes statements about the level of reservation required.

#### Subregional constraints in order of priority

(see Appendix B, key g)

**Competing Land Uses:** Pastoral production and mining.

**Economic Constraints:** Land prices for pastoral leases.

#### Bioregional and subregional priority for reserve consolidation

The Dampierland has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). However this may need to be increased because of the creation of several conservation parks within the Fitzroy Trough subregion. There continue to be problems with the continued impact of inappropriate fire regimes and uncontrolled stock grazing. The fire issue is becoming particularly relevant for the Pindanland subregion. It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity).

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

In terms of priority the Pindanland subregion would have a higher priority than the Fitzroy Trough subregion.

#### Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial prescribed burning along with some opportunistic hand burns with the latter being confined to very small areas of the Fitzroy Trough subregion. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks particularly in valley systems.

Estate	Rank <sup>1</sup>	Issues
<b>National Parks</b>		
Windjana Gorge	ii	Ranger presence during the tourist season. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
Geikie Gorge	ii	Full time ranger presence. Full extent of threatening processes (Fire, weeds, feral animals) need to be

		documented.
<b>Conservation Parks</b>		
Brooking Gorge	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
Devonian Reef	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.
<b>Nature Reserves</b>		
Point Coulomb	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in Pindanland subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats  
 The Action Plan for Australian Birds 2000  
 Action Plan for Australian Marsupials and Monotremes  
 Gouldian Finch Recovery Plan.  
 Draft Kimberley Region Management Plan (various strategies).

### Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of

strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Environmental Management Systems:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, traditional owners and the broader community. For example with mound springs the recovery actions would be (ix) fire management, (vii) feral animal control, (vi) weed control.

### Existing ecosystem recovery plans

There are no existing Recovery Plans that are relevant to any of the ecosystems at risk listed in DL2.

### Subregion priority for off reserve conservation

For much of the subregion the off park conservation priority is (ii) (see Appendix C, rank 6), where a large off park effort needed, resource constraints and a limited community capacity exist. However for some focused areas (iv), limited off park measures will result in significant conservation gains.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Environmental Management Systems:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committees.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management, for example in making national parks accessible.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be necessary for both subregions however due to the continuing and growing impacts within the Pindanland subregion this may have higher priority than the Fitzroy Trough. The rank for both subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production or development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation and regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the

subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

**Other Priority Data Gaps:** Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 120, 132, 173, 258, 268, 298, 418, 437, 483, 487, 488, 492, 495,

551, 556, 595, 626, 634, 635, 636, 637, 648, 674, 692, 693 and 714 in Appendix A.

# Esperance 1 (*ESP1 - Fitzgerald subregion*)

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SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

The Esperance bioregion is characterised by myrtaceous and proteaceous scrub and mallee heaths on sandplain overlying Eocene sediments; rich in endemics. Herbfields and heaths (rich in endemics) on abrupt granite tors and quartzite ranges that rise from the plain. Eucalypt woodlands occur in gullies and alluvial foot-slopes. The ESP1 subregion has variable relief, comprising subdued relief on the sandplains of the coastal region, punctuated with metamorphosed granite and quartzite ranges both inland and on the coastal plain. It lies mainly on the Bremer Sedimentary Basin and the eastern and western sections of the ESP1 subregion within the Albany-Fraser Orogen of the Yilgarn Craton. It has extensive western plains over Eocene marine sediment basement with small areas of Gneiss outcropping. Archaean greenstones – sand sheets with varying levels of lateritisation with gravel soils also occurs. The region is dominated by duplex soils and deep and shallow sands on the plains and dissected areas and by shallow sandy soils on the mountain ranges.

Vegetation types are diverse, often cryptic and significantly endemically localised in nature. Eucalypts dominate most systems in an unparalleled array of diversity. They very broadly include: coastal dune woodlands of *Eucalyptus utilis* and *E. cornuta*, coastal shrublands and heathlands dominated by *Agonis flexuosa*, *Eucalyptus angulosa* and *E. notactites*, mallee shrubland and heath (rich in endemics) dominated by *Eucalyptus captiosa*, *E. decipiens* subsp. *chalarata* and subsp. *adsmophloia*, *E. falcata*, *E. flocktoniae*, *E. lehmannii*, *E. phaenophylla*, *E. pleurocarpa*, *E. sporadica*, *E. tetraptera*, *E. thamnoides* and *E. uncinata*; mallet and moort woodlands on gravel rises, clay sheets and colluvial slopes and greenstone (rich in endemics) *Eucalyptus astringens* subsp. *redacta*, *E. cernua*, *E. divicola*, *E. megacornuta*, *E. platypus* subsp. *platypus* and *E. praetermissa* are typical dominants of these woodlands; Yate and York Gum (in the Pallinup system) woodlands on alluvials, Jarrah/Marri woodlands in the west and Goldfields woodland and mallee systems mixing with south coast and wheatbelt taxa on Greenstone in the east with *Eucalyptus annulata*, *E. bradycalyx*, *E. cernua*, *E. desmunderis*, *E. gardneri* subsp. *ravensthorpeensis*, *E. occidentalis*, *E. oleosa* subsp. *corvina*, and *E. salmonophloia*.

More cryptic vegetation communities comprise herbfields and heaths (rich in endemics) on abrupt granite tors and quartzite ranges that rise from the plain and the greenstone heath and shrublands. The subregion has a Temperate Mediterranean climate with 600 – 800 mm annual rainfall.

### Dominant land use

Mainly (vii) grazing - improved pasture & (iv) cultivation - dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves, (xiv) roads and other easements, (v) forestry plantation (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class of ESP1 is 3.

The subregion should be a higher continental stress class than 3 (perhaps 2), as approximately half of it has been cleared of native vegetation. There are some large reserves and areas of Unoccupied Crown Land in North-West and eastern end of the subregion, but agriculturally productive landscapes (and the vegetation types that previously grew there) are now almost completely cleared.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Near Shore Islands:

- Bald Island: haul out sites for New Zealand Fur Seal (*Arctocephalus forsteri*) and Australian Sea-lions (*Neophoca cinerea*); One of two known island refuges for Quokkas, and the only one on the south coast (isolated for approx 10,000 years); Significant breeding island for Great-winged Petrels (*Pterodroma macroptera*); Successful translocation site for Noisy Scrub-bird (*Atrichornis clamosus*); Vegetation is distinctive with stands of long unburnt (more than 100) *Callitris preissi* plus type locality for Bald Island Marlock *Eucalyptus conferruminata*.
- Doubtful Island: is a breeding site for both New Zealand Fur Seals and Australian Sea lions.
- Middle Doubtful Island is one of only two islands in WA known to have population of Yellow-footed Antechinus (*Antechinus flavipes*), the other is Michlemas.
- Red Islet (part of Fitzgerald River National Park) breeding site for Australian Sea-lions and New Zealand Fur Seals.
- Glasse Island: haul out and breeding site for Australian Sea-lions.
- Cheyne Island: Nesting sites for Hooded Plovers (*Charadrius rubricollis*) and Little Penguins (*Eudyptula minor*) and recently acquired as a Nature Reserve.

#### Rare Ecosystems:

- Stirling Range Montane Thicket and Heath of the South West Botanical Province – DRF includes *Dryandra montana*, *Sphenotoma drummondii* and *Andersonia axilliflora*, other priority taxa are *Adenanthos filifolius*, *Calothamnus crasus* and *Andersonia echinocephala*.

- Vegetation communities of the Ravensthorpe Range - *Eucalyptus argyphaea* low forest on magnesite on ridgetops and upper slopes. Species include *Beyeria brevifolia*, *Eremophila latrobei*, *Lasiopetalum rosmarifolium*, *Leucopogon carinatus*, *Melaleuca striata* and *Scaevola densifolia*.
- Thumb Peak/Mid Mount Barren Woolburup Hill *Eucalyptus acies* mallee heath - DRF includes *Cooperhooia georgei*, *Daviesia obovata* and *Grevillea infundibularis*.
- Montane Mallee Thicket Community, including *Banksia brownii*, *B. solandri*, *Eucalyptus marginata* and *Kunzea montana*.
- Plant assemblages of the Stirling Range National Park.
- Proteaceous and Myrtaceous assemblages of the Fitzgerald River National Park - sandplain and Barren Ranges heath families (e.g. Proteaceae, Myrtaceae, Epacridaceae)
- Manypeaks - Waychincup National Park. Diversity of avifauna, including high number of threatened species. High floristic diversity, especially Proteaceae, Epacridaceae, Papilionaceae and Myrtaceae.
- Cape Riche
- Ravensthorpe Range exhibits very high Eucalypt diversity

#### Vulnerable and Specially Protected Fauna:

- Birds include the Noisy Scrub-bird (*Atrichornis clamosus*), Western Ground Parrot (*Pezoporus wallicus*), Western Bristlebird (*Dasyornis longirostris*), Western Whipbird (*Psophodes nigrogularis*), Malleefowl (*Leipoa ocellata*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Little Bittern (*Ixobrychus minutus*), Australian Bustard (*Botaurus poiciloptilus*), Shy Heathwren (*Hylacola cauta*) and Rufous Fieldwren (*Calamanthus campestris*).
- CWR mammals, such as the Dibbler (*Parantechinus apicalis*), Heath Rat (*Pseudomys shortridgei*), Red-tailed Phascogale (*Phascogale calura*), Brush-tailed Phascogale (*Phascogale tapoatafa*), Southern Brown Bandicoot (*Isodon obesulus*), Tamar Wallaby (*Macropus eugenii derbianus*), Western Brush Wallaby (*Macropus irma*), and Water Rat (*Hydromys chrysogaster*). Numbats (*Myrmecobius fasciatus*) have been released into Stirling Range National Park.
- Reptiles such as *Lerista viduata* and Carpet Python (*Morelia spilota*).
- Rare invertebrates *Moggridgea* sp. S and *Rhytidid* sp. Undescribed.

#### Centres of Endemism:

- Stirling Ranges Flora
- Fitzgerald River National Park (Biosphere)
- Ravensthorpe Range Flora (see Landform Junctions below)

#### Refugia:

- Mountain-top and gully communities of the Stirling Range (Threatened Montane Heath community, *Allocasuarina decussata*).
- Gondwanan refugia in deeply incised south facing gullies contain relictual species ie. *Moggridgea* sp. S, unnamed Rhytidid).
- Mt Manypeaks - Two Peoples Bay (crossing into JF2 subregion) mountain tops as climatic refugia for Gondwanan relictual species including threatened birds.
- Fitzgerald River National Park is a refuge for CWR mammals, proteaceous endemics from impacts of *Phytophthora* sp.
- Bremer Bay-Pallinup area may provide relictual habitat for some species normally restricted to west of Albany and Two Peoples Bay area including: *Stipa compressa*, *Eucalyptus calcicola* subsp. *unita*, *Banksia grandis*, *Beaumea vaginalis* and others.

#### High Species or Ecosystem Diversity:

#### Geology:

- The igneous granite systems of the Yilgarn Craton southern edge inland, and the coastal and sub-coastal Albany - Fraser Orogen which includes Porongurup Range,
- The igneous greenstone gneiss and mixed quartzite metamorphose complex of the Ravensthorpe Range,
- The metamorphose sedimentary quartzite systems of the Stirlings and Barrens Group
- The Eocene sedimentary plain,
- Laterite archipelagos as breakaways and gravel rises, and
- Quaternary Aeolian coastal limestone units.

#### Drainage Systems:

- The internal lake systems of the North Stirlings area
- The long south eastern draining Pallinup and Corackerup system that brings the western wheatbelt flora to the Subregion,
- Very short south-eastern draining creeks and rivers south from Lookout Point east to Groper Bluff.
- Short southern draining rivers south of the Jarrahwood axis of the Bremer, Gairdner, Fitzgerald and Hamersley rivers,
- The Phillips and Jerdacuttup systems that drain south off the Ravensthorpe Ramp over the Jerdacuttup Fault,
- The Mallee Road sump internal drainage,
- The Pabelup wetland swamp system

#### Soil Systems:

- Limestone sands
- Duplex sand plains
- Spongolite colluviums
- Laterite gravel colluviums and rises
- Alluvial flats and valleys
- Clay plains and rises
- Granite sands and loams
- Quartzite sands
- Wetland sands and loams

#### Landform Junctions:

Considerable diversity exists along borders where different land systems and soil types meet. This means that species and vegetation types that are common in other areas are found in unique combinations at landform junctions. For example:

- East Mt Barren and Hopetoun marks the edge of the Esperance sandplain and contains a mix of sandplain and quartzite species. Indeed this is the edge of the two ESP subregions.

- Ravensthorpe Range contains a mix of species that are common in the Wheatbelt and South Coast and also includes endemic species.
- The Pallinup system provides a corridor where wheatbelt species such as York gum *Eucalyptus loxophleba*, jam *Acacia acuminata*, Swamp sheoak *Casuarina obesa* and flooded gum *Eucalyptus rudis* can exist on the South Coast.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern South Coast (System 3) and South Coast (System 2) in the CTRC Green Book (Conservation Through Reserves Committee 1974). Some but not all of these recommendations (with modification) were implemented over the following ten years. The ESP1

subregion is covered by a CALM Regional Management Plan, that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail (Department of Conservation and Land Management 1992). The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion. Management plans exist for the Stirling Range National Park (Herford *et al.* 1999) and Fitzgerald River National Park (Moore *et al.* 1991), and is in preparation for the Ravensthorpe Range. Interim Management Guidelines are in place for other conservation reserves (Waychinicup (Department of Conservation and Land Management 1994d), Corackerup, Peniup). The South Coast Macro Corridor Project identifies areas in ESP1 where improved landscape connectivity will benefit biodiversity conservation.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name	Location	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Balicup Lake System	34° 13'-34° 18' S, 117° 46'-118° 00' E 20 km E of Cranbrook	B8, B12	iii	vi	ii	xii (agricultural activity in part of catchment impacts on wetlands in the system), x, i, vi (agricultural weeds), ix
Culham Inlet System	33° 54' S, 120° 04' E; 6 km NW of Hopetoun	B7, B1, B12	ii	iii	iii	ix, xi (eutrophication, siltation), x, i, xii (increased flow and frequency of flooding)
Fitzgerald Inlet System	33° 49'-34° S, 119° 18'-119° 40' E; 35 km NE of Bremer Bay	A10, B8, B2, B12	iii	iii-iv	iii	ix (river inflows), xi (eutrophication), i, xii (increased flow and frequency of flooding)
Yellilup Yate Swamp System	34° 18'-34° 23' S 118° 51'-119° 09' E 22 km WNW of Bremer Bay	B15, B7	i	ii	iii	ix, x (inundation, eutrophication, siltation), i

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Blue Lagoon Suite	34° 27' S 119° 13' E Cheynes	A11-A12	ii, iii, v	iv	vi	i	No known threatening processes
Pabelup Suite	34° 06' S 119° 24' E Bremer	B6, B7, B8, B14	ii, iii, v	iii-i	iii-ii	iii	iv, ix, x, xii (eutrophication)
Corimup Suite	34° 35' S 118° 20' E (& surrounds) Manypeaks	B9, B10, B15	ii, iii, v	iii	iii	iii	xii (eutrophication), vii
Coyanarup Suite	34° 24' S 118° 06' E Borden	B15	ii, iii	iv	iv	ii	vii
Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Kojaneerup Suite	34° 21'- 30' S 118° 16'- 29' E Borden	B8	ii, iii	iii	iii	ii	ix
Manypeaks Suite	34° 11'- 34° 49' S 118° 04'- 119° 16' E South Stirling	B6, B8, B14	ii, iii, iv	iii-i	iv-ii	iii	ii, iv, ix, x
Marendiup Suite	34° 25' S	B9	ii, iii	iii	iv	i	vii, xi

	119° 10' - 11' E Bremer						
Mt Bland Lake	34° 11' S 119° 29' E Bremer	B9	ii	iv	iv	iii	x (possibly affected by diminishing rainfall)
Lake Chillinup	34° 33' S 118° 04' E South Stirlings	B7/B8	ii, iii, iv	ii	iii	iii	ix, x, i, iv, xii (access road has been re-aligned, may lead to runoff problems in lake)
Pabelup Suite (not including Yellilup Yate swamp system wetlands)	34° 06' - 23' S 119° 01' E - 25' Bremer	B6, B7, B8, B14	ii, iii	iii-i	iii-ii	iii	iv, ix, x, xii (eutrophication)
Qualimup Suite	34° 25' S 118° 59' E Bremer	A11	ii	iii-ii	iii	i	x
Swan Lake Suite	34° 43' S 117° 28' E Manypeaks	A11	ii, iii, iv, v	iii	iii	iii	xii (part of sandmining reserve), viii, i, vii

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

In general, when rivers in ESP1 are inundated (particularly with summer rainfall), bank erosion, and uprooting/burial of native riparian vegetation occurs.

Weed plant species then invade and overrun riparian areas.

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Fitzgerald River	ii	iv - iii	ii	ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion), i, ii, v, iii, vii, viii
Gairdner River	i - ii	ii - iii	ii	vi (Bridal Creeper, agricultural weeds), ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion)
Bremer River	i - ii	ii	ii	vi (Bridal Creeper, agricultural weeds), ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion)
Pallinup River	i - ii	ii	ii	vi (Bridal Creeper, agricultural weeds), ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion)
Hamersley River	iii	iv	ii	xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion), x
Phillips River	ii	iii	ii	ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion), vi (boxthorn, Bridal Creeper)
Waychinicup River	iii	iii - iv	ii	ix, x, xii (agricultural drainage; bank erosion, destruction of native vegetation, altered flow regimes and weed invasion), viii, vi (Bridal Creeper, Pine trees, agricultural weeds, <i>Watsonia</i> )

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

NOTE: Ranks for condition of riparian vegetation reflect variations in catchment land use activities e.g. for the Fitzgerald River much of the riparian vegetation is in good condition within conservation estate, while two major tributaries – the Sussetta and Twertup Rivers – are classed as degraded. Threatening processes refer to the latter listing.

## Ecosystems at Risk

### Threatened Ecological Communities (TECs)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
East Stirling Range Montane Heath and Thicket	CR	28	i	iii	iii	ii, viii ( <i>Phytophthora</i> sp.), vii
Thumb Peak, mid mount Barren, Woolburnup Hill <i>Eucalyptus acies</i> mallee heath	VU	29	iv	iv	iii	iii, iv
Montane Mallee Thicket Community	EN	29	ii	iii	iii	viii ( <i>Phytophthora</i> sp.)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
691	Mallee heath on Quartzite ranges of the Fitzgerald River National Park - <i>Eucalyptus</i> spp. Heath on quartzite ranges	DD, NE	29	iv	iv	iii	vii, viii
936, 142	Cocanarup Timber Reserve - <i>Eucalyptus salmonophloia</i> over <i>Acacia acuminata</i> woodland on red loams	NE	16	iii	v	ii	vii, vi (agricultural weeds, <i>Pycnantha</i> )
980, 38	Shallow loam and sandy loam over schist Mountain peaks of eastern Stirling Range (surrounding the East Stirling Ranges Montane Thicket TEC)	CR	28	ii	ii	iii	viii, vii, v (rabbit), xii (recreation)
986	High altitude peat swamps of the Stirling Range National Park <i>Xyris exilis</i>	NE	43	ii-iii	iii	ii	vii, v (rabbit)
968	Vegetation of ravines draining Southern Stirling Ranges	NE	4	ii-iii	ii-iii	i	vii, viii
42	<i>Eucalyptus goniantha</i> subsp. <i>notactites</i> mallee heath; <i>Eucalyptus goniantha</i> and <i>E. calcicola</i> on sandy limestone between Cape Riche and Bremer Bay	NE, DD	29	ii-iii	iv	i	vii
968, 4, 991	<i>Eucalyptus wandoo</i> woodland on loamy clays of Stirling Range National Park	NE	8	iii	iii	i	vii, viii, vi (wild oats), xii (heavy Mistletoe infestations)
982, 980	<i>Eucalyptus decipiens</i> low woodland of on sandy gravels South Stirlings	NE, DD	29	iii	iv	i	i (remnants remaining from broadscale vegetation clearing), vi (african love grass, veldt grass, Sydney wattle, Bridal Creeper), vii ( <i>Phytophthora</i> sp.)

Beard Veg Assoc	Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
931	<i>Eucalyptus occidentalis</i> woodlands over loamy clay in riparian zones (low landscape position)	NE, DD	8	ii	iii	i	i (remnants remaining from broadscale vegetation clearing), iv (historical grazing), vi (thistle, bridle creeper, wild oats, taylorina, arum lily), x, xii (lerp - ptsidid)
1967	<i>Eucalyptus occidentalis</i> woodlands on high ground loam over granite	NE, DD	8, 9	ii-iii	iii-iv	i	i (remnants remaining from broadscale vegetation clearing), iv, vi (wild oats), x, xii (lerp - ptsidid)
980	Jarrah-mallee heath on sandy gravels in the Cape Riche system	NE, DD	29	ii	iii	i	i (remnants remaining from broadscale vegetation clearing), viii, vii, vi (potential for invasion of Victorian Teatree)
931	Stirling Range Upland Yate Woodlands (to 15m) of <i>Eucalyptus cornuta</i> over a sparse shrub layer and open herbs.	P4	8	i	iii	ii	vii, v (rabbit), vi ( <i>Solanum nigrum</i> , <i>Carduus</i> sp, <i>Hypochoeris</i> sp.)
48	North Porongurups Ironstone - Winter wet shrubland. <i>Kunzea</i> sp, <i>Hakea</i> sp dominants	NE, DD	32	ii	iv	i	xii (restricted distribution)
929	Moort Woodlands - <i>Eucalyptus platypus</i> low forest on heavy clays	NE, DD	8		iv	i	ix, i (remnants remaining from broadscale vegetation clearing), x, vii
691, 552, 47	Ravensthorpe Range - Proteaceous heath thickets of the Ravensthorpe Range laterite upland	NE, DD	30	iii-iv	iv	i	vii, viii, xii (mining exploration)
938, 352, 47	Ravensthorpe Range - Mallet woodlands of breakaway slopes of Ravensthorpe Range	NE, DD	8	iii-iv	iv	i	xii (mining exploration), vii
48, 980	<i>Banksia</i> proteaceous heath on deep sands over gravel in the Waychinicup area	NE, DD	28	i	ii	i	viii ( <i>Phytophthora</i> sp.), vii, xii (human disturbance, recreation particularly 4WD vehicles and motor bikes)
48, 980	<i>Hakea</i> proteaceous heath of Mt Manypeaks and Waychinicup - <i>Hakea cucullata</i> , <i>H. elliptica</i> and <i>H. lasianthoides</i> heaths on gravels over granite	NE, DD	28	ii-iii	iii	i	viii ( <i>Phytophthora</i> sp.), vii
938, 352, 47	Ravensthorpe Range - <i>Eucalyptus</i> spp on red loams lower foothills of the eastern Ravensthorpe Range	NE, DD	27	iii	iv	i	i (remnants remaining from broadscale vegetation clearing), xii (mining exploration)
48	<i>Banksia baxteri</i> and <i>Lambertia inermis</i> heath on deep sands in Fitzgerald River National Park	NE, DD	28	iii	iv	i	viii, vii
48	<i>Banksia coccinea</i> community in dieback free area - Gull Rock	P2	30		ii	ii	viii (aerial canker, <i>Armillaria</i> , <i>Phytophthora</i> sp.), vii, xii (recreation)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroi</i>	V	iii	v	iii	v (fox, cat) vii
<i>Myrmecobius fasciatus</i> (release)	V	ii	unknown	iii	v (fox, cat), vii, ii (loss of habitat)
<i>Parantechinus apicalis</i>	E	ii	iv	iii	v (fox, cat), vii, viii
<i>Phascoqale calura</i>	E	ii	vi	i-ii	v (fox, cat), vii
<i>Pseudocheirus occidentalis</i>	V	ii	iii-iv	ii	v (fox, cat), vii
<i>Pseudomys shortridgei</i>	V	ii	iii-iv	ii	v (fox, cat), vii, xii (potential for mining in area)
<i>Setonix brachyurus</i>	V	iii	v	iii	v (fox, cat), vii, viii
** <i>Eubalaena australis</i>	E	unknown	v	ii	xii (whale watching; ecotourism)
** <i>Balaenoptera musculus</i>	V	unknown	vi	unknown	xii (whale watching; ecotourism)

<b>**Megaptera novaeangliae</b>	V	unknown	vi	unknown	xii (whale watching; ecotourism)
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Atrichornis clamosus</i>	V	ii-iii	v	iv	vii
<i>Botaurus poiciloptilus</i>	V	unknown	iii-iv	i	ix, x (loss of drought refuges), iv
<i>Calyptorhynchus baudinii</i>	V	unknown	vi	unknown	i, ii, vii
<i>Calyptorhynchus latirostris</i>	E	unknown	vi	unknown	i, ii, vii
<i>Dasyornis longirostris</i>	V	ii-iii	vi	unknown	vii
<i>Leipoa ocellata</i>	V	unknown	vi	unknown	v (foxes, cats, rabbits, goats), ii, vii, ix, iv, i
<i>Pezoporus wallicus flaviventris</i>	E	i	ii	iii	v (fox, cat), vii, viii
<i>Psophodes nigrogularis oberon</i>	V	iii	v	iv	v (fox), vii, viii
<i>Psophodes nigrogularis nigrogularis</i>	E	ii-iii	v	iii	v (fox), vii, viii
<b>**Cereopsis novaehollandiae grisea</b>	V	unknown	iv	unknown	xii (climate change; historic hunting by humans)
<b>**Diomedea exulans</b>	V	unknown	vi	unknown	xii (long line fishing, collision with trawlers)
<b>**Diomedea gibsoni</b>	V	unknown	vi	unknown	xii (long line fishing, collision with trawlers)
<b>**Thalassarche cauta</b>	V	ii	iv	iii	xii (long line fishing, collision with cables/trawlers)
<b>**Diomedea amsterdamensis</b>	E	unknown	vi	unknown	xii (long line fishing, collision with trawlers)
<b>**Halobaena caerulea</b>	V	unknown	vi	unknown	No information for species in region
<b>**Pterodroma mollis</b>	V	unknown	vi	unknown	No information for species in region
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 5 (FISH)</b>					
<b>**Carcharodon carcharias</b>	V	unknown	vi	unknown	xii (incidental capture by fisheries; shark control activities such as targeted hunting and shark nets; removal of fins; ecotourism)
<b>**Carcharias Taurus</b>	V	unknown	vi	unknown	xii (commercial and recreational fisheries; shark control activities such as targeted hunting and shark nets; ecotourism)
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 6 (SNAILS)</b>					
Undescribed <i>Rhytidid</i> sp. (WAM#2295-69)	E	i-ii	ii-iii	ii	vii, xii (climate change)

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	iii	vi	i	i, v (grazers), xii (pasture improvement; predation)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Neophoca cinera</i>	Near Threatened	unknown	unknown	unknown	xii (historic harvesting of high numbers of individuals has lead to small population size; commercial fishing removing food source and net entanglements); xi (pollution via oil spills is a potential threat)
<i>Arctocephalus forsteri</i>	Conservation Dependent	unknown	unknown	unknown	xii (historic harvesting of high numbers of individuals has lead to small population size; commercial fishing removing food source and net entanglements)

Species marked with \*\*asterisks indicate these species are occasional visitors to the subregion.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Flora

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Andersonia axilliflora</i>	CR	i	ii	iii	viii, vii
<i>Banksia brownii</i>	CR	i	ii	iii	viii, vii
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	CR	ii	v	ii	vi ( <i>Myrsiphyllum asparagoides</i> , <i>Oxalis</i> sp., Annual grasses), v (rabbit), xii (small number of individuals)
<i>Daviesia glossosema</i>	CR	i	ii	iii	viii, vii, xii (small number of individuals)
<i>Daviesia pseudaphylla</i>	CR	i	ii	iii	viii, vii, xii (small number of individuals)
<i>Drakaea confluens</i>	CR	ii	v	ii	xii (small number of individuals)
<i>Dryandra anatonata</i>	CR	i	ii	iii	viii, vii
<i>Dryandra montana</i>	CR	i	ii	iii	viii, vii, xii (small number of individuals)
<i>Grevillea maxwellii</i>	CR	ii	v	iii	xii (drought), vii
<i>Isopogon uncinatus</i>	CR	i	iii	iii	viii
<i>Lambertia orbifolia</i>	CR	ii	v	ii	viii, vii, xii (restricted distribution)
<i>Leucopogon gnaphalioides</i>	CR	i	ii	iii	vii, viii, xii (small number of individuals)
<i>Nemcia luteifolia</i>	CR	ii	iii	iii	viii, xii (single population)
<i>Persoonia micranthera</i>	CR	i	ii	iii	viii, vii, xii (small number of individuals)
<i>Acacia rhaphophylla</i>	E	iii	iv	ii	xii (single population)
<i>Adenanthos cunninghamii</i>	E	iii	iv	ii	ix (small number of individuals), vii ( <i>Phytophthora</i> sp.)
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	E	i	vi	ii	ii
<i>Apium prostratum</i> subsp. <i>phillipii</i>	E	iii	iv	ii	vi ( <i>Dolichus</i> pea, <i>Rubus fruticosus</i> , <i>Myosotis sylvatica</i> )
<i>Boronia clavata</i>	E	iii	iv	ii	xii (restricted distribution, small number of individuals)
<i>Centrolepis caespitosa</i>	E	ii	iv	ii	vi, xii (roadworks)
<i>Coopermookia georgei</i>	E	iv	iv	ii	xii (restricted distribution)
<i>Darwinia collina</i>	E	i	iii	ii	viii, vii
<i>Darwinia oxylepis</i>	E	ii	iii	ii	viii

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Darwinia</i> sp. Stirling Range (G.J. Keighery 5732)	E	ii	iii	ii	viii, vii
<i>Darwinia wittwerorum</i>	E	ii	iii	iii	viii
<i>Daviesia megacalyx</i>	E	iii	iv	ii	xii (restricted distribution)
<i>Dryandra ionthocarpa</i>	E	ii	iii	iii	viii, vii, vi ( <i>Myrsiphyllum asparagoides</i> , <i>Citrullus lanatus</i> , annual grasses, cape weed), xii
<i>Eucalyptus bennettiae</i>	E	ii	iv	ii	xii (small number of individuals)
<i>Eucalyptus burdettiana</i>	E	iii	iv	ii	xii (restricted distribution)
<i>Eucalyptus coronata</i>	E	iii	iv	ii	xii (restricted distribution)
<i>Grevillea infundibularis</i>	E	iv	iv	ii	xii (restricted distribution)
<i>Lambertia fairallii</i>	E	i	ii	iii	viii, vii, xii (restricted distribution)
<i>Myoporum cordifolium</i>	E	iii	v	iii	vii, xii (roadworks, small number of individuals), ix
<i>Orthrosanthus muelleri</i>	E	ii	iv	ii	vi (annual grasses), ix
<i>Sphenotoma drummondii</i>	E	ii	iii	ii	viii
<i>Verticordia fimbriolepis</i> subsp. <i>australis</i>	E	unknown	i	unknown	Unknown threatening processes
<i>Verticordia pityrhops</i>	E	iii	iv	ii	xii (restricted distribution)
<i>Villarsia calthifolia</i>	E	iii	iv	ii	xii (restricted distribution)
<i>Xyris exilis</i>	E	ii	iii	ii	vii (single population)
<i>Acacia awestoniana</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Acacia trulliformis</i>	V	ii	iii	ii	ii
<i>Adenanthos dobagii</i>	V	iv	iv	ii	xii (restricted distribution)
<i>Adenanthos ellipticus</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	V	iv	iv	ii	xii (restricted distribution)
<i>Andersonia pinaster</i>	V	ii	iii	iii	viii
<i>Asplenium obtusatum</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Banksia goodii</i>	V	iii	iv	ii	ii, xii (road works)
<i>Banksia verticillata</i>	V	iii	iv	ii	viii ( <i>Phytophthora</i> sp., <i>Armillaria</i> , canker)
<i>Caladenia harringtonii</i>	V	unknown	vi	unknown	vi ( <i>Watsonia</i> sp., <i>Acacia longifolia</i> , <i>Senecio glastifolius</i> )
<i>Chordifex abortivus</i>	V	iv	iv	ii	vii (single population)
<i>Conostylis misera</i>	V	iii	iii	ii	vi ( <i>Leptospermum laevigatum</i> , <i>Watsonia</i> sp., <i>Eragrostis curvula</i> ), v (rabbit)
<i>Darwinia meeboldii</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Darwinia squarrosa</i>	V	iii	iii	ii	viii, vii
<i>Deyeuxia drummondii</i>	V	ii	v	ii	xii (restricted distribution)
<i>Drakaea micrantha</i>	V	ii	iv	ii	xii (small number of individuals)
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	V	iii	iv	ii	vii
<i>Eremophila veneta</i>	V	ii	iv	ii	ix, iv
<i>Kunzea pauciflora</i>	V	iii	v	ii	xii (restricted distribution)
<i>Laxmannia jamesii</i>	V	iii	iv	ii	xii (small number of individuals)
<i>Lepidium aschersonii</i>	V	unknown	i	unknown	Unknown threatening processes
<i>Marianthus villosus</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Meziella trifida</i>	V	unknown	vi	unknown	Unknown threatening processes
<i>Microtis globula</i>	V	iii	iv	ii	vii
<i>Pleurophascum occidentale</i>	V	iii	v	ii	vii
<i>Ricinocarpos trichophorus</i>	V	iii	iv	ii	xii (small number of individuals)
<i>Stylidium galioides</i>	V	iv	iv	ii	xii (restricted distribution)
<i>Thelymitra psammophila</i>	V	iii	v	ii	xii (small number of individuals), vi (annual grasses), ix
<i>Tribonanthes purpurea</i>	V	iii	iv	ii	xii (restricted distribution)
<i>Verticordia carinata</i>	V	iii	iv	ii	xii (restricted distribution)
Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Verticordia crebra</i>	V	iii	iv	ii	xii (restricted distribution)

<i>Verticordia helichrysantha</i>	V	iii	iv	ii	xii (restricted distribution)
<b>PRIORITY 1</b>					
<i>Caladenia longifimbriata</i> ms	1	unknown	vi	unknown	Unknown threatening processes
<i>Dampiera sericantha</i>	1	ii	vi	ii	xii (appears to be disturbance opportunist)
<b>Priority 2</b>					
<i>Acacia nitidula</i>	2	iii	iv	iii	Unknown threatening processes
<i>Andersonia carinata</i>	2	unknown	iv	unknown	Unknown threatening processes
<i>Astroloma</i> sp. Fitzgerald (GJ Keighery 8376)	2	ii	vi	iii	xii (appears to be disturbance opportunist; soil disturbance), vii
<i>Austrostipa exilis</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Calochilus</i> sp. Hopetoun (H Taylor s.n.) [aff. <i>campestris</i> ]	2	ii-iii	iv	iii	Unknown threatening processes
<i>Gastrolobium rigidum</i>	2	ii-iii	iv	iii	xii (appears to be disturbance opportunist), Craig & Coates (2001) recommended deletion from priority list
<i>Goodenia scapiger</i> subsp. <i>graniticola</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Haegiela tatei</i>	2	unknown	iv	iii	xii (species is poorly collected)
<i>Hydrocotyle decipiens</i> ms	2	unknown	vi	unknown	Unknown threatening processes
<i>Isolepis australiensis</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Keraudrenia adenogyna</i> ms	2	unknown	vi	unknown	Unknown threatening processes
<i>Lasiopetalum maxwellii</i>	2	iii	iv	iii	xii (genus is undergoing taxonomic revision).
<i>Leucopogon compactus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Leucopogon florulentus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Leucopogon pleurandroides</i>	2	iii	iv	iii	xii (mining; appears to be disturbance opportunist), viii ( <i>Phytophthora cinnamomi</i> )
<i>Leucopogon</i> sp. Kau Rock (MA Burgman 1126) [aff. <i>allittii</i> ]	2	unknown	vi	unknown	Unknown threatening processes
<i>Melaleuca viminea</i> subsp. <i>appressa</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Opercularia rubioides</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Pimelea halophila</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Thysanotus brachiatus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Thysanotus parviflorus</i>	2	iii	iv	iii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease	Priority
4	Medium woodland; marri & wandoo				
8	Medium woodland; salmon gum & gimlet				
14	Low forest; jarrah				
27	Low woodland; paperbark ( <i>Melaleuca</i> sp.)	X			
31	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered York gum	X			
38	Shrublands; thicket, mixed	X			
42	Shrublands; mallee & acacia scrub on south coastal dunes	X			
47	Shrublands; tallerack mallee-heath	X			
48	Shrublands; scrub-heath	X			
50	Shrublands; dwarf scrub on granite (South coast)	X	X		
51	Sedgeland; reed swamps, occasionally with heath	X			
125	Bare areas; salt lakes	X			
126	Bare areas; freshwater lakes	X			
128	Bare areas; rock outcrops	X			

Beard Veg Assoc	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease	Priority
129	Bare areas; drift sand	X			
142	Medium woodland; York gum & salmon gum	X			
352	Medium woodland; York gum	X			
423	Shrublands; Acacia scrub-heath unknown spp	X			

511	Medium woodland; salmon gum & morrel	X			
516	Shrublands; mallee scrub, black marlock	X			
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>	X			
552	Shrublands; <i>Casuarina acutivalvus</i> & calothamnus (also melaleuca) thicket on greenstone hills				
676	Succulent steppe; samphire	X			
691	Shrublands; <i>Dryandra quercifolia</i> & <i>Eucalyptus</i> spp. thicket	X			
929	Low forest; moort ( <i>E. platypus</i> )				
931	Medium woodland; yate	X			
934	Shrublands; mallee scrub <i>Eucalyptus nutans</i>	X	X		
936	Medium woodland; salmon gum	X			
938	Medium woodland; York gum & yate	X			
940	Mosaic: Shrublands; mallee scrub, black marlock/Shrublands; tallerack mallee-heath	X			
942	Mosaic: Medium woodland; yate/Shrublands; mallee scrub, black marlock	X			
964	Shrublands; mallee scrub, black marlock & <i>Eucalyptus decipiens</i>	X			
965	Medium woodland; jarrah & marri	X			
967	Medium woodland; wandoo & yate	X			
968	Medium woodland; jarrah, marri & wandoo	X			
970	Low forest; jarrah & <i>Eucalyptus decipiens</i>	X			
975	Low woodland; jarrah	X			
976	Succulent steppe with low woodland; myoporum over samphire	X			
978	Low forest; jarrah, <i>Eucalyptus staeri</i> & <i>Allocasuarina fraseriana</i>				
980	Shrublands; jarrah mallee-heath	X			
982	Low woodland; <i>Eucalyptus decipiens</i>	X			
986	Shrublands; mallee-heath (Stirling Ra.)	X			
987	Medium woodland; jarrah & wandoo	X			
989	Shrublands; Albany blackbutt mallee-heath	X			
991	Medium woodland; small wandoo patches surrounded by e2, 5Mi; e5, 7Mi	X			
992	Medium forest; jarrah & wandoo ( <i>E. wandoo</i> )	X			
994	Low forest; jarrah & casuarina (probably <i>Allocasuarina fraseriana</i> )	X	X		
995	Shrublands; mallee scrub, bushy yate & Bald l. marlock	X			
1075	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & black marlock ( <i>E. redunca</i> )				
1077	Medium woodland; jarrah & river gum				
1413	Shrublands; acacia, casuarina & melaleuca thicket				
1967	Medium woodland; wandoo, yate & river gum	X			
2048	Shrublands; scrub-heath in the Mallee Region				

## Subregional constraints in order of priority

(see Appendix B, key g)

**Irreplacibility:** Very few options remain to conserve ecosystem and landscape.

### Limited Opportunity Remains to Meet CAR Criteria

**Economic Constraints** (to a lesser extent)

**Competing Land Uses:** Major components of the landscape are covered by mines, mining tenements or exploration leases (e.g. Mining in Ravensthorpe Range) and to a lesser extent grazing.

### Bioregional and subregional priority for reserve consolidation

Reserve consolidation rank is 5 (see Appendix D) on the table provided, but the bioregion should have an overall rank of 4 (Appendix C, rank 4). ESP1 is ranked 5 due to the relatively high level of reservation in the subregion, but ESP2 is under significantly more threat from mining, some vegetation associations have been extensively cleared and the reserve system is biased. Therefore, ESP2 should have a reserve consolidation rank of 3.

## Reserve management standard

Many ESP1 reserves, particularly in the higher rainfall western end of the Bioregion, are subject to loss of biodiversity due to impact from *Phytophthora cinnamomi*. Minor agricultural weed invasion on sandy soils along western and northern boundaries of conservation reserves does occur. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks

which are installed and maintained, some prescribed fuel reduction burning is undertaken on larger reserves - Manypeaks, Waychincup, Stirling Range, Corackerup, and Fitzgerald River. Feral predator control occurs in Manypeaks, Waychincup, Stirling Range, Corackerup, and Fitzgerald River National Parks only. Feral herbivore grazing (e.g. rabbits) occurs across most reserves, but goats are confined to Fitzgerald River.

Land status Class	Purpose	Reserve Number	Name	Category	Reserve Management <sup>1</sup>
A	National Park	14792	Stirling Range	National Park	iv
A	Conservation of Flora and Fauna	26160	Jebarjup	Nature Reserve	ii
A	Conservation of Flora and Fauna	26161	Camel Lake	Nature Reserve	ii
A	Conservation of Flora and Fauna	9159	Formby	Nature Reserve	ii
A	Conservation of Flora and Fauna	25583	Kalgan Plains	Nature Reserve	ii
A	Conservation of Flora and Fauna	25386	Chillinup	Nature Reserve	ii
C	Conservation of Flora and Fauna	26688	South Stirling	Nature Reserve	ii
A	National Park	25865	Waychincup	National Park	iii-iv
C	Conservation of Flora and Fauna	36028	Mount Manypeaks	Nature Reserve	iii
C	National Park	27502	Waychincup	National Park	iii-iv
C	Conservation of Flora and Fauna	36719	Arpenteur	Nature Reserve	i
A	Conservation of Flora and Fauna	25869	Bald Island	Nature Reserve	iii
C	Conservation of Flora and Fauna	27157	Cheyne Road	Nature Reserve	ii
A	National Park	26650	Hassell	National Park	i
C	Conservation of Flora and Fauna	26264	Tinkelelup	Nature Reserve	ii
A	Conservation of Flora and Fauna	29128	Basil Road	Nature Reserve	ii
C	Conservation of Flora and Fauna	26894	Mettler Lake	Nature Reserve	ii
C	Conservation of Flora and Fauna	26264	Mailalup	Nature Reserve	ii
C	Conservation of Flora and Fauna	17298	Greaves Road	Nature Reserve	ii
A	Conservation of Flora and Fauna	26793	Corackerup	Nature Reserve	ii
A	Conservation of Flora and Fauna	39971	Coomaldannerup	Nature Reserve	ii
A	Conservation of Flora and Fauna	28687	Pallinup	Nature Reserve	i-ii
A	National Park	31737	Fitzgerald River	National Park	iv
C	Conservation of Flora and Fauna	31425	Koomong	Nature Reserve	ii
A	Conservation of Flora and Fauna	31881	Long Creek	Nature Reserve	ii
C	Conservation of Flora and Fauna	31424	Aerodrome Road	Nature Reserve	ii
C	Conservation of Flora and Fauna	27525	Overshot Hill	Nature Reserve	ii
A	Conservation of Flora and Fauna	29184	Hayes Road	Nature Reserve	ii

Land status Class	Purpos	Reserve Number	Name	Category	Reserve Management <sup>1</sup>
C	Conservation of Flora and Fauna	26662	Steere River	Nature Reserve	ii
C	Conservation of Flora and Fauna	31128	Kundip	Nature Reserve	ii
C	Conservation of Flora and Fauna	27177	Unnamed	Nature Reserve	ii
A	Conservation of Flora and Fauna	25869	Bald Island	Nature Reserve	ii
A	Conservation of Flora and Fauna	31909	Glasse Island	Nature Reserve	ii
A	National Park	31738	Red Island, Unnamed, Unnamed	National Park	ii
A	Conservation of Flora and Fauna		Cheyne Island	Nature Reserve	i-ii
A	Conservation of Flora and Fauna	23516	Doubtful Islands	Nature Reserve	ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Beard Veg Assoc	Species Recovery Plan	General Recovery Plans	Prioritise for Subregion <sup>1</sup>
<i>Neophoca cinerea</i>	N/A	No	Action Plan for Australian Seals; South Coast Regional Management Plan.	
<i>Arctocephalus forsteri</i>	N/A	No	Action Plan for Australian Seals; South Coast Regional Management Plan.	
<i>Atrichornis clamosus</i>		RP	Action Plan for Australian Birds; South Coast Regional Management Plan.	iv
<i>Leipoa ocellata</i>		Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds; South Coast Regional Management Plan.	
<i>Calyptorhynchus latirostris</i>		RP (draft)	Action Plan for Australian Birds; South Coast Regional Management Plan.	
<i>Dasyornis longirostris</i>		No	Action Plan for Australian Birds; South Coast Regional Management Plan.	
<i>Pseudocheirus occidentalis</i>		IRP	Action Plan for Australian Birds; South Coast Regional Management Plan.	
<i>Morelia spilota imbricata</i>		No	Action Plan for Australian Reptiles; South Coast Regional Management Plan.	
<i>Acacia rhamphophylla</i>	48	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Acacia trulliformis</i>	931	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Adenanthos cunninghamii</i>	42	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Andersonia pinaster</i>	978, 994	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Banksia brownii</i>	980,986	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Banksia goodii</i>	994	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv

Species	Beard Veg Assoc	Species Recovery Plan	General Recovery Plans	Prioritise for Subregion <sup>1</sup>
<i>Boronia clavata</i>	48	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	931, 938, 967	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii
<i>Caladenia harringtonii</i>	50	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Centrolepis caespitosa</i>		No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Conostylis misera</i>	14, 27	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii
<i>Darwinia meeboldii</i>	986	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Daviesia megacalyx</i>	691, 47	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii
<i>Drakaea confluens</i>	965	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Dryandra ionthocarpa</i>	47	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Eremophila veneta</i>	676, 48	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Eucalyptus bennettiae</i>	47	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Grevillea maxwellii</i>	48,	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Isopogon uncinatus</i>	48	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Kunzea pauciflora</i>	48	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Lambertia orbifolia</i>	14	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	ii
<i>Laxmannia jamesii</i>	994	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Lepidium aschersonii</i>		No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Marianthus villosus</i>	47	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Meziella trifida</i>		No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Myoporum cordifolium</i>	931, 929	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii

Species	Beard Veg Assoc	Species Recovery Plan	General Recovery Plans	Prioritise for Subregion <sup>1</sup>
<i>Orthrosanthus muelleri</i>	967	IRP	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii
<i>Pleurophascum occidentale</i>	14,994	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Thelymitra psammophila</i>	47	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii
<i>Verticordia fimbriolepis</i> subsp. <i>australis</i>		No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iv
<i>Verticordia helichrysantha</i>	48	No	Declared Rare and Poorly Known Flora in the Albany District; South Coast Regional Management Plan.	iii

<sup>1</sup>Appendix C, rank 6.

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Neophoca cinerea</i>	i, iii, vii, vi, ix, xii, xiii, xiv	Habitat retention and protection through reserves and on other state lands; Feral animal control (rabbits); Weed control; Fire management; Research; Capacity building with Coast Care; Other – changes to commercial fishing and public education.
<i>Arctocephalus forsteri</i>	i, iii, vii, vi, ix, xii, xiii, xiv	Habitat retention and protection through reserves and on other state lands; Feral animal control (rabbits); Weed control; Fire management; Research; Capacity building with Coast Care; Other – changes to commercial fishing and public education.
<i>Atrichornis clamosus</i>	i, ii, iv, ix, x, xii, iii, vii, v, vi, xiv	Habitat retention and protection through reserves and on private land; Regrowth retention; Fire management; Translocation; Research; Habitat protection on other state lands; Feral animal control (rabbits); Fencing; Weed control; Other - consolidation of strategic connectivity between priority areas – e.g. The Macro Corridor priority linkages.
<i>Leipoa ocellata</i>	i, ii, iii, iv, v, vi, vii, viii, ix, xii, xiii, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Regrowth retention; Fencing; Weed control; Feral animal control; Revegetation; Fire management; Research; Capacity building; Other - consolidation of strategic connectivity between priority areas – e.g. The Macro Corridor priority linkages.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, iv, viii, ix, xi, xii, xiii, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Regrowth retention; Revegetation; Fire management; Reinstatement of hydrology; Research; Capacity building; Other - consolidation of strategic connectivity between priority areas – e.g. The Macro Corridor priority linkages.
<i>Dasyornis longirostris</i>	ix, xii,	Fire management; Research – survey and monitoring.
<i>Pseudocheirus occidentalis</i>	vii, xii	Feral animal control; Research – survey and monitoring.
<i>Morelia spilota imbricata</i>	i, ii, iii, iv, vii, ix, xii, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Regrowth retention; Feral animal control; Fire management; Research; Other - public awareness and consolidation of strategic connectivity between priority areas – e.g. The Macro Corridor priority linkages.
<i>Acacia rhamphophylla</i>	iii	Habitat protection on other state lands.
<i>Acacia trulliformis</i>	ii, ix, xi,	Habitat protection on private land; Fire management; Reinstatement of hydrology.
<i>Adenanthos cunninghamii</i>	i, iii, xii	Habitat retention and protection through reserves and on other state lands; Research.
<i>Andersonia pinaster</i>	iii, xiv	Habitat protection on private land; Other - phosphite application.
<i>Banksia brownii</i>	i, iii, ix, xiv	Habitat retention and protection through reserves and on other state lands; Fire management; Other - phosphite application.
<i>Banksia goodii</i>	i, ii, iii, ix, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Fire management; Other - roadside markers.
<i>Boronia clavata</i>	iii, ix, xi, xiv	Habitat protection on private land; Fire management; Reinstatement of hydrology; Other - seed collection.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	i, ii, iii, vi, ix, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Weed control; Fire management; Other - seed collection and public education.
<i>Caladenia harringtonii</i>	iii, ix, vi, xiv	Habitat protection on private land; Fire management; Weed control; Other - seed collection.
<i>Centrolepis caespitosa</i>	iii	Habitat protection on private land.
<i>Conostylis misera</i>	i, ii, iii, v, vi, vii,	Habitat retention and protection through reserves, on private land and on other state lands; Fencing; Weed control; Feral animal control.
<i>Darwinia meeboldii</i>	i, ii, ix	Habitat retention and protection through reserves and on private land; Fire management.
<i>Daviesia megacalyx</i>	iii, ix, xiv	Habitat protection on other state lands; Fire management; Other - seed collection.
<i>Drakaea confluens</i>	i, ii, vii, ix, xiv	Habitat retention and protection through reserves and on private land; Feral animal control; Fire management; Other - public education.
<i>Dryandra ionthocarpa</i>	iii, vi, ix, x, i, xii	Habitat protection on other state lands; Weed control; Fire management; Translocation;

		Habitat retention and protection through reserves; Research.
<i>Eremophila veneta</i>	ii, v, xi	Habitat protection on private land; Fencing; Reinstatement of hydrology.
<i>Eucalyptus bennettiae</i>	i, iii, xiii	Habitat retention and protection through reserves and on other state lands; Capacity building.
<i>Grevillea maxwellii</i>	ii, iii, v, vi, ix, xii, xiv	Habitat protection on private land and on other state lands; Fencing; Weed control; Fire management; Research; Other - public education.
<i>Isopogon uncinatus</i>	i, iii, ix, xiv	Habitat retention and protection through reserves and on other state lands; Fire management; Other - phosphite application.
<i>Kunzea pauciflora</i>	i, iii, ix	Habitat retention and protection through reserves and on other state lands; Fire management.
<i>Lambertia orbifolia</i>	i, ii, iii, v, vi, ix, x, xiii	Habitat retention and protection through reserves, on private land and on other state lands; Fencing; Weed control; Fire management; Translocation; Capacity building.
<i>Laxmannia jamesii</i>	i, iii	Habitat retention and protection through reserves and on other state lands;
<i>Lepidium aschersonii</i>		Recovery actions not known
<i>Marianthus villosus</i>	iii, ix	Habitat protection on other state lands; Fire management.
<i>Meziella trifida</i>		Recovery actions not known
<i>Myoporum cordifolium</i>	i, ii, iii, ix, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Fire management; Other - roadside markers.
<i>Orthrosanthus muelleri</i>	ii, iii, vi, ix, xi, xiv	Habitat retention and protection on private land and on other state lands; Weed control; Fire management; Reinstatement of hydrology; Other - roadside markers.
<i>Pleurophascum occidentale</i>	i, ii, iii, ix	Habitat retention and protection through reserves, on private land and on other state lands; Fire management.
<i>Thelymitra psammophila</i>	i, ii, iii, vi, ix, xiv	Habitat retention and protection through reserves, on private land and on other state lands; Weed control; Fire management; Other - public education and roadside markers.
<i>Verticordia fimbriolepis</i> subsp. <i>australis</i>		Recovery actions not known
<i>Verticordia helichrysantha</i>	i, iii, ix, xiv	Habitat retention and protection through reserves and on other state lands; Fire management; Other - management of access.

<sup>1</sup>Appendix B, key h.

All terrestrial mammals and most of the birds listed as being species at risk in this subregion are found within current Department of CALM estate and there are few if any recent records outside reserves. However, many of these species do have relevant recovery or interim recovery plans:

- Chuditch (*Dasyurus geoffroii*) (Orell and Morris 1994)
- Numbat (*Myrmecobius fasciatus*) (Friend 1994 (unpublished))
- Dibbler (*Parantechinus apicalis*) (Start 1998)
- Western Ground Parrot (*Pezoporus wallicus flaviventris*) (Burbidge *et al.* 1997)
- Giant Andersonia (*Andersonia axilliflora*) (Evans *et al.* 1999)
- Maroon-flowered Daviesia (*Daviesia glossema*) (Phillimore and Brown 2001)
- Stirling Range Daviesia (*Daviesia pseudaphylla*) (Phillimore and Brown 2001)
- Cactus Dryandra (*Dryandra anaton*) (Phillimore and Brown 2001)
- Stirling Range Dryandra (*Dryandra montana*) (Kershaw *et al.* 1997)
- Round-leafed Honeysuckle (*Lambertia orbifolia* subsp. *orbifolia* ms) (Phillimore and Brown 2002)
- Stirling Range Beard Heath (*Leucopogon gnaphalioides*) (Phillimore and Brown 2001)
- Small-flowered Snottygobble (*Persoonia micranthera*) (Evans *et al.* 1999)
- Gillham's Bell (*Darwinia oxylepis*) (Phillimore *et al.* 2001)
- South Stirling Morning Iris (*Orthrosanthus muelleri*) (Phillimore *et al.* 2001)
- Mountain Paper Heath (*Sphenotoma drummondii*) (Holland 1999)
- Grey Nurse Shark (*Carcharias taurus*) (Environment Australia 2002a)
- Great White Shark (*Carcharodon carcharias*) (Environment Australia 2002b)

In addition to these recovery or interim recovery that apply in to individual species, there are a number of action plans that are applicable for birds (Garnett and Crowley 2000), marsupials and monotremes (Maxwell *et al.* 1996), reptiles (Cogger *et al.* 1993), rodents (Lee 1995), seals (Shaugnessy 1999), albatrosses and petrels (Environment Australia 2001) and Declared Rare and poorly known flora of the Albany region (Robinson and Coates 1995).

### Ecosystems, existing recovery plans and appropriate recovery actions

There are no off-park conservation actions required for Ecosystems at Risk. An Interim Recovery Plan is available for East Stirling Range Montane Heath and Thicket (Barrett 2000), but this TEC is currently in Department of CALM reserve. The Department's South Coast Regional Management Plan (1992) is also relevant to ecosystems and species at risk in the subregion.

### Subregion priority for off reserve conservation

Most species in the above table have been assigned separate priorities.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** May include fencing subsidies for protection of remnant vegetation which are moderately effective; private land conservation covenants; Land for Wildlife.

**Legislation:** Some aspects of State Government legislation is not enforced, e.g. Soil Land Conservation Act other legislation e.g. Wildlife Conservation Act is

outdated and requires replacement with comprehensive biodiversity protection legislation.

**Threat Abatement Planning:** Western Shield fox control programme very successful on some Crown lands in assisting the recovery of fauna numbers; Rabbit Calici Virus also maintaining some effect against rabbit numbers; Australian Locust control programme also moderately effective as a control; *Phytophthora* controlled in small areas using phosphite; Weed control occurs in some areas.

**Industry Codes of Practice:** Mining and environmental protection and revegetation in Ravensthorpe area; Kangaroo shooters are required to adhere to a code of practice to ensure treatment and killing of animals.

**Environmental Management Systems & Ecologically Sustainable Product Marketing:** Introduction of Sandalwood plantations on private land for essential oil production on private land; Limited application of organic agriculture.

**Capacity Building:** For example, South Coast Regional Initiative Planning Team (SCRIPT); the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** Including: local government planning; National Action Plan for Water Quality and Salinity – Salinity Action Plan and Ribbons of Blue projects successfully in place; Southern Prospects, Southern Shores.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Landcare District Committees active in most areas of the Subregion providing opportunities for public participation in conservation projects. eg revegetation.

## Feasible opportunities for NRM

**Incentives:** Have a lot of potential as channels for people to use to protect biodiversity on their land. Examples include expansion of the Land for Wildlife scheme and other government run conservation programmes.

**Legislative:** Revision is required eg Wildlife Conservation Act.

**Institutional Reform:** Rural reconstruction and new management systems which further incorporate opportunities for renewable resources, rural resources such as agroforestry, oil mallees and other specialty crops to make better use of cleared land and relieve commercial pressure on native flora.

protect remnant vegetation on private land e.g. taxation incentives or benefits a rural land rating

**Valuing Ecosystem Services and Tradable Rights:** Greater incentives are necessary to incentives for remnant vegetation protection.

**Threat Abatement Planning:** Further research and control measures are necessary into potential environmental weeds and those already causing impacts;

Research needs to be continued to improve feral cat control; Local governments need to be involved for management of threats in road and shire reserves; Further development of rabbit control techniques needs to occur.

**Environmental Management Systems:** Greater coordination is needed in planning and management of feral animals and weeds across all land tenure; Organic farming has the potential to be much more widely applied.

**Capacity Building:** Greater acknowledgement of the intrinsic environmental values of uncleared lands through public awareness education and property management planning – promoted through the South Coast Regional Initiative Planning Team (SCRIPT) – an interagency environmental and conservation planning approach or Landcare groups. There is further scope for the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Codes of Practice:** These are needed for the agricultural industry (particularly for the issues of weeds, pesticides and insecticides), local governments and road reserves.

**Other Planning Opportunities:** The agricultural industry needs to aim for greater sustainability in farming practices.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Needs to occur across all land tenures.

## Impediments or constraints to opportunities

Outdated legislation represents an impediment to biodiversity conservation as do operational constraints arising from limited financial and human resources available for many ideas, initiatives and public education programmes. The Macro Corridor concept is a useful tool to raise awareness of biodiversity issues, however, existing land use conflicts have implication for natural land management. In general there is a lack of appreciation of complex biodiversity issues by the community. The terms of Native Title agreements (and future settlements) are likely to have profound implications for NRM actions in the future and the legal and administration issues are likely to be complex.

## Subregions where specific NRM actions are a priority to pursue

Major constraints exist to implement effective NRM actions to achieve biodiversity outcomes in Jerramungup and Kent Shires in the ESP1 subregion due to past land clearing practices and current land management practices. Some NRM instruments are in place elsewhere, with some achieved biodiversity outcomes, giving an overall NRM rank of (ii) (see Appendix C, rank 7).

## Data gaps

Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Vegetation map resolution is 1:250,000 at best. Fitzgerald River National Park has 1:100,000 vegetation mapping.

**Systematic Fauna Survey:** No systematic quadrat-based fauna survey information available for existing conservation reserves, except for the Fitzgerald River National Park (1: 100,000). No systematic quadrat-based fauna survey information available for off conservation reserves either. Data is confined to bird atlas, specific threatened bird distributions (ie Western Bristlebird, Western Ground Parrot, Noisy Scrub-bird), Fitzgerald River National Park surveys and six Western Shield monitoring sites for mammals. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion. Most reserves don't have long-term survey data on species presence or absence even for vertebrates.

**Flora Survey:** No systematic quadrat-based flora survey, except for the Fitzgerald River Nature Park. Most reserves don't have long-term survey data on species presence/absence; data is confined to specific threatened flora, and a few large reserves. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion.

**Ecological and Life History Data:** There is little data available on habitat requirements of virtually all

invertebrate species, most ephemeral plants (except some DRF), persisting and translocated CWR mammals (except dibbler, chuditch, tammar, numbat, phascogale), persisting E/V birds (except Noisy Scrub-bird, Whipbirds, Bristle Birds, Ground Parrots, Malleefowl), and uncommon vertebrate- and plant-species. There is no data to provide a regional context on life-history (including population-trend) of most species, including foxes, except baseline information on CWR mammals on Stirling Range National Park and Fitzgerald River National Park (data collected during Western Shield Monitoring).

**Other priority data gaps include:**

- No quantitative data on the effect of *Phytophthora* sp. on flora and fauna, exotic predators, weed colonisation, fragmentation & farm clean-up, fire.
- No data on effect of mining (exploration) on greenstone communities in Ravensthorpe Range.
- Effect of rising water table on species composition of communities remaining within the agricultural landscape.
- Impact of reduced rainfall on vegetation.
- No comprehensive biological survey of island biota.

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R = Report; J = Journal article; O = Other.

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# Esperance 2 (*ESP2 – Recherche subregion*)

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2001

## Subregional description and biodiversity values

### Description and area

The Esperance bioregion is characterised by proteaceous scrub and mallee heaths on sandplain overlying Eocene sediments; rich in endemics. Herbfields and heaths (rich in endemics) on abrupt granite and quartzite ranges that rise from the plain. Eucalypt woodlands occur in gullies and alluvial foot-slopes. ESP2 Subregion has variable relief, comprising the Quaternary coastal sandplains and dunes overlying Proterozoic gneiss and granite as well as Eocene and more recent coastal limestones. Numerous granitic islands occur in the near shore area of this subregion. Vegetation comprises heath, coastal dune scrub, mallee, mallee-heath and granite heath. Vegetation types are diverse. The climate is Temperate Mediterranean, with 400-700 mm annual rainfall and total area is 1,606,517 ha.

### Dominant land use

Mainly (vii) grazing - improved pasture & (iv) cultivation - dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves, (xiv) roads and other easements, (v) forestry plantation (see Appendix B, key b).

### Continental Stress Class

ESP2 has a Continental Stress Class of 5

Known special values in relation to landscape, ecosystem, species and genetic values

#### Near Shore Islands:

- The Recherche Archipelago incorporates some 105 islands totaling 9720 ha or 97.2 square kms in size, containing distinct land flora which incorporates representations of the nearby mainland flora plus species restricted to islands. New Zealand Fur Seals (*Arctocephalus forsteri*) and Australian Sea-lion (*Neophoca cinerea*) breeding on various islands of the Recherche. CWR mammals include Tammar (*Macropus eugenii derbianus*), Southern Brown Bandicoot (*Isodon obesulus*), Rock Wallabies (*Petrogale lateralis lateralis* & *Petrogale lateralis hacketti*), and reptiles include *Pseudonaja affinis tanneri* (on Cull Island), *Morelia spilota imbricata*. Avifauna include Cape Barren Geese (*Cereopsis novaehollandiae*), Flesh-footed shearwaters (*Puffinus carneipes*) (breeding). Woody Island

breeding area for Flesh-footed Shearwaters, and is a known haul out site for Australian Sea-lions and New Zealand Fur Seals. Recherche Archipelago Nature Reserve and Woody Island Nature Reserve contain breeding sites for the Little Penguins (*Eudyptula minor*).

- Investigator Island is breeding site for Australian Sea-lions and New Zealand Fur Seals.

#### Rare Ecosystems:

- Vegetation communities of *Eucalyptus megacornuta* on the Ravensthorpe Range (Bandalup Hill) - *Eucalyptus argyphaea* low forest on magnesite on ridgetops and upper slopes. Species include *Beyeria brevifolia*, *Eremophila latrobei*, *Lasiopetalum rosmarifolium*, *Leucopogon carinatus*, *Melaleuca striata* and *Scaevola densifolia*;
- Pink Lake - Stromatolite Community Number 3 of Coastal Hypersaline Lakes. Dominant species are *Dunaliella salina* and *Microcoleus vaginatus*, with *Charadrius rubricollis*;
- Esperance Sandplain - Scrub heath on deep sand with *Banksia* and *Lambertia*, and *Banksia* scrub heath on sandplain. Includes the dominants *Banksia speciosa*, and *Lambertia inermis* and priority taxa *Andersonia macranthera*, *Comesperma acerosum*, *Dampiera sericantha*;
- Mixed thicket complex of the Russell Range - includes dominants *Eucalyptus doratoxylon*, *Adenanthos oreophilus*, *Dampiera parvifolia*, *Monaotoca oligarrhenoides*, DRF *Kennedia beckiana*, and priority taxa *Leucopogon apiculatus* and *Chorizema nervosum*.

#### Vulnerable and Specially Protected Fauna:

- Threatened birds e.g. Western Ground Parrot (*Pezoporus wallicus flaviventris*), Malleefowl (*Leipoa ocellata*), Recherche Cape Barren Goose (*Cereopsis novaehollandiae grisea*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Peregrine Falcon (*Falco peregrinus*) and Australasian Bittern (*Botaurus poiciloptilus*)
- Threatened mammals including the Chuditch (*Dasyurus geoffroi*), Red-tailed Phascogale (*Phascogale calura*), Black-footed Rock-wallaby (*Petrogale lateralis lateralis*), Recherche Black-footed Rock-wallaby (*Petrogale lateralis hacketti*), Heath Rat (*Pseudomys shortridgei*) and Dibbler (*Parantechinus apicalis*).
- Priority mammals such as Tammar (*Macropus eugenii derbianus*)

- Reptiles such as *Parasuta spectabilis bushi* and *Phyllodactylus* sp. Cape Le Grand, and Carpet Python (*Morelia spilota imbricata*).

**Declared Rare Flora:**

- DRF plants include: *Lambertia echinata echinata*, *Eucalyptus insularis*, *Anigozanthos bicolor minor*, *Conostylis lepidospermoides*, *Eremophila denticulata denticulata*, *Eucalyptus merrickiae*, *Marianthus villosus*.
- Priority plants include *Kunzea similis* (Bandalup Hill), which is currently under threat from mining.

**Significant Geomorphological Features:**

- Magnesite mounds west of Bandalup Hill are associated with an old depression and support at unique *Eucalyptus indurata* mallee community.
- Granite hills and outcrops at Cape Le Grand and Cape Arid.
- Extensive salt lakes
- Recherche Archipelago

**Centres of Endemism:** Include vegetation communities of the Ravensthorpe Range (Bandalup Hill), southern end of Russell Range (Brooke Park) and Esperance Sandplain. Details are listed above.

**Refugia:** Various islands of the Recherche provide refugia for CWR mammals (for example, Tammars & Rock Wallabies). Near coastal hills at Cape Le Grand and Mississippi Hill are refugia for DRF including *Lambertia echinata* subsp. *echinata*.

**High Species or Ecosystem Diversity:** Evident at Pink Lake, Russell Range (Brooke Park), Ravensthorpe Range

(Bandalup Hill) and Esperance Sandplain. Details are listed above.

**Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats**

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern South Coast (System 3) in the CTRC Green Book (Conservation Through Reserves Committee 1974). Some, but not all of these recommendations (with modification) were implemented over the following ten years. The subregion is covered by a CALM Regional Management Plan, that provides an overview of biota, addresses land and wildlife conservation issues, but is generalised in its attention to detail (Department of Conservation and Land Management 1992). The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion. Management plans exist for the Esperance Lakes (Department of Conservation and Land Management 1997), and Interim Management Guidelines are currently in place for Lake Shaster Nature Reserve (Department of Conservation and Land Management 1995b), Woody Island Nature Reserve (CALM 1996e), Helms Forestry Reserves (CALM 1998c), Stokes National Park (CALM 1998d), Cape Le Grand National Park (CALM 1999e), Cape Arid National Park (CALM 2000c), Recherche Archipelago Nature Reserve (CALM 2000d) and Nuytsland Nature Reserve (CALM 1997a) in ESP2. The South Coast Macro Corridor project identified corridors within ESP2 that have the potential to improve landscape connectivity for wildlife in the bioregion.

**Wetlands**

**Wetlands of National significance (DIWA listings)**

Name	Location	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Warden System - includes Windabout, Woody, Wheatfield, Station, Mullet and Ewans lakes.	33° 49' S 121° 52' E 5 km N of Esperance	B7, B12	ii	iii	iii	i, ix, x, xi, xii (urban encroachment), vi (Bridal creeper), viii
Lake Gore System -includes lakes Carbul, Kubitch and Gidong and Quallilup lakes.	33° 47' S 121° 31' E 35 km W of Esperance	B7, B8, B12, B14	ii	iii	iii	i, ix, x, xi, vi (Bridal creeper)
Lake Mortjinup System – includes Namburup lake and Namburup west swamp	33° 48' S 121° 39' E 25 km W of Esperance	B7, B14, B10	iii	vi	ii	i, ix, x

Name	Location	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Pink Lake	33° 505' S 121° 495' E 5 km W of Esperance	B7	ii	iii	iii	i, ix (water salinity is changing – getting fresher), x (leaching of water from Lake Warden system), xi (nutrient enrichment & eutrophication), xii (salt mining; trampling), vi (Bridal Creeper, Victorian Teatree)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Bannitup Lake	33° 499' S 122° 037' E	B7	iii	ii	iii	i	i, ix, x, ix
Barkers Inlet	33° 486' S 121° 204' E	A6	iii	ii	iv	i	i, ix
Baylemup Swamp	33° 471' S 121° 418' E	B7	iii	ii	vi	i	i, ix, x
Beaumont Swamp	33° 383' S 122° 413' E	B7	iii	ii	iv	i - ii	i, ix, x
Benje Benjemup	33° 423' S 121° 54' E	B7	iii, v	ii	iii	i	i, ix, x, xi
Boolenup Lake	33° 51' S 122° 59' E	B7	iii	ii	iii	i	i, ix
Burdett Suite	426000/ 6288000	B11	ii	iii	vi	iii	iv, x
Cape Le Grand Suite	427000/ 6244000	B9	v, ii, iii	iv	iv	iii	iv
Coobidge Creek/Lower Coobidge Suite	360000/ 6279000	B7/B8	iii	ii	iii	i	ix, x
Coolinup Swamp	33° 467' S 122° 116' E	B7	iii	i	iii	i	i, ix, x
Coomalbidgup Swamp	33° 43' S 121° 225' E	B7	iii	i	ii	i - iii	i, ix, x, xi
Coujinup Swamp	260000/ 6285000	B12	ii	ii	iii	iii	i, iv
Dunns Swamp Suite	236800/ 6242500	A11/B10	iii	iii	iv	iii	xi
Ewarts Lake	33° 505' S 122° 523' E	B5	ii, iii, iv	iii	iv	i	i, viii, ix
Howick Suite	478000/ 6264000	B11	iii	iii	iv	iii	x
Jerdacuttup Lakes	33° 555' S 120° 12' E	B6, B8	iv, iii	ii	iii	i - ii	i, ix, x, xi
Lake Carbul	33° 46' S 121° 10' E	B7	v	ii	iii	i	i, ix, x
Lake Cubinup	33° 48' S 121° 10' E	B7	ii	ii	iv	i	i, ix, x
Lake Daringdell	33° 39' S 123° 48' E	B7	v	iv	iv	i	Unknown threatening processes
Lake Gidong	33° 466' S 121° 288' E	B7	v	ii	iii	i	i, ix, x
Lake Hillier (Middle Island)	33° 058' S 123° 12' E	A4	ii	iv	iv	i	xii (tourist boats; recreation)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Kubitch	33° 465' S 121° 296' E	B7	v	ii	iii	i	i, ix, x
Lake Shaster	33° 521' S 120° 43' E	B7	i, iv, iii, v	ii	vi	i	i, ix, x
Mainberup Swamp	33° 47' S 121° 339' E	B7	iii	ii	iii	i	i, ix, x
Monjingup Lake suite	388500/ 6258700	B5/B9	iii	ii	iii	iii	v, ix, x, xi
Mortup Suite	488000/ 6255500	B7, B8/B9, B10	v, iii	iii	iii	iii	xi, xii (vehicles)
Munglinup River Suite		B2/B11/B12	ii	iii	iii	iii	i, iv, vi, x
Oceanview suite	476000/ 6253500	B8/B10	ii	iii	iii	iii	xii (vehicles)
Oldfield Estuary Suite	295000/ 6249500	A6	v, iii	iii	iii	iii	iv, xi
Oldfield Inlet	33° 527' S 120° 472' E	A6	iii	iii	iii	i	i, ix, x
Quallilup Lake	33° 49' S 121° 355' E	B7	iii	ii	iii	i	i, ix, x, xi
Shark Lake	33° 462' S 121° 515' E	B9	i, ii, iii, iv	iii	iii	i - ii	i, ix, x, xi
Single Winds Suite	305000/ 6265000	B8/b10	v, iii	iii	iii	iii	x
Stokes Inlet	33° 491' S 121° 096' E	A6	iii, iv	iii	iii	i - ii	i, ix, x, xi
Suite Sixteen	389000/ 6269000	B8	v, iii	iii	iv	iii	Unknown threatening processes
Thistle Lake	33° 598' S 122° 12' E	B5	ii	iv	iv	i	Unknown threatening processes
Torradup Lake	33° 51' S 121° 008' E	A6	iii	ii	iii	i	i, ix, x, xi
Tyrells Swamp	33° 475' S 122° 094' E	B7	iii	ii	iii	i	i, ix, x
Washpool Swamp	33° S 122° E	B10	iii	iii	iii	i	i, ix, x
Woodup Swamp	33° 507' S 122° 09' E	B10	iii	iv	iv	i	viii, ix, x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

In general, when rivers in ESP1 are inundated (particularly with summer rainfall), bank erosion, and uprooting/burial of native riparian vegetation occurs.

Weed plant species then invade and overrun riparian areas.

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Lort River	ii	iii	i-ii	i, ii, iv, v (foxes & rabbits), vi, ix, x (agricultural drainage), xi, xii (broad acre farming)
Young River	i	iii	i-ii	i, ii, iv, v (foxes & rabbits), ix, x, xi
Oldfield River	ii	iii	i-ii	i, ii, iv, v (foxes & rabbits), ix, x, xi
Dalyup River	i	iii	i-ii	i, ii, iv, v (foxes & rabbits), ix, x, xi
Coramup River	i	iii	i-ii	i, ii, iv, v (foxes & rabbits), ix, x, xi
Thomas River	unknown	vi	unknown	Unknown threatening processes
Jerdacuttup River	ii	iii	i-ii	i, ii, iv, v (foxes & rabbits), ix, x, xi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
1047, 510, 514, 4048	Plant assemblages of mixed thicket complexes in the Russell Range System (Brooke Park)	V	29, 27	iv	iii	iii	vii, viii (potential)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Community	Status <sup>1</sup>	NVIS <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
59	Pink Lake (PINKLK01) - Stomatolite community Number 3 of Coastal Hypersaline Lakes	V	41	ii	iii	iii	i, ix (water salinity is changing – getting fresher), x (leaching of water from Lake Warden system), xi (nutrient enrichment & eutrophication), xii (salt mining; trampling), vi (Bridal Creeper, Victorian Teatree)
47	Ravensthorpe Range (ARG1 & ARG2) Pale grey sand low ridge Magnesite, 3.5 km SE of Bandalup Hill, 31km ESE Ravensthorpe.	V	27, 29	iii	iii	iii	viii ( <i>Phytophthora</i> sp.), xii (mining activities), v (foxes & goats), vi (Bridal Creeper), xii (recreation activities – trail bikes)
24	Esperance Sandplain (HELMS1 & HELMS2) Scrub heath on Esperance Sandplain: Scrub heath on deep sand with Banksia and Lambertia, and Banksia Scrub heath on sandplain 16km NNW of Esperance, on the Coolgardie-Esperance Highway	V	28	ii	iii	iii	viii ( <i>Phytophthora</i> sp. and other fungi), x (water quality and/or quantity), vi (Victorian Teatree, bridal creeper), i, ii, v (foxes, goats, deer, horses), xii (recreational activities)
N/A	Lake Warden System - naturally brackish/saline coastal lakes	V	38, 39, 41, 15, 30	ii	iii	iii	i, ix, x, xi, xii (urban encroachment), vi (Bridal Creeper, Victorian Teatree), vii, viii
N/A	Lake Gore System - saline coastal lakes of varied depth and salinity, which at time have extensive associated brackish saline marshes	V		ii	iii	ii	i, ix, x, xi, vi (Bridal Creeper, Victorian Teatree), viii, ii
	Unique mallee on magnesite ridges west of Bandalup Hill		27, 29	ii	iv (subject to no further mining)	ii	xii (mining activity)

Beard Veg Assoc	Community	Status <sup>1</sup>	NVIS <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
512	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & Forrest's marlock ( <i>E. forrestiana</i> )		27, 29	ii	iii	iii	ix, x
929	Low forest; moort ( <i>E. platypus</i> )		27	ii	iii	iii	ix, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i> (translocated population)	V	iii	iv	iii	v (fox & cat), ii
<i>Pseudomys shortridgei</i>	V	unknown	vi	unknown	v (predators), viii
<i>Petrogale lateralis hacketti</i>	V	iii	iii-iv	iii	xii (small population size), vii
<i>Petrogale lateralis lateralis</i>	V	unknown	vi	ii	iv, viii, xii (small population size)
** <i>Eubalaena australis</i>	E	unknown	v	ii	xii (whale watching; ecotourism)
** <i>Balaenoptera musculus</i>	V	unknown	vi	unknown	xii (whale watching; ecotourism)
** <i>Megaptera novaeangliae</i>	V	unknown	vi	unknown	xii (whale watching; ecotourism)
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	i-ii	iii	ii	i, ii, xii (competition with bees and other birds for nest sites)
<i>Pezoporopus wallicus flaviventris</i>	E	i	ii	iii	vii, v (foxes & cats), viii ( <i>Phytophthora cinnamomi</i> leading to loss of habitat)
<i>Cereopsis novaehollandiae grisea</i>	V	ii	iv	iii	xii (drought)
<i>Leipoa ocellata</i>	V	unknown	vi	unknown	v (foxes & cats), ii, xii (roads), vii
<i>Psophodes nigrogularis oberon</i>	V	ii	iv	iii	v (fox), viii, vii, xii (habitat may be subject to mining)
** <i>Diomedea amsterdamensis</i>	E	unknown	vi	unknown	xii (commercial fishing practice)
** <i>Diomedea exulans</i>	V	unknown	vi	unknown	xii (commercial fishing practice)
** <i>Diomedea gibsoni</i>	V	unknown	vi	unknown	xii (commercial fishing practice, shooters), xi
** <i>Halobaena caerulea</i>	V	unknown	vi	unknown	xii (predation)
** <i>Pterodroma mollis</i>	V	unknown	vi	unknown	Unknown threatening processes
** <i>Thalassarche cauta</i>	V	ii	v	iii	xii (commercial fishing practices)
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	iii	vi	i	xii (decline in population of food source), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 5 (FISH)</b>					
** <i>Carcharodon carcharias</i>	V	unknown	vi	unknown	xii (incidental capture by fisheries; shark control activities such as targeted hunting and shark nets; removal of fins; ecotourism)
** <i>Carcharias Taurus</i>	V	unknown	vi	unknown	xii (commercial and recreational fisheries; shark control activities such as targeted hunting and shark nets; ecotourism)
Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Neophoca cinerea</i>	Near Threatened	i-ii	iii	iii	xii (small population size; commercial fisheries)
<i>Arctocephalus forsteri</i>	Conservation Dependant	iii	v	iii	No known threatening processes
<i>Charadrius rubricollis</i>		unknown	unknown	unknown	v (foxes and cats), x (inundation from water logging), xii (recreational vehicles on beaches)

Species marked with \*\*asterisks indicate these species are occasional visitors to the subregion.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

### Declared rare and priority flora

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk. These fungi eliminate numerous species of structurally

and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	CR	unknown	iii	ii	ii, vii, i
<i>Lambertia echinata</i> subsp. <i>echinata</i>	CR	i	ii	iii	viii ( <i>Phytophthora</i> sp.), xii (translocated plants have died)
<i>Adenanthos eyrei</i>	E	iii	iv	iii	vii, xii (population difficult to locate and naturally rare)
<i>Eucalyptus insularis</i>	E	iii	iv	ii	No known threatening processes
<i>Myoporum turbinatum</i>	E	iii	iv	iii	vii (post fire species), ii, ix, xii (roadworks)
<i>Rhizanthella gardneri</i>	E	ii	iii	iii	vii, ii, ix, i, iv, x, xii (very hard to locate)
<i>Ricinocarpus trichophorus</i>	E	iii	iv	iii	ii
<i>Conostylis lepidospermoides</i>	V	ii-iii	iv	ii	vi, vii, xii (roadworks), i, ii
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	V	ii	iv	ii	vii, xii (roadworks)
<i>Eucalyptus merrickiae</i>	V	ii-iii	iv	ii	ii, ix, xii (roadworks)
<i>Marianthus villosus</i>	V	unknown	iv	ii	xii (mining), ii, vii
<i>Pleurophascum occidentale</i>	V	iii	iv	iii	No known threatening processes
<b>PRIORITY 1</b>					
<i>Acacia diminuta</i>	1	unknown	vi	iii	Unknown threatening processes
<i>Acacia dorsenna</i>	1	ii	vi	iii	xii (small population size; known populations are on Main Roads Reserves), iv, ii
<i>Astartea</i> sp. Esperance (A Fairall 2431)	1	unknown	vi	unknown	Unknown threatening processes
<i>Astartea</i> sp. Jerdacuttup (A Strid 21898)	1	unknown	vi	unknown	Unknown threatening processes
<i>Baeckea crassifolia</i> var. <i>icosandra</i>	1	iii	vi	iii	Unknown threatening processes
<i>Boronia baeckeeacea</i> subsp. <i>patula</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Caladenia longifimbriata</i> ms	1	unknown	vi	unknown	Unknown threatening processes
<i>Chorizema circinale</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Coleanthera coelophylla</i>	1	ii	iii	iii	xii (no collections have been made for approx 60 years)
<i>Conostephium marchantiorum</i>	1	iii	iv	iii	No known threatening processes
<i>Dampiera sericantha</i>	1	ii	vi	iii	xii (appears to be disturbance opportunist)
<i>Darwinia</i> sp. Mt Baring (KR Newbey 9775)	1	iii	iv	iii	xii (small number of individuals); vii
<i>Dodonaea hexandra</i>	1	unknown	vi	iii	No known threatening processes, species is widely dispersed in Western Australia
<i>Dryandra longifolia</i> subsp. <i>calcicola</i>	1	ii	iii	iii	viii ( <i>Phytophthora</i> sp.)
<i>Eremophila compressa</i>	1	iii	iv	iii	vii, xii (appears to be disturbance opportunist)
<i>Eucalyptus balanopelex</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Eucalyptus foliosa</i>	1	unknown	vi	unknown	Unknown threatening processes
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Eucalyptus varia</i> subsp. <i>salsuginosa</i>	1	unknown	vi	iii	Unknown threatening processes
<i>Goodenia</i> sp. Scaddan (CD Turley 41VM/1099)	1	unknown	vi	ii	Unknown threatening processes
<i>Hydatella australis</i>	1	iii	iv	ii	xii (rarely collected)
<i>Lepidium fasciculatum</i>	1	unknown	iv	ii	ix, ii, i, xii (species is very hard to locate)
<i>Melaleuca similis</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Myoporum velutinum</i> ms	1	unknown	vi	ii	ix, x, i
<i>Stachystemon</i> sp. Mt Baring (KR Newbey 9773)	1	iii	iv	iii	xii (small number of individuals); vii
<b>PRIORITY 2</b>					
<i>Acacia incanearpa</i>	2	iii	iv	iii	xii (small population size)
<i>Acacia kerryana</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Acacia nitidula</i>	2	iii	iv	iii	Unknown threatening processes
<i>Acrotriche patula</i>	2	iii	iv	iii	xii (potential for mining in the area)
<i>Andersonia carinata</i>	2	unknown	vi	unknown	viii ( <i>Phytophthora</i> sp.)
<i>Andersonia macranthera</i>	2	iii	iv	iii	viii ( <i>Phytophthora</i> sp.), xii (species has been poorly collected)
<i>Angasomyrtus salina</i>	2	iii	iv	iii	vii, ix, x, ii
<i>Angianthus newbeyi</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Astartea</i> sp. Jyndabinbin Rocks (KR Newbey 7689)	2	unknown	vi	unknown	Unknown threatening processes

<i>Astroloma</i> sp. Fitzgerald (GJ Keighery 8376)	2	unknown	vi	unknown	Unknown threatening processes
<i>Banksia epica</i>	2	iii	iv	ii	No known threatening processes, potentially vii
<i>Boronia coriacea</i>	2	iii	iv	iii	xii (limited geographic range)
<i>Dampiera decurrens</i>	2	iii	iv	iii	xii (limited geographic range)
<i>Dampiera orchardii</i>	2	unknown	vi	ii	i, ii
<i>Daviesia newbeyi</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Daviesia pauciflora</i>	2	ii	iii	iii	iv, xii (road works; limited geographic range)
<i>Dryandra longifolia</i> subsp. <i>archeos</i>	2	iii	iv	ii	No known threatening processes, potentially viii
<i>Eucalyptus litorea</i>	2	ii-iii	iii	iii	iii, vii
<i>Eucalyptus preissiana</i> subsp. <i>lobata</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Eucalyptus stoataptera</i> x	2	unknown	vi	unknown	Unknown threatening processes
<i>Eucalyptus surgens</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Goodenia quadrilocularis</i>	2	iii	iv	iii	xii (limited geographic range)
<i>Goodenia scapigera</i> subsp. <i>graniticola</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Goodenia varia</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Grevillea plurijuga</i> subsp. <i>superba</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Lasiopetalum maxwellii</i>	2	iii	iv	iii	Unknown threatening processes
<i>Lepyrodia fortunata</i> ms	2	unknown	iv	ii	Unknown threatening processes
<i>Leucopogon compactus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Leucopogon florulentus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Leucopogon interruptus</i>	2	unknown	vi	ii	xii (island populations); vii
<i>Leucopogon multiflorus</i>	2	iii	iv	iii	No known threatening processes, response to fire is unknown
<i>Leucopogon pleurandroides</i>	2	ii-iii	iv	iii	vii
<i>Leucopogon</i> sp. Kau Rock (MA Burgman 1126) [aff. <i>allittii</i> ]	2	unknown	vi	unknown	Unknown threatening processes
<i>Levenhookia pulcherrima</i>	2	unknown	iv	ii	Unknown threatening processes
<i>Melaleuca eximia</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Opercularia hirsuta</i>	2	ii-iii	vi	ii	xii (very difficult to distinguish from other species of same genus)
<i>Paracaleana</i> sp. Nuytsland (AP Brown s.n.)	2	unknown	vi	ii	xii (limited geographic range)
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Patersonia inaequalis</i>	2	iii	iv	iii	xii (small population size)
<i>Pomaderris paniculosa</i> subsp. <i>paralia</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Scaevola brookeana</i>	2	iii	iv	ii	xii (limited geographic range)
<i>Scaevola paludosa</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Spyridium mucronatum</i> subsp. <i>multiflorum</i>	2	ii-iii	iv	iii	xii (limited geographic range; poorly collected)
<i>Thysanotus brachiatus</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Thysanotus parviflorus</i>	2	unknown	iv	iii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease	Priority
16	Low forest: bushy yate ( <i>E. cornuta</i> ) & Bald Is. marlock ( <i>E. lehmannii</i> )	X	X		
27	Low woodland: paperbark ( <i>Melaleuca</i> sp.)		X		
41	Shrublands: teatree scrub	X			
42	Shrublands: mallee & acacia scrub on south coastal dunes	X			
47	Shrublands: tallerack mallee-heath	X			
48	Shrublands: scrub-heath	X			
125	Bare areas; salt lakes	X			
128	Bare areas; rock outcrops	X	X		
129	Bare areas; drift sand	X			
479	Shrublands: mallee-heath (Nuytsland)	X			
512	Shrublands: mallee scrub, <i>Eucalyptus eremophila</i> & Forrest's marlock ( <i>E. forrestiana</i> )				

514	Shrublands; mallee scrub, white mallee ( <i>Eucalyptus cooperiana</i> )	X			
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )				
516	Shrublands; mallee scrub, black marlock	X			
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>				
929	Low forest; moort ( <i>E. platypus</i> )				
931	Medium woodland; yate	X			
934	Shrublands; mallee scrub <i>Eucalyptus nutans</i>				
1047	Shrublands; <i>Eucalyptus incrassata</i> mallee-heath	X			
1516	Shrublands; mallee scrub, black marlock & Forrest's marlock				
4048	Shrublands; scrub-heath in the Esperance Plains incl. Mt Ragged scrub-heath	X			
4801	Shrublands; heath with scattered <i>Nuytsia floribunda</i> on sandplain	X			
6048	Shrublands; banksia scrub-heath on sandplain in the Esperance Plains Region	X	X		
7048	Shrublands; banksia scrub-heath on coastal plain in the Esperance Plains Region	X			

**Subregional constraints in order of priority**  
(see Appendix B, key g)

**Economic Constraints**

**Other:** Finer scale biodiversity data and information on reserves

**Limited Opportunity to Meet CAR Criteria:** Large areas of some vegetation types have already been cleared.

**Competing Land Uses:** Such as agriculture and mining.

**Bioregional and subregional priority for reserve consolidation**

Reserve consolidation rank is 5 (see Appendix D) on the table provided, but the bioregion should have an overall rank of 4 (Appendix C, rank 4). ESP1 is ranked 5 due to the relatively high level of reservation in the subregion, but ESP2 is under significantly more threat from mining,

some vegetation associations have been extensively cleared and the reserve system is biased. Therefore, ESP2 should have a reserve consolidation rank of at least 3.

**Reserve management standard**

Most ESP 2 Conservation reserves are in good condition (see Appendix C, rank 5). *Phytophthora cinnamomi* has severely impacted upon Cape Le Grand National Park and near coastal section of Cape Arid National Park. Wildfire management facilities are limited by resources in the remote reserves, except for fire breaks and fire-access tracks which are installed and maintained. Prescribed burning is confined to Cape Arid National Park, Cape Le Grand National Park, and Stokes National Park. Feral herbivore grazing activities are widespread (e.g. rabbits). Goats are scattered but widespread, though currently in low numbers. Feral predator control systems are in place on Cape Arid National Park, Cape Le Grand National Park, Stokes National Park, and Lake Shaster Nature Reserve.

Class	Purpose	Reserve Number	Name	Category	Reserve Management Rank <sup>1</sup>
C	Conservation of Flora & Fauna	32339	Lake Shaster	Nature Reserve	i-ii
A	National Park	32590	Stokes	National Park	ii
C	Conservation of Flora & Fauna	31755	East Naernup	Nature Reserve	ii
A	Conservation of Flora & Fauna	32419	Lake Gore	Nature Reserve	i
A	Conservation of Flora & Fauna	35557	Lake Mortjijnup	Nature Reserve	i
A	Conservation of Flora & Fauna	15231	Woody Lakes	Nature Reserve	ii-iii
C	Reserve for Forestry	23527	Helms	Timber Reserve	ii
A	Conservation of Flora & Fauna	23825	Mullet Lake	Nature Reserve	ii-iii
A	Conservation of Flora & Fauna	32257	Lake Warden	Nature Reserve	ii-iii
C	Conservation of Flora & Fauna	24511	Pink Lake	Nature Reserve	ii
C	Conservation of Flora & Fauna	27888	Warrenup	Nature Reserve	ii
A	National Park	22795	Cape Le Grand	National Park	i
A	National Park	24047, 14234	Cape Arid	National Park	ii
A	Conservation of Flora & Fauna	22796	Recherche Archipelago	Nature Reserve	ii
A	Primitive Area for the Preservation and Study of Flora, Fauna, Geological and Anthropological Features	27632	Nuytsland	Nature Reserve	i-ii
C	Conservation of Flora & Fauna	27087	Unnamed	Nature Reserve	ii
A	Conservation of Flora & Fauna	32128	Part Beaumont Group	Nature Reserve	ii
C	Conservation of Flora & Fauna	19628	Dalyup	Nature Reserve	ii
C	Conservation of Flora & Fauna	43060	Scarlet Pear Gum	Nature Reserve	ii
A	Conservation of Flora & Fauna	40156	Jerdacuttup Lakes	Nature Reserve	ii
C	Conservation of Flora & Fauna	28168	Springdale	Nature Reserve	ii
C	Conservation of Flora & Fauna	26410	Munglinup	Nature Reserve	ii
C	Conservation of Flora & Fauna	26885	West of Lake Gore	Nature Reserve	ii
A	Conservation of Flora & Fauna	36183	Edwards Road	Nature Reserve	ii
C	Conservation of Flora & Fauna	25958	Speddingup	Nature Reserve	ii

Class	Purpose	Reserve Number	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of Flora & Fauna	31313	Unnamed	Nature Reserve	ii
C	Conservation of Flora & Fauna	24953	Unnamed	Nature Reserve	ii
A	Conservation of Flora & Fauna	31197	Shark Lake	Nature Reserve	ii-iii
A	Conservation of Flora & Fauna	39435	Woody Island	Nature Reserve	ii
A	Conservation of Flora & Fauna	36056	Investigator Island	Nature Reserve	ii
A	Conservation of Flora & Fauna	26885	Unnamed	Nature Reserve	ii
A	Conservation of Flora & Fauna	27354	Coolinup	Nature Reserve	ii
A	Conservation of Flora & Fauna	27388	Burdett	Nature Reserve	ii
C	Conservation of Flora & Fauna	27086	Alexander	Nature Reserve	ii
A	Conservation of Flora & Fauna	31799	Part Muntz Group	Nature Reserve	ii
A	Conservation of Flora & Fauna	32800	Bebenorin	Nature Reserve	ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority Species or Groups and Existing Recovery Plans

Beard Veg Assoc	Species/Ecosystem	Specific Recovery Plan	General Recovery Plan	Prioritise for Subregion <sup>1</sup>
50	<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
47	<i>Conostylis lepidospermoides</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
929, 931	<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
995	<i>Eucalyptus insularis</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iv
125, 519	<i>Eucalyptus merrickiae</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
47	<i>Marianthus villosus</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
1413	<i>Rhizanthella gardneri</i>	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii

<sup>1</sup>Appendix C, rank 6

### Appropriate recovery actions

Beard Veg Assoc	Species/Ecosystem	Species Recovery Actions <sup>1</sup>	Recovery Descriptions
50	<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	ii, iii, ix	Habitat protection on private lands and on other state lands; Fire management.
47	<i>Conostylis lepidospermoides</i>	ii, iii, xiv	Habitat protection on private lands and on other state lands; Other - roadside markers.
929, 931	<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	iii, ix, xiv	Habitat protection on other state lands; Fire management; Other - roadside markers.
995	<i>Eucalyptus insularis</i>	i, ix	Habitat retention through reserves; Fire management.
125, 519	<i>Eucalyptus merrickiae</i>	iii, ii, ix, xiv, xi	Habitat protection on other state lands and on private lands; Fire management; Other - roadside markers; Reinstatement of hydrology.
47	<i>Marianthus villosus</i>	iii, ix	Habitat protection on other state lands; Fire management.
1413	<i>Rhizanthella gardneri</i>	i, ii, iii, ix, vii	Habitat retention and protection through reserves, on private lands and on other state lands; Fire management; Feral animal control.

<sup>1</sup>Appendix B, key h

All terrestrial mammals and most of the birds listed as being species at risk in this subregion are found within current Department of CALM estate and there are few if any recent records outside reserves. However, many of

these species do have relevant recovery or interim recovery plans:

- Chuditch (*Dasyurus geoffroii*) (Orell and Morris 1994)

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (Cale 2000a draft)
- Western Ground Parrot (*Pezoporus wallicus flaviventris*) (Burbidge *et al.* 1997)
- Malleefowl (*Leipoa ocellata*) (Benshemesh 2000)
- Hooded Plover (*Charadrius rubricollis*) (Raines 2002)
- Prickly Honeysuckle (*Lambertia echinata* subsp. *echinata*) (Monks *et al.* 2001)
- Grey Nurse Shark (*Carcharias taurus*) (Environment Australia 2002a)
- Great White Shark (*Carcharodon carcharias*) (Environment Australia 2002b)

In addition to these recovery or interim recovery that apply in to individual species, there are a number of action plans that are applicable for birds (Garnett and Crowley 2000), marsupials and monotremes (Maxwell *et al.* 1996), reptiles (Cogger *et al.* 1993), rodents (Lee 1995), seals (Shaugnessy 1999), albatrosses and petrels (Environment Australia 2001) and Declared Rare and poorly known flora of the Esperance region (Craig and Coates 2001).

## Ecosystems, existing recovery plans, and appropriate recovery actions

No off-park conservation actions or recovery plans have been identified for species at risk. The TEC Plant assemblages of mixed thicket complexes in the Russell Range System (Brooke Park) does not have a recovery plan and is found within CALM reserve (Cape Arid National Park). The Department's South Coast Regional Management Plan (1992) is relevant to ecosystems and species at risk in the subregion.

## Subregion priority for off reserve conservation

The overall rank for ESP2 is (iv) - limited off park measures required (see Appendix C, rank 6).

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Including legislation relating to Declared Rare Flora; Clearing; Soil and Land Conservation; Mining Act; Bushfire Act; Local Government rulings

**Threat Abatement Planning:** e.g. vegetation management plans and pest management plans – Western Shield fox control programme effective in enhancing fauna populations particularly in baited areas; Fire management; Recovery Catchment Plans; River Action Plan (for Jerdacuttup and Dalyup Rivers and Oldfield Estuary); Park Management Plans; Recovery and Interim Recovery Plans.

**Industry Codes of Practice:** in relation to agricultural, agroforestry mining and fisheries activities.

**Capacity Building:** the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity – Salinity Action Plan (no scalar measurement available on the effectiveness of this programme); SCRIPT (South Coast Regional Integrated Planning Team); Southern Prospects; Coastal Management (Southern Shores).

**Integration with Property Management Planning, Catchment Planning and Land Care:** Land Care and South Coast Regional Integrated Planning Team revegetation of catchments and damaged land variably effective in addressing salinity and erosion problems.

**Other:** On ground management of reserves by CALM staff; Education and awareness raising in the community (SCRIPT).

## Feasible opportunities for NRM

**Threat Abatement Planning:** Research is necessary to identify threats and to develop appropriate management plans particularly in relation to environmental weeds and feral animals.

**Legislation:** A review of some existing legislation is necessary to provide the legal capacity to effectively address current issues and problems of biodiversity protection.

**Threat Abatement Planning:** Further research is necessary into the extent of potential impacts of environmental weeds and their management greater resourcing of pest management is required.

**Capacity Building:** In place with community, landholders, industry and institutions – need for greater level of coordination of planning and land management issues between agencies and the community and recognition of differing stakeholder objectives. In addition, there is further scope for the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other:** Complete the reserve proposals set out in the South Coast Management Plan.

**Valuing Ecosystems & Tradable Rights:** Social benefit values, e.g. rural land purchases.

## Impediments or constraints to opportunities

There is a paucity of suitable and motivated people to effectively promote the conservation message to various interest groups in the community, further, there is a reducing base of funding for conservation particularly for off-park issues which need to be addressed if initiatives are to succeed. Outdated legislation represents an impediment to biodiversity conservation, as do operational constraints arising from limited financial and human resources available for many ideas, initiatives and public education programs. The Macro Corridor concept is a useful tool to raise awareness of biodiversity issues,

however, existing land use conflicts have implication for natural land management. In general there is a lack of appreciation of complex biodiversity issues by the community. The terms of Native Title agreements (and future settlements) are likely to have profound implications for NRM actions in the future and the legal and administration issues are likely to be complex.

### Subregions where specific NRM actions are a priority to pursue

The NRM rank is (iv) (see Appendix C, rank 7) indicating some NRM instruments are in place with some achieved biodiversity outcomes, however a greater achievement is possible with increased public awareness of conservation issues, particularly in relation to agricultural production systems.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available and vegetation map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** Some fauna survey work has been done for vertebrates in Stokes National Park, Oldfield River, Cape Le Grand and Bandalup Hill. Other data has been collected for the bird atlas, specific threatened bird distributions and three western shield monitoring sites for mammals. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion as part of the Macro Corridor project. Most reserves don't have long-term survey data on species presence/absence even for vertebrates.

**Floristic Data:** Most reserves don't have long-term survey data on species presence/absence; data is confined to specific threatened flora, and a few large reserves. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants (except some DRF), persisting CWR mammals (except Dibbler, Chuditch, Tammar), persisting E/V birds (except Western Ground Parrots, Western Whipbird, Malleefowl), and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of most species.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of *Phytophthora*, exotic predators, weed colonisation, fragmentation & farm clean-up, fire, and affect of mining

(exploration) on greenstone communities in Ravensthorpe Range.

- Effect of rising water table on species composition of communities remaining within the agricultural landscape.

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142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
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841	Department of Conservation and Land Management	(1998c).	Helms Forestry Reserve - Interim Management Guidelines	Department of Conservation and Land Management	O
838	Department of Conservation and Land Management	(1998d).	Stokes National Park - Interim Management Guidelines	Department of Conservation and Land Management	O
843	Department of Conservation and Land Management	(2000c).	Cape Arid National Park - Interim Management Guidelines	Department of Conservation and Land Management	O
840	Department of Conservation and Land Management	(2000d).	Recherche Archipelago Nature Reserve - Interim Management Guidelines	Department of Conservation and Land Management	O
802	Environment Australia	(2002).	Recovery Plan for the Grey Nurse Shark, <i>Carcharias taurus</i> , in Australia	Environment Australia, Canberra	O
803	Environment Australia	(2002).	White Shark ( <i>Carcharodon carcharias</i> ) Recovery Plan	Environment Australia, Canberra.	O
790	Environment Australia in consultation with the Albatross and Giant-Petrel Recovery Team	(2001).	Recovery Plan for Albatrosses and Giant Petrels	Environment Australia, Canberra.	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
483	Maxwell, S., Burbidge, A.A. and	(1996).	The 1996 Action Plan for Australian	Environment Australia, Canberra.	R

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532	Orell, P., and Morris, K.	(1994).	Chuditch Recovery Plan 1992-2001. WA Wildlife Management Program No. 13.	Department of Conservation and Land Management, Perth.	R
805	Raines, J.	(2002).	Hooded plover management plan (2002-2012), Western Australia	Western Australian Bird Notes, Supplement 7. Birds Australia, Western Australia.	O
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R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 001, 003, 004, 006, 014, 015, 030, 043, 050, 084, 087, 089, 096, 101, 112, 113, 129, 138, 196, 205, 219, 255, 256, 257, 263, 273, 278, 292, 295, 296, 297, 300, 3007, 310, 334, 337, 340, 343,

363, 367, 368, 370, 371, 375, 426, 427, 441, 529, 580, 587, 590, 598, 599, 608, 609, 610, 611, 642, 644, 666, 667, 675, 690, 691, 696 and 697 in Appendix A.

# Gascoyne 1 (*GAS1 – Ashburton subregion*)

PETER KENDRICK  
OCTOBER 2001

## Subregional description and biodiversity values

### Description and area

Mountainous range country divided by broad flat valleys, associated with Ashburton River Catchment of the Ashburton Basin (shales, sandstones and conglomerates), and the north-western part of Bangemall Basin (sandstone, shale, carbonates). Mulga/snakewood low woodlands occur on shallow earthy loams over hardpan on the plains, with mulga scrub and *Eremophila* shrublands on the shallow stony loams of the ranges. Low mixed shrublands on hills with other areas supporting large areas of *Triodia*. Arid (desert) climate with bimodal (winter and summer) rainfall, with tropical monsoon influences. The subregional area of GAS1 is 4, 039, 387ha.

### Dominant land use

Dominant land use is Grazing – (ix) native pastures (see Appendix B, key b), (xi) UCL and Crown reserves, (xiii) conservation.

### Continental Stress Class

The Continental Stress Class for GAS1 is 4.

## Known special values in relation to landscape, ecosystem, species and genetic values

### Gorges of Barlee Range Nature Reserve:

Particularly those of Kookhabinna Creek. Deeply incised gorges, up to 100m deep, containing extensive permanent spring-fed streams and pools. Contain relictual species: an undescribed *Bothriembryon* landsnail, *Pseudophryne douglasi* (a frog), plants (*Wurmbea saccata*), and *Rhinonictis aurantius* (a bat). Spectacular exposures of banded sedimentary formations, and many waterfalls and gorge features. This is the only area within GAS1 where any intensive biology has been undertaken.

### Yadjiyugga Claypan:

A large ephemeral claypan, with open coolibah woodland (*Eucalyptus victrix*) over bunch grass (*Eriachne benthamii*) and samphire (*Tecticornia verrucosa*). Also contains an undescribed *Peplidium*. Previously severely degraded by stock and donkeys, it has been protected by exclusion fencing since 1996. Recovery has been very

successful. This flora assemblage is unique to the GAS1 subregion.

### Centres of Endemism:

There are no known centres of endemism with GAS1, however there is a strong possibility of troglofauna in calcrete deposits associated with the Lyons River.

### Refugia:

Note that Morton *et. al* (1995) list no refugia in GAS1, however the following should be included:

- Gorges of the Barlee Range Nature Reserve. Permanent water and protected from fire. Provide refuge sites for humidophiles and fire intolerant species.
- Yadjiyugga Claypan (see above).
- Calcrete deposits of PIL3, for troglofauna. No survey has yet been undertaken, but calcrete deposits along the southern boundary of GAS1 are very likely to contain troglodites (Humphreys 2001).
- Permanent spring systems, such as Minnie Spring (on the Henry River) and the Irragully Creek (Wanna Station), and elsewhere scattered through the bioregion.
- Range country throughout the bioregion would provide areas of fire refuge.

### High Species and Ecosystem Diversity:

- There is high *Eremophila* diversity in GAS1.
- Stygofaunal crustacean fauna within calcrete environments. So far unknown, but indications are for a significant fauna.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8), in the 'Red Book' reports of 1976 – 1984 (Environmental Protection Authority 1975). These recommendations were reviewed in 1993 (Environmental Protection Authority 1993). Reserve recommendations for GAS1 were limited to endorsing the existing Barlee Range Nature Reserve (recommendation 8.15), and deferring any action on the proposed Teano Range – Jeealia River Downs reserve (recommendation 8.17) (Environmental Protection Authority 1993). No other subregional or bioregional planning for biodiversity conservation has been attempted.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Kookhabinna Creek Gorges, GAS001WA	B2, B14	iii	iv	ii	v (cattle, donkey), vi (buffel grass)
Yadjiyugga Claypan, GAS004WA	B6	iii	iv	iii	v (cattle, donkey, but now fenced)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Calcrete aquifers of the Lyons River	Southern boundary of GAS1	B19	Probably stygofauna	iv	iv	ii	vi (weeds)
Minnie Spring	Henry River, adjacent to Barlee Range NR	B2, B17	Large running spring wetlands	ii	iii	ii	v (cattle, donkey), vi (weeds; buffel grass)
Irragully Creek	Flows into Ashburton from Wanna Station.	B2, B17	Spring wetlands and ephemeral pools	ii	iii	ii	v (cattle, donkey), vi (weeds; buffel grass)
Major pools in Ashburton and Hardy Rivers	Many and scattered along rivers	B2,	Semi-permanent and ephemeral pools and flood-outs	i	iii	ii	v (cattle, donkey), vi (weeds; buffel grass)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	ii (Buffel grass very common, permanent and semi-permanent pools affected by cattle and feral animals.)	iii	ii	iv (cattle), v (donkeys, horses), vi (buffel grass, date palm, ruby dock), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GAS1.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Yadjiyugga Claypan		19, 39	ii	v	iii	iv (cattle), v (donkey) currently protected by fencing
Wetland systems of the Ashburton and Lyons drainage (including permanent and semi-perm pools, springs and		10, 15, 19,	i	iii	ii	iv (cattle), v (donkey, horse, cattle), vi (buffel grass)
Dwarf shrublands of the Ashburton catchment (Ashburton Downs – Kooline land system)		29	ii	iii	ii	iv (cattle), (v) donkey, horse, cattle), vii
Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Saltbush community, alluvial plains of Ashburton (type CHAT in Payne <i>et al.</i> 1988)		31	i	iii	ii	iv (cattle), v (donkey, horse, cattle), vii
Bluebush community, alluvial plains of Ashburton (type CHMA in Payne <i>et al.</i> 1988)		31	i	iii	ii	iv (cattle), v (donkey, horse, cattle), vii
Mulga creekline community, alluvial plains of Ashburton (type MUCR in Payne <i>et al.</i> 1988)		20	ii	iii	ii	iv (cattle), vii, v (donkey, horse, cattle)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Rhinonictes aurantius</i>	V	ii	iv	iii	No known threatening processes
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Liasis olivaceus barroni</i>	V	iv (common and widespread)	iv	ii	Not currently threatened or likely to be
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	iii	No known threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Sminthopsis longicaudata</i>	P4	i	vi	i	v (possibly cats)
<i>Macroderma gigas</i>	P4	i	vi	ii	xii (barb-wire fences)
<i>Pseudomys chapmani</i>	P4	ii	vi	ii	Not threatened, or likely to be.
<i>Ardeotis australis</i>		i	vi	ii	v (possibly cats)
<i>Burhinus grallarius</i>		i	vi	ii	v (possibly cats)
<i>Leiopotherapon ahenius</i>	P4	i	vi	ii	iv, v (cattle, donkey pollution and fouling of waters)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Eremophila rigens</i>	1	iii	vi	ii	iv, vi, vii
<i>Helichrysum oligochaetum</i>	1	iii	vi	ii	iv, vi, vii
<b>PRIORITY 2</b>					
<i>Euphorbia drummondii</i> sup sp. Pilbara (BG Thomson 3503)	2	ii	vi	ii	iv, vi, vii
<i>Sida</i> sp Barlee Range (S van Leeuwen 1642)	2	ii	vi	ii	iv, vi, vii
<i>Stylidium weeliwoffi</i>	2	ii	vi	ii	iv, vi, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )	0.0	0.0	0.0	H
18	Low woodland; mulga ( <i>Acacia aneura</i> )	0.0	0.0	0.0	H
28	Open low woodland; mulga	0.0	0.0	0.0	H
29	Sparse low woodland; mulga, discontinuous in scattered groups	0.0	0.0	0.0	H
39	Shrublands; mulga scrub	0.0	0.0	0.0	H
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	0.0	0.0	0.0	M
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	0.0	0.0	0.0	M
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	0.0	0.0	0.0	H
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	M
103	Hummock grasslands, shrub steppe; snakewood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	M
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	0.0	0.0	0.0	M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	81,455.8	0.0	0.0	L
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>	0.0	0.0	0.0	M
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub	0.0	0.0	0.0	H
161	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>	0.0	0.0	0.0	H
162	Shrublands; snakewood scrub	0.0	0.0	0.0	M
163	Shrublands; eremophila and cassia dwarf scrub	0.0	0.0	0.0	H
165	Low woodland; mulga & snakewood ( <i>A. eremaea</i> )	26.9	0.0	0.0	H
166	Low woodland; mulga & <i>Acacia victoriae</i>	0.0	0.0	0.0	M
168	Shrublands; mulga, <i>Acacia victoriae</i> & snakewood scrub	0.0	0.0	0.0	M
169	Shrublands; mulga & minnieritchie scrub	0.0	0.0	0.0	M
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	0.0	0.0	0.0	M
180	Shrublands; mulga open scrub	0.0	0.0	0.0	M
181	Shrublands; mulga & snakewood scrub	33,315.8	0.0	0.0	H
197	Sedgeland; sedges with scattered medium trees; coolibah over various sedges & forbs	0.0	0.0	0.0	H
264	Low woodland; <i>Acacia victoriae</i> & snakewood	0.0	0.0	0.0	H
563	Shrublands; acacia scrub ( <i>Acacia</i> sp. unknown various locations)	0.0	0.0	0.0	H
567	Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	M
580	Mosaic: Shrublands; eremophila and cassia dwarf scrub/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0	H
588	Shrublands; <i>Acacia victoriae</i> scrub	0.0	0.0	0.0	M
624	Hummock grasslands, shrub steppe; mulga over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	H
641	Medium woodland; coolibah & river gum	0.0	0.0	0.0	H
1162	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i> & <i>T. basedowii</i>	0.0	0.0	0.0	M
1322	Shrublands; <i>Acacia sclerosperma</i> , <i>A. victoriae</i> & snakewood scrub	0.0	0.0	0.0	M

Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
1601	Mosaic: Shrublands; snakewood & <i>A. victoriae</i> scrub/Hummock grasslands; grass steppe, hard spinifex <i>Triodia basedowii</i>	0.0	0.0	0.0	M
1602	Mosaic: Shrublands; snakewood scrub/Hummock grasslands; grass steppe, hard spinifex <i>Triodia basedowii</i> & <i>T. wiseana</i>	0.0	0.0	0.0	M
2675	Hummock grasslands, low tree & shrub steppe; scattered eucalypts, kanji over <i>Triodia pungens</i> & <i>T. basedowii</i>	0.0	0.0	0.0	M

### Subregional constraints in order of priority (see Appendix B, key g)

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and productive systems are of high value.

**Competing Land Uses:** In particular current and prospective mining interests and pastoral values.

### Bioregional and subregional priority for reserve consolidation

GAS has 10.4% of its surface under some form of conservation tenure. GAS1 has 2.8%, placing it in reservation Class 2b (see Appendix D, and Appendix C, rank 4). There is strong bias at the subregional level.

### Reserve management standard

GAS1 contains one Nature Reserve (Barlee Range Nature Reserve) but has no residential staff. Managed from both Karratha and Exmouth. Visited approximately 6 times per year. Fencing around Yadjiyugga Claypan maintained, feral herbivores controlled by periodic aerial shooting. The boundaries are not fenced and no weed control is undertaken, even though ruby dock has appeared in the nature reserve over the last 4 years or so.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of fauna and flora.	Barlee Ranger Nature Reserve	Nature Reserve	ii

<sup>1</sup>Appendix C, rank 5

### Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Known Information	Specific Recovery Plan	General Recovery Plan
<i>Ardeotis australis</i>	Commonly observed at Barlee Range Nature Reserve, and elsewhere in the bio-subregion. Not considered under threat in this area.	No	Action Plan for Australian Birds
<i>Burhinus grallarius</i>	Observed at Barlee Range Nature Reserve, and probably relatively common elsewhere in the bio-subregion.	No	Action Plan for Australian Birds
<i>Falco peregrinus</i>	Uncommon resident. Very little data apart from occasional sightings. No information on local GAS1 population.	No	Action Plan for Australian Birds
<i>Leiopotherapon ahenius</i>	Uncommon, although present in permanent pools of Kookhabinna Gore (Barlee Range Nature Reserve). Also known from Nicholl Spring, 350 km east, on the boundary of GAS1 and GAS3 (within the Ashburton drainage). Requires more survey, and research into tolerance of disturbance from cattle in areas of the Ashburton catchment between these two sites.	No	No
<i>Liasis olivaceus</i>	Known mainly from throughout Barlee Range Nature Reserve, where it appears to be common along water courses. It is not threatened, and should not be listed as such.	No	Action Plan for Australian Reptiles

Species	Known Information	Specific Recovery Plan	General Recovery Plan
<i>Macroderma gigas</i>	A population of <i>Macroderma gigas</i> is present within Barlee Range Nature Reserve. Occasional dead bats have been found on barbed wire fences on the reserve boundary. There are records of <i>Macroderma</i> living in a cave on Ullawarra, south of the reserve. Further survey and monitoring required.	No	Action Plan for Australian Bats
<i>Pseudomys chapmani</i>	Present within Barlee Range Nature Reserve, and probably elsewhere within the bio-subregion.	No	Action Plan for Australian Rodents
<i>Rhinonictis aurantius</i>	A population of <i>Rhinonictis aurantius</i> is known from Barlee Range Nature Reserve, and is presumed to be breeding there (Kookhabinna Gorge). Maternity roosts have not been identified. It may be present elsewhere in GAS1.	No	Action Plan for Australian Bats
<i>Sminthopsis longicaudata</i>	A population of <i>Sminthopsis longicaudata</i> is present within Barlee Range Nature Reserve. It may be present elsewhere in GAS1.	No	Action Plan for Australian Marsupials and Monotremes
Priority 1 and 2 Flora species including <i>Eremophila rigens</i> , <i>Euphorbia drummondii</i> sup sp. Pilbara (BG Thomson 3503), <i>Helichrysum oligochaetum</i> , <i>Sida</i> sp Barlee Range (S van Leeuwen 1642), <i>Stylidium weeliwolli</i> , <i>Wurmbea saccata</i>	Very little information available.	No	No

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Ardeotis australis</i>	xii	Status of species is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.
<i>Burhinus grallarius</i>	xii	Status of species is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.
<i>Falco peregrinus</i>	xii	Little data on status of GAS1 population. Unlikely that specific recovery actions are required.
<i>Leiopotherapon ahenius</i>	xii	Status of population is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.
<i>Liasis olivaceus</i>	xii	Barlee Range Nature Reserve population is secure and common. Further information for rest of bioregion is required.
<i>Macroderma gigas</i>	v, xii	Status of population is uncertain. Barbed wire fences to be removed where possible or replaced with plain wire.
<i>Pseudomys chapmani</i>	None required	Status of species is secure; widespread and abundant. No further action necessary.
<i>Rhinonictis aurantius</i>	xii	Research into habitat requirements and distribution.
<i>Sminthopsis longicaudata</i>	xii	Status of this species throughout in GAS1 is uncertain. More survey work is required, as habitat appears highly suitable.
Priority 1 and 2 Flora species including <i>Eremophila rigens</i> , <i>Euphorbia drummondii</i> sup sp. Pilbara (BG Thomson 3503), <i>Helichrysum oligochaetum</i> , <i>Sida</i> sp Barlee Range (S van Leeuwen 1642), <i>Stylidium weeliwolli</i> , <i>Wurmbea saccata</i>	xii	Status of species is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.

<sup>1</sup>Appendix B, key h.

## Ecosystems and appropriate recovery actions

Community	Recovery Action <sup>1</sup>	Recovery Descriptions
Yadjiyugga Claypan	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing has been done but needs to be maintained. Weed control. Feral animal control. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Research into species distributions, requirements and threatening processes.
Wetland systems of the Ashburton and Lyons drainage (including permanent and semi-perm pools, springs and	i, ii, iii, vi, ix, vii, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Weed control of date palms, however it is probably impossible to do anything about buffel grass. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Feral animal control. Research into species distributions, requirements and threatening processes.
Dwarf shrublands of the Ashburton catchment (Ashburton Downs – Kooline land system)	i, ii, iii, v, vii, vi, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing stock away from sensitive areas, especially highly palatable communities like blue-bush, salt-bush etc. Feral animal control. Weed control, however it is probably impossible to do anything about buffel grass. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Research into species distributions, requirements and threatening processes.
Saltbush community, alluvial plains of Ashburton (type CHAT in Payne <i>et al.</i> 1988)	i, ii, iii, v, vii, vi, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing stock away from sensitive areas, especially highly palatable communities like blue-bush, salt-bush etc. Feral animal control. Weed control, however it is probably impossible to do anything about buffel grass. Research into species distributions, requirements and threatening processes.
Bluebush community, alluvial plains of Ashburton (type CHMA in Payne <i>et al.</i> 1988)	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing stock away from sensitive areas, especially highly palatable communities like blue-bush, salt-bush etc. Feral animal control. Weed control, however it is probably impossible to do anything about buffel grass. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Research into species distributions, requirements and threatening processes.
Mulga creekline community, alluvial plains of Ashburton (type MUCR in Payne <i>et al.</i> 1988)	i, ii, iii, v, vii, vi, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing stock away from sensitive areas, especially highly palatable communities like blue-bush, salt-bush etc. Feral animal control. Weed control, however it is probably impossible to do anything about buffel grass. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Research into species distributions, requirements and threatening processes.

<sup>1</sup>Appendix B, key h

### Existing ecosystem recovery plans

There are no recovery plans for ecosystems at risk in GAS1.

### Subregion priority for off reserve conservation

The off park priority for conservation is (ii) (see Appendix C, rank 6), indicating that a range of off park measures is required.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Institutional Reform:** GMS (Gascoyne – Murchison Strategy) restructuring of the pastoral industry.

**Threat Abatement Planning as Part of NRM:** Feral animal control, mainly feral herbivores. There is no weed control to speak of.

#### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands, especially pastoral and aboriginal leases, and mining areas.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements; includes resumption of high quality lands for reservation from existing pastoral leases (GMS).

**Threat Abatement Planning as Part of NRM:** e.g. Pest management, feral herbivore control on pastoral lands.

**Industry Codes of Practice:** Potentially powerful, but due to the small size of most pastoral companies involved, effects will be patchy and up to individuals.

**Environmental Management Systems:** Can be very powerful, but will be limited as per comments in Industry Codes of Practice above.

**Capacity Building:** Further capability building in resource and pastoral industries.

**Other Planning Opportunities:** including local and State government planning for a CAR conservation reserve system (including GMS).

### Impediments or constraints to opportunities

- Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, let alone any further acquisitions. Impediments exist in operations of the Pastoral Lands Board (need to re-structure un-viable leases after reserve areas are removed);
- Need to increase awareness of conservation values through education of various industry (mining, pastoral) groups and the public in general.

- High value conservation areas are held under pastoral leases, and we can't afford to purchase them. Resumption is the only option.
- Control of feral herbivores is at an inadequate level – not enough money available to undertake effective control within Karijini National Park.
- Weed control is inadequate.
- Need more resources for basic inventory research and work into threatened species.

Subregions where specific NRM actions are a priority to pursue

The NRM priority for GAS1 is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development system.

## Data gaps

Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists (Barlee Range Nature Reserve). Quadrat-based floristic data is available from relatively few localities (all in Barlee Range Nature Reserve).

**Quantitative Fauna Survey:** Subregional survey of fauna has not been undertaken.

**Ecological and Life History Data:** There are few detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species. (e.g., native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush and ruby dock).

### Other Priority Data Gaps Include:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of subregional troglofaunas.

## Source

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadlier, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
273	Environmental Protection Authority	(1975).	Conservation Reserves for Western Australia. Systems 4,8,9,10,11,12..	Environmental Protection Authority. Perth, Western Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
391	Humphreys, W.F.	(2001).	Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. Pp 63 - 83 in Subterranean Biology in Australia 2000, W.F. Humphreys and M.S. Harvey (eds).	Records of the Western Australian Museum, Supplement No. 64.	B
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R
541	Payne, A.L., Mitchell, A.A. and Holman, W.F.	(1988).	An inventory and condition survey of rangelands in the Ashburton River catchment, Western Australia.	Department of Agriculture Technical Bulletin No. 62.	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 012, 024, 026, 065, 082, 094, 118, 148, 173, 181, 182, 258, 266, 281, 383, 387, 399,

402, 407, 419, 463, 493, 620, 625, 634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.

# Gascoyne 2 (*GAS2 – Carnegie subregion*)

MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Underlain by the Earraheedy Basin of the Capricorn Orogen (Proterozoic) and the south-eastern extension of the Bangemall Basin. Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. Shallow earthy loams over hardpan on the plains and shallow stony loams associated with the ranges. Extensive salt lake systems. Low Mulga communities occur on hills and plains. Samphire and saltbush steppes are associated with salt lakes while ranges are dominated by mulga scrub and *Eremophila* shrublands. Desert climate, with bimodal rainfall. Subregional area of GAS2 is 5, 260, 969ha.

### Dominant land use

(see Appendix B, key b)

(ix) Grazing – native pastures. This accounts for the vast majority of land use in the subregion –66.06%

(xi) Unallocated Crown Land and Crown Reserves-32.19%

(vii) Lakes and major water courses-1.43%

### Continental Stress Class

The Continental Stress Class for GAS2 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Calcrete Aquifers:

Found in part of the subregion and are likely to support a range of subterranean aquatic fauna as occur in aquifers of the adjoining Murchison 1 subregion. Our understanding of biogeography for these groups is very limited, but work by Humphries (2001) suggests that there is likely to be significant stygofauna in aquifers at Lorna Glen and Cunyu and these are frequently short range endemics.

#### Rare Species:

Include *Egernia kintorei* (Great Desert Skink), *Leipoa ocellata* (Mallee Fowl), *Polytelis alexandrae* (Alexandra's Parrot), *Dasyercus cristicauda* (Mulgara) and a priority gecko, *Diplodactylus kenneallyi*. There are no rare plants documented for the subregion but this may just reflect the lack of detailed work conducted in the area although the largely homogenous landscape is unlikely to support many endemic or restricted species.

#### Ecosystems:

Beard Vegetation Associations 97 (Hummock grasslands, shrub steppe: acacia species over *Plectrachne melvillei*) and 546 (Succulent steppe with low woodland: mulga over samphire) are endemic to Gascoyne 2.

#### Centres of Endemism:

There are no identified endemic taxa/groups within the subregion although the Gascoyne region supports at least two species of endemic reptiles- the gecko *Diplodactylus wilsoni* and the skink *Lerista stictopleura*.

It is likely that a number of subterranean aquatic fauna within calcrete aquifers are endemics but currently only the following are identified:

- Family Diosaccidae (marine family): *Schizopera* sp. nov. 4 - known only from Lake Way and Lorna Glen: *Schizopera* sp. nov. 5 known only from Jundee and Lorna Glen
- Family Ameiridae (mostly a marine family): *Nitocrella* n. sp. 4 Lorna Glen

**Refugia:** Although probably not recognised as a true refugia site, the Lake Carnegie System is documented as an important site for the breeding of Black Swans (*Cygnus atratus*). It is a large shallow, saline, internal drainage basin that is episodic in terms of inundation. In 1980 as many as 1000 breeding pairs of Black Swans were observed with 130 broods and numerous nests with eggs. This represents the highest numbers breeding at any site in WA. Another 24 species of waterbird have been documented from with several of them, including the Grey Teal and Australian Shelduck, also breeding.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern Goldfields (System 11), which includes Gascoyne 2, in the CTRC Green Book (Environmental Protection Authority 1974). Some, but not all of these recommendations (with modification) were implemented over the following two years. A review of outstanding recommendations was initiated in 1988 and culminated in the production of a report – Nature Conservation Reserves in the Eastern Goldfields, Western Australia (Henry-Hall 1990). This report made recommendations on a nature conservation reserve system for the southern and central Goldfields, which incorporates GAS2. Most of the subregion is covered by a CALM Regional Management Plan, published in 1994 (Department of Conservation and Land Management 1994b), that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of

subregions, or even bioregions, individually (Department of Conservation and Land Management 1994).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Carnegie system, WA032	B8	iii	iv	iii	iv (grazing on adjoining lands)
Windich Springs, WA033	B17	ii	iii-iv	iii	iv, v (camels)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of subregional significance in GAS2.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Gascoyne Catchment Area	ii	iii-iv	ii	iv (cattle),v (camels), vi, x, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

As all water courses within the subregion are only episodically inundated there is really almost no vegetation that can be described as riparian. However, internal drainage systems are frequently degraded by stock use and through feral herbivores and thus may alter drainage

patterns which may in turn alter vegetation structures and contribute to eutrophication downstream after rainfall events.

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) within GAS2.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Carnegie	V	41	iii	iv	iii	No specific threatening processes other than much of the surrounding land is pastoral lease and there may be some impacts from stock grazing (iv, v, x)
Windich Springs	V	42	ii-iii	iii	iii	iv (grazing by cattle, horses and camels has been causing damage to creek bed and some decline in dense sedgelands which fringed the pools), v, x (faeces from stock and feral animals may foul the water, vii)
Subterranean fauna of Calcrete aquifers	V	N/A	iii-iv	iv	iii	Potential threats: ix, x, xi, vi, i.

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus cristicauda</i>	V	ii	iii	iii	v (foxes & cats), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	V	ii	iii	iii	vii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	i	ii	iii	v (foxes & cats), vii, iv
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Acanthiza iredalei iredalei</i>	Commonweal lth	ii-iii	iii	ii	vii, iv
<i>Diplodactylus kenneallyi</i>	P2	ii-iii	vi	iii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

There are no DRF or Priority plant species listed due to lack of knowledge and survey information, however the risks through grazing are considerable.

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )				L
18	Low woodland; mulga ( <i>Acacia aneura</i> )			X	M
19	Low woodland; mulga between sandridges				L
24	Low woodland; <i>Allocasuarina cristata</i>				L
29	Sparse low woodland; mulga, discontinuous in scattered groups			X	M
39	Shrublands; mulga scrub			X	M
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>			X	M
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges				M
97	Hummock grasslands, shrub steppe; acacia species over <i>Plectrachne melvillei</i>			X	M
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex				L
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex				L
125	Bare areas; salt lakes			X	M
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				L
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite				M
142	Medium woodland; York gum & salmon gum				M
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				M
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )				H
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub				M
204	Succulent steppe with open scrub; scattered mulga & <i>Acacia sclerosperma</i> over saltbush & bluebush			X	M
508	Succulent steppe with open scrub; scattered mulga over saltbush				H
546	Succulent steppe with low woodland; mulga over samphire			X	M
Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM Purchased Lease	Priority
547	Mosaic: Low woodland; mulga & bowgada/Succulent steppe; samphire				H
676	Succulent steppe; samphire			X	M

1195	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, shrub steppe; acacia species over <i>Triodia basedowii</i>				M
1446	Succulent steppe with scrub; mulga over bluebush			X	M

**Subregional constraints in order of priority**  
(see Appendix B, key g)

**Competing Land Uses:** In that pastoralism occupies more than 65% of the subregion.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values due to a distinct lack of resolution of data; level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores.

**Bioregional and subregional priority for reserve consolidation**

GAS is reservation class 3 (see Appendix D, and Appendix C, rank 4) with only 1.93% of area in

conservation reserve (IUCN I-IV) At the subregional level GAS1 has 2.84% in reserve (IUCN I-IV) while GAS2 has nothing in IUCN I-IV conservation reserve and GAS3 has 2.53% in IUCN I-IV reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 2 as a primary classification is more appropriate.

**Reserve management standard**

In GAS, no feral predator programs are in place yet. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained. Feral herbivore grazing activities still pose a conservation risk in some areas and no feral predator control is being undertaken. Therefore, the overall reserve management rank for GAS is (ii) (see Appendix C, rank 5).

Name	Category	Reserve Management Rank <sup>1</sup>
Earaheedy	Unallocated Crown Land (now managed for conservation)	ii-iii
Lorna Glen	Unallocated Crown Land (now managed for conservation).	ii-iii

<sup>1</sup>Appendix C, rank 5

**Off reserve conservation**

**Priority species or groups and existing recovery plans**

Species	Beard Vegetation Association or Ecosystem	Specific Recovery Plan	General Recovery Plan
Stygofauna	Calcrete aquifers	No	No
<i>Polytelis alexandrae</i>	39 – Shrublands: mulga scrub; 95 – Hummock grasslands, shrub steppe: acacia and grevillea over <i>Triodia basedowii</i> ; 96 – Hummock grasslands, shrub steppe: acacia species (+ grevillea) over <i>Triodia basedowii</i> often between sand ridges; 97 - Hummock grasslands, shrub steppe: acacia species over <i>Plectrachne melvillei</i> ; 107 – Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex; 111 – Hummock grasslands, shrub steppe: <i>Eucalyptus gamophylla</i> over hard spinifex; 11 – Medium woodland: red mallee group; 24 – Low woodland: <i>Allocasuarina cristata</i> .	No	Action Plan for Australian Birds
<i>Acanthiza iredalei iredalei</i>	676 – Succulent steppe: samphire; 508 – Succulent steppe with open scrub: scattered mulga over saltbush; 546 – Succulent steppe with low woodland; mulga over samphire; 144 – Medium woodland: wandoo, salmon gum, morrel, gimlet & rough fruited mallee.	No	Action Plan for Australian Birds
<i>Dasyercus cristicauda</i>	18 – Low woodland: mulga ( <i>Acacia aneura</i> ); 39 – Shrublands: mulga scrub; 107 – Hummock grasslands, shrub steppe: mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex.	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes

Species	Beard Vegetation Association or Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Diplodactylus kenneallyi</i>	unknown	No	Action Plan for Australian Reptiles
<i>Egernia kintorei</i>	39 – Shrublands: mulga scrub, 96 - Hummock grasslands, shrub steppe: acacia species (+ grevillea) over <i>Triodia basedowii</i> often between sand ridges; 107 - Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex; 111 - Hummock grasslands, shrub steppe: <i>Eucalyptus gamophylla</i> over hard spinifex; 178 – Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i> .	Yes - National Threatened Species Recovery team	Action Plan for Australian Reptiles

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Polytelis alexandrae</i>	i, ii, iii, vii	habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, vii	The loss of habitat through grazing of chenopod shrubland by sheep and rabbits
<i>Dasyercus cristicauda</i>	i, ii, iii, vii, ix, xii	CWR species that requires specific fire age spinifex habitat. Predated upon by foxes and cats. Ecological research currently being conducted by D. J. Pearson
<i>Egernia kintorei</i>	i, ii, iii, vii, ix, xii	It is likely that reduction has occurred through direct predation (cats, foxes) as well as habitat alteration through changed fire regimes as well as grazing impacts.

<sup>1</sup>Appendix B, key h.

## Ecosystems and appropriate recovery actions

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Lake Carnegie	i, ii, iii, xiii, vii, vi	Habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry. Feral animal control: cats, foxes, and camels. Weed control.
Windich Springs	i, ii, iii, xiii, vii, vi	Habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry. Feral animal control: cats, foxes, and camels. Weed control.
Subterranean fauna of Calcrete aquifers	i, ii, iii, xiii, vii, vi	Habitat retention through reserves or on other State lands or on private lands. Weed control.

<sup>1</sup>Appendix B, key h.

## Existing ecosystem recovery plans

There are no recovery plans relevant to ecosystems at risk in GAS2, however the subregion is included in Goldfields Regional Management Plan (Department of Conservation and Land Management 1994b).

## Subregion priority for off reserve conservation

The priority for off park conservation in GAS2 is (ii) (see Appendix C, rank 6), indicating that there is a significant off park effort needed, and resource constraints and limited community capacity exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to mining and exploration activities.

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas already attempting to identify and implement ecologically sustainable practices through the EMU process developed by AgWA. Needs a greater level of support to be successful.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, and Conservation Through Reserves is limited through mining leases and tenements. There needs to be an increase awareness of conservation values through education of various industries (mining and pastoral) and the public in general. Limited financial resources are also a major constraint.

## Subregions where specific NRM actions are a priority to pursue

The NRM priority in GAS2 is (i) (see Appendix C, rank 7), which indicates that there are major constraints to implement effective NRM actions and achieve biodiversity outcomes. Much of GAS2 is severely degraded through past agricultural practices (primarily cattle grazing) and feral herbivores. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes.

## Data gaps

Gaps in Data Needed for the Identification of Biodiversity Values and Management Responses

**Vegetation and Regional Ecosystem Mapping:**

Regional survey of flora has not been conducted and regional ecosystem mapping has only been conducted at 1:1000000 scale by Beards vegetation mapping. Mabbutt *et al.* (1963) produced land system mapping for the Wiluna-Meekatharra area at a scale of 1:500000. The Western Australian Department of Agriculture has also produced Land system mapping at the 1:500000 scale for much of the rangelands but the information was developed to reflect pastoral value rather than conservation or ecosystem status.

**Systematic Fauna Survey:** There has been no systematic fauna surveys conducted in the subregion and as such the majority of data has been opportunistically collected and sampling sites are sparse and probably restricted to areas of good access.

**Ecological and Life History Data:** There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of any species.

**Other Priority Data Gaps Include:**

- No quantitative data on the effect of exotic predators, weed colonisation, fire, mineral-extraction etc.
- There is no regolith mapping for any of the subregion at better than 1:250,000.

## Source

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
354	Henry-Hall, N.J., Hopper, S.D., McKenzie, N.L. and Keighery, S.D.	(1990).	Nature Conservation Reserves in the Eastern Goldfields, Western Australia - Southern Two Thirds of CTCRC System 11.	Report submitted to EPA Red Book Task Force.	R
391	Humphreys, W.F.	(2001).	Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. Pp 63 - 83 in Subterranean Biology in Australia 2000, W.F. Humphreys and M.S. Harvey (eds).	Records of the Western Australian Museum, Supplement No. 64.	B
461	Mabbutt, J.A., Litchfield, W.H., Speck, N.H., Sofoulis, J., Wilcox, D.G., Arnold, M., Brookfield, M. and Wright, R.L.	(1963).	General Report on Lands of the Wiluna-Meekatharra area, Western Australia, 1958.	CSIRO Land Research Series No 7.	J
483	Maxwell, S., Burbidge, A. A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Egernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
545	Pearson, D.J.	(1991).	First record of the Mulgara <i>Dasyercus cristicauda</i> , from the Gibson Desert and Queen Victoria Springs nature Reserves.	Western Australian Naturalist 18: 159-161.	J

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 040, 065, 067, 075, 090, 098, 099, 101, 118, 211, 232, 241, 258, 260, 272, 278, 279, 313, 370, 394, 395, 406, 450, 459, 507, 519, 526, 560,

561, 577, 584, 647, 648, 680, 685 and 686 in Appendix A.

# Gascoyne 3 (*GAS3* – *Augustus subregion*)

ANTHONY DESMOND, PETER KENDRICK AND ALANNA CHANT  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys. Also includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. Although the Gascoyne River System provides the main drainage of this subregion, it is also the headwaters of the Ashburton and Fortescue Rivers. There are extensive areas of alluvial valley-fill deposits. Mulga woodland with *Triodia* occur on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland. A desert climate with bimodal rainfall. The subregional area for GAS3 is 10,687,739ha.

**Dominant land use**  
(see Appendix B, key b)

Mainly (ix) native pasture grazing (84.2%), with lesser areas of (xi) UCL and Crown Reserves (9.76%), (x) Aboriginal reserves (3.37%) and (xiii) conservation - the majority of conservation estate in the subregion falls outside the IUCN I-IV categories (2.5%).

### Continental Stress Class

The Continental Stress Class for GAS3 is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- Stygofauna of the calcrete aquifers of the Carnegie drainage that appear to be short range endemics. Our understanding of biogeography for these groups is very limited but work by Humphries (2001) suggests that there is significant stygofauna in the Carnegie drainage.
- Rare species for the subregion include, *Leipoa ocellata* (Mallee Fowl), *Polytelis alexandrae* (Alexandra's Parrot), *Dasyercus cristicauda* (Mulgara), and *Ctenophorus yinnietharra*.

### Ecosystem Types Have at Least 85% of Their Total Extent Confined to The Gascoyne 3 Subregion:

Beard Veg Assoc	Description
21	Low woodland; waterwood
161	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>
167	Shrublands; <i>Acacia victoriae</i> & snakewood open scrub
183	Low woodland; mulga, <i>Acacia victoriae</i> & snakewood
207	Hummock grasslands, shrub steppe; red mallee over hard spinifex
216	Low woodland; mulga (?with spinifex) on rises
222	Sparse low woodland; mulga & <i>Acacia victoriae</i> in scattered groups
225	Shrublands; snakewood & minnieritchie scrub
262	Shrublands; acacia & other spp on Mt Augustus
285	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches/Scattered groups of succulents

#### Centres of Endemism:

- *Eremophila* spp. on Landor Station.
- *Ctenophorus yinnietharra*, granites on Yinnietharra Station.
- *Lerista stictopleura* around base of Mount Augustus.
- Troglobitic communities in calcrete aquifers associated with palaeo-drainage lines.

#### Refugia:

Morton *et al.* (1995) do not list any refugia in GAS3, but potential for freshwater pools to be described as refugia for species requiring more mesic conditions. Hills may provide refuge from fire (e.g. Mount Augustus). Protection Authority 1974). The Collier Range National Park was established as a result.

#### High Species or Ecosystem Diversity:

- *Eremophila* spp. on Landor Station.
- *Lerista* throughout GAS in general.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara Region (System 8) in the CTRC Green Book, which encompasses this subregion (Environmental

The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are

targeted for reservation. An unpublished report by Department of Conservation and Land Management "Gascoyne - Murchison Strategy, Establishment and Management of a Conservation Reserve System" outlines

the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in the article Filling the Gaps (McNamara *et al.* 2000).

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance in GAS3.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Edithana Pool	24° 07' 25"S, 116° 29' 32"E	B5	iii	iii	iii	ii	iv (cattle), v (Tilapia, goats)
Cattle Pool	24° 17' 01"S, 116° 49' 33"E	B5	iii, v	iii	iii	ii	iv (cattle), v (Tilapia, goats)
Mibbly Pool	24° 58' 38"S, 118° 13' 43"E	B5	iii, v	iii	iii	ii	iv (cattle), v (goats)
Erong Springs	25° 28' 44"S, 116° 52' 36"E	B5	iii, v	iii	iii	ii	iv (cattle), v (goats)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name and Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Gascoyne Rivers	i	iii	ii	iv, v (foxes, rabbits & goats), vi (Buffel grass, Athel Pine), x (increased flow), vii
Lyons Rivers	i	iii	ii	iv, v (foxes, rabbits & goats), vi (Buffel grass, Athel Pine), x (increased flow), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GAS3.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Invertebrate assemblages of Edithana Pool (-240725S, 1162932E) High quality river pool on the Lyons River. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (Tilapia, goats)
Invertebrate assemblages of Cattle Pool (-241701S, 1164933E). High quality river pool on the Lyons River adjacent to Mt Augustus National Park. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (Tilapia, goats)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Invertebrate assemblages of Yinnietharra Cattle Pool (-243627S, 1160303E). Permanent freshwater pool on the middle Gascoyne. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	Unknown	vi	ii	iv (cattle), v (goats)
Invertebrate assemblages of Mibbly pool (-245838, 1181343). Large relatively undisturbed freshwater pool on the upper Gascoyne River (therefore unusual). Until recently protected from stock by thick riparian vegetation. Shire has recently cleared a track to the pool which has allowed stock access (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iv	iii	ii	iv (cattle), v (goats)
Invertebrate assemblages of Erong Springs (-252844, 1165236). High aquatic invertebrate diversity site in the Gascoyne area. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	V	NA	iii	iv	ii	iv (cattle), v (goats)
Vegetation communities dominated by <i>Eremophila</i> species. Landor Station, North of racetrack. 26 <i>Eremophila</i> species in this area, one undescribed <i>Eremophila</i> occurs in a unique community (A.Brown pers. comm.).	V	32	Unknown	vi	ii	iv (sheep and cattle), v (goats)
Plant assemblages of Robinson Range. Has populations of DRFs ( <i>Pityrodia augustensis</i> ) and several endemic <i>Eremophila</i> . Includes Mt Fraser and higher peaks. Is currently in very good condition but potentially subject to mining (A.Brown pers. comm.).	V	32	iv	vi	i	xii (mining and exploration), v (sheep and cattle), v (goats)
Jeeaila River Downs vegetation complexes. East of Mount Augustus (proposed Nature Reserve) (B.Barton pers. comm.).	V		Unknown	vi	ii	v (sheep and cattle), v (goats)
Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	19	Variable	iii	ii	v (sheep and cattle), v (goats), vii
Stony short grass-forb association of the undulating terrain of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	37	Variable	iii	ii	v (sheep and cattle), v (goats)
Stony chenopod association of strew covered drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	31	Variable	iii	ii	v (sheep and cattle), v (goats)
Chenopod association of tributaries and major drainage lines of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	31	Variable	vi	ii	v (sheep and cattle), v (goats)
Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	V	37	Variable	vi	ii	v (sheep and cattle), v (goats), vii
Plant assemblages of high diversity landscapes and unusual landforms being studied for the Ecological Management Unit, Gascoyne-Murchison Strategy e.g. Mt Arapiles (Milgun)	V		Unknown	vi	ii	v (sheep and cattle), v (goats)
Stygofauna of the Carnegie Drainage system (Humphries)	V	N/A	Unknown	vi	ii	xi, x (siltation etc of catchment areas)
Critical Weight Range Mammals such as <i>Macrotis lagotis</i> , <i>Dasyercus crassicaudata</i> , <i>Dasyurids</i> .	V	N/A	ii	vi	ii	v (foxes, cats), vii
Chenopod community of Weelarana Station. Heavily grazed and trampled by cattle, camel, and rabbits. (Stephen van Leeuwen, pers. comm.).	V	31	ii	iii	i	iv, v (camel, rabbits)
Clay pan dominated by <i>Nymphoides indica</i> . One occurrence, located 70 km south of Newman. Others probably occur, and are also threatened by grazing.	V	38	iii	iii	i	iv, v (rabbits, goats)
<i>Eucalyptus ferriticola</i> over trees on drainage lines in Gascoyne e.g. Doolgunna Station (K. Tinley pers. comm.)	V	8	ii	iv	i	No known threatening processes

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	i	iii	iii	v (foxes), vii
<i>Dasyercus cristicauda</i>	V	ii	iii	iii	v (foxes, cats), vii
<b>Schedule 1: Rare/likely to become extinct, Div 2 (Birds)</b>					
<i>Polytelis alexandrae</i>	V	i	iii	iii	vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Ctenophorus yinnietharra</i>	V	iii	iv	ii	v (foxes, cats), vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	ii	ii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Acanthiza iredalei iredalei</i>	Commonweal lth	iii	iii	ii	vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Pityrodia augustensis</i>	V	unknown	vi	ii	v (goats), iv, vii
<b>PRIORITY 1</b>					
<i>Acacia wilcoxii</i>	1	unknown	vi	ii	v (goats), iv, vi
<i>Eremophila arguta</i> ms	1	unknown	vi	ii	v (goats), iv, vi
<i>Eremophila flaccida</i> subsp. <i>attenuata</i> ms	1	unknown	vi	ii	v (goats), iv, vi
<i>Eremophila gracillima</i> ms	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Eremophila lanata</i> ms	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Eremophila micrantha</i> ms	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Eremophila prolata</i> ms	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Eremophila rigida</i> ms	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Goodenia berringbinensis</i>	1	unknown	vi	ii	v (goats), vi, vii
<i>Hemigenia</i> sp. Glenburgh (RJ Cranfield 9725)	1	unknown	vi	ii	v (goats), iv, vi, vii
<i>Homalocalyx chapmanii</i>	1	unknown	vi	ii	v (goats), iv, vi, vii
<i>Ptilotus astrolasius</i> var. <i>luteolus</i>	1	unknown	vi	ii	iv, v (goats), vii, vi
<i>Ptilotus lazaridis</i>	1	unknown	vi	ii	iv, v (goats), x
<i>Ptilotus trichocephalus</i>	1	unknown	vi	ii	iv, v (goats)
<i>Rhodanthe sphaerocephala</i>	1	unknown	vi	ii	iv, v (goats), vii, vi
<b>PRIORITY 2</b>					
<i>Gonocarpus ephemerus</i>	2	unknown	vi	ii	v, vi, vii
<i>Rhodanthe frenchii</i>	2	unknown	vi	ii	iv, v (goats), x
<i>Stylidium weeliwoffi</i>	2	unknown	vi	ii	iv, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )				M
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X			M
21	Low woodland; waterwood				H
28	Open low woodland; mulga				H
29	Sparse low woodland; mulga, discontinuous in scattered groups	X		X	H
39	Shrublands; mulga scrub	X		X	M
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>				L
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex				L
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex	X			M
117	Hummock grasslands, grass steppe; soft spinifex				L
125	Bare areas; salt lakes				L
128	Bare areas; rock outcrops				L
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				L
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>				L
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub			X	M
161	Hummock grasslands, low open tree & shrub steppe; scattered eucalypts, <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>				H
162	Shrublands; snakewood scrub				L
163	Shrublands; eremophila and cassia dwarf scrub			X	H
165	Low woodland; mulga & snakewood ( <i>A. eremaea</i> )			X	H
166	Low woodland; mulga & <i>Acacia victoriae</i>	X		X	H
167	Shrublands; <i>Acacia victoriae</i> & snakewood open scrub				H
168	Shrublands; mulga, <i>Acacia victoriae</i> & snakewood scrub				H
169	Shrublands; mulga & minnieritchie scrub				H
175	Short bunch grassland - savannah/grass plain (Pilbara)				L
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				L
181	Shrublands; mulga & snakewood scrub			X	L
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )	X		X	M
183	Low woodland; mulga, <i>Acacia victoriae</i> & snakewood				L
184	Shrublands; mulga & bowgada scrub				H
185	Sedgeland; sedges with medium woodland; sedges with coolibah over various sedges				L
186	Shrublands; <i>Acacia sclerosperma</i> & <i>A. victoriae</i> open scrub				H
197	Sedgeland; sedges with scattered medium trees; coolibah over various sedges & forbes				H
199	Hummock grasslands, shrub steppe; mulga over soft spinifex <i>Triodia</i> on rises				H
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub				M
207	Hummock grasslands, shrub steppe; red mallee over hard spinifex				H
216	Low woodland; mulga (?with spinifex) on rises				H
222	Sparse low woodland; mulga & <i>Acacia victoriae</i> in scattered groups	X		X	L
225	Shrublands; snakewood & minnieritchie scrub				H
228	Shrublands; <i>Acacia quadrimarginea</i> scrub				H
262	Shrublands; acacia & other spp on Mt Augustus				L
264	Low woodland; <i>Acacia victoriae</i> & snakewood				H
265	Low woodland; <i>Acacia sclerosperma</i> & <i>A. victoriae</i>				H
Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe; saltbush & bluebush				M
269	Low woodland over scrub; mulga over bowgada scrub				H
285	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches / Scattered groups of succulents				H
676	Succulent steppe; samphire				L
2081	Shrublands; bowgada and associated spp. scrub				L
	Invertebrate assemblages of Edithana Pool				H
	Invertebrate assemblages of Cattle Pool	X			L
	Invertebrate assemblages of Yinnietharra Cattle Pool				H
	Invertebrate assemblages of Mibley pool				H
	Invertebrate assemblages of Erong Springs				H

	Vegetation communities dominated by Eremophila species.				H
	Plant assemblages of Robinson Range.				H
	Jeeaila River Downs vegetation complexes.				H
	Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment				H
	Stony short grass-forb association of the undulating terrain of the Gascoyne catchment	X			H
	Stony chenopod association of strew covered drainage plains of the Gascoyne catchment				H
	Chenopod association of tributaries and major drainage lines of the Gascoyne catchment	X			H
	Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment	X			H
	Plant assemblages of high diversity landscapes and unusual landforms				H
	Stygofauna of the Carnegie Drainage system (Humphreys)				H
	Critical Weight Range Mammals				H
	Chenopod community of Weelarana Station				H
	Clay pan dominated by <i>Nymphoides indica</i>				H
	Eucalyptus ferritcola over shrubs on drainage lines in Murchison e.g. Doolgunna Station			X	M

**Subregional constraints in order of priority**  
(see Appendix B, key g)

**Competing Land Use:** Is the primary issue as pastoralism occupies nearly 85% of the region and mining also has considerable interests.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data; level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores.

**Bioregional and subregional priority for reserve consolidation**

GAS is reservation class 3 (see Appendix D, and Appendix C, rank 4) with only 1.92% of area in conservation reserve (IUCN I-IV) At the subregional level GAS1 has 2.88% in reserve (IUCN I-IV), GAS2 has no conservation reserve and GAS3 has 2.5% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive

**Off reserve conservation**

**Priority species or groups and existing recovery plans**

Species or System	Ecosystem	Specific Recovery Plan	General Recovery Plan
Stygofauna	Calcrete aquifers	No	No
<i>Falco peregrinus</i>		No	Action Plan for Australian Birds
<i>Macrotis lagotis</i>	18 – Low woodland: mulga ( <i>Acacia aneura</i> ); 28 – Open low woodland: mulga; 29 – Sparse low woodland: mulga, discontinuous in scattered groups.	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Polytelis alexandrae</i>		No	The Action plan for Australian Birds
<i>Acanthiza iredalei iredalei</i>		No	The Action plan for Australian Birds
<i>Dasyercus cristicauda</i>	18 - Low woodland: mulga ( <i>Acacia aneura</i> ); 39 – Shrublands: mulga scrub; 107 – Hummock grasslands, shrub steppe: mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex.	No	Action Plan for Australian Marsupials and Monotremes

or representative in terms of ecosystem representation so Class 2 with possibility of changing to a higher primary classification is appropriate.

**Reserve management standard**

**Mount Augustus National Park:** Reserve Management standard is fair (ii) (see Appendix C, rank 5). There are no feral predator programs are in place. Wildfire management facilities are limited by resources (except for fire breaks and fire-access tracks which are installed and maintained). Feral herbivore grazing activities may pose a conservation risk.

**Collier Range National Park:** Reserve Management standard is poor (i). The park is baited annually for wild dogs (by Department of Agriculture). No management apart from occasional visits by Karratha staff. Park has significant problems with feral herbivores (donkey) and stock (cattle). At present, no fire management is taking place and weed problems are unknown. There is no detailed information on biological values.

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Macrotis lagotis</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. CWR species that is no longer extant in the subregion. Control of feral animals, notably foxes, as well as fire management are essential. Possibility for translocation.
<i>Polytelis alexandrae</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, vii	Need to address the loss of habitat through grazing of chenopod shrubland by sheep and rabbits. Habitat retention through reserves or on other State lands or on private lands.
<i>Dasycercus cristicauda</i>	i, ii, iii, vii, ix, xii	CWR species that requires specific fire age spinifex habitat. Predated upon by foxes and cats. Ecological research currently being conducted by D.J. Pearson
<i>Ctenophorus yinnietharra</i>	i, ii, iii, vii, xii	Species with a restricted range. Habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores. Research into requirements of species.
<i>Acacia wilcoxii</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire and other disturbance mechanisms as well as the species general biology.
<i>Eremophila arguta ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila flaccida subsp. attenuata ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila gracillima ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila lanata ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila micrantha ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eremophila prolata ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila rigida ms</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Gonocarpus ephemerus</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Goodenia berringinensis</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Hemigenia</i> sp. Glenburgh (RJ Cranfield 9725)	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Homalocalyx chapmanii</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Pityrodia augustensis</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.
<i>Ptilotus astrolasius</i> var. <i>luteolus</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptilotus lazardis</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptilotus trichocephalus</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rhodanthe frenchii</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rhodanthe sphaerocephala</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium weeliwoili</i>	i, ii, iii, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Invasive

		weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
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<sup>1</sup>Appendix B, key h.

### Ecosystems and appropriate recovery actions

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Invertebrate assemblages of Edithana Pool (-240725S, 1162932E) High quality river pool on the Lyons River. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Invertebrate assemblages of Cattle Pool (-241701S, 1164933E). High quality river pool on the Lyons River adjacent to Mt Augustus National Park. High invertebrate diversity. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Invertebrate assemblages of Yinnietharra Cattle Pool (-243627S, 1160303E). Permanent freshwater pool on the middle Gascoyne. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Invertebrate assemblages of Mibley pool (-245838, 1181343). Large relatively undisturbed freshwater pool on the upper Gascoyne River (therefore unusual). Until recently protected from stock by thick riparian vegetation. Shire has recently cleared a track to the pool which has allowed stock access (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures).
Invertebrate assemblages of Erong Springs (-252844, 1165236). High aquatic invertebrate diversity site in the Gascoyne area. (W.Kay, M.Smith, M.Scanlon, S.Halse pers. comm.).	i, iii, v, vii	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes.
Vegetation communities dominated by <i>Eremophila</i> species. Lander Station, North of racetrack. 26 <i>Eremophila</i> species in this area, one undescribed <i>Eremophila</i> occurs in a unique community (A.Brown pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Plant assemblages of Robinson Range. Has populations of DRFs ( <i>Pityrodia augustensis</i> ) and several endemic <i>Eremophila</i> . Includes Mt Fraser and higher peaks. Is currently in very good condition but potentially subject to mining (A.Brown pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Jeeaila River Downs vegetation complexes. East of Mount Augustus (proposed Nature Reserve) (B.Barton pers. comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Mulga short grass-forb association of non-saline tributary drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stony short grass-forb association of the undulating terrain of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stony chenopod association of strew covered drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Chenopod association of tributaries and major drainage lines of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Wanderrie association on sandy alluvial drainage plains of the Gascoyne catchment (Wilcox and McKinnon 1992)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Plant assemblages of high diversity landscapes and unusual landforms being studied for the Ecological Management Unit, Gascoyne-Murchison Strategy e.g. Mt Arapiles (Milgun)	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Stygofauna of the Carnegie Drainage system (Humphries)	i, iii, v,	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Fire management.
Critical Weight Range Mammals such as <i>Macrotis lagotis</i> , <i>Dasyercus crassicaudata</i> , <i>Dasyurids</i> .	i, iii, v, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Feral animal control - mainly goats and foxes. Fire management, especially of mulgara habitat at Collier Range National Park.
Chenopod community of Weelarana Station. Heavily grazed and trampled by cattle, camel and rabbit (Stephen van Leeuwen, pers comm.).	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
Clay pan dominated by <i>Nymphoides indica</i> . One occurrence, located 70 km south of Newman. Others probably occur, and are also threatened by grazing.	i, iii, v, vi, vii, ix	Habitat protection through reserves - more reservation needed of high priority areas. Habitat protection on state lands (pastoral leases). Fencing of sensitive areas where there are heavy goat numbers (as exclosures). Weed control for critical habitats. Feral animal control - mainly goats and foxes. Fire management.
<i>Eucalyptus ferricola</i> over shrubs on drainage lines in Murchison e.g. Doolgunna Station	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

<sup>1</sup>Appendix B, key h.

## Existing ecosystem recovery plans

There are no existing recovery plans for Ecosystems at Risk in GAS3.

## Subregion priority for off reserve conservation (see Appendix C, rank 6)

The subregional priority for off park conservation in GAS3 is (ii), indicating that there is a large off-park effort required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Through the Gascoyne Murchison Strategy. Purchase of leases for conservation estate.

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to pastoral, mining and exploration activities

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

**Integration with Property Management Planning, Catchment Planning and Landcare:** Through Land Care District committees in the region.

### Feasible Opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by the Rangelands Environmental Management Program of GMS. Requires a greater level of support to be successful.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. Conservation Through

Reserves is limited by the presence of mining leases and tenements. There is a need to increase awareness of conservation values through education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue (see Appendix C, rank 7)

The NRM priority for GAS3 is (i), indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of GAS is severely degraded through past agricultural practices (primarily sheep & cattle grazing) and feral herbivores. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes.

## Data gaps

### Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Regional ecosystem mapping has been produced at the broad scale, 1:1 000 000 for Beard's vegetation, and 1:250 000 for Landsystems by the Western Australian Dept. Agriculture (Wilcox and McKinnon 1972).

**Systematic Fauna Survey:** Data has not been collected. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

**Floristic Data:** No regional survey of the flora has been conducted. Information on flora sparse.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There is no data to provide a regional context on life history (including population-trend) of most species, including rabbits, cat, fox and CWR mammals.

### Other Priority Data Gaps Include:

- No quantitative data on the effect of exotic predators, and weed colonisation.
- No quantitative data on the effect of mineral extraction, and pastoralism on landscape processes.
- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and

- other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of the long term impact of mining below water tables, particularly with respect to leaving flooded voids subject to salinisation.
- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
391	Humphreys, W.F.	(2001).	Groundwater calcrete aquifers in the Australian arid zone: the context to an unfolding plethora of stygal biodiversity. Pp 63 - 83 in Subterranean Biology in Australia 2000, W.F. Humphreys and M.S. Harvey (eds).	Records of the Western Australian Museum, Supplement No. 64.	B
483	Maxwell, S., Burbidge, A. A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscape. 15 (4) 43 - 49.	J
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R
695	Wilcox, D.G. and McKinnon, E.A.	(1992).	A Report on the Condition of the Gascoyne Catchment.	Department of Agriculture, Western Australia.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 012, 026, 067, 075, 082, 086, 091, 094, 100, 118, 173, 181, 182, 258, 268, 281, 372,

383, 387, 395, 402, 407, 419, 493, 634, 635, 636, 637, 638, 641, 647, 648, 679 and 699 in Appendix A.

# Geraldton Sandplains 1 (*GS1 - Edel subregion*)

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NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

The Geraldton Sandplains bioregion comprises mainly proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage. The Edel subregion (GS1) includes parts of the southern Carnarvon Basin (including Dirk Hartog, Bernier and Dorre Islands as well as Edel Land and the northern end of the Geraldton Sandplains (North of Kalbarri)). In terms of its flora and fauna, this is an interzone between the South-western Bioregions of WA and the Carnarvon Bioregion. It is underlain by Phanerozoic sediments and characterised by proteaceous tree-heaths and *Acacia-Casuarina* thickets on pale red Quaternary sand (white sand on the coast). The climate is semi-arid, warm, and Mediterranean and subregion area is 928, 297ha.

### Dominant land use

(see Appendix B, key b)

Mainly (ix) Grazing - Native pastures (80.88%), with lesser areas of (xiii) conservation (3.04%), (xi) UCL and Crown reserves (2.81%) and (xiv) lakes and major watercourses (2.52%).

### Continental Stress Class

The Continental Stress Class for GS1 is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Vertebrates Found in GS1 Are:

- CWR mammals such as Boodie (*Bettongia lesueur*), Rufous Hare-wallaby (*Lagorchestes hirsutus*), Bernier Island Banded Hare-wallaby (*Lagostrophus fasciatus*), Western Barred Bandicoot (*Perameles bougainville*), Shark Bay Mouse (*Pseudomys fieldi*).
- Birds such as the Mallee Fowl (*Leipoa ocellata*), Thick-billed Grass Wren (*Amytornis textilis*), Black and White Fairy Wren (*Malurus leucopterus*), Bernier Island Variegated Fairy-wren (*Malurus lamberti*).
- The frog species Sandhill Frog (*Arenophryne rotunda*) (endemic to the area).

**The following ecosystem types have at least 85% of their total extent confined to the Geraldton Sandplains 1 subregion:**

Beard Veg Assocs	Vegetation Association Description
099	Hummock grassland; shrub steppe; wattle scrub & heath <i>Acacia ligulata x rostellifera</i>
260	Mosaic: Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., Melaleuca and mallee/Shrublands; scrub-heath
368	Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., Melaleuca and mallee
384	Shrublands; mallee & acacia thicket on ?coastal dunes (central west)
406	Shrublands; acacia, casuarina, <i>Eucalyptus eudesmioides</i> , <i>Banksia ashbyi</i> & other mixed species thicket
984	Mosaic: Shrublands; acacia & melaleuca scrub/Succulent steppe; saltbush
1100	Hummock grassland; dwarf shrub Steppe; mixed ericoid shrubs & spinifex
1104	Mosaic: Shrublands; scrub-heath/Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thickets
1106	Mosaic: Shrublands; scrub-heath/Shrublands; acacia various species scrub
1107	Open low woodland; <i>Eucalyptus oraria</i>
1423	Shrublands; scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.
1550	Shrublands; dwarf scrub (Dirk Hartog Island)

#### Centres of Endemism:

- Reptiles are highly endemic in GS1, particularly the *Lerista* group of skinks.
- The following reptiles are endemic to the subregion: *Ctenotus alleni*, *C. zasticus*, *Lerista axillaries*, *L. humphriesi*, *L. kendricki*, *L. macropisthopus galea*, *L. maculosa*, *Menetia amaura*.

- Invertebrate groups such as Mygalomorph spiders and Millipedes.

#### Refugia:

- Edel Land, Heirisson Prong and Peron Peninsula - refuge for endangered mammals and reptiles from exotic animals.

- Zuytdorp - refuge from land clearing - area of high botanical diversity in transition zone between Eremean and South - west botanical provinces.
- Bernier and Dorre Islands - Island refugia for endangered mammals.

#### High Species and Ecosystem Diversity:

- Reptiles record high diversity in the area.
- Tree heath on Victoria Sand Plain District at base of Peron Peninsula has high floristic diversity.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Geraldton Sandplains (System 5) in the CTRC Green Book (Environmental Protection Authority 1974). In 1976 these recommendations were further developed by the Environmental Protection Authority as the Red Book recommendations Environmental Protection Authority 1976). Some but not all of these recommendations (with modification) were implemented over the following ten years. No other systematic assessment of biodiversity has been undertaken in the subregion.

In 2000 a report on the Biodiversity of the Southern Carnarvon Basin (McKenzie *et al.* 2000) was written and included a paper on reserve system gaps. The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation.

#### Other ecosystems at risk

An unpublished report by Department of Conservation and Land Management - "Gascoyne - Murchison

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Coastal heath communities at Steep Point (P. Brown pers. comm.)	V	32	iii	iii	i	iv, v (goats), xii (clearance for proposed developments)
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	V	Various	iii	iii	i	v (cats, foxes, goats), iv, vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank ;; <sup>3</sup>Appendix C, rank 3 <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Strategy, Establishment and Management of a Conservation Reserve System" outlines the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in McNamara *et al.* (2000). Although no systematic assessment of biodiversity was undertaken, recommendations on reserve status of the Shark Bay area are included in the Shark Bay Terrestrial Reserves Management Plan (Department of Conservation and Land Management and National Parks and Nature Conservation Authority 2000).

#### Wetlands

##### Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance are recorded in GS1.

##### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no Wetlands of Subregional Significance are recorded in GS1.

##### Riparian zone vegetation

There are no riparian areas in GS1.

#### Ecosystems at risk

##### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) listed in GS1.

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Perameles bougainville bougainville</i>	E	i	iv	iv	v, viii
<i>Pseudomys fieldi</i>	E	i	iv	iv	v
<i>Bettongia lesueur lesueur</i>	V	i	iv	iv	v
<i>Lagorchestes hirsutus bernieri</i>	V	i	iv	iv	v
<i>Lagorchestes hirsutus dorrae</i>	V	i	iv	iv	v
<i>Lagostrophus fasciatus fasciatus</i>	V	i	iv	iv	v
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Malurus leucopterus leucopterus</i>	E	iii	iii	iii	iv, v (cats), ii
<i>Acanthiza iredalei iredalei</i>	V	i	iv	iii	iv, v (goats, rabbits, foxes, cats), ii
<i>Calamanthus campestris dorrei</i>	V	iii	iv	iii	iv, ii
<i>Calamanthus campestris hartogi</i>	V	iii	iii	iii	iv, v (cats), ii
<i>Leipoa ocellata</i>	V	i	iii	iii	v (foxes, cats), ii, iv
<i>Stipiturus malachurus</i>	V	ii	iii	iii	iv, v (cats), ii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Caretta caretta</i>	E	i	iii	ii	v (foxes, cats), xi, xii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
<i>Chelonia mydas</i>	E	ii	iii	ii	v (foxes, cats), xi, xii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
<i>Dermochelys coriacea</i>	E	i	iii	ii	v (foxes, cats), xi, viii (sand blowouts on Dirk Hartog Island have potential to interfere with nesting sites)
<i>Egernia stokesii badia</i>	V	ii	iii	ii	v (foxes, cats), ii
<i>Egernia stokesii aethiops</i>	V	iii	iv	ii	v (foxes, cats), ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Aspidites ramsayi</i>	SP	i	iii	ii	v (foxes, cats), ii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Malurus lamberti</i>	V	ii	iv	iii	iv, v (goats, rabbits, foxes, cats), ii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Beyeria gardneri</i>	1	ii	iii	ii	v (goats), iv
<i>Eremophila cuneata</i> ms	1	ii	iv	iii	xii (mining), v (goats)
<i>Eremophila splendens</i> ms	1	ii	iv	ii	iv
<i>Goodenia berrinbinensis</i>	1	iii	iv	ii	v (goats), vi vii
<i>Malleostemon</i> sp. Nerren Nerren (A Payne 360)	1	ii	iii	ii	v (goats), iv, vii, vii
<i>Millotia depauperata</i>	1	ii	iii	ii	iv, v (goats), vi
<i>Prostanthera petrophila</i>	1	iii	iii	ii	v (goats), iv
<i>Ptilotus stirlingii</i> var. <i>pumilus</i>	1	ii	iii	ii	iv, i, ii, vi, vii, v (goats), ix
<i>Tetragonia coronata</i>	1	ii	iii	ii	iv, vi, x
<i>Thryptomene</i> sp. Carrarang (ME Trudgen 7420)	1	ii	iii	ii	ii, iv, vii
<i>Thryptomene</i> sp. Steep Point (ME Trudgen 7421)	1	ii	iii	ii	ii, iv, vii
<i>Thryptomene</i> sp. Tamala (ME Trudgen 7384)	1	i	iii	ii	ii, iv, vii
<b>PRIORITY 2</b>					
<i>Abutilon</i> sp. Hamelin (AM Ashby 2196)	2	iii	iv	ii	v (goats), iv, vi

<i>Abutilon</i> sp. Quobba (H Demarz 3858)	2	ii	iii	ii	v (goats), iv, vi
<i>Acacia gelasina</i>	2	ii	iii	ii	v (goats), iv
<i>Acacia subrigida</i>	2	ii	iii	ii	v (goats), iv, vi
<i>Chthonocephalus muellerianus</i>	2	ii	iii	ii	v (goats), iv, vi
<i>Eremophila glabra</i> subsp. <i>psammophora</i> ms	2	iii	iv	ii	v (goats), iv, vi
<i>Eremophila occidentens</i> ms	2	iii	iv	ii	vii, v (goats)
<i>Lepidium biplicatum</i>	2	iii	iv	ii	v (goats), vi, vii, ix
<i>Melaleuca filifolia</i>	2	iii	iii	ii	i, ii, iv, vii, ix, x
<i>Melaleuca huegelii</i> subsp. <i>pristicensis</i>	2	iii	iv	ii	iv, v (goats), vii, vi
<i>Olearia occidentissima</i>	2	iii	iv	ii	iv, v (goats), vi
<i>Philotheca kalbarriensis</i>	2	ii	iii	ii	v (goats), iv, i, ii, iv, vii
<i>Ptilotus alexandri</i>	2	iii	iv	ii	v (goats), iv, vii, vi
<i>Rhodanthe oppositifolia</i> subsp. <i>ornata</i>	2	ii	iv	ii	iv, v (goats)
<i>Scaevola chrysopogon</i>	2	iii	iii	ii	iv, v (goats), vii
<i>Scaevola paludosa</i>	2	ii	vi	ii	iv, v (goats), vii
<i>Scholtzia</i> sp. Eurardy (JS Beard 6886)	2	ii	vi	ii	iv, v (goats)
<i>Scholtzia</i> sp. Folly Hill (ME Trudgen 12097)	2	ii	vi	ii	v (goats), vii, ii
<i>Sclerolaena stylosa</i>	2	ii	vi	ii	iv, ii, v (goats)
<i>Sondotia glabrata</i>	2	ii	iii	ii	iv, ii, v (goats)
<i>Tricoryne arenicola</i> ms	2	ii	vi	ii	i, ii, iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
17	Shrublands; <i>Acacia rostellifera</i> thicket	X	X		H
36	Shrublands; thicket, acacia-casuarina alliance ?species				H
49	Shrublands; mixed heath	X			L
112	Hummock grasslands, shrub steppe; <i>Acacia ligulata</i> over <i>Triodia plurinervata</i>	X			H
128	Bare areas; rock outcrops		X		L
129	Bare areas; drift sand	X	X		L
246	Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i>				L
260	Mosaic: Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee/Shrublands; scrub-heath	X	X		L
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine				L
365	Shrublands; bowgada & jam scrub with scattered York gum & red mallee				L
368	Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee				H
380	Shrublands; scrub-heath on sandplain	X	X		L
383	Shrublands; <i>Acacia rostellifera</i> scrub-heath	X			M
384	Shrublands; mallee & acacia thicket on ?coastal dunes (central west)				H
385	Shrublands; bowgada & jam scrub with scattered York gum				H
387	Shrublands; <i>Melaleuca cardiophylla</i> thicket				L

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
401	Mosaic: Shrublands; scrub-heath on coastal association on yellow sandplain/Shrublands; acacia patchy scrub				H
402	Shrublands; heath on coastal limestone	X			L
405	Shrublands; <i>Acacia sclerosperma</i> , bowgada & jam scrub				L
406	Shrublands; acacia, casuarina, <i>Eucalyptus eudesmioides</i> , <i>Banksia ashbyi</i> & other mixed species thicket	X			H
676	Succulent steppe; samphire	X	X		L
984	Mosaic: Shrublands; acacia & melaleuca scrub/Succulent steppe; saltbush	X			H
1099	Hummock grassland; shrub steppe; wattle scrub & heath <i>Acacia ligulata x rostellifera</i>	X			H
1100	Hummock grassland; dwarf shrub Steppe; mixed ericoid shrubs & spinifex	X	X		H
1101	Shrublands; <i>Acacia ligulata x rostellifera</i> thicket		X		L
1102	Mosaic: Shrublands; mixed heath/Shrublands; acacia patchy scrub				H
1104	Mosaic: Shrublands; scrub-heath/Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thickets				H
1106	Mosaic: Shrublands; scrub-heath/Shrublands; acacia various species scrub	X			H
1107	Open low woodland; <i>Eucalyptus oraria</i>				H
1423	Shrublands; scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	X			H
1550	Shrublands; dwarf scrub (Dirk Hartog Island)	X	X		L?
2081	Shrublands; bowgada and associated spp. scrub	X			L
371	<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough Alluvial Flats.				H
1100	Coastal heath communities at Steep Point (P. Brown pers. comm.)				H
Various	Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	X			L

L=Low, M=Medium, H=High.

### Subregional constraints in order of priority

(see Appendix B, key g)

**Competing Land Use:** The primary issue in that pastoralism occupies more than 85% of the region.

**Economic Constraints:** The cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data.

### Bioregional and subregional priority for reserve consolidation

GS is reservation Class 4 (see Appendix D, and Appendix C, rank 4) because 10-15% of its area reserved (any tenure). GS1 has 3.04% of the subregion in conservation reserves. GS2 has 13.84% of the subregion in conservation reserves. GS3 has 17.67% of the subregion in conservation reserves. GS2 has been extensively cleared for agricultural purposes leaving a biased reserve system and salinity problems are ubiquitous so Class 1 is more appropriate. Two reserves in the northern extremity of GS2 make up over 88% of the conservation estate. GS3 has also been extensively cleared in the eastern portion of

the subregion and has salinity problems however reservation levels are higher and more widely spread over the landscape so Class 2 is more appropriate. GS1 has very little conservation estate however threats are less urgent (mainly relating to stock and feral animals) so Class 2 is more appropriate.

### Reserve management standard

Many GS reserves in the agricultural zone are becoming saline or encountering rising water tables; wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained except on Zuytdorp Nature Reserve, areas of Beekeepers Nature Reserve and Nature Reserves smaller than 200ha; feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made a observable difference to rabbit numbers, goats are common in north and east, pigs are undergoing drastic increases in numbers and spread), and feral predator control systems are in place only on Kalbarri, Badgingarra and Nambung National Parks. The Reserve Management rank is i (poor) (see Appendix C, rank 5).

## Off reserve conservation

## Priority species or groups

Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Bettongia lesueur lesueur</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	No	The Action Plan for Australian Marsupials and Monotremes
<i>Lagorchestes hirsutus bernieri</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	Yes - RP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
<i>Lagorchestes hirsutus dorreeae</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	Yes - RP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
<i>Lagostrophus fasciatus fasciatus</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	No	The Action Plan for Australian Marsupials and Monotremes
<i>Perameles bougainville bougainville</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.	Yes – IRP (Unpublished)	The Action Plan for Australian Marsupials and Monotremes
<i>Pseudomys fieldi</i>	1100 - Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex	Djoongari (Shark Bay Mouse) Recovery Plan	The Action Plan for Australian Rodents
<i>Leipoa ocellata</i>	17 – Shrublands: <i>Acacia rostellifera</i> thicket; 260 – Mosaic: Shrublands tree heaths between sandhills. <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., Melaleuca and mallee/shrublands. Scrub heath; 246 – Hummock grasslands, low tree steppe; <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i> ; , 365 – Shrublands: bowgada & jam scrub with scattered York gum & red mallee; 368 – Shrublands tree-heath between sandhills: <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., Melaleuca and mallee.	Recovery Plan for Mallee Fowl	The Action plan for Australian Birds
<i>Acanthiza iredalei iredalei</i>	676 – Succulent Steppe: samphire; 984 – Mosaic: Shrublands, acacia & melaleuca scrub/Succulent steppe, saltbush.	No	The Action plan for Australian Birds

Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Malurus lamberti</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
<i>Stipiturus malachurus</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
<i>Calamanthus campestris dorrei</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
<i>Calamanthus campestris hartogi</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
<i>Malurus leucopterus leucopterus</i>	402 – Shrublands: heath on coastal limestone; 1099 – Hummock grasslands: shrub steppe: wattle scrub & heath <i>Acacia ligulata x rostellifera</i> ; 1100 – Hummock grassland: dwarf shrub steppe, mixed ericoid shrubs & Spinifex; 104 – Hummock grasslands, shrub steppe: <i>Grevillea refracta</i> & hakea over soft spinifex; 1423 – Shrublands: scrub-heath in Shark Bay Area, mainly <i>Acacia</i> spp.; 1550 – Shrublands: dwarf scrub (Dirk Hartog Island).	The Action plan for Australian Birds including a Coordinated Conservation Plan for the Shark Bay area.	The Action plan for Australian Birds
<i>Caretta caretta</i>	Beaches for breeding	No	The Action Plan for Australian Reptiles
<i>Chelonia mydas</i>	Beaches for breeding	No	The Action Plan for Australian Reptiles
<i>Dermochelys coriacea</i>	Beaches for breeding	No	The Action Plan for Australian Reptiles
<i>Egernia stokesii badia</i>	205 – Shrublands; Acacia sclerosperma & bowgada scrub; 243 – Shrublands: bowgada & minnieritchie scrub; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee.	No	The Action Plan for Australian Reptiles
<i>Egernia stokesii aethiops</i>	205 – Shrublands; Acacia sclerosperma & bowgada scrub; 243 – Shrublands: bowgada & minnieritchie scrub; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee.	No	The Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	112 – Hummock grasslands, shrub steppe: <i>Acacia ligulata</i> over <i>Triodia plurinervata</i> ; 205 – Shrublands: <i>Acacia sclerosperma</i> & bowgada scrub; 243 - Shrublands: bowgada & minnieritchie scrub; 246 – Hummock grasslands, low tree steppe: <i>Eucalyptus dongarraensis</i> & <i>E. foecunda</i> over <i>Triodia plurinervata</i> ; 365 - Shrublands: bowgada & jam scrub with scattered York gum & red mallee; 401 – Mosaic: Shrublands, scrub-heath on coastal association on yellow sandplain/Shrublands, acacia patchy scrub.	No	The Action Plan for Australian Reptiles
Species	Ecosystem	Specific Recovery Plan	General Recovery Plan
Threatened flora of GS1	Various	No recovery plan exist for threatened flora in the GS1 subregion. Although no Endangered flora occurs further research into the status of vulnerable species and management requirement is needed.	Declared Rare and Poorly Known Flora in the Geraldton District

Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Bettongia lesueur lesueur</i>	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs, reintroduction to create new mainland populations. Protection from wildfire.
<i>Lagorchestes hirsutus bernieri</i>	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and

		suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
<i>Lagorchestes hirsutus dorraeae</i>	i, ii, iii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
<i>Lagostrophus fasciatus fasciatus</i>	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
<i>Perameles bougainville bougainville</i>	xii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs reintroduction to create new mainland populations. Protection from wildfire.
<i>Pseudomys fieldi</i>	xii, vii, x, ix	Monitoring of existing populations. Where control of feral predators has been achieved and suitable habitat occurs, reintroduction to create new mainland populations. Fire management.
<i>Leipoa ocellata</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of feral predators and herbivores (goats) required. Reduction of grazing intensity may be required. Fire management.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Malurus lamberti</i>	vii, xii	Control of herbivores such as rabbits and goats may be required. Monitoring of existing populations.
<i>Stipiturus malachurus</i>	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
<i>Calamanthus campestris dorrei</i>	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
<i>Calamanthus campestris hartogi</i>	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
<i>Malurus leucopterus leucopterus</i>	xii, ix	Monitoring of existing population. Protection from threats such as wildfire.
<i>Caretta caretta</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Chelonia mydas</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Dermochelys coriacea</i>	i, vii, xii, xiii	Protection of breeding sites. Control of feral predators of eggs etc (primarily foxes). Monitoring of populations and research into threats. Education of boat operators, ecotourism operators and general public
<i>Egernia stokesii badia</i>	xii, ix, i, x	Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
<i>Egernia stokesii aethiops</i>	vii, xii, ix, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Aspidites ramsayi</i>	vii, xii, ix, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands. Reintroduction to previous areas of habitat.
<i>Abutilon</i> sp. Hamelin (AM Ashby 2196)	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<b>Species</b>	<b>Recovery Actions<sup>1</sup></b>	<b>Recovery Descriptions</b>
<i>Abutilon</i> sp. Quobba (H Demarz 3858)	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Acacia gelasina</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Acacia subrigida</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Beyeria gardneri</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Chthonocephalus muellerianus</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Eremophila cuneata</i> ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila glabra</i> subsp. <i>psammophora</i> ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila occidens</i> ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Eremophila splendens</i> ms	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Goodenia berringinensis</i>	i, ii, iii, vii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire management.
<i>Lepidium biplicatum</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Nerren Nerren (A	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire

Payne 360)		as well as the species general biology.
<i>Melaleuca filifolia</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Melaleuca huegelii</i> subsp. <i>pristicensis</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Millotia depauperata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Olearia occidentissima</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Philotheca kalbarriensis</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Prostanthera petrophila</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptilotus alexandri</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Ptilotus stirlingii</i> var. <i>pumilus</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Rhodanthe oppositifolia</i> subsp. <i>ornata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scaevola chrysopogon</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scaevola paludosa</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Eurardy (JS Beard 6886)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Folly Hill (ME Trudgen 12097)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Sclerolaena stylosa</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Sondottia glabrata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Tetragonia coronata</i>	i, iii, ix, xii	Habitat retention through reserves or on other State lands. Research into the effects of fire as well as the species general biology.
<i>Thryptomene</i> sp. Carrarang (ME Trudgen 7420)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Steep Point (ME Trudgen 7421)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Tamala (ME Trudgen 7384)	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Tricoryne arenicola</i> ms	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.

<sup>1</sup>Appendix B, key h.

## Existing species recovery plans

A coordinated conservation plan for threatened birds of the Shark Bay area was published in The Action Plan for Australian Birds (Garnett and Crowley 2000). Other Recovery Plans include: National Recovery Plan for Malleefowl (Benshemesh 2000), The Action Plan for Australian Rodents (Lee 1995), Action Plan for Australian Marsupials and Monotremes (Maxwell *et al.*

1996), and The Action Plan for Australian Reptiles (Cogger *et al.* 1993).

## Ecosystems and existing recovery plans

One of the Ecosystems at risk (Coastal heath communities at Steep Point) is not currently held on CALM estate and is a high priority to be reserved. There are no recovery plans for ecosystems at risk or vegetation associations at risk.

Community	Specific Recovery Plan	General Recovery Plan
Coastal heath communities at Steep Point (P. Brown pers. comm.)	No	No
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	No	No

## Appropriate ecosystem recovery actions

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Coastal heath communities at Steep Point (P. Brown pers. comm.)	i, iii, vii, v, vi	Habitat protection through reserves and on other state lands (currently not held on CALM estate and a high priority to reserve). Feral animal control, especially goats and foxes. Fencing as exclosures where there are heavy goat numbers. Weed control.
Reptile assemblages of islands, gulfs and peninsulas, Shark Bay (Storr and Harold 1990)	i, iii, vii, v, vi	Habitat protection through reserves and on other state lands. Feral animal control, especially goats and foxes. Fencing as exclosures where there are heavy goat numbers. Weed control.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The priority for off-park conservation in GS1 is rank (ii) – large off-park effort required (see Appendix C, rank 6).

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Through the Gascoyne Murchison Strategy; purchase of leases for conservation estate.

**Threat Abatement Planning:** Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to pastoral, mining and exploration activities.

### Environmental Management Systems

**Integration with Property Management Planning, Catchment Planning and Landcare:** Through Land Care District committees in the region.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems:** Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by the Rangelands Environmental Management Program of GMS. Requires a greater level of support to be successful.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. CTR is somewhat limited by the presence of a small number of mining leases and tenements. There is a need to increase awareness of conservation values through education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

GS1 has a rank of (i) (see Appendix C, rank 7), which indicates there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of GS is degraded through past agricultural practices (primarily sheep grazing) and feral herbivores. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping is available. Beards vegetation systems are at a map resolution of 1:250 000 at best. Department of Agriculture land system mapping has been conducted on a scale of 1:250 000.

**Systematic Fauna Survey:** Data is confined to vertebrates (but not birds) and selected invertebrate taxa, is sparse (ca. 6 terrestrial quadrats and 4 wetland quadrats across subregion), quadrats only positioned on 4 of the most widespread surface-types, and only 1-2 quadrats per surface-type, few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

**Floristic Data:** Although regional survey of flora has been completed, it is based on very sparse sampling (about 70 quadrats across subregion), quadrats positioned on 10 most widespread surface-types.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There is no data to provide a regional context on life-history (including population-trend) of most species, including rabbits, cat, fox and CWR mammals.

**Other Data Gaps Include:** There is little quantitative data on the affect of exotic predators, no quantitative data on the affect of weed colonisation, fragmentation, fire, introduced herbivores

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
254	Department of Conservation and Land Management and National Parks and Nature Conservation Authority	(2000).	Shark Bay Terrestrial Reserves Management Plan 2000-2009, Management Plan No. 45.	Department of Conservation and Land Management.	R
274	Environmental Protection Authority	(1976).	Conservation Reserves for Western Australia. Systems 1,2,3,4.	Environment Protection Authority, Perth.	R
270	Environmental Protection Authority	(1974).	Conservation Reserves for Western Australia.	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
761	Lundie-Jenkins, G. and Moore, G.	(1996).	Unpublished Recovery Plan for the Mala ( <i>Lagorchestes hirsutus</i> )	Parks and Wildlife Commission of the Northern Territory	O
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
710	McKenzie, N.L., Halse, S.A. and Gibson, N.	(2000).	Some gaps in the reserve system of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement No. 61: 511-546.	R
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscape. 15 (4) 43 - 49.	J
513	Morris, K., Speldewinde, P. and Orell, P.	(2000).	Djoongari (Shark Bay Mouse) Recovery Plan.	Department of Conservation and Land Management.	R
537	Patrick, S.J.	(2001).	Declared Rare and Poorly Known Flora in the Geraldton District. Wildlife Management Program No. 26.	Department of Conservation and Land Management.	R
600	Short, J.	(1995).	Interim Recovery Plan for the Western Barred Bandicoot ( <i>Perameles bougainville</i> ) (unpublished).		R
631	Storr, G.M. and Harold, G.	(1990).	Amphibians and reptiles of the Shark Bay area, Western Australia. In Research in Shark Bay (Eds) P.F. Berry, S.D. Bradshaw, B.R. Wilson.	Western Australian Museum, Perth.	B

R = Report; J = Journal article; O = Other.

### Other Relevant Publications

See reference numbers 026, 047, 065, 066, 075, 094, 097, 101, 114, 117, 118, 137, 177, 241, 253, 267, 268,

272, 273, 277, 278, 299, 372, 387, 405, 406, 419, 425, 429, 450, 459, 708, 505, 506, 519, 526, 540, 584, 603, 630, 646 and 647 in Appendix A.

# Geraldton Sandplains 2 (*GS2 - Geraldton Hills subregion*)

ANTHONY DESMOND AND ALANNA CHANT  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

The Geraldton Sandplains bioregion comprises mainly proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, and lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage. The Geraldton Hills subregion (GS2) incorporates the southern end of Carnarvon Basin and northern end of the Perth Basin, with exposed areas of Permian/Silurian siltstone and Jurassic sandstones, mostly overlain by sandplains, alluvial plains, and coastal limestones. Sand heaths with emergent *Banksia* and *Actinostrobos*, York Gum woodlands on alluvial plains, proteaceous heath and *Acacia* scrubs on limestones depending on depth of coastal-sand mantle, low closed forest of *Acacia rostellifera* (now cleared) on alluvial plains of Greenough and Irwin River (behind beach dune system south of Geraldton). Also includes the Pinjara Orogen which is an area of Hill country with a Proterozoic basement, and comprises extensive, undulating, lateritic uplands mantled in sandplain supporting proteaceous shrublands and mallees while valleys support York Gum and Jam. Warm semi-arid to Mediterranean climate with 400 – 500 mm of rainfall annually, and the subregional area is 2, 242, 033 ha.

### Dominant land use

The dominant land use is mainly (iv) dry-land agriculture (65.78%), with lesser areas of (xiii) conservation (13.84%), (viii) grazing native pastures (13.21%) and (x) UCL and Crown reserves (6.47%) (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class for GS2 is currently listed as 4, however it should be 2 or worse. Most of GS2 is in a similar situation to Avon Wheatbelt, but the northern periphery is slightly better as it includes parts of Kalbarri National Park, Wandana Nature Reserve & Unallocated Crown Land. Over 68% of the area in conservation estate in this subregion is contained in Kalbarri National Park at the far north-western periphery of the subregion. Wandana Nature Reserve in the north-eastern periphery contains over 20% of the conservation estate of the subregion. The remainder of the subregion has very few reserves, the majority of which are small and on agriculturally unproductive land. Many reserves are threatened by salinity.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- *Acacia rostellifera* forest
- Hutt Lagoon samphire communities
- Houtman Abrolhos islands with Tammar population, rare breeding seabirds and sea lion colonies
- Moresby Range communities with rare plants such as the mallee species *Eucalyptus blaxellii*, *Eucalyptus cuprea*, heath *Drummondita ericoides* and orchid *Caladenia hoffmanii* subsp. *hoffmanii*.

#### Threatened Vertebrates:

- CWR mammals such as Tammar Wallaby (*Macropus eugenii derbianus*), Black-footed Rock-wallaby (*Petrogale lateralis lateralis*), Northern Brushtail Possum (*Trichosurus vulpecula*), and Western Brush Wallaby (*Macropus irma*).
- Birds such as: Peregrine Falcon (*Falco peregrinus*), Red-tailed Tropicbird (*Phaethon rubricauda*), Malleefowl (*Leipoa ocellata*), *Anous tenuirostris melanops*, Carnaby's Cockatoo (*Calyptorhynchus latirostris*).
- Reptiles such as: Spiny-tailed Skink (*Egernia stokesii stokesii*), Carpet Python (*Morelia spilota imbricata*).

#### Ecosystem Types Which Have at Least 85% of Their Total Extent Confined to GS2:

Beard Veg Assoc	Description
35	Shrublands; jam scrub with scattered York gum
351	Shrublands; mallee & acacia scrub with scattered York gum & red mallee
353	Shrublands; mallee & acacia scrub with scattered York gum
359	Shrublands; acacia & banksia scrub
371	Low forest; <i>Acacia rostellifera</i>
Beard Veg Assoc	Description
372	Mosaic: Shrublands; scrub-heath on deep sandy flats/Shrublands; thicket, acacia-casuarina alliance

380	Shrublands; scrub-heath on sandplain
386	Low woodland; York gum
401	Mosaic: Shrublands; scrub-heath on coastal association on yellow sandplain/Shrublands; acacia patchy scrub
402	Shrublands; heath on coastal limestone
403	Shrublands; <i>Acacia ligulata</i> scrub-heath
407	Low woodland over scrub; <i>Allocasuarina huegeliana</i> over jam scrub
408	Shrublands; scrub-heath on coastal association, yellow sandplain
424	Shrublands; York gum mallee scrub
427	Shrublands; jam scrub with scattered <i>Allocasuarina huegeliana</i> & York gum
431	Shrublands; <i>Acacia rostellifera</i> open scrub
440	Shrublands; <i>Acacia ligulata</i> open scrub
675	Shrublands; mixed thicket (melaleuca & hakea?)
1141	Shrublands; jam, <i>Acacia rostellifera</i> & <i>Melaleuca megacephala</i> thicket
1142	Shrublands; <i>Acacia ligulata</i> & <i>Melaleuca uncinata</i> dominated thicket on dark brown loamy soil

### Centres of endemism:

The region is rich and diverse in flora with many sandplain genera having a high degree of endemism, e.g. *Scholtzia* spp. having over 16 taxa endemic to the subregion. The reptiles *Lerista yuna*, *Cyclodomorphus branchialis*, *Aprasia* sp. nov aff. *fusca* are endemic to the subregion.

### Refugia:

Abrolhos Islands provide refugia for breeding Seabirds, Tamar Wallabies (*Macropus eugenii derbianus*), Australian Sea lions (*Neophoca cinerea*), Carpet Pythons (*Morelia spilota imbricata*), and Spiny-tailed Skink (*Egernia stokesii stokesii*) from introduced predators.

### High Species and Ecosystem Diversity:

- Sandplain shrublands on Moresby Range - Diverse flora including a number of different ecosystem types (e.g. Mesa tops, west facing slopes, East facing slopes).

- Sandplain shrublands of Burma Rd area - Diverse flora including a number of Endangered and Rare species.
- Kalbarri National Park contains over 1070 floral taxa (a mix of south-western and more arid species). Many of these are endemic to the subregion.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Geraldton Sandplains (System 5) in the CTRC Green Book (Environmental Protection Authority 1974). In 1976 these recommendations were further developed by the Environmental Protection Authority as the Red Book recommendations Environmental Protection Authority 1976). Some but not all of these recommendations (with modification) were implemented over the following ten years. No other systematic assessment of biodiversity has been undertaken in the subregion.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Hutt Lagoon System WA035 (GS001WA)	B8, B6, B12, B10	ii	iii	iii	iv, x (rising watertable), vi (wild oats, lupins), xiii (potential for expansion of Dunaliella ponds)
Murchison River (Lower Reaches) WA037 (GS003WA)	A6, B1, B2	ii	iii	iii	iv, vi (saffron thistle, wild oats), x (increased sediment load), xii (historical lead mining operations)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Greenough River pools	300 000 mE, 6 810 000mN	B2	iv	i	ii	ii	ix, x (occluding with sand)
Freshwater springs in Northampton area	235 000 mE, 6 880 000 mN	B17	v	iii	iv	ii	x (increase in discharge though water is fresh currently), iv, vi (glossy nightshade, saffron thistle, soursob, lupins, wild oats)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Greenough River	i	iii	ii	ix, x (increased flow), i (historical), ii (historical), iv, v (foxes, rabbits & goats), vi (castor oil bush, box thorn, wild oats, soursob, lupins), xi, xii (urbanisation, recreation and tourism)
Chapman River	i	iii	ii	ix, x (increased flow), i (historical), ii (historical), iv, v (foxes, rabbits & goats), vi (castor oil bush, box thorn, pattersons curse, wild oats, soursob, lupins, pennisetum, star thistle), xi, xii (urbanisation, recreation and tourism)
Irwin River	i	iii	ii	ix, x (increased flow), i (historical), ii (historical), iv, v (foxes, rabbits & goats), vi (castor oil bush, box thorn, wild oats, soursob, lupins), xi, xii (urbanisation, recreation and tourism)
Lower Murchison River	ii	iii	ii	ix, x (increased flow), i (historical), ii (historical), iv, v (foxes, rabbits & goats), vi (castor oil bush, box thorn, wild oats, soursob, lupins), xi, xii (urbanisation, recreation and tourism)
Bowes River	i	iii	ii	iv, ix, x, xii, xi (lead contamination from Nokenina Brook Northampton), vi (grasses, box thorn, star thistles), v (pigs, cats, foxes and rabbits), iii
Buller River	iii (uncleared areas), ii (elsewhere)	iii	ii	ix, x, vi (star thistle, grasses, lupins, radish, pattersons curse), iv, v (pigs, cats, foxes and rabbits)
Lower Hutt River	iii	iii	ii	iii, xii (recreation), iv, v (goats and pigs), vi, vii, ix, xi (agricultural chemicals)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

Wetlands, estuarine and river systems often contained sites of significance to the Aboriginal community.

## Ecosystems at risk

## Threatened Ecological Communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough River Alluvial Flats (Beard 1976e, Beard 1976g)	CR	14	i	iii	iii	xi, ix
Clay Flat assemblages of the Irwin River (Beard 1976e)	E PD	14	i	i	iii	ii, iv, v (rabbits), vii

(Presumed Totally Destroyed)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Melaleuca megacephala</i> and <i>Hakea pycnoneura</i> thicket on stony slopes of Moresby Range (Beard 1976g, G. Keighery and N. Gibson pers. comm.)	V	32	ii	iv	ii	ii, iv, v (rabbits), vii
<i>Eucalyptus macrocarpa</i> over Proteaceous sandplain community (M. Fitzgerald pers. comm.)	V	29	ii	ii	i	ii, iv, v (rabbits), vii
Plant assemblages of the Irwin River Headwater flats (Beard 1976e)	V	28	i	iii	ii	x (increased flow), ii, iv, v (rabbits), vii
Plant assemblages of Hutt Lagoon (G. Keighery pers. comm.)	V	39	ii	iii	ii	ix, x (increased water table)
<i>Verticordia</i> dominated low heath on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)	V	29, 30	ii	iv	ii	ii, iv, v (rabbits), vii
<i>Allocasuarina campestris</i> and <i>Melaleuca uncinata</i>	V	28	ii	iv	ii	ii, iv, v (rabbits), vii

thicket on superficial laterite on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)						
<i>Eucalyptus mallee</i> sp. and <i>Acacia</i> scrub with scattered <i>E. loxophleba</i> (Hopkins <i>et al.</i> 1996)	V	8	ii	vi	iv	ii, iv, v (rabbits), vii
<i>Acacia rostellifera</i> low forest (Hopkins <i>et al.</i> 1996)	V	14	ii	iii	iv	ii, iv, v (rabbits), vii
Vegetation of Gorges of Murchison River lower reaches. Includes Endangered flora such as <i>Drakaea concolor</i> , <i>Caladenia wanosa</i> , <i>Lechenaultia chlorantha</i> , and <i>Hypocalymma longifolium</i> . Vulnerable flora such as <i>Calytrix harvestiana</i> , <i>Malleostemon</i> sp. Kalbarri, <i>Murchisonia fragrans</i> .	V	9	i	ii	i	v (goats, pigs), vi (saffron thistle, wild oats, lupins) x (increased flow affecting riparian vegetation)
Vegetation of the Northampton block - Beard's Hutt System. Vegetation type species rich and appears different, reservation rate extremely low, 3 Critically Endangered, 3 Endangered and 8 Vulnerable flora species occur in the area.	V	Various	ii	iii	ii	v (goats, pigs, rabbits), vi (saffron thistle, wild oats, lupins)
Burma Rd Sandplain. Species rich proteaceous sandplains communities containing 3 endangered flora, 7 vulnerable flora.	V	30	ii	iii	i	v (goats, pigs, rabbits), vi (saffron thistle, wild oats, lupins)
Critical weight range mammals (extant species) <i>Trichosurus vulpecula hypoleucus</i> , <i>Macropus eugenii</i> <i>derbianus</i> , <i>Macropus irma</i> ; locally extinct species <i>Parantechinus apicalis</i> , <i>Dasyurus geoffroi</i> , <i>Isodon obesulus</i> , <i>Petrogale lateralis lateralis</i> .	E	NA	i	ii - iii	iii	v (fox, cat), vii, iv
Houtman Abrolhos islands mangrove communities (including seabird nesting sites and Australian Sea lion nursery sites)	V	40	iii	vi	iii	xi (rubbish from inhabited islands, fishing operations and visitors, raw sewage from fishing huts), v (rats, mice)
Houtman Abrolhos <i>Atriplex cinerea</i> dwarf shrubland including nesting burrows of seabirds such as shearwaters and petrels.	V	31	iii	vi	iii	vi (iceplant, Bryophyllum, Boxthorn), xii (damage by visitors), vii (fire has not been recorded in most areas)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Pavement limestone, dunes and consolidated dunes on North Island and East and West Wallabi Islands	V	32	ii	vi	iii	vi (iceplant, Bryophyllum, Boxthorn), xii (damage by visitors), vii (fire has not been recorded in most areas)
<i>Eucalyptus oraria</i> on East Wallabi Island	V	29	iii	vi	iii	vi (iceplant), xii (damage by visitors), vii (fire has not been recorded in most areas)
Saltlake and saltbush flats on islands such as North and West Wallabi	V	31		vi	iii	vi (iceplant, annuals such as wild oats), xii (damage by visitors), vii (fire has not been recorded in most areas)
<i>Melaleuca megacephala</i> – <i>Allocasuarina campestris</i> river heath (Lower Chapman River) part of Beard Vegetation Association 359	V	26, 15	iii	ii	ii	xii (human access on horses and mountain and trail bikes), ii, v (rabbits), vi (box thorn, pattersons curse, grasses) vii
Verticordia low heath (Chapman River Regional Park) part of Beard Vegetation Association 359	V	30	iii	iii	ii	v (rabbits and cats), vi (pattersons curse, grasses), xii (urban encroachment, human access on horses and mountain and trail bikes, proposed road works)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Petrogale lateralis lateralis</i>	V	i	i	ii	v (foxes, goats, cats), iii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Anous tenuirostris melanops</i>	V	ii	iii	iii	v (rats, mice), ii (ice plant, wild oats, boxthorn)
<i>Calyptorhynchus latirostris</i>	E	ii	iii	ii	ii, v (foxes & cats), xii (poaching of nests)
<i>Leipoa ocellata</i>	V	i	iii	iii	v (foxes, cats), iii, iv
<i>Turnix varia scintillans</i>	V	iii	iv	ii	v (rats, mice), ii (ice plant, wild oats, boxthorn)
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iv	iii	ii	ii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Aspidites ramsayi</i>	SP	i	i	i	ii, v (foxes, cats), iii
<i>Macropus eugenii derbianus</i>		i	iii	ii	v (foxes, cats), iii, iv
<i>Morelia spilota imbricata</i>	SP	ii	iii	ii	ii, v (foxes, cats), iii
<i>Neophoca cinerea</i>	SP	ii	iv	ii	xi (debris from fishing activities), xii (disturbance by human activities, injury through encounters with boats)
<i>Phaethon rubricauda</i>		ii	iii	ii	v (rats, mice), ii (ice plant, wild oats, boxthorn)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Acacia</i> sp. Dandaragan (S van Leeuwen 269)	CR	ii	iii	iii	i, ii, vi
<i>Beyeria lepidopetala</i>	CR	i	i	ii	vii, ii, i
<i>Caladenia elegans</i>	CR	i	iii	iii	i, ii, vi, v (pigs, goats), vii, x
<i>Chorizema humile</i>	CR	i	ii	iii	i, ii, vi, v, vii
<i>Eucalyptus cuprea</i>	CR	i	ii	iii	i, ii, vii

<i>Eucalyptus impensa</i>	CR	ii	iii	iii	i, ii, vi, vii
<i>Gastrolobium hamulosum</i>	CR	ii	iii	ii	i, ii, vi,
<i>Pterostylis</i> sp. Northampton (SD Hopper 3349)	CR	i	ii	iii	i, ii, vi (numerous), v (pigs, goats)
<i>Caladenia barbarella</i>	E	ii	iii	iii	v (pigs, goats), vii, vi
<i>Caladenia bryceana</i> subsp. <i>cracens</i>	E	ii	iii	iii	i, ii, iv, v (goats, pigs), vi
<i>Caladenia hoffmanii</i> subsp. <i>hoffmanii</i>	E	i	ii	iii	v (pigs), i, ii, vi, vii
<i>Caladenia wanosa</i>	E	i	ii	iii	v (goats, pigs), i, ii, vii
<i>Drummondita ericoides</i>	E	i	iii	iii	i, ii, vi
<i>Eucalyptus beardiana</i>	E	iii	iii	iii	iv, vii
<i>Eucalyptus blaxellii</i>	E	iii	iii	iii	ii, vii
<i>Grevillea christineae</i>	E	i	ii	iii	i, ii, vi, vii
<i>Hydatella leptogyne</i>	E	i	i	ii	ix, x
<i>Hypocalymma longifolium</i>	E	i	ii	iii	x, ix, v (goats), vi (numerous)
<i>Lechenaultia chlorantha</i>	E	ii	ii	iii	v (pigs, goats)
<i>Acacia forrestiana</i>	V	ii	iii	iii	i, ii, vii
<i>Conostylis dielsii</i> subsp. <i>teres</i>	V	ii	iii	iii	i, ii, vi, v (rabbits)
<i>Conostylis micrantha</i>	V	ii	iii	iii	i, ii, vi, v (rabbits)
<i>Drakaea concolor</i> ms	V	i	ii	iii	v (pigs, goats), ii
<b>PRIORITY 1</b>					
<i>Acacia ampliata</i>	1	ii	iii	iii	i, ii, v (goats)
<i>Acacia lineolata</i> subsp. <i>multilineata</i>	1	ii	ii	ii	i, ii
<i>Acacia nigripilosa</i> subsp. <i>latifolia</i>	1	ii	iii	ii	i, ii
<i>Acacia pelophila</i>	1	ii	iii	ii	i, ii, v, vi
<i>Baeckea</i> sp. East Yuna (R Spjut & C Edson 7077)	1	ii	iii	ii	i, ii, vi
<i>Chamelaucium oenanthum</i> ms	1	ii	vi	iii	v (goats, pigs), iv
<i>Cuphonotus humistratus</i>	1	ii	vi	ii	i, ii, vi
<i>Desmocladius glomeratus</i>	1	i	iii	ii	i, ii, vi
<i>Eremophila brevifolia</i>	1	i	ii	ii	i, ii, vi, vii, v (pigs and rabbits)
<i>Erymophyllum hemisphaericum</i>	1	i	i	ii	i, ii, vi
<i>Eucalyptus sargentii</i> subsp. <i>fallens</i>	1	ii	iii	iii	i, ii, ix
<i>Frankenia bracteata</i>	1	ii	vi	ii	i, ii
<i>Gastrolobium propinquum</i>	1	ii	iii	iii	i, ii, vi (numerous)
<i>Gnephosis cassiniana</i>	1	ii	iii	iii	i, ii,
<i>Grevillea filliloba</i>	1	ii	iii	iii	i, ii, vi (numerous)
<i>Leucopogon teretostylus</i> ms	1	ii	vi	ii	i, ii, vi (numerous)
<i>Macarthuria georgeana</i>	1	ii	iii	ii	i, ii, vi (numerous)
<i>Malleostemon</i> sp. Erangy Springs (M Trudgen 12030)	1	ii	iii	iii	i, ii, vi (numerous)
<i>Malleostemon</i> sp. Hardabutt Rapids (Bellairs 1654A)	1	ii	iii	ii	v (pigs, goats)
<i>Malleostemon</i> sp. Mullewa (B Winson B7365)	1	ii	iii	ii	i, ii, vi
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Malleostemon</i> sp. Unmade Road (Griffin 7537)	1	ii	iii	ii	i, ii
<i>Malleostemon</i> sp. Yerina (SJ Patrick 2728)	1	ii	iii	ii	i, ii, vii, iv, vi
<i>Melaleuca huttensis</i>	1	ii	iii	ii	i, ii, iv, vi, vii
<i>Melaleuca oldfieldii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix
<i>Micromyrtus rogeri</i>	1	ii	iii	ii	i, ii, iv, vi
<i>Micromyrtus</i> sp. Three Springs (Cranfield 7885)	1	ii	iii	ii	i, ii, iv, vi, vii
<i>Persoonia papillosa</i>	1	ii	iii	ii	i, ii
<i>Prostanthera scutata</i>	1	unknown	unknown	ii	i, ii
<i>Ptilotus chortophytum</i>	1	ii	vi	ii	i, ii
<i>Schoenia filifolia</i> subsp. <i>arenicola</i>	1	ii	vi	ii	i, ii, vi (numerous)
<i>Schoenia filifolia</i> subsp. <i>subulifolia</i>	1	ii	iii	ii	i, ii, vi (numerous)
<i>Scholtzia cordata</i> ms	1	ii	vi	ii	i, ii, v (goats, pigs)

<i>Scholtzia</i> sp. Binu (M Trudgen 2218)	1	ii	iii	ii	i, ii
<i>Scholtzia</i> sp. Binu East Road (ME Trudgen 12013)	1	ii	iii	ii	i, ii
<i>Scholtzia</i> sp. Kojarena (AM Ashby 1904)	1	ii	iii	ii	i, ii
<i>Scholtzia</i> sp. Nolba (E Place s.n. Jan 1964)	1	ii	iii	ii	i, ii
<i>Scholtzia</i> sp. Valentine Road (S Patrick 2142)	1	ii	iii	ii	i, ii
<i>Scholtzia</i> sp. Whelarra (ME Trudgen 12018)	1	ii	iii	ii	i, ii
<i>Stenanthemum bilobum</i>	1	ii	iii	ii	i, ii
<i>Stenanthemum gracilipes</i>	1	ii	iii	ii	i, ii
<i>Stylidium pseudocaespitosum</i>	1	ii	iii	iii	i, ii
<i>Stylidium xanthopis</i>	1	ii	iii	ii	i, ii, ix, vii
<i>Synaphea oulopha</i>	1	ii	vi	ii	i, ii, iv, vii
<i>Synaphea sparsiflora</i>	1	ii	iii	ii	i, vi, vii
<i>Tricoryne thiniigena</i> ms	1	ii	iii	ii	i, ii, iv, vii, v (rabbits)
<i>Verticordia eurardyensis</i> x	1	ii	iii	iii	v (goats), iv
<i>Verticordia lepidophylla</i> var. <i>quantula</i>	1	ii	vi	ii	v (goats), iv
<i>Vittadinia cervicalis</i> var. <i>occidentalis</i>	1	i	i	ii	i, ii, vi, vii
<b>PRIORITY 2</b>					
<i>Acacia gelasina</i>	2	ii	iii	ii	v (goats), iv
<i>Acacia lanceolata</i>	2	ii	iii	iii	i, ii, vi
<i>Acacia leptospermoides</i> subsp. <i>obovata</i>	2	ii	ii	iii	i, ii, v (goats, pigs)
<i>Acacia megacephala</i>	2	iii	iv	iii	i, ii
<i>Acacia stereophylla</i> var. <i>cyllindrata</i>	2	ii	iii	iii	i, ii, v
<i>Acacia subrigida</i>	2	ii	vi	ii	v (goats), iv, vi
<i>Anthotroche myoporoides</i>	2	iii	iv	iii	v (goats), iv
<i>Baeckea</i> sp. Whelarra (AC Burns 7)	2	ii	iii	ii	i, ii, v (pigs)
<i>Baeckea</i> sp. Yuna (M Trudgen 2224)	2	ii	iii	ii	i, ii, v (pigs)
<i>Baeckea subcuneata</i>	2	ii	iii	iii	v (goats), iv
<i>Calectasia browneana</i>	2	ii	iii	ii	i, ii, v (pigs, goats)
<i>Calytrix harvestiana</i>	2	ii	iii	iii	v (goats), iv
<i>Calytrix paucicostata</i>	2	ii	iii	iii	v (goats, pigs)
<i>Calytrix purpurea</i>	2	ii	iii	iii	v (goats, pigs)
<i>Chthonocephalus tomentellus</i>	2	iii	iii	ii	v (goats), iv, vi
<i>Comesperma rhadinocarpum</i>	2	ii	iii	ii	i, ii, vi
<i>Cryptandra glabriflora</i>	2	ii	iii	iii	i, ii, v (goats, pigs)
<i>Cryptandra nola</i>	2	ii	iii	iii	i, ii
<i>Cryptandra scoparia</i> var. <i>microcephala</i>	2	iii	vi	iii	v (goats, pigs), i, ii
<i>Dampiera krauseana</i>	2	ii	iii	ii	i, ii, vi
<i>Dicrastylis incana</i>	2	ii	iii	iii	i, ii
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Epitriche demissus</i>	2	ii	iii	iii	i, ii
<i>Eremaea acutifolia</i>	2	ii	iii	ii	i, ii, vi
<i>Frankenia confusa</i>	2	ii	vi	ii	i, ii
<i>Grevillea bracteosa</i>	2	i	ii	iii	i, ii, vi (numerous)
<i>Grevillea stenomera</i>	2	ii	iii	iii	v (goats, pigs), iv
<i>Guichenotia quasicalva</i> ms	2	ii	iii	ii	i, ii, vi (numerous)
<i>Hemigenia pimellifolia</i>	2	ii	iii	ii	i, ii, vi, v (rabbits, pigs)
<i>Homalocalyx inerrabundus</i>	2	ii	iii	ii	i, ii, v (goats), iv, vi, vii
<i>Leucopogon oblongus</i> ms	2	ii	ii	ii	i, ii, vi, vii
<i>Malleostemon</i> sp. Kalbarri (LA Craven 7083)	2	ii	iii	ii	v (pigs, goats), i, ii, iv, vii, vi
<i>Malleostemon</i> sp. Moonyoonooka (RJ Cranfield 2947)	2	ii	vi	ii	i, ii, iv, vi, vii
<i>Melaleuca fillifolia</i>	2			ii	i, ii, iv, vii, ix, x

<i>Microcorys tenuifolia</i>	2	ii	iii	ii	i, ii, iv, vi
<i>Micromyrtus</i> sp. Arrowsmith River (LA Craven 6873 & C Chapman)	2	ii	iv	ii	i, ii, iv, vi, vii
<i>Millotia jacksonii</i>	2	ii	iii	ii	i, ii, iv, vi, vii
<i>Murchisonia fragrans</i>	2	ii	iii	ii	v (pigs, goats), vi, xii (recreation)
<i>Persoonia brachystylis</i>	2	ii	iii	ii	iv, v (goats) vi, vii
<i>Persoonia pentasticha</i>	2	ii	iii	ii	i, ii, iv, v (goats) vi, ix
<i>Philotheca kalbarriensis</i>	2	ii	vi	ii	v (goats) iv, i, ii, iv, vii
<i>Platysace</i> sp. Kalbarri (D & B Bellairs 1383)	2	ii	vi	ii	xii (recreation), vii
<i>Schoenus badius</i>	2	ii	iii	ii	i, vi
<i>Schoenus griffinianus</i>	2	ii	vi	ii	i, ii, iv, v (rabbits), vi, vii
<i>Schoenus</i> sp. Kalbarri (K Newbey 9352)	2	ii	iii	ii	iv, v (goats)
<i>Scholtzia</i> sp. East Yuna (AC Burns 6)	2	ii	iii	ii	i, ii, v (rabbits)
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	2	ii	iii	ii	i, ii, iv, v (goats), vii
<i>Scholtzia</i> sp. Eurardy (JS Beard 6886)	2	ii	iii	ii	iv, v (goats)
<i>Scholtzia</i> sp. Folly Hill (ME Trudgen 12097)	2	ii	vi	ii	v (goats), vii, ii
<i>Scholtzia</i> sp. Galena (WE Blackall 4728)	2	ii	vi	ii	v (goats), vi
<i>Scholtzia</i> sp. Geraldton (F Lullfitz 3216)	2	ii	iv	ii	i, ii
<i>Scholtzia</i> sp. Murchison River (AS George 7098)	2	ii	iii	ii	v (goats, pigs), vii, xii (recreation)
<i>Scholtzia</i> sp. Ross Graham Lookout (S Maley 6)	2	ii	iii	ii	v (goats, pigs), xii (recreation)
<i>Scholtzia</i> sp. Z-Bend (Bellairs-Kalfiora 912A)	2	ii	iii	ii	v (goats, pigs), xii (recreation)
<i>Stenanthemum poecilum</i>	2	ii	vi	ii	iv, v (goats)
<i>Stylidium wilroyense</i>	2	ii	iii	ii	i, ii, iv
<i>Thryptomene johnsonii</i>	2	ii	vi	ii	vii, v (goats)
<i>Thryptomene</i> sp. Eagle Gorge (AG Guinness 2360)	2	ii	iii	ii	v (goats), xii (recreation)
<i>Thryptomene</i> sp. East Yuna (JW Green 4639)	2	ii	iii	ii	ii, v (rabbits), vii
<i>Thryptomene</i> sp. Eneabba (RJ Cranfield 8433)	2	ii	vi	ii	vii, vi
<i>Thryptomene</i> sp. Eurardy (Bellairs 1649)	2	ii	vi	ii	iv, v (goats)
<i>Thryptomene</i> sp. Yuna Reserve (AC Burns 100)	2	ii	iii	ii	ii, v (rabbits), vii
<i>Thryptomene stenophylla</i>	2	ii	iii	iii	ii, xii (roadworks, urban pressure, mountain and trail bikes, horse riding), vii, v (rabbits)
<i>Thysanotus kalbarriensis</i> ms	2	ii	iii	ii	ii, vi
<i>Thysanotus</i> sp. Badgingarra (EA Griffin 2511) [ <i>aff. sparteus</i> ]	2	ii	vi	ii	i, ii, iv, vii
<i>Verticordia aereiflora</i>	2	ii	iii	ii	i, ii, iv, vii, v (rabbits)
<i>Verticordia argentea</i>	2	ii	vi	iii	i, ii
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Verticordia blepharophylla</i>	2	ii	vi	ii	i, ii, iv, vii, v (rabbits)
<i>Verticordia dasystylis</i> subsp. <i>kalbarriensis</i>	2	ii	iii	ii	v (goats, pigs), vii
<i>Verticordia galeata</i>	2	ii	iii	ii	v (goats), iv, vii
<i>Verticordia muelleriana</i> subsp. <i>minor</i>	2	ii	iii	ii	vii, ii, v (pigs)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchase d Lease	Priority
17	Shrublands; <i>Acacia rostellifera</i> thicket	X			M
35	Shrublands; jam scrub with scattered York gum	X			H
36	Shrublands; thicket, acacia-casuarina alliance ?species	X			L
48	Shrublands; scrub-heath				L
49	Shrublands; mixed heath				L
125	Bare areas; salt lakes				L

129	Bare areas; drift sand				L
142	Medium woodland; York gum & salmon gum				H
308	Mosaic: Shrublands; <i>Acacia sclerosperma</i> sparse scrub/Succulent steppe; saltbush & bluebush	X			L
325	Succulent steppe; saltbush & samphire				L
351	Shrublands; mallee & acacia scrub with scattered York gum & red mallee	X			H
352	Medium woodland; York gum	X			M
353	Shrublands; mallee & acacia scrub with scattered York gum	X			H
359	Shrublands; acacia & banksia scrub	X			H
360	Shrublands; bowgada scrub with scattered mulga				H
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine				L
365	Shrublands; bowgada & jam scrub with scattered York gum & red mallee	X			H
368	Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee	X			L
371	Low forest; <i>Acacia rostellifera</i>	X			H
372	Mosaic: Shrublands; scrub-heath on deep sandy flats/Shrublands; thicket, acacia-casuarina alliance	X			L
378	Shrublands; scrub-heath with scattered <i>Banksia</i> spp <i>E. todtiana</i> & <i>Xylomelum angustifolium</i> on deep sandy flats in the Geraldton Sandplain Region				L
379	Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region	X			L
380	Shrublands; scrub-heath on sandplain	X			L
383	Shrublands; <i>Acacia rostellifera</i> scrub-heath	X			L
385	Shrublands; bowgada & jam scrub with scattered York gum				M
386	Low woodland; York gum				H
387	Shrublands; <i>Melaleuca cardiophylla</i> thicket				H
392	Shrublands; <i>Melaleuca thyioides</i> thicket				H
401	Mosaic: Shrublands; scrub-heath on coastal association on yellow sandplain/Shrublands; acacia patchy scrub	X			H
402	Shrublands; heath on coastal limestone	X			M
403	Shrublands; <i>Acacia ligulata</i> scrub-heath	X			M
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub				L
405	Shrublands; <i>Acacia sclerosperma</i> , bowgada & jam scrub				L
406	Shrublands; acacia, casuarina, <i>Eucalyptus eudesmioides</i> , <i>Banksia ashbyi</i> & other mixed species thicket				L
407	Low woodland over scrub; <i>Allocasuarina huegeliana</i> over jam scrub	X			L
408	Shrublands; scrub-heath on coastal association, yellow sandplain	X			L
412	Succulent steppe with scrub; teatree ( <i>Melaleuca thyioides</i> ?) over samphire				H
413	Shrublands; <i>Acacia neurophylla</i> & <i>A. species</i> thicket				H
420	Shrublands; bowgada & jam scrub	X			L

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchase d Lease	Priority
424	Shrublands; York gum mallee scrub	X			L
427	Shrublands; jam scrub with scattered <i>Allocasuarina huegeliana</i> & York gum	X			H
431	Shrublands; <i>Acacia rostellifera</i> open scrub	X			H
433	Mosaic: Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thicket/Sparse low woodland; illyarrie	X			H
440	Shrublands; <i>Acacia ligulata</i> open scrub	X	X		H
675	Shrublands; mixed thicket (melaleuca & hakea?)	X	X		H
687	Shrublands; bowgada & jam scrub with scattered <i>Allocasuarina huegeliana</i> & York gum	X			H
1102	Mosaic: Shrublands; mixed heath/Shrublands; acacia patchy scrub		X		H
1141	Shrublands; jam, <i>Acacia rostellifera</i> & <i>Melaleuca megacephala</i> thicket				H
1142	Shrublands; <i>Acacia ligulata</i> & <i>Melaleuca uncinata</i> dominated thicket on dark brown loamy soil	X			L
371	<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough River Alluvial Flats				M
352	Clay Flat assemblages of the Irwin River				M
675	<i>Melaleuca megacephala</i> and <i>Hakea pycnoneura</i> thicket on stony slopes of Moresby Range	X			H
352	Plant assemblages of the Irwin River Headwater flats				H
371	Plant assemblages of Hutt Lagoon	X			H
408	<i>Verticordia</i> dominated low heath on Moresby Range	X			H
675	<i>Allocasuarina campestris</i> and <i>Melaleuca uncinata</i> thicket on superficial laterite on Moresby Range	X			H
371	<i>Acacia rostellifera</i> low forest	X			H
17	Vegetation of Gorges of Murchison River lower reaches. Includes Endangered flora such as <i>Drakaea concolor</i> , <i>Caladenia wanosa</i> , <i>Lechenaultia chlorantha</i> , and <i>Hypocalymma longifolium</i> . Vulnerable flora such as <i>Calytrix harvestiana</i> , <i>Malleostemon</i> sp. Kalbarri, <i>Murchisonia fragrans</i> .	X			L
	Vegetation of the Northampton block - Beard's Hutt System. Vegetation type species rich and appears different, reservation rate extremely low, 3 Critically Endangered, 3 Endangered and 8 Vulnerable flora species occur in the area.				H
379	Burma Rd Sandplain. Species rich proteaceous sandplains communities containing 3 endangered flora, 7 vulnerable flora.	X			H
	Critical weight range mammals (extant species <i>Trichosurus vulpecula hypoleucus</i> , <i>Macropus eugenii derbianus</i> , <i>Macropus irma</i> : locally extinct species <i>Parantechinus apicalis</i> , <i>Dasyurus geoffroi</i> , <i>Isoodon obesulus</i> , <i>Petrogale lateralis lateralis</i> )				H
	Houtman Abrolhos islands mangrove communities (including seabird nesting sites and Australian Sea lion nursery sites)		X		H
	Houtman Abrolhos <i>Atriplex cinerea</i> dwarf shrubland including nesting burrows of seabirds such as shearwaters and petrels.		X		H
	Pavement limestone, dunes and consolidated dunes on North Island and East and West Wallabi Islands		X		H
	<i>Eucalyptus oraria</i> on East Wallabi Island		X		H
	Saltlake and saltbush flats on islands such as North and West Wallabi		X		H

L=Low, M=Medium, H=High.

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Use:** The primary issue is that agricultural activities occupy over 79% of the subregion.

**Economic Constraints:** The cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data. The level of degradation of much of the subregion is significant due to agricultural practices and the impacts of feral herbivores.

### Bioregional and subregional priority for reserve consolidation

GS is reservation Class 4 (see Appendix D, and Appendix C, rank 4) because 10 - 15% of its area reserved (any tenure). GS1 has 3.04% of the subregion in conservation reserves. GS2 has 13.84% of the subregion in

conservation reserves. GS3 has 17.67% of the subregion in conservation reserves. GS2 has been extensively cleared for agricultural purposes leaving a biased reserve system and salinity problems are ubiquitous so Class 1 is more appropriate. Two reserves in the northern extremity of GS2 make up over 88% of the conservation estate. GS3 has also been extensively cleared in the eastern portion of the subregion and has salinity problems however reservation levels are higher and more widely spread over the landscape so Class 2 is more appropriate. GS1 has very little conservation estate however threats are less urgent (mainly relating to stock and feral animals) so Class 2 is appropriate.

### Reserve management standard

Many Geraldton Sandplains reserves are becoming saline or encountering rising water tables; wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained except on areas of Beekeepers Nature Reserve and Nature Reserves smaller than 200 ha; feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made a

observable difference to rabbit numbers, goats are common in north and east, pigs are undergoing drastic increases in numbers and spread), and feral predator control systems are in place on Kalbarri, Badgingarra and Nambung National Parks only. The reserve management standard for GS2 is poor (see Appendix C, rank 5).

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species or System	Specific Recovery Plan	General Recovery Plan
<i>Macropus eugenii derbianus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Petrogale lateralis lateralis</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds
<i>Phaethon rubricauda</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Anous tenuirostris melanops</i>	No	Action Plan for Australian Birds
<i>Calyptorhynchus latirostris</i>	Yes - RP (draft)	Action Plan for Australian Birds
<i>Turnix varia scintillans</i>	No	Action Plan for Australian Birds
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles
<i>Egernia stokesii stokesii</i>	No	Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	No	Action Plan for Australian Reptiles
<i>Neophoca cinerea</i>	No	Action Plan for Australian Seals
<i>Acacia ampliata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia forrestiana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia gelasina</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia lanceolata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia leptospermoides</i> subsp. <i>obovata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia lineolata</i> subsp. <i>multilineata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia megacephala</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia nigripilosa</i> subsp. <i>latifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia pelophila</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia</i> sp. Dandaragan (S van Leeuwen 269)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia stereophylla</i> var. <i>cylindrata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia subrigida</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Anthroche myoporoides</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Baeckea</i> sp. East Yuna (R Spjut & C Edson 7077)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Baeckea</i> sp. Whelarra (AC Burns 7)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Baeckea</i> sp. Yuna (M Trudgen 2224)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Baeckea subcuneata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Beyeria lepidopetala</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Caladenia barbarella</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Caladenia bryceana</i> subsp. <i>cracens</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Caladenia elegans</i> ms	Yes - IRP	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Caladenia hoffmanii</i> subsp. <i>hoffmanii</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Caladenia wanosa</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
Species or System	Specific Recovery Plan	General Recovery Plan
<i>Calectasia browneana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Calytrix harvestiana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Calytrix paucicostata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Calytrix purpurea</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Chamelaucium oenanthem</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Chorizema humile</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Chthonocephalus tomentellus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Comesperma rhadinocarpum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Conostylis dielsii</i> subsp. <i>teres</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Conostylis micrantha</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Cryptandra glabriflora</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Cryptandra nola</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Cryptandra scoparia</i> var. <i>microcephala</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Cuphonotus humistratus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Dampiera krauseana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District

<i>Desmocladus glomeratus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Dicrastylis incana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Drakaea concolor</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Drummondita ericoides</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Epitriche demissus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eremaea acutifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eremophila brevifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Erymophyllum hemisphaericum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus beardiana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus blaxellii</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus cuprea</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus impensa</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus sargentii</i> subsp. <i>fallens</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Frankenia bracteata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Frankenia confusa</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Gastrobium hamulosum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Gastrobium propinquum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Gnephosis cassiniana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Grevillea bracteosa</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Grevillea christineae</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Grevillea filifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Grevillea stenomera</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Guichenotia quascalva</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Hemigenia pimelifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Homalocalyx inerrabundus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Hydatella leptogyne</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Hypocalymma longifolium</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Lechenaultia chlorantha</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Leucopogon oblongus</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Leucopogon terelastylus</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Macarthuria georgeana</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Erangy Springs (M Trudgen 12030)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Hardabutt Rapids (Bellairs 1654A)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Kalbarri (LA Craven 7083)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Moonyoonooka (RJ Cranfield 2947)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Mullewa (B Winson B7365)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Unmade Road (Griffin 7537)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Malleostemon</i> sp. Yerina (SJ Patrick 2728)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Melaleuca filifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Melaleuca huttensis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Melaleuca oldfieldii</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Microcorys tenuifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Micromyrtus rogeri</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<b>Species or System</b>	<b>Specific Recovery Plan</b>	<b>General Recovery Plan</b>
<i>Micromyrtus</i> sp. Arrowsmith River (LA Craven 6873 & C Chapman)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Micromyrtus</i> sp. Three Springs (Cranfield 7885)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Millotia jacksonii</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Murchisonia fragrans</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Persoonia brachystylis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Persoonia papillosa</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Persoonia pentasticha</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Philotheca kalbarriensis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Platysace</i> sp. Kalbarri (D & B Bellairs 1383)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Prostanthera scutata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Pterostylis</i> sp. Northampton (SD Hopper 3349)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Ptilotus chortophytum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Schoenia filifolia</i> subsp. <i>arenicola</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Schoenia filifolia</i> subsp. <i>subulifolia</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Schoenus badius</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Schoenus griffinianus</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Schoenus</i> sp. Kalbarri (K Newbey 9352)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia cordata</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Binu (M Trudgen 2218)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Binu East Road (ME Trudgen 12013)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. East Yuna (AC Burns 6)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Eurardy (JS Beard 6886)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Folly Hill (ME Trudgen 12097)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Galena (WE Blackall 4728)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Geraldton (F Lullfitz 3216)	No	Declared Rare and Poorly Known Flora in the Geraldton District

<i>Scholtzia</i> sp. Kojarena (AM Ashby 1904)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Murchison River (AS George 7098)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Nolba (E Place s.n. Jan 1964)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Ross Graham Lookout (S Maley 6)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Valentine Road (S Patrick 2142)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Whelarra (ME Trudgen 12018)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Scholtzia</i> sp. Z-Bend (Bellairs-Kalflora 912A)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stenanthemum bilobum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stenanthemum gracilipes</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stenanthemum poecilum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stylidium pseudocaespitosum</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stylidium wilroyense</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Stylidium xanthopis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Synaphea oulopha</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Synaphea sparsiflora</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene johnsonii</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene</i> sp. Eagle Gorge (AG Gunness 2360)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene</i> sp. East Yuna (JW Green 4639)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene</i> sp. Eneabba (RJ Cranfield 8433)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene</i> sp. Eurardy (Bellairs 1649)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene</i> sp. Yuna Reserve (AC Burns 100)	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thryptomene stenophylla</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thysanotus kalbarriensis</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Thysanotus</i> sp. Badgingarra (EA Griffin 2511) [aff. <i>sparteus</i> ]	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Tricoryne thiniigena</i> ms	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia aereiflora</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia argentea</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia blepharophylla</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia dasystylis</i> subsp. <i>kalbarriensis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia eurardensis</i> x	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia galeata</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
Species or System	Specific Recovery Plan	General Recovery Plan
<i>Verticordia lepidophylla</i> var. <i>quantula</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia muelleriana</i> subsp. <i>minor</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Vittadinia cervicalis</i> var. <i>occidentalis</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District

There is no specific regional recovery plans prepared for the Midwest.

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Macopus eugenii derbianus</i>	i, vi, xii, xiii	Re-vesting of breeding sites as Conservation Reserves. Control of weeds (e.g. Box thorn). Research into threatening processes and monitoring of populations. Capacity building.
<i>Petrogale lateralis lateralis</i>	vii, i, ii, ix, xii	Control of feral predators, particularly foxes. Habitat retention through reserves and on private lands. Fire management. Research.
<i>Falco peregrinus</i>	xii	Monitoring of existing populations.
<i>Phaethon rubricauda</i>	i, vi, xii, xiii	Re-vesting of breeding sites as Conservation Reserves. Control of weeds (e.g. Box thorn). Research into threatening processes and monitoring of populations. Capacity building.
<i>Leipoa ocellata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of feral predators and herbivores (goats) required. Fire management. Research for reduction of grazing intensity may be required.
<i>Anous tenuirostris melanops</i>	i, vi, xii, xiii	Re-vesting of breeding sites as Conservation Reserves. Control of weeds (e.g. Box thorn). Research into threatening processes and monitoring of populations. Capacity building.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, vii, xiv	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Turnix varia scintillans</i>	i, ii, iii, xii, vii	Re-vesting of breeding sites as Conservation Reserves. Further habitat retention and protection on private lands and other state lands. Monitoring of existing population. Protection from threats such as wildfire.
<i>Morelia spilota imbricata</i>	x, vii, xii, i	Reintroduction to previous areas of habitat. Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves.
<i>Egernia stokesii stokesii</i>	x, vii, xii, i	Reintroduction to previous areas of habitat. Re-vesting of breeding sites as Conservation Reserves. Control of feral predators such as foxes and cats. Research. Habitat retention through reserves.
<i>Aspidites ramsayi</i>	x, vii, xii, i	Reintroduction to previous areas of habitat. Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Neophoca cinerea</i>	i, xiii, vi, xii	Re-vesting of breeding sites as Conservation Reserves. Capacity building through education of fishing industry. Control of weeds (e.g. Box thorn). Monitoring of populations.
<i>Acacia ampliata</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of

		herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia forrestiana</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia gelasina</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Fire management. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia lanceolata</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia leptospermoides</i> subsp. <i>obovata</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia lineolata</i> subsp. <i>multilineata</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Acacia megacephala</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia nigripilosa</i> subsp. <i>latifolia</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia pelophila</i>	i, ii, iii, vi, viii, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Weed control. Revegetation. Control of herbivores (goats, rabbits) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia</i> sp. Dandaragan (S van Leeuwen 269)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia stereophylla</i> var. <i>cylindrata</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia subrigida</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Anthroche myoporoides</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Baeckea</i> sp. East Yuna (R Spjut & C Edson 7077)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Baeckea</i> sp. Whelarra (AC Burns 7)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Baeckea</i> sp. Yuna (M Trudgen 2224)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Baeckea subcuneata</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Beyeria lepidopetala</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Fire ecology needs determination and then management of the area to suit. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caladenia barbarella</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caladenia bryceana</i> subsp. <i>cracens</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caladenia elegans</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caladenia hoffmanii</i> subsp. <i>hoffmanii</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caladenia wanosa</i>	i, ii, iii, v, vi, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Calectasia browneana</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Calytrix harvestiana</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Calytrix paucicostata</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Calytrix purpurea</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chamelaucium oenanthum</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chorizema humile</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chthonocephalus tomentellus</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Comesperma rhadinocarpum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Conostylis dielsii</i> subsp. <i>teres</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Conostylis micrantha</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Cryptandra glabriflora</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Cryptandra nola</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Cryptandra scoparia</i> var. <i>microcephala</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Cuphonotus humistratus</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dampiera krauseana</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Desmocladius glomeratus</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dicrastylis incana</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Drakaea concolor</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Drummondita ericoides</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Epitriche demissus</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eremaea acutifolia</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eremophila brevifolia</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits, pigs) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Erymophyllum hemisphaericum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus beardiana</i>	i, ii, iii, ix, x, xii	Habitat retention through reserves or on other State lands or on private lands. Fire ecology needs determination and then management of the area to suit. Translocation. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus blaxellii</i>	i, ii, iii, ix, x, xii	Habitat retention through reserves or on other State lands or on private lands. Fire ecology needs determination and then management of the area to suit. Translocation. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus cuprea</i>	i, ii, iii, v, vii, x, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Translocation. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus impensa</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Fire ecology needs determination and then management of the area to suit. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus sargentii</i> subsp. <i>fallens</i>	i, ii, iii, xi, xii	Habitat retention through reserves or on other State lands or on private lands. Research into most appropriate method of dealing with hydrological issues required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Frankenia bracteata</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Frankenia confusa</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Gastrolobium hamulosum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Gastrolobium propinquum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Gnephosis cassiniana</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Control of herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea bracteosa</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea christineae</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Fire ecology needs determination and then management of the area to suit. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea filliloba</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea stenomera</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Guichenotia quasicalva</i> ms	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Hemigenia pimellifolia</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Homalocalyx inerrabundus</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hydatella leptogyne</i>	i, ii, iii, xi, xii	Habitat retention through reserves or on other State lands or on private lands. Research required into hydrological requirements and techniques for managing changes in hydrology. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hypocalymma longifolium</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Lechenaultia chlorantha</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Leucopogon oblongus</i> ms	i, ii, iii, xii ix,	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Leucopogon teretastylus</i> ms	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Macarthuria georgeana</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Erangy Springs (M Trudgen 12030)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Hardabutt Rapids (Bellairs 1654A)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Kalbarri (LA Craven 7083)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Moonyoonooka (RJ Cranfield 2947)	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Malleostemon</i> sp. Mullewa (B Winson B7365)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Unmade Road (Griffin 7537)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Yerina (SJ Patrick 2728)	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Melaleuca filifolia</i>	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Melaleuca huttensis</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Melaleuca oldfieldii</i>	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Microcorys tenuifolia</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores and stock required (possibly with exclosures). Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Micromyrtus rogeri</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores and stock required (possibly with exclosures). Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Micromyrtus</i> sp. Arrowsmith River (LA Craven 6873 & C Chapman)	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Micromyrtus</i> sp. Three Springs (Cranfield 7885)	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Millotia jacksonii</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.

<i>Murchisonia fragrans</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research. Tourism uses require monitoring and remedial action if required.
<i>Persoonia brachystylis</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Persoonia papillosa</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Persoonia pentasticha</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Philotheca kalbarriensis</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Platysace</i> sp. Kalbarri (D & B Bellairs 1383)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research. Tourism uses require monitoring and remedial action if required.
<i>Prostanthera scutata</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Pterostylis</i> sp. Northampton (SD Hopper 3349)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, rabbits) required. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptilotus chortophytum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Schoenia filifolia</i> subsp. <i>arenicola</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Schoenia filifolia</i> subsp. <i>subulifolia</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Schoenus badius</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<b>Species</b>	<b>Recovery Actions<sup>1</sup></b>	<b>Recovery Descriptions</b>
<i>Schoenus griffinianus</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Schoenus</i> sp. Kalbarri (K Newbey 9352)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia cordata</i> ms	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Binu (M Trudgen 2218)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Binu East Road (ME Trudgen 12013)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. East Yuna (AC Burns 6)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Eurardy (JS Beard 6886)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Folly Hill (ME Trudgen 12097)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Galena (WE Blackall 4728)	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Geraldton (F Lullfitz 3216)	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Kojarena (AM	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds

Ashby 1904)		required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Murchison River (AS George 7098)	i, ii, iii, v, vii, vi, xii, xiv	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research. Recreation activities in the area need to be monitored and remedial actions carried out as required.
<i>Scholtzia</i> sp. Nolba (E Place s.n. Jan 1964)	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Ross Graham Lookout (S Maley 6)	i, ii, iii, v, vii, vi, xii, xiv	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research. Recreation activities in the area need to be monitored and remedial actions carried out as required.
<i>Scholtzia</i> sp. Valentine Road (S Patrick 2142)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Whelarra (ME Trudgen 12018)	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Scholtzia</i> sp. Z-Bend (Bellairs-Kalflora 912A)	i, ii, iii, v, vii, xii, xiv	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research. Recreation activities in the area need to be monitored and remedial actions carried out as required.
<i>Stenanthemum bilobum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stenanthemum gracillipes</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stenanthemum poecilum</i>	i, ii, iii, v, vi, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs, goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium pseudocaespitosum</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium wilroyense</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium xanthopis</i>	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Synaphea oulopha</i>	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Synaphea sparsiflora</i>	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Thryptomene johnsonii</i>	i, ii, iii, v, vi, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Eagle Gorge (AG Guinness 2360)	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. East Yuna (JW Green 4639)	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Eneabba (RJ Cranfield 8433)	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Thryptomene</i> sp. Eurardy (Bellairs 1649)	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Yuna Reserve (AC Burns 100)	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene stenophylla</i>	i, ii, iii, vi, vii, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores required. Control of weeds possibly required. Fencing and capacity building required to prevent damage during roadworks.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Thysanotus kalbarriensis</i> ms	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thysanotus</i> sp. Badgingarra (EA Griffin 2511) [ <i>aff. sparteus</i> ]	i, ii, iii, xii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.
<i>Tricoryne thiniigena</i> ms	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia aereiflora</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia argentea</i>	i, ii, iii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia blepharophylla</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (rabbits) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia dasystylis</i> subsp. <i>kalbarriensis</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia eurardyensis</i> x	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia galeata</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia lepidophylla</i> var. <i>quantula</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (goats) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia muelleriana</i> subsp. <i>minor</i>	i, ii, iii, v, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing. Control of herbivores (pigs) required. Control of weeds possibly required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Vittadinia cervicalis</i> var. <i>occidentalis</i>	i, ii, iii, xii, ix,	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Fire ecology needs determination and then management of the area to suit.

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

System	Beard Vegetation Association	Specific Recovery Plan	General Recovery Plan
<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough River Alluvial Flats (Beard 1976e, Beard 1976g)	371 – Low forest: <i>Acacia rostellifera</i> .	IRP	Declared Rare and Poorly Known Flora in the Geraldton District
Clay Flat assemblages of the Irwin River (Beard 1976e)	NVIS 29 – Mallee heath and shrublands	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Melaleuca megacephala</i> and <i>Hakea pycnoneura</i> thicket on stony slopes of Moresby Range (Beard 1976g, G. Keighery and N. Gibson pers. comm.)		No	Declared Rare and Poorly Known Flora in the Geraldton District

System	Beard Vegetation Association	Specific Recovery Plan	General Recovery Plan
<i>Eucalyptus macrocarpa</i> over Proteaceous sandplain community (M. Fitzgerald pers. comm.)	352 – Medium woodland: York gum.	No	Declared Rare and Poorly Known Flora in the Geraldton District
Plant assemblages of the Irwin River Headwater flats (Beard 1976e)	675 – Scrublands: mixed thicket (melaleuca & hakea).	No	Declared Rare and Poorly Known Flora in the Geraldton District
Plant assemblages of Hutt Lagoon (G. Keighery pers. comm.)	380 – Shrublands: scrub-heath on sandplains.	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Verticordia</i> dominated low heath on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)	352 – Medium woodland: York gum.	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Allocasuarina campestris</i> and <i>Melaleuca uncinata</i> thicket on superficial laterite on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)	371 – Low forest: <i>Acacia rostellifera</i> ; 440 – Shrublands: <i>Acacia ligulata</i> open scrub.	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus mallee</i> sp. and <i>Acacia</i> scrub with scattered <i>E. loxophleba</i> (Hopkins <i>et al.</i> 1996)	675 - Scrublands: mixed thicket (melaleuca & hakea).	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Acacia rostellifera</i> low forest (Hopkins <i>et al.</i> 1996)	675 - Scrublands: mixed thicket (melaleuca & hakea).	No	Declared Rare and Poorly Known Flora in the Geraldton District
Vegetation of Gorges of Murchison River lower reaches. Includes Endangered flora such as <i>Drakaea concolor</i> , <i>Caladenia wanosa</i> , <i>Lechenaultia chlorantha</i> , and <i>Hypocalymma longifolium</i> . Vulnerable flora such as <i>Calytrix harvestiana</i> , <i>Malleostemon</i> sp. Kalbarri, <i>Murchisonia fragrans</i> .	353 – Shrublands: mallee & acacia scrub with scattered York gum	No	Declared Rare and Poorly Known Flora in the Geraldton District
Vegetation of the Northampton block - Beard's Hutt System. Vegetation type species rich and appears different, reservation rate extremely low, 3 Critically Endangered, 3 Endangered and 8 Vulnerable flora species occur in the area.	371 - Low forest: <i>Acacia rostellifera</i>	No	Declared Rare and Poorly Known Flora in the Geraldton District
Burma Rd Sandplain. Species rich proteaceous sandplains communities containing 3 endangered flora, 7 vulnerable flora.	17 – Shrublands: <i>Acacia rostellifera</i> thicket	No	Declared Rare and Poorly Known Flora in the Geraldton District
Critical weight range mammals (extant species) <i>Trichosurus vulpecula hypoleucus</i> , <i>Macropus eugenii derbianus</i> , <i>Macropus irma</i> ; locally extinct species <i>Parantechinus apicalis</i> , <i>Dasyurus geoffroii</i> , <i>Isoodon obesulus</i> , <i>Petrogale lateralis lateralis</i> .	Various	Interim Recovery plans prepared for some species but not for the Ecosystem.	Action Plan for Australian Marsupials and Monotremes
Houtman Abrolhos islands mangrove communities (including seabird nesting sites and Australian Sea lion nursery sites)	379 – Shrublands: scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region	Interim Recovery plans prepared for some species but not for the Ecosystem.	Action Plan for Australian Birds; Recovery Plan for Albatrosses and Giant Petrels; The Action Plan for Australian Seals.
Houtman Abrolhos <i>Atriplex cinerea</i> dwarf shrubland including nesting burrows of seabirds such as shearwaters and petrels.	Various	No	Action Plan for Australian Birds; Recovery Plan for Albatrosses and Giant Petrels; The Action Plan for Australian Marsupials and Monotremes
Pavement limestone, dunes and consolidated dunes on North Island and East and West Wallabi Islands	NVIS 40 – Mangroves, tidal mudflats and coastal samphire	No	Action Plan for Australian Birds
<i>Eucalyptus oraria</i> on East Wallabi Island	NVIS 31 – Chenopod shrublands		Action Plan for Australian Birds; Declared Rare and Poorly Known Flora in the Geraldton District

System	Beard Vegetation Association	Specific Recovery Plan	General Recovery Plan
Saltlake and saltbush flats on islands such as North and West Wallabi	NVIS 39 – Mixed chenopod, samphire and forblands	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Eucalyptus macrocarpa</i> over Proteaceous sandplain community (M. Fitzgerald pers. comm.)	NVIS 39 – Mixed chenopod, samphire and forblands	No	Declared Rare and Poorly Known Flora in the Geraldton District
Endangered flora of sandplain areas.	379 – Shrublands: scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region	No	Declared Rare and Poorly Known Flora in the Geraldton District
<i>Melaleuca megacephala</i> – <i>Allocasuarina campestris</i> river heath (Lower Chapman River) part of Beard Vegetation Association 359	359 – Shrublands: acacia and banksia scrub	No	Declared Rare and Poorly Known Flora in the Geraldton District.
<i>Verticordia</i> low heath (Chapman River Regional Park) part of Beard Vegetation Association 359	359 - Shrublands: acacia and banksia scrub	No	Declared Rare and Poorly Known Flora in the Geraldton District.

### Appropriate ecosystem recovery actions

System	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough River Alluvial Flats (Beard 1976e, Beard 1976g)	xii, vi, i	Further survey and research to find other occurrences. Weed control. Research original plant species. Add any further occurrences to conservation estate.
Clay Flat assemblages of the Irwin River (Beard 1976e)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Melaleuca megacephala</i> and <i>Hakea pycnoneura</i> thicket on stony slopes of Moresby Range (Beard 1976g, G. Keighery and N. Gibson pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Eucalyptus macrocarpa</i> over Proteaceous sandplain community (M. Fitzgerald pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Plant assemblages of the Irwin River Headwater flats (Beard 1976e)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Plant assemblages of Hutt Lagoon (G. Keighery pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Verticordia</i> dominated low heath on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as enclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.

System	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Allocasuarina campestris</i> and <i>Melaleuca uncinata</i> thicket on superficial laterite on Moresby Range (Beard 1976e, G. Keighery and N. Gibson pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other state lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Eucalyptus mallee</i> sp. and <i>Acacia</i> scrub with scattered <i>E. loxophleba</i> (Hopkins <i>et al.</i> 1996)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Acacia rostellifera</i> low forest (Hopkins <i>et al.</i> 1996)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Vegetation of Gorges of Murchison River lower reaches. Includes Endangered flora such as <i>Drakaea concolor</i> , <i>Caladenia wanosa</i> , <i>Lechenaultia chlorantha</i> , and <i>Hypocalymma longifolium</i> . Vulnerable flora such as <i>Calytrix harvestiana</i> , <i>Malleostemon</i> sp. Kalbarri, <i>Murchisonia fragrans</i> .	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits, goats and pigs. Fire management, especially for species with generations greater than 5 to 8 years.
Vegetation of the Northampton block - Beard's Hutt System. Vegetation type species rich and appears different, reservation rate extremely low, 3 Critically Endangered, 3 Endangered and 8 Vulnerable flora species occur in the area.	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Burma Rd Sandplain. Species rich proteaceous sandplains communities containing 3 endangered flora, 7 vulnerable flora.	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Critical weight range mammals (extant species) <i>Trichosurus vulpecula hypoleucus</i> , <i>Macropus eugenii derbianus</i> , <i>Macropus irma</i> ; locally extinct species <i>Parantechinus apicalis</i> , <i>Dasyurus geoffroi</i> , <i>Isoodon obesulus</i> , <i>Petrogale lateralis lateralis</i> .	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits and goats. Fire management, especially for species with generations greater than 5 to 8 years.
Houtman Abrolhos islands mangrove communities (including seabird nesting sites and Australian Sea lion nursery sites)	i, iii, ii, vi, ix	Habitat protection through reserves, on other State lands and on private lands. Weed control for critical habitats. Fire management, especially for species with generations greater than 5 to 8 years.
Houtman Abrolhos <i>Atriplex cinerea</i> dwarf shrubland including nesting burrows of seabirds such as shearwaters and petrels.	i, iii, ii, vi, ix	Habitat protection through reserves, on other State lands and on private state lands. Weed control for critical habitats. Fire management, especially for species with generations greater than 5 to 8 years.
Pavement limestone, dunes and consolidated dunes on North Island and East and West Wallabi Islands	i, iii, ii, vi, ix	Habitat protection through reserves, on other State lands and on private lands. Weed control for critical habitats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Eucalyptus oraria</i> on East Wallabi Island	i, iii, ii, vi, ix	Habitat protection through reserves, on other State lands and on private lands. Weed control for critical habitats. Fire management, especially for species with generations greater than 5 to 8 years.

System	Recovery Actions <sup>1</sup>	Recovery Descriptions
Saltlake and saltbush flats on islands such as North and West Wallabi	i, iii, ii, vi, ix	Habitat protection through reserves, on other State lands and on private lands. Weed control for critical habitats. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Eucalyptus macrocarpa</i> over Proteaceous sandplain community (M. Fitzgerald pers. comm.)	i, iii, ii, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits, goats and foxes. Fire management, especially for species with generations greater than 5 to 8 years.
Endangered flora of sandplain areas.	i, iii, ii, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits, goats and foxes. Fire management, especially for species with generations greater than 5 to 8 years.
<i>Melaleuca megacephala</i> – <i>Allocasuarina campestris</i> river heath (Lower Chapman River) part of Beard Vegetation Association 359	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits, goats and foxes. Fire management, especially for species with generations greater than 5 to 8 years.
Verticordia low heath (Chapman River Regional Park) part of Beard Vegetation Association 359	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, on other State lands and on private lands. Fencing as exclosures where feral herbivores are present. Weed control for critical habitats. Feral animal control of rabbits, goats and foxes. Fire management, especially for species with generations greater than 5 to 8 years.

<sup>1</sup>Appendix B, key h

Most communities have various component species covered by recovery or action plans, but these are not yet available for the community unit.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation in GS2 has a rank of (ii) (see Appendix C, rank 6) indicating a large off-park effort is required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

NRM Action	Description	Effectiveness
Legislation	Soil conservation and land clearing legislation.	Low. Not rigorously enforced, penalties ineffective.
Incentives	Covenanted of bushland by landholders	Incentives are inadequate (e.g. rate or tax deductibility, lack of management advice and assistance).
Capacity Building	Bushcare Programme, leadership training for volunteer organizations.	Uptake low.
Other Planning Opportunities	Batavia Coast Regional Strategy, Local Government strategies for controlling development and assessing proposals	Low to moderate. Frequently discussion of NRM is minimal.
Integration with Property Management Planning, Catchment Planning and Landcare	Number of Land Conservation District Committees; Northern Agriculture Catchment Council (NACC) is the Regional NRM group (mixed Government, landholders and community representation).	Low to moderate. LCDCs are largely inactive or focused on enterprise activities. NACC is poorly representative and with limited capacity but is improving. NACC strategy will set priorities for future funding opportunities with NHT2 and the National Action Plan for salinity

### Feasible opportunities for NRM

**Legislation:** Requires more rigorous control.

**Institutional Reform:** Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Tradable Rights:** Carbon credits would provide impetus to new revegetation efforts.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity. NACC strategy will set priorities for

future funding opportunities with NHT2 and the National Action Plan for salinity. As fragmentation and decline of remnant vegetation is the top priority in this strategy, it provides an excellent opportunity to obtain funding for biodiversity.

### Integration with Property Management Planning, Catchment Planning and Landcare

**Other:** Increasing the role of NRM in all agricultural activities.

### Impediments or constraints to opportunities

A number of impediments exist. The current role of Government Departments in NRM and policing of activities such as land clearing is fragmented and unclear. Departments who have responsibility for resource exploitation may also have resource protection roles. Penalties for undertaking activities such as land clearing are comparatively minor and do not have the support of the greater rural community. Need to increase awareness of conservation values through education of various industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for GS2 (i) (see Appendix C, rank 7), indicating that there are major constraints. It is a similar situation as AW1 & MAL2.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regolith mapping availability limited to very small areas

(less than 5%) of the subregion at a scale of 1:50 000. Beards vegetation is mapped at a resolution of 1:250 000 at best. This data is critical, without more data further analysis and prioritisation can't occur.

**Systematic Fauna Survey:** Although a regional fauna survey has been completed, it was sparse (18 terrestrial quadrats and 4 wetland quadrats across subregion), with quadrats only positioned on 10 of the most widespread surface-types and only 1-2 quadrats per surface-type. Also, it was confined to vertebrates and selected invertebrate taxa, and few quadrats were sampled on more than two occasions. There is no long-term survey data on species population trends in most reserves, even for vertebrates.

**Floristic Data:** Although regional survey of flora has been completed, it is based on very sparse sampling (71 quadrats across subregion), with the quadrats confined to the 11 most widespread surface-types.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There is no data to provide a regional context on life-history (including population-trend) of most species, including CWR mammals and introduced pests such as rabbits, goats, cats and foxes.

**Other Data Gaps Include:** There is little quantitative data on the affect of exotic predators, and no quantitative data on the affect of weed colonisation, fragmentation, fire and introduced herbivores.

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298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
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483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
537	Patrick, S.J.	(2001).	Declared Rare and Poorly Known Flora in the Geraldton District. Wildlife Management Program No. 26.	Department of Conservation and Land Management.	R
815	Phillimore, R. and English, V.	(2001).	Long-leaved myrtle ( <i>Hypocalymma longifolium</i> ) Interim Recovery Plan 2001-2004 (IRP No 88)	Department of Conservation and Land Management, Perth	O
812	Phillimore, R., Brown, A., Kershaw, K., Holland, E. and English, V.	(2000).	Elegant spider orchid ( <i>Caladenia elegans</i> ms) Interim Recovery Plan 2000-2003 (IRP No 63)	Department of Conservation and Land Management, Perth	O
781	Shaugnessy, P.D.	(1999).	The action plan for Australian seals	Environment Australia, Canberra.	O
731	Stack, G. and English, V.	(1999).	Prostrate Flame Flower ( <i>Chorizema humile</i> ) Interim Recovery Plan 1999-2002 (IRP No 31)	Department of Conservation and Land Management	O

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 026, 065, 070, 083, 094, 101, 114, 118, 128, 137, 162, 241, 267, 268, 273, 277, 285, 294, 299, 326, 335, 341, 347, 369, 381, 387, 406, 412, 419, 429, 451, 459, 476, 526, 531, 562, 731, 633, 647, 648, 685, 686 and 811 in Appendix A.

# Geraldton Sandplain 3 (*GS3 - Lesueur Sandplain subregion*)

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## Subregional description and biodiversity values

### Description and area

The Geraldton Sandplains bioregion is composed mainly of proteaceous scrub-heaths, rich in endemics, on the sandy earths of an extensive, undulating, lateritic sandplain mantling Permian to Cretaceous strata. Extensive York Gum and Jam woodlands occur on outwash plains associated drainage. The Lesueur Sandplain (GS3) comprises coastal Aeolian and limestones, Jurassic siltstones and sandstones (often heavily lateritised) of central Perth Basin. Alluvials are associated with drainage systems. There are extensive yellow sandplains in south-eastern parts, especially where the subregions overlaps the western edge of the Pilbara Craton. Shrub-heaths rich in endemics occur on a mosaic of lateritic mesas, sandplains, coastal sands and limestones. Heath on lateritised sandplains along the subregions north-eastern margins. The climate is Mediterranean and the subregional area is 1,358,915 ha.

### Dominant land use

Mainly (iv) (see Appendix B, key b) dry-land agriculture (69.34%), with lesser areas of (xiii) conservation (17.6%), and (x) UCL and Crown reserves (12.5%).

### Continental Stress Class

The Continental Stress Class listed for GS3 is 4, however, it should be 3 or worse. The level of threat faced is

### Ecosystem Types Which Have at Least 85% of Their Total Extent Confined to the Geraldton Sandplains 3 Subregion:

Beard Veg Assoc	Vegetation Description
254	Shrublands; <i>Melaleuca uncinata</i> thicket with scattered wandoo and powderbark wandoo
255	Shrublands; mallee scrub, <i>Eucalyptus dongarraensis</i>
377	Mosaic: Shrublands; scrub-heath on limestone in the northern Swan Region / Sparse low woodland; illyarrie
378	Shrublands; scrub-heath with scattered <i>Banksia spp E. todiana</i> & <i>Xylomelum angustifolium</i> on deep sandy flats in the Geraldton Sandplain Region
379	Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region
391	Shrublands; <i>Melaleuca uncinata</i> thicket
392	Shrublands; <i>Melaleuca thyoides</i> thicket
393	Shrublands; <i>Melaleuca thyoides</i> thicket with scattered <i>Casuarina obesa</i>
432	Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thicket
694	Shrublands; scrub-heath on yellow sandplain banksia-xyломelum alliance in the Geraldton Sandplain & Avon-Wheatbelt Regions
Beard Veg Assoc	Vegetation Description
697	Shrublands; scrub-heath on lateritic sandplain in the southern Geraldton Sandplain Region
748	Shrublands; <i>Melaleuca thyoides</i> thicket with scattered river gum

similar to that of the Avon Wheatbelt, but the reserve system is more representative (particularly in the west of the subregion) due to Beekeepers Nature Reserve, Coomallo Nature Reserve, Lesueur and Badgingarra National Parks & Unallocated Crown Land. Over 60% of the area in conservation estate in this subregion is contained in these western reserves. The remainder of subregion has very few reserves, the majority of which are small and on agriculturally unproductive land and many of which are threatened by salinity.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

- Lesueur floristic communities - a large number of distinct, species rich and geographically restricted communities occur in the Mt Lesueur and Coomallo area.
- Stygofauna of cave communities in the Beekeepers Nature Reserve area.

#### Rare Vertebrates:

Including: Peregrine Falcon (*Falco peregrinus*), Malleefowl (*Leipoa ocellata*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Boullanger Island Dunnart (*Sminthopsis griseoventer boullangerensis*), Southern Dibbler (*Parantechinus apicalis*), Carpet Python (*Morelia spilota imbricata*), *Simoselaps calonotos*, Western Spiny-tailed Skink (*Egernia stokesii badia*).

#### Rare Flora:

A large number of rare flora are recorded from the area.

772	Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> heath
1031	Mosaic: Shrublands; hakea scrub-heath/Shrublands; dryandra heath
1032	Mosaic: Medium woodland; marri, wandoo, powderbark/Shrublands; dryandra heath
1034	Medium woodland; marri, wandoo & powderbark
1037	Medium woodland; York gum & river gum (incl e6,18Mr?)
1044	Mosaic: Medium woodland; York gum & salmon gum/Shrublands; <i>Melaleuca thyioides</i> thicket
1149	Shrublands; scrub-heath <i>Acacia-Ecdeiocolla</i> association in the south-east Geraldton Sandplain Region

**Centres of endemism:**

The area exhibits extremely high floristic endemism, with over 250 species of sandplain flora endemic to the subregion. The area is known Australia-wide and internationally as having particularly high floristic diversity and levels of endemism.

**Refugia:**

Islands provide refugee from feral predators and herbivores for species such as Australian Sea Lions (*Neophoca cinerea*), Boullanger Island Dunnart (*Sminthopsis griseoventer boullangerensis*) and Southern Dibbler (*Parantechinus apicalis*).

**High Species or Ecosystem Diversity:**

Lesueur floristic communities - a large number of distinct, species rich and geographically restricted communities occur in the Mt Lesueur and Coomallo area.

**Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats**

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Geraldton Sandplains (System 5 – North Sand Heaths) in the CTRC Green Book (Environmental Protection Authority 1974). In 1976 these recommendations were further developed by the Environmental Protection Authority as the Red Book recommendations (Environmental Protection Authority 1976). Some but not all of these recommendations (with modification) were implemented over the following ten years. No other systematic assessment of biodiversity has been undertaken in the subregion.

Although no systematic assessment of biodiversity was undertaken recommendations on reserve status of specific areas within the subregion have been included in the Lesueur National Park and Coomallo Nature Reserve Management Plan (Department of Conservation and Land Management 1995).

**Wetlands****Wetlands of National significance (DIWA listings)**

Name & Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake - Logue Inlood System WA036 (GS002WA)	B6, B7, B10, B2	ii	ii	iii	ix, x (increased inundation), viii ( <i>Phytophthora</i> sp.), v (bees, foxes, cats, rabbits and pigs (deliberately dumped by pig hunters)), xiii (seismic blasting, gas fields; bees using tree hollows and excluding native insects and birds)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

**Wetlands of subregional significance (in addition to the DIWA listed wetlands)**

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
White and Green Lakes	320 000 m E, 6 780 000m N	B7	ii	ii	ii	ii	i, ii, iv, ix, x (overland flows)
Saline lakes of Coolimba – Jurien	310 000 m E, 6 670 000 m N	B7	ii	iii	iv	ii	vi (wild oats), xii (mining of gypsum)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

**Riparian zone vegetation**

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Irwin River	i	iii	ii	ix, x (increased flow), i, ii, iv, v (foxes, rabbits and goats), vi (castor oil bush, box thorn, wild oats)
Hill River	i	ii	ii	ix, x (increased flow), i, ii, iv, v (foxes, rabbits and goats), vi (castor oil bush, box thorn, wild oats)
Moore River	i	iii	ii	ix, x (increased flow), i, ii, iv, v (foxes, rabbits and goats), vi (castor oil bush, victorian tea tree, wild oats)
Arrowsmith River	ii	iii	ii	xii (mining), iv, v (goats, pigs and rabbits), viii ( <i>Phytophthora</i> dieback), vii (changed fire regimes), x (increased flow)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lesueur-Coomallo Floristic Community D1 (Martinick and Associates 1988a)	E	30	iii	iv	iii	xi, ix
Lesueur-Coomallo Floristic Community A1.2 (Martinick and Associates 1988a)	E	30	iii	iv	iii	iv, v (goats, rabbits), vii
Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1,2,3&7) and margins (Vegetation Types 4,5&6) of the Watheroo-Marchagee region (Griffin 1991)	E	30	ii	iii	iii	iv, v (goats, rabbits), vii
Ferricrete floristic community (Rocky Springs type) (Griffin <i>et al.</i> 1983)	V	29	iii	iii	iii	iv, v (goats, rabbits), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Critical weight range mammals (extant species <i>Trichosurus vulpecula hypoleucus</i> , <i>Macropus eugenii derbianus</i> , <i>Macropus irma</i> : locally extinct species <i>Parantechinus apicalis</i> , <i>Dasyurus geoffroi</i> , <i>Isoodon obesulus</i> )	E	Various	i	iii	ii	v (foxes, cats)
Lesueur-Coomallo Floristic Community M2 (Martinick and Associates 1988a)	V	30	iii	iv	iii	iv, v (goats, rabbits), vii
Lesueur-Coomallo Floristic Community DFGH (Martinick and Associates 1988a)	V	30	iii	iv	ii	iv, v (goats, rabbits), vii
Low heath dominated by <i>Petrophile chrysantha</i> on Lesueur Dissected Uplands (Griffin 1994)	V	30	iii	iv	iii	iv, v (goats, rabbits), vii
Spring communities, Eneabba sandplain (D. Rose pers. comm.)	V	9	ii	iii	i	iv, v (goats, rabbits), vii
Cave invertebrate communities of the Dongara area (R. Shepherd pers. comm.)	V	N/A	ii	vi	i	ix, x, xi

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Parantechinus apicalis</i>	E	i	iv	iii	xii (disturbance by human activities,
<i>Sminthopsis griseoventer boullangerensis</i>	V	iii	iv	iii	xii (disturbance by human activities)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	ii	ii	ii, v (foxes & cats), xii (poaching of nests)
<i>Leipoa ocellata</i>	V	ii	iii	iii	v (foxes, cats), iii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia stokesii badia</i>	V	ii	iii	ii	ii, v (foxes, cats), iii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	ii	ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	ii	iii	iii	ii, v (foxes, cats), iii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Simoselaps calonotus</i>	V	ii	iii	ii	ii, v (foxes, cats), iii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Acacia aprica</i>	CR	ii	iii	iii	ii, vi
<i>Acacia cochlocarpa</i> subsp. <i>cochlocarpa</i>	CR	ii	iii	iii	ii, vi
<i>Acacia vassalii</i>	CR	ii	vi	iii	ii, vi
<i>Caladenia drakeoides</i>	CR	ii	iv	iii	i, ii, vi, vii
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	CR	i	ii	ii	i, ii, vi
<i>Daviesia bursarioides</i>	CR	i	iii	iii	i, ii, vi, vii
<i>Daviesia dielsii</i>	CR	iii	vi	iii	i, ii
<i>Eucalyptus absita</i>	CR	i	iii	iii	i, ii, iv
<i>Eucalyptus dolorosa</i>	CR	ii	iii	iii	i, ii, vi, vii
<i>Grevillea althoferorum</i>	CR	ii	iii	iii	vii, ii, x, xii (track maintenance chemical), v (rabbits)
<i>Grevillea batrachioides</i>	CR	i	vi	iii	i, ii, vi, vii
<i>Grevillea calliantha</i>	CR	iii	iii	iii	i, ii, vi
<i>Grevillea humifusa</i>	CR	i	ii	iii	ii, vi, xii (track & fire break maintenance), iv, v, vii
<i>Hemiandra gardneri</i>	CR	ii	ii	iii	i, ii, vi, vii
<i>Jacksonia pungens</i> ms	CR	i	ii	ii	i, ii, viii, xii (low seed viability)
<i>Synaphea quartzitica</i>	CR	i	ii	iii	i, ii, xii (mining)
<i>Thomasia</i> sp. Green Hill (Paust 1322)	CR	ii	iii	ii	i, ii
<i>Drakaea elastica</i>	E	ii	vi	iii	i, ii, vi
<i>Dryandra serratuloides</i> subsp. <i>perissa</i>	E	ii	ii	iii	vii
<i>Eucalyptus balanites</i> x	E	ii	ii	iii	i, ii, xii (gravel scraping)
<i>Eucalyptus crispata</i>	E	iii	iv	iii	i, ii, vi
<i>Eucalyptus lateritica</i>	E	iii	iv	iii	i, ii, vi, vii
<i>Eucalyptus leprophloia</i>	E	iii	iv	iii	i, ii, vi, vii, xii (insect damage)
<i>Eucalyptus pruiniramis</i>	E	iii	iv	iii	i, ii, vi, xii (gravel extraction)

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	E			iii	ii, vi, xii (track maintenance chemical), iv, v, vii
<i>Leucopogon oblectus</i>	E	i	ii	iii	i, ii, vii, viii ( <i>Phytophthora</i> sp.), xii (mining)
<i>Patersonia spirifolia</i>	E	ii	iii	ii	i, ii
<i>Spirogardnera rubescens</i>	E	ii	iii	iii	i, ii, vii
<i>Thelymitra stellata</i>	E	ii	iii	iii	i, ii, vii
<i>Acacia recurvata</i>	V	ii	iii	iii	ii, vi
<i>Andersonia gracilis</i>	V	ii	iii	ii	ii
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	V	ii	iv	iii	ii, viii, vi
<i>Chamelaucium griffinii</i> ms	V	ii	vi	iii	i, i, vii
<i>Chorizema humile</i>	V	i	iii	iii	i, ii, vi, v, vii
<i>Darwinia chapmaniana</i>	V	ii	vi	iii	ii, i
<i>Eleocharis keigheryi</i>	V	ii	ii	iii	i, ii, vi, vii
<i>Eucalyptus johnsoniana</i>	V	iii	iv	iii	i, ii, vi, xii (mining), vii
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	V	iii	iv	iii	i, ii, xii (habitat degradation)
<i>Eucalyptus suberea</i>	V	iii	iii	iii	vii
<i>Hakea megalosperma</i>	V	iii	iv	iii	i, ii
<i>Ptychosema pusillum</i>	V	ii	vi	iii	i, ii, vii
<i>Stawellia dimorphantha</i>	V	iii	vi	iii	i, ii, vi, vii
<b>PRIORITY 1</b>					
<i>Acacia congesta</i> subsp. <i>cliftoniana</i>	1	ii	vi	iii	ii, vi, vii
<i>Calectasia palustris</i>	1	ii	vi	ii	i, ii
<i>Corymbia chlorolampra</i>	1	ii	vi	ii	i, ii, vii
<i>Dampiera tephrea</i>	1	iii	vi	ii	ii
<i>Diuris</i> sp. Arrowsmith (K Dixon 924)	1	ii	vi	ii	i, ii, iv
<i>Drosera marchantii</i> subsp. <i>prophylla</i>	1	iii	vi	ii	i, ii, vi
<i>Eucalyptus absita</i> x <i>loxophleba</i>	1	ii	iii	iii	i, ii
<i>Eucalyptus annuliformis</i>	1	ii	iii	iii	i, ii
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	1	ii	iii	ii	i, ii, vi, vii
<i>Grevillea metamorpha</i>	1	iii	vi	ii	ii, vi, iv, vii
<i>Grevillea pinifolia</i>	1	ii	iii	ii	ii, vi, vii
<i>Grevillea synapheae</i> subsp. A Flora of Australia (SD Hopper 6333)	1	iii	iv	iii	i, ii
<i>Grevillea synapheae</i> subsp. <i>minyolo</i>	1	iii	iv	iii	i, ii
<i>Hypocalymma</i> sp. Cataby (GJ Keighery 5151) [aff. <i>tetrapterum</i> ]	1	ii	ii	ii	i, ii, vi, vii
<i>Jacksonia</i> sp. Badgingarra (H Demarz D6601) [sp. 14]	1	ii	iii	ii	i, ii, vi, vii
<i>Lasiopetalum miseryense</i> ms	1	ii	ii	ii	i, ii, vi, vii
<i>Lasiopetalum ogilvieanum</i>	1	ii	iii	ii	i, ii, vi, vii
<i>Lepidium fasciculatum</i>	1	iii	vi	ii	i, ii, vi, vii
<i>Malleostemon</i> sp. Cooljarloo (B Backhouse s.n. 16.11.88)	1	ii	vi	ii	i, ii
<i>Mesomelaena stygia</i> subsp. <i>deflexa</i>	1	iii	vi	ii	i, ii
<i>Myriocephalus suffruticosus</i>	1	iii	vi	ii	ii
<i>Onychosepalum microcarpum</i>	1	ii	vi	ii	i, ii, vi, iv, vii
<i>Paracaleana dixonii</i> ms	1	ii	iii	iii	i, ii, vii
<i>Scaevola eneabba</i>	1	ii	ii	ii	ii, i,
<i>Stylidium pseudocaesпитosum</i>	1	ii	iv	iii	i, ii
<i>Stylidium tinkeri</i>	1	ii	vi	ii	i, ii, iv, vi
<i>Synaphea oulopha</i>	1	iii	vi	ii	i, ii, iv, vii
Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Synaphea sparsiflora</i>	1	iii	vi	ii	i, vi, vii

<i>Tetradlea remota</i>	1	ii	vi	iii	i, ii
<i>Thomasia</i> sp. New Norcia (Cayser s.n. Nov 1918)	1	ii	ii	ii	i, ii
<i>Verticordia luteola</i> var. <i>rosea</i>	1	ii	iii	iii	ii, i
<b>PRIORITY 2</b>					
<i>Acacia carens</i>	2	ii	vi	ii	ii, vi
<i>Acacia chapmanii</i> subsp. <i>chapmanii</i>	2	ii	vi	ii	ii, vi
<i>Acacia flabellifolia</i>	2	ii	vi	iii	ii, vi
<i>Acacia lanceolata</i>	2	ii	iii	iii	ii, vi
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (EA Griffin 2039)	2	ii	iii	ii	ii, i
<i>Acacia retrorsa</i>	2	ii	vi	iii	ii, i, vi
<i>Acacia vittata</i>	2	ii	iii	iii	ii
<i>Acacia wilsonii</i>	2	ii	vi	ii	ii, vi
<i>Andersonia longifolia</i>	2	ii	iii	ii	ii
<i>Anigozanthos humilis</i> subsp. <i>grandis</i> ms	2	ii	vi	iii	ii, vi
<i>Arnocrinum gracillimum</i>	2	ii	iii	ii	ii
<i>Baeckea</i> sp. Three Springs (ME Trudgen 5368)	2	ii	iii	ii	i, ii
<i>Boronia ramosa</i> subsp. <i>lesueurana</i>	2	ii	vi	ii	i, ii
<i>Boronia scabra</i> subsp. <i>condensata</i>	2	ii	vi	ii	i, ii
<i>Calectasia browneana</i>	2	ii	vi	ii	i, ii, v (pigs, goats)
<i>Calytrix platycheiridia</i>	2	iii	vi	iii	i, ii
<i>Caustis gigas</i> ms	2	ii	vi	iii	i, ii
<i>Comesperma rhadinocarpum</i>	2	i	vi	ii	i, ii, vi
<i>Daviesia debillior</i> subsp. <i>debillior</i>	2	iii	vi	ii	ii, i
<i>Dryandra catoglypta</i>	2	iii	vi	ii	i, ii, vi
<i>Dryandra cypholoba</i>	2	iii	vi	ii	i, ii, vi
<i>Eucalyptus angularis</i>	2	ii	iii	iii	ii, i
<i>Gompholobium</i> sp. Marchagee (BR Maslin 1427) [aff. <i>aristatum</i> ]	2	ii	vi	ii	i, ii, vi
<i>Goodenia xanthotricha</i>	2	ii	iii	ii	i, ii, vi, vii
<i>Grevillea biformis</i> subsp. <i>cymbiformis</i>	2	ii	iii	ii	i, ii, vi, vii
<i>Grevillea bracteosa</i>	2	i	ii	iii	i, ii, vi (numerous)
<i>Grevillea delta</i>	2	ii	iii	ii	i, vi, vii
<i>Hydrocotyle coorowensis</i>	2	ii	ii	ii	x, ix, i, ii, vi
<i>Hypocalymma tenuatum</i> ms	2	ii	ii	ii	i, ii, vi, vii
<i>Hypocalymma xanthopetalum</i> var. <i>linearifolium</i> ms	2	ii	iii	ii	ii
<i>Hypolaena robusta</i>	2	ii	vi	ii	i, ii, vi, vii
<i>Lasiopetalum molle</i> subsp. <i>boothendarrense</i> ms	2	ii	ii	ii	i, ii, vi, vii
<i>Leucopogon plumuliflorus</i>	2	iii	vi	ii	i, ii, vi, vii
<i>Leucopogon</i> sp. Badgingarra (R Davis 421)	2	ii	ii	ii	i, ii, vi, vii
<i>Loxocarya gigas</i>	2	iii	vi	ii	i, ii, vi, vii
<i>Persoonia filliformis</i>	2	iii	iii	ii	ii, i
<i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>	2	iii	iii	ii	ii, i
<i>Schoenus griffinianus</i>	2	iii	vi	ii	i, ii, iv, v (rabbits), vi, vii
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	2	iii	vi	ii	i, ii, iv, v (goats), vii
<i>Stenanthemum limitatum</i>	2	iii	vi	ii	ii, i
<i>Stylidium aeonioides</i>	2	iii	vi	iii	ii, i
<i>Stylidium torticarpum</i>	2	iii	vi	ii	i, ii, iv, ix
<i>Synaphea endoctrix</i>	2	iii	vi	ii	i, ii, iv
<i>Synaphea lesueurensis</i>	2	iii	vi	ii	i, ii, iv
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Synaphea rangiferops</i>	2	iii	vi	iii	i, ii, iv
<i>Thryptomene</i> sp. Lancelin (ME Trudgen 14000)	2	iii	vi	ii	vii, vi

<i>Tricoryne robusta</i> ms	2	iii	vi	iii	i, ii
<i>Verticordia blepharophylla</i>	2	iii	vi	ii	i, ii, iv, vii, v (rabbits)
<b>Other Species at Risk</b>					
<i>Catacolea enodis</i>		iii	vi	ii	i, ii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
4	Medium woodland; marri & wandoo	X			M
7	Medium woodland; York gum ( <i>E. loxophleba</i> ) & wandoo	X			H
17	Shrublands; <i>Acacia rostellifera</i> thicket	X			M
31	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered York gum				H
49	Shrublands; mixed heath	X			L
125	Bare areas; salt lakes	X			L
126	Bare areas; freshwater lakes	X			L
129	Bare areas; drift sand	X			L
142	Medium woodland; York gum & salmon gum	X			H
254	Shrublands; <i>Melaleuca uncinata</i> thicket with scattered wandoo and powderbark wandoo				H
255	Shrublands; mallee scrub, <i>Eucalyptus dongarraensis</i>	X			L
352	Medium woodland; York gum	X			L
354	Shrublands; jam and <i>Acacia rostellifera</i> (+hakea?) scrub with scattered York gum				L
377	Mosaic: Shrublands; scrub-heath on limestone in the northern Swan Region/Sparse low woodland; illyarrie	X			L
378	Shrublands; scrub-heath with scattered <i>Banksia</i> spp, <i>E. todiana</i> & <i>Xylomelum angustifolium</i> on deep sandy flats in the Geraldton Sandplain Region	X			M
379	Shrublands; scrub-heath on lateritic sandplain in the central Geraldton Sandplain Region	X			M
391	Shrublands; <i>Melaleuca uncinata</i> thicket	X			M
392	Shrublands; <i>Melaleuca thyooides</i> thicket	X			H
393	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered <i>Casuarina obesa</i>	X			L
432	Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thicket	X			L
433	Mosaic: Shrublands; <i>Acacia rostellifera</i> & <i>Melaleuca cardiophylla</i> thicket/Sparse low woodland; illyarrie	X			M
551	Shrublands; <i>Allocasuarina campestris</i> thicket	X			L
631	Succulent steppe with woodland and thicket; york gum over <i>Melaleuca thyooides</i> & samphire	X			L
694	Shrublands; scrub-heath on yellow sandplain banksia-xylomelum alliance in the Geraldton Sandplain & Avon-Wheatbelt Regions	X			L
696	Shrublands; casuarina & dryandra thicket with wandoo and powderbark wandoo	X			L
697	Shrublands; scrub-heath on lateritic sandplain in the southern Geraldton Sandplain Region	X			L
748	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered river gum	X			M
772	Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> heath	X			L
936	Medium woodland; salmon gum	X			H
946	Medium woodland; wandoo	X			H
988	Succulent steppe with thicket; <i>Melaleuca thyooides</i> over samphire	X			L
999	Medium woodland; marri	X			M

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
1026	Mosaic: Shrublands; <i>Acacia rostellifera</i> , <i>A. cyclops</i> (S) & <i>Melaleuca cardiophylla</i> (N) thicket/Shrublands; <i>Acacia lasiocarpa</i> & <i>Melaleuca acerosa</i> heath	X			L
1029	Shrublands; scrub-heath Dryandra-Calothamnus assoc. with <i>B. prionotes</i> on limestone in the northern Swan Region	X			L
1030	Low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>	X			L
1031	Mosaic: Shrublands; hakea scrub-heath/Shrublands; dryandra heath	X			L
1032	Mosaic: Medium woodland; marri, wandoo, powderbark/Shrublands; dryandra heath	X			L
1034	Medium woodland; marri, wandoo & powderbark	X			M
1035	Mosaic: Medium open woodland; marri/Shrublands; dryandra heath	X			H
1036	Low woodland; <i>Banksia prionotes</i>	X			L
1044	Mosaic: Medium woodland; York gum & salmon gum/Shrublands; <i>Melaleuca thyaoides</i> thicket	X			L
1149	Shrublands; scrub-heath Acacia-Ecdeiocolia association in the south-east Geraldton Sandplain Region	X			M
1032	Lesueur-Coomallo Floristic Community D1 (Martinick & Associates 1988)	X			H
1032	Lesueur-Coomallo Floristic Community A1.2 (Martinick & Associates 1988)	X			L
694	Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1,2,3&7) and margins (Vegetation Types 4,5&6) of the Watheroo-Marchagee region (Griffin 1991)	X			H
379	Ferricrete floristic community (Rocky Springs type) (Griffin <i>et al.</i> 1983)				H
1031	Lesueur-Coomallo Floristic Community M2 (Martinick & Associates 1988)	X			L
1032	Low heath dominated by <i>Petrophile chrysantha</i> on Lesueur Dissected Uplands (Griffin 1994)	X			L
748	Spring communities, Eneabba sandplain (D. Rose pers. comm.)	X			H
NA	Cave invertebrate communities of the Dongara area (R. Shepherd pers. comm.)	X			H
1032	Lesueur-Coomallo Floristic Community DFGH (Martinick & Associates 1988)	X			L

L=Low, M=Medium, H=High.

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Uses:** The primary issue in that agricultural activities occupies over 69% of the subregion.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data; level of degradation of much of the subregions is significant due to agricultural practices and the impacts of feral herbivores.

### Bioregional and subregional priority for reserve consolidation

GS is reservation Class 4 (see Appendix D, and Appendix C, rank 4) because 10 - 15% of its area reserved (any tenure). GS1 has 3.04% of the subregion in conservation reserves. GS2 has 13.84% of the subregion in conservation reserves. GS3 has 17.67% of the subregion in conservation reserves. GS2 has been extensively cleared for agricultural purposes leaving a biased reserve system and salinity problems are ubiquitous so Class 1 is more

### Off reserve conservation

#### Priority species or groups

Species	Specific Recovery Plan	General Recovery Plan
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Calyptorhynchus latirostris</i>	RP	Action Plan for Australian Birds

appropriate. Two reserves in the northern extremity of GS2 make up over 88% of the conservation estate. GS3 has also been extensively cleared in the eastern portion of the subregion and has salinity problems however reservation levels are higher and more widely spread over the landscape so Class 2 is more appropriate. GS1 has very little conservation estate however threats are less urgent (mainly relating to stock and feral animals) so Class 2 is appropriate.

### Reserve management standard

Many GS reserves are becoming saline or encountering rising water tables. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained except on Zuytdorp Nature Reserve, areas of Beekeepers Nature Reserve and Nature Reserves smaller than 200 ha. Feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made a observable difference to rabbit numbers, goats are common in north and east, pigs are undergoing drastic increases in numbers and spread). Feral predator control systems are in place on Kalbarri, Badgingarra and Nambung National Parks only. The overall reserve management rank for GS3 is (i) (poor) (see Appendix C, rank 5).

<i>Sminthopsis griseoventer boullangerensis</i>	No	Action Plan for Australian Monotremes and Marsupials
<i>Parantechinus apicalis</i>	IRP	Action Plan for Australian Monotremes and Marsupials
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles
<i>Simoselaps calonotus</i>	No	Action Plan for Australian Reptiles
<i>Egernia stokesii badia</i>	No	Action Plan for Australian Reptiles
<i>Acacia aprica</i>	IRP	No
<i>Acacia carens</i>	No	No
<i>Acacia chapmanii</i> subsp. <i>chapmanii</i>	No	No
<i>Acacia cochlocarpa</i> subsp. <i>cochlocarpa</i>	IRP	No
<i>Acacia congesta</i> subsp. <i>cliftoniana</i>	No	No
<i>Acacia flabellifolia</i>	No	No
<i>Acacia lanceolata</i>	No	No
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (EA Griffin 2039)	No	No
<i>Acacia recurvata</i>	No	No
<i>Acacia retrorsa</i>	No	No
<i>Acacia vassalii</i>	No	No
<i>Acacia vittata</i>	No	No
<i>Acacia wilsonii</i>	No	No
<i>Andersonia gracilis</i>	No	No
<i>Andersonia longifolia</i>	No	No
<i>Anigozanthos humilis</i> subsp. <i>grandis</i> ms	No	No
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	No	No
<i>Arnocrinum gracillimum</i>	No	No
<i>Baeckea</i> sp. Three Springs (ME Trudgen 5368)	No	No
<i>Boronia ramosa</i> subsp. <i>lesueurana</i>	No	No
<i>Boronia scabra</i> subsp. <i>condensata</i>	No	No
<i>Caladenia drakeoides</i> ms	IRP	No
<i>Calectasia browneana</i>	No	No
<i>Calectasia palustris</i>	No	No
<i>Calytrix platycheiridia</i>	No	No
<i>Catcolea enodis</i>	No	No
<i>Cautis gigas</i> ms	No	No
<i>Chamelaucium griffinii</i> ms	No	No
<i>Chorizema humile</i>	IRP	No
<i>Comesperma rhadinocarpum</i>	No	No
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	No	No
<i>Corymbia chlorolampra</i>	No	No
<i>Dampiera tephrea</i>	No	No
<i>Darwinia chapmaniana</i> ms	No	No
<i>Daviesia bursarioides</i>	No	No
<i>Daviesia debilior</i> subsp. <i>debilior</i>	No	No
<i>Daviesia dielsii</i>	No	No
<i>Diuris</i> sp. Arrowsmith (K Dixon 924)	No	No
<i>Drakaea elastica</i>	No	No
<i>Drosera marchantii</i> subsp. <i>prophylla</i>	No	No
<i>Dryandra cataglypta</i>	No	No
<i>Dryandra cypholoba</i>	No	No
<b>Species</b>	<b>Specific Recovery Plan</b>	<b>General Recovery Plan</b>
<i>Dryandra serratuloides</i> subsp. <i>perissa</i>	No	No
<i>Eleocharis keigheryi</i>	No	No
<i>Eucalyptus absita</i>	No	No
<i>Eucalyptus absita</i> x <i>loxophleba</i>	No	No
<i>Eucalyptus angularis</i>	No	No
<i>Eucalyptus annuliformis</i>	No	No
<i>Eucalyptus balanites</i> x	No	No
<i>Eucalyptus crispata</i>	No	No
<i>Eucalyptus dolorosa</i>	No	No
<i>Eucalyptus johnsoniana</i>	No	No
<i>Eucalyptus lateritica</i>	No	No
<i>Eucalyptus leprophloia</i>	No	No
<i>Eucalyptus pruiniramis</i>	No	No
<i>Eucalyptus rhodantha</i> var. <i>petiolaris</i>	No	No
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	No	No
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	No	No
<i>Eucalyptus suberea</i>	No	No
<i>Gompholobium</i> sp. Marchagee (BR Maslin 1427) [aff. <i>aristatum</i> ]	No	No
<i>Goodenia xanthotricha</i>	No	No
<i>Grevillea althoferorum</i>	IRP	No

<i>Grevillea batrachioides</i>	No	No
<i>Grevillea biformis</i> subsp. <i>cymbiformis</i>	No	No
<i>Grevillea bracteosa</i>	No	No
<i>Grevillea calliantha</i>	No	No
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	IRP	No
<i>Grevillea delta</i>	No	No
<i>Grevillea humifusa</i>	No	No
<i>Grevillea metamorpha</i>	No	No
<i>Grevillea pinifolia</i>	No	No
<i>Grevillea synapheae</i> subsp. A Flora of Australia (SD Hopper 6333)]	No	No
<i>Grevillea synapheae</i> subsp. <i>minyolo</i>	No	No
<i>Hakea megalosperma</i>	No	No
<i>Hemiantra gardneri</i>	No	No
<i>Hydrocotyle coorowensis</i>	No	No
<i>Hypocalymma</i> sp. Cataby (GJ Keighery 5151) [ <i>aff. tetrapterum</i> ]	No	No
<i>Hypocalymma tenuatum</i> ms	No	No
<i>Hypocalymma xanthopetalum</i> var. <i>linearifolium</i> ms	No	No
<i>Hypolaena robusta</i>	No	No
<i>Jacksonia pungens</i> ms	No	No
<i>Jacksonia</i> sp. Badgingarra (H Demarz D6601) [sp. 14]	No	No
<i>Lasiopetalum miseryense</i> ms	No	No
<i>Lasiopetalum molle</i> subsp. <i>boothendarrense</i> ms	No	No
<i>Lasiopetalum ogilvieanum</i>	No	No
<i>Lepidium fasciculatum</i>	No	No
<i>Leucopogon obtectus</i>	No	No
<i>Leucopogon plumuliflorus</i>	No	No
<i>Leucopogon</i> sp. Badgingarra (R Davis 421)	No	No
<i>Loxocarya gigas</i> ms	No	No
<i>Malleostemon</i> sp. Cooljarloo (B Backhouse s.n. 16.11.88)	No	No
<i>Mesomelaena stygia</i> subsp. <i>deflexa</i>	No	No
<i>Myriocephalus suffruticosus</i>	No	No
<i>Onychosepalum microcarpum</i>	No	No
<i>Paracaleana dixonii</i> ms	No	No
<i>Patersonia spirifolia</i>	No	No
<i>Persoonia filiformis</i>	No	No
<b>Species</b>	<b>Specific Recovery Plan</b>	<b>General Recovery Plan</b>
<i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>	No	No
<i>Ptychosema pusillum</i>	No	No
<i>Scaevola eneabba</i>	No	No
<i>Schoenus griffinianus</i>	No	No
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	No	No
<i>Spirogardnera rubescens</i>	No	No
<i>Stawellia dimorphantha</i>	No	No
<i>Stenanthemum limitatum</i>	No	No
<i>Stylidium aeonioides</i>	No	No
<i>Stylidium pseudocaesitosum</i>	No	No
<i>Stylidium tinkeri</i>	No	No
<i>Stylidium torticarpum</i>	No	No
<i>Synaphea endotrinx</i>	No	No
<i>Synaphea lesueurensis</i>	No	No
<i>Synaphea oulopha</i>	No	No
<i>Synaphea quartzitica</i>	IRP	No
<i>Synaphea rangiferops</i>	No	No
<i>Synaphea sparsiflora</i>	No	No
<i>Tetralthea remota</i>	No	No
<i>Thelymitra stellata</i>	No	No
<i>Thomasia</i> sp. Green Hill (Paust 1322)	IRP	No
<i>Thomasia</i> sp. New Norcia (Cayser s.n. Nov 1918)	No	No
<i>Thryptomene</i> sp. Lancelin (ME Trudgen 14000)	No	No
<i>Tricoryne robusta</i> ms	No	No
<i>Verticordia blepharophylla</i>	No	No
<i>Verticordia luteola</i> var. <i>rosea</i>	No	No

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Leipoa ocellata</i>	i, ii, iii, vii, xiv	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, vii, xiv	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Sminthopsis griseoventer boullangerensis</i>	i, vii, ix, xii	Habitat retention through reserves. Control of foxes and cats. Research into appropriate fire regimes is required.
<i>Parantechinus apicalis</i>	i, vii, ix, xii	Habitat retention through reserves. Control of foxes and cats. Research into appropriate fire regimes is required.
<i>Morelia spilota imbricata</i>	x, vii, xii, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Simoselaps calonotus</i>	x, vii, xii, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Egernia stokesii badia</i>	x, vii, xii, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Acacia aprica</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia carens</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia chapmanii</i> subsp. <i>chapmanii</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia cochlocarpa</i> subsp. <i>cochlocarpa</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Acacia congesta</i> subsp. <i>cliftoniana</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia flabellifolia</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia lanceolata</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia lasiocarpa</i> var. <i>lasiocarpa</i> Cockleshell Gully variant (EA Griffin 2039)	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia recurvata</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia retrorsa</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia vassalii</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia vittata</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia wilsonii</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Andersonia gracilis</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Andersonia longifolia</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Anigozanthos humilis</i> subsp. <i>grandis</i> ms	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (rabbits) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Arnocrinum gracillimum</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Baeckea</i> sp. Three Springs (ME Trudgen 5368)	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Boronia ramosa</i> subsp. <i>lesueurana</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Boronia scabra</i> subsp.	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life

<i>condensata</i>		history requirements for all rare flora very limited and needs additional research.
<i>Caladenia drakeoides</i> ms	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Calectasia browneana</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (pigs, goats, rabbits) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Calectasia palustris</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Calytrix platycheiridia</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Catacolea enodis</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Caustis gigas</i> ms	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chamelaucium griffinii</i> ms	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chorizema humile</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of feral herbivores and weeds may be required at some populations. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Comesperma rhadinocarpum</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Corymbia chlorolampra</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dampiera tephrea</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Darwinia chapmaniana</i> ms	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Daviesia bursarioides</i>	i, ii, iii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Daviesia debillior</i> subsp. <i>debillior</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Daviesia dielsii</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Diuris</i> sp. Arrowsmith (K Dixon 924)	i, ii, iii, v, ix	Habitat retention through reserves or on other State lands or on private lands. Fencing of populations required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Drakaea elastica</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Drosera marchantii</i> subsp. <i>prophylla</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dryandra catoglypta</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dryandra cypholoba</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dryandra serratuloides</i> subsp. <i>perissa</i>	ix, xii	Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eleocharis keigheryi</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eucalyptus absita</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus absita x loxophleba</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus angularis</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus annuliformis</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus balanites x</i>	i, ii, iii, ix, xiii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Provision of education to gravel extraction workers.
<i>Eucalyptus crispata</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus dolorosa</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus johnsoniana</i>	i, ii, iii, vi, vii, xiii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of various herbivores and weed species. Education of miners of the affect of their activities. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus lateritica</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus leprophloia</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research (particularly insect infestation).
<i>Eucalyptus pruiniramis</i>	i, ii, iii, vi, vii, xiii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of various herbivores and weed species. Education of miners of the affect of their activities. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus rhodantha</i> var. <i>petiolaris</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus rhodantha</i> var. <i>rhodantha</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus suberea</i>	v, viii	Fencing as exclosures, control of feral herbivores (rabbits, goats)
<i>Gompholobium</i> sp. Marchagee (BR Maslin 1427) [aff. <i>aristatum</i> ]	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Goodenia xanthotricha</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea althoferorum</i>	v, vii, xiii	Habitat retention through reserves or on other State lands or on private lands. Fencing to protect populations from rabbits, chemical overspray and track maintenance activities. Understanding of life history requirements for all rare flora very limited and needs additional research. Education of community.
<i>Grevillea batrachioides</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea biformis</i> subsp. <i>cymbiformis</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Grevillea bracteosa</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea calliantha</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	i, ii, iii, v, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing to protect populations from chemical overspray and track maintenance activities. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea delta</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea humifusa</i>	i, ii, iii, v, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Fencing to protect populations from rabbits, chemical overspray and track maintenance activities. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea metamorpha</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea pinifolia</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea synapheae</i> subsp. A Flora of Australia (SD Hopper 6333)]	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea synapheae</i> subsp. <i>minyolo</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hakea megalosperma</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hemiandra gardneri</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hydrocotyle coorowensis</i>	xi, xii, viii, vi	Research into hydrology of site and remedial actions required. Weed control required.
<i>Hypocalymma</i> sp. Cataby (GJ Keighery 5151) [ <i>aff. tetrapterum</i> ]	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hypocalymma tenuatum</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hypocalymma xanthopetalum</i> var. <i>linearifolium</i> ms	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hypolaena robusta</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Jacksonia pungens</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Jacksonia</i> sp. Badgingarra (H Demarz D6601) [sp. 14]	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Lasiopetalum miseryense</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Lasiopetalum molle</i> subsp. <i>boothendarrense</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Lasiopetalum ogilvieanum</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Lepidium fasciculatum</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Leucopogon oblectus</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Leucopogon plumuliflorus</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Leucopogon</i> sp. Badgingarra (R Davis 421)	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Loxocarya gigas</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Malleostemon</i> sp. Cooljarloo (B Backhouse s.n. 16.11.88)	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Mesomelaena stygia</i> subsp. <i>deflexa</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Myriocephalus suffruticosus</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Onychosepalum microcarpum</i>	i, ii, iii, ix, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds and herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Paracaleana dixonii</i> ms	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Patersonia spirifolia</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Persoonia filliformis</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Phlebocarya pilosissima</i> subsp. <i>teretifolia</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Ptychosema pusillum</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of various herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scaevola eneabba</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Schoenus griffinianus</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds and herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of goats required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Spirogardnera rubescens</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stawellia dimorphantha</i>	i, ii, iii, ix, vii, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Control of various weeds & herbivores required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Stenanthemum limitatum</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium aeonioides</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium pseudocoespitum</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium linkeri</i>	i, ii, v, vi, viii, xii	Fencing of populations as exclosures. Control of feral herbivores. Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stylidium torticarpum</i>	i, ii, v, vi, viii, xii	Fencing of populations as exclosures. Control of feral herbivores. Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea endoathrix</i>	i, ii, v, vi, viii, xii	Fencing of populations as exclosures. Control of feral herbivores. Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research. Management of fire regime required.
<i>Synaphea lesueurensis</i>	i, ii, v, vi, viii, xii	Fencing of populations as exclosures. Control of feral herbivores. Habitat retention through reserves or

		on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea oulopha</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea quartzitica</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea rangiferops</i>	i, ii, v, vi, viii, xii	Fencing of populations as exclosures. Control of feral herbivores. Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea sparsiflora</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Tetradlea remota</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thelymitra stellata</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thomasia</i> sp. Green Hill (Paust 1322)	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thomasia</i> sp. New Norcia (Cayser s.n. Nov 1918)	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Thryptomene</i> sp. Lancelin (ME Trudgen 14000)	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Tricoryne robusta</i> ms	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia blepharophylla</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Verticordia luteola</i> var. <i>rosea</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands. Understanding of life history requirements for all rare flora very limited and needs additional research.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Ecosystem/Beard Vegetation Association	Specific Recovery Plan	General Recovery Plan
Lesueur-Coomallo Floristic Community D1 (Martinick & Associates 1988)	1032 – Mosaic: Medium woodland: marri , wandoo, powderbark/Shrublands: dryandra heath	No	No
Lesueur-Coomallo Floristic Community A1.2 (Martinick & Associates 1988)	1032 – Mosaic: Medium woodland: marri , wandoo, powderbark/Shrublands: dryandra heath	Yes - IRP	No
Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1,2,3&7) and margins (Vegetation Types 4,5&6) of the Watheroo-Marchagee region (Griffin 1991)	694 – Shrublands: scrub-heath on yellow sandplain banksia-xyloelum alliance in the Geraldton Sandplains & Avon Wheatbelt Regions	No	No
Ferricrete floristic community (Rocky Springs type) (Griffin <i>et al.</i> 1983)	379 – Shrublands: scrub-heath on lateritic sandplain in the central Geraldton Sandplain Subregion	No	No
Lesueur-Coomallo Floristic Community M2 (Martinick & Associates 1988)	1031 – Mosaic: Shrublands: hakea scrub-heath/Shrublands dryandra heath	No	No
Low heath dominated by <i>Petrophile chrysantha</i> on Lesueur Dissected Uplands (Griffin 1994)	1032 – Mosaic: Medium woodland: marri , wandoo, powderbark/Shrublands: dryandra heath	No	No
Spring communities, Eneabba sandplain (D. Rose pers. comm.)	748 – Shrublands: Melaleuca thyoides thicket with scattered river gum	No	No
Cave invertebrate communities of the Dongara area (R. Shepherd pers. comm.)	NA	No	No
Lesueur-Coomallo Floristic Community DFGH (Martinick & Associates 1988)	1032 – Mosaic: Medium woodland: marri , wandoo, powderbark/Shrublands: dryandra heath	No	No

There are no specific regional recovery plans for any of the above biota/systems. Most species of flora have broad discussion of actions required to assist recovery detailed in the publication Declared rare and poorly known flora in the Moora District (Patrick and Brown 2001). Other Recovery Plans include; National Recovery

Plan for Malleefowl (Benshemesh 2000), The Action Plan for Australian Birds (Garnett and Crowley 2001), Action Plan for Australian Marsupials and Monotremes (Maxwell *et. al* 1996), The Action Plan for Australian Reptiles (Cogger *et al.* 1993).

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Description
Lesueur-Coomallo Floristic Community D1 (Martinick & Associates 1988)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Lesueur-Coomallo Floristic Community A1.2 (Martinick & Associates 1988)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1,2,3&7) and margins (Vegetation Types 4,5&6) of the Watheroo-Marchagee region (Griffin 1991)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on state lands (UCL); Habitat protection on private lands; Fencing of sensitive areas (as exclosures) where there are heavy goat and/or rabbit numbers; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Description
Ferricrete floristic community (Rocky Springs type) (Griffin <i>et al.</i> 1983)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Ecosystem	Recovery Actions <sup>1</sup>	Recovery Description
Lesueur-Coomallo Floristic Community M2 (Martinick & Associates 1988)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Low heath dominated by <i>Petrophile chrysantha</i> on Lesueur Dissected Uplands (Griffin 1994)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Spring communities, Eneabba sandplain (D. Rose pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on state lands (UCL); Habitat protection on private lands; Fencing of sensitive areas (as enclosures) where there are heavy goat and/or rabbit numbers; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.
Cave invertebrate communities of the Dongara area (R. Shepherd pers. comm.)	i, iii, ii, vi	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on state lands (UCL); Habitat protection on private lands; Weed control for critical habitats.
Lesueur-Coomallo Floristic Community DFGH (Martinick & Associates 1988)	i, ii, vi, vii, ix	Habitat protection through reserves including more reservation needed of high priority areas; Habitat protection on private lands; Weed control for critical habitats; Feral animal control of rabbits, goats and foxes; Fire management, especially of species with generations greater than 5-8 years.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation in GS3 has a rank of (ii) (see Appendix C, rank 6) indicating a large off-park effort is required

## Conservation actions as an integral part of NRM

### Existing NRM actions

NRM Action <sup>1</sup>	Description	Effectiveness
Legislation	Soil conservation and land clearing legislation	Low. Not rigorously enforced, penalties ineffective.
Capacity Building	Bushcare Programme, leadership training for volunteer organizations.	Uptake low.
Other Planning Opportunities	Batavia Coast Regional Strategy, Local Government strategies for controlling development and assessing proposals	Low to moderate. Frequently discussion of NRM is minimal.
Integration with Property Management Planning, Catchment Planning and Landcare	Number of Land Conservation District Committees and the Northern Agricultural Catchment Council Regional Strategy (NACC). Regional NRM group (mixed Government, landholders and community representation).	Low to moderate. LCDC's largely inactive or focused on enterprise activities. NACC is poorly representative and with limited capacity currently. NACC strategy will set priorities for future funding opportunities with NHT2 and the National Action Plan for salinity.

<sup>1</sup>Appendix B, key i.

### Feasible opportunities for NRM

**Legislation:** Requires more rigorous control.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Tradable Rights:** Carbon credits would provide impetus to new revegetation efforts.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity. NACC strategy will set future funding opportunities with NHT2 and the National

Action Plan for salinity. As fragmentation and decline of remnant vegetation is the top priority in this strategy, it provides an excellent opportunity to obtain funding for biodiversity.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Increasing the role of NRM in all agricultural activities.

### Impediments or constraints to opportunities

A number of impediments exist. The current role of Government Departments in NRM and policing of activities such as land clearing is fragmented and unclear. Departments whose have responsibility for resource

exploitation may also have resource protection roles. Penalties for undertaking activities such as land clearing are comparatively minor and do not have the support of the greater rural community. Need to increase awareness of conservation values through education of various industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for NRM actions in GS3 is (i) (see Appendix C, rank 7), indicating that there are major constraints. This is a similar situation to both AW1 & MAL2.

### Data gaps

#### Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available for the subregion. Beards' vegetation is mapped at a resolution of 1:250 000. Diversity is so great that species composition changes occur over very small distances in Kwongan vegetation and this would only be evident at a high level of resolution.

### Sources

#### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptrorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
251	Department of Conservation and Land Management and National Parks and Nature Conservation Authority	(1995a).	Lesueur National Park and Coomallo Nature Reserve Management Plan 1995-2005 Management Plan No. 31.	Department of Conservation and Land Management.	R
274	Environmental Protection Authority	(1976).	Conservation Reserves for Western Australia. Systems 1,2,3,4.	Environment Protection Authority, Perth.	R
270	Environmental Protection Authority	(1974).	Conservation Reserves for Western Australia.	Environmental Protection Authority, Perth.	R
745	Evans, R. and English, V.	(1999).	Green Hill Thomasia ( <i>Thomasia</i> sp. Green Hill) Interim Recovery Plan 1999-2002 (IRP No 26)	Department of Conservation and Land Management	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
324	Griffin, E.A.	(1991).	Flora and Vegetation of Watheroo Bentonitic Lakes.	Unpublished report prepared for Bentonite Australia Pty Ltd.	R
329	Griffin, E.A., Hopkins, A.J.M., and Hnatiuk, R.J.	(1983).	Regional Variation in Mediterranean-type shrublands near Eneabba, south-western Australia.	Vegetatio 52, 103-127.	R
854	Hamilton-Brown, S.	(2002).	Lesueur-Coomallo floristic community A1.2 Interim Recovery Plan (IRP No 106) 2002-2007	Department of Conservation and Land Management, Perth.	854
767	Hamilton-Brown, S. and English, V.	(1999).	Split-leaved grevillea ( <i>Grevillea althoferorum</i> ) Interim Recovery Plan 1999-2002 (IRP No 42)	Department of Conservation and Land Management	O
853	Holland, E., Brown, A. and	(1999).	Hinged dragon orchid ( <i>Caladenia</i>	Department of Conservation and	853

**Systematic Fauna Survey:** Data is confined to vertebrates (but not birds) and selected invertebrate taxa, is sparse and has not been analysed yet (ca. 30 terrestrial quadrats and 10 wetland quadrats across subregions), quadrats only positioned on 10 of the most widespread surface-types, and only 2 – 3 quadrats per surface-type, few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence even for vertebrates.

**Floristic Data:** Although regional survey of flora has been completed, it is based on sparse sampling (about 70 quadrats across subregions), quadrats positioned on 10 most widespread surface-types.

**Ecological and Life History Data:** Currently little data available on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of most species, including rabbits, cat, fox and CWR mammals.

#### Other Priority Data Gaps Include:

- No quantitative data on the effect of exotic predators, weed colonisation, fragmentation & farm clean-up, fire, mineral-extraction on gypsum and lime surfaces.
- No monitoring of the effect of salinity on species composition of communities is in place, although approximately 30 bench-mark quadrats are now established

	Kershaw, K.		drakeoides ms) Interim Recovery Plan (IRP No 29) 1999-2001	Land Management, Perth.	
850	Martinick, W.G. and Associates and CRA Exploration	(1988).	Gairdner Range: coal project: vegetation types, vegetation mapping and rare plants: for CRA Exploration Pty Ltd	Martinick, Perth	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
538	Patrick, S.J. and Brown, A.P.	(2001).	Declared rare and poorly known flora in the Moora District (Western Australian Wildlife Management Program ; 28).	Department of Conservation & Land Management, Perth.	R
734	Phillimore, R., and English, V.	(2000).	Narrow Curved-leaf Grevillea ( <i>Grevillea curviloba</i> subsp. <i>incurva</i> ) Interim Recovery Plan 2000-2003 (IRP No 67)	Department of Conservation and Land Management	O
616	Stack, G. and English, V.	(1999).	Blunt Wattle ( <i>Acacia aprica</i> ms) Interim Recovery Plan 1999-2002.	Department of Conservation and Land Management, Western Australia.	R
731	Stack, G. and English, V.	(1999).	Prostrate Flame Flower ( <i>Chorizema humile</i> ) Interim Recovery Plan 1999-2002 (IRP No 31)	Department of Conservation and Land Management	O
748	Stack, G. and English, V.	(1999).	Quartz Loving Synaphea ( <i>Synaphea quartzitica</i> ) Interim Recovery Plan 1999-2002 (IRP No 50)	Department of Conservation and Land Management	O
852	Stack, G. and English, V.	(1999).	Spiral fruited wattle ( <i>Acacia cochlocarpa</i> subsp. <i>Cochlocarpa</i> ms) Interim Recovery Plan (IRP No 24) 1999-2002	Department of Conservation and Land Management, Perth.	852
617	Start, A.N.	(1998).	Dibbler, <i>Parantechinus apicalis</i> , Interim Recovery Plan 1998-2000. Interim Recovery Plan No. 18.	Department of Conservation and Land Management.	R

R = Report; J = Journal article; O = Other.

#### Other Relevant Publications

See reference numbers **026, 075, 083, 094, 101, 114, 118, 124, 135, 200, 226, 233, 241, 250, 252, 267, 268, 273, 276, 277, 309, 325, 327, 335, 341, 366,**

**369, 371, 387, 406, 412, 419, 429, 451, 459, 472, 476, 526, 562, 578, 584, 643, 685, 686 and 851 in Appendix A.**

# Gibson Desert 1 (*GD1 - Lateritic Plain subregion*)

DARREN GRAHAM, BRAD BARTON AND MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Monotonous, gently undulating plain with few sandstone mesas. Solitic gravelly sandplains and laterised upland on flat-lying Jurassic and Cretaceous sandstones of Canning (Gunbarrel) Basin. Vegetation described as 'Carnegie Botanical District', Mulga parkland over *Triodia*

*basedowii* on lateritic "buckshot" plains. Mixed shrub steppe of Acacia, Hakea and Grevillea over *Triodia pungens* on red sand plains and dune fields. Lateritic uplands support shrub steppe in the north and mulga scrub in the south. Quaternary alluvia associated with palaeo-drainage features support Coolibah woodlands over bunch grasses. Climate is Arid, mean annual rainfall 200mm of mainly summer rainfall. Subregional area is 14, 038, 333ha.

### Dominant land use

(see Appendix B, key b)

Description	Percentage of Subregion
Aboriginal Reserve	5.43%
Conservation Reserves	14.57%
Grazing - Leasehold	29.26%
Unallocated Crown Land and Crown Reserves	50.74%

### Continental Stress Class

The Continental Stress Class for GD1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

- Lake Gruszka: is a large (500ha) seasonal/intermittent freshwater wooded lake, and as such plays an important ecological role, and is of historical and cultural significance. It is also listed in the directory of important wetlands of Australia, (WA039).
- Gibson Desert Gnamma Holes: are a series of 'rock pools', in the vicinity of the 'Patjar' community. They may play an important ecological role, and are of historical and cultural significance. They are also listed in the directory of important wetland of Australia, (WA038).

#### Declared Rare and Priority Flora:

Include: *Abutilon* sp. Warburton, *Acacia balsamea*, *Calandrinia porifera*, *Calytrix warburtonensis*, *Dampiera atriplicina*, *Eremophila pallida* ms, *Eremophila revoluta* ms, *Eremophila viscimarginata* ms, *Melaleuca apostiba*, *Neurachne lanigera*, *Philotheca eremicola*.

#### Rare and specially Protected Fauna:

Including: Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Princess Parrot (*Polytelis alexandrae*), Scarlet-chested Parrot (*Neophema splendida*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Malleefowl (*Leipoa ocellata*), Night Parrot (*Pezoporus occidentalis*), Bilby (*Macrotis lagotis*), Southern Marsupial Mole (*Notoryctes typhlops*), Mulgara (*Dasyercus cristicauda*), Black-footed Rock-wallaby (*Petrogale lateralis*), Long-tailed Dunnart (*Sminthopsis longicauda*), Great Desert Skink (*Egernia kintorei*), and Woma (*Aspidites ramsayi*).

#### Ecosystem Types Which Have More Than 90% of Their Total Extent Within GD1

Bear Veg Assoc	Description
102	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>
185	Sedgeland; sedges with medium woodland; sedges with coolibah over various sedges
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite

#### Refugia:

There are no known true refugia in GD 1, however the 'Gibson Desert Gnamma Holes', Lake Gruszka, Lake Blair, Boyd Lagoon, The Lake Broaden System, Lake Cohen, Lake Hancock and the West Clutterbuck Hills Creek System have the potential to act as refugia during periods of drought, or as breeding locations.

#### Species and Ecosystem Diversity:

The Central Australian Deserts (of which the Gibson Desert is a part) are known to exhibit particularly high reptile species richness.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book. The CTRC status report (Red Book 1993) noted that recommendations for reservation by the CTRC in GD1 (Gibson Desert Nature Reserve, Mangkili Claypan Nature Reserve) were implemented. Baker Lake recommendation was deemed no longer appropriate as the area was now included within an aboriginal reserve. Most of the GD1 subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the region's biota, addresses land

## Wetlands

### Wetlands of National Significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Gibson Desert Gnamma Holes (WA038)	B17	i, cultural values	iii	iii-iv	ii-iii	xii (siltation is a major problem as many of the sites are no longer regularly maintained by traditional owners), v (camels, foxes and cats)
Lake Gruszka (WA039)	B6, B14	i, cultural values	iv	iv	ii	vii (altered fire regimes in fringing flora), v (foxes and cats), iv (camels, goats and rabbits)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Blair	761932E 7265099N	B6	i, iii, cultural values	iv	iv	i	vii, v (camels, rabbits, foxes and cats)
West Clutterbuck Hills Creek System	829696E 7277216N	B2	i, iii, cultural values	iv	iv	i	vii, v (camels, rabbits, foxes and cats)
Boyd Lagoon	735000E 7127000N	B6	i, iii	iv	iv	i	vii, v (camels, rabbits, foxes and cats)
Lake Breaden System	763000E 7146000N	B6	i, iii	iv	iv	i	vii, v (camels, rabbits, foxes and cats)
Lake Cohen	706000E 7296000N	B6	i, iii	iv	iv	i	vii, v (camels, rabbits, foxes and cats)
Lake Hancock	688000E 7277000N	B6	i, iii	iv	iv	i	vii, v (camels, rabbits, foxes and cats)

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral creek line vegetation	iii	iv	i-ii	iv (camels and rabbits), vii, v (cats and foxes), vi (buffel grass)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GD1.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>	V	23	iii	iv	iii	iv, v (camels, rabbits), vii
Gorge communities - desert ranges (D. Pearson pers. comm.)	V	43	iii	iv	ii	iv, vii
Wooded coolibah freshwater wetland of Lake Gruszka (D. Pearson pers. comm.)	V	42	iii	iv	ii	iv, v, (camels), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Notoryctes typhlops</i>	E	ii	iii	ii	vii
<i>Dasyercus cristicauda</i>	V	ii	iii	ii	v (foxes, cats), vii
<i>Macrotis lagotis</i>	V	ii	iii	i-ii	v (foxes, cats)
<i>Petrogale lateralis</i>	V	i	ii	iii	v (foxes, cats), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Pezoporus occidentalis</i>	CR	i	i	ii	v (foxes, cats)
<i>Leipoa ocellata</i>	V	i	vi	ii	v (foxes, cats), vii
<i>Polytelis alexandrae</i>	V	ii	vi	ii	vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	i	iii	ii	vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Cacatua leadbeateri</i>	SP	ii	iii-iv	ii	ii, vii
<i>Acanthiza iredalei iredalei</i>		ii	vi	ii	vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	SP	i	iii	ii	iv, vii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Neophema splendida</i>	P4	unknown	vi	ii	ii
<i>Sminthopsis longicauda</i>	P4	ii	vi	ii	v (foxes, cats), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Abutilon</i> sp. Warburton	1	unknown	vi	ii	vii
<i>Eremophila viscimarginata</i> ms	1	unknown	vi	ii	vii
<i>Melaleuca apostiba</i>	1	unknown	vi	ii	vi, vii
<i>Neurachne lanigera</i>	1	unknown	vi	ii	vii
<i>Philotheca eremicola</i>	1	unknown	vi	ii	vii
<b>PRIORITY 2</b>					
<i>Calytrix warburtonensis</i>	2	unknown	vi	ii	vii
<b>Species Name</b>					
<i>Dampiera atriplicina</i>	2	unknown	vi	ii	vii
<i>Eremophila pallida</i> ms	2	unknown	vi	ii	vii
<i>Eremophila revoluta</i> ms	2	unknown	vi	ii	vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Analysis of appropriate management scenarios

#### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X			L
19	Low woodland; mulga between sandridges				M
39	Shrublands; mulga scrub	X			L
40	Shrublands; acacia scrub, various species	X			L
45	Shrublands; mallee scrub (Great Victoria Desert)				L
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	X			L
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges	X			M
102	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over <i>Triodia</i>				H

	<i>basedowii</i>				
125	Bare areas; salt lakes	X			L
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	X			L
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				H
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite	X			L
151	Sedgeland; sedges with open low trees; coolibah over various sedges				L
185	Sedgeland; sedges with medium woodland; sedges with coolibah over various sedges	X			L
217	Hummock grasslands, steppe woodland; desert oak ( <i>Allocasuarina decasneana</i> ) & soft spinifex (soft spinifex)				L
230	Mosaic: Medium sparse woodland; desert oak between sand dunes/Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	X			L
236	Hummock grasslands, shrub steppe; mulga and mallee (marble gum) over hard spinifex				L
239	Hummock grasslands, open medium tree & mallee steppe; marble gum ( <i>E. gonglocarpa</i> ) & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				L
252	Hummock grasslands, shrub steppe; mulga and mallee over soft spinifex				L
676	Succulent steppe; samphire	X			L
1217	Hummock grasslands, steppe woodland; desert oak & soft spinifex between sandhills				H
2041	Succulent steppe with scrub; teatree over saltflats				L
	Gorge communities - desert ranges (D. Pearson pers. comm.)	X			M
	Wooded coolibah freshwater wetland of Lake Gruszka. Most wetlands in that area are saline (D. Pearson pers. comm.).	X			L

## Subregional constraints in order of priority (see Appendix B, key g)

**Economic:** In terms of resources to secure and adequately manage reserves

**Competing Landuses:** Mining interests may have some influence on CTR establishment.

## Bioregional and subregional priority for reserve consolidation

Overall 12% of Gibson Desert bioregion is reserved in IUCN I-IV reserves and is classified as IBRA reservation class 4 (see Appendix D, and Appendix C, rank 4). GD1

has 14.7% and GD2 has 0% reserved in IUCN I-IV reserves and therefore, at the subregional scale GD1 should also remain with IBRA reservation Class 4

## Reserve management standard

The overall ranking for GD1 is (ii) Fair (see Appendix C, rank 5), i.e. biodiversity values and/or management issues poorly identified; some resource degradation is occurring though retrievable. Wildfire management is non-existent. Mining exploration activities are supervised. The impact of feral herbivores is likely to be considerable although not quantified, and there are no feral predator control programs in the subregion.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of flora and fauna	Gibson Desert Nature Reserve	Nature Reserve	ii-iii
A	Conservation of flora and fauna	Mangkill Claypan Nature Reserve	Nature Reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

Species	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
<i>Cacatua leadbeateri</i>	vii	No	Action Plan for Australian Birds
<i>Polytelis alexandrae</i>	v (foxes and cats), vii	No	Action Plan for Australian Birds
<i>Neophema splendida</i>	v (foxes and cats), iv (feral herbivores), vii	No	Action Plan for Australian Birds
<i>Acanthiza iredalei iredalei</i>	v (foxes and cats), vii	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	v (foxes and cats), iv (feral herbivores), vii	No CALM Recovery Plan, however Malleefowl Preservation Society has current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Pezoporus occidentalis</i>	v (foxes and cats), vii	Yes - IRP	Action Plan for Australian Birds
<i>Macrotis lagotis</i>	v (foxes and cats), iv (rabbits), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes typhlops</i>	v (foxes and cats), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Dasyercus cristicauda</i>	v (foxes and cats), iv (feral herbivores), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Sminthopsis longicauda</i>	v (foxes and cats), iv (feral herbivores), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Petrogale lateralis</i>	v (foxes and cats)	No	Action Plan for Australian Marsupials and Monotremes
<i>Egernia kintorei</i>	v (foxes and cats), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	v (foxes and cats), vii	No	Action Plan for Australian Reptiles

<sup>1</sup>Appendix B, key e

## Appropriate recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
<i>Cacatua leadbeateri</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands.	Insufficient resources to implement management activities.
<i>Polytelis alexandrae</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands	Insufficient resources to implement management activities.
<i>Neophema splendida</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands	Insufficient resources to implement management activities.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands	Insufficient resources to implement management activities.
<i>Leipoa ocellata</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Pezoporus occidentalis</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Macrotis lagotis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control. Translocation from secure populations	Insufficient resources to implement management activities.
<i>Notoryctes typhlops</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Dasyercus cristicauda</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Sminthopsis longicauda</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Petrogale lateralis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control. Translocation from secure populations	Insufficient resources to implement management activities.
<i>Egernia kintorei</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.
<i>Aspidites ramsayi</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.

<sup>1</sup>Appendix B, rank i.

## Existing species recovery plans

A recovery plan for *Egernia kintorei* 2001 – 2011 is in place with a National Recovery team established. *Dasyercus cristicauda* is a species monitored by the National Threatened Species Recovery team. Most species are included in National Action Plans including The Action Plan for Australian Birds, 2000, The Action Plan for Australian Reptiles, 1996 Action Plan for Australian Marsupials and Monotremes.

## Ecosystems, existing recovery plans and appropriate recovery actions

All ecosystems at risk in GD1 are currently held on reserve, so no off-park conservation actions are applicable. However, a number of recovery actions generally apply to improving ecosystem health in the subregion, including fire management, research and feral animal control.

## Subregion priority for off reserve conservation

The off-reserve conservation priority is (ii – iii) (see Appendix C, rank 6) indicating that there are a range of off-park measures required, limited resources, and there is capacity for community involvement to achieve this. There are no major conflicting land uses as much of GD1 is Unoccupied Crown Land, Aboriginal Reserve or Conservation Reserve. Mineral exploration and possible mine establishment are considered the main conflicting land use. Grazing leases (30%) of subregion are not currently in operation.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Industry Codes of Practice:** Pertaining to mining and exploration.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands

**Threat Abatement Planning:** Vegetation and threatened species management plans, pest management, and fire management plans.

**Capacity Building:** Particularly developing relationships with Aboriginal communities.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and the operations of the Pastoral Land Board although this only impacts on a small portion of GVD1 (western margin). CTR could be limited through mining leases and tenements although not currently a major factor. There is a need to increase awareness of conservation values through education of various industries (particularly mining) and the public in general. Limited financial resources are also a major constraint. Developing association with Aboriginal communities is essential.

Subregions where specific NRM actions are a priority to pursue

GD1 has an NRM rank of (iv) (see Appendix C, rank 7), indicating that NRM instruments are in place with some achieved biodiversity outcomes.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** There has been no complete and systematic bioregional survey of flora or fauna.

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse. Burrows, Christensen, Ward and Liddelow's (unpublished CALM data) work in the Young Ranges looked at fauna across the landscape 1988 – 1991 (ranges to sand dunes). They also developed a long term (10 years) study site at Eagle bore in the Gibson Desert Nature Reserve researching and monitoring fire ecology, fauna and feral predator control in the arid zone. CWR mammal re-introductions (8 monitoring sites, 50 pit traps at each site) have been trialed. Other fauna surveys conducted have been one off samplings or opportunistic collections.

**Floristic Data:** Vegetation mapping by Beard has been produced at the 1:1000000 scale. Burrows, Christensen, Ward and Liddelow's work at Eagle bore in the Gibson Desert Nature Reserve is restricted to 12 sites (50m x 50m) studying fire and vegetation regeneration post fire. Other sampling has been opportunistic and generally confined to access routes.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CRW mammals, and uncommon vertebrate and plant species.

#### **Other Priority Data Gaps Include:**

- No quantitative data present on the effect of exotic predators/herbivores, weed invasion, fire, mineral extraction or other threatening processes

### Sources

#### Other relevant publications

See reference numbers 053, 054, 063, 075, 081, 090, 091, 098, 099, 101, 104, 105, 115, 116, 118, 119, 131, 140, 141, 170, 181, 211, 231, 232, 241, 258, 268, 272, 278, 298, 313, 321, 370, 420, 459, 483, 484, 486, 490, 497, 519, 526, 545, 546, 548, 584, 607, 627, 628, 638, 685, and 686 in Appendix A.

# Gibson Desert 2 (*GD2 Dune Field subregion*)

DARREN GRAHAM, BRAD BARTON AND MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Red dune fields mantling Permian strata of Gunbarrel Basin. Lateritised upland on flat-lying Jurassic and Cretaceous sandstones of Canning Basin. Mulga parkland over *Triodia basedowii* on lateritic "buckshot" plains.

Mixed shrub steppe of *Acacia*, *Hakea* and *Grevillea* over *Triodia pungens* on red sand plains and dune fields. Lateritic uplands support shrub steppe in the north and mulga scrub in the south. Quaternary alluvia associated with palaeo-drainage features support Coolibah woodlands over bunch grasses. The climate is arid, with mainly summer rainfall, 200mm annually. Subregional area is 3, 198, 464ha.

### Dominant land use

(see Appendix B, key b)

Description	Percentage of Subregion
Aboriginal Reserve	32.21%
Grazing - Leasehold	42.32%
Unallocated Crown Land and Crown Reserves	25.47%

### Continental Stress Class

The Continental Stress Class for GD2 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Declared Rare and Priority Flora:

Includes: *Goodenia lyrata* and *Melaleuca nanophylla*

#### Rare and Specially Protected Fauna:

Include: Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Princess Parrot (*Polytelis alexandrae*), Night Parrot (*Pezoporus occidentalis*), Bilby (*Macrotis lagotis*), Mulgara (*Dasyercus cristicauda*), Black-footed Rock-wallaby (*Petrogale lateralis*), and Woma (*Aspidites ramsayi*).

#### High Species and Ecosystem Diversity:

The Central Australian Deserts (of which the Gibson Desert is a part) are known to exhibit particularly high reptile species richness.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974, the Conservation Through Reserves Committee (CTRC) made no recommendations for reserves within the GD2 subregion. Most of the GD 2 subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the region's biota, addresses land and wildlife conservation

### Other ecosystems at risk

issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually.

### Wetlands

#### Wetlands of national significance (DIWA listings)

There are no wetlands of National Significance in GD2.

#### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of subregional significance identified in GD2.

#### Riparian zone vegetation

There is no true riparian vegetation in GD2.

### Ecosystems at risk

#### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GD2.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Gorge communities - desert ranges (D. Pearson pers. comm.)	V	43	ii-iii	iii	ii	iv, v (camels), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	ii	iii	i-ii	v (foxes, cats)
<i>Dasyercus cristicauda</i>	V	ii	iii	ii	v (foxes, cats), vii
<i>Petrogale lateralis</i>	V	i	ii	iii	v (foxes, cats), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Pezoporus occidentalis</i>	CR	i	i	ii	v (foxes, cats)
<i>Polytelis alexandrae</i>	V	ii	vi	ii	vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Cacatua leadbeateri</i>	SP	ii	iii-iv	ii	ii, vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	SP	i	iii	ii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Goodenia lyrata</i>	1	unknown	vi	ii	iv, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation Priorities of Ecosystems

Beard Veg Type	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )				L
19	Low woodland; mulga between sandridges				L
39	Shrublands; mulga scrub				L
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges				L
125	Bare areas; salt lakes				L
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				H
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite				L
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex				L
217	Hummock grasslands, steppe woodland; desert oak ( <i>Allocasuarina decasneana</i> & soft spinifex (soft spinifex)				M
219	Hummock grasslands, grass steppe; soft & hard spinifex & <i>T. basedowii</i>				M

Beard Veg Type	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
230	Mosaic: Medium sparse woodland; desert oak between sand dunes/Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				M
676	Succulent steppe; samphire				L
1217	Hummock grasslands, steppe woodland; desert oak & soft spinifex between sandhills				L
2041	Succulent steppe with scrub; teatree over saltflats				M
	Gorge communities - desert ranges (D. Pearson pers. comm.)				M

### Subregional constraints in order of priority

(see Appendix B, key g)

**Economic:** In terms of resources to secure and adequately manage reserves

**Competing Landuses:** Mining interests have significant influence on Conservation Through Reserves establishment. Grazing leases are not currently stocked or operational.

### Bioregional and subregional priority for reserve consolidation

Overall 12% of Gibson Desert bioregion is reserved in IUCN I-IV reserves and is classified as IBRA reservation

### Off reserve conservation

#### Priority species or groups and existing recovery plans

Species	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
<i>Cacatua leadbeateri</i>	vii	No	Action Plan for Australian Birds
<i>Polytelis alexandrae</i>	v (foxes, cats), vii	No	Action Plan for Australian Birds
<i>Pezoporus occidentalis</i>	v (foxes, cats), vii	Yes - IRP	Action Plan for Australian Birds
<i>Macrotis lagotis</i>	v (foxes, cats), iv (rabbits), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Dasyercus cristicauda</i>	v (foxes, cats), iv (feral herbivores), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Petrogale lateralis</i>	v (foxes, cats)	No	Action Plan for Australian Marsupials and Monotremes
<i>Aspidites ramsayi</i>	v (foxes, cats), vii	No	Action Plan for Australian Reptiles

<sup>1</sup>Appendix B, key e

### Existing recovery plans

*Dasyercus cristicauda* is a species monitored by the National Threatened Species Recovery team. No existing State based recovery plans apply to individual species. Most species are included in National Action Plans including The Action Plan for Australian Birds (2000),

class 4 (see Appendix D, and Appendix C, rank 4). The subregions have the following representation. GD1 has 14.7% and GD2 has 0% reserved in IUCN I-IV reserves. Subregional bias exists with 0% of GD2 reserved. Classification of GD2 = Class 3 as the reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation (no IUCN reserves in GD2). Higher rating is not considered appropriate, as threatening processes (fire and ferals) are not significant.

### Reserve management standard

(see Appendix C, rank 5)

There are no reserves in GD2.

The Action Plan for Australian Reptiles (1993), and Action Plan for Australian Marsupials and Monotremes (1996).

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
<i>Cacatua leadbeateri</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands, fire management.	Insufficient resources to implement management activities.
<i>Polytelis alexandrae</i>	i, ii, iii, ix	Habitat retention through reserves or on other State lands or on private lands, fire management	Insufficient resources to implement management activities.
<i>Pezoporus occidentalis</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control, fire management.	Insufficient resources to implement management activities.
<i>Macrotis lagotis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control, fire management. Translocation from secure populations	Insufficient resources to implement management activities.
<i>Dasycercus cristicauda</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control, fire management	Insufficient resources to implement management activities.
<i>Petrogale lateralis</i>	i, ii, iii, vii, x, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control essential. Translocation from secure populations	Insufficient resources to implement management activities.
<i>Aspidites ramsayi</i>	i, ii, iii, vii, ix	Habitat retention through reserves or on other State lands or on private lands, feral predator control.	Insufficient resources to implement management activities.

<sup>1</sup>Appendix B, rank h.

## Ecosystems and appropriate recovery actions

Beard Veg Assoc	Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	ix, xii, vii, i, iii	Fire management, research, feral animal control, habitat retention on reserves and protection on other state lands.	Insufficient resources to implement management activities.

<sup>1</sup>Appendix B, rank h.

## Subregion priority for off reserve conservation

The subregional rank for off reserve conservation is (ii – iii) (see Appendix C, rank 6), indicating that there is a range of off park measures required, limited resources, there is capacity for community involvement. There are no major conflicting land uses as much of GD2 is UCL and Aboriginal Reserve. Mineral exploration and possible mine establishment are considered the main conflicting land use. Grazing leases within the subregion are not in operation.

## Conservation actions as an integral part of NRM

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and the operations of the Pastoral Land Board, although this only impacts a small portion of GVD2, CTR could be limited through mining leases and tenements; although not currently a major factor.

## Existing NRM actions

**Industry Codes of Practice:** Pertaining to mining and exploration.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands

**Threat Abatement Planning:** Vegetation and threatened species management plans, pest management, and fire management plans.

**Capacity Building:** Particularly developing relationships with Aboriginal communities.

Need to increase awareness of conservation values through education of various industries (mining) and the public in general. Limited financial resources are also a major constraint. Developing association with Aboriginal communities is essential.

Subregions where specific NRM actions are a priority to pursue

GD2 has an NRM priority of rank of (ii) (see Appendix C, rank 7), which indicates that there are significant constraints to implement NRM, primarily due to the subregions isolation and resource requirements to implement NRM.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** There has been no bioregional survey of flora or fauna.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 053, 054, 063, 075, 081, 090, 091, 098, 099, 101, 104, 105, 115, 116, 118, 119, 131,

**Systematic Fauna Survey:** No survey work has been completed. Survey work has been confined to individual species and opportunistic collection, data is confined to vertebrates and is sparse.

**Floristic Data:** Floristic survey is also restricted to opportunistic collections, mostly confined to access routes.

**Ecological and Life History:** There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CRW mammals, and uncommon vertebrate and plant species.

### Other Priority Data Gaps Include:

- No quantitative data present on the affect of exotic predators/herbivores, weed invasion, fire, mineral extraction or other threatening processes.

140, 141, 170, 211, 232, 241, 258, 268, 272, 278, 313, 321, 370, 420, 459, 486, 490, 497, 519, 526, 545, 546, 548, 584, 607, 627, 628, 638, 685, and 686 in Appendix A.

# Great Sandy Desert 1 (*GSD1 – McLarty subregion*)

GORDON GRAHAM  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

This is mainly tree steppe grading to shrub steppe in south; comprising open hummock grassland of *Triodia pungens* and *Triodia schinzii* with scattered trees of *Owenia reticulata* and Bloodwoods, and shrubs of *Acacia* spp, *Grevillea wickhamii* and *G. refracta*, on Quaternary red longitudinal sand dune fields overlying Jurassic and Cretaceous sandstones of the Canning and Armadus Basins. *Casuarina decasneana* (Desert Oak) occurs in the far east of the region. Gently undulating lateritised uplands support shrub steppe such as *Acacia pachycarpa* shrublands over *Triodia pungens* hummock grass. Calcrete and evaporite surfaces are associated with occluded palaeo-drainage systems that traverse the desert; these include extensive salt lake chains with samphire low shrublands, and *Melaleuca glomerata* - *M. lasiandra* shrublands. It includes the Mandora Paleoriver System. Red-brown dunefields with finer texture than further south. Includes gravely surfaces of Anketell Ridge along its northern margin.

The subregion is arid tropical with summer rain and is influenced by monsoonal activity. Morning fogs are recorded during the dry season. Subregional area is 13, 173, 266 ha.

### Dominant land use

The only land use in GSD1 is (xi) UCL and Crown reserves (see Appendix B, key b)

### Continental Stress Class

The Continental Stress Class on GSD1 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Special Features:

- The very complex and diverse wetland system associated with the Mandora Marsh area.
- Most inland distribution of mangroves (*Avicennia marina*) in Australia. This species has been recorded 60 kms inland along the Mandora Marsh area and is separated from the coast.
- Salt Creek within the Mandora Marsh area is quite unique particularly with respect to its relationship with other wetlands within the area. This relationship is not understood.

## Wetlands

### Wetlands of National significance (DIWA listings)

- The mound springs within the Mandora Marsh area and in particular springs such as Eil Eil with its distinctive tall *Melaleuca leucadendra* closed forest.
- Dragon Tree Soak with its particular vegetation association.
- The series of interdunal ephemeral wetlands which are dominated by Coolibah (*Eucalyptus victrix*).

#### Refugia:

Several permanent soaks (e.g. Dragon Tree Soak) are of particular importance in the desert environment. Likewise the vast array of less permanent soaks and wetlands perform significant refuge functions. Mound springs such as Eil Eil, supporting tall *Melaleuca leucadendra* forest, are identified as being important bird nesting sites.

#### High Species and Ecosystem Diversity:

All freshwater mound spring and soak systems clearly exhibiting an array of vegetation assemblages and are gradually being studied to determine the level of faunal complexity.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The Conservation Through Reserves Committee report in 1974 System 7 (Environmental Protection Authority 1974) formed the basis of the Department's publication Nature Conservation Reserves in the Kimberley (Burbidge *et al.* 1991), which has itself been incorporated in a Departmental Draft Regional Management Plan (Portlock *et al.* 2001). These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. An overall biological survey of the Great Sandy Desert was undertaken in the early 1980's. A land management assessment is also in preparation for publication that covers the Mandora Marsh area.

Apart from specific survey work there has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial and annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Dragon Tree Soak WA040	B17	ii	iii	ii	v (camels are causing significant damage to the spring), vii (the potential for too frequent burning of the soak).
Mandora Salt Marsh WA042	B11	Currently iii (good), but some components are being degraded	vi	ii	iv, v (cattle and camels)
Rock Pools of the Breaden Hills WA043	B17	Unknown	Unknown	Unknown	Unknown threatening processes.

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

No wetlands of subregional significance have been identified in GSD1.

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Organic mound spring community of Dragon Tree Soak, Great Sandy Desert.	E	43	ii	iii	iii	v (camels are causing significant damage to the spring), vii (the potential for too frequent burning of the soak)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the southern Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Widespread vegetation types and widespread threats such as changed fire regimes.	V	11	Unknown	vi	ii	Unknown threatening process
Organic mound spring communities of Anna Plains Station ('Mandora Marsh' area), Dampierland/Great Sandy Desert.	P1	43	Unknown	iii	iii	iv
Inland Mangrove ( <i>Avicennia marina</i> ) community of Salt Creek, Anna Plains Station.		40	Unknown	iii	iii	iv (cattle), xii (trampling of vegetation)
Microbiolite community of Salt Creek, Anna Plains Station.		43	Unknown	iii	iii	xii (trampling of vegetation)
Microbiolite community of McDonaldson Spring, Great Sandy Desert.		43	Unknown	vi	ii	Unknown threatening process

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	Unknown	vi	ii	vii, v (feral predators)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Phaps histrionica</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
PRIORITY 2					
<i>Olax sparteae</i>	2	Unknown	vi	Unknown	No known threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Great Sandy Desert vegetation associations are not reserved within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
39	Shrublands; mulga scrub.	20,188
41	Shrublands; teatree ( <i>Melaleuca spp.</i> ) scrub.	92,819
78	Hummock grasslands, low tree steppe; eucalypts over soft spinifex ( <i>Triodia pungens</i> ).	338,740
80	Hummock grasslands, low tree steppe; desert walnut ( <i>Owenia reticulata</i> ) over soft spinifex ( <i>Triodia pungens</i> ) between sandridges.	172,057
81	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	28,307
91	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	183
93	Hummock grasslands, shrub steppe; Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	46,395
100	Hummock grasslands, shrub steppe; <i>Acacia delibrata</i> over soft spinifex ( <i>Triodia pungens</i> ).	2,274
101	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex ( <i>Triodia pungens</i> ).	701,564
102	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over lobed spinifex ( <i>Triodia basedowii</i> ).	78,640
104	Hummock grasslands, shrub steppe; silverleaf grevillea ( <i>Grevillea refracta</i> ) and <i>Hakea spp.</i> over soft spinifex ( <i>Triodia pungens</i> ).	5,686
106	Hummock grasslands, shrub steppe; <i>Hakea spp.</i> over soft spinifex ( <i>Triodia pungens</i> ).	451,606
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills.	3,068
137	Hummock grasslands, low tree steppe; desert walnut ( <i>Owenia reticulata</i> ) over soft spinifex ( <i>Triodia pungens</i> ) / <i>Plectrachne spp.</i> on sandplain.	217,620
138	Mosaic: Hummock grasslands, low tree steppe; eucalypts over feathertop spinifex ( <i>Plectrachne schinzii</i> ) between dunes / Hummock grasslands, patchy shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex ( <i>Triodia pungens</i> ) on lateritic rises.	1,084,977
151	Sedgeland; sedges with open low trees; coolibah over various sedges.	2,835
152	Hummock grasslands, grass steppe; soft ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	377
155	Hummock grasslands, low tree steppe; eucalypts over soft ( <i>Triodia pungens</i> ) and feathertop spinifex ( <i>Plectrachne schinzii</i> ) between sandhills.	6,316,789
157	Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ), <i>Triodia wiseana</i> .	34,232
173	Hummock grasslands, shrub steppe; Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and <i>Triodia wiseana</i> on basalt.	1
Beard Veg Assoc	Description	Area (Ha.)
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex ( <i>Triodia pungens</i> ).	1,103,747
178	Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ), lobed spinifex ( <i>Triodia basedowii</i> ).	4,882
217	Hummock grasslands, steppe woodland; desert oak ( <i>Allocasuarina decaisneana</i> ) and soft spinifex ( <i>Triodia pungens</i> ).	13,041
218	Hummock grasslands, shrub steppe; corkwood ( <i>Hakea suberea</i> ) and <i>Acacia spp.</i> over soft spinifex ( <i>Triodia pungens</i> ).	18,291
219	Hummock grasslands, grass steppe; soft ( <i>Triodia pungens</i> ), winged spinifex ( <i>Triodia intermedia</i> ) and lobed spinifex ( <i>Triodia basedowii</i> ).	39,744
676	Succulent steppe; samphire.	4,292
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus spp.</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) on sandplain.	286,746
701	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> and <i>Grevillea spp.</i> over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ) on sandy plateau.	1
703	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	1,546
712	Mosaic: Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus spp.</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly spinifex ( <i>Triodia bitextura</i> ) / Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), baobab ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over ribbon grass ( <i>Chrysopogon spp.</i> ).	289
849	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	23,225
922	Hummock grasslands, low tree steppe; eucalypts over soft ( <i>Triodia pungens</i> ) and feathertop spinifex ( <i>Plectrachne schinzii</i> ) between sandhills	8
923	Hummock grasslands, grass steppe; spinifex <i>Triodia inutills</i> .	24,281
1121	Mixed short grass and spinifex with scattered coolibah.	3,595
1271	Bare areas; claypans.	29,361
2041	Succulent steppe with scrub; teatree ( <i>Melaleuca spp.</i> ) over saltflats.	30,908

2175	Grass savannah on clay plains (Tanami).	10,770
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Poorly represented ecosystems subject to threat:

Organic mound spring communities of Anna Plains Station ('Mandora Marsh' area), Dampierland/Great Sandy Desert.
Inland Mangrove ( <i>Avicennia marina</i> ) community of Salt Creek, Anna Plains Station.
Microbiolite community of Salt Creek, Anna Plains Station.
Microbiolite community of McDonaldson Spring, Great Sandy Desert.
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the southern Kimberley region.

Note: the lack of study in some areas precludes statements about the level of reservation required.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

## Bioregional and subregional priority for reserve consolidation

The Great Sandy Desert bioregion has a ranking priority under the preliminary bioregional NRS priorities of 2 (see Appendix D, and Appendix C, rank 4). There is a

lack of adequate data on the condition of the McLarty subregion to compare this to the Mackay subregion in terms of prioritising between the two however the Dragon Tree Soak Nature Reserve is found within the McLarty subregion.

## Reserve management standard

The bioregion is ranked at poor (i) (see Appendix C, rank 5). No feral animal control programmes in place and no prescribed burning is undertaken. The extent of other threatening processes (for example weeds) is yet to be determined. Due to uncontrolled stock access, changes are occurring within parks.

Estate	Reserve Management Rank <sup>1</sup>	Issues
Nature Reserves		
Dragon Tree Soak	i	Full extent of threatening processes (fire, weeds, feral animals) need to be documented. Camel impact occurring threatening the know feature of the soak.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the McLarty subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and vegetation composition and structure is of concern.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

**Weed Control:** Need to define weeds priorities. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity. Minimise loss of the mineral A horizon and protection of organic layers.

**Feral Animal Control:** Removal of feral stock from conservation estate, specifically camels.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important may well be predation of fauna by cats and occasionally foxes. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, Traditional owners and the broader community.

### Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes.  
Draft Kimberley Region Management Plan (various strategies).

### Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Further fire research is required.

### Subregion priority for off reserve conservation

For much of the subregion the off park conservation priority is (ii) (see Appendix C, rank 6), indicating that a large off park effort is needed, resource constraints and limited community capacity. However for some focused areas (Mandora Marsh) the off park priority is (iv),

indicating that limited off park measures will result in significant conservation gains.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Capacity Building:** La Grange groundwater management committee established. This may prove to be an important capacity building resource.

### Feasible opportunities for NRM

**Threat Abatement Planning:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

Subregions where specific NRM actions are a priority to pursue  
(see Appendix C, rank 7)

Given the current possibility of a large irrigated agriculture industry being proposed (La Grange) there is an immediate need to gain a better understanding of possible impacts on groundwater resources along with impact on the existing wetlands that may be linked to the system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale. As an initial step a review of the Beard vegetation mapping database is warranted.

**Systematic Fauna Survey:** No systematic quadrat based fauna and flora sampling programme across the subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. An efficient methodology to undertake mapping needs to be designed.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

### Other Priority Data Gaps:

- Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys, camels and pigs), fire and weeds.
- Specifically for this environment research to gain an improved understanding of the vast array of wetlands within the subregion is warranted.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
272	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority.	Environmental Protection Authority, Perth	R
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R
556	Portlock, C., Graham, G., Done, C., Gilmour, J. and Williamson, J.	(2001).	Kimberley Region Draft Regional Management Plan. (Unpubl)	Department of Conservation and Land Management.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 094, 100, 118, 120, 132, 173, 258, 268, 272, 298, 317, 437, 483, 551, 556, 626, 634, 635, 636, 637, 648, 674, 692 and 693 in Appendix A.

# Great Sandy Desert 2 (*GSD2 – Mackay subregion*)

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*Information from Western Australia and the Northern Territory has been listed separately in this synopsis as a result of the different vegetation mapping protocols that have been used in the two jurisdictions and the associated difficulties in combining that information.*

## Subregional description and biodiversity values

### Description and area

#### *Western Australia:*

Tropical inland 'red-centre' desert. Includes 'Percival' and 'Auld' palaeoriver systems. Mainly tree steppe grading to shrub steppe in south; comprising open hummock grassland of *Triodia pungens* and *Triodia schinzii* with scattered trees of *Owenia reticulata* and bloodwood (*Corymbia* spp.), and shrubs of *Acacia* spp., *Grevillea wickhamii* and *G. refracta*, on Quaternary red longitudinal sand dune fields overlying Jurassic and Cretaceous sandstones of the Canning and Amadeus Basins. *Casuarina decaisneana* (Desert Oak) occurs in the south and east of the region. Gently undulating lateritised uplands support shrub steppe such as *Acacia pachycarpa* shrublands over *Triodia pungens* hummock grass. Calcrete and evaporite surfaces are associated with occluded palaeo-drainage systems that traverse the desert; these include extensive salt lake chains with samphire low shrublands, and *Melaleuca glomerata* - *M. lasiandra* shrublands. Monsoonal influences are apparent in the north-western sector of this region. The climate is arid tropical with summer rainfall. Subregional area is 18,636,695 ha.

#### *Northern Territory:*

The Mackay subregion forms a large area south of the Tanami Desert and west of the MacDonnell Ranges. The major geological units are the Arunta Inlier and the Amadeus and Ngalia Basins. It is made up of a complex of sedimentary and metamorphic rocks of various ages. Soils are predominantly shallow sands. The climate is arid with annual average rainfall varying between 300 to 400 mm, and there are temperature extremes between summer and winter. Elevation varies between 350 and 800 m. Vegetation is dominated by hummock grassland (*Triodia basedowii* and *T. pungens*) with areas of tall-shrubland (*Acacia* spp.) or low open woodland (*Allocasuarina decaisneana*). There is little drainage in the subregion, although a large playa lake, Lake Mackay, occurs on the Western Australia border.

### Dominant land use

#### *Western Australia:*

Unallocated Crown land (xi) (see Appendix B, key b), Conservation (xiii), Aboriginal lands and Reserves (x), Mining leases (vii), and small areas of Urban (i).

#### *Northern Territory:*

No information supplied.

### Continental Stress Class

The Continental Stress Class for both the West Australian and Northern Territory components of GSD2 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

#### *Western Australia:*

**Rudall River Draining into Lake Dora:** The only example of an arid zone river, with near permanent wetlands along its course, flowing from uplands across the desert and into a major salt lake within the Great Sandy Desert. Note that only the lower half of the course of the Rudall River is within GSD2.

**Wetlands:** Small permanent wetlands associated with palaeo-drainage lines, now occupied by salt lakes. These small fresh-water springs and seepages are locally significant water sources, and have high biological and cultural significance. E.g. Percival Lakes, Lake Dora, Joanna Spring.

**Rockpools:** Small permanent rockhole wetlands associated with ranges and uplands. These are locally significant water sources, and are of high biological and cultural significance.

**Small Artificial Surface Water Sources Constructed Along the Canning Stock Route:** Many in disrepair, but there is an active program of refurbishment underway, and many are open again. Sometimes locally significant sources of water.

#### **Centres of Endemism:**

Possibility of high endemism within troglobitic faunas associated with calcrete systems along palaeo-drainage lines. So far not investigated, but likelihood of unique faunas very high.

#### **Refugia:**

The only refugia listed by Morton *et al.* (1995) within GSD2 is the Rudall River. They note that it may provide a seasonal refuge to wildlife.

#### **High Species or Ecosystem Diversity:**

High numbers of arid zone reptiles, particularly skink lizards (genera *Ctenotus* and *Lerista*).

*Northern Territory:***Refugia:**

Uluru and Kata Tjuta provide moist habitats for rare, relict, and unusual species. George Gill Ranges provide moist gorges and habitat for rare and relict species (Morton *et al.* 1995). DIWA-listed Lake Amadeus important ecological refuge providing complex mixture of habitats with dependable supplies of moisture.

**Wetlands:**

Lake Amadeus and Lake MacDonald.

**Existing Subregional or Bioregional Plans and/or Systematic Reviews of Biodiversity and Threats***Western Australia:*

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the

Pilbara (System 8), in the 'Red Book' reports of 1976 – 1984 (Environmental Protection Authority 1993). Reserve recommendations GSD2 included the Anketell Ridge Nature Reserve (part), Rudall River National Park (part), Percival Lakes Nature Reserve, Lake Auld Nature Reserve and Southesk Tablelands National Park. In 1993, the 'Red Book Status Report' reviewed the implementation of these recommendations (Environmental Protection Authority 1993). Most recommendations had not progressed beyond initial survey and definition of proposed boundaries. Only the Rudall River National Park has proceeded to reservation. No other subregional or bioregional planning for biodiversity conservation has been attempted.

*Northern Territory:*

There are no plans for the subregion, other than a Management Plan for single reserve (Uluru).

## Wetlands

### Wetlands of National significance (DIWA listings)

*Western Australia:*

Name & Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Lake Dora – Rudall River, GSD004WA	ii-iii	iii-iv	ii	v, (camel), vi (buffel grass)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

*Northern Territory:*

Name & Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Lake Amadeus – NT005	iii	vi	Unknown	v (Camels on salt lake margins; rabbits), vi (buffel grass, couch). Note: Lake occurs mostly in GSD4 subregion.

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

*Western Australia:*

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Minor spring wetlands of Percival Lakes	Several, along lake chain	B17	ii (only fresh water sources for large distances).	ii	ii-iii	ii	v (camel)
Minor spring wetlands of other lake systems	Not known in detail	B17	ii (only fresh water sources for large distances)	ii	ii-iii	ii	v (camel)
Soaks excavated by Aboriginal people, now no longer maintained	Many and scattered.	B17	ii (only fresh water sources for large distances)	ii	ii		v (camel), xii (lack of maintenance resulting in burial of water).

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Salt lakes throughout region	Various	B8	iii (saltlake fauna including small crustaceans, supporting wading birds in season).	iv	iv	ii	Unknown threatening processes
Underground waters, associated with calcrete deposits along palaeo-drainage lines	Various	N/A	Possibly stygofauna – some stygofauna known from vicinity of CSR.	iv	vi	ii	Unknown threatening processes

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

*Northern Territory:*

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake MacDonald	Not stated	B8	iii (important aggregation site for poorly known wetland birds).	iii	vi	Unknown	Not stated
Lake MacKay and adjacent swamps and pans	Not stated	B8	iii (Australia's fourth largest lake. Supports significant populations of water birds).	iii	vi	Unknown	Not stated

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

*Western Australia:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Rudall River	ii	iii	ii	v (camel), vi (buffel grass)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

*Northern Territory:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral creek lines	iii	iii	Unknown	vii, vi, v

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

*Western Australia:*

There are no Threatened Ecological Communities (TECs) in GSD2.

*Northern Territory:*

No information supplied.

## Other ecosystems at risk

Western Australia:

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Semi-permanent pools along course of Rudall River.	V	18	ii-iii	iii	ii	v, vi
Small spring wetlands, Percival Lakes	V	38	ii	iii	ii	v
Any other permanent or semi-permanent wetlands within the sub-bioregion	V	38	ii	iii	ii	v

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Northern Territory:

No information supplied.

## Species at risk

## Fauna

Western Australia:

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasymercus cristicauda</i>	V	Unknown	vi	ii	v (fox and cat), vii
<i>Dasymercus hillieri</i>	E	Unknown	vi	ii	v (fox and cat), vii
<i>Notoryctes caurinus</i>	E	Unknown	vi	ii	v (fox and cat), vii
<i>Macrotis lagotis</i>	V	Unknown	vi	ii	v (fox and cat), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Pezoporus occidentalis</i>	E	Unknown	vi	ii	v (fox and cat), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 REPTILES)</b>					
<i>Egernia kintorei</i>	V	Unknown	vi	ii	v (fox and cat), vii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	SP	Unknown	vi	ii	v (fox and cat), vii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Ardeotis australis</i>	P4	Unknown	vi	ii	v (fox and cat), vii
<i>Polytelis alexandrae</i>	P4	Unknown	vi	ii	v (fox and cat), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

Northern Territory:

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Dasymercus cristicauda</i>	V	ii	iii	Not stated	v (cats), iv (degradation of preferred habitat through grazing by camels), vii (loss of preferred habitat through recent change in scale and timing of fire)
<i>Lagorchestes hirsutus</i>	EX	i	i	Not stated	v, vii
<i>Notoryctes typhlops</i>	V	ii	iii	Not stated	v (cats and foxes), vii (possible impacts of increased incidence of extensive hot fire rather than fine-scale cooler burns)
<i>Petrogale lateralis</i> MacDonnell Ranges race	V	ii	iii	Not stated	vii (increased incidence of extensive hot fire), vi (broad-scale invasion of weeds), v (foxes and cats), iv (livestock, donkeys and camels).
<i>Sminthopsis psammophila</i>	E	ii	iii	Not stated	Little information but possibly v (cats and foxes) and vii (reduction in habitat quality because of increased incidence of extensive hot fire)

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Trichosurus vulpecula</i>	E	ii	ii	Not stated	iv (camels and donkeys), v (foxes and cats), vi (broad-scale weed invasion), vii (increased incidence of hot extensive fires)
<i>Pezoporus occidentalis</i>	E	i	vi	Not stated	iv (stock, rabbits and camels), vii (degradation of habitat), v (foxes and cats)
<i>Polytelis alexandrae</i>	V	iii	iii	Not stated	vii (increased incidence of extensive hot fires, possibly at expense of fine-scale cooler fires), v (rabbits, camels and donkeys), iv ((possibly) reduction in habitat quality through vegetation change associated with pastoralism)
<i>Stictonetta naevosa</i>	V	iii	iv	Not stated	x (national scale alteration of wetland habitat suitability for this nomadic species)
<i>Egernia kintorei</i>	V	ii	iii	Not stated	vii (alteration of scale, timing and frequency of fire), iv (livestock, donkeys and camels), v (foxes and cats)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Western Australia:

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 2</b>					
<i>Acacia auripila</i>	2	Unknown	vi	ii	Unknown threatening processes
<i>Goodenia hartiana</i> ms	2	Unknown	vi	ii	Unknown threatening processes
<i>Ptilotus mollis</i>	2	Unknown	vi	ii	Unknown threatening processes
<i>Thysanotus solitaster</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

Northern Territory:

No information supplied.

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Western Australia:

Beard Veg Assoc	Ecosystem Description	IUCN I-IV (hectares)	Non-IUCN Reserve	CALM Purchased Lease	Priority
39	Shrublands; mulga scrub				H
41	Shrublands; teatree scrub	12,550.8			M
99	Hummock grasslands, shrub steppe; <i>Acacia coriacea</i> & hakea over hard spinifex <i>Triodia basedowii</i>	2.2			H
100	Hummock grasslands, shrub steppe; <i>Acacia delibrata</i> over soft spinifex				M
101	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex				M
102	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over <i>Triodia basedowii</i>				M
106	Hummock grasslands, shrub steppe; hakea over soft spinifex soft spinifex				M
117	Hummock grasslands, grass steppe; soft spinifex	410.4			M
125	Bare areas; salt lakes	51,710.9			L

Beard Veg Assoc	Ecosystem Description	IUCN I-IV (hectares)	Non-IUCN Reserve	CALM Purchased Lease	Priority
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhill/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	734,969.2			L
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				M
137	Hummock grasslands, low tree steppe; desert walnut over (soft) spinifex/plectrachne on sandplain				M
138	Mosaic: Hummock grasslands, low tree steppe; eucalypts over feathertop between dunes/Hummock grasslands, patchy shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex on lateritic rises				M
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite				H
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex				M
155	Hummock grasslands, low tree steppe; eucalypts over soft and feathertop spinifex between sandhills				M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>				M
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt				M
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex				M
175	Short bunch grassland - savanna/grass plain				H
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				M
217	Hummock grasslands, steppe woodland; desert oak ( <i>Allocasuarina decaisneana</i> & soft spinifex (soft spinifex)				M
218	Hummock grasslands, shrub steppe; corkwood ( <i>Hakea suberea</i> ) & acacia species over soft spinifex soft spinifex				M
219	Hummock grasslands, grass steppe; soft & hard spinifex & <i>T. basedowii</i>				M
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>E. dichromophloia</i> ) & <i>E. setosa</i> over soft & curly spinifex on sandplain				M
2041	Succulent steppe with scrub; teatree over saltflats	31,145.6			H
2151	Low woodland; coolibah & paperbark ( <i>Melaleuca</i> sp.)	5,192.6			H
2175	Grass savanna on clay plains (Tanami)				H

## Northern Territory:

Veg Number	Ecosystem Description	IUCN I-IV (hectares)	Non-IUCN Reserve	Conservation Purchased Lease	Priority
82	<i>Triodia basedowii</i> hummock grassland with <i>A. aneura</i> (Mulga) tall sparse-shrubland overstorey between	yes			
90	<i>Triodia irritans</i> (Porcupine Grass) open-hummock grassland.	yes			
93	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>Allocasuarina decaisneana</i> (Desert Oak) open-woodland overstorey between dunes.	yes			
27	<i>E. microtheca</i> (Coolibah) low open-woodland with open-grassland understorey.	0	0	0	
30	<i>E. gongylocarpa</i> (Marble Gum) open-woodland with open-hummock grassland understorey. None	0	0	0	
43	Eucalyptus low open-woodland and/or Acacia sparse-shrubland with <i>Triodia spicata</i> (Spike Flower)	0	0	0	
52	<i>Melaleuca glomerata</i> (Inland Teatree) open-shrubland.	0	0	0	
58	<i>A. aneura</i> (Mulga)/mixed species low open-woodland with open-grassland understorey. None	0	0	0	
59	<i>A. estrophiolata</i> (Ironwood), <i>Atalaya hemiglauca</i> (Whitewood) low open-woodland with open-grassland understorey.	0	0	0	
65	<i>A. aneura</i> (Mulga) tall open-shrubland with <i>Eragrostis eriopoda</i> (Woollybutt) open grassland understorey.	0	0	0	

Veg Number	Ecosystem Description	IUCN I-IV (hectares)	Non-IUCN Reserve	Conservation Purchased Lease	Priority
66	<i>A. aneura</i> (Mulga) tall open-shrubland with Cassia, Eremophila (Fuchsia) open-shrubland understorey.	0	0	0	
67	<i>A. ammobia</i> tall open-shrubland with sparse-grassland understorey.	0	0	0	
68	<i>A. kempeana</i> (Witchetty Bush) Acacia tall open-shrubland with Cassia, Eremophila (Fuchsia) open-shrubland understorey.	0	0	0	
69	<i>A. aneura</i> (Mulga) tall sparse-shrubland with <i>Aristida contorta</i> (Bunched Kerosene Grass) or <i>Triodia</i> open-tussock/hummock grassland understorey.	0	0	0	
71	<i>A. aneura</i> (Mulga) tall sparse-shrubland with grassland understorey.	0	0	0	
72	<i>A. kempeana</i> (Witchetty Bush) sparse-shrubland to tall sparse-shrubland with grassland understorey.	0	0	0	
73	<i>A. tetragonophylla</i> (Dead Finish), <i>A. kempeana</i> (Witchetty Bush) sparse-shrubland with herb/grassland understorey.	0	0	0	
76	<i>Triodia pungens</i> (Soft Spinifex), <i>Plectrachne schinzii</i> (Curly Spinifex) hummock grassland with Acacia tall sparse-shrubland overstorey.	0	0	0	
78	<i>Triodia spicata</i> (Spike Flowered Spinifex) hummock grassland with <i>Grevillea wickhamii</i> (Holly Grevillea), Acacia sparse-shrubland overstorey.	0	0	0	
79	<i>Plectrachne melvillei</i> (Spinifex) hummock grassland with <i>A. aneura</i> (Mulga), <i>A. kempeana</i> (Witchetty Bush) tall open-shrubland overstorey.	0	0	0	
81	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with Acacia tall sparse-shrubland overstorey.	0	0	0	
83	<i>Triodia basedowii</i> (Hard Spinifex) or <i>Triodia pungens</i> (Soft Spinifex) hummock grassland with <i>E. gamophylla</i> (Blue Mallee), Acacia tall sparse-shrubland overstorey.	0	0	0	
84	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>E. gamophylla</i> (Blue Mallee) tall sparse-shrubland overstorey.	0	0	0	
86	<i>Triodia pungens</i> (Soft Spinifex) or <i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with Acacia tall sparse-shrubland overstorey between dunes	0	0	0	
87	<i>Triodia</i> (Spinifex) open-hummock grassland with <i>A. aneura</i> tall sparse-shrubland overstorey.	0	0	0	
89	<i>Triodia pungens</i> (Soft Spinifex) open-hummock grassland with scattered shrubs. None	0	0	0	
92	<i>Triodia clelandii</i> (Weeping Spinifex) hummock grassland with mixed species low open-woodland overstorey.	0	0	0	
94	<i>Triodia basedowii</i> (Hard Spinifex) hummock grassland with <i>Allocasuarina decasneana</i> (Desert Oak) low open-woodland or Acacia tall sparse-shrubland overstorey.	0	0	0	
111	Halosarcia (Samphire) low open-shrubland fringing bare salt pans.	0	0	0	
112	Bare salt pan.	0	0	0	

### Subregional constraints in order of priority

(see Appendix B, key g)

#### Western Australia:

**Competing Land Uses:** Mainly Aboriginal interests, concerning native title. Reserve acquisition can only proceed under a cooperative management model.

#### Northern Territory:

No information supplied.

### Bioregional and subregional priority for reserve consolidation

#### Western Australia:

GSD2 is reservation Class 2b (see Appendix D, and Appendix C, rank 4) with 4.6% of area in conservation reserve, and > 30% natural vegetation.

#### Northern Territory:

No information supplied.

## Reserve management standard

### Western Australia:

The Great Sandy Desert has one national park (part of Rudall River), and one large nature reserve (McLarty Hills). Neither area has permanent staff. Both are visited on an occasional basis, by Karratha or Broome based staff.

**Rudall River National Park:** Reserve Management Standard is (i) (see Appendix C, rank 5). Rudall River National Park has no management plan, and is rarely visited by staff despite having high tourist visitation, two

Aboriginal communities within the park (Parnngurr and Punmu, between 200-500 people), two mining communities relatively close to the park (Nifty and Telfer), and ongoing feral animal problems with camel and occasionally donkey. Formal fire management is absent, although Aboriginal people provide a regular burning regime along roads.

**McLarty Hills Nature Reserve:** Reserve Management Standard is (i-ii). Very remote, and rarely visited by anyone. No on-ground management to speak of, despite severe degradation of the Dragon-Tree Soak wetland by camel.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of fauna and flora & Recreation.	Rudall River National Park	National Park	i
A	Conservation of fauna and flora.	McLarty Hills Nature Reserve	Nature Reserve	i-ii

<sup>1</sup>Appendix C, rank 5

### Northern Territory:

No information supplied.

## Off reserve conservation

### Priority species or groups and existing recovery plans

#### Western Australia:

Species	Specific Recovery Plan	General Recovery Plan
<i>Dasymercus cristicauda</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Dasymercus hillieri</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes caurinus</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Macrotis lagotis</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Pezoporus occidentalis</i>	Yes - IRP	Action Plan for Australian Birds
<i>Egernia kintorei</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Reptiles
<i>Aspidites ramsayi</i>	No	Action Plan for Australian Reptiles
<i>Ardeotis australis</i>	No	Action Plan for Australian Birds
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Acacia auripila</i>	No	No
<i>Goodenia hartiana</i> ms	No	No
<i>Ptilotus mollis</i>	No	No
<i>Thysanotus solitaster</i>	No	No

### Northern Territory:

No information supplied.

## Appropriate species recovery actions

#### Western Australia:

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Dasymercus cristicauda</i>	xii	Research - Low level of knowledge.
<i>Dasymercus hillieri</i>	xii, xiv	Research - Low level of knowledge. Other - Less well known than <i>D. cristicauda</i> .
<i>Notoryctes caurinus</i>	xii, xiv	Research - Low level of knowledge.
<i>Macrotis lagotis</i>	xiv	Other - Definition of areas inhabited, and monitoring of some populations
<i>Pezoporus occidentalis</i>	xii, xiv	Research - Locate and protect any existing populations
<i>Egernia kintorei</i>	xii, xiv	Research - Low level of knowledge.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Aspidites ramsayi</i>	xii	Research - Appears secure
<i>Ardeotis australis</i>	none	Research - Appears secure
<i>Polytelis alexandrae</i>	xii, xiv	Research - Low level of knowledge.
<i>Acacia auripila</i>	xii, xiv	Research - Poor knowledge
<i>Goodenia hartiana</i> ms	xii, xiv	Research - Poor knowledge
<i>Ptilotus mollis</i>	xii, xiv	Research - Poor knowledge
<i>Thysanotus solitaster</i>	xii, xiv	Research - Poor knowledge

<sup>1</sup>Appendix B, key h.

*Northern Territory:*

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Dasyercus cristicauda</i>	xiii, vii, ix	Capacity building with stakeholders. Feral animal control. Fire management.
<i>Lagorchestes hirsutus</i>	xiv	Other - Re-introduction of extirpated populations.
<i>Notoryctes typhlops</i>	vii, ix	Feral animal control to reduce numbers of feral cats and foxes. Fire management to reduce the number of extensive hot fires.
<i>Petrogale lateralis</i> MacDonnell Ranges race	v, vii, ix,	Fencing for exclusion of stock from colony sites. Feral animal broad-scale control of foxes and cats. Fire management to reduce the incidence of extensive hot fires.
<i>Sminthopsis psammophila</i>	vii, ix	Feral animal control to reduce numbers of feral cats and foxes. Fire management to reduce the incidence of extensive hot fires, and possibly increase in incidence of fine-scale cooler fires.
<i>Trichosurus vulpecula</i>	v, vii, ix	Fencing is possibly useful in some areas to exclude stock, in order to protect habitat. Feral animal control of camels, donkeys, foxes and cats. Fire management to reduce the incidence of extensive hot fires.
<i>Pezoporos occidentalis</i>	xii	Research to establish occurrence, distribution, abundance and threats.
<i>Polytelis alexandrae</i>	vii, ix	Feral animal control to reduce numbers in rabbits, camels, etc. Fire management to reduce the incidence of extensive hot fires.
<i>Stictonetta naevosa</i>	xi	Reinstatement of hydrology on a national-scale, rather than specific actions in this subregion.
<i>Egernia kintorei</i>	xiii, vii, ix	Capacity building with stakeholders - fire management and feral animal control through IPAs. Feral animal broad-scale control of cats & foxes. Fire management to reduce the incidence of extensive hot fires.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

*Western Australia:*

Community	Specific Recovery Plan	General Recovery Plan
Semi-permanent pools along course of Rudall River.	No	No
Small spring wetlands, Percival Lakes	No	No
Any other permanent or semi-permanent wetlands within the sub-bioregion	No	No

*Northern Territory:*

No information supplied.

## Appropriate ecosystem recovery actions

*Western Australia:*

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Semi-permanent pools along course of Rudall River.	vii, vi	Feral animal control, especially of camels. Weed control.
Small spring wetlands, Percival Lakes	vii	Feral animal control, especially of camels.
Any other permanent or semi-permanent wetlands within the sub-bioregion	vii	Feral animal control, especially of camels.

<sup>1</sup>Appendix B, key h.

*Northern Territory:*

No information supplied.

## Subregion priority for off reserve conservation

*Western Australia:*

The subregional priority for off park conservation is (iii) (see Appendix C, rank 6), indicating that a range of off park measures are required.

*Northern Territory:*

No information supplied.

## Conservation actions as an integral part of NRM

## Existing NRM Actions

*Western Australia:*

Almost nothing, except some very limited threat abatement planning as part of NRM e.g. pest management.

*Northern Territory:*

**Other:** Newhaven station recently purchased by Birds Australia (area in GSD2 184, 183 ha); Monitoring programs established on all pastoral leaseholds.

**Threat Abatement Planning:** Some regional fire management, monitoring and control through regional offices of Bushfires Council.

**Legislation:** Fire management and tourist pressure managed in Uluru and Kata Tjuta National Park.

## Feasible Opportunities for NRM

*Western Australia:*

**Threat Abatement Planning as Part of NRM:** Further pest management.

**Capability Building:** With Aboriginal communities.

*Northern Territory:*

**Threat Abatement Planning:** There is scope for greater capacity for broad-scale management of fire, ferals and weeds.

## Impediments or Constraints to Opportunities

*Western Australia:*

Recognition of Native Title will require cooperative work with desert Aboriginal communities. In some cases, this will mean a big change in the way we do business with traditional owners. However, opportunities could be significant, due to the close proximity of large communities (Parnngurr, Punmu, Kunawarritji, Kiwikurra, Bililuna)

*Northern Territory:*

No information supplied.

## Subregions where specific NRM actions are a priority to pursue

*Western Australia:*

The NRM priority for GSD2 is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of a production or development system. This mainly applies to acquisition of reserves under Native Title, and lack of control of feral herbivores.

*Northern Territory:*

The NRM priority for GSD2 is (i), indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. There is a need to expand resources to, and capability of, Aboriginal landowners for conservation management.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

*Western Australia:*

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists. Quadrat-based floristic data is available from few or no localities.

**Systematic Fauna Survey:** Quantitative subregional survey of fauna has not been undertaken.

**Ecological and Life History Data:** There is little detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). Information is sparse on providing a regional context on population-trends for even ecologically significant species (e.g. native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass).

## Other Priority Data Gaps Include:

- No data on the fauna/flora of small permanent wetland associated with palaeo-drainage systems within the Great Sandy Desert.
- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No data on the impact of camel on desert environments, particularly on water sources, and upon the fauna which are dependant upon such water sources.

- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.

*Northern Territory:*

**Other Priority Data Gaps Include:**

Monitoring to assess trends and responses to landscape-wide disturbance.

## Source

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
764	Baker, L.M. and Johnson, K.A.	(undated).	Draft Recovery Plan for the Mulgara ( <i>Dasyercus cristicauda</i> )	Conservation Commission of the Northern Territory	O
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
778	Blyth, J.	(1996).	Night parrot ( <i>Pezoporus occidentalis</i> ) Interim Recovery Plan for Western Australia 1996 to 1998 (IRP No 4)	Department of Conservation and Land Management	O
181	Cogger, H., Cameron, E., Sadler, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Ergernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 026, 054, 094, 118, 120, 182, 210, 258, 266, 272, 281, 383, 387, 407, 419, 493, 625,

## Ecological and Life History Data

**Systematic Fauna Survey:** Survey information.

**Vegetation and Regional Ecosystem Mapping:** Survey information.

634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.

# Great Victoria Desert 1 (*GVD1 – Great Victoria Desert Shield subregion*)

BRAD BARTON AND MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

The western end of GVD1 is underlain by Yilgarn Craton. There is a higher proportion of sandplains in comparison to the entire bioregion. To the east is an arid active sand-ridge desert of deep Quaternary aeolian sands overlying Permian and Mesozoic strata of the Officer Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains with patches of seif dunes running east west. Areas of moderate relief with out-cropping and silcrete-capped mesas and plateaus (breakaways). The subregion contains major a paleo-channel of Ponton Creek.

Spinifex (*Triodia spp*) and mallee (*Eucalyptus kingsmillii*, *E. youngiana*) over hummock grassland dominated by *Triodia basedowii* occur on the aeolian sand plain. Scattered marble gum (*E. gongylocarpa*) and native pine (*Callitris*) occur on the deeper sands of the sand plains. Mulga and acacia woodlands occur mainly on the colluvial and residual soils. Halophytes such as salt bush (*Atriplex*), Bluebush (*Kochia*), and samphire (*Arthrocnemum*) occur, margins of salt lakes and in saline drainage areas. The climate is arid, with summer and winter rain approximately 190mm per annum. Subregional area is 5, 442, 741ha.

**Dominant land use**  
(see Appendix B, key b)

Category	Description	Percentage of Subregion
x	Aboriginal Reserve	12.33%
xiii	Conservation Reserves	7.05%
ix	Grazing Native Pastures	24.85%
xv	Other – Lakes and major watercourse	0.09%
ix	Unallocated Crown Land and Crown Reserves	55.68%

### Continental Stress Class

The Continental Stress Class for GVD1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Special features:

- Yellow sandplain communities with very diverse mammalian and reptile fauna, distinctive plant communities (D.Pearson pers. comm.) Threats from mining, extensive summer wildfires and feral predators.
- Assemblages of Queen Victoria Spring Great Victoria Desert (Burbidge *et al.* 1976) (A.George, D.Pearson pers. comm.).
- Hummock grasslands, open low tree steppe (mulga over *Triodia scariosa*) is confined entirely to the Great Victoria Desert 1 subregion.

#### Rare Vertebrates:

Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Major Mitchell Cockatoo (*Cacatua leadbeateri*), Malleefowl (*Leipoa*

*ocellata*), Sandhill Dunnart (*Sminthopsis psammophila*), Southern Marsupial Mole (*Notoryctes typhlops*), Mulgara (*Dasyercus cristicauda*), Woma python (*Aspidites ramsayi*) and *Lerista puncticauda*. Records of *S. psammophila* are from two locations in GVD1. There is one Western Australian museum record for each of *N. typhlops* and *D. cristicauda* from Queen Victoria Spring Nature Reserve. *L. puncticauda* is endemic to GVD1.

#### Rare Flora:

*Eucalyptus articulata* is known from only 2 locations and is considered to be a genuinely rare species. *Conospermum toddii* is found on sand dune ridges across a large part of GVD1. Recent inspections of known populations have shown that germination and recruitment is high after fire but little else is understood of the species life history. *Thryptomene wittweri* has been found from the Pilbara (Hamersley Ranges) through the Carnarvon ranges with only 1 record in GVD1. Other flora include *Eremophila* species at Queen Victoria Spring Nature Reserve, *Dampiera ramosa* and *Dicrasyllis nicholastii*.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book (Environmental Protection Authority 1974). Recommendations for reservation by the CTRC in GVD1 (De La Poer Range Nature Reserve and Queen Victoria Springs Nature Reserve) were implemented. The subregion is covered by a CALM Regional Management

Plan, published in 1994, that provides an overview of the regions biota, addresses land and conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail (Department of Conservation and Land Management 1994b). The reviews and strategies therein (for reserve development or management of weeds, feral animals, fire, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregions, or even bioregions, individually.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance identified in the subregion.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Minigwal	Eastings 520 000, Northings 6730 000, zone 52	B8	ii	iii	iv	i	v (foxes, cats, rabbits and goats, occasional camels), x (de-watering of minesites and discharge of hypersaline water into lake beds (Lake Carey – flows into Lake Minigwal))
Ponton Creek	Major occasional paleodrainage channel from North-East Goldfields to Lake Boonderoo	B2	Unknown	Unknown	Unknown	Unknown	Unknown threatening processes

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral Creek lines	The extent of riparian vegetation is limited and confined to major creek systems which only flow intermittently. (i) degraded on pastoral leases on western edge of subregion, (iv) in remaining area of subregion	iii (declining on pastoral leases), iv (static for remainder of subregion)	ii	iv (grazing pressure on pastoral lease areas in western section of subregion), v (foxes, cats, rabbits & goats), vii, x (de watering of mines, lowering water tables)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GVD1.

## Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Reliability <sup>3</sup>	Trend <sup>4</sup>	Threatening Processes <sup>5</sup>
Yellow sandplain communities of the Great Victoria Desert Very diverse mammalian and reptile fauna, distinctive plant assemblages (D.Pearson pers. comm.)	V	18, 23, 33, 31	ii-iii	ii	iv	iv, v (camel, rabbits, foxes & cats), vii (extensive fires), xii (mining)
Assemblages of Queen Victoria Spring Great Victoria Desert (Burbidge <i>et al.</i> 1976)	V	18, 23, 33, 31	ii-iii	ii	iv	iv, v (camel, rabbit), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Sminthopsis psammophila</i>	V	ii	vi	iii	v (cats, foxes), vii
<i>Notoryctes typhlops</i>	E	ii	vi	ii	v (cats, foxes), vii
<i>Dasyercus cristicauda</i>	V	ii	vi	ii	v (cats, foxes), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	E	ii	vi	ii	vii
<i>Acanthiza iredalei</i>	V	ii	vi	ii	v (cats, foxes), vii, iv
<i>Leipoa ocellata</i>	V	Unknown	iii	iii	v (foxes, cats), iii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Cacatua leadbeateri</i>	SP	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	SP	Unknown	vi	Unknown	vii, v (foxes)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Lerista puncticauda</i>	P	ii	vi	ii	v (cats, foxes), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Caesia rigidifolia</i>	EX	i	i	iii	Presumed extinct due to v (rabbits)
<i>Eucalyptus articulata</i>	EN	ii-iii	iv	iii	Unknown threatening processes, possibly vii?
<i>Conospermum toddii</i>	EN	ii-iii	iv	iii	vii, v (camels, rabbits), iv
<i>Thryptomene wittweri</i>	V	ii-iii	iv	ii	vii, v, iv (goats)
<b>PRIORITY 1</b>					
<i>Dampiera eriantha</i>	1	Unknown	vi	ii	vii, v, iv
<i>Philothea linearis</i>	1	Unknown	vi	ii	vii, v, iv
<i>Philothea tubiflora</i>	1	Unknown	vi	ii	vii, v, iv
<i>Thysanotus baueri</i>	1	Unknown	vi	ii	vii, v, iv
<b>PRIORITY 2</b>					
<i>Dicrastylis nicholasii</i>	2	Unknown	vi	ii	vii, v, iv
<i>Grevillea secunda</i>	2	Unknown	vi	ii	vii, v, iv
<i>Isotropis canescens</i>	2	Unknown	vi	ii	vii, v, iv
<i>Malleostemon</i> sp Officer Basin	2	Unknown	vi	ii	vii, v, iv
<i>Micromyrtus stenocalyx</i>	2	Unknown	vi	ii	vii, v, iv
<i>Newcastelia insignis</i>	2	Unknown	vi	ii	vii, v, iv
<i>Olearia arida</i>	2	Unknown	vi	ii	vii, v, iv
<i>Physopsis chrysotricha</i>	2	Unknown	vi	ii	vii, v, iv

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X			L
19	Low woodland; mulga between sandridges				L
20	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)				L
24	Low woodland; <i>Allocasuarina cristata</i>				L
45	Shrublands; mallee scrub (Great Victoria Desert)				M
84	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	X			L
85	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex on sandplain	X			M
86	Hummock grasslands, open low tree steppe; mulga, <i>Allocasuarina cristata</i> & hard spinifex between sand ridges	X			H
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>				L
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex				L
109	Hummock grasslands, shrub steppe; <i>Eucalyptus youngiana</i> over hard spinifex	X			H
110	Hummock grasslands, shrub steppe; red mallee over spinifex <i>Triodia scariosa</i>	X			L
125	Bare areas; salt lakes				M
128	Bare areas; rock outcrops				L
239	Hummock grasslands, open medium tree & mallee steppe; marble gum ( <i>E. gonglocarpa</i> ) & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	X			M
251	Low woodland; mulga & <i>Allocasuarina cristata</i>				L
289	Succulent steppe; saltbush & bluebush				L
389	Succulent steppe with open low woodland; mulga over saltbush				H
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush	X	X		L
444	Hummock grasslands, open low tree steppe; mulga over <i>Triodia scariosa</i>				M
467	Mosaic: Medium woodland; salmon gum & gimlet/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>				L
676	Succulent steppe; samphire				L
936	Medium woodland; salmon gum				L
1239	Hummock grasslands, open medium tree & mallee steppe; marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> on sandplain				H
1446	Succulent steppe with scrub; mulga over bluebush				M
4621	Shrublands; mallee scrub, <i>Eucalyptus eudesmioides</i>				H
	Yellow sandplain communities of the Great Victoria Desert Very diverse mammalian and reptile fauna, distinctive plant assemblages (D.Pearson pers. comm.)	X			H
	Assemblages of Queen Victoria Spring Great Victoria Desert (Burbidge <i>et al.</i> 1976)	X			M

## Subregional constraints in order of priority (see Appendix B, key g)

**Other Subregional Constraints:** These are primarily resource related in terms of management.

**Competing Land Uses:** In particular prospective exploration and mining leases and to a minor extent pastoral values.

## Bioregional and subregional priority for reserve consolidation

Overall 9.4% of the Great Victoria Desert is reserved in IUCN I-IV reserves and the bioregion is IBRA reservation Class 5 (i) (see Appendix D, and Appendix C, rank 4). GVD1 has 7.8%, GVD2 has 10.3%, and GVD3 has 8.4% areas within IUCN I-IV reservations.

Threatening processes exist (such as changed fire regimes, feral predators, feral herbivores, mining interests and inadequate knowledge). Subregional bias is minimal with 7.8% of GVD1 and 35% of GVD1 vegetation systems in IUCN reserves. GVD1 is considered Class 4.

## Reserve management standard

The Reserve Management Standard for GVD1 is (ii) Fair (see Appendix C, rank 5), indicating that biodiversity values and management issues poorly identified, resource degradation is occurring though retrievable. Some feral predator control through aerial dog baiting programs, but this is limited to pastoral areas. Wildfire management is non-existent and impact of feral herbivores is unknown. Mining exploration activities are supervised.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of Flora and Fauna	Queen Victoria Spring Nature Reserve	Nature Reserve	ii-iii
A	Conservation of Flora and Fauna	Plumridge Lakes Nature Reserve	Nature Reserve	ii-iii
C	Conservation of Flora and Fauna	De La Poer Range Nature Reserve	Nature Reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Eucalyptus articulata</i>	No	No
<i>Conospermum toddii</i>	No	No
<i>Thryptomene wittweri</i>	No	No
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Acanthiza iredalei</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Group have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Sminthopsis psammophila</i>	Yes - RP	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes typhlops</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Dasyercus cristicauda</i>	Yes - Draft RP, National Threatened Species Recovery team.	Action Plan for Australian Marsupials and Monotremes
<i>Lerista puncticauda</i>	No	Action Plan for Australian Reptiles

## Appropriate species recovery actions

For GVD1, fire management (ix) is needed to reduce the impact of large intense, summer wildfires on biota. Further research (xii) required in determining species status and distribution, and gain increased knowledge of

subregion. Feral animal control (vii) would assist with CWR species recovery. Research into fire ecology of vertebrates in GVD1 could assist in management at the subregional level.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eucalyptus articulata</i>	i, iii, ix, xii	Habitat retention through reserves and protection on other state lands. Research to confirm status and species requirements. Fire management may be a requirement.
<i>Conospermum toddii</i>	i, iii, ix, xii, vii	Habitat retention through reserves and protection on other state lands. Research to confirm status and species requirements. Fire management and feral grazing animal control may be necessary.
<i>Thryptomene wittweri</i>	i, iii, ix, xii, vii	Habitat retention through reserves and protection on other state lands. Research to confirm status and species requirements. Fire management and feral grazing animal control may be necessary.
<i>Dasycercus cristicauda</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Notoryctes typhlops</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Sminthopsis psammophila</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Polytelis alexandrae</i>	ix, xii	Further research into species ecology and habitat requirements is needed. Fire management may be necessary.
<i>Acanthiza iredalei</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary.
<i>Lerista puncticauda</i>	xii, ix, vii	Research on the species ecology is required. Fire management and feral animal control may also be important.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Yellow sandplain communities of the Great Victoria Desert	No	No
Assemblages of Queen Victoria Spring	No	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Yellow sandplain communities of the Great Victoria Desert	i, iii, ix, vii, xii	Habitat retention through reservation or protection on other state lands. Fire management, feral animal control and further research are additional requirements.
Assemblages of Queen Victoria Spring	i, iii, ix, vii, xii	Habitat retention through reservation or protection on other state lands. Fire management, feral animal control and further research are additional requirements.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required, capacity exists and some achieved biodiversity gains. There are no major conflicting land uses as much of GVD1 is UCL, Aboriginal Reserve or Conservation Reserve. Mineral exploration and possible mine establishment and pastoral activities are considered the main conflicting land use. Mining companies own many of the pastoral leases and levels of stocking are reduced.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Industry Codes of Practice:** Particularly for the mining industry.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Threat Abatement Planning as Part of NRM:** e.g. vegetation and threatened species management plans, pest management, fire management plans.

### Capacity Building Required With Community, Landholders, Industry and Institutions

### Impediments or constraints to opportunities

A number of impediments exists including the Land Administration Act and the operations of the Pastoral Land Board. Conservation Through Reserve is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (particularly mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

### Subregions where Specific NRM actions are a priority to pursue

The NRM priority for GVD1 is (iv) (see Appendix C, rank 7) NRM instruments in place with some achieved biodiversity outcomes.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regolith mapping is unavailable at better than 1:250000 resolution.

**Systematic Fauna Survey:** There has been no systematic biological survey of the subregion although there has been some assessment of biota, McKenzie and Burbidge (1979) who compiled a basic species inventory for a number of reserves and proposed reserves. There have been a number of localised studies with some being both intensive and long term. This particularly relates to work on reptile ecology by Eric Pianka to the east of Laverton (Pianka 1996) and unpublished work on the fire ecology of vertebrates in the Queen Victoria Springs Nature Reserves by David Pearson (1994), CALM. The latter study has focused on Queen Victoria Spring Nature Reserve and has been running for more than 10 years. Some surveys for Sandhill Dunnarts have been

undertaken by Glenn Gaikhorst and co-workers to the north of Queen Victoria Spring Nature Reserve.

**Floristic Data:** Pearson (1994) submitted a MSc thesis on the vegetation and flora of Queen Victoria Spring Nature Reserve but there is little fine scale floristic data available for the subregion as a whole.

**Ecological and Life History Data:** Reports on the ecological requirements and a recovery plan have been produced for the Sandhill Dunnart (Churchill 2001). There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals and uncommon vertebrate and plant species. There is no data to provide regional context on life history (including population trend) of any species.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, introduced herbivores or weed colonisation.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
764	Baker, L.M. and Johnson, K.A.	(undated).	Draft Recovery Plan for the Mulgara ( <i>Dasycerus cristicauda</i> )	Conservation Commission of the Northern Territory	O
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
171	Churchill, S.	(2001a).	Recovery Plan for the Sandhill Dunnart ( <i>Sminthopsis psammophila</i> ).	National Parks and Wildlife SA and Natural Heritage Trust. Adelaide.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R

271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A. A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
490	McKenzie, N.L. and Burbidge, A.A. (eds)	(1979).	The Wildlife of some existing and proposed reserves in the Gibson, Little Sandy and Great Victoria deserts.	Western Australian Wildlife Research Bulletin 8.	J
547	Pearson, D.J.	(1994).	The vegetation and Flora of Queen Victoria Spring Nature Reserve.	Unpublished MSc thesis.	R
552	Pianka, E.R.	(1996).	Long-Term Changes in Lizard Assemblages in the Great Victoria Desert, Dynamic Habitat Mosaics in Response to Wildfires.	Academic Press.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 040, 062, 075, 081, 098, 101, 107, 133, 167, 172, 241, 268, 278, 306, 370, 561, 685 and 686 in Appendix A.

# Great Victoria Desert 2 (*GVD2 – Great Victoria Desert Central subregion*)

BRAD BARTON AND MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Arid active sand-ridge desert with extensive dune fields of deep Quaternary aeolian sands overlying Permian strata of the Gunbarrel Basin. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains with extensive seif dunes running east west, occasional outcropping (breakaways) and quartzite hills provide minor relief.

Vegetation is primarily a Tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* on the aeolian sands. The *Acacia* dominates colluvial soils with *Eremophila* and *Santalum* spp., halophytes are confined to edges of salt lakes and saline drainage systems. The climate is arid, with summer and winter rain averaging 150 –180mm. Subregional areas is 14, 286, 995ha.

### Dominant land use

(see Appendix B, key b)

Category	Description	Percentage of Subregion
x	Aboriginal Reserve	7.36
xiii	Conservation Reserves	9.11
ix	Grazing - Freehold	1.02
ix	Grazing - Leasehold	3.39
xv	Lakes and Major Watercourses	0.19
xi	Unallocated Crown Land and Crown Reserves	78.92

### Continental Stress Class

The Continental Stress Class for GVD2 is 5.

Known special values in relation to landscape, ecosystem, species and genetic values

### Ecosystem at Risk in GVD2:

Yellow sandplain communities of the Great Victoria Desert Very - diverse mammalian and reptile fauna, distinctive plant communities (D. Pearson pers. comm.) Threats are from mining, extensive summer wildfires, feral predators and rabbits.

### Vertebrates at Risk:

Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbills (*Acanthiza iredalei iredalei*), Mulgara (*Dasyercus cristicauda*) and Great Desert Skink (*Egernia kintorei*).

### Flora at Risk:

Flora at risk includes: *Conospermum toddii*, *Calytrix warburtonensis*, *Dampiera ramosa*, *Dicrasyllis nicholasii*, *Eremophila aureivisca* ms, *Eremophila undulata*, *Labichea deserticola*, *Micromyrtus helmsii*, *Olearia arida*, and *Ptilotus stipitatus*.

### Ecosystems Have Greater Than 85% of Their Area Confined to the Great Victoria Desert 2 Subregion:

Beard Veg Assoc	Description
2245	Shrublands; mallee scrub (Nullarbor) <i>Eucalyptus socialis</i> , <i>E. cooperana</i> & <i>E. gracilis</i>
4621	Shrublands; mallee scrub, <i>Eucalyptus eudesmiooides</i>

### Centres of Endemism:

*Ramphotyphlops margaretae* only current record is from Great Victoria Desert 2 subregion.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book (Environmental Protection Authority 1974).

Recommendations for reservation by the CTRC in GVD2 (Nature Reserve, Plumridge Lakes Nature Reserve, Neale Junction Nature Reserve, Yeo Lake Nature Reserve, Great Victoria Desert Nature Reserve) were implemented, and proposed Lake Throssell Nature reserve is still pending. The subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the regions biota, addresses land and conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail (Department of Conservation and Land Management 1994b). The reviews and strategies therein

(for reserve development or management of weeds, feral animals, fire, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregions, or even bioregions, individually.

The Spinifex Agreement – signed between the State of Western Australia and the Pila Nguru (Aboriginal Corporation) is likely to influence biodiversity planning and management in GVD2.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Yeo Lake/Lake Throssell WA044	B8	iii	v (condition improving. Removal of stock is aiding in the recovery of the wetland system)	i	v (feral animals including rabbits, goats, foxes, cats and stray stock). Yeo Lake and Lake Throssell were old pastoral leases, Lake Throssell was never taken up or developed, Yeo Lake is now a Nature Reserve and Lake Throssell is a proposed reserve.

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Rason	Eastings 640 000 Northings 6820 000, zone 52	B8	ii	iv	iv	i	v (rabbits, goats, camels, foxes, cats), xii (disturbance from mineral exploration)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

There are no identified riparian vegetation within the subregion.

### Ecosystems at risk

#### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GVD2.

#### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Yellow sandplain communities of the Great Victoria Desert - Very diverse mammalian and reptile fauna, distinctive plant communities (D.Pearson pers. comm.)	V	18,23,33,31 Beards 84	Unknown	iv	ii	iv, v (camel, rabbits), vii, xii (mining).

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus cristicauda</i>	V	ii	vi	ii	v (cats, foxes), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	V	ii	vi	ii	v (cats, foxes), vii
<i>Polytelis alexandrae</i>	E	ii	vi	ii	v (cats, foxes), vii
<i>Leipoa ocellata</i>	V	Unknown	iii	iii	v (foxes, cats), iii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	i	iii	ii	vii, v (cats and foxes)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Conospermum toddii</i>	E	i	iv	iii	vii, v, iv (camels & rabbits)
<b>PRIORITY 1</b>					
<i>Eremophila aureivisca</i> ms	1	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Labichea deserticola</i>	1	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Micromyrtus helmsii</i>	1	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Ptilotus stipitatus</i>	1	ii	vi	ii	vii, v, iv (camels & rabbits)
<b>PRIORITY 2</b>					
<i>Calytrix warburtonensis</i>	2	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Dampiera ramosa</i>	2	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Dicrastylis nicholasii</i>	2	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Eremophila undulata</i>	2	ii	vi	ii	vii, v, iv (camels & rabbits)
<i>Olearia arida</i>	2	ii	vi	ii	vii, v, iv (camels & rabbits)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X			M
19	Low woodland; mulga between sandridges				H
24	Low woodland; <i>Allocasuarina cristata</i>				H
39	Shrublands; mulga scrub				L
45	Shrublands; mallee scrub (Great Victoria Desert)	X			L
46	Shrublands; mallee scrub (e=?)				L-M
84	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	X			M
85	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex on sandplain	X			L
86	Hummock grasslands, open low tree steppe; mulga, <i>Allocasuarina cristata</i> & hard spinifex between sand ridges	X			H
92	Hummock grasslands, sparse tree steppe; bloodwood over hard spinifex <i>Triodia basedowii</i>				L

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM Purchased Lease	Priority
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>				L
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges				L
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex				L
109	Hummock grasslands, shrub steppe; <i>Eucalyptus youngiana</i> over hard spinifex				L
110	Hummock grasslands, shrub steppe; red mallee over spinifex <i>Triodia scariosa</i>	X			M
125	Bare areas; salt lakes	X			L
128	Bare areas; rock outcrops				L
139	Hummock grasslands, patchy shrub steppe; mulga over hard spinifex on laterite				L
236	Hummock grasslands, shrub steppe; mulga and mallee (marble gum) over hard spinifex				H
239	Hummock grasslands, open medium tree & mallee steppe; marble gum ( <i>E. gonglocarpa</i> & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	X			M
252	Hummock grasslands, shrub steppe; mulga and mallee over soft spinifex				H
289	Succulent steppe; saltbush & bluebush				H
389	Succulent steppe with open low woodland; mulga over saltbush				L
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush				L
442	Low open woodland; mulga & <i>Allocasuarina cristata</i>	X			L
676	Succulent steppe; samphire	X			L
1239	Hummock grasslands, open medium tree & mallee steppe; marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> on sandplain	X			L
1446	Succulent steppe with scrub; mulga over bluebush				L
2245	Shrublands; mallee scrub (Nullarbor) <i>Eucalyptus socialis</i> , <i>E. cooperana</i> & <i>E. gracilis</i>	X			L
4621	Shrublands; mallee scrub, <i>Eucalyptus eudesmioides</i>	X			L
	Yellow sandplain communities of the Great Victoria Desert - Very diverse mammalian and reptile fauna, distinctive plant communities (D.Pearson pers. comm.)	X			H

### Subregional constraints in order of priority (see Appendix B, key g)

**Other Subregional Constraints:** These are primarily resource related in terms of management and research.

**Competing Landuses:** In particular prospective exploration and mining leases.

### Bioregional and subregional priority for reserve consolidation

Overall 9.4% of GVD is reserved in IUCN I-IV reserves and the bioregion is IBRA reservation Class 5 (i) (see Appendix D, and Appendix C, rank 4). GVD1 has 7.8%, GVD2 has 10.3%, and GVD3 has 8.4% areas within IUCN I-IV reservations. Threatening processes exist

(such as changed fire regimes, feral predators, feral herbivores, mining interests and inadequate knowledge). Subregional bias is minimal with 7.8% of GVD1 and 35% of GVD1 vegetation systems in IUCN reserves. GVD2 is considered Class 4.

### Reserve management standard

The overall reserve management standard for GVD2 is (ii) Fair (see Appendix C, rank 5), indicating that biodiversity values and management issues are poorly identified, and some resource degradation is occurring though it is retrievable. Some feral predator control occurs through aerial dog baiting programs, but this is limited to pastoral areas. Wildfire management is non-existent, and the impact of feral herbivores is unknown. Mining exploration activities are supervised.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of Flora and Fauna	Neale Junction Nature reserve	Nature Reserve	ii-iii
A	Conservation of Flora and Fauna	Plumridge Lakes Nature Reserve	Nature Reserve	ii-iii
A	Conservation of Flora and Fauna	Yeo Lake Nature Reserve	Nature Reserve	ii-iii
A	Conservation of Flora and Fauna	Great Victoria Desert Nature reserve	Nature Reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Conospermum toddii</i>	No	No
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Acanthiza iredalei</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Group have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Dasyercus cristicauda</i>	Yes - National Threatened Species Recovery team.	Action Plan for Australian Monotremes and Marsupials
<i>Egernia kintorei</i>	Yes - National Threatened Species Recovery team.	Action Plan for Australian Reptiles

### Appropriate species recovery actions

In GVD2, there is a need for fire management (ix) to reduce the impact of large intense, summer wildfires. Further research (xii) required to determine species

status, distribution and gain increased knowledge of subregion. Feral animal control (vii) would assist with CWR species recovery.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Conospermum toddii</i>	i, iii, ix?, xii, vii	Habitat retention through reserves and protection on other state lands. Research to confirm status and species requirements. Fire management and feral grazing animal control may be necessary.
<i>Dasyercus cristicauda</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Polytelis alexandrae</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary
<i>Acanthiza iredalei</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary
<i>Egernia kintorei</i>	ix, vii, i, ii, xii	Fire management and feral animal control is very important. Habitat retention and protection through reserves and on other lands is required. Continued research on the species ecology is required.

<sup>1</sup>Appendix A, key h.

### Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Yellow sandplain communities of the Great Victoria Desert	No	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Yellow sandplain communities of the Great Victoria Desert	i, iii, ix, vii, xii	Habitat retention through reservation or protection on other state lands. Fire management, feral animal control and further research are additional requirements.

<sup>1</sup>Appendix A, key h.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required, capacity exists and some achieved biodiversity gains have been observed. There are no major conflicting land uses as much of GVD2 is UCL, Aboriginal Reserve or Conservation Reserve. Mineral exploration and possible mine establishment is considered the main conflicting land use.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Industry Codes of Practice:** Mining industry.

#### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation and threatened species management plans, pest management, fire management plans.

#### Capacity Building Required With Community, Landholders, Industry and Institutions

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and the operations of the Pastoral Land Board, CTR is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (particularly mining and pastoral) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for GVD2 is (iv) (see Appendix C, rank 7), indicating that NRM instruments are in place with some achieved biodiversity outcomes.

### Data gaps

Gaps in data needed for the Identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regolith mapping is unavailable at better than 1:250 000 resolution.

**Systematic Fauna Survey:** There has been no systematic biological survey of the subregion although there has been some assessment of biota on proposed and current reserves and there have been a number of localised studies with some being both intensive and long term. This particularly relates to work on reptile ecology by Eric Pianka (Pianka 1996) and McKenzie and Burbidge's work (1979) that compiled a basic species inventory for a number of reserves and proposed reserves.

**Floristic Data:** There is little fine scale floristic data available for the subregion as a whole.

**Ecological and Life History Data:** Reports on the ecological requirements and a recovery plan have been produced for the and Great Desert Skink (McAlpin 2001). There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals and uncommon vertebrate and plant species. There are no data to provide regional context on life history (including population trend) of any species.

#### Other Priority Data Gaps Include:

- No quantitative data on the affect of exotic predators, introduced herbivores or weed colonisation.

## Source

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
764	Baker, L.M. and Johnson, K.A.	(undated).	Draft Recovery Plan for the Mulgara ( <i>Dasycerus cristicauda</i> )	Conservation Commission of the Northern Territory	O
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A. A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Egernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
490	McKenzie, N.L. and Burbidge, A.A. (eds)	(1979).	The Wildlife of some existing and proposed reserves in the Gibson, Little Sandy and Great Victoria deserts.	Western Australian Wildlife Research Bulletin 8.	J
552	Pianka, E.R.	(1996).	Long-Term Changes in Lizard Assemblages in the Great Victoria Desert, Dynamic Habitat Mosaics in Response to Wildfires.	Academic Press.	B

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 040, 062, 075, 081, 098, 101, 107, 133, 166, 172, 241, 268, 272, 278, 288, 306, 370, 547, 561, 649, 685 and 686 in Appendix A.

# Great Victoria Desert 3 (*GVD3 – Great Victoria Desert Eastern subregion*)

BRAD BARTON AND MARK COWAN  
OCTOBER 2001

## Subregional description and biodiversity values

### Description and area

The eastern section is underlain by Devonian sediments of the Gunbarrel Basin, with extensive sandplains of deep Quaternary aeolian sands. Landforms consists of salt lakes and major valley floors with lake derived dunes. Sand plains with extensive seif dunes running east west, occasional outcropping (breakaways) and quartzite hills

provide minor relief. Vegetation is primarily a Tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* on the aeolian sands, *Acacia*, dominates the colluvial soils with *Eremophila* and *Santalum* spp, halophytes are confined to edges of salt lakes and saline drainage systems. The climate is arid, with summer and winter rain averaging 150 –180mm. Subregional area is 5, 051, 155ha.

Dominant land use  
(see Appendix B, key b)

Category	Description	Percentage of Subregion
x	Aboriginal Reserve	57.37
xiii	Conservation Reserves	9.76
ix	Unallocated Crown Land and Crown Reserves	32.87

### Continental Stress Class

The Continental Stress Class for GVD3 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Feature:

The Ecosystem at risk in GVD3 is Mirramiratjarra dune field (Unique dune formation, vegetation and drainage system).

#### Vertebrates at Risk:

Includes: Princess Parrot (*Polytelis alexandrae*), Slender-billed Thornbill (*Acanthiza iredalei*), Southern Marsupial Mole (*Notoryctes typhlops*), Great Desert Skink (*Egernia kintorei*).

#### Refugia:

Breakaways and ranges act as refugia.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book (Environmental Protection Authority 1974). Recommendations for reservation by the CTRC in GVD3 (Great Victoria Desert Nature Reserve) were implemented. The subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the regions biota, addresses land and conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail (Department of Conservation and Land Management 1994b). The reviews and strategies therein (for reserve development or management of weeds, feral animals, fire, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregions, or even bioregions, individually.

The Spinifex Agreement – signed between the State of Western Australia and the Pila Nguru (Aboriginal Corporation) is likely to influence biodiversity planning and management in GVD.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no Wetlands of National Significance identified in GVD3.

### Wetlands of subregional significance

There are no wetlands of subregional importance identified within GVD3, primarily because of a lack of knowledge of the wetlands within the subregion.

## Riparian zone vegetation

There is no identified riparian vegetation within GVD3.

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in GVD3.

## Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Mirramirajarra dune field. Unique dune formation, vegetation and drainage system. (Ian Kealley pers. comm.)	V	43	ii	iv	i	iv, v (camels and rabbits)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Notoryctes typhlops</i>	E	ii	vi	ii	v (cats, foxes), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	V	ii	vi	ii	v (cats, foxes), vii
<i>Polytelis alexandrae</i>	E	ii	vi	ii	v (cats, foxes), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	i	iii	ii	vii, v (cats and foxes)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

There are no declared rare or priority flora in GVD3.

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )				L
19	Low woodland; mulga between sandridges				L
45	Shrublands; mallee scrub (Great Victoria Desert)				H
46	Shrublands; mallee scrub (e=?)				H
84	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				L
85	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex on sandplain	X			L
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM Purchased Lease	Priority
92	Hummock grasslands, sparse tree steppe; bloodwood over hard spinifex <i>Triodia basedowii</i>				M
120	Succulent steppe with open low woodland; mulga & sheoak		X		L

125	Bare areas; salt lakes				L
128	Bare areas; rock outcrops				L
236	Hummock grasslands, shrub steppe; mulga and mallee (marble gum) over hard spinifex				H
239	Hummock grasslands, open medium tree & mallee steppe; marble gum ( <i>E. gonglocarpa</i> & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				H
676	Succulent steppe; samphire	X			L
	Mirramiratjarra dune field. Unique dune formation, vegetation and drainage system. (Ian Kealley pers. comm.)				H

### Subregional constraints in order of priority (see Appendix B, key g)

**Other Subregional Constraints:** These are primarily resource related in terms of management and research.

**Competing Landuses:** In particular prospective exploration and mining leases. Aboriginal Land Agreement will in all likelihood work in favour of biodiversity conservation.

### Bioregional and subregional priority for reserve consolidation

Overall 9.4% of GVD is reserved in IUCN I-IV reserves and the bioregion is IBRA reservation Class 5 (i) (see Appendix D, and Appendix C, rank 4). GVD1 has 7.8%,

GVD2 has 10.3%, and GVD3 has 8.4% areas within IUCN I-IV reservations. Threatening processes exist (such as changed fire regimes, feral predators, feral herbivores, mining interests and inadequate knowledge). Subregional bias is minimal with 7.8% of GVD1 and 35% of GVD1 vegetation systems in IUCN reserves. GVD3 is considered Class 4.

### Reserve management standard

Rating for GVD3 is (ii) Fair (see Appendix C, rank 5), indicating that biodiversity values and or management issues poorly identified. Some resource degradation is occurring, though it is retrievable. Wildfire management is non-existent and impact of feral herbivores is unknown. Mining exploration activities are supervised.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of Flora and Fauna	Great Victoria Desert Nature reserve	Nature Reserve	ii - iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Acanthiza iredalei</i>	No	Action Plan for Australian Birds
<i>Egernia kintorei</i>	Yes - National Threatened Species Recovery team	Action Plan for Australian Reptiles
<i>Notoryctes typhlops</i>	No	Action Plan for Australian Marsupials and Monotremes

### Appropriate species recovery actions

For GVD3, there is a need for fire management (ix) to reduce the impact of large intense, summer wildfires on biota. Further research (xii) is required to determine

species status, distribution and gain increased knowledge of subregion. Feral animal control (vii) would assist with extant Critical Weight Range species recovery.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Polytelis alexandrae</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary
<i>Acanthiza iredalei</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary
<i>Egernia kintorei</i>	ix, vii, i, ii, xii	Fire management and feral animal control is very important. Habitat retention and protection through reserves and on other lands is required. Continued research on the species ecology is required.
<i>Notoryctes typhlops</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Mirramiratjarra dune field. Unique dune formation, vegetation and drainage system. (Ian Kealley pers. comm.)	No	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Mirramiratjarra dune field. Unique dune formation, vegetation and drainage system. (Ian Kealley pers. comm.)	ix, xii, vii, i, iii	Fire management. Research. Feral animal control. Habitat retention through reservation or protection on other state lands.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required. The Spinifex Agreement, once implementation commences, will see all lands associated with this agreement managed for conservation. There are no major conflicting land uses as much of GVD3 is UCL, Aboriginal Reserve or Conservation Reserve. Mineral exploration and possible mine establishment is considered the main conflicting land use.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Industry Codes of Practice:** Particularly for the mining exploration industry.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation and threatened species management plans, pest management, and fire management plans.

### Capacity Building Required With Community, Landholders, Industry and Institutions

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and the negotiations with the Spinifex Land Agreement people. Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for GVD3 has a rank of (iv) (see Appendix C, rank 7), indicating that NRM instruments in place with some achieved biodiversity outcomes.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regolith mapping is unavailable at better than 1:250000 resolution.

**Systematic Fauna Survey:** There has been no systematic biological survey of the subregion although there have been a number of localised studies with some being both intensive and long term. This particularly relates to work on reptile ecology by Eric Pianka (Pianka 1996) and McKenzie and Burbidge's work (1979) that compiled a basic species inventory for a number of reserves and proposed reserves.

**Floristic Data:** There is little fine scale floristic data available for the subregion as a whole.

**Ecological and Life History Data:** Reports on the ecological requirements and a recovery plan have been produced for the Great Desert Skink (McAlpin 2001). There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting Critical Weight Range mammals and uncommon vertebrate and plant species. There are no data to provide regional context on life history (including population trend) of any species.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, introduced herbivores or weed colonisation.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
181	Cogger, H., Cameron, E., Sadlier, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A. A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Egernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
490	McKenzie, N.L. and Burbidge, A.A. (eds)	(1979).	The Wildlife of some existing and proposed reserves in the Gibson, Little Sandy and Great Victoria deserts.	Western Australian Wildlife Research Bulletin 8.	J
552	Pianka, E.R.	(1996).	Long-Term Changes in Lizard Assemblages in the Great Victoria Desert, Dynamic Habitat Mosaics in Response to Wildfires.	Academic Press.	B

R = Report; J = Journal article; O = Other.

### Other Relevant Publications

See reference numbers 040, 062, 075, 081, 098, 101, 107, 133, 167, 171, 172, 241, 268, 272, 278, 306, 370, 547, 649, 685 and 686 in Appendix A.

# Hampton (*HAM*)

SANDRA GILFILLAN, MALCOM GRANT, SARAH COMER, SARAH BARRETT, KLAUS TIEDEMANN AND LAWRIE ANDERSON  
2001

## Subregional description and biodiversity values

### Description and area

The bioregion is dominated by quaternary marine dune systems on a coastal plain of the Eucla Basin, backed by stranded limestone scarp. Areas of marine sand are also perched along the top edge of the scarp. Various mallee communities dominate the limestone scree slopes and pavements, as well as the sandy surfaces. Alluvial and calcareous plains below the scarp support eucalypt woodlands and Myall open low woodlands. There are no subregional divisions and the area of HAM is 1, 229, 189 ha.

### Dominant land use

Mainly (xi) (see Appendix B, key b) UCL and Crown reserves, and (xiii) conservation.

### Continental Stress Class

The Continental Stress Class for HAM is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

Extensive karst features including underground network of caves, blowholes and subterranean streams. The limestone caves of the Eucla Basin are one of the largest karst systems in the world. They contain a unique stygofauna and a number of threatened invertebrates (Gondwanan relicts), and sub-fossil remains.

## Wetlands

### Wetlands of National significance (DIWA listings)

There are no wetlands of National Significance listed for HAM.

#### Centres of endemism:

If the slopes of the Hampton escarpment are included in the region, high levels of endemism are found in stygofauna of karst systems that extend back under the NUL2 subregion. Dispersal mechanisms between individual aquifer systems are limited, and faunas have evolved in isolation (e.g. *Tartarus mullamullangensis*, *Tartarus nurinensis*). Coastal dunes of the region support three endemic reptile species (*Pseudemoia baudini*, *Lerista arenicola* and *L. baynesi*) and one endemic sub-species of reptile (*Ctenotus brooksi euclae*). A variety of coastal dune plants also occur nowhere else: *Scaevola crassifolia*, *Atriplex cinerea* and *Euphorbia paralais* (Keighery, Robinson and Downing 1987).

#### Refugia:

- Karst features provide refugia for a largely unknown fauna.

#### High Species and Ecosystem Diversity:

- Stygofauna
- Coastal dune communities of the Roe Plain

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The subregion is covered by the South Coast Regional Management Plan (Department of Conservation and Land Management 1992), which provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the bioregion. Interim management guidelines exist for the two major reserves in this bioregion – Eucla (Department of Conservation and Land Management 1996a) and Nuytsland (Department of Conservation and Land Management 1997).

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Weebubbie Cave	31 300' S 128 400' E	B19	ii	iv	vi	i	xii (uncontrolled recreational use)
Nurina Cave	32 000' S 127 000' E	B19	ii	iv	vi	i	xii (uncontrolled recreational use)
Winbirra Cave	31 400' S 128 300' E	B19	ii	iv	vi	i	xii (uncontrolled recreational use)
Pannikin Plains Cave – Nuytsland Nature Reserve	32 000' S 126 100' E	B19	ii	iii	vi	i	xii (compaction via public visitation; earth bund constructed during natural flood event), v (rabbits, foxes and cats)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

There is no true riparian vegetation within HAM.

## Ecosystems at risk

## Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in Hampton.

## Other ecosystems at risk

Beard Veg Assoc	Description	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
47	Shrublands; tallerack mallee-heath	V	29	Unknown	iii	ii	v (rabbits, cats, dogs), xii
129	Bare areas; drift sand	V	41	Unknown	vi	ii	v (rabbits, cats, dogs), xii
1241	Succulent steppe; bluebush	V	N/A	Unknown	iv	ii	iv (sheep), v (rabbits, cats, dogs), xii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	V	ii	iv	ii	iv (sheep & rabbits), vi (Wards Weed)
<i>Leipoa ocellata</i>	V	Unknown	vi	Unknown	v (foxes), ii, xii (reduction in species richness of communities), possibly vii
<i>**Thalassarche cauta</i>	V	ii	v	iii	xii (commercial fishing)
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 7 (ARACHNIDS)</b>					
<i>Tartarus murdochensis</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)
<i>Tartarus nurinensis</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)
<i>Tartarus thampannensis</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 8 (CRUSTACEANS)</b>					
<i>Abelaiscia troglodytes</i>	V	Unknown	vi	ii	x (changed hydrology in caves), xii (habitat disturbance due to recreation)

Species marked with \*\*asterisks indicate these species are occasional visitors to the subregion.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Thysanotus baueri</i>	1	iii	iv	iii	xii (likely to be poorly collected rather than rare)
<b>PRIORITY 2</b>					
<i>Acrotriche patula</i>	2	iii	iv	iii	xii (mining)
<i>Phlegmatospermum eremaeum</i>	2	unknown	iv	ii	vi (Ward's weed), v (rabbits)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease	Priority
42	Shrublands; mallee & acacia scrub on south coastal dunes	X			
47	Shrublands; tallerack mallee-heath	X			
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush	X			
125	Bare areas; salt lakes				
129	Bare areas; drift sand	X			
289	Succulent steppe; saltbush & bluebush				
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )	X			
1241	Succulent steppe; bluebush				
1515	Shrublands; mallee scrub <i>Eucalyptus gracilis</i>	X			

Subregional constraints in order of priority  
(see Appendix B, key g)

**Competing Land Uses:** The subregion is currently largely held in reserves and pastoral leases

**Economic Constraints:** High costs associated with the remoteness of the subregion have lead to severe financial constraints.

Bioregional and subregional priority for reserve consolidation

The bioregional priority for HAM is Class 4 (see Appendix D, and Appendix C, rank 4) indicating that 11% of bioregion is in CALM reserves (10%-15%).

### Reserve management standard

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Primitive Area for the Preservation and Study of Flora, Fauna, Geological and Anthropological Features	Nuytsland Nature Reserve	Nature Reserve	i - ii
A	Conservation of Fauna and Flora and Recreation	Eucla National Park	National Park	i - ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Species Recovery Plan	General Recovery Plans
CWR mammals	Some have specific recovery plans but not all	Action Plan for Australian Marsupials and Monotremes; Action Plan for Australian Rodents
<i>Acanthiza iredalei iredalei</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds

<sup>1</sup>Appendix B, key e

### Appropriate species recovery actions

Species	Recovery Actions <sup>2</sup>	Recovery Notes
CWR mammals	xiii, vi, vii, ix, xii	Need capacity building in pastoral industry to optimise chenopod grassland biomass and productivity by minimizing loss of mineral-A soil horizon and leaf-litter layer, indigenous grasses, shrub layer and tree regeneration through close-order husbandry of sheep herds and use of fire. Research into controlling the weed <i>Carrictua annua</i> (Wards Weed) is needed. monitoring of rabbit numbers following the population reduction caused by Callicivirus. Fire protection of existing reserves is essential. Need to construct a list of the original mammal fauna of the region using exposed sub-fossil deposits and historical records so that re-introduction programs to reconstruct CWR mammal communities can have a scientific basis.
<i>Acanthiza iredalei iredalei</i>	xiii, vi, vii, ix, xii	As above.
<i>Leipoa ocellata</i>	xiii, vi, vii, ix, xii	As above.

<sup>1</sup>Appendix B, key e; <sup>2</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Ecosystem	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plans
Chenopod communities	vi (accelerating weed colonization, especially by Wards Weed <i>Carrictua annua</i> ), xii (reduction in species richness of communities)	No	No

<sup>1</sup>Appendix B, key e

### Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Notes
Chenopod communities	xiii, vi, vii, ix, xii	See appropriate species recovery actions above.

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Relating to conservation, environmental protection, pastoral activities and mining in place. Sandalwood Act is applicable but outdated and ineffective in its protection of Sandalwood populations. It requires repeal and incorporation as the Wildlife Conservation Act into a new comprehensive biodiversity conservation Act.

**Threat Abatement Planning:** Some rabbit and fox controls applied however limited access means that there is limited effect and action are mostly confined to areas used for pastoral activities; Some bushfire preventative action is taken.

**Industry Codes of Practice:** Mining Industry is involved in limestone quarrying activities on Hampton Escarpment.

### Feasible opportunities for NRM

**Incentives:** Pastoral leases in good condition could be converted to conservation estate.

**Legislation:** Wildlife Conservation Act and Sandalwood Act are both outdated and need to be repealed. More wide-ranging and comprehensive legislation is required.

**Institutional Reform:** Pastoral leases in good condition could be converted to conservation estate.

**Threat Abatement Planning:** More comprehensive controls need to be developed for foxes, rabbits and cats.

**Codes of Practice:** There is a need to develop codes of practice and standards of management for pastoral lands.

**Capacity Building:** Closer liaisons need to be developed with community groups and land holders on issues, e.g. pastoral industry; There is further scope for the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** Closer liaisons with local governments are also required for relevant issues.

**Other:** Establishment of conservation areas to fully represent salient features of the Hampton landscape and the Roe Plains are highly desirable. Fauna species such as Pygmy possums (*Cercartetus concinnus*) occur in the coastal mallee scrubs and low woodlands which represents the extreme eastern occurrence of this species, and Major-Mitchell Cockatoos (*Cacatua leadbeateri*) occur in district populations south of Mundrabilla also in coastal woodlands; Costs associated with the establishment of National Parks or nature reserves are not high, however on-going management initiating and commitments will be difficult due to remoteness of the area.

### Impediments or constraints to opportunities

Financial constraints and high costs associated with the remoteness of the subregion will have an impact on the extent of NRM actions applied in this subregion. There is very little infrastructure in the bioregion, i.e. there are only several roadhouses and stations, no towns.

Subregions where specific NRM actions are a priority to pursue (see Appendix C, rank 7)

HAM is not divided into subregions.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available and vegetation map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** No systematic quadrat-based fauna survey. Data is confined to bird atlas, specific threatened bird distributions and limited monitoring sites for mammals (e.g. Hooper and Wells, 1987).

**Floristic Data:** No systematic quadrat-based flora survey. Most reserves don't have long-term survey data on

species presence or absence; data is confined to specific threatened flora, and a few large reserves.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants (except some DRF), persisting CWR mammals and uncommon vertebrate and plant species. There is no data to provide a regional context on life history (including population-trend) of most species, including foxes.

**Other Priority Data Gaps Include:**

- No quantitative data on the effect of exotic predators, weed colonisation, and fire.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
236	Department of Conservation and Land Management	(1997).	Interim Management Guidelines for Nuytsland Nature Reserve.	CALM, South Coast Region.	R
234	Department of Conservation and Land Management	(1996a).	Interim Management Guidelines for Eucla National Park.	CALM, South Coast Region.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
364	Hooper, G. and Wells, B.	(1989).	Western Pygmy Possum Survey 1987. In: Eyre Bird Observatory Report 5 1986-1987.	RAOU Report No. 66.	R
720	Keighery, G.J., Robinson, A.C. and Downing, B.H.	(1987).	Vegetation. In A Biological Survey of the Nullarbor Region, South and Western Australia in 1984 (eds N.L. McKenzie & A.C. Robinson).	Department of Environment and Planning, South Australia, 39-102	R
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 013, 033, 034, 075, 112, 230, 261, 293, 308, 409, 410, 457, 496, 519, 549, 563, 564, 565, 566, 567, 629, 632, 671 and 717 in Appendix A.

# Jarrah Forest 1 (*JF1 – Northern Jarrah Forest subregion*)

KIM WILLIAMS AND DAVE MITCHELL  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by woodlands of Wandoo - Marri on clayey soils. Eluvial and alluvial deposits support *Agonis* shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean.

Northern Jarrah Forest incorporates the area east of the Darling Scarp, overlying Archaean granite and metamorphic rocks of an average elevation of 300 m, capped by an extensive lateritic duricrust, dissected by later drainage and broken by occasional granite hills. In the east the laterite becomes deeply dissected until it compresses isolated remnants. Rainfall is from 1300 mm on the scarp to approximately 700 mm in the east and north. Vegetation comprises Jarrah - Marri forest in the west with Bullich and Blackbutt in the valleys grading to Wandoo and Marri woodlands in the east with Powder bark on breakaways. There are extensive but localised sand sheets with *Banksia* low woodlands. Heath is found on granite rocks and as a common understorey of forests and woodlands in the north and east. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Subregional area for JF1 is 2, 255, 904 ha.

### Dominant land use

(see Appendix B, key b)

Dominant land uses mainly include forestry (native forests), conservation, grazing (improved pastures), cultivation (dry land agriculture), forestry (plantations), and mining. There are lesser areas of rural residential, easements for roads, power lines etc, and urban land use.

### Continental Stress Class

The Continental Stress Class for JF1 is 3.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

Extensive native forest cover, however the biota is patchy considering geological & geomorphic uniformity.

#### Refugia:

- Threatened bird translocation sites for Noisy Scrub-Bird (*Atrichornis clamosus*).

- Primary populations of Critical Weight Range mammals such as Southern Brown Bandicoot (*Isoodon obesulus fusciventer*), Chuditch (*Dasyurus geoffroii*), Woylie (*Bettongia penicillata ogilbyi*) and Brush-tailed Phascogale (*Phascogale tapoatafa*). Some species such as Quokka (*Setonix brachyurus*) and Western Ring-tailed Possum (*Pseudocheirus occidentalis*) are often restricted to riparian habitat.
- Freshwater wetland: Baumea reed beds in forest areas.
- Granite outcrops and associated flora/fauna.
- Wandoo and Wandoo/Powderbark woodlands in the eastern zone such as Dryandra supporting species: Numbat (*Myrmecobius fasciatus*), Woylie (*Bettongia penicillata ogilbyi*) and the Tamar (*Macropus eugenii derbianus*).
- The RFA process identified other refugia (Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998c - including map 2 of report, and the non-National Estate thresholded map of refugia (IMB plot identifier - rfa\_980119\_01))

#### Centres of Endemism:

Analysis done for the Regional Forest Agreement identified concentrations of local endemics (species with ranges of less than 100km) in the South West Forest Region. It identified several areas that constituted centres of narrow endemism: near the northern boundary of the RFA region between Gingin and New Norcia mostly on non-CALM managed lands but also including the Udumung Nature Reserve; near the eastern boundary of the RFA region between Great Eastern Highway and the Great Southern Highway mostly on non-CALM managed lands; near the eastern boundary of the RFA region including the eastern part of the proposed Wandoo National Park, and non-CALM managed lands to the east; to the east of Perth in the area of the John Forrest National Park and the proposed Mundaring, Pickering Brook, Canning and Helena Valley National Parks and adjacent areas of State Forest; along the Darling Scarp between Kelmscott and Jarrahdale in State forest (Hearn *et al.* 2003, Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998c).

#### High Species and Ecosystem Diversity:

The Northern Jarrah Forest region has moderate species richness (400 – 600 species per km). Although the western and central zones reflected higher richness in the RFA (Map 5 Species Richness), recent studies on the mosaic of forests, woodlands and heaths on the eastern and northeastern fringes are in the moderate range of species (Department of Conservation and Land Management 1998). As indicated above the majority of this species richness results from the rapid changes in communities on the lower slopes and on the variable soil

types. Other analysis has been done using data sets at a more regional scale (Gioia and Pigott 2000).

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Jarrah Forest in the CTRC Red Book (Environmental Protection Authority 1974). Some but not all of these recommendations (with modification) were implemented over the following ten years. All but the south eastern corner (approx 30km width x 105km length) of the subregion are covered by the Department of CALM's Regional Management Plans (Department of Conservation and Land Management 1987b), that provides an overview of biota, addresses land and wildlife

conservation issues. However these plans were generalised in their attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific biodiversity conservation needs of the subregion, or even the bioregion.

The 1999 Regional Forest Agreement (RFA) systematically reviewed biodiversity values and the adequacy of the CAR reserve system over an area incorporating most of the JF1 subregion (Commonwealth and Western Australian Governments 1999). The Forest Management Plan (draft) was released in 2002 and further develops the CAR reserve system established in the RFA process.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Avon River Valley WA045	B2	ii	iii	iii	ix, xii (erosion, siltation and eutrophication), xi
Chittering-Needonqa WA047	B7, B14	iii	iii	iii	ix, xii (erosion and eutrophication), xi

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no Wetlands of Subregional Significance except rivers listed under Riparian Zone Vegetation below.

### Riparian zone vegetation

Rivers are the only wetlands of subregional significance in JF1. The water courses of the subregion are dominated by the creation of water storage structures (dams and

reservoirs) within the forested catchment primarily to provide:

- potable water to the metropolitan area of Perth and outlying suburbs, and
- irrigation water for the intensive horticulture and irrigation needs of agricultural users on the coastal plain.

All major rivers with the exception of the Avon, Swan and Murray have existing water storage structures in place. Issues arising from damming include: loss of riparian vegetation, modified flow patterns, introduction of exotic fish species.

Name	Location	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>	Water Storage
Avon River	425200 E, 6502400 N, zone 50	B2	ii	iii	iv	i, v, ix,	No
Brockman River	412587 E, 6523196 N zone 50	B2	ii	iii	iii	i, iv, v, ix, x	No
Swan River	427972 E, 6484700 N zone 50	B2	ii	iii	iii	i, ix, x,	No
Helena River	425000 E, 6461000 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Canning River	433000 E, 6425000 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Serpentine River	418000 E, 6413800 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Name and Code	Location	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>	Water Storage
South Dandalup River	414140 E, 6385710 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
North Dandalup River	408021 E, 6402038 N zone 50	C1	iv	iv	iii	v (pigs)	Yes
Murray River	428529 E, 6349132 N zone 50	B2	iv	iv	iii	ix, v (pigs)	No
Wungong Brook	412395 E, 6435750 N zone 50	C1	iv	iv	iii	Unknown threatening processes	Yes
Harvey River	411000 E, 6337000 N zone 50	B2, C1	iv	iv	iii	v (pigs)	Yes
Harris River	420000 E, 6323000 N zone 50	B2, C1	iv	iv	iii	v (pigs)	Yes
Collie River	409100 E, 6309900 N	B2, C1	ii	v	iii	i, ii, v, ix,	Yes

	zone 50						
Brunswick River	409900 E, 6323000 N zone 50	C1	iii	iii	iii	ii, iv,	Yes
Logue Brook	404125 E, 6348334 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Samson Brook	408800 E, 6361700 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Drakes Brook	405517 E, 6364899 N zone 50	C1	iii	iv	iii	v (pigs)	Yes
Moore River	417000 E, 6569000 N zone 50	B2	ii	iii	iii	i, ix,	No

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Eucalyptus calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain	CR	8	ii	iii	iii	i, ii, vi, vii, xii (urbanisation)
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain	EN	30	ii	iii	iii	i, ii, vi, vii, xii (urbanisation), viii
<i>Eucalyptus calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain	VU	8	ii	iii	iii	i, ii, vi, vii, xii (urbanisation)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
973	Low forest: paperbark ( <i>Melaleuca raphiophylla</i> )	V	15	iii	iii	iii	i, vii, x
1021	Mosaic: Medium open woodland; wandoo/Shrublands; dryandra heath	E	8	iii	vi	iii	i, ii, ix, x (upland section in good condition, lowland section subject to clearing and salinity)
7	Medium woodland: York gum ( <i>E. loxophleba</i> ) & wandoo	V	8	Variable	iii	iii	i, ii, ix, x, vii, vi
1043	Mosaic: Medium open woodland; wandoo & powderbark wandoo/Shrublands; dryandra heath	V	8	iii	vi	iii	i, ii, ix, x (upland section in good condition, lowland section subject to clearing and salinity)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Analysis of the pre-european and remaining extent of Beard's vegetation associations (spreadsheet supplied by Angas Hopkins), shows that of the 39 vegetation associations that covered greater than 0.1% (i.e. 2256 ha) of the subregion in pre-european times (ie covering in total over 99.98% of original area) there are:

- Two vegetation associations (973 and 1182) with less than 10% of their original JF1 area remaining, and so could be considered threatened.
- Association 1182 is distributed across 3 subregions. JF1 contains only the smallest occurrences representing 0.2% of the total current extent of this association. Conservation of this association would be better achieved in other subregions.
- In JF1 vegetation association 1182 is not contained in the CALM estate. However 64.4% of the current total extent representing 30.1% of the pre-european extent in other subregions is contained in the CALM estate. Reservation of the JF1 occurrences of 1182 is not a priority for the conservation of this vegetation association.
- Association 973 is distributed across 4 subregions. JF1 contains only 1.1% of the total current extent of this association. While conservation of this association should be sought in the other subregions, to date this has not been achieved with only 6.6% of the total current extent (3.8% of the pre-european extent) contained in the CALM estate.
- 22.9% (4.7 ha) of the occurrence of 973 in the JF1 subregion is contained in CALM estate. Priority should be given to reserving further occurrences of this association across its distribution including those contained in JF1.

There are 11 vegetation associations that have between 10% and 30% of their pre-european JF1 area remaining, and so could be considered threatened. All eleven have <10% of their JF1 pre-European area contained in CALM reserves. However only three (1021, 4, 7) have greater than 10% of their total extent in JF1 and thus may be of priority for conservation in this subregion.

- Association 1021 is found exclusively in JF1, yet only 10.8% (157.9 ha) of the pre-european extent survives. There is no representation of this association in the CALM estate. Conservation of

vegetation association 1021 should be a priority in the JF1 subregion.

- 73.1% of the total current extent of association 4 occurs within JF1. This subregion has reserved 23.6% (69 255.3 ha) of the total current extent across all regions in CALM estate. Reservation of further remnants of association 4 would be of low priority.
- JF1 contains 27.1% of the total current extent of association 7. Across all bioregions only 1.8% (526.4 ha) of the current extent is contained in CALM estate reserves. In JF1 only 1.6% of the subregional extent of this association is contained in the CALM estate. Further reservation of this association should be a priority in the JF1 subregion.
- Vegetation Association 1043 is also of interest though it falls outside the 10 – 30% remaining criterion. Association 1043 is found exclusively within the JF1 subregion and adjoins association 1021. Though 40.5% (1795.4 ha) of the pre-european extent remains, there is no representation of this association in the CALM estate. Reservation of this association should be a priority in the JF1 subregion.

### Analysis For the RFA Shows the Following at a Regional Level:

Forest ecosystems and vegetation complexes need to be covered as these are the primary units of vegetation that have been used for reservation analysis in this region in recent processes (Department of Conservation and Land Management 1994b; Commonwealth and Western Australian Regional Forest Agreement Steering Committee 1998a, 1998b and 1998c; Department of Conservation and Land Management and Conservation Commission of Western Australia 2002).

Both the RFA and Draft Forest Management Plan (2002) identify ecosystems in terms of 'forest ecosystems'. A number of ecosystems are identified as rare and have a CAR reservation target 100% of extant area, which is not achieved (Jarrah Rates Tingle, Jarrah Red Tingle, Karri rates Tingle, Bullich and Yate). Conservation Commission (2002) recommended that Government should refuse approvals of applications for clearing in the Darling Scarp and Jarrah Leeuwin

ecosystems as these ecosystems have been extensively cleared. Additionally, reservation in the Darling Scarp ecosystems is below the 15% target for CAR reserves.

Havel (2002) identified that nearly one-third of more than 300 vegetation complexes in the RFA region are poorly reserved using the Conservation Commission (2002) threshold of (i) < 10% of pre-European area in proposed and existing formal reserves and (ii) < 15% in proposed and existing formal and informal reserves.

Havel noted that the Swan Coastal Plain and Dandaragan Plateau subregion has a large number of very poorly reserved vegetation complexes and is therefore a conservation priority area, with 13 poorly reserved vegetation complexes. Some 36 vegetation complexes in the RFA region have less than 10% of their original area remaining, and 61 vegetation complexes have between 10% and 30% of their original area remaining (from analysis of primary data - not directly from Havel 2002)

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroi</i>	V	iii	v	iii	v (fox)
<i>Myrmecobius fasciatus</i>	V	ii	iv	iii	ii, v (fox, cat)
<i>Pseudocheirus occidentalis</i>	V	iii	v	iii	ii, v (fox, cat), vii
<i>Setonix brachyurus</i>	V	ii	iv	iii	v (fox), vii,
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, vii
<i>Atrichornis clamosus</i>	V	ii	v	iii	v (fox, cat, pig, black rat), vii
<i>Botaurus poiciloptilus</i>	V	ii	iii	iii	i, ii, v, vii, ix, x
<i>Calyptorhynchus baudinii</i>	V	ii	iii	iii	i, ii, vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 11 (NATIVE BEES)</b>					
<i>Leioproctus douglasiellus</i>	E	Unknown	vi	ii	Unknown threatening processes
<i>Neopasiphae simplicior</i>	E	Unknown	vi	ii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Arbanitis inornatus</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Trichosternus relictus</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Throscodectes xiphos</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Ninox connivens connivens</i>	P2	ii	iii	iii	i, ii
<i>Leioproctus bilobatus</i>	P2	Unknown	vi		Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*).

Species Name	WA Status	Number of Populations in JF1	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>						
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	CR	15	iii	iv	iii	i, ii, iv, v, vi, vii, viii, x, xii (roads)
<i>Darwinia carnea</i>	CR	4	i	ii	iii	i, ii, iv, v, vi, vii
<i>Eremophila scaberula</i>	CR	2	i	v	Unknown	iv (stock)
<i>Hemigenia ramosissima</i>	CR	3	iii	iv	Unknown	xii (small population size)
<i>Thomasia</i> sp. Green Hill (Paust 1322)	CR	2	ii	iii	iii	i, ii, v, vi, vii, xii (roads)

Species Name	WA Status	Number of Populations in JF1	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	CR	1	ii	iii	iii	i, ii, iv, v, vi, vii, xii (roads; area subject to mining)
<i>Conospermum densiflorum</i> subsp. <i>unicephalatum</i>	E	4	ii	iii	iii	i, ii, vi, xii (roads), viii ( <i>Phytophthora</i> sp.)
<i>Conostylis drummondii</i>	E	1	ii	iv		xii (small population size)
<i>Darwinia acerosa</i>	E	5	iii	iii	iii	i, ii, iv, vi, vii
<i>Drakaea elastica</i>	E	1	ii	iii	iii	i, ii, iv, vi, vii, xii (roads; small population size)
<i>Dryandra mimica</i>	E	12	iii	v	iii	i, ii, vi, vii, xii (roads), viii ( <i>Phytophthora</i> sp.)
<i>Eucalyptus dolorosa</i>	E	1	iii	iii	iii	i, ii, vii, xii (only one population)
<i>Eucalyptus impensa</i>	E	1	iii	iii	iii	i, ii, vii, viii, xii (sand mining)
<i>Eucalyptus pruiniramis</i>	E	2	iii	iii	iii	i, ii, vii, viii, xii (roads)
<i>Grevillea rara</i>	E	13	iii	v	iii	ii, x,
<i>Jacksonia velveta</i> ms	E	1	ii	iii		xii (small population size)
<i>Thelymitra stellata</i>	E	3	ii	ii	iii	i, ii, vi, vii, xii (roads, gravel extraction and recreation)
<i>Acacia anomala</i>	V	5	ii	iii	iii	i, ii, iii, vi, vii, viii, xii (roads; recreation; small population size)
<i>Acacia forrestiana</i>	V	3	iii	iii	iii	i, ii, vii, viii
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	V	24	iii	v	iii	vii
<i>Daviesia dielsii</i>	V	3	iii	iii	iii	i, ii, vi, xii (roads), vii
<i>Diuris micrantha</i>	V	1	iii	iv	iii	No known threatening processes
<i>Dryandra serratuloides</i> subsp. <i>serratuloides</i>	V	19	ii	iii	iii	viii ( <i>Phytophthora</i> sp.)
<i>Eleocharis keigheryi</i>	V	4	iii	iv	iii	i, ii, iv, v, vi, ix, x, xii (roads)
<i>Eucalyptus olivacea</i> ms	V	2	ii	iii	iii	ii, xii (lack of recruitment)
<i>Ptychosema pusillum</i>	V	1	ii	iv	iii	i, ii, vi, vii (appears only after fire), xii (roads; only one population)
<i>Tribonanthes purpurea</i>	V	1	iii	iv	iii	i, ii, vi, vii,
<b>PRIORITY 1</b>						
<i>Dampiera tephrea</i>	1		iii	iv	iii	xii (very little is known about the species)
<i>Eucalyptus annuliformis</i>	1		iii	iv	iii	xii (very little is known about the species)
<i>Micromyrtus rogeri</i> ms	1		iii	iv	iii	xii (small population size)
<i>Stenanthemum introprubens</i>	1		Unknown	vi	Unknown	Unknown threatening processes
<i>Synaphea panhesya</i>	1		iii	iii	iii	viii ( <i>Phytophthora</i> sp.)
<i>Verticordia huegellii</i> var. <i>tridens</i>	1		iii	iii	iii	viii ( <i>Phytophthora</i> sp.)
<b>PRIORITY 2</b>						
<i>Andersonia carinata</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion), viii ( <i>Phytophthora</i> sp.)
<i>Dryandra subpinnatifida</i> var. <i>imberbis</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Goodenia arthrotricha</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Grevillea candolleana</i>	2		ii-iii	iv	iii	xii (small population size), vii
<i>Grevillea crowleyae</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)
<i>Leucopogon florulentus</i>	2		ii-iii	iv	iii	xii (populations on edge of geographic range in subregion)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Vegetation Associations containing more than 80% of their total extent in the JF1 subregion and for which less than 30% is contained in any type of reserve are considered reservation priorities. There are 11 vegetation associations that only have between 10% and 30% of their pre-european JF1 area remaining, and so could be

considered threatened. All eleven have less than 10% of their JF1 pre-European area contained in CALM reserves. However only three (Beard Vegetation Associations 1021, 4, and 7) have greater than 10% of their total extent in JF1 and thus may be of priority for conservation in this subregion.

Beard Veg Assoc	Description	IUCN I-V (ha)	IUCN V-VI (ha)	CALM Lease	Priority	Notes
1021	Mosaic: Medium open woodland; wandoo/Shrublands; dryandra heath	0	0	0	H	Found exclusively in JF1, yet only 10.8% (157.9 ha) of the pre-european extent survives. There is no representation of this association in the CALM estate.
1043	Medium woodland: York gum, wandoo & salmon gum ( <i>E. salmonophloia</i> )	0	0	0	H	Found exclusively within the JF1 subregion and adjoins association 1021. Though 40.5% (1795.4 ha) of the pre-european extent remains, there is no representation of this association in the CALM estate.
973	Low forest: paperbark ( <i>Melaleuca raphiophylla</i> )				H	JF1 contains only 1.1% of the total current extent of this association. While conservation of this association should be sought in the other subregions, to date this has not been achieved with only 6.6% of the total current extent (3.8% of the pre-european extent) contained in the CALM estate.
1182	Medium woodland: <i>Eucalyptus rudis</i> & <i>Melaleuca raphiophylla</i>				L	JF1 contains only the smallest occurrences representing 0.2% of the total current extent of this association. Conservation of this association would be better achieved in other subregions
4	Medium woodland: marri & wandoo	69 255.3			L	73.1% of the total current extent of association occurs within JF1. This subregion has reserved 23.6% (69 255.3 ha) of the total current extent across all regions in CALM estate.
7	Medium woodland: York gum ( <i>E. loxophleba</i> ) & wandoo	526.4			H	JF1 contains 27.1% of the total current extent of association. Across all bioregions only 1.8% (526.4 ha) of the current extent is contained in CALM estate reserves. In JF1 only 1.6% of the subregional extent of this association is contained in the CALM estate.

- In JF1 vegetation association 1182 is not contained in the CALM estate. However 64.4% of the current total extent representing 30.1% of the pre-european extent in other subregions is contained in the CALM estate. Reservation of the JF1 occurrences of 1182 is not a priority for the conservation of this vegetation association.
- 22.9% (4.7 ha) of the occurrence of 973 in the JF1 subregion is contained in CALM estate. Priority should be given to reserving further occurrences of this association across its distribution including those contained in JF1.
- The RFA has identified a range of ecosystems that have a high priority for reservation, including Jarrah Rates Tingle, Jarrah Red Tingle, Karri rates Tingle, Bullich and Yate, many ecosystems in the Darling Scarp and Jarrah in the Leeuwin.

### Subregional constraints in order of priority

(see Appendix B, key g)

**Other:** Regional Forest Agreement reserve recommendations already in process of being implemented, and may supersede the above reserve consolidation priorities.

**Irreplacibility:** In South east and northern portions of the subregion due to extensive agricultural clearing.

### Bioregional and subregional priority for reserve consolidation

(see Appendix D, and Appendix C, rank 4)

The priority for reserve consolidation can be viewed in two ways:

- 1) Considering only reserves meeting IUCN categories I - IV criteria:
  - 5.8% of the bioregion area is contained in reserves and 56.4% of the native vegetation cover remains.
  - This places the JF region into IBRA Class 3d#. ie: (5-10%) reservation and >30% remaining vegetation cover.

2) Considering all CALM estate:

- 36.4% of the area is reserved and 56.4% of the native vegetation cover remains.
- This falls into IBRA Class 5d#. ie: >15% reservation and >30% native vegetation cover.

Analysis has been based on only gazetted reserves have been used for calculations, therefore formal proposals have the potential to more than double the reserve system, however these have not yet been finalised.

The south-eastern and northern portions of the Northern Jarrah Forest region, below the 600mm isohyet are generally poorly represented in conservation reserves. This is the woolbelt and wheatbelt portions of the subregion which have had extensive clearing for agriculture. The 700 – 500mm rainfall zone is exhibiting rapid rises in ground water levels up to 1m per year which is impacting on riparian vegetation and contributing to accelerated *Phytophthora* disease impacts. *Armillaria* fungus is very critical in eastern areas of woodlands and forest.

## Reserve management standard

JF1 contains 60 nature reserves, 8 National Parks and 9 Conservation Parks (including Lane Poole as a Conservation Park). At present there are government proposals for an additional five national parks, but these are in the early stages of implementation, and so have been excluded from this discussion.

**Nature Reserves:** Reserve Management standards is (i) Poor (see Appendix C, rank 5). Threatening Processes are not well managed and this is leading to permanent resource degradation for majority of reserves in the eastern and northern zone. Management standards are (ii) Fair (biodiversity values and/or management issues are poorly identified, resource degradation is occurring though retrievable), for other reserves.

The bulk of the nature reserves are small (<100 ha) and scattered across the subregion. There are no resident staff for these reserves, management visitation varies but is usually restricted to a minimum of once per year. None of these reserves have formal approved management plans or interim management guidelines. Their small size and often remnant vegetation function means that most reserves have significant weed invasion, especially pasture grasses. In the eastern portion of the subregion, reserves containing drainage lines and water courses are increasingly impacted by salinity and/or rising water tables. Feral animals (foxes, rabbits and increasingly in the western sections, pigs) are not controlled in all but the largest reserves. In the western and middle parts of the subregion, *Phytophthora* disease is impacting on

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Species Recovery Plan	General Recovery Plan
<i>Pseudocheirus occidentalis</i>	IRP	Action Plan for Australian Marsupials and Monotremes
<i>Calyptorhynchus baudinii</i>	No	Action Plan for Australian Birds
<i>Calyptorhynchus latirostris</i>	RP (draft)	Action Plan for Australian Birds
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)

vegetation communities in the reserves. This is compounded by the rising water tables.

In the eastern reserves understory species composition is often depauperate and in a degraded state resulting from grass weed invasion, grazing impacts and extended fire frequencies. Fire regimes based on biodiversity outcomes area absent, and deliberately lit wildfires can and do occur frequently depending on the proximity of the reserve to urbanisation. Formalised biodiversity monitoring programs are absent.

**National Parks:** Reserve Management standards is (iii) Good, major biodiversity issues effectively managed. The majority of parks have management plans which are being implemented, though targeted ecological monitoring programs are either absent or inadequate. Size ranges from 20ha to 4300ha, with 7 of the 8 parks primarily servicing the recreation and day visitor requirements of the Perth metropolitan area. Five of the parks have staff in residence. Excluding Avon Valley National Park, all parks are situated on the western edge of the subregion, on or close to the Darling Escarpment and often associated with river valleys. Thus the overall diversity of vegetation communities contained across these reserves is limited. Feral animal control in these parks can be hampered by their close proximity to urbanisation. Salinity issues are generally not evident on the western side of the subregion but are impacting in the Avon Valley National Park. Fungal disease (*Phytophthora cinnamomi*) is present in all of the parks as are a range of weed species, especially species associated with riparian and moisture gaining sites. Fire regimes are often influenced by the requirement to protect adjoining land values. In most parks formalised biodiversity monitoring programs are absent.

**Conservation Parks:** Reserve Management standards is (ii) Fair, biodiversity values and issues are poorly identified, degradation is retrievable. Management Plans in preparation stages for only 1 reserve (Lane Poole). None of the Conservation Parks have resident staff. Size ranges from 32ha to approx 5100ha with the majority being larger than 1000 ha. Four of these reserves are located in the eastern side of the subregion and are subject to increasing salinity degradation and/or rising water tables which impacts on the riparian habitats. Weed invasion along riparian habitats and extensive pasture grass in the eastern zone is of concern. Fire regimes are yet to be optimised for biodiversity outcomes. In most parks formalised biodiversity monitoring programs are absent although the eastern zone parks may have permanent monitoring plots, established as part of the State Salinity Strategy (State Salinity Council of Western Australia 2000).

<i>Darwinia carnea</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Eremophila scaberula</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Grevillea althoferorum</i>	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Hemigenia ramosissima</i>	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Thomasia</i> sp. Green Hill (Paust 1322)	IRP	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Forest Management Plan (draft)

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Pseudocheirus occidentalis</i>	ii, iii, xiv, x, xiii,	Conservation on public lands managed by CALM. Other - Research into impacts of logging and minimise impacts of land developments; Management of injured, displaced or nuisance possums. Translocations into areas of fox control. Capacity building with community and landholders including education, liaison and communication.
<i>Calyptorhynchus baudinii</i>	xii, xi	Research - Develop repeatable population monitoring technique and monitor in different areas of the birds' range. Other - Help orchardists develop non-lethal damage control measures, and make shooting of birds illegal.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, xii, xiv	Habitat protection through reserves, on private lands and on other state lands - Management of feeding habitat in non-breeding areas and in priority areas. Research - Population monitoring. Other - Encourage community involvement and establish captive breeding programme.
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	xiii, xii, xiv, vi, ix, v	Capacity building with landowners and authorities. Research - Population monitoring, preservation of genetic diversity in the form of seed collection, further surveys and research of ecological and biological information. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written. Weed control. Fire management. Fencing as exclosures.
<i>Darwinia carnea</i>	v, ix, xii, vii, vi, xiv, i, x	Fencing of one sub-population. Fire management. Research - Preservation of genetic diversity of the species in the form of seed collection, population monitoring and conduction of further surveys. Feral animal control (rabbits). Weed control. Other - Information regarding the species needs to be disseminated to as many people as possible. Habitat retention through purchase of land for reserves. Translocation of propagated plants.
<i>Eremophila scaberula</i>	vi, xii, ix, xiv	Weed control. Research - Attempt to stimulate germination, population monitoring, conduction of further surveys and research of ecological and biological information. Fire management. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
<i>Grevillea althoferorum</i>	xii, xiii, ix, x, xiv	Research - Population monitoring, monitoring of the spread of dieback and implement disease hygiene procedures, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research of ecological and biological information. Capacity building required with adjacent land manager. Fire management. Translocation of plants, including propagation of new plants. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Hemigenia ramosissima</i>	xiii, xii, xiv, x, ix	Capacity building with landholders and other government departments. Research - Population monitoring, conduction of further surveys, and research biological and ecological information. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written. Weed control using proven, best practice methods. Translocation of plants, including propagation of new plants (via collect seed or cutting material). Fire management.
<i>Thomasia</i> sp. Green Hill (Paust 1322)	xiv, v, vi, ix, xii	Other - Notify all relevant land managers of species. Maintain boundary fence. Weed control. Fire management. Research - Population monitoring, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research biological and ecological information. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	ix, xii, xiv	Fire management. Research - Population monitoring, monitoring of the spread of dieback and implement disease hygiene procedures, preservation of genetic diversity of the species in the form of seed and cutting collection, conduction of further surveys and research of ecological and biological information. Other - Re-assessment of Critical ranking may be warranted since survey work revealed more populations.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Species Recovery Plan	General Recovery Plan
Threatened flora on farmland in the eastern and northern zone of the subregion.	Interim Recovery Plans are in place for critically endangered species. Only limited work has been undertaken for other	State Salinity Strategy being implemented.

	species.	
Understorey vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches	Interim Recovery Plans are in place for critically endangered species. Only limited work has been undertaken for other species.	State Salinity Strategy being implemented.
Low Forest: paperbark ( <i>Melaleuca raphiophylla</i> ) (Beard Veg Assoc 973)	No	No
Mosaic: Medium open woodland/Shrublands: Dryandra heath (Beard Veg Assoc 1021)	No	No
Mosaic: Medium open woodland wandoo and powderbark wandoo/Shrublands: Dryandra heath (Beard Veg Assoc 1043)	No	No
Medium woodland: York gum ( <i>E. loxophleba</i> ) & wandoo (Beard Veg Assoc 7)	No	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Description
Threatened flora on farmland in the eastern and northern zone of the subregion.	Recovery Actions are detailed in the State Salinity Strategy. Suggested recovery actions could be: i, ii, iii, v, vi, vii, ix, xi, xiii.	Habitat retention through reserves, on private land and on state lands. Fencing of sensitive areas as exclosures. Weed control. Feral animal control. Fire management. Reinstatement of hydrology. Capacity building with community and landholders.
Understorey vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches	Recovery Actions are detailed for some vegetation patches in the State Salinity Strategy. Recovery actions are yet to be identified for other patches. Suggested recovery actions could be: i, ii, iii, v, vi, vii, ix, xi, xiii.	Habitat retention through reserves, on private land and on state lands. Fencing of sensitive areas as exclosures. Weed control. Feral animal control. Fire management. Reinstatement of hydrology. Capacity building with community and landholders.
Low Forest: paperbark ( <i>Melaleuca raphiophylla</i> ) (Beard Veg Assoc 973)	i, ii, vi, viii, vii, ix	Habitat retention through reserves and on private lands. Weed control, particularly invasive pasture grasses. Revegetation. Feral animal control of cats, foxes, and rabbits. Fire management.
Mosaic: Medium open woodland/Shrublands: dryandra heath (Beard Veg Assoc 1021)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.
Ecosystem	Recovery Actions <sup>1</sup>	Recovery Description
Mosaic: Medium open woodland wandoo and powderbark wandoo/Shrublands: dryandra heath (Beard Veg Assoc 1043)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.
Medium woodland: York gum ( <i>E. loxophleba</i> ) & wandoo (Beard Veg Assoc 7)	i, ii, xi, vii, ix	Habitat retention through reserves and on private lands. Reinstatement of hydrology. Feral animal control of rabbits. Fire management.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

The priority for off park conservation in JF1 is (ii) (see Appendix C, rank 6), particularly in the Eastern and Northern Zones. A large off park effort needed, however resource constraints, limited community capacity to deal with salinity and rising water levels, and habitat loss or fragmentation exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Hardwood timber industry via the RFA process.

**Threat Abatement Planning as Part of NRM:** e.g. State Salinity Strategy; feral animal control programs such as Western Shield, which has limited cooperative participation by landholders.

**Industry Codes of Practice:** Such as for Bluegum Plantations.

**Integration With Property Management Planning:** Limited application only.

### Feasible opportunities for NRM

**Institutional Reform:** Rural reconstruction, industry reconstruction, new tenure and management arrangements in the woolbelt and wheatbelt. ie: Eastern and Northern Zones of the subregion.

**Other Planning Opportunities Including Local Government Planning and National Action Plan for Water Quality and Salinity.**

**Integration With Property Management Planning, and Catchment Planning.**

### Impediments or constraints to opportunities

There are a variety of constraints to this these opportunities, such as: lack of funding; agency and community staffing resources; and the community's poorly developed understanding of biodiversity and processes of integrating conservation practises into other forms of land management.

## Subregions where specific NRM actions are a priority to pursue

The NRM priority for Eastern and Northern zone of JF1 is (i) (see Appendix C, rank 7), indicating that there are major constraints to NRM, and structural reform is needed owing to extent of past degradation, social and economic disruption. The remainder of JF1 has a rank of (iii) because NRM in place. The overall rank is (iii).

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Vegetation mapping under several different systems (Beard 1980a, Beard 1974d) is available at a resolution of 1:100000 or 1:250000, whilst the mapping by Matisse and Havel (1998b) is available at a resolution of 1:50 000 and published at 1:250 000. The mapping for these systems is based on (informed and attributed) structural types or (informed and attributed) underlying geomorphic/landscape relationships with vegetation communities present. Both have strengths and weaknesses in development of a CAR reserve system. Other regional scale vegetation mapping has been completed to support the RFA process.

Community identification based on floristics has been done for most of the bioregion (see Matisse and Havel 1997) but complexity of pattern on the landscape (hence cost of mapping) has prevented vegetation and ecosystem mapping based on the community types delineated, although localised areas have been mapped at the more detail local scale.

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075	Beard, J.S.	(1980a).	A new phytogeographic map of Western Australia.	Western Australian Herbarium Research Notes 3, 37-58.	J
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142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
183	Commonwealth and Western Australian Governments	(1999).	Regional Forest Agreement for the south-west forest region of Western Australia between the Commonwealth of Australia & the State of Western Australia.	Government of Western Australia, Perth.	R
184	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998a).	Comprehensive Regional Assessment: A Regional Forest Agreement for Western Australia. Volume 1.	The Committee, Canberra.	R
185	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998b).	Comprehensive Regional Assessment: A Regional Forest Agreement for Western Australia. Volume 2, Maps.	The Committee, Canberra.	R
186	Commonwealth and Western Australian Regional Forest Agreement Steering Committee	(1998c).	Comprehensive Regional Assessment: National estate identification and assessment in the south west forest	A Regional Forest Agreement for Western Australia. The Committee, Canberra.	R

**Systematic Vertebrate Survey:** Data is not available for approximately 80% of subregion. Invertebrate plots are confined to Noisy Scrub Bird Sites in southern sections of subregion. Fauna data sparse & patchy, limited to SAP quadrats & Operation Foxglove quadrants and roadside cage trap transects associated with Western Shield monitoring. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates. Surveys have also been undertaken on a range of research sites in the region.

**Floristic Data:** Although regional survey of flora has been completed, it is based on patchy sampling quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of most species, including predators (foxes, cats), invertebrates and reptiles.

#### Other Priority Data Gaps Include:

- At present there is some quantitative data on the effect of exotic predators (Operation Foxglove) but no quantitative data on weed colonisation, fragmentation effects, fire, *Phytophthora* sp. impacts on threatened species.
- The effect of salinity/inundation on species composition of communities in the eastern zone of the region is currently being documented.

			region of Western Australia.		
859	Conservation Commission	(2002).	Conservation Commission advice and recommendations to the Minister for Environment and Heritage. A review of high conservation values in Western Australia's south-west forests. 25th March 2002.	Conservation Commission of Western Australia. <a href="http://www.conservation.wa.gov.au/files/docs/59.pdf">http://www.conservation.wa.gov.au/files/docs/59.pdf</a>	O
223	Department of Conservation and Land Management	(1987b).	Northern Forest Region Management Plan.	Department of Conservation and Land Management	R
225	Department of Conservation and Land Management	(1994a).	Forest Management Plan 1994 - 2003.	Department of Conservation and Land Management	R
816	Department of Conservation and Land Management	(1998).	Comprehensive Regional Assessment - Maps (Volume 2)	Commonwealth and Western Australian Regional Forest Agreement (RFA) Steering Committee	B

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745	Evans, R. and English, V.	(1999).	Green Hill Thomasia ( <i>Thomasia</i> sp. Green Hill) Interim Recovery Plan 1999-2002 (IRP No 26)	Department of Conservation and Land Management	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
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767	Hamilton-Brown, S. and English, V.	(1999).	Split-leaved grevillea ( <i>Grevillea althoferorum</i> ) Interim Recovery Plan 1999-2002 (IRP No 42)	Department of Conservation and Land Management	O
860	Havel, J.J.	(2002).	Review of management options for poorly represented vegetation complexes.	Prepared for Conservation Commission by Mattiske Consulting Pty Ltd. December 2002.	R
857	Hearn, R., Stoneman, G.L., Keighery, G., Burrows, N., Yates, C. and Hopper, S.	(2003).	Advice to the Conservation Commission's Forest Management Plan Steering Committee in Relation to the Management of Significant Flora Values.		R
756	Holland, E., Kershaw, K. and Brown, A.	(1996).	Mogumber bell ( <i>Darwinia carnea</i> ) Interim Recovery Plan 1996-1999 (IRP No 10) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O
478	Mattiske, E.M., Havel, J.J.	(1997).	Review and integration of floristic classifications in the south-west forest region of Western Australia: a report to the Commonwealth and Western Australian governments for the Western Australian Regional Forest Agreement.	Mattiske Consulting Pty.Ltd. Perth.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
746	Stack, G. and English, V.	(1999).	Rough Emu Bush ( <i>Eremophila scaberula</i> ) Interim Recovery Plan 1999-2002 (IRP No 28)	Department of Conservation and Land Management	O
828	State Salinity Council of Western Australia	(2000).	Salinity: natural resource management in Western Australia. The salinity strategy Salinity actions: a guide for land managers	State Salinity Council of Western Australia	O
698	Williams, K., Horan, A., Wood, S. and Webb, A.	(2001).	Declared rare and poorly known flora in the Central Forest Region: Western Australian wildlife management program 33.	Department of Conservation and Land Management, Perth.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 098, 181, 221, 222, 225, 258, 351, 452, 480, 573, 614, 647 and 658 in Appendix A.

# Jarrah Forest 2 (JF2 – Southern Jarrah Forest subregion)

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## Subregional description and biodiversity values

### Description and area

Duricrusted plateau of Yilgarn Craton characterised by Jarrah-Marri forest on laterite gravels and, in the eastern part, by Wandoo - Marri woodlands on clayey soils. Eluvial and alluvial deposits support *Agonis* shrublands. In areas of Mesozoic sediments, Jarrah forests occur in a mosaic with a variety of species-rich shrublands. The climate is Warm Mediterranean and.

Southern Jarrah Forest: South of Collie the plateau broadens and slopes gently to the south coast. Drainage is still dissected in the west but broadening and leveling of the surface in the east causes poor drainage and large and small wetlands. The ironstone becomes less evident being buried beneath sands. Rainfall is from 1200 mm in the south-west to 500 mm in the east. Vegetation comprises Jarrah - Marri forest in the west grading to Marri and Wandoo woodlands in the east. There are extensive areas of swamp vegetation in the south-east, dominated by Paperbarks and Swamp Yate. The understory component of the forest and woodland reflects the more mesic nature of this area. The majority of the diversity in the communities occurs on the lower slopes or near granite soils where there are rapid changes in site conditions. Subregional area of JF2 is 3, 160, 122ha.

### Dominant land use

(see Appendix B, key b)

Dominant land use is mainly grazing (improved pastures) & dry land agriculture, forestry (of native forest), and conservation. There are smaller (but still significant) areas of forestry (plantations), irrigated horticulture, mining, rural residential, and easements (for roads, power lines etc).

### Continental Stress Class

The Continental Stress Class for JF2 is 3, however this is an underestimate. While substantial parts of the west in the subregion reasonably reflect the Continental Stress Class of 3, the eastern half of the subregion is cleared for dryland agriculture and is suffering the same fate as the Avon Wheatbelt. The number of threatened plants has also been seriously underestimated for the subregion (54 DRF and at least 90 P1 & P2) with many of the P1 and P2 taxa likely to move to Declared Rare Flora as their status is confirmed. A Continental Stress Class of 1 (or at least 2) would more accurately reflect the reality for the subregion overall.

Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

There is extensive native forest cover, but the biota is patchy considering geological & geomorphic uniformity.

- The subregion is home to rare plants (such as eastern zone Critical status orchids *Drakaea confluens*, and *Caladenia bryceana* subsp *bryceana*).
- Rare birds - Muir's Corella (*Cacatua pastinator pastinator*), Western Whipbird (*Psophodes nigrogularis*), Western Bristlebird (*Dasyornis longirostris*), Noisy Scrub-Bird (*Atrichornis clamosus*).
- Critical Weight Range mammals - Gilbert's Potoroo (*Potorous gilbertii*), Southern Brown Bandicoot (*Isodon obesulus*), Chuditch (*Dasyurus geoffroii*), and Red-tailed Phascogale (*Phascogale calura*).
- Rare frogs (for example, White-bellied Frog (*Geocrinia alba*), Yellow-bellied Frog (*G. vitellina*), and Sunset Frog (*Spicospina flammocaerulea*).
- Freshwater wetland *Baumea* reed beds are a unique feature in forest and adjacent areas.

### Centres of Endemism:

Unlike the Warren Bioregion, no systematic analyses have been carried out on the flora of the Southern Jarrah subregion. However, analysis done for the Regional Forest Agreement identified concentrations of local endemics (species with ranges of less than 100km) in the South West Forest Region. It identified several areas that constituted centres of narrow endemism: the Blackwood Plateau, the Busselton Ironstones and Whicher Ranges, and the "Denbarker" area North East of Walpole (Department of Conservation and Land Management 1998).

At the taxonomic group level, like the whole South West, this area is rich in endemics in families such as the Orchidaceae, Papilionaceae, Myrtaceae, Restionaceae and Rutaceae.

As with the Warren, on the limited data available, the aquatic fauna of the bioregion shows a similar, if not stronger pattern of endemism than the flora (Trayler *et al.* 1996). The peat swamp communities, the fresh water and naturally saline wetland systems all contain local endemics of significance. The invertebrate fauna shows similar patterns with a significant endemic fauna in the forests and wetlands of the region.

### Refugia:

Despite the impacts of climate fluctuations through the quaternary on the South-West, significant characteristics of this bioregion exist because it has to a large extent been buffered against the complete intrusion of the

eremean. Close to the south-west coastal strip and with south to south west slopes rising to the darling plateau it has benefited from proximity to the southern ocean and the rain bearing weather systems that have trailed the coast even during the driest periods of the ice ages. While more modified than the Warren bioregion, the JF2 subregion contains refugia with relict taxa of a wetter milder era with groups and species of vascular and cryptic flora and invertebrates normally associated with the rainforests/*Nothofagus* forests and wetlands of South East Australia, these species now absent from the rest of the State. For example, peat or organic wetlands are home to relictual and other aquatic invertebrates and restricted and rare frogs (such as *Spicospina flammocaerulea* and the *Geocrinia* species of the Blackwood Valley).

Three ground dwelling near flightless birds species (Noisy Scrub Bird, Western Whipbird and Western Bristlebird) and highly restricted mammals (Gilberts Potoroo and Dibbler) are found at Two Peoples Bay Nature Reserve.

The Porongurups provide refugia for *Moggridgea* species of spider and velvet worms (Oncophora) and a range of like relict taxa.

The Lake Muir – Unicup complex of wetlands are home to a range of aquatic invertebrates such the Poarginup water mites and other taxa with affinities with species groups in Tasmania and South Eastern Australia. Similar data exists for some wetlands of the Denbarker area.

#### **High Species or Ecosystems Diversity:**

Regional Forest Agreement analysis of species diversity highlighted areas of the Blackwood Plateau, and the Denmark – Mount Barker (Denbarker) area for flora. Early results of survey of aquatic invertebrates in the wetlands of the Muir-Unicup and Denbarker area indicate high species richness relative to similar systems elsewhere in the southern states.

Recent studies on the mosaic of forests, woodlands and heaths on the eastern and northeastern fringes are in the moderate range of species. As indicated above the majority of this species richness results from the rapid changes in communities on the lower slopes and on the variable soil types.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 and 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the in the CTRC Green and Red Books, as did the System 6 study of 1981 (Environmental Protection Authority 1975; Environmental Protection Authority 1983). Some but not all of these recommendations (with modification) were implemented over the following years.

The southern and western parts of the subregion are covered by a CALM Regional Management Plan published in 1994, that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its approach. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion (Department of Conservation and Land Management 1994a).

South West Forests Regional Forest Agreement throughout 1997 and 1998 reviewed all but Eastern parts of the Warren Bioregion against National CAR criteria and developed a reserve system and agreed strategies to conform to National Biodiversity Conservation Objectives (Lamont *et al.* 1997; Mattiske and Havel 1997; Atkins 1997; Christensen 1997; Commonwealth and Western Australian Governments 1999). The Forest Management Plan (draft) was released in 2002 and further develops the CAR reserve system established in the RFA process (Department of Conservation and Land Management and the Conservation Commission 2002).

The South West Regional Strategy for Natural Resource Management was released as a working draft in January 2001 (South West Catchment Council 2002a). The Bush & Biodiversity section based on the same data sets used for this Biodiversity Audit identified poorly conserved vegetation associations and nodes of high value fauna conservation within all but the eastern quarter of the JF2 bioregion. Other sections of the document deal with Waterways and Wetlands, Land Resources and Coastal Environs. The final draft in March 2002 establishes strategic targeted recommendations for implementation within the NRM Region and cover a substantial part of the Bioregion (South West Catchment Council 2002b).

The South Coast NRM Region has yet to produce a similar analysis.

## Wetlands

## Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Byenup Lagoon System, JF002WA	B5, B7, B13, B14, B15	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, deer, horses, cats & rabbits), vi (Watsonia, East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies), vii, viii (particularly <i>Phytophthora</i> dieback in adjacent forests and heaths), ix, x, xi (herbicide runoff from agricultural areas and plantations), xii (eutrophication from agricultural and plantation fertilisers; plantation harvesting and return to traditional agriculture on several significant holdings; illegal Tea Tree cutting for bean sticks, cray pots and brush fencing; illegal cattle and horse grazing).
Lake Muir, JF004WA	B8, B12	iii & iv	iv	iii	v (foxes, pigs, deer, horses, cats & rabbits), vii, xi (spray drift from Blue Gum Plantations), xii (illegal use of lake surface and margins and adjacent wetlands by motor vehicles, horse riders; illegal cattle and horse grazing; adjacent peat mining).
Blackwood River (Lower Reaches) and Tributaries System to Sues Bridge WAR001WA	B1, B2	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, cats & rabbits), vi (Watsonia, exotic Grasses, various clovers and allies), vii, viii ( <i>Phytophthora</i> dieback in adjacent forests and heaths), ix, x, xi (herbicides - agricultural and plantation), xii (eutrophication resulting from agricultural and plantation fertilisers; plantation harvesting and return to traditional agriculture on several significant holdings; illegal Tea Tree cutting for bean sticks, cray pots and brush fencing; Contains threatened species <i>Geocrinia alba</i> , and <i>G. vitellina</i> )
Lake Pleasant View System, JF005WA	B9, B15	ii	iii	iii	vii, xii (eutrophication resulting from agricultural and plantation fertilisers), vi (Bridal Creeper, Agricultural crops), xi (herbicides - agricultural and plantation).
Moates Lake System, JF006WA	B5, B7, B9	iii	iii - iv	iii	vi (Blackberry, Bridal Creeper, Inkweed, Taylorina, East Coast Wattles, Victorian Tea Tree), v (exotic fish), iv (cattle), ix, vii.
Oyster Harbour, JF007WA	A6, A2, A7, A8	ii	iii	iii	xii (eutrophication, sedimentation)
Mt Soho Swamps, WAR007WA	B15	iii & iv	iv	iii	v (foxes, pigs, cats & rabbits), vi (East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies, tagasaste), vii, viii ( <i>Phytophthora</i> dieback in adjacent forests and heaths), xii (upslope erosion filling important swamps).

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Components	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Margaret River Swamps Wetland System	AMG (AGD84) 350000, 6252200	B4, B10.	ii	iv	iv	iii	iii (currently small scale but likely future increase due to proximity of Margaret River Townsite), v (pigs), vii, viii ( <i>Phytophthora</i> sp.)
St John Brook Conservation Park	AMG (AGD84) 377500, 6247700	B1	ii	iii	iv	iii	v (pigs), vii, viii ( <i>Phytophthora</i> sp.)
Milyeannup Brook and Red Gully Floodplain Systems (Headwater Swamp Systems)	AMG (AGD84) 371400, 6214100	B10, B13.	ii	iv	iv	iii	v (pigs), vii, viii ( <i>Phytophthora</i> sp.)
Powlalup Nature Reserve	AMG (AGD84) 399200, 6252700	B2, B4.	ii	iii	iii	iii	v (pigs), vi (Blackberry, <i>Pinus radiata</i> ), vii.
Tone River Floodplains – Talvelwelup Wetland System	AMG (AGD84) 479000, 6225000	B4, B10.	ii	ii - iii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Perup Swamps System	AMG (AGD84) 455000, 6207000	B2, B4, B9, B10, B13, B15, B17.	ii, v	ii - iii	iv	iii	v (foxes, pigs), vi (Bridal Creeper, pasture species), vii, viii ( <i>Phytophthora</i> sp.), ix, x, xi (fertiliser loads from adjacent

							agricultural lands).
Frankland River and Kent River Wetland System (South of Muirs Highway)	AMG (AGD84) 500000, 6167000	B1, B2, B4, B9, B10, B13, B15, B17.	ii, v	ii - iii	iii	iii	v (foxes, pigs), vi (pasture species), vii, viii ( <i>Phytophthora</i> ), ix, x, xi (fertiliser loads from adjacent agricultural lands).
Frankland/Gordon Rivers Wetland System ( North of Muirs Highway)	AMG (AGD84) 500000, 6200000	B2, B4, B5, B6, B8, B10, B12.	ii, v	i - ii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Upper Kent River Wetland System ( North of Muirs Highway)	AMG (AGD84) 532000, 6185000	B2, B4, B5, B6, B8, B10, B12.	ii, v	i - ii	iii	iii	vi (pasture species), ix, x, xi (fertilisers, pesticides).
Denmark River/Hay River System	AMG (AGD84) 544000, 6140000	B1, B2, B4, B9, B10, B13, B15, B17, C1.	ii, v	i – ii for Hay and lower Denmark; iii – iv for other areas	iv	iii	v (foxes, pigs), vi (Bridal Creeper, Gorse, pasture species), vii, viii ( <i>Phytophthora</i> ), ix, x, xi (fertiliser loads from adjacent agricultural lands).
Arthur River Wetland System (including Towering Lake, etc)	AMG (AGD84) 479900, 6284100	B7, B8, B2.	ii	ii	ii	iii	i, ii, ix, x.
Beaufort River Wetland System	AMG (AGD84) 500000, 6288000	B7, B8, B2.	ii	i - ii	ii	iii	ii, ix, x.
Mill Brook	AMG (AGD84) 576000, 6142000	B2, B4, B10	ii, v	iii	iii	iii	i, v, vi, vii, viii, ix, xi
Gull Rock/Ledge Point Wetlands	AMG (AGD84) 591000, 6126000	A11, B2, B5, B10, B13, B15	ii, iii, v	iv	iv	iii	v, vii
Lake Seppings	AMG (AGD84) 583500, 6125000	A7, A8, A9, A11	ii, iii, v	iii	iii	iii	i, v, vi, x, xi

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Collie River	i	v	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (existing water diversion and storage upstream: mining)
Preston River/Ferguson River	i	iv	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
Capel River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Ludlow River (Blackwood Plateau and Scarp only)	iii	iv	ii	vii
Abba River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Sabina River (Blackwood Plateau only)	iii	iv	ii	vii
Vasse River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Buayanyup River (Blackwood Plateau only)	i	iv	ii	i, ii, vi, vii, x, xi (fertilizers and pesticides)
Carbanup River (Blackwood Plateau only)	i	iv	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides)
Margaret River	ii-iii	iii-iv	ii	i, vi (Blackberry, Arum Lilly, pasture species), vii, x, xi (fertilizers and pesticides)
Blackwood River (and tributaries outside main forest belt)	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (recreation use; water diversion and storage upstream)
Blackwood River Tributaries within the main forest belt	ii-iii	iv	ii	v (pigs), vi (Blackberry), vii
Donnelly River (headwater floodplains)	i	iii	ii	i, ii, vi, (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides)
Warren River	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides), xii (future water diversion and storage)
Deep River	iii	iii	iv	vii
Frankland River	i	iii	ii	i, ii, vi (Blackberry, pasture species), vii, ix, x, xi (fertilizers and pesticides)
Bow River	iii	iv	ii	vii, xii (future water diversion and storage)
Kent River/Styx River	ii-iii	iv	ii	i, ii, vii, ix, x, xi (fertilizers and pesticides), xii (future water diversion and storage)

Denmark River	iii	iii	ii	vii, xii (future water diversion and storage)
Hay River	i-ii	iii	ii	i, ii, vi (pasture species), vii, x, xi (fertilizers and pesticides), xii (current water diversion and storage)
Sleeman Creek	i	iii	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
King River/Mill Brook	i	iii	ii	i, ii, vi (pasture species), vii, ix, x, xi (fertilizers and pesticides)
Kalgan River/Napier Creek/Young River	i	iii	ii	i, ii, vi, vii, ix, x, xi (fertilizers and pesticides)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Subregion	Threatening Processes <sup>5</sup>
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area)	CR	28	iii	iii	iii	SWA2/JF2	i, ii, viii, iv, xii (mineral exploration)
<i>Calothamnus graniticus</i> heaths on south west coastal granites	V	32	iii	iv	iii	JF2	i, ii, vii, viii, xii (recreation), iv

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

In general, plant communities comprised of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Subregion	Threatening Processes <sup>5</sup>
Rimstone pools, algal nodules and cave structures formed by microbial activity on marine shorelines.	EN	41	ii	iii	iii	WAR/JF2	vi (kikuyu), x
<i>Banksia coccinea</i> community in dieback free area - Gull Rock (South Coast region pers. comm.)	VN	30	iii	iv	iv	JF2	vii, viii
Mount Lindesay	VN	6, 38, 41	iii	iii	iii	JF2	v (pigs), vii, viii, xii (vehicle recreation, damming river)
North Porongurup wet ironstone heath community	VN	29, 30	iii	iii	ii	JF2	xii (only small remnants remain)
Porongurup Range Karri forest	VN	3	ii	iii	iii	JF2	vi, vii
Karri community at edge of geographic range (Plantagenet District). (Ken Tinley pers. comm.)	P2	4	ii - iii	iii	ii	JF2	ii, iv, vi (pastures), ix, x
Flat wetlands Rocky Gully to Denmark (M. Graeme pers. comm.)	P2	38,42	iii	iii	ii	JF2	v (pigs, horses), vii, viii
<i>Melaleuca lanceolata</i> forests, Leeuwin Naturaliste Ridge	P2	15	ii	vi	ii	WAR/JF2	ii, vii, xii (recreation site development)
<i>Taxandria linearifolia</i> , <i>Acacia pulchella</i> thicket (Rosa Glen variant). South of Margaret River.	P2	28	iii	vi	i	JF2	i, ii, x (residential developments and expansion of wine industry)
<i>Reedia spathacea</i> peat swamps of the Blackwood River	VN	42, 43	ii	iii	ii	WAR/JF2	v (pigs), vii, xii (urban development)
Plant assemblages of primary saline wetlands (J. Buegge pers. comm.)	NE	31,43	ii - iii	ii	ii	JF2	ix, x
Perched wooded wetlands of the southern Wheatbelt (R. Brazell pers. comm.)	NE	42	ii	ii	i	JF2	ix, x,
Naturally brackish/saline coastal lakes in the south west region (S. Halse pers comm.)	NE	26,40,39	i - iii	iii	ii	JF2/WAR	ix, x
Aquatic invertebrates associated with permanent freshwater/brackish pools (S. Halse pers. comm.)	NE	42	i - iii	iii	ii	JF2/WAR	ix, x
Diatom assemblages of south-west rivers (John 1998)	NE	42	i - iii	iii	ii	WAR/JF2	ix, x
<i>Eucalyptus occidentalis</i> association (Robinson 1997) Lake Muir area	NE	8, 9, 16	ii	iii	iii	JF2/JF1	ix, x
<i>Eucalyptus decipiens</i> low woodland (Hopkins <i>et al.</i> 1996)	NE	8, 9, 16	iii	iv	iii	JF2	ix, x

Wheatbelt lowland mallet communities (G. Durrell & J. Buegge pers comm.)	NE	16	i	ii	iii	JF2	i, ii
Valley communities of <i>Eucalyptus wandoo</i> woodland (Beard 1980c, Beard 1980d, Beard 1980e)	NE	6, 8	ii	ii	iii	JF2	ix, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Potorous gilbertii</i>	CR	ii	v	iii	v (foxes, vii)
<i>Parantechinus apicalis</i>	E	i	i	iii	i, v (foxes, cats), vii (presumed locally extinct)
<i>Dasyurus geoffroi</i>	V	iii	v	iii	v (foxes), i (especially clearing in riparian areas), xii (road traffic; poisoning; trapping; timber harvesting), vii
<i>Myrmecobius fasciatus</i>	V	ii	iv	iii	v (foxes), vii, i
<i>Pseudocheirus occidentalis</i>	V	iii	iii	iii	i, ii, v (foxes), vii, xii (logging)
<i>Setonix brachyurus</i>	V	iii	v	iii	v (foxes), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	iii	iii	ii	ii, vii, ix
<i>Pezoporus wallicus flaviventris</i>	E	ii	iii	iii	v (foxes), vii
<i>Atrichornis clamosus</i>	V	iii	v	iv	vii
<i>Botaurus poiciloptilus</i>	V	ii	iii	iii	vii, ix
<i>Cacatua pastinator pastinator</i>	V	ii	iii	iii	i, xii (illegal culling)
<i>Calyptorhynchus baudinii</i>	V	iii	iii	ii	ii, vii, ix
<i>Dasyornis longirostris</i>	V	ii	iii	iii	v (foxes), vii
<i>Leipoa ocellata</i>	V	i	i	iii	v (foxes, cats, rabbits), vii
<i>Psophodes nigrogularis oberon</i>	V	ii	iii	iii	i, ii, v (foxes), vii
<i>Psophodes nigrogularis nigrogularis</i>	V	iii	v	iii	v (foxes), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 4 (FROGS)</b>					
<i>Geocrinia alba</i>	CR	ii	iii	iv	i, ii, iv, v (pigs), vii, viii, x (resulting from removal or dieback of vegetation cover in catchment area or upstream dams), xi (fertiliser and pesticide runoff)
<i>Geocrinia vitellina</i>	V	iii	v	iv	v (pigs), vii, viii, xi
<i>Spicospina flammocaerulea</i>	V	iii	iv	iv	vii, xii (physical damage to swamps; mining; collection for illegal trade), v (pigs), x (siltation; construction of dams), viii, xi (chemical and surfactant)
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	P1	i	vi	iii	i, ii, v (foxes and cats), vii (this is not a forest species)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Windbalea viride</i>	P1	i	vi	ii	vii, i, ii fire, clearing
<i>Ninox connivens connivens</i>	P2	i	ii	iii	Very low numbers, estimated 50 pairs in WA, xii (logging practices, reduction in tree hollows)
<i>Ixobrychus flavicollis</i>	P2	ii	ii	ii	i, ii, v, vii, ix, x
<i>Austromerope poultoni</i>	P2	i	vi	ii	i, xii (logging; mining); vii (this species has only been found from pitfall traps and never been seen alive)
<i>Pseudohydromantes doegi</i>	P2	i	vi	ii	ix, x
<i>Acercella poarginup</i>	P2	i	vi	ii	ix, x
<i>Hemisaga lucifer</i>	P2	i	vi	ii	Vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
DECLARED RARE FLORA					
<i>Adenanthos pungens</i> subsp. <i>effusus</i>	CR	iii	iii	iii	i, ii, ix, x, viii, vi, iv, vii
<i>Banksia brownii</i>	CR	ii	iv	Unknown	ii, vii, viii, xii (road works)
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	CR	i	ii	iii	v (rabbits), vi (pasture grasses), vii, ix, x
<i>Caladenia viridescens</i>	CR	ii	ii	iv	i, ii, v (rabbits), vii, xii (physical disturbance)
<i>Conostylis setigera</i> subsp. <i>dasys</i>	CR	iii	iii	iii	i, ii, xii (single population)
<i>Drakaea confluens</i> ms	CR	iii	iv	iii	vii, xii (roadside disturbance)
<i>Dryandra mucronulata</i> subsp. <i>retrorsa</i>	CR	iii	iii	iii	vii, viii
<i>Eucalyptus phylacis</i> x	CR	iii	iii	iv	vii, viii (canker)
<i>Isopogon uncinatus</i>	CR	i	v	iii	vii, viii ( <i>Phytophthora</i> sp.)
<i>Rulingia</i> sp. Trigwell Bridge	CR	ii	v	iv	v (rabbits), vii, xii (small populations)
<i>Verticordia apecta</i>	CR	i	ii	iv	vii, xii low number
<i>Verticordia fimbriolepis</i> subsp. <i>fimbriolepis</i>	CR	ii	iii	iii	ii, vi, ix, x, iv, xii (road maintenance), viii ( <i>Phytophthora</i> sp.)
<i>Adenanthos velutinus</i>	E	iii	iii	iii	i, ii, vi, vii, viii ( <i>Phytophthora</i> sp.)
<i>Adenanthos</i> x <i>cunninghamii</i>	E	iii	iv	iii	ix (small number of individuals), viii ( <i>Phytophthora</i> sp.)
<i>Apium prostratum</i> subsp. <i>phillipii</i>	E	ii	v	iii	vi (Dolichus pea, <i>Rubus fruticosus</i> , <i>Myosotis sylvatica</i> )
<i>Banksia oligantha</i>	E	iii	iii	iii	i, ii, iv, v - rabbits, vi
<i>Boronia exilis</i>	E	iii	iv	iii	ii, vii, viii
<i>Caladenia caesarea</i> subsp. <i>maritima</i>	E	ii	iv	iii	xii (low population numbers; trampling by people; urbanisation); vi
<i>Caladenia christineae</i>	E	iii	iii	iii	vi, ix, x
<i>Caladenia dorrienii</i>	E	i - ii	iii	iii	v (rodents), vi, vii
<i>Caladenia excelsa</i>	E	iii	vi	ii	ii, v (rabbits), vii, xii (physical disturbance)
<i>Caladenia huegelii</i>	E	iii	iv	iii	ii, vi, vii, xii (roadside disturbance), xii (urbanisation)
<i>Conostylis drummondii</i>	E	ii	iii	iii	i, ii, iv, vi, vii
<i>Drakaea elastica</i>	E	ii	iii	iii	i, ii, v (rabbits), vi (pasture grasses), vii, xii (roadside disturbance)
<i>Dryandra nivea</i> subsp. <i>uliginosa</i>	E	iii	iii	ii	i, ii, vii, viii, xii (roadside disturbance)
<i>Dryandra squarrosa</i> subsp. <i>argillacea</i>	E	iii	iii	iii	i, ii, v (rabbits), vii, viii, xii (roadside disturbance)
<i>Grevillea elongata</i>	E	ii	v	iii	i, ii, v (rabbits), vi (pasture grasses), viii
<i>Jacksonia velveta</i> ms	E	iii	iv	iii	xii (utility alignment maintenance)
<i>Nemcia lehmannii</i>	E	iii	iii	iii	i, ii, (small number of individuals and populations)
<i>Orthrosanthus muelleri</i>	E	iii	v	iii	vi (annual grasses), ix
<i>Sphenotoma drummondii</i>	E	i - ii	iii - iv	iii	vii, viii
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	E	ii	iii	iii	i, ii, v (rabbits), vi (grasses), vii, viii, xii (roadside disturbance)
Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Verticordia fimbriolepis</i> subsp. <i>australis</i>	E	iii	iv	iii	vii, viii, ix, x
<i>Villarsia calthifolia</i>	E	iii	iv	iii	xii (restricted distribution)
<i>Andersonia pinaster</i>	V	iii	iii	iii	vii, viii, vi
<i>Asplenium obtusatum</i> subsp. <i>northlandicum</i>	V	iii	iv	iii	xii (restricted distribution)
<i>Banksia verticillata</i>	V	ii - iii	iv		vii, viii
<i>Brachysema modestum</i>	V	iii	iv	iii	vii, viii, xii (plantation forestry)
<i>Caladenia harringtoniae</i>	V	iii	iii	iii	vii, ix, x

<i>Conostylis misera</i>	V	iii	iii	ii	vi, vii, ix, x, xii (verge populations)
<i>Daviesia elongata</i> subsp. <i>elongata</i>	V	ii	iv	iii	viii ( <i>Phytophthora</i> )
<i>Diuris drummondii</i>	V	ii - iii	iii	iii	i, ii, v (pigs), vii, ix, x
<i>Diuris micrantha</i>	V	ii	iii	iii	xii (roadside disturbance, small number of populations)
<i>Drakaea micrantha</i> ms	V	iii	iii	iii	vii, xii (roadside disturbance, small number of populations)
<i>Dryandra mimica</i>	V	iii	iv	iii	vii, viii, xii (mining)
<i>Laxmannia jamesii</i>	V	iii	iv	ii	xii (small number of individuals)
<i>Meziella trifida</i>	V	iii	v	iii	i, x, xii (mining)
<i>Microtis globula</i>	V	i	ii	iii	vii, x
<i>Pleurophascum occidentale</i>	V	iii	iv	iii	vii, xii (climate change)
<i>Tribonanthes purpurea</i>	V	iii	iv	iii	xii (restricted distribution)
<i>Wurmbea calcicola</i>	V	iii	iv	iii	vii, xii (physical disturbance)
<b>PRIORITY 1</b>					
<i>Andersonia ferricola</i> ms	1	ii	iii	iii	i, viii
<i>Andersonia</i> sp. Mitchell River	1	iii	iii	iii	vii, viii
<i>Austrofestuca littoralis</i>	1	ii	iv	i	vi (marrum grass)
<i>Boronia humifusa</i>	1	iii	iv	iii	vii, xii (roadside disturbance)
<i>Caladenia longicauda</i> subsp. <i>clivicola</i>	1	iii	iv	iii	xii (roadside disturbance)
<i>Caladenia uliginosa</i> subsp. <i>patulens</i>	1	iii	iii	ii	vii, xii (inadequate survey)
<i>Calothamnus</i> sp. Whicher	1	ii	iv	iii	i, ii, vii, xii (roadside disturbance)
<i>Carex tereticaulis</i>	1	i	iii	ii	vi, ix, x
<i>Caustis</i> sp. Boyanup	1	iii	iii	iii	i, xii (potential mine site disturbance)
<i>Conospermum caeruleum</i> subsp. <i>contortum</i>	1	iii	iv	i.	viii, vii
<i>Cryptandra arbutiflora</i> var. <i>pygmaea</i>	1	iii	iii	iii	xii (small and few populations): vii
<i>Deyeuxia inaequalis</i>	1	i	iii	ii	vi (agricultural), vii
<i>Eryngium</i> sp. Lake Muir	1	iii	iv	iii	x, xii (single small population)
<i>Eucalyptus lane-poolei</i> var. <i>Whicher</i>	1	iii	iv	iv	vii, xii (single population)
<i>Johnsonia inconspicua</i>	1	iii	iii	iii	i., ii, xii, vii
<i>Nemcia cordata</i> ms	1	i	ii	iii	i, ii, iv
<i>Pentapogon quadrifidus</i> var. <i>quadrifidus</i>	1	ii	iv	ii	vi (exotic grasses), ix, x
<i>Plumatictilos turfusus</i>	1	iii	iv	iii	vii
<i>Schoenus</i> sp. Beaufort	1	iii	iv	iii	ix, x
<i>Selliera radicans</i>	1	ii - iii	iv	iii	x, xi
<i>Stylidium rhipidium</i>	1	ii	iv	ii	vi, vii, ix, x, xii (verge disturbance)
<i>Stylidium tylosum</i>	1	iii	iii	ii	i, ii, vi (pasture grasses), vii
<i>Synaphea nexosa</i>	1	ii	iii	iii	i, ii, v (rabbits), xii (roadside disturbance)
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Synaphea decumbens</i>	1	iii	iii	iii	viii, ix, x, xii (verge populations at risk)
<i>Synaphea macrophylla</i>	1	iii	vi	iii	viii, vii
<i>Synaphea otlostigma</i>	1	iii	iv	iii	viii, vii
<i>Tetratheca</i> sp. Kent River	1	ii	iv	iii	viii, ix, x, xii (verge populations at risk)
<i>Thomasia laxiflora</i>	1	iii	iv	iii	i, ii, iv
<i>Thysanotus formosus</i>	1	iii	iv	iii	No known threatening processes
<b>PRIORITY 2</b>					
<i>Acacia mooreana</i>	2	iii	iv	ii	vii
<i>Actinotus whicherae</i> ms	2	iii	vi	iii	vii
<i>Alexgeorgea ganopoda</i>	2	iii	iv	iii	vii, x, xii (road works)
<i>Amperea protensa</i>	2	iii	iv	iii	xii, x
<i>Andersonia annelsii</i> ms	2	i	ii	iii	vii, viii

<i>Andersonia auriculata</i>	2	ii	iii	iii	vii, viii
<i>Andersonia hammersleyana</i> ms	2	iii	iv	iv	vii, viii, xii (dam construction)
<i>Andersonia virolens</i> ms	2	iii	iii	iii	vii, viii
<i>Apodasmia ceramophila</i>	2	iii	iv	iii	x
<i>Boronia capitata</i> subsp. <i>gracilis</i>	2	iii	vi	iii	vii
<i>Borya longiscapa</i>	2	iii	iv	iii	v (pigs), viii
<i>Caladenia erythochila</i>	2	iii	iv	iii	iv, vii
<i>Caladenia luteola</i>	2	iii	iv	iii	iv, vii
<i>Caladenia starteorum</i>	2	iii	iv	iii	iv, v (pigs), vii
<i>Calothamnus microcarpus</i>	2	iii	vi	iii	viii
<i>Calothamnus</i> sp. Mt Lindesay [ <i>aff. crassus</i> ]	2	iii	iv	iii	vii, viii
<i>Cardamine paucijuga</i>	2	iii	iv	iii	ix, x
<i>Chamaelucium forrestii</i> subsp. <i>forrestii</i>	2	iii	iv	ii	xii, xiii
<i>Chordifex jacksonii</i> ms	2	iii	iv	ii	ix, x
<i>Cryptandra congesta</i>	2	iii	iv	iii	vii, x (low numbers)
<i>Dampiera orchardii</i>	2	i	i	ii	Suspected to be extinct
<i>Daviesia mesophylla</i>	2	iii	iii	iii	viii, vii
<i>Drepanocladus fluitans</i>	2	ii	iv	ii	vii, x
<i>Dryandra acanthopoda</i>	2	iii	vi	iii	viii
<i>Dryandra subpinnatifida</i> subsp. <i>imberbis</i>	2	iii	vi	iii	vii, viii
<i>Eucalyptus virginae</i> ms	2	iii	iii - iv	ii	ii (lack of recruitment)
<i>Euphrasia</i> aff. <i>scabra</i>	2	iii	iii	iii	v (pigs), vi (pasture spp), vii, x, xii (single population left)
<i>Gastrolobium</i> sp. East Peak	2	iii	iv	iii	vii, viii, xii (low numbers in 2 populations)
<i>Grevillea acropogon</i>	2	iii	iii	iii	viii, xii (< 50 plants)
<i>Grevillea fuscolutea</i>	2	iii	vi	iii	vii, viii, xii (low numbers and few populations)
<i>Hybanthus volubilis</i>	2	iii	iv	ii	vii
<i>Hydatella sessilis/australis</i>	2	iii	iv	iii	x, xii (wetland silting ex road drains)
<i>Hydrocotyle hamelinensis</i> ms	2	iii	vi	iii	vii
<i>Juncus meianthus</i> ms	2	i	vi	ii	x, ix
<i>Laxmannia grandiflora</i> subsp. <i>brendae</i>	2	ii	iii	iii	vii, xii (very low numbers and only 2 populations)
<i>Leptinella drummondii</i>	2	iii	vi	iii	vi (blackberry), ix, x
<i>Leptomeria furtiva</i> ms	2	iii	vi	iii	xii (plant is very hard to find for surveying)
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Leucopogon polystachyus</i>	2	iii	iv	iii	viii, x
<i>Lilaeopsis polyantha</i>	2	iii	iv	iii	x
<i>Melaleuca ordinifolia</i>	2	iii	vi	iii	ix
<i>Melaleuca pritzellii</i>	2	iii	vi	ii	x
<i>Metzgeria decipiens</i>	2	ii	iii	iii	vii
<i>Millotia tenuifolia</i> var. <i>laevis</i>	2	iii	vi	iii	No known threatening processes
<i>Mitreola minima</i>	2	iii	iv	iii	x
<i>Phyllangium palustre</i>	2	iii	vi	ii	x, v (pigs)
<i>Pimelea cracens</i> subsp. <i>glabra</i>	2	iii	vi	ii	No known threatening processes
<i>Pimelea neokyrea</i>	2	iii	vi	iii	i, ii
<i>Rorippa dictyosperma</i>	2	iii	vi	ii	vii
<i>Schoenus loliaceus</i>	2	iii	vi	ii	x
<i>Spyridium riparium</i>	2	iii	iv	iii	vi, ix, x, xii (road and track maintenance)
<i>Stylidium emarginatum</i> subsp. <i>exappendiculatum</i>	2	iii	vi	iii	ix
<i>Stylidium paulineae</i>	2	iii	vi	iii	No known threatening processes

<i>Trichocline</i> sp. Treeton	2	iii	vi	ii	viii
<i>Verticordia endlicheriana</i> subsp. <i>angustifolia</i>	2	iii	iv	iii	vii, viii
<i>Wurmbea</i> sp. Cranbrook	2	iii	iv	iii	v (pigs, rodents), vii, x
<b>OTHER FLORA AT RISK</b>					
<i>Lambertia orbifolia</i> subsp. Narrikup		ii	iv	iii	vii, viii, xii (low numbers, all populations verge and private property)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	IUCN Reserve I-IV	Non IUCN Reserve	CALM Leases	Priority	Notes
3	Medium forest; jarrah-marri	3%	67%		L	Main Jarrah forest and includes many community and forest types – reservation levels ex RFA to strict IUCN reserve pending for many component community types – additional reservation in Albany area possibly desirable
4	Medium woodland; marri & wandoo	4%	4%		H	Area primarily the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels.
14	Low forest; jarrah	2%	35%		M	Low jarrah forests of the Denbarker/Kent River area – targeted for reservation as part of RFA CAR reserve system
23	Low woodland; jarrah-banksia	1%	6%		H	Jarrah-Banksia woodlands primarily coastal sands of older dune systems in WAR – either extensively cleared for agriculture, or affected by dieback. Unreserved areas in the Denbarker area are targeted for reservation.
27	Low woodland; paperbark ( <i>Melaleuca</i> sp.)	12%	29%		L	A type with several communities within it differing by spatial distribution – large tracts to be reserved as a result of RFA – areas in Scott River Lower Blackwood deficient as a result of land clearing
37	Shrublands; teatree thicket	10%	84%		L	A scattered type poorly defined, but well reserved as non-strict IUCN reserve.
963	Medium woodland; yate & paperbark ( <i>Melaleuca</i> spp)	0%	3%		H	Yate paperbark valleys of the upper Warren and upper Kent Rivers cleared for agriculture – no potential for reservation (see Ecosystems at risk <i>E. occidentalis</i> yet to be evaluated)
Beard Veg Assoc	Vegetation Association Description	IUCN Reserve I-IV	Non IUCN Reserve	CALM Leases	Priority	Notes
965	Medium woodland; jarrah & marri	0%	100%		L	Scattered pockets in JF2 – mostly to reserve or not reservable
969	Mosaic: Medium forest; jarrah-marri/Low forest; jarrah	0%	15%		H	Area is essentially that land east and west of Denmark considered suitable for agriculture and consequently extensively cleared or alienated; a few pockets remain and should be sought for reservation or protected from clearing
972	Medium woodland; jarrah, marri, wandoo & yate	5%	0%		H	Woodlands of Jarrah, Wandoo Marri and Yate in the upper Kent River catchment – extensively cleared for agriculture and now often salt affected - a few pockets remain, mostly in reserve – no real capacity to achieve further reservation
973	Low forest; paperbark ( <i>Melaleuca raphiophylla</i> )	0%	0%		H	Low forest of <i>Melaleuca raphiophylla</i> – includes several different scattered communities, in JF2 primarily associated with the cleared valley system of the upper Kent, again with little or no capacity to improve the reservation status of the type
975	Low woodland; jarrah	0%	82%		L	Scattered pockets in JF2 – mostly to reserve or not reservable
977	Low forest; teatree & casuarina	0%	79%		L	Mostly the cleared agricultural land West of Denmark – most uncleared component to be reserved shortly
978	Low forest; jarrah, <i>Eucalyptus staeri</i> & <i>Allocasuarina fraseriana</i>	14%	0%		H	The low woodlands of Jarrah, Albany Blackbutt and casuarina West, North and East of Albany – mostly cleared for agriculture with little or no chance of improving reservation levels
979	Mosaic: Medium forest; jarrah-marri/Low forest; jarrah & casuarina (probably <i>Allocasuarina fraseriana</i> )	0%	0%		H	Extension of 978 (NE of Albany) above without the Albany blackbutt, – again mostly cleared for agriculture with little or no chance of improving reservation levels
987	Medium woodland;	0%	0%		H	A collection of unrelated communities, in JF2 really an extension of

	jarrah & wandoo					type 4 above, the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels
992	Medium forest; jarrah & wandoo ( <i>E. wandoo</i> )	2%	6%		H	An extension of type 4 above in the Boyup Brook area, the wandoo/marri woodlands of the western wheatbelt – extensively cleared and with most remnant areas reserved or notionally protected from clearing. – Little prospect of improving reservation levels.
1000	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree ( <i>Melaleuca spp.</i> )	14%	0%		H	Mainly a SWA type – extensively cleared on the coastal plain and in the Dunsborough where it occurs in JF2. Little prospect of improving reservation levels
1002	Medium open woodland; jarrah	0%	100%		L	Most of type reserved as State Forest on the Blackwood Plateau with tracts for reservation as strict IUCN reserve
1034	Medium woodland; marri, wandoo & powderbark	0%	0%		H	A non JF2 type – a small pocket occurring on the Lower Blackwood – probably represents a different type of community – however is alienated and not available for reservation
1051	Shrublands; teatree thicket with scattered wandoo & yate	1%	0%		H	Valley teatree and scrub thicket associated with scattered wandoo and yate in the upper Blackwood – extensively cleared degraded agricultural land - little prospect of improving reservation levels
1073	Medium woodland; wandoo & mallet	5%	0%		H	Wandoo Mallet woodlands of the upper Blackwood - extensively cleared degraded agricultural land - little prospect of improving reservation levels
<b>Beard Veg Assoc</b>	<b>Vegetation Association Description</b>	<b>IUCN Reserve I-IV</b>	<b>Non IUCN Reserve</b>	<b>CALM Leases</b>	<b>Priority</b>	<b>Notes</b>
1077	Medium woodland; jarrah & river gum	9%	0%		H	Jarrah River Gum valley floor of the Gordon (upper Frankland) – cleared (and degraded) for agriculture with little prospect of improving reservation levels
1114	Shrublands tree-heath; paperbark over teatree thickets	2%	40%		L	Mostly teatree paperbark thickets in valleys east of Collie, mostly cleared for Agriculture, but other parts in State forest – some targeted for reservation
1132	Medium forest; marri	0%	89%		L	In JF2 as pockets of Marri on the Margaret and Blackwood Rivers – small areas that may end up reserved
1134	Medium woodland; jarrah (south coast)	9%	63%		L	Jarrah woodland on sandy tracts – most within JF2 reserved as SF and proposed for strict IUCN status
1157	Tall forest; jarrah & marri	0%	100%		L	Difficult to map units within the jarrah forest, but the majority is protected within SF, part to become NR with planned tenure changes
1181	Medium woodland, jarrah & <i>Eucalyptus haematoxylon</i> (Whicher Ra.)	0%	67%		L	Much cleared, but remnants in SF, some proposed as reserve in the Scarp south of Bunbury/Busselton
1182	Medium woodland; <i>Eucalyptus rudis</i> & <i>Melaleuca raphiophylla</i>	0%	68%		L	Mainly cleared valleys of the Preston, Capel Rivers but remnants in SF
1183	Medium woodland; <i>Eucalyptus rudis</i> & blackbutt with some bullich, jarrah & marri (fringing Blackwood R.)	0%	X		L	Blackwood River valley – a mix of cleared agricultural land and State Forest – parts to be further reserved
1184	Medium woodland-fringing; jarrah, marri, <i>Eucalyptus rudis</i> & <i>Agonis flexuosa</i>	7%	50%		M	
1185	Medium woodland; jarrah, marri & blackbutt	0%	96%		L	Medium Jarrah Marri of the hills in the Donnybrook Capel area – mostly in State Forest
2051	Sedgeland; sedges with low tree savannah woodland; paperbarks over & various sedges	8%	71%		L	Hay and Mitchell River valleys – either cleared or to be reserved as National Park (from SF)

Subregional constraints in order of priority  
(see Appendix B, key g)

**Other:** Regional Forest Agreement reserve recommendations already in process of being implemented, and will include the above reserve consolidation priorities where feasible with existing tenures.

**Irreplacibility, Limited Opportunity Remains to Meet CAR Criteria, Economic Constraints, and Competing Land Uses:** Major components of the landscape are covered by mines, mining tenements, exploration leases and already cleared land.

Bioregional and subregional priority for reserve consolidation

JF2 has 54.7% of the subregion in CALM estate. However the table shown in Appendix D shows the IBRA region JF as being in 2d category (see Appendix D, and Appendix C, rank 4). This is reasonable given the eastern and south-eastern portions of the JF2 subregion, below the 700mm isohyet are very poorly represented in conservation reserves. This is the woolbelt and wheatbelt portions of the subregion which have been extensively cleared for agriculture. The 800 – 600mm rainfall zone is exhibiting rapid rises in ground water levels up to 1m per year which is changing the distribution of riparian vegetation and contributing to accelerated *Phytophthora* (and *Armillaria* in Karri regrowth) disease impacts. It could be argued that this part of the subregion should actually be treated as Reserve Consolidation Rank of 1 (given table and notes above).

## Reserve management standard

There are 89 nature reserves, 5 national parks, and no conservation parks occur within JF2. There are current government proposals for an additional 30 national parks are in the early stages of implementation, but have been excluded from this discussion.

**Nature Reserves:** Reserve Management standards is (i) Poor (see Appendix C, rank 5), for majority of reserves in the eastern zone, and (ii) Fair, for other reserves. The bulk of the nature reserves are small (<150 ha) and scattered across the subregion. There are no resident staff for these reserves, and management visitation varies, with a minimum of once per year. Very few of these reserves have formal approved management plans or interim management guidelines.

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Potorous gilbertii</i>	Yes - Interim Wildlife Management Guidelines (Recovery Plan currently in draft stage)	Action Plan For Australian Marsupials and Monotremes
<i>Parantechinus apicalis</i>	Yes - IRP	Action Plan For Australian Marsupials and Monotremes
<i>Dasyurus geoffroi</i>	Yes - RP	Action Plan For Australian Marsupials and Monotremes
<i>Myrmecobius fasciatus</i>	Yes – draft RP	Action Plan For Australian Marsupials and Monotremes
<i>Pseudocheirus occidentalis</i>	Yes - IRP	Action Plan For Australian Marsupials and Monotremes
<i>Setonix brachyurus</i>	No	Action Plan For Australian Marsupials and Monotremes
<i>Phascogale calura</i>	No	Action Plan For Australian Marsupials and Monotremes
<i>Calyptorhynchus latirostris</i>	Yes - RP	Action Plan for Australian Birds
<i>Pezoporus wallicus flaviventris</i>	Yes - IRP	Action Plan for Australian Birds
<i>Atrichornis clamosus</i>	Yes - RP	Action Plan for Australian Birds
<i>Botaurus poiciloptilus</i>	No	Action Plan for Australian Birds
<i>Cacatua pastinator pastinator</i>	Yes – currently in preparation	Action Plan for Australian Birds

The small size, and in many cases remnant vegetation function, most reserves have significant weed invasion especially pasture grasses. Reserves containing drainage lines and water courses are increasingly impacted by salinity and/or rising water tables. Feral animals (foxes, rabbits and increasingly in the western sections, pigs) are not controlled in all but the largest reserves. In the western and middle parts of the subregion, *Phytophthora* disease is impacting on vegetation communities in the reserves. This is compounded by the rising water tables. Understorey species composition is often depauperate and in a degraded state resulting from grazing impacts and extended fire frequencies.

**National Parks:** Reserve Management standards is (iii) Good for Leeuwin Naturaliste, Porongurup and Waychinicup, (ii) Fair for Scott and Hassell. JF2 contains 2 national parks in their entirety (Porongurup & Waychinicup National Parks) and parts of 2 others (Leeuwin Naturaliste and Hassell National Parks). Staff are resident and management plans exist for Leeuwin Naturaliste & Porongurup National Parks. Other parks being serviced by staff as needed.

Primary factors impacting on conservation values are: 1) linear design of Leeuwin Naturaliste, Hassell, and Scott National Parks. Hassell is effectively two strips of remnant roadside vegetation totaling 150m in width along its length. Leeuwin Naturaliste is restricted to 150m width at its narrowest points and is comprised of numerous fragmented reserves. 2) Semi rural land developments and an intensification of agricultural practices on adjoining lands is impacting on surface water flows into the Leeuwin Naturaliste and Scott National Parks. 3) Regular and routine feral animal (fox, some limited rabbit) control undertaken in Leeuwin Naturaliste and Scott National Parks. Declared weeds and selected environmental weeds are subjected to annual control programs. Spread of some weeds (african thistle) is being exacerbated by high recreational visitor numbers. Both feral animal and weed control programs constrained by funding limitations. Fire regimes are strongly influenced by high visitation numbers and protection of adjoining land uses.

Species	Specific Recovery Plan	General Recovery Plan
<i>Calyptorhynchus baudinii</i>	No	Action Plan for Australian Birds
<i>Dasyornis longirostris</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Psophodes nigrogularis oregon</i>	No	Action Plan for Australian Birds
<i>Psophodes nigrogularis nigrogularis</i>	No	Action Plan for Australian Birds
<i>Geocrinia alba</i>	Yes - IRP	Action Plan for Australian Frogs
<i>Geocrinia vitellina</i>	Yes - IRP	Action Plan for Australian Frogs
<i>Spicospina flammocaerulea</i>	Yes - RP	Action Plan for Australian Frogs
Rare and Priority listed (P1 to P4) plants associated with wetlands subject to salinisation, eutrophication and inundation, and competition from weeds, primarily within the agricultural area in the Eastern parts of the bioregion.	No	Declared Rare and Poorly Known Flora in the Central Forest Region; Declared Rare and Poorly Known Flora of the Albany Region.
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
<i>Caladenia viridescens</i>	No	Declared Rare and Poorly Known Flora in the Central Forest Region
<i>Drakaea confluens</i> ms	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
<i>Rulingia</i> sp Trigwell Bridge	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region
<i>Boronia exilis</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Central Forest Region

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Potorous gilbertii</i>	ix, xiv, vii	Exclusion of fire from site where species is found. Other - Establishment of captive breeding colony in case of deaths in wild population. Other - Dieback affects habitat vegetation and fungi food source, so prevention of infection of site and phosphate may need to be applied to infected areas. Feral animal control via fox baiting.
<i>Parantechinus apicalis</i>	xii, vii, ix	Continue studying island and mainland populations and survey for new populations. Feral animal control, with special emphasis on not allowing feral predators to be introduced to island populations. Fire management by excluding fire from dibbler habitats (fire history is unknown but appears to be long unburnt).
<i>Dasyurus geoffroii</i>	xii, xiv, x	Research about the impact of fire regimes on diet. Research into effects of foxes and fox baiting. Population and habitat monitoring. Further surveys on distribution and habitat requirements, especially in eastern part of subregion. Other -Maintenance of adequate refuge and den logs. Rehabilitation after mining. Prevention of further clearing, especially in riparian areas. Captive breeding and translocations.
<i>Myrmecobius fasciatus</i>	xiv, xii, x, xiii	Other - Management of existing populations and habitat. Research - Genetic survey of existing populations and habitat. Further translocations to establish at least six further self-sustaining populations. Captive breeding to provide animals for display and supplement translocations. Capacity building – establishment and support of public awareness and sponsorship programmes.
<i>Pseudocheirus occidentalis</i>	ii, iii, xiv, x, xiii,	Conservation on public lands managed by CALM. Other - Research into impacts of logging and minimise impacts of land developments. Management of injured, displaced or nuisance possums. Translocations into areas of fox control. Capacity building with community and landholders including education, liaison and communication.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Setonix brachyurus</i>	ix, vii, xii	Habitat manipulation through use of fire; Fox baiting and pig control. Survey of reported occurrences outside known population range. Further surveys to assess population size, extent of immigration and emigration and assessment of range of habitat types used (and spatial analysis of current populations and potentially suitable habitat).
<i>Phascogale calura</i>	xii, ix,	Research to review and assess current knowledge of distribution and ecology. Predict suitable habitat for further surveys. Radio track individuals. Fire management.
<i>Calyptorhynchus latirostris</i>	xii, xiv	Research to determine conservation status of sub populations. Other – Retain breeding population and reverse decline in remaining breeding areas.
<i>Pezoporus wallicus flaviventris</i>	xii, xiv, x	Research to survey all known populations. Monitoring of subpopulations in relation to changing post fire age and fox control programme. Research into micro-habitat requirements and breeding success. Prepare IRP. Evaluation of the use of translocation for this species.
<i>Atrichornis clamosus</i>	ix, vii, iii, x, xii, xiii	Fire management at Two People's Bay, Waychinicup National Park, Many Peaks Nature Reserve and Gull Rock Nature Reserve. Feral animal control. Habitat protection on other state lands. Translocations. Research to monitor population numbers. Capacity building and publicity with community, education groups and sponsors.
<i>Botaurus poiciloptilus</i>	xii, xiv	Research to develop methods for assessing population trends. Further survey and search of historical records for information on distribution and breeding grounds. Other – Rehabilitation of some wetlands as part of Landcare.
<i>Cacatua pastinator pastinator</i>	xii, xiii, vii	Research to a technique to exclude birds from grain being fed to livestock. Determine the area of feeding habitat required to sustain population. Obtain a greater understanding of breeding biology, clarify taxonomic status and ongoing monitoring of population size. Capacity building to increase community involvement. Feral animal control of the introduced eastern Long-billed Corella.
<i>Calyptorhynchus baudinii</i>	xii, xi	Research - Develop repeatable population monitoring technique and monitor in different areas of the birds' range. Other – Help orchardists develop non-lethal damage control measures, and make shooting of birds illegal.
<i>Dasyornis longirostris</i>	xii, x	Research to survey known subpopulations; Monitoring of subpopulations in relation to post fire age. Research microhabitat requirements. Evaluation of translocation for management of species.
<i>Leipoa ocellata</i>	xii, xiii, vii, xiv,	Research and population monitoring and associated habitat surveys (including road verges). Capacity building with community, school groups and rural interest groups. Fox and feral cat eradication. Other - Establishment of wildlife corridors. Records of malleefowl and nest sightings. Newsletter production.
<i>Psophodes nigrogularis oregon</i>	xii	Research to survey of all known subpopulations. Assessment of taxonomic of populations in WA. Monitoring of subpopulations in relation to changing post fire age and a fox control programme. Research of microhabitat requirements.
<i>Psophodes nigrogularis nigrogularis</i>	xii, x	Research to survey of all known subpopulations. Assessment of taxonomic of populations in WA. Monitoring of subpopulations in relation to changing post fire age and a fox control programme. Research of microhabitat requirements. Evaluation of translocations for management.
<i>Geococcyx alba</i>	xii, ix, iii, xiii, x	Research to survey suitable habitat for further populations. Population monitoring and genetic studies. Fire management and research. Habitat protection on other state lands. Capacity building to encourage community participation. Translocation and captive breeding.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Geocrinia vitellina</i>	xii, ix, xiii, x	Research to survey suitable habitat for further populations. Population monitoring and genetic studies. Fire management and research. Capacity building to encourage community participation. Translocation and captive breeding.
<i>Spicospina flammocaerulea</i>	xii, ix, xiii	Research into development of predictive models for calling activity. Search for new populations. Monitoring of population size. Fire management, especially prevention of burning in population areas. Capacity building with private landholders.
Rare and Priority listed (P1 to P4) plants associated with wetlands subject to salinisation, eutrophication and inundation, and competition from weeds, primarily within the agricultural area in the Eastern parts of the bioregion.	ii, iii, v, vi, vii, ix, x, xii, xiii	General recovery plans involve habitat protection on private and other state lands for those species not currently well represented in reserves. Fencing to exclude stock. Weed and feral animal control. Fire management. Plant propagation and translocation can be an option. Further research to obtain biological and ecological information. Capacity building is necessary with community, landowners, other agencies, etc.
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	vi, ix, xii, xiv, x,	Implement weed control. Develop a fire management strategy. Research to collect seed, conduct further surveys, monitor known populations and obtain biological and ecological information. Other – Promote awareness of the species, relocate the information bay at one of the populations and write a full recovery plan. Develop a translocation proposal.
<i>Caladenia viridescens</i>	xiii, ix, vi, v, i, xii, xiv, x	Capacity building with other agencies and land managers to coordinate recovery actions and to promote awareness. Finalise the fire management plan. Continue weed control. Continue control of grazing. Change land vesting and purpose. Research to conduct further surveys. Obtain biological and ecological information. Collect seed and fungal material. Investigate germination of seed in soil. Monitor populations. Other - Stimulate seed set; Artificially water populations, if statistically significant; Rehabilitate habitat, if necessary; Review the need for a full Recovery Plan. Undertake translocation.
<i>Drakaea confluens</i> ms	xiii, ix, xii, iii, v, vi, xiv,	Capacity building with other agencies and relevant landowners to coordinate recovery actions promote awareness. Develop and implement a fire management strategy. Research to monitor populations. Collect seed and tissue culture material. Obtain biological and ecological information. Conduct further surveys. Protect populations on private land. Monitor and control vertebrate grazing. Undertake weed control. Other - Incorporate recovery actions into the Interim Management Guidelines (IMG's) for a new conservation park; Write a full Recovery Plan; Apply phosphite as required and monitor the impact of phosphite application.
<i>Rulingia</i> sp Trigwell Bridge	v, vi, xiv, xii, ix, x	Fencing to control grazing. Weed control. Other – Maintain dieback hygiene; Preservation of genetic diversity of the species; Implement an approved Translocation Proposal Research to monitor wild population. Develop fire management strategy. Research to obtain biological and ecological information. Other - Information regarding the species needs to be disseminated to as many people as possible and a full recovery plan needs to be written.
<i>Boronia exilis</i>	xiii, xii, ix, xiv, i, x,	Capacity building with landholders and other government agencies to coordinate recovery actions and liaise with land managers. Research to confirm existing populations and conduct further surveys, monitor populations, collect seed and cutting material, monitor dieback spread and implement disease hygiene measures, and obtain biological and ecological information. Develop and implement a fire management strategy. Other – Install signs and DRF markers and promote awareness of the species. Habitat retention via negotiations to alter the purpose of a reserve at which <i>B. exilis</i> grows. Start translocation process. Other – Include general recommendations for <i>B. exilis</i> in management plan for Scott River National Park and write full recovery plan.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Busselton Ironstone communities and North Porongurup wet ironstone heath community	Busselton Ironstone TEC has RP	Forest Management Plan (draft)
Wetlands, rivers, cave rootmat communities and estuaries throughout the region	No	State Salinity Strategy being implemented
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation	No	Forest Management Plan (draft)
The Muir Unicup Recovery Catchment	No	Forest Management Plan (draft)
Remnant vegetation, specifically of poorly reserved complexes, on private property and currently crown reserves (not vested for conservation) in the eastern agricultural parts of the subregion	No	Forest Management Plan (draft)
The understory vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches are threatened by weeds (grass invasion)	No	Forest Management Plan (draft)

and grazing (sheep, rabbits & kangaroos)		
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## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Busselton Ironstone communities and North Porongurup wet ironstone heath community	xiv, xiii, xii, ix, vi, iii, v, i	Other – Establish a recovery team; Implement dieback treatments and dieback hygiene; Disseminate information. Capacity building with landholders, management bodies and managers. Research – Monitor boundaries and encroachment of dieback; Ongoing monitoring of timing and depth of inundation events, flora, <i>Armillaria</i> fungus, and weeds; Develop strategy for in situ propagation. Implement fire management plans. Implement weed control. Habitat protection on state lands via transfer of care, control and management of road and rail reserve to the Conservation Commission and develop management plan for road and rail reserves. Fence communities on private land. Habitat retention through reserves by seeking to acquire community on private land. Other – Report on management strategies.
Wetlands, rivers, cave rootmat communities and estuaries throughout the region	xiii	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas.
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation	xiii, xi, xiv	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas. Reinstatement of hydrology. Other – Change in landuse upstream.
The Muir Unicup Recovery Catchment	xi, viii	This is an identified specific case of the above at crisis point where salt, inundation and acid sulphate soils are in danger of destroying a remnant, relatively healthy wetland complex of international standing. Therefore recovery actions include reinstatement of hydrology and revegetation.
Remnant vegetation, specifically of poorly reserved complexes, on private property and currently crown reserves (not vested for conservation) in the eastern agricultural parts of the subregion	i, ii, iii	Habitat retention and protection through reserves, on private land and on other state lands, with options for covenanting or acquisition being explored.
The understory vegetation complexes in small woolbelt & wheatbelt remnant vegetation patches are threatened by weeds (grass invasion) and grazing (sheep, rabbits & kangaroos)	xiii, vi, v	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas. Weed control. Fencing to prevent grazing.
All ecosystems within JF2	vi, vii	All ecosystems within JF2 generally face two major threats: Weeds – work with other agencies and the community to resource environmental weed control programs on and off reserve; assess potential of "exotic" taxa as weeds and develop control programs for those considered threats. Feral animals – maintain and expand existing baiting/control programs; develop techniques for cats, rabbits, etc. and integrate these into farm planning/community schemes.

<sup>1</sup>Appendix B, key h.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6) for the Eastern Zone of JF2. There is a large off park effort needed, and resource constraints and limited community capacity exist to deal with salinity and rising water levels.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** Farm forestry with State funded (Forest Products Commission and Water & Rivers) plantation initiatives to recover health of rivers (Tone/Warren and Collie); Farm forestry sharefarm schemes; Remnant vegetation fencing under various programs; establishment of perennial crops and revegetation on farms as part of salt and water management actions.

**Institutional Reform:** Hardwood timber industry restructure via the Regional Forest Agreement and post

RFA process; State Planning policy now requires Rural Planning Strategies and Schemes to address NRM issues.

**Threat Abatement Planning as Part of NRM:** State Salinity Strategy, Muir Unicup Biodiversity Recovery Catchment, Collie and Warren River potable water recovery catchments; feral animal control programs (Western Shield – limited cooperative participation by landholders); State Weed Strategy.

**Industry Codes of Practice:** The Plantation industry code of practice; move to a range of Agricultural codes as facilitated by Department of Agriculture.

**Environmental Management Systems:** EMS for forest management (harvesting) developed.

**Capacity Building:** Department of Agriculture, Department of Conservation and Land Management and Water and Rivers Commission all contribute to community forums, workshops and education as part of increasing understanding processes and management actions available to landowners and community in relation to Salt and Water issues; Weed action groups are supported by the Departments of Conservation and Land Management and Agriculture.

**Other Planning Opportunities:** Regional NRM strategies (eg South West Catchments Council) include or will include (eg SCRIPT) Biodiversity issues; Shire Rural Strategies and Town Planning schemes now addressing biodiversity and environmental issues within an NRM context as a result of Ministry for Planning and Infrastructure requirements.

**Integration With Property Management Planning:** Some application at this stage mostly associated with water/salt management in eastern agricultural zone; some input to planning stage of development proposals through Ministry for Planning and Infrastructure and Local Government referrals.

### Feasible opportunities for NRM

**Incentives:** Extend Landcare and revegetation funding options to landowners. Tax or rate relief for owners for returning or protecting native vegetation.

**Institutional Reform:** Finalise reservation actions pending for many years. Tax or rate relief provisions for owners for returning and protecting native vegetation. Facilitate greater input from State agencies to developing Regional NRM Strategies. Staff agencies with sufficient capable people who understand and are able to plan and implement NRM actions.

**Threat Abatement Planning as Part of NRM:** Extend resourcing of preparation of catchment plans.

**Industry Codes of Practice:** During development of codes, develop systems to contain impacts of industry to owner/operator land.

**Capacity Building:** Facilitate greater community education/involvement in a range of areas in conservation biology and NRM.

**Other Planning Opportunities:** Continued development of Regional NRM strategies; Input to Shire Rural Strategies and Town Planning.

### Impediments or constraints to opportunities

**Economic Constraints:** Limited financial resources are a major constraint.

**Other:** Lack of resourcing with agency staff trained in conservation biology and NRM – numbers capability and resourcing.

Subregions where specific NRM actions are a priority to pursue

Overall, JF2 has an NRM priority of (iii) (see Appendix C, rank 7), indicating that NRM actions are in place across most of the subregion. However, the Eastern zone of JF2 is ranked as (i) because there are major constraints to NRM, and structural reform is needed owing to extent of past degradation, social and economic disruption.

## Data Gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Vegetation mapping under several different systems (Beard 1974d, Beard 1979e) is available at a resolution of 1:100000 or 1:250000, whilst the mapping by Mattiske and Havel (1998a, 1998b, 1998c and 1998d) is available at a resolution of 1:50 000 and published at 1:250 000. The mapping for these systems is based on (informed and attributed) structural types or (informed and attributed) underlying geomorphic/landscape relationships with vegetation communities present. Both have strengths and weaknesses in development of a CAR reserve system. Community identification based on floristics has been done for most of the bioregion (see Mattiske and Havel 1997) but complexity of pattern on the landscape (hence cost of mapping) has prevented vegetation and ecosystem mapping based on the community types delineated, although localised areas have been mapped at the more detail local scale.

**Systematic Fauna Survey:** No systematic fauna surveys (vertebrate or invertebrate) have been conducted across the bioregion.

Data is sparse and patchy. Most reserves don't have long-term survey data on species presence or absence for vertebrates. Systematic vertebrate survey data is not available for 95% of subregion, most confined to Perup and Kingston.

Invertebrate studies confined to some wetlands and to selected invertebrate taxa. Area has been identified as a significant area for relict taxa and their habitat, in particular for invertebrates (Main 1996; Horowitz 1997a; Horowitz 1997b), but targeted survey and assessment only just begun.

**Floristic Data:** Regional survey of vascular flora has been mostly completed, but it is based on sampling quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. There are a range of sample designs dependent on the objectives of the individual studies that combined can be considered to be the Regional Survey. Studies have been done on frogs (Wardell-Johnson and Roberts 1993 and Wardell-Johnson *et al.* 1995), South coast wetlands (Lyons *et al.* 2000), Torndirrup National Park (Keighery 1988a) and West Cape Howe National Park (Keighery 1988b). Some gaps were identified during the RFA study of the South-West forests and additional plots & quadrats established (see summary by Mattiske and Havel 1997).

Regional survey of the non-vascular flora has not been undertaken. However based on the collections made by a number of local botanists and enthusiasts and those made by international and interstate bryologists, the bioregion (and WA) has a severely depleted moss and liverwort flora compared to equivalent community types in Tasmania, Victoria and New South Wales. Climate change and land management under a changing climatic regime place a

large part (that usually associated with rainforest and wet forest ecotypes) of this remaining flora at risk.

Both qualitative and quantitative macro fungi assessment work has been undertaken in the Tingle, Karri and South Coast heath and Jarrah forests, but it is not comprehensive across the region (Bougher 1997).

Rare flora surveys and monitoring are ongoing, but the work is limited by resources. Status of many taxa remains in doubt and it is likely that many of the P1 and P2 taxa listed in this document will end up listed as Endangered or Vulnerable.

**Ecological and Life History Data:** Limited accessible data on population ecology and biology of persisting CWR mammals. Generally less for all other vertebrates, particularly the uncommon ones.

No accessible data on habitat requirements, life histories, ecology or distributions of virtually all invertebrate species.

Limited accessible data on population ecology and biology of the vascular flora of the bioregion limiting decision making on conservation status of and conservation management of the many rare and priority taxa. Likewise communities as reflected by the flora.

**Other Priority Gaps Include:**

- No consistent regolith mapping available at better than 1:250000 scale.
- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, mineral-extraction on heavy metals, etc.
- Fire effect/response data is limited to few communities and taxa.
- An understanding of the effect of salinity/inundation on species and communities (including saline wetlands) is limited or lacking.
- Detailed *Phytophthora* mapping lacking for most of the region. Detail data on impacts on individual species and communities limited.
- Mapped location of Peat Communities absent.

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R = Report; J = Journal article; O = Other.

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# Little Sandy Desert 1 (*LSD1 – Rudall subregion*)

PETER KENDRICK  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

Sparse shrub-steppe over *Triodia basedowii* on stony hills, with River Gum communities and bunch grasslands on alluvial deposits in and associated with ranges. The climate is Arid with summer rainfall. The Rudall Complex, Throssell Group and Lamil Group of the Patterson Orogen. Proterozoic hill country of Throssell, Mount Sears, Broadhurst and Harbutt Ranges. Includes headwaters and course of Rudall River. Extensive areas of tussock grass are associated with footslopes. River Gum communities along drainage. Extensive *Triodia* hummock grasslands on hills and surrounding plains. The area of the subregion is 1, 078, 070 ha.

### Dominant land use

Dominant land uses in the subregion are Conservation (xiii), Unallocated Crown land (xi), (x), Mining leases (vii), and Urban (i) (Parnngurr Aboriginal Community near Cotton Creek in Rudall River National Park) (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class for LSD1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

- The upper Rudall River, draining into Lake Dora. One of two arid zone rivers, with near permanent wetlands along its course, flowing from uplands

## Wetlands

### Wetlands of National significance (DIWA listings)

Name & Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Dora – Rudall River, GSD004WA	B2, B8, B1	ii - iii	iii - iv	ii	v (camel), vi (buffel grass)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

across the desert and into a major salt lake within the Little Sandy Desert (the other is Savory Creek). Only the upper half of the course of the Rudall River is within LSD1.

- Small permanent rockhole wetlands associated with ranges and uplands. Locally significant water sources, with high biological and cultural significance.
- Small artificial surface water sources constructed along the Canning Stock Route (far eastern part of LSD1). Many in disrepair, but there is an active program of refurbishment underway, and many are open again. Sometimes a locally significant source of water.

#### Refugia:

- The only refuge listed by Morton *et al.* (1995) within LSD1 is the Rudall River. They note that it may provide a seasonal refuge to wildlife.
- The hills of the McKay, Harbutt, Fingoon and Broadhurst Ranges present some areas that are protected from fire.

#### High Species and Ecosystem Diversity:

There is a high number of arid zone reptiles, particularly skink lizards (genera *Ctenotus* and *Lerista*).

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8), in the 'Red Book' reports of 1976 – 1984. This national park has been reserved as recommended. No other subregional or bioregional planning for biodiversity conservation has been attempted.

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Minor rockhole wetlands of various Ranges	Many and various	B17	ii (only fresh water sources for large distances)	ii	ii-iii	ii	v (camel)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Rudall River	ii (Buffel grass common along Rudall River, and permanent and semi-permanent pools badly affected by camel)	iii	ii	v (camel), vi (buffel grass)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

There are no threatened ecological communities in LSD1.

## Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Semi-permanent pools along course of Rudall River.	V	18	ii	iii	ii	v, vi, vii
Minor rockhole wetlands of various Ranges	V	41	ii	iii	ii	v, vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus hillieri</i>	E	Unknown	iii	ii	v (fox and cat), vii
<i>Notoryctes caurinus</i>	E	ii	iv	ii	v (fox and cat), vii
<i>Dasyercus cristicauda</i>	V	Unknown	vi	ii	v (fox and cat), vii
<i>Macrotis lagotis</i>	V	ii	iv	ii	v (fox and cat), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Pezoporus occidentalis</i>	CR	Unknown	vi	ii	v (fox and cat), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	Unknown	iii	ii	v (fox and cat), vii
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Aspidites ramsayi</i>	SP	ii	vi	ii	v (fox and cat), vii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Ardeotis australis</i>	P4	Unknown	vi	ii	v (fox and cat), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Eremophila tenella</i> ms	1	Unknown	vi	ii	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Acacia auripila</i>	2	Unknown	vi	ii	Unknown threatening processes
<i>Goodenia hartiana</i> ms	2	Unknown	vi	ii	Unknown threatening processes
<i>Ptilotus mollis</i>	2	Unknown	vi	ii	Unknown threatening processes
<i>Thysanotus solitaster</i>	2	Unknown	vi	ii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN I-IV Reserve Ha	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
39	Shrublands; mulga scrub				H
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	153,865.9			L
99	Hummock grasslands, shrub steppe; <i>Acacia coriacea</i> & hakea over hard spinifex <i>Triodia basedowii</i>	154,570.5			L
117	Hummock grasslands, grass steppe; soft spinifex	92,089.8			L
125	Bare areas; salt lakes				H
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				H
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				M
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex				M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>				M
2151	Low woodland; coolibah & paperbark ( <i>Melaleuca</i> sp.)	1,816.3			H

## Subregional constraints in order of priority (see Appendix B, key g)

**Competing land uses:** Mainly Aboriginal interests, concerning native title. Reserve acquisition can only proceed under a cooperative management model. There are some issues with mining interests.

## Bioregional and subregional priority for reserve consolidation

The Little Sandy Desert is reservation Class 2 (see Appendix D, and Appendix C, rank 4) with 4.58% of area in conservation. There is considerable bias at the subregional level with only 1.4% of LSD2 (however LSD1 has 37.32% of its area) in the reserve system so reservation class 1 is more appropriate here. In LSD1 the priority for reserve consolidation is (ii), indicating that the reserve system is highly biased in terms of CAR

criteria at the subregional level and is not comprehensive or representative in terms of ecosystem representation.

## Reserve management standard

Part of Rudall River National Park is contained in LSD bioregion. The Reserve Management standard for Rudall River National Park is (i) poor (see Appendix C, rank 5). There is no management plan for the park, no staff permanently on site (though the park is visited on an occasional basis by Karratha staff), despite having high tourist visitation and two Aboriginal communities within the park (Parnngurr and Punmu, between 200-500 people). There are two mining communities relatively close to the park (Nifty and Telfer), and there have been ongoing feral animal problems with camels and occasionally donkeys. Formal fire management is absent, although Aboriginal people provide a regular burning regime along roads.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of fauna and flora & Recreation	Rudall River National Park	National Park	i

<sup>1</sup>Appendix C, rank 4

## Off reserve conservation

## Priority species or groups and existing recovery plans

Species	Location	Ecosystem	Threats/Info	Specific Recovery Plan	General Recovery Plan
<i>Dasyercus cristicauda</i>	Status unclear. Historically collected from CSR in sympatry with <i>Dasyercus hillieri</i> .	Sandplains and sand dunes	Requires further survey.	Yes - National Threatened Species Recovery team	Action Plan For Australian Marsupials and Monotremes
<i>Dasyercus hillieri</i>	Status unclear. Historically collected from CSR in sympatry with <i>D. cristicauda</i> .		Requires further survey.	No	Action Plan For Australian Marsupials and Monotremes
<i>Notoryctes caurinus</i>	Status unclear. Rarely encountered, and little known of biology or conservation status.		Requires further survey.	No	Action Plan For Australian Marsupials and Monotremes
<i>Macrotis lagotis</i>	Locally common, but distribution patchy. Appears to be coping with cats, but foxes may be too much for them.		Requires further survey and monitoring.	Yes - National Threatened Species Recovery team	Action Plan For Australian Marsupials and Monotremes
<i>Pezoporus occidentalis</i>	Until recently presumed extinct. Very rarely encountered, and nothing known of its recent status or biology. No known populations, but rumours of its presence. Requires further survey, and careful investigation of threatening processes.			No	Action Plan For Australian Birds
<i>Egernia kintorei</i>	Poorly known, and apparently declining		Requires further survey.	Yes - National Threatened Species Recovery team	Action Plan For Australian Reptiles
<i>Aspidites ramsayi</i>	Frequently captured by Aboriginal people in this area for food.	Not uncommon in suitable habitat.	No further management required.	No	Action Plan For Australian Reptiles
<i>Ardeotis australis</i>	Episodically very abundant, and commonly seen throughout region		No further management required.	No	Action Plan For Australian Birds
<i>Acacia auripila</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Bulbine pendula</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Daviesia eremaea</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Eremophila tenella</i> ms	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Goodenia hartiana</i> ms	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Goodenia purpurascens</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Goodenia schwerinensis</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
Species	Location	Ecosystem	Threats/Info	Specific Recovery Plan	General Recovery Plan
<i>Ptilotus aphyllus</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Ptilotus mollis</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No
<i>Thysanotus solitaster</i>	No detailed knowledge of biology or requirements documented.		Needs further survey.	No	No

## Appropriate species recovery actions

Species/System	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Dasyercus cristicauda</i>	xiv	Low level of knowledge.
<i>Dasyercus hillieri</i>	xii, xiv	Low level of knowledge. Less well known than <i>D. cristicauda</i> .
<i>Notoryctes caurinus</i>	xii, xiv	Low level of knowledge.
<i>Macrotis lagotis</i>	xiv	Definition of areas inhabited, and monitoring of some populations
<i>Pezoporus occidentalis</i>	xii, xiv	Locate and protect any existing populations
<i>Egernia kintorei</i>	xii, xiv	Low level of knowledge.
<i>Aspidites ramsayi</i>	xii	Appears secure
<i>Ardeotis australis</i>	none	Appears secure
<i>Polytelis alexandrae</i>	xii, xiv	Low level of knowledge.

<i>Acacia auripila</i>	xii, xiv	Poor knowledge
<i>Bulbine pendula</i>	xii, xiv	Poor knowledge
<i>Daviesia eremaea</i>	xii, xiv	Poor knowledge
<i>Eremophila tenella</i> ms	xii, xiv	Poor knowledge
<i>Goodenia hartiana</i> ms	xii, xiv	Poor knowledge
<i>Goodenia purpurascens</i>	xii, xiv	Poor knowledge
<i>Goodenia schwerinensis</i>	xii, xiv	Poor knowledge
<i>Ptilotus aphyllus</i>	xii, xiv	Poor knowledge
<i>Ptilotus mollis</i>	xii, xiv	Poor knowledge
<i>Sauropus arenosus</i>	xii, xiv	Poor knowledge
<i>Thysanotus solitaster</i>	xii, xiv	Poor knowledge

<sup>1</sup>Appendix B, key h.

## Ecosystems and appropriate recovery actions

Beard Veg Assoc	Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions	Constraints
125	Bare areas; salt lakes	ix, xii, vii, i, iii	Fire management, research, feral animal control, habitat retention on reserves and protection on other state lands.	Insufficient resources to implement management activities.
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	ix, xii, vii, i, iii	Fire management, research, feral animal control, habitat retention on reserves and protection on other state lands.	Insufficient resources to implement management activities.

<sup>1</sup>Appendix B, rank h.

## Existing ecosystem recovery plans

There are no recovery plans for ecosystems at risk in LSD1.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation in LSD1 is (iii) (see Appendix C, rank 6), indicating that a range of off park measures is required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

At present there is almost nothing being done in terms of NRM, except some very limited threat abatement planning (pest management). Industry codes of practice have been useful in getting mineral explorers to undertake biological work.

### Feasible opportunities for NRM

**Threat Abatement Planning:** Further implementation of pest management strategies.

**Industry Codes of Practice:** Continue to work via industry codes of practice with mineral explorers.

**Capability Building:** In place through Aboriginal communities.

## Impediments or constraints to opportunities

Recognition of Native Title will require cooperative work with desert Aboriginal communities. In some cases, this will mean a big change in the way we do business with traditional owners. However, opportunities could be significant, due to the close proximity of large communities (Parnngurr and Punmu). Mineral tenements may be an obstacle.

## Subregions where specific NRM actions are a priority to pursue

LSD1 has an NRM priority of (ii) (see Appendix C, rank 7) indicating that there are significant constraints to integrate conservation as part of a production/development system. Mainly applies to

acquisition of reserves under Native Title, and lack of control of feral herbivores.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Ecosystem Mapping:** No environmental geology/regolith mapping is available at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Quantitative Fauna Survey:** Quantitative subregional survey of fauna has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists, associated with mining exploration. Quadrat-based floristic data is available from few if any localities.

**Ecological and Life History:** There are few detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species. (e.g., native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass).

### Other Priority Data Gaps Include:

- No data on the fauna/flora of small permanent rockhole wetlands associated within LSD1.
- Little data on aquatic environments of the Rudall River.
- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No data on the impact of camel on desert environments, particularly on water sources, and upon the fauna which are dependant upon such water sources.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.

## Sources

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadlier, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 026, 086, 091, 094, 118, 120, 181, 182, 210, 258, 266, 281, 298, 345, 346, 383, 387, 407, 419, 473, 474, 475, 483, 493, 519, 625, 634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.

# Little Sandy Desert 2 (*LSD2 – Trainor subregion*)

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AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The Trainor subregion is red centre desert on Neoproterozoic sedimentary basement (Officer Basin). Red Quaternary dune fields with abrupt Proterozoic sandstone ranges of Bangemall Basin. Shrub steppe of acacias, *Aluta maisonneuvei* and grevilleas over *Triodia schinzii* on sandy surfaces. Sparse shrub-steppe over *Triodia basedowii* on stony hills, with eucalypt and coolibah communities and bunch grasslands on alluvial deposits and drainage lines associated with ranges. The climate is Arid with episodic summer rainfall. Subregional area is 11,114,705ha.

### Dominant land use

The dominant landuses are (xi) UCL and Crown reserves (95.87%), (ix) Grazing-Native pastures (1.93%), (xiii) conservation reserves (1.41%), and (x) Aboriginal Reserves (0.75%) (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class for LSD2 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

Ecosystem type 545-Hummock grasslands, sparse low tree-steppe; mulga over *Triodia basedowii*. Total extent of this ecosystem is approximately 505 hectares and it is entirely in LSD2.

### Ecosystems That Have Greater Than 85% of Total Extent Confined to LSD2:

Beard Veg Assoc	Description
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>
194	Hummock grasslands, tree steppe; desert oak & hard spinifex between sandhills
215	Low woodland; mulga on dolerite
545	Hummock grasslands, sparse low tree-steppe; mulga over <i>Triodia basedowii</i>
1195	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, shrub steppe; acacia species over <i>Triodia basedowii</i>

#### Centres of endemism:

The palaeo-drainage lines associated with Lake Disappointment may carry a unique troglofauna, but this is yet to be investigated.

#### Refugia:

Rudall River is classified as a refuge by Morton et al. (1995), in that it is a wetland that may provide refuge to animals during dry times (the Rudall flows in LSD1 for half of its length). Savory Creek could also be classed as refugia by the same criteria. Other ephemeral and permanent water sources could also be considered refuges, particularly the more reliable of these. Numerous rockholes, springs and soaks occur throughout LSD2, particularly in range country.

#### High Species and Ecosystem Diversity:

Arid zone reptiles, especially the genera *Ctenotus* and *Lerista* species. The area also displays high diversity within the *Acacia* and *Goodenia* genera.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

Most of the subregion is covered by a CALM Regional Management Plan, published in 1994, that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore is generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually; see Department of Conservation and Land Management 1994).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Disappointment WA052	B8	ii	iii-iv	ii	iv, v (feral cattle, camels, donkeys and rabbits), vii (vegetation around the lake has sustained some damage from fire)
Pools of the Durba Hills (Killagurra Spring, Durba Springs, Biella Spring) WA053	B17	iii	iv	ii	vi (introduction of serious environmental weed, date palm), v (camel, possibly rabbit grazing in vicinity), xii (cultural values degraded through vandalism of petroglyphs and historical points)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Rockholes and Pools of the Carnarvon Range - Virgin Spring	270040E, 7220332N	B17	v (new species of algae recently identified), iii (important drought refuges for a variety of taxa) Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Rockholes and Pools of the Carnarvon Range - Good Camp Rockhole	270318E, 7203935N	B17	v (new species of algae recently identified), iii (important drought refuges for a variety of taxa) Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Rockholes and Pools of the Carnarvon Range - Muirs Pool	267068E, 7202450N	B17	v (new species of algae recently identified), iii (important drought refuges for a variety of taxa) Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Rockholes and Pools of the Carnarvon Range - Yamad & Kadyara Waterholes	268578E, 7220307N	B17	v (new species of algae recently identified), iii (important drought refuges for a variety of taxa) Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Rockholes and Pools of the Carnarvon Range - Miringka & Wandam Waterholes	266694E, 7202565N	B17	v (new species of algae recently identified), iii (important drought refuges for a variety of taxa) Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Rockholes and springs of the Calvert Range	122° 45' E; 24° 00' S	B17	v (population of <i>Petrogale lateralis</i> , only one left in western desert, only one in LSD2), iii (important drought refuges for a variety of taxa). Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Savory Creek	121° 00' E; 23° 45' S to 122° 30' E; 23° 15' S	B2	ii (a large creek that flows across 250 km of LSD2), iii (important drought refuges for a variety of taxa). Also have high cultural and historical values.	iii	iii	ii	xii (tourism), v (camels & donkeys)
Salt lakes of the western Little Sandy Desert - Yanneri Lake	120° 30' E; 24° 27' S	B8	ii (large creek that flows across 250 km of LSD2), v (contains only known populations of <i>Halosarcia</i> sp. Yanneri Lake)	iii	iii	ii	iv, v (camels), vii, xii (gypsum mining)
Salt lakes of the western Little Sandy Desert - Terminal Lake	120° 36' E; 24° 27' S	B8	Unknown	Unknown	vi	ii	iv, v (camels), vii, xii (gypsum mining)
Salt lakes of the western Little Sandy Desert - Lake Wilderness	121° 05' E; 24° 20' S	B8	Unknown	Unknown	vi	ii	iv, v (camels), vii, xii (gypsum mining)
Salt lakes of the western Little Sandy Desert - Lake Sunshine		B8	v (contains only known population of <i>Halosarcia</i> sp. Little Sandy Desert)	Unknown	vi	ii	Unknown threatening processes

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Rudall River	ii	iii - iv	ii	iv, v (cattle, donkeys, camels and rabbits), vi (buffel grass), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in LSD2

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Saline lakes of Little Sandy Desert	V	39	iii	iii	ii	v (rabbit, camel and donkey)
Riparian zone of Savory Creek	V	39	ii	iii	ii	v (rabbit, camel, donkey), vi
Permanent springs, Durba Hills (Durba Spring)	V	9, 38	iii	iii	iii	vi (weeds, date palms), v (feral grazers), xii (visitor impacts)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Riparian zone and pools of upper Rudall River	V	19, 15, 38,	ii	iii	ii	vi (weeds, date palms), v (feral grazers)
Samphire communities, Lake Disappointment	V	39	iii	iv	ii	v (feral grazers), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Notoryctes caurinus</i>	E	unknown	vi	ii	v (cats and foxes)
<i>Notoryctes typhlops</i>	E	unknown	vi	ii	v (cats and foxes)
<i>Dasyercus cristicauda</i>	V	unknown	vi	ii	viii, v (cats and foxes)
<i>Macrotis lagotis</i>	V	ii	iv	iii	v (predation by foxes and habitat destruction/competition from feral herbivores)
<i>Petrogale lateralis lateralis</i>	V	ii	iii	iii	v (foxes and cats)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	V	unknown	vi	iii	v (foxes, cats)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Morelia olivaceus barroni</i>	V	unknown	vi	ii	Unknown Threatening Processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	SP	unknown	vi	ii	iv (grazing of chenopods by introduced herbivores), v
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Macroderma gigas</i>	Commonwealth	unknown	vi	unknown	Unknown threatening processes
<i>Antechinomys laniger</i>	Data deficient	unknown	vi	unknown	vii, v (cats and foxes)
<i>Diplodactylus fulleri</i>	P2	unknown	vi	iii	v, vii
<i>Lerista macropisthopus remota</i>	P2	unknown	vi	iii	v
<i>Pseudomys chapmani</i>	P4	unknown	vi	iii	vii, v (cats and foxes)
<i>Sminthopsis longicaudata</i>	P4	unknown	vi	ii	vii, v (cats and foxes)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Daviesia arthropoda</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Ptilotus stipitatus</i>	1	iii	iv	ii	Unknown threatening processes
<i>Stemodia linophylla</i>	1	unknown	vi	unknown	No known threats, common in LSD1 and LSD2
<i>Tetralthea chapmanii</i>	1	iii	iv	iii	No current threatening are known but there is potential for mining in future
<b>PRIORITY 2</b>					
<i>Comesperma viscidulum</i>	2	unknown	vi	unknown	No known threatening processes
<i>Dampiera atriplicina</i>	2	unknown	vi	unknown	No known threatening processes
<i>Dampiera ramosa</i>	2	unknown	vi	unknown	No known threats, common in subregion
<i>Gonocarpus ephemerus</i>	2	unknown	vi	unknown	No known threatening processes
<i>Halosarcia</i> sp. Little Sandy Desert		unknown	vi	unknown	Unknown threatening processes
<i>Halosarcia</i> sp. Yanneri		unknown	vi	unknown	xii (few populations)
<b>Species Name</b>					
<i>Ptilotus tetrandrus</i>	2	unknown	vi	unknown	x (small population size)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )				H
18	Low woodland; mulga ( <i>Acacia aneura</i> )				M
19	Low woodland; mulga between sandridges				M
29	Sparse low woodland; mulga, discontinuous in scattered groups				M
39	Shrublands; mulga scrub				M
40	Shrublands; acacia scrub, various species				H
41	Shrublands; teatree scrub				H
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>				H
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges				H
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>				M
99	Hummock grasslands, shrub steppe; <i>Acacia coriacea</i> & hakea over hard spinifex <i>Triodia basedowii</i>	X			H
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex				L
117	Hummock grasslands, grass steppe; soft spinifex	X			L
125	Bare areas; salt lakes				M
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	X			M
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills				M
139	Hummock grasslands, patchy shrub steppe; mulga over hard Spinifex on laterite				L
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex				H
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	X			L
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>	X			H
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt				L
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex				M
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>				H
194	Hummock grasslands, tree steppe; desert oak & hard spinifex between sandhills				H
198	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, <i>Acacia pachycarpa</i> & <i>A. victoriae</i> over <i>Triodia brizoides</i> on chert				L
199	Hummock grasslands, shrub steppe; mulga over soft spinifex <i>Triodia</i> on rises				H
215	Low woodland; mulga on dolerite				H
545	Hummock grasslands, sparse low tree-steppe; mulga over <i>Triodia basedowii</i>				H
676	Succulent steppe; samphire				M
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
1195	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, shrub steppe; acacia species over <i>Triodia basedowii</i>				H
2041	Succulent steppe with scrub; teatree over saltflats				M
2151	Low woodland; coolibah & paperbark ( <i>Melaleuca</i> sp.)				H

Subregional constraints in order of priority  
(see Appendix B, key g)

**Competing Land Use:** Prospective mining interests exist.

**Economic Constraints:** In terms of effective implementation of management objectives.

**Other:** We do not have fine enough resolution of biodiversity values to identify priorities of acquisition so further research is required.

Bioregional and subregional priority for reserve consolidation

The Little Sandy Desert is reservation Class 2 (see Appendix D, and Appendix C, rank 4) with 4.58% of area in conservation. There is considerable bias at the subregional level with only 1.4% of LSD2 (however LSD1 has 37.32% of its area) in the reserve system so reservation class 1 is more appropriate here. In LSD2 the priority for reserve consolidation is (ii), indicating that the reserve system is highly biased in terms of CAR criteria at the subregional level and is not comprehensive or representative in terms of ecosystem representation.

## Reserve management standard

No feral predator programs are in place yet in the Little Sandy Desert. Wildfire management is not practicable. Buffel grass is widespread, common and increasing, probably to the exclusion of many native species. Mining exploration or operation activities are not always

supervised. Feral herbivore grazing activities may be considerable (cattle, donkeys, camels and rabbits) and feral predator/herbivore or weed control is not undertaken. Therefore the overall reserve management system rank is (ii) (see Appendix C, rank 5) indicating that biodiversity values and management issues are poorly identified and resource degradation is occurring though it is recoverable.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	National Park	Rudall River National Park	National Park	ii - iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Threatening Processes <sup>1</sup>	Specific Recovery Plans	General Recovery Plans
<i>Polytelis alexandrae</i>	vii (large scale fires), v (introduced herbivores)	No	Action Plan for Australian Birds
<i>Lerista macropisthopus remota</i>	None known	No	Action Plan for Australian Reptiles
<i>Diplodactylus fulleri</i>	None known	No	Action Plan for Australian Reptiles
<i>Morelia olivaceus barroni</i>	v (predation of juveniles by introduced predators fox & cat)	No	Action Plan for Australian Reptiles
<i>Acanthiza iredalei iredalei</i>	iv (grazing of chenopods by introduced herbivores), v	No	Action Plan for Australian Birds
<i>Macroderma gigas</i>	xii (barbed wire fences)	No	Action Plan for Australian Bats
<i>Macrotis lagotis</i>	v (introduced predators - fox, cat), vii	Yes - National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes

Species	Threatening Processes <sup>1</sup>	Specific Recovery Plans	General Recovery Plans
<i>Sminthopsis longicaudata</i>	v (introduced predators - fox, cat)	No	Action Plan for Australian Rodents
<i>Pseudomys chapmani</i>	v (introduced predators - fox, cat)	No	Action Plan for Australian Rodents
<i>Antechinomys laniger</i>	v (introduced predators - fox, cat)	No	Action Plan for Australian Marsupials and Monotremes
<i>Dasyercus cristicauda</i>	v (introduced predators - fox, cat), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes typhlops</i>	v (introduced predators - fox, cat), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Notoryctes caurinus</i>	v (introduced predators - fox, cat), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Petrogale lateralis lateralis</i>	v (introduced predators - fox, cat), vii	No	Action Plan for Australian Marsupials and Monotremes
<i>Daviesia arthropoda</i>	Unknown threatening processes	No	No
<i>Ptilotus stipitatus</i>	Unknown threatening processes	No	No
<i>Stemodia linophylla</i>	No known threats, common in LSD1 and LSD2	No	No
<i>Tetralochea chapmanii</i>	Unknown threatening processes, potential for mining in future	No	No
<i>Comesperma viscidulum</i>	Unknown threatening processes	No	No
<i>Dampiera atriplicina</i>	Unknown threatening processes	No	No
<i>Dampiera ramosa</i>	No known threats, common in subregion	No	No
<i>Gonocarpus ephemerus</i>	Unknown threatening processes	No	No
<i>Halosarcia</i> sp. Little Sandy Desert	Unknown threatening processes	No	No
<i>Halosarcia</i> sp. Yanneri	xii (few populations)	No	No
<i>Ptilotus tetrandrus</i>	xii (small population size)	No	No

<sup>1</sup>Appendix B, key e

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Polytelis alexandrae</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Lerista macropisthopus remota</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Research into current status and habitat requirements
<i>Diplodactylus fulleri</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Research into current status and habitat requirements
<i>Morelia olivaceus barroni</i>	i, ii, iii, xii	Habitat retention through reserves or on other State lands or on private lands. Research into current status and habitat requirements. Juvenile stage may be vulnerable to predation by cats and foxes
<i>Acanthiza iredalei iredalei</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Macroderma gigas</i>	Recovery actions not known	Recovery actions not known
<i>Macrotis lagotis</i>	vii	Control of foxes, cats and dogs. Reduction of competition by feral herbivores

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Sminthopsis longicaudata</i>	vii, ix	Control of foxes and cats. Need to identify present conservation status.
<i>Pseudomys chapmani</i>	vii	Control of foxes and cats.
<i>Antechinomys laniger</i>	vii, ix, xii	Control of foxes and cats. Need to identify present conservation status.
<i>Dasyercus cristicauda</i>	ix, vii, i, ii, iii	Habitat retention through reserves or on other State lands. Control of foxes and cats.
<i>Notoryctes typhlops?</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands. Control of foxes and cats.
<i>Notoryctes caurinus</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands. Control of foxes and cats.
<i>Petrogale lateralis lateralis</i>	vii	Control of foxes, cats and dogs. Reduction of competition by feral herbivores.
<i>Ptilopus stipitatus</i>	i, ii, iii	Habitat retention through reserves or on other State lands.
<i>Tetralthea chapmanii</i>	i, ii, iii	Habitat retention through reserves or on other State lands.
<i>Dampiera atriplicina</i>	i, ii, iii	Habitat retention through reserves or on other State lands.
<i>Gonocarpus ephemerus</i>	i, ii, iii	Habitat retention through reserves or on other State lands.

<sup>1</sup>Appendix B, key h.

### Existing species recovery plans

There are no specific regional recovery plans for any of the above biota/systems but in broad terms they are covered under the Goldfields/Pilbara Regional Management Plans. Other Recovery Plans include The Action Plan for Australian Birds 2000; Action Plan for

Australian Marsupials and Monotremes; The Action Plan for Australian Reptiles; The Action Plan for Australian Bats; Action Plan for Australian Rodents; and Bilby Recovery Plan.

### Ecosystems and appropriate recovery actions

Beard Veg Assoc	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Description
11	Medium woodland; coolibah ( <i>E. microtheca</i> )	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state land. Research.
40	Shrublands; acacia scrub, various species	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
41	Shrublands; teatree scrub	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
96	Hummock grasslands, shrub steppe; acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
99	Hummock grasslands, shrub steppe; <i>Acacia coriacea</i> & hakea over hard spinifex <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
194	Hummock grasslands, tree steppe; desert oak & hard spinifex between sandhills	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
199	Hummock grasslands, shrub steppe; mulga over soft spinifex <i>Triodia</i> on rises	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
215	Low woodland; mulga on dolerite	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.

Beard Veg Assoc	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Description
545	Hummock grasslands, sparse low tree-steppe; mulga over <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
1195	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, shrub steppe; acacia species over <i>Triodia basedowii</i>	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.
2151	Low woodland; coolibah & paperbark ( <i>Melaleuca</i> sp.)	i, ii, iii, xii	Habitat retention or protection through reserves, on private lands or on other state lands. Research.

## Existing ecosystem recovery plans

There are no recovery plans for ecosystems at risk in LSD2.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation in LSD2 is (ii) (see Appendix C, rank 6), indicating that significant off park effort is needed, resource constraints exist, and there is limited community capacity.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning:** Vegetation management plans, and pest management.

**Industry Codes of Practice:** Particularly in relation to mining and exploration activities.

### Feasible opportunities for NRM

No further NRM actions are required.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, so Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through

education of various industry groups (mining, pastoral) and the public in general. Limited financial resources are also a major constraint. Recreational users of the Canning Stock Route are causing localised degradation of camping areas and tracks.

### Subregions where specific NRM actions are a priority to pursue

The subregional priority for NRM in LSD2 is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of a production/development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of any species.

### Other Priority Data Gaps Include:

- No quantitative data on the affect of exotic herbivores or predators, weed colonisation, fire, etc.

**Vegetation and Regional Ecosystem Mapping:** There is no regolith mapping for any of the subregion at better than 1:250,000.

## Source

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
231	Department of Conservation and Land Management	(1994).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 026, 075, 091, 094, 098, 101, 118, 148, 166, 173, 181, 182, 189, 211, 231, 232, 241, 258, 260, 268, 278, 281, 298, 313, 354, 383, 387, 406,

419, 459, 483, 493, 519, 526, 562, 577, 634, 635, 636, 637, 638, 647, 685, 686 and 699 Appendix A.

# Mallee 1 (*MAL1 – Eastern Mallee subregion*)

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## Subregional description and biodiversity values

### Description and area

The Mallee bioregion is the south-eastern part of Yilgarn Craton is gently undulating, with partially occluded drainage. Mainly mallee over myrtaceous-protaceous heaths on duplex (sand over clay) soils. Melaleuca shrublands characterise alluvia, and Halosarcia low shrublands occur on saline alluvium. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. The Eastern Mallee subregion comprises calcareous clays and loams as duplex soils that often contain sheet and modular kankar, outcrops of metamorphosed sandstone, and white and yellow sandplains and loamy plains with numerous salt pans (pan fields). Mallee on sandplains, samphire around small salt lakes, mallee and patches of woodland on clay, and scrub-heath on sandstone. Mallee with Boree (*Melaleuca pauperiflora*) on calcareous clay and loam. Climate is semi-arid (Dry) Warm Mediterranean and has 300 – 500 mm of annual rainfall during winter.

### Dominant land use

Mainly (vii) grazing - improved pasture & (iv) cultivation - dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves, (xiv) roads and other easements, (v) forestry plantation (see Appendix B, key b).

### Continental Stress Class

The Continental Stress Class for MAL1 is 4.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features Include:

- Gypsum dunes at Lake Tay contain rare plants such as *Anigozanthos bicolor* subsp. *minor*, *Eremophila lactea*, *Myoporum turbinatum*, *Ricinocarpos trichophorus*, etc;
- Rare birds such as Western Whipbird (*Psophodes nigrogularis oregon*), Western Ground Parrot (*Pezoporus wallicus*), Malleefowl (*Leipoa ocellata*), Cape Barren Goose (*Cereopsis novaehollandiae*), Slender-billed Thornbill (*Acanthiza iredalei*).
- Rare mammal *Dasyurus geoffroii*
- Rare reptiles *Parasuta spectabilis bushi* locations

### Wetlands

#### Wetlands of National significance (DIWA listings)

- Rare ecosystems include Mixed thicket complex of the Russell Range – includes dominants *Eucalyptus doratoxylon*, *Adenanthos oreophilus*, *Dampiera parvifolia*, *Monaotoca oligarrhenoides*, DRF *Kennedia beckiana*, and priority taxa *Leucopogon apiculatus* and *Chorizema nervosum*.

#### Centres of Endemism:

- Plant assemblages of the Russell Range including Mt Ragged. Examples of endemics include *Darwinia* sp. Mt Ragged, *Dryandra longifolia* subsp. *archeos*, *Phebalium rude* subsp. *lineare* and *Scaevola brookeana*.

#### Refugia:

- Peak Charles
- Mount Ragged
- Granite outcrops are also likely to be significant

#### High Species or Ecosystem Diversity:

- Plant assemblages of the Russell Range including Mt Ragged vegetation communities. Typical species include *Eucalyptus doratoxylon*, *Adenanthos oreophilus*, *Dampiera parvifolia*, and *Monotoca oligarrhenoides*. Endemics include *Dryandra longifolia* subsp. *archeos*, *Phebalium rude* subsp. *lineare* and *Scaevola brookeana*.
- Salt Lake systems are also likely to have a high level of species diversity, but lack sufficient survey information to quantify this.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Wheatbelt in the CTRC Green Book (Conservation Through Reserves Committee 1974). Some, but not all, of these recommendations (with modification) were implemented over the following ten years. The subregion is covered by a CALM Regional Management Plan, that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail (Department of Conservation and Land Management 1992). The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion. Interim Management Guidelines are in place for Frank Hann, Peak Charles, and Cape Arid National Parks (Department of Conservation and Land Management 2000c). The South Coast Macro Corridor Project identifies areas in MAL1 where improved landscape connectivity will benefit biodiversity conservation.

There are no wetlands of national significance in MAL1.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Bostock Swamp	33° 26' S 121° 48' E	B7	ii	ii	iii	i	i, ix, x
Harms Lake	32° 14' S 123° 04' E	B7	ii	iv	vi	i	Unknown threatening processes
Roberts Swamp	33° 11' S 121° 245 E	B10	ii	iii	vi	i	i, ix, x
Swan Lagoon	33° 153' S 121° 385 E	B7	ii	iii	iii	i	i, ix, x
Unknown Lakes (Salmon Gums)	32° 54' S 121° 50' E	B7	iii, iv	iii	vi	i	i, ix, x
Cascade west suite & Cascade east suite	3236400 6298000 325000 6293000	B10, B12	ii, iii	iii	vi	i	xii (road runoff), vi, iv
Reserve Swamp	318600 6297000	B10, B12	ii	Unknown	vi	i	xii (road runoff), vi, iv
Lort River mid suite & upper-mid suite	351000/6306000 341000/6318000	B2, B4	ii, iii	iii	iii	i	xi (surrounding land use)
Peak Charles System	32° 52' S 121° 09' E	B11, B12	ii	Unknown	vi	Unknown	Unknown threatening processes
Native Dog Swamp Suite	345300/6293200	B4	ii	Unknown	vi	Unknown	Unknown threatening processes
Clarke Road Suite	229300/6327600	B7, B8	v, iii	iv	iv	i	xii (gypsum mining)
Lake Chidnup	769000/6305000 33° 21' S 119° 53' E	B8	ii, iii	Unknown	vi	Unknown	Unknown threatening processes
Lake Tay	32° 54' S 120° 48' E	Unknown	ii	Unknown	vi	Unknown	Unknown threatening processes, xii (gypsum mining)
Bundara Suite	751500/6291000	B8	ii	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

A large number of wetlands are found in this subregion (ca 1000). Survey has not assessed all for subregional

significance. Only those with documented survey are included in this table.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Young River	i	iii	i	i, ii, iv, v (foxes & rabbits), ix, x
Lort River	ii	iii	i	i, ii, iv, v (foxes & rabbits), ix, x
Oldfield River	iv	unknown	i	Unknown threatening processes
Jerdacuttup River	iv	unknown	i	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Plant assemblages of mixed thicket complexes in the Russell Range System	V	29	iii	iii	iii	vii, viii ( <i>Phytophthora</i> sp.)
Herblands and Bunch Grasslands on gypsum lunette dunes alongside saline playa lakes	V	38	iii	iii	iii	vi, iv, x, xii (mining)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Beard Veg Code	Description	Status <sup>1</sup>	NVIS <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
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	<i>Eucalyptus redunca</i> and <i>E. uncinata</i> mallee scrub on sand over clays in valleys of the southern wheatbelt	-	29	unknown	vi	ii	ix
	<i>Eucalyptus eremophila</i> and <i>E. redunca</i> mallee scrub	-	29	unknown	vi	ii	i
	<i>Eucalyptus eremophila</i> and <i>E. forrestiana</i> mallee/very low forest scrub	-	29, 27	unknown	vi	ii	i, ix
	<i>Eucalyptus eremophila</i> mallee scrub	-	29	unknown	vi	ii	Unknown threatening processes
126	Bare areas; freshwater lakes	-	42	variable	iii	iii	ix, x
934	Shrublands; mallee scrub <i>Eucalyptus nutans</i>	-	29	ii-iii	iii	iii	ix
6048	Shrublands; banksia scrub-heath on sandplain in the Esperance Plains Region	-	30	ii-iii	iii	iii	i, viii ( <i>Phytophthora</i> sp.)
51	Sedgeland; reed swamps, occasionally with heath	-	38	iii	ii	iii	ix, x
931	Medium woodland; yate	-	8	iii	ii	iii	ix
929	Low forest; moort ( <i>E. platypus</i> )	-	4	iii	ii	iii	ix
552	Shrublands; <i>Casuarina acutivalvis</i> & <i>calothamnus</i> (also <i>melaleuca</i> ) thicket on greenstone hills	-	32	iii	ii	iii	xii (mining)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroi</i>	V	iii	iv	iii	v (fox, cat), ii
<i>Parantechinus apicalis</i>	E	unknown	unknown	unknown	Unknown threatening processes
** <i>Eubalaena australis</i>	E	iii	v	ii	No known threatening processes
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	i-ii	iii	ii	ii, i, xii (competition with bees and other birds for nest sites)
<i>Acanthiza iredalei iredalei</i>	V	ii	iv	ii	iv (sheep & rabbits)
<i>Cereopsis novaehollandiae grisea</i>	V	unknown	vi	unknown	xii (drought)
<i>Leipoa ocellata</i>	V	unknown	vi	unknown	v (fox), iii
<i>Psophodes nigrogularis oberon</i>	V	ii	iv	iii	vii, ii

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>**Thalassarche cauta</i>	V	ii	v	iii	xii (commercial fishing)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Neophoca cinerea</i>	Near Threatened	i-ii	iii	iii	xii (small population size; commercial fisheries)
<i>Falculunculus frontatus</i>	Near Threatened	unknown	unknown	unknown	Unknown threatening processes
<i>Morelia spilota</i>	SP	unknown	unknown	unknown	Unknown threatening processes
<i>Charadrius rubricollis</i>	P4	unknown	unknown	unknown	Unknown threatening processes

Species marked with \*\*asterisks indicate these species are occasional visitors to the subregion.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	CR	unknown	iii	ii	ii, vii, i
<i>Eremophila lactea</i>	CR	ii	iv	ii	vii, ii, xii (roadworks), iv, i
<i>Adenanthos eyrei</i>	E	iii	iv	iii	vii, xii (population difficult to locate and naturally rare)
<i>Conostylis lepidospermoides</i>	E	unknown	ii-iii	iv	ii
<i>Leucopogon marginatus</i>	E	unknown	vi	unknown	Unknown threatening processes
<i>Myoporum turbinatum</i>	E	iii	iv	iii	vii (post fire species), ii, ix, xii (roadworks)
<i>Ricinocarpus trichophorus</i>	E	ii	iii	iii	vii, ii, ix, i, iv, x, xii (very hard to locate)
<i>Drummondita longifolia</i>	V	unknown	iv	ii	xii (very restricted distribution), vii
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	V	ii	iv	ii	vii, xii (roadworks)
<i>Eucalyptus merrickiae</i>	V	ii-iii	iv	ii	ii, ix, xii (roadworks)
<b>PRIORITY 1</b>					
<i>Acacia diaphana</i>	1	unknown	vi	iii	ii, v (stock), i
<i>Acacia diminuta</i>	1	unknown	vi	iii	Unknown threatening processes
<i>Acacia</i> sp. Esperance (MA Burgman 1833b)	1	unknown	vi	iii	ii, i
<i>Astartea</i> sp. Esperance (A Fairall 2431)	1	vi	unknown	unknown	Unknown threatening processes
<i>Baeckea crassifolia</i> var. <i>icosandra</i>	1	iii	vi	iii	Unknown threatening processes
<i>Boronia baeckeacea</i> subsp. <i>patula</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Chorizema circinale</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Conostephium marchantiorum</i>	1	iii	iv	iii	No known threatening processes
<i>Conostephium uncinatum</i>	1	iii	vi	iii	No known threatening processes
<i>Darwinia calothamnoides</i> ms	1	iii	vi	iii	xii (appears to be disturbance opportunist), vii
<i>Darwinia</i> sp. Mt Ney (MA Burgman & S McNee 1274)	1	unknown	iv	iii	vii
<i>Dicrastylis archeri</i>	1	iii	vi	iii	xii (appears to be disturbance opportunist)

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Dicrastylis capitellata</i>	1	ii-iii	vi	iii	Unknown threatening processes
<i>Dillwynia acerosa</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Dodonaea hexandra</i>	1	unknown	vi	iii	No known threatening processes, species is widely dispersed in Western Australia
<i>Eremophila compressa</i>	1	iii	iv	iii	vii, xii (appears to be disturbance opportunist)
<i>Eucalyptus burghmaniana</i> ms	1	iii	iii	iii	ii, i, xii (residential development)
<i>Eucalyptus foliosa</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Eucalyptus varia</i> subsp. <i>salsuginosa</i>	1	unknown	vi	iii	Unknown threatening processes
<i>Eutaxia</i> sp. Peak Eleanora (Burgman 3862)	1	unknown	vi	unknown	Unknown threatening processes
<i>Hydrocotyle</i> sp. Truslove (MA Burgman 4419)	1	unknown	iv	iii	Unknown threatening processes
<i>Hydrocotyle vigintimilla</i> ms	1	unknown	vi	unknown	Unknown threatening processes
<i>Lepidium fasciculatum</i>	1	unknown	iv	ii	ix, ii, i, xii (species is very hard to locate)
<i>Leucopogon</i> sp. Bonnie Hill (KR Newbey 9831)	1	iii	iii	iii	i, ii, vii, viii, genus currently undergoing taxonomic revision
<i>Leucopogon</i> sp. Mount Heywood (MA Burgman 1211) [aff. <i>hamulosus</i> ]	1	iii	iv	iii	Unknown threatening processes, genus currently undergoing taxonomic revision
<i>Leucopogon</i> sp. Roberts Swamp (KR Newbey 8173)	1	ii-iii	iv	iii	ii, i, vii, viii ( <i>Phytophthora</i> sp.), genus currently undergoing taxonomic revision
<i>Leucopogon</i> sp. South Coast (KR Newbey 8213)	1	iii	iii	iii	Unknown threatening processes, genus currently undergoing taxonomic revision
<i>Melaleuca agathosmoides</i>	1	ii	vi	iii	xii (mining; limited geographic range)
<i>Mirbella densiflora</i>	1	iii	vi	iii	Unknown threatening processes
<i>Philotheca gardneri</i> subsp. <i>globosa</i>	1	unknown	vi	unknown	Unknown threatening processes
<i>Pimelea pelinos</i>	1	unknown	vi	ii	xii (limited geographic range)
<i>Thysanotus baueri</i>	1	iii	iv	iii	xii (species is poorly collected)
<i>Verticordia sieberi</i> var. <i>pachyphylla</i>	1	unknown	vi	iii	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Acacia amyctica</i>	2	iii	iv	iii	Unknown threatening processes
<i>Acacia asepala</i>	2	unknown	vi	iii	Unknown threatening processes
<i>Angasomyrtus salina</i>	2	iii	iv	iii	vii, ix, x, ii
<i>Angianthus newbeyi</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Astartea</i> sp. Jyndabinbin Rocks (KR Newbey 7689)	2	unknown	vi	unknown	Unknown threatening processes

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Asteridea</i> sp. Ragged (W Archer 1509903)	2	unknown	vi	unknown	Unknown threatening processes
<i>Astroloma</i> sp. Grass Patch (AJG Wilson 110)	2	iii	iv	iii	i, ii, ix, x, v (stock)
<i>Bentleya diminuta</i>	2	ii	vi	iii	xii (limited geographic range; road verge population; appears to be disturbance opportunist)
<i>Boronia acanthoclada</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Boronia corynophylla</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Bossiaea cucullata</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Chthonocephalus multiceps</i>	2	unknown	iv	iii	xii (species is poorly collected)
<i>Comesperma calcicola</i> ms	2	unknown	vi	unknown	Unknown threatening processes
<i>Conospermum sigmoideum</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Darwinia luehmannii</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Darwinia</i> sp. Peak Charles (AS George 10627)	2	unknown	vi	iii	vii
<i>Daviesia campephylla</i>	2	iii	iv	iii	xii (limited geographic range), vii
<i>Daviesia newbeyi</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Dicrastylis obovata</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Drosera salina</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Elachanthus pusillus</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Eremophila chamaeophila</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Gastrolobium acrocaroli</i> ms	2	unknown	vi	unknown	Unknown threatening processes
<i>Gastrolobium rigidum</i>	2	ii-iii	iv	iii	No known threatening processes, may be a disturbance opportunist
<i>Goodenia scapigera</i> subsp. <i>graniticola</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Grotiola pedunculata</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Grevillea plurijuga</i> subsp. <i>superba</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Haegiela tatei</i>	2	unknown	iv	iii	xii (species is poorly collected)
<i>Hibbertia charlesii</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Hydrocotyle decipiens</i> ms	2	unknown	vi	unknown	Unknown threatening processes
<i>Isolepis australiensis</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Leucopogon</i> sp. Kau Rock (MA Burgman 1126) [aff. <i>allittii</i> ]	2	unknown	vi	unknown	Unknown threatening processes
<i>Levenhookia pulcherrima</i>	2	unknown	iv	ii	Unknown threatening processes
<i>Melaleuca eximia</i>	2	unknown	vi	unknown	Unknown threatening processes
<i>Melaleuca viminea</i> subsp. <i>appressa</i>	2	unknown	vi	ii	Unknown threatening processes

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Olearia laciniifolia</i>	2	ii	vi	ii	i, ii, xii (species is poorly collected), vii
<i>Opercularia hirsuta</i>	2	ii-iii	vi	ii	xii (very difficult to distinguish from other species of same genus)
<i>Opercularia loganioides</i>	2	ii-iii	vi	ii	xii (species is poorly collected), i, ii
<i>Opercularia rubioides</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Otiorhynchus rigidus</i> ms	2	unknown	vi	ii	Unknown threatening processes
<i>Philotheca apiculata</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Phlegmatospermum eremaicum</i>	2	iii	iv	iii	xii (small population size)
<i>Pimelea halophila</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Spyridium subochreatum</i> var. <i>subochreatum</i>	2	unknown	vi	ii	Unknown threatening processes
<i>Thysanotus brachyantherus</i>	2	unknown	vi	ii	vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease
8	Medium woodland; salmon gum & gimlet	X		
9	Medium woodland; coral gum ( <i>E. torquata</i> ) & goldfields blackbutt ( <i>E. le souefii</i> ) (also some e10, 11)			
10	Medium woodland; red mallee group	X		
41	Shrublands; teatree scrub	X		
47	Shrublands; tallerack mallee-heath	X		
51	Sedgeland; reed swamps, occasionally with heath			
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush,			
125	Bare areas; salt lakes	X		
126	Bare areas; freshwater lakes			
128	Bare areas; rock outcrops	X		
221	Succulent steppe; saltbush			
413	Shrublands; <i>Acacia neurophylla</i> & <i>A. species</i> thicket	X		
479	Shrublands; mallee-heath (Nuytsland)	X		
482	Medium woodland; merrit & red mallee	X		
486	Mosaic: Medium woodland; salmon gum & red mallee/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>	X		
493	Medium woodland; salmon gum mixed with merrit & red mallee	X		
507	Succulent steppe with woodland; salmon gum & saltbush			
510	Shrublands; Mt Ragged heath	X		
512	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & Forrest's marlock ( <i>E. forrestiana</i> )	X		
514	Shrublands; mallee scrub, white mallee ( <i>Eucalyptus cooperiana</i> )	X		
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )	X		
516	Shrublands; mallee scrub, black marlock	X		
518	Mosaic: Medium woodland; merrit & coral gum/Shrublands; mallee scrub <i>Eucalyptus eremophila</i>	X		
519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i>	X		
521	Medium woodland; salmon gum & red mallee	X		
522	Medium woodland; redwood ( <i>E. transcintentalis</i> ) & merrit ( <i>E. flocktoniae</i> )		X	

Beard Veg Code	Ecosystem Description	IUCN Reserves	Non-IUCN Reserve	CALM Purchased Lease
524	Medium woodland; Dundas blackbutt & red mallee	X		
552	Shrublands; <i>Casuarina acutivalvis</i> & calothamnus (also melaleuca) thicket on greenstone hills	X		
924	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & red mallee	X		
925	Shrublands; mallee scrub, red mallee	X		
929	Low forest; moort ( <i>E. platypus</i> )	X		
931	Medium woodland; yate	X		
934	Shrublands; mallee scrub <i>Eucalyptus nutans</i>	X		
936	Medium woodland; salmon gum	X		
1047	Shrublands; <i>Eucalyptus incrassata</i> mallee-heath	X		
1413	Shrublands; acacia, casuarina & melaleuca thicket	X		
1516	Shrublands; mallee scrub, black marlock & Forrest's marlock	X		
1519	Shrublands; mallee scrub, <i>Eucalyptus eremophila</i> & banksia			
2048	Shrublands; scrub-heath in the Mallee Region			
4048	Shrublands; scrub-heath in the Esperance Plains incl. Mt Ragged scrub-heath	X		
6048	Shrublands; banksia scrub-heath on sandplain in the Esperance Plains Region	X		

### Subregional constraints in order of priority

Subregional constraints affecting ability to acquire the above ecosystem and vegetation types to the reserve system are irreplaceability, economic constraints and competing land-uses (major components of the landscape are covered by mines, mining tenements or exploration leases and to a lesser extent grazing) (see Appendix B, key g).

### Bioregional and subregional priority for reserve consolidation

The Mallee bioregion is IBRA Reservation Class 5 (>15% of its area reserved in any CALM tenure). However, MAL1 is reservation Class 4 because <15 % of its area reserved (any tenure), its western and central parts have been cleared for wheatfields leaving a biased reserve

system and salinity problems are ubiquitous so Class 3 is more appropriate (see Appendix D, and Appendix C, rank 4).

### Reserve management standard

Most MAL 2 reserves are relatively undisturbed, however potential does exist for hydrological disturbance to occur on those reserves located within the agricultural cleared area. Minor agricultural weed invasion on sandy soils along western and northern boundaries of conservation reserves does occur. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained. Feral herbivore grazing activities by the rabbits does occur across many of the reserves and no feral predator control systems are in place (except for Cape Arid National Park).

Land status Class	Purpose	Reserve Number	Name	Category	Reserve Management <sup>1</sup>
B	Conservation of Flora & Fauna	36957	Dundas	Nature Reserve	ii-iii
A	Conservation of Flora & Fauna		Salmon Gums Nature Reserve	Nature Reserve	ii
C	Conservation of Flora & Fauna	16801	Truslove North	Nature Reserve	ii
C	Conservation of Flora & Fauna	27985	Truslove Townsite	Nature Reserve	ii
A	National Park	36004	Peak Charles	National Park	ii
A	Conservation of Flora & Fauna	31799	Muntz Road	Nature Reserve	ii
A	Conservation of Flora & Fauna		Wittenoom Hills	Nature Reserve	ii
A	Conservation of Flora & Fauna & Water	8019	Swan Lagoon	Nature Reserve	ii
A	Conservation of Flora & Fauna & Water	3042	Jeffrey Lagoon	Nature Reserve	ii
A	Conservation of Flora & Fauna	29012	Bishops Road Nature Reserve	Nature Reserve	ii
A	Conservation of Flora & Fauna	30583	Griffiths Road	Nature Reserves	ii
A	Conservation of Flora & Fauna		Grass Patch (East)	Nature Reserves	ii
C	Conservation of Flora & Fauna	35659	Unnamed	Nature Reserves	ii

Land status Class	Purpose	Reserve Number	Name	Category	Reserve Management <sup>1</sup>
C	Catchment Protection & Conservation of Flora & Fauna	43949	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna	31744	Cascades	Nature Reserves	ii
C	Conservation of Flora & Fauna	31745	Cascades	Nature Reserves	ii
A	Conservation of Flora & Fauna	31743	Cascades	Nature Reserves	ii
A	Conservation of Flora & Fauna	31742	Fields		ii
C	Conservation of Flora & Fauna	43221	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna	36608	Dowak	Nature Reserves	ii
C	Conservation of Flora & Fauna	33501	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna	33113	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna	29860	Red Lake	Nature Reserves	ii
C	Conservation of Flora & Fauna	27768	Ridley South	Nature Reserves	ii
C	Conservation of Flora & Fauna	28300	Ridley North	Nature Reserves	ii
A	Conservation of Flora & Fauna	27386	Mount Ridley	Nature Reserves	ii
A	Conservation of Flora & Fauna	27384	Mount Burdett	Nature Reserves	ii
A	Conservation of Flora & Fauna	27387	Burdett South	Nature Reserves	ii
A	Conservation of Flora & Fauna	27388	Burdett North	Nature Reserves	ii
A	Conservation of Flora & Fauna	32776, 32777, 32779, 32780	Kau Rock Group	Nature Reserves	ii
A	Conservation of Flora & Fauna	32782	Mount Ney	Nature Reserves	ii
A	Conservation of Flora & Fauna	32129, 32130, 32783	Part Beaumont Group	Nature Reserves	ii
A	Conservation of Flora & Fauna	32131	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna & Water	38334	Unnamed	Nature Reserves	ii
A	Conservation of Flora & Fauna	32784	Neredup	Nature Reserves	ii
A	Conservation of Flora & Fauna	38544	Niblick	Nature Reserves	ii
A	Conservation of Flora & Fauna	38545	Clyde Hill	Nature Reserves	ii
A	National Park	24047	Cape Arid	National Park	iii
C	Conservation of Flora & Fauna	41934	Unnamed	Nature Reserves	ii
A	Primitive Area for the Preservation and Study of Flora, Fauna, Geological and Anthropological Features	27632	Nuytsland	Nature Reserve	i-ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

Species	Beard Veg Assoc	Specific Recovery Plan	General Recovery Plan	Prioritise for Subregion <sup>1</sup>
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	50	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
<i>Conostylis lepidospermoides</i>	47	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	929, 931	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii

Species	Beard Veg Assoc	Specific Recovery Plan	General Recovery Plan	Prioritise for Subregion <sup>1</sup>
<i>Eremophila lactea</i>	940, 942	IRP 1999-2002	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	ii
<i>Eucalyptus merrickiae</i>	125, 519	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iii
<i>Myoporum turbinatum</i>	125	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	ii
<i>Ricinocarpus trichophorus</i>	47	No	Declared Rare and Poorly Known Flora of the Esperance District; South Coast Regional Management Plan.	iv

<sup>1</sup>Appendix C, rank 6

There are a number of action plans that cover a wide range of species that are applicable for birds (Garnett and Crowley 2000), marsupials and monotremes (Maxwell *et al.* 1996), reptiles (Cogger *et al.* 1993), rodents (Lee

1995), seals (Shaugnessy 1999), albatrosses and petrels (Environment Australia 2001) and Declared Rare and poorly known flora of the Esperance region (Craig and Coates 2001).

### Appropriate species recovery actions

Species	Beard Veg Assoc	Species Recovery <sup>1</sup>	
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	50	ii, iii, ix	Habitat protection on private lands and on other state lands; Fire management.
<i>Conostylis lepidospermoides</i>	47	ii, iii, xiv	Habitat protection on private lands and on other state lands; Other - roadside markers.
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	929, 931	iii, ix, xiv	Habitat protection on other state lands; Fire management; Other - roadside markers.
<i>Eremophila lactea</i>	940, 942	ii, iii, ix, xiv, xii	Habitat protection on private lands and on other state lands; Fire management; Other - roadside marking; Research - further survey, seed collection
<i>Eucalyptus merrickiae</i>	125, 519	iii, ii, ix, xiv, xi	Habitat protection on other state lands and on private lands; Fire management; Other - roadside markers; Reinstatement of hydrology.
<i>Myoporum turbinatum</i>	125	ii, iii, i, xi, ix, vi, xiv	Habitat retention and protection on private lands, on other state lands, and through reserves; Reinstatement of hydrology; Fire management; Weed control; Other - roadside markers)
<i>Ricinocarpus trichophorus</i>	47	iii, ix	Habitat protection on other state lands; Fire management.

<sup>1</sup>Appendix B, key h

### Ecosystems and appropriate recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Banded ironstone range plant communities	No	South Coast Regional Management Plan

### Appropriate ecosystem recovery actions

Ecosystem	Species Recovery <sup>1</sup>	Recovery Descriptions
Banded ironstone range plant communities	i, ii, iii, xiii	Habitat retention and protection through reserves, on private lands and on other state lands; Capacity building with community, landholders, industry and institutions.

<sup>1</sup>Appendix B, key h

### Subregion priority for off reserve conservation

The Subregional priority for off-park conservation in MAL1 is (iv) (see Appendix C, rank 6), limited off park measures are required.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** Tax deductions for fencing on pastoral leases

**Legislation:** Pastoral Act has regulations on stocking rates, etc; Wildlife Conservation Act; Sandalwood Act.

**Threat Abatement Planning:** Vegetation management plans; pest management; feral animal control; Kangaroo shooting; Dingo baits; Callicivirus control of rabbit populations

Environmental Management Systems: Interim Management Guidelines only.

**Capacity Building:** the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** e.g. South Coast Regional Integrated Planning Team (SCRIPT); Bushfire control program.

## Feasible Opportunities for NRM

**Incentives:** Pastoral leases in good condition could be converted to conservation estate.

**Legislation:** Wildlife Conservation Act and Sandalwood Act are both outdated and need to be repealed. More wide-ranging and comprehensive legislation is required.

**Institutional Reform:** Pastoral leases in good condition could be converted to conservation estate.

**Threat Abatement Planning:** More comprehensive controls need to be developed for foxes, rabbits and cats.

**Codes of Practice:** There is a need to develop codes of practice and standards of management for pastoral lands.

**Capacity Building:** Closer liaisons need to be developed with community groups and land holders on issues, e.g. pastoral industry; There is further scope for the Macro Corridor project is used as a tool to be used to identify strategic landscape level connectivity.

**Other Planning Opportunities:** Closer liaisons with local governments are also required for relevant issues.

**Other:** There is a need to identify and establish other conservation areas that contain values not already represented in CALM estate. e.g. this may include granite outcrops from Cape Arid National Park to Dundas Nature Reserve.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. The Macro Corridor concept is a useful tool to raise awareness of biodiversity issues, however, existing land use conflicts have implication for natural land management. Limited financial resources are also a major constraint.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
043	Barrett, S.	(1996).	Biological survey of mountains of southern Western Australia.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadlier, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
190	Conservation Through Reserves	(1974).	Conservation Reserves in Western	Department of Conservation and	R

Subregions where specific NRM actions are a priority to pursue

The subregional NRM priority for MAL1 is (iii) (see Appendix C, rank 7). The capacity for conservation to be integrated into NRM to achieve significant biodiversity outcomes has been recognised. NRM instruments in place with some achieved biodiversity outcomes.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Veg map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** Very limited systematic quadrat-based fauna survey (Department of Conservation and Land Management 2000a; Barrett 1996). Other data is confined to bird atlas. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

**Floristic Data:** No systematic quadrat-based flora survey. Most reserves don't have long-term survey data on species presence or absence; data is confined to specific threatened flora, and a few large reserves. No funding for ongoing monitoring of stratified set of LTERM quadrats currently being sampled across the subregion.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants (except some DRF), persisting CWR mammals (except Dibbler, Chuditch), persisting E/V birds (except Hooded Plover, Malleefowl, Western Whipbird), and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of most species, including foxes,

**Other Priority Data Gaps:** Including:

- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, fire, and affect of mining and exploration on communities.
- Effect of rising water table on species composition of communities on composition of vegetation communities remaining within the agricultural landscape.

	Committee		Australia. Systems 1, 2, 3, 4, 5, 8, 9, 10, 11, 12. Report of the Conservation Through Reserves Committee to the Environmental Protection Authority.	Environment (WA).	
194	Craig G.F and Coates D.J.	(2001).	Declared Rare and Poorly Known Flora in the Esperance District. Wildlife Management Program No 21.	Department of Conservation and Land Management, Western Australia.	R
230	Department of Conservation and Land Management	(1992).	South Coast Region Regional Management Plan 1992-2002. Management Plan No. 24.	Department of Conservation and Land Management.	O
239	Department of Conservation and Land Management	(2000a).	CALM Biodiversity Survey of the Agricultural Zone June 2000 Status Report. Salinity Action Plan Biological Survey of the Agricultural Zone.	Department of Conservation and Land Management, Western Australia.	R
790	Environment Australia in consultation with the Albatross and Giant-Petrel Recovery Team	(2001).	Recovery Plan for Albatrosses and Giant Petrels	Environment Australia, Canberra.	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
781	Shaugnessy, P.D.	(1999).	The action plan for Australian seals	Environment Australia, Canberra.	O
807	Stack, G. and Brown, A.	(1999).	Milky Emu Bush ( <i>Eremophila lactea</i> ) Interim Recovery Plan 1999-2002 (IRP No 38)	Department of Conservation and Land Management, Perth.	O

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 014, 045, 050, 101, 156, 263, 273, 278, 307, 328, 340, 354, 373, 409, 410, 454, 485, 580, 581, 587, 590, 675, 677 and 695 in Appendix A.

## Mallee 2 (MAL2 - Western Mallee subregion)

BRETT BEECHAM AND ALAN DANKS  
NOVEMBER 2001

### Subregional description and biodiversity values

#### Description and area

The Mallee bioregion is the south-eastern part of Yilgarn Craton. Its landscape is gently undulating, with partially occluded drainage. Mallee over myrtaceous-proteaceous heaths on duplex (sand over clay) soils are common. Melaleuca shrublands characterise alluvia, and Halosarcia low shrublands occur on saline alluvium. A mosaic of mixed eucalypt woodlands and mallee occur on calcareous earth plains and sandplains overlying Eocene limestone strata in the east. Landscape is fragmented with particular surface-types almost completely cleared as wheat-fields.

Western Mallee (MAL2) subregion has more relief than its eastern counterpart: main surface-types comprise clays and silts underlain by Kankar, exposed granite, sandplains and laterite pavements. Salt lake systems on a granite basement. Occluded drainage system. Mallee communities occur on a variety of surfaces; *Eucalyptus* woodlands occur mainly on fine-textured soils, with scrub-heath on sands and laterite. The climate is warm Mediterranean and annual rainfall is 250-500mm. Total area of the subregion is 4,763,963 ha.

#### Dominant land use

Mainly (iv) dry-land agriculture, with lesser areas of (xiii) conservation, (xi) UCL and Crown reserves,

(xiv) roads and other easements (see Appendix B, key b).

#### Continental Stress Class

MAL2 currently has a Continental Stress Class listed as 3. However, it should probably be 2, although it is difficult to identify exactly which condition attributes require amending. I would suggest that the c4 class "Degree of Connectivity" be revised to "1" not "2" because connectivity within the cleared areas of the subregion is really no better than in the Avon Wheatbelt bioregion. Overall the differences between the MAL2 and AW 1 & 2 subregions are not great. MAL2 straddles a divide between cleared and non-agricultural lands. Over three-quarters of the subregion is dominated by intensive land use with similar condition attributes to the AW1 & 2. The remaining quarter is essentially uncleared and under far fewer threats is not necessarily representative of the majority of the subregion. Therefore I believe that the continental stress class should be 2 or even 1, to better reflect the on-ground realities, and that the majority of the subregion is essentially a continuation of the AW1 and 2 subregions in terms of threats and management.

#### Known special values in relation to landscape, ecosystem, species and genetic values

**Critical Weight Range mammals:** 35-7 000 g weight range mammals threatened by fox predation. Two species are now totally extinct; the Pig-footed Bandicoot and Crescent Nailtail Wallaby. Several species are subregionally extinct, and some are still extant

Species	Current Conservation Status (WA)	Status in MAL2 Subregion
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Subregionally Extinct
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)
Western Barred Bandicoot ( <i>Perameles b. bougainville</i> )	Threatened (Endangered)	Subregionally Extinct
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Subregionally Extinct
Numbat ( <i>Myrmecobius fasciatus</i> )	Threatened (Vulnerable)	Subregionally Extinct
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Subregionally Extinct
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Subregionally Extinct
Banded Hare-wallaby ( <i>Lagostrophus f. fasciatus</i> )	Threatened (Vulnerable)	Subregionally Extinct
Black-flanked Rock-wallaby ( <i>Petrogale l. lateralis</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Subregionally Extinct
Pseudomys shortridgei	Threatened (Vulnerable)	Threatened (Vulnerable)

Species	Current Conservation Status (WA)	Status in MAL2 Subregion
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Quenda ( <i>Isaodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Subregionally Extinct
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent
Pseudomys occidentalis	Priority ?	Priority ?
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent

#### Granite outcrops:

Important as seasonal resources and temporary refuge for fauna of surrounding habitats; Black-flanked Rock Wallaby, four species of reptiles are restricted to granite outcrops; at least 1320, and possibly 2000 plant species occur on Western Australian granite outcrops – most diverse in the southwest with individual outcrops having up to 200 species, including many endemics; the mygalomorph genus *Teyl* shows extensive radiation in the southern half of WA (Harvey and Main undated), is a Gondwanan relic of “wet” habitats (Main 1996a). They occur in meadows on many granite outcrops (Main 2000) and are restricted to granite outcrops as are the larvae chironomid fly *Archaeochlus* (Withers and Edward 1997); recent surveys in the wheatbelt have identified at least 230 species of aquatic invertebrates from granite pools, they contribute significantly to endemism of aquatic fauna of the inland south-west and have particular conservation value for about 50 species restricted to them (Pinder *et al.* 2000).

#### Gypsum dunes:

Plant species are generally unique to each IBRA Region and often smaller scales; several DRF and Priority flora species are restricted to gypsiferous habitats, and at least 80 species are likely to be gypsiphyllic (Mattiske Consulting 1995a).

#### Mallee Eucalypts and Melaleuca for Oil Production:

It is seen as vital to identify local *Eucalyptus* and *Melaleuca* species that can be introduced in commercial quantities to develop a plantation based oil mallee industry in the south west of Western Australia. The use of locally endemic species is seen as preferable to minimise the risk of eastern Australian species hybridising with local species and becoming environmental weeds. The use of local species is also seen as providing some fauna habitat benefits as well. Populations of numerous mallee *Eucalyptus* species (Series: Oleosae, Cneoripholiae, Ovulares, Erythronemae, Loxophlebae, Calycogonae and the Spathulata Group) and *Melaleuca uncinata* sens. lat. and *M. lateriflora* contain individuals that produce higher than average quantities of cineole oil. Identifying these individuals in native vegetation, and introducing their genetic material into breeding programs is critical to the success of this program. The subregion supports significant populations of many of these species.

#### South West Botanical Province:

Shows a very high degree of endemism, particularly in the Proteaceae family (632 spp, 99% endemic; 16 genera, 5 endemic); MAL2 in particular the genera *Grevillea* and *Hakea* (Cowling and Lamont 1998), *Eucalyptus* and *Acacia* (Lamont *et al.* 1984), and *Dryandra* and the Asteraceae (Keighery and Lyons 2001a) contain very high numbers of endemics.

**Transitional Rainfall Zone** (equivalent to the Mallee, Avon Wheatbelt and Geraldton Sandplains IBRA Regions):

- *Acacia* and *Verticordia* (Hopper *et al.* 1996)
- *Lhotskya*, *Eriostemon*, *Wehliia*, *Baeckea*, *Melaleuca*, *Chamelaucium*, *Micromyrtus* and *Thryptomene* (Hopper 1979)

#### Lake Bryde - East Lake Bryde:

As surrounding wetlands become salinised, the lakes form increasingly important freshwater refugia for waterbirds and aquatic invertebrates. Both Lake Bryde and East Lake Bryde are freshwater wetlands with *Muehlenbeckia horrida* subsp. *abdita* and *Tecticornia verrucosa* dominating the lake bed, surrounded by *Eucalyptus occidentalis* woodland with an understory dominated by *Melaleuca* spp. The shrub-dominated lake bed community experiences intermittent freshwater inundation, and the major components of the plant community and other elements of the biota depend on relatively fresh water and frequent drying out of the lake bed for survival. The lakes are the only known occurrences of the community of this type in the Wheatbelt and this community has been classified at the State level as a Critically Endangered Threatened Ecological Community (Hamilton-Brown and Blyth 1999b; Hamilton-Brown and Blyth 2001a). Of 106 wetlands in nature reserves of the south-west of Western Australia, Lakes Bryde and East Bryde were found to be the only wetlands with beds dominated by shrubs (Halse *et al.* 1993). The Lake Bryde wetland system has been identified as a wetland of substantial ornithological importance (Raines 1994). A survey of the aquatic invertebrates of Lake Bryde has shown the fauna to be highly diverse in relation to other Wheatbelt wetlands such as Toolibin Lake (S.A.Halse pers. comm.) and probably richer than those on the Swan Coastal Plain (Davis 1993).

The lake bed is dominated by *Tecticornia verrucosa* and *Muehlenbeckia horrida* subsp. *abdita* (the latter is only known from these two wetlands and is Declared Rare Flora (Endangered) at the State level). The lake is surrounded by *Eucalyptus occidentalis* woodland and a combination of *Melaleuca strobophylla*, *M.*

*lanceolata*, *M. thyoides*, *M. adnata*, *M. lateriflora* subsp. *lateriflora* and *M. cuticularis* understorey. Sixteen bird species have been recorded on Lake Bryde, and two are listed under treaties. The sixteen include seven ducks and allies, and five wader species which were recorded only in April-May 1985, when the lake was confined to shallow pools less than 0.1m deep. Six species found breeding at Lake Bryde. In October 1983, White-faced Heron (*Egretta novaehollandiae*), Pacific Black Duck (*Anas superciliosa*), Grey Teal (*Anas gibberifrons*), Pink-eared Duck (*Malacorhynchus membranaceus*) and Musk Duck (*Biziura lobata*) were found breeding in or near tall living shrubs that had been inundated by freshwater (to a depth exceeding 0.5m). Young Australian Shelducks (*Tadorna tadornoides*) were observed in 1984. The highest count of waterbirds at Lake Bryde in one survey was 133 in July 1983. The most abundant species are Grey Teal (90 in July 1983), Australian Shelduck (70 in April 1985) and Maned Duck (*Chenonetta jubata*) (30 in February 1984). (Jaensch *et al.* 1988). Initial surveys of Lake Bryde have revealed a highly diverse aquatic invertebrate fauna (S.A.Halse pers. comm.).

#### Lake Cronin:

Provides a temporary refuge for waterfowl, including Freckled Duck (*Stictonetta naevosa*). Inundated closed scrub and low woodlands fringing open water; when dry, the lake bed is covered by a closed-herbland. The best example of a melaleuca-dominated freshwater lake/marsh in the bioregion. The lake is fringed by dense thickets and low woodlands of paperbarks *Melaleuca strobophylla*, *M. uncinata* and *M. aff. cuticularis* with low shrubs *Goodenia viscida* and lignum *Muehlenbeckia cunninghamii*. The perennial grass *Eragrostis dielsii* and annuals *Angianthus conocephalus*, *Calandrinia granulifera*, *Centrolepis polygyna*, *Myriocephalus nudus* occur. Mosses and liverworts growing in the waterlogged soil of the lake's edge include *Bryum*, *Funaria*, *Riccia* and *Tortula* spp. *Elatine gratioloides*, a rarely- collected creeping annual herb, grows submerged or in the wet mud of the drying lake bed. This population appears entirely cleistogamous (closed flowering and self-pollinating) - a habit not previously reported in this genus. When the lake dries, a dense herbland dominated by *Goodenia viscida* and *Glycyrrhiza acanthocarpa* covers the area. The site supports uncommon *Melaleuca strobophylla* tall shrublands which are much less extensive in smaller swamps to the south and west (Keighery 1984; Henry-Hall *et al.* 1990; Halse *et al.* 1993).

Fifteen species of birds have been recorded at the lake, including two grebes, two herons and allies and ten waterfowl. A report of 20-30 pairs of Freckled Duck in summer 1971-72 (P. Kennington) is unconfirmed, but an unspecified number were seen on the lake in 1975 (T. Spence). Four Red-necked Avocet (*Recurvirostra novaehollandiae*) were seen on the lake in Nov. 1989 and two Chestnut Teal (*Anas castanea*)

in May 1991 (L. Silvester). Breeding by Hoary-headed Grebe (*Poliiocephalus poliocephalus*), Australian Shelduck (*Tadorna tadornoides*), Grey Teal (*Anas superciliosa*), Pacific Black Duck (*A. gibberifrons*) (P. Lambert, Oct. 1978) and Pink-eared Duck (*Malacorhynchus membranaceus*) (L. Silvester) has been reported. The lake has habitat suitable for Freckled Duck breeding, but it is small and can only briefly support substantial numbers. Maximum counts are 300-400 Grey Teal (February to April 1976), 100 Hoary-headed Grebe (1981) (How *et al.* 1988; WADCALM files).

The endemic elapid Lake Cronin Snake (*Denisonia atriceps*) (Cogger 1993) has been captured in melaleuca thicket and *Eucalyptus salmonophloia* open woodland west of the lake. This species is known from only three confirmed specimens collected in the Lake Cronin area, however further surveys are required before its status can be determined. Fifteen species of bush birds have been recorded in the eucalypt woodlands and mallees surrounding the lake; 97 species have been recorded in the Nature Reserve and adjacent areas (L. Silvester pers. comm.). Western Grey Kangaroos (*Macropus fuliginosus*) have been observed grazing on the dry lake bed. Four species of bat occur in the Melaleuca tall shrublands. Three species of frog occur at the lake including a genetically and physiologically distinct population of *Crinia pseudinsignifera* which breeds in summer rather than winter. Two gecko, three dragon and three skink species have been collected in the woodland adjacent to the lake. The Lake Cronin area is well-known for its large and diverse populations of jewel beetles (Buprestidae). Over 20 species have been recorded in the nature reserve and some may utilise melaleuca woodlands of the lake when flowering (How *et al.* 1988; Henry-Hall 1990; Ehmann 1993).

#### Eucalypt Woodlands:

Display a particularly high floristic diversity (Table 4; Yates *et al.* 2000), they contain a high proportion of Declared Rare Flora (around 25%) (Yates *et al.* 2000; Hopper *et al.* 1990). The South-west botanical province is also very diverse in genera and numbers of species; *Acacia* (400+), *Eucalyptus* (285+), *Grevillea* (150), *Stylidium* (130), *Leucopogon* (115), *Dryandra* (95), *Caladenia* (91) (Hopper *et al.* 1996).

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Wheatbelt in the CTRC Green Book (Environmental Protection Authority 1974). Some but not all of these recommendations (with modification) were implemented over the following ten years. The southern and eastern parts of the subregion are covered by a CALM Regional

Management Plan (Department of Conservation and Land Management 1994b) that provides an overview of biota, addresses land and wildlife conservation issues, but was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion.

There has been no comprehensive subregional or regional biodiversity planning process or systematic review of biodiversity or threats. Several publications have reviewed specific elements of biota at this scale, but not necessarily using IBRA boundaries:

- Beard's Vegetation Mapping at a scale of 1:250 000 – broad structural vegetation types covers all of the subregion (Beard 1972a, Beard 1972f, Beard 1973, Beard 1980c, Beard 1980e)
- Conservation status of vegetation types throughout Western Australia. (Hopkins *et al.* 1996) – based on modified Beard vegetation mapping at 1:250 000.
- Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna (Saunders and Ingram 1995)
- SAP Biodiversity Survey of the Agricultural Zone (unpublished data; Frost *et al.* 2001) – a systematic, broadscale biogeographic survey of the biota (aquatic invertebrates, waterbirds, terrestrial vascular flora, ground-dwelling arachnids, scorpions, centipedes, small mammals, reptiles and frogs) occurring low in the landscape and under threat from salinity.
- Salinity Risk Mapping completed for the agricultural zone by the Land Monitor project showing both current and predicted extent (Frost *et al.* 2001).
- The Wheatbelt Region of the Department of Conservation and Land Management is currently drafting a Regional Plan that includes a broad analysis of biodiversity values, threatening processes and management priorities (unpublished).

Several other surveys have reviewed elements of the biota and threatening processes at smaller scales within

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Grace System, WA055	B8, B12	ii	iii	iii	xii (mining - a small amount of gypsum mining, also existing exploration permits; lake edges are sometimes disturbed by recreational use of vehicles)

the subregion, or have reviewed the biota of a selection of reserves within the subregion (but not necessarily using IBRA boundaries). This list does not include the numerous surveys that have been completed for individual reserves or single species:

- Botanical values of gypsum dunes in the wheatbelt (Mattiske Consulting 1995a)
- Biological Survey of the Western Australian Wheatbelt Part 1 (Kitchener *et al.* 1976), Part 2 (Muir 1977), Parts 3 and 4 (Kitchener *et al.* 1977).
- Conservation values of small reserves in the wheatbelt of Western Australia (Safstrom 1995; Safstrom *et al.* 1996; Ecoscape 2000) - brief survey of biological and human use values of numerous reserves using a standard methodology to assist with land use planning.
- Management of Granite Outcrops Symposium, Hyden, April 16-18, 1999 (Withers and Hopper 2000).
- Regional Assessment of the Wheatbelt of Western Australia: Central Wheatbelt (Wooller and Moore 2000) MAL2 (part)
- Production of habitat hollows by wheatbelt eucalypts (Rose 1993) – survey of tree diameter, age and hollow formation of wandoo and salmon gum from across the major east-west rainfall gradient.
- Some nature reserves of the Western Australian wheatbelt Part 1-28 (Muir 1978-1979) – brief surveys of various reserves providing a vegetation map and description, and list of fauna, human uses and other values.
- A review of grassy woodlands in the Western Australian Wheatbelt (Mattiske Consulting 1995b) – literature review, survey of possible sites to document flora and a report detailing location and describing floristics.
- “Native Vegetation Handbook” series for various Shires in the Avon and Blackwood Basins (eg. Grein 1994) – contain basic information on and lists of native vegetation, wetlands, fauna and flora, land resources and land management and land degradation issues.

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Bryde-East Lake Bryde, WA112	B13	ii	iii	iii	ix, x (increased levels of salinity resulting from input of saline surface water. There is potential for increased periods of inundation, resulting from increased run-off following clearing of the catchment; increased soil salinities and the threat of both inundation and salinity increasing massively if regional water tables rise to the surface within the lakes themselves or nearby in their catchments)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Kondinin Salt Marsh MAL2	629000E 6393000N Zone 50	B8, B12 The best area of lowland mallees and central gypsophilous communities in very good to good condition. Very difficult to protect because it is in a major paleodrainage system.	i	ii	iii	iii	ix, x
Kent Road Braided Saline Drainage Line MAL2	659000E 6361000N Zone 50	B8 Possible alternative to the Kondinin Salt Marsh, as it is closer to the headwaters of the system.	i	ii	iii	iii	ix, x
Dunn Rock/Lake King Chain MAL2	740000E 6335000N Zone 50	B8 Headwaters of the drainage system, includes a large area of unallocated Crown land (UCL). Very extensive areas of lowland woodlands, mallees and gypsophilous communities, most are in excellent condition. Lake King gypsophilous communities are floristically different from elsewhere.	i	iii	iv	iii	No known threatening processes
Lake Magenta (UCL) MAL2	703000E 6296000N Zone 50	B8 Gypsophilous woodlands, shrublands and the rare "lawn" community, all in excellent condition.	i	iii	iv	iii	No known threatening processes
Chinocup System, MAL2	643000E 6294000N Zone 50	B8 A diverse range of gypsophilous dune communities, lacking much of the lowland woodland communities but these are similar to those in the UCL at Magenta. Melaleuca and mallee communities are potentially floristically distinct.	i	ii	iii	iii	ix, x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

According to the State of the Environment Report 1998, virtually all “fringing vegetation” along substantial streamlines (defined as any stream shown

on a 1:50 000 topographic map) is in “very poor” condition (land cleared of virtually all natural vegetation) (Wallis and Higham 1998).

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Pallinup River	i	iii	ii	i, ii, iv, v (foxes & rabbits), vi, ix, x, viii, xi (fertiliser load)
Fitzgerald River	ii	iii	ii	i, ii, iv, v (foxes & rabbits), vi, ix, x, viii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abdita</i> and <i>Tecticornia verrucosa</i> across the lake floor.	CR	42	ii	ii	iii	ix, x, vii
Herblands and Bunch Grasslands on gypsum lunette dune community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species <i>Danthonia caespitosa</i> , <i>Lawrenzia squamata</i> , <i>Maireana marginata</i> , <i>Podolepis rugosa</i> , <i>Senecio lautus</i> subsp. <i>maritimus</i> , <i>Asteridea chaetopoda</i> , <i>Atriplex paludosa</i> , <i>Halosarcia syncarpa</i> , <i>Scaevola spinescens</i> and <i>Stipa junifolia</i> .	V	38	ii	iii	iii	v, vi, ix, x, xii (mining), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk\*

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Plant assemblages of the Bremer Range System - <i>Eucalyptus rhomboidea</i> ms and <i>E. eremophila</i> woodland on the side slopes of low ridges; <i>E. flocktoniae</i> woodland (with <i>E. salubris</i> , <i>E. salmonophloia</i> , <i>E. dundasii</i> and <i>E. tenuis</i> ) on broad flat ridges and side slopes; <i>E. flocktoniae</i> and/or <i>E. longicornis</i> woodland on saline soils on ridges and flats adjacent to large salt lake systems; <i>E. longicornis</i> and/or <i>E. salmonophloia</i> or, <i>E. georgei</i> subsp <i>georgei</i> or, <i>E. dundasii</i> woodland, on low areas; <i>E. livida</i> woodland on lateritic tops or <i>Allocasuarina</i> thickets on greenstone ridges of lateritic breakaways; <i>Acacia duriuscula</i> , <i>Allocasuarina globosa</i> , <i>E. georgei</i> subsp <i>georgei</i> and <i>E. oleosa</i> thickets on greenstone ridges with skeletal soils.	V	8	ii	iii	iii	i, xii (mining), vii
<i>Eucalyptus</i> aff. <i>incrassata</i> mallee over low scrub on gypsum dunes.	P	8	ii	iii	iii	ix, x, xii (mining), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

\*Specific communities are listed in the tables above, however vegetation types on dissection valley floors and lower slopes are more than 90% cleared for agriculture and comprise about 1/3 of the total number of the vegetation types in the subregion. The remaining areas of valley floor woodlands are subject to secondary salinity. Therefore, a further 20 to 30 vegetation types in this subregion should be treated as “at risk”

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Phascogale calura</i>	E	ii	iv	iii	v, i, ii
<i>Dasyurus geoffroi</i>	V	ii	v	iii	v, i, ii
<i>Myrmecobius fasciatus</i>	V	i	vi	ii	v, i, ii
<i>Pseudomys shortridgei</i>	V	ii	vi	ii	v, i, ii, vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, ix, x, vi

<i>Amytornis textilis textilis</i>	V	ii	i	iii	Regionally Extinct
<i>Leipoa ocellata</i>	V	ii	iii	iii	i, ii, vii, vi, iv
<i>Psophodes nigrogularis oberon</i>	V	ii	iii	ii	i, ii, vii
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	ii	iv	iii	i, ii
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	ii	iv	iii	i, ii, v (fox predation)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Pseudomys occidentalis</i>		ii	iii	iii	v (cats, foxes, rabbits), i, ii, vii
<i>Acanthiza iredalei iredalei</i>	V	ii	iv	iii	iv
<i>Platycercus icterotis xanthogenys</i>	2	ii	iii	iii	i, iv
<i>Ninox connivens connivens</i>	2	ii	iii	iii	i, ii
<i>Bothriembryon bradshawi</i>	1	ii	vi	ii	i, ii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Acacia auratiflora</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Caladenia hoffmanii</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Drakaea isolata</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Eremophila subteretifolia</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Eremophila veneta</i>	CR	ii	ii	iii	i, ii, vii, vi, xiii (road maintenance), ix
<i>Eremophila verticillata</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Grevillea scapigera</i>	CR	ii	ii	iii	i, ii, vi, vii, ix, x
<i>Roycea pycnophylloides</i>	CR	ii	ii	iii	x, i, ii, vi, vii, ix
<i>Muehlenbeckia horrida</i> subsp. <i>abdita</i>	CR	ii	iii	iii	ix, x
<i>Acacia lanuginophylla</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Acacia leptalea</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Bentleya spinescens</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Boronia revoluta</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Conostylis lepidospermoides</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Conostylis misera</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Grevillea involucreta</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Lechenaultia pulvinaris</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Orthrosanthus muelleri</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Ricinocarpos trichophorus</i>	E	ii	iii	iii	viii ( <i>Phytophthora</i> sp.) i, ii, vi, vii, ix, x
<i>Thelymitra stellata</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Verticordia staminosa</i> var. <i>erecta</i>	E	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Acacia depressa</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Allocasuarina tortiramula</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Banksia sphaerocarpa</i> var. <i>dolichostyla</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Calectasia arnoldii</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Daviesia spiralis</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Eucalyptus merrickiae</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Eucalyptus olivacea</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Eucalyptus steedmanii</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Goodenia integerrima</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Myoporum cordifolium</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Stylidium merrallii</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Thelymitra psammophila</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<i>Tribonanthes purpurea</i>	V	ii	iii	iii	i, ii, vi, vii, ix, x
<b>PRIORITY 1</b>					
<i>Acacia mutabilis</i> subsp. <i>stipulifera</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia tetraneura</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Baeckea crispiflora</i> subsp. Ongerup (A.Scougall & C.Garawanta E35)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dampiera scaevolina</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Darwinia</i> sp. Bending (B.Lullfitz s.n.July 1965)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Drosera grievlei</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus myriadena</i> subsp. <i>parviflora</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Frankenia glomerata</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Grevillea lullfitzii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Hibbertia axillibarba</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Hydrocotyle hexaptera</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Hydrocotyle muriculata</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Jacksonia debilis</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Lasiopetalum</i> sp. Ironcaps (P.G.Wilson 7024)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Microcorys</i> sp. Forrestania (V.English 2004)	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Neofuscelia scabrosina</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thysanotus lavanduliflorus</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thysanotus sabulosus</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Xanthoparmelia nashii</i>	1	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>PRIORITY 2</b>					
<i>Acacia drewiana</i> subsp. <i>minor</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Acacia tuberculata</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Astartea clavifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Baeckea pretssiana</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Boronia ericifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Caladenia melanema</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Conostylis seorsiflora</i> subsp. Nyabing (A.Coates s.n.)	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dampiera orchardii</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Drosera salina</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra conferta</i> var. <i>parva</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra drummondii</i> var. <i>macrorufa</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Dryandra erythrocephala</i> var. <i>inopinata</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra foliosissima</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra idlogenes</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Dryandra rufistylis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus angustissima</i> subsp. <i>quaerenda</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Eucalyptus sparsicoma</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Fitzwillia axilliflora</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Guichenotia asteriskos</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Haegiela tatei</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x

<i>Melaleuca pritzellii</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Melaleuca pungens</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Millotia steetziana</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Nemcia effusa</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Opercularia rubioides</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Persoonia brevihachis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Persoonia hakeiformis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Pimelea halophila</i>	2	ii	vi	ii	x, i, ii, iv, vi, vii, ix
<i>Rinzia affinis</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea canaliculata</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea cervifolia</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea flexuosa</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea parviflora</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Synaphea tripartita</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x
<i>Thysanotus acerosifolius</i>	2	ii	vi	ii	i, ii, iv, vi, vii, ix, x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
	Plant assemblages of the Bremer Range System	?	65000?	0	0	0	M
	Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abdita</i> and <i>Tecticornia verrucosa</i> across the lake floor.	100	145	50 (34%)	95 (66%)	34	H
	Herblands and Bunch Grasslands on gypsum lunette dunes.	100	3.5	0	0	0	H
	Chinocup Eucalyptus aff. <i>incrassata</i> mallee over low scrub on gypsum dunes.	100	100	100%	0	100%	H
7	Medium woodland; York gum ( <i>E. loxophleba</i> ) & wandoo	0.5	140.3	0.0	0.0	0.0	H
25	Low woodland; <i>Allocasuarina huegeliana</i> & York gum	3.9	52.4	0.0	0.0	0.0	H
126	Bare areas; freshwater lakes	0.0	14.7	0.0	0.0	0.0	M
141	Medium woodland; York gum, salmon gum & gimlet	0.0	22.7	0.0	0.0	0.0	M
352	Medium woodland; York gum	0.4	487.2	0.0	0.0	0.0	H

Beard Veg Assoc	Vegetation Association Description	% of total extent in IBRA subregion	Area in IBRA subregion (ha)	% in IUCN Reserve	% in Non-IUCN Reserve	Total % Area in CALM Estate	Priority
368	Shrublands tree-heath between sandhills; <i>Banksia ashbyi</i> , <i>Grevillea gordoniana</i> , <i>Acacia</i> spp., <i>Melaleuca</i> and mallee	0.0	8.9	0.0	0.0	0.0	M
468	Medium woodland; salmon gum & goldfields blackbutt	0.1	622.3	0.0	0.0	0.0	M
522	Medium woodland; redwood ( <i>E. transcontinentalis</i> ) & merrit ( <i>E. flocktoniae</i> )	0.4	3,055.9	0.0	0.0	0.0	L
552	Shrublands; <i>Casuarina acutivalvus</i> & calothamnus (also melaleuca) thicket on greenstone hills	31.0	11,711.7	0.0	0.0	0.0	L
934	Shrublands; mallee scrub <i>Eucalyptus nutans</i>	0.4	255.7	0.0	0.0	0.0	M
939	Succulent steppe with woodland; york gum, sparse teatree scrub & samphire	100.0	10.4	0.0	0.0	0.0	H
940	Mosaic: Shrublands; mallee scrub, black marlock/Shrublands; tallerack mallee-heath	0.0	61.8	0.0	0.0	0.0	M
942	Mosaic: Medium woodland; yate/Shrublands; mallee scrub, black marlock	13.2	1,298.3	0.0	9.8	9.8	M
966	Succulent steppe with sparse woodland & thicket; salmon gum & morrell over teatree & samphire	83.6	157.1	0.0	0.0	0.0	H
974	Medium woodland; York gum, salmon gum & morrel	82.6	584.2	0.0	0.0	0.0	H
981	Medium woodland; wandoo, York gum & yate	71.6	1,036.2	0.0	0.0	0.0	H
993	Medium woodland; York gum & <i>Allocasuarina huegelliana</i>	82.6	693.6	0.0	0.0	0.0	H
1005	Low woodland; <i>Allocasuarina huegelliana</i>	25.7	61.5	0.0	0.0	0.0	H
1068	Medium woodland; salmon gum, morrel, gimlet & <i>Eucalyptus sheathiana</i>	0.0	28.6	0.0	0.0	0.0	M
1093	Succulent steppe with open woodland & thicket; eucalypts & <i>Allocasuarina obesa</i> over teatree & samphire	1.5	13.6	0.0	0.0	0.0	M
1095	Medium woodland; York gum, yate & salmon gum	72.5	247.6	0.0	0.0	0.0	H
1096	Medium woodland; yate & salmon gum	82.9	177.4	0.0	0.0	0.0	H

Subregional constraints in order of priority (see Appendix B, key g)

**Irreplaceability & Limited Opportunity to Meet CAR Criteria:** The majority of ecosystems have been extensively cleared well below CAR thresholds. Within the agricultural zone virtually all remnants are important for biodiversity conservation and building towards CAR thresholds.

**Other:** Many ecosystems low in the landscape are under threat from rising watertables. Most lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems will be lost. These systems support over 1,500 plant species, of which 450 are endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.

**Economic Constraints:** Insufficient resources to acquire and manage an increased conservation estate.

**Competing Land Uses:** Whilst some opportunities exist to add to the conservation estate through the vesting of unallocated Crown land and the re-vesting of other Crown reserves, there is some competition with other government agencies and local government for these areas. The process is also lengthy and somewhat ad hoc.

**Other:** Inadequate systematic knowledge of biodiversity values at an appropriately fine scale.

Bioregional and subregional priority for reserve consolidation

MAL is currently listed as IBRA Reservation Class 5 (>15% of its area reserved in any CALM tenure) (see Appendix D, and Appendix C, rank 4).

MAL2 should be reservation Class 3a because 5-10% (9.97%) of its area is reserved (any tenure) and approximately 33% of native vegetation cover remains. However in the cleared western and central parts of

the subregion only 17.3% of native vegetation cover remains, and widespread threats such as salinity are ubiquitous. This leaves a biased reserve system across the region, and therefore at least Class 3 is appropriate (bordering on Class 2 depending on the accuracy of the various figures supplied – eg. the biodiversity assessment spreadsheet claims the MAL2 subregion is about 4,764,000 ha, whilst the GIS file supplied by CALM lists it as approximately 3,990,000 ha in area). This discrepancy could have a significant impact on the final percentages calculated for the various indices.

### Reserve management standard

The Reserve Management Standard is poor (see Appendix C, rank 5). Many nature reserves in the western portion of the region are under significant threat from rising saline groundwater levels that at present are unmanaged (except in very localised circumstances) and are currently and projected to cause major declines and extinctions in many lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline

wetland systems. Several major reserves are routinely fox baited - Lake Magenta Nature Reserve, Dragon Rocks Nature Reserve, Bendinger Nature Reserve, Roe Nature Reserve, North Karlgarin Nature Reserve and Cape Arid National Park. Within MAL2 approximately 34% (136 400 ha) of the conservation estate is baited; much less in MAL1. Biodiversity values are generally poorly identified. There is no overview of the region's biota - the recent Salinity Action Plan Biodiversity Survey project was the first systematic overview of a significant portion of the region's biota, but was largely confined to MAL2 within this region. There is no systematic fine scale vegetation mapping (1:25 000 or better); the best available is Beard's at 1:250 000. Some reserves have vegetation maps, but there is little consistency between methodologies. Inappropriate fire regimes are also a major threat to biodiversity, but little is known of the response of individual species to fire. Fire histories for all reserves are also poorly known and documented.

### Off reserve conservation

#### Priority species or groups

#### CWR mammals

Species	Current Conservation Status (WA)	Status in MAL2 Subregion	Recovery Plan
Mala ( <i>Lagorchestes hirsutus</i> )	Threatened (Extinct in the wild)	Regionally Extinct	No
Red-tailed Phascogale ( <i>Phascogale calura</i> )	Threatened (Endangered)	Threatened (Endangered)	No
Western Barred Bandicoot ( <i>Perameles b. bougainville</i> )	Threatened (Endangered)	Regionally Extinct	National
Chuditch ( <i>Dasyurus geoffroi</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)	State
Numbat ( <i>Myrmecobius fasciatus</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)	National & State
Bilby ( <i>Macrotis lagotis</i> )	Threatened (Vulnerable)	Regionally Extinct	National
Boodie ( <i>Bettongia lesueur lesueur</i> )	Threatened (Vulnerable)	Regionally Extinct	No
Banded Hare-wallaby ( <i>Lagostrophus f. fasciatus</i> )	Threatened (Vulnerable)	Regionally Extinct	No
Black-flanked Rock-wallaby ( <i>Petrogale l. lateralis</i> )	Threatened (Vulnerable)	Regionally Extinct	No
Greater Stick-nest Rat ( <i>Leporillus conditor</i> )	Threatened (Vulnerable)	Regionally Extinct	No
Heath Mouse ( <i>Pseudomys shortridgei</i> )	Threatened (Vulnerable)	Threatened (Vulnerable)	No

Mallee 2

Species	Current Conservation Status (WA)	Status in MAL2 Subregion	Recovery Plan
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	Priority 4, Conservation Dependent	Regionally Extinct?	No
Quenda ( <i>Isoodon obesulus fusciventer</i> )	Priority 4, Conservation Dependent	Threatened	No
Western Brush Wallaby ( <i>Macropus irma</i> )	Priority 4, Conservation Dependent	Priority 4, Conservation Dependent	No
Western Mouse ( <i>Pseudomys occidentalis</i> )	Priority? Conservation Dependent	Priority 4, Conservation Dependent	No (draft?)
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No listing	Conservation Dependent	No

Other priority species and groups:

Western Wheatbelt Coordinated Conservation Plan for 14 bird species (Garnett and Crowley, 2000)

Flora and fauna of granite outcrops – numerous species including *Teyl* spp., *Caladenia hoffmanii* subsp. *graniticola*, *Daphnia jollyi*

District Threatened Flora Recovery Team – the Katanning District TFRT already covers the following species with IRPs - *Acacia auratiflora*, *Adenanthos*

*pungens* subsp. *Effusus*, *Drakaea isolata*, *Eremophila veneta*, *Eremophila verticillata*, and *Muehlenbeckia horrida* subsp. *abdita*.

Threatened flora of roadsides – for example *Acacia auratiflora* and *Grevillea involucrata*.

Threatened flora of lowland communities, including tall woodlands, mallee and Melaleuca shrublands, freshwater and naturally saline wetland systems. Eg. *Drakaea isolata*, *Muehlenbeckia horrida* subsp. *abdita*

Threatened flora

Species	Status EPBC Act	Status WA
<i>Acacia auratiflora</i>	E	CR
<i>Acacia depressa</i>	V	V
<i>Acacia lanuginophylla</i>	E	E
<i>Acacia leptalea</i>	E	E
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	V	E
<i>Allocasuarina tortiramula</i>	V	V
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	E	CR
<i>Banksia sphaerocarpa</i> var. <i>dolichostyla</i>	V	V
<i>Bentleya spinescens</i>	E	E
<i>Boronia revoluta</i>	E	E
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	E	-
<i>Caladenia hoffmanii</i>	E	CR
<i>Calectasia arnoldii</i>	V	-
<i>Conostylis lepidospermoides</i>	E	E
<i>Conostylis misera</i>	E	-
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	E	-
<i>Daviesia spiralis</i>	V	-
<i>Drakaea isolata</i>	E	CR
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	V	-
<i>Eremophila subteretifolia</i>	E	CR
<i>Eremophila veneta</i>	E	CR
<i>Eremophila verticillata</i>	E	CR
Species	Status EPBC Act	Status WA
<i>Eucalyptus merrickiae</i>	V	-
<i>Eucalyptus olivacea</i>	V	V

<i>Eucalyptus steedmanii</i>	V	V
<i>Goodenia integerrima</i>	V	V
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	E	E
<i>Grevillea involucrata</i>	E	E
<i>Grevillea scapigera</i>	E	CR
<i>Lechenaultia pulvinaris</i>	E	E
<i>Muehlenbeckia horrida</i> subsp. <i>abditata</i>	-	CR?
<i>Myoporum cordifolium</i>	V	-
<i>Orthrosanthus muelleri</i>	E	-
<i>Ricinocarpos trichophorus</i>	E	-
<i>Stylidium merrallii</i>	V	V
<i>Thelymitra psammophila</i>	V	-
<i>Thelymitra stellata</i>	E	E
<i>Tribonanthes purpurea</i>	V	V
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	E	E
<i>Verticordia staminosa</i> var. <i>erecta</i>	-	E

## Priority 1 and 2 flora

Species	Priority
<i>Acacia mutabilis</i> subsp. <i>stipulifera</i>	1
<i>Acacia sclerophylla</i> var. <i>teretiuscula</i>	1
<i>Acacia tetraneura</i>	1
<i>Baeckea crispiflora</i> subsp. Ongerup (A.Scougall & C.Garawanta E35)	1
<i>Dampiera scaevolina</i>	1
<i>Darwinia</i> sp. Bending (B.Lullfitz s.n.July 1965)	1
<i>Drosera grieviei</i>	1
<i>Eucalyptus myriadena</i> subsp. <i>parviflora</i>	1
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	1
<i>Frankenia glomerata</i>	1
<i>Grevillea lullfitzii</i>	1
<i>Hibbertia axillibarba</i>	1
<i>Hydrocotyle hexaptera</i>	1
<i>Hydrocotyle muriculata</i>	1
<i>Jacksonia debilis</i>	1
<i>Lasiopetalum</i> sp. Ironcaps (P.G.Wilson 7024)	1
<i>Microcorys</i> sp. Forrestania (V.English 2004)	1
<i>Neofuscelia scabrosina</i>	1
<i>Thysanotus lavanduliflorus</i>	1
<i>Thysanotus sabulosus</i>	1
<i>Xanthoparmelia nashii</i>	1
<i>Acacia drewiana</i> subsp. <i>minor</i>	2
<i>Acacia tuberculata</i>	2
<i>Astartea clavifolia</i>	2
<i>Baeckea preissiana</i>	2
Species	Priority
<i>Caladenia melanema</i>	2
<i>Conostylis seorsiflora</i> subsp. Nyabing (A.Coates s.n.)	2

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<i>Dampiera orchardii</i>	2
<i>Drosera salina</i>	2
<i>Dryandra conferta</i> var. <i>parva</i>	2
<i>Dryandra drummondii</i> var. <i>macrorufa</i>	2
<i>Dryandra erythrocephala</i> var. <i>inopinata</i>	2
<i>Dryandra foliosissima</i>	2
<i>Dryandra idiogenes</i>	2
<i>Dryandra rufistylis</i>	2
<i>Eucalyptus angustissima</i> subsp. <i>quaerenda</i>	2
<i>Eucalyptus sparsicoma</i>	2
<i>Fitzwillia axilliflora</i>	2
<i>Gastrobium rigidum</i>	2
<i>Goodenia</i> sp. Lake King (M.Gustafsson et K.Bremer 132)	2
<i>Guichenotia asteriskos</i>	2
<i>Haegiela tatei</i>	2
<i>Melaleuca pritzellii</i>	2
<i>Melaleuca pungens</i>	2
<i>Millotia steetziana</i>	2
<i>Nemcia effusa</i>	2
<i>Opercularia rubioides</i>	2
<i>Persoonia brevihachis</i>	2
<i>Persoonia hakeiformis</i>	2
<i>Pimelea halophila</i>	2
<i>Rinzia affinis</i>	2
<i>Synaphea canaliculata</i>	2
<i>Synaphea cervifolia</i>	2
<i>Synaphea flexuosa</i>	2
<i>Synaphea parviflora</i>	2
<i>Synaphea tripartita</i>	2
<i>Thysanotus acerosifolius</i>	2

Priority species or groups and existing recovery plans

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Other Management Plans
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	Yes – unpublished IRP	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Chuditch ( <i>Dasyurus geoffroyi</i> )	Yes – State	Action Plan for Australian Marsupials and Monotremes - Recovery Outline	Western Shield Fauna Recovery Program
Numbat ( <i>Myrmecobius fasciatus</i> )	Yes – National (unpublished)	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Bilby ( <i>Macrotis lagotis</i> )	Yes – National	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program

Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Species or Group
Boodie ( <i>Bettongia lesueur lesueur</i> )	No (Draft Interim Recovery Plan)	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	No	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	No (no longer current)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	No (old draft)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Quenda ( <i>Isodon obesulus fusciventer</i> )	No (old draft)	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Red-tailed Phascogale ( <i>Phascogale calura</i> )	No	Action Plan for Australian Marsupials and Monotremes -Recovery Outline	Western Shield Fauna Recovery Program
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	No	Action Plan for Australian Marsupials and Monotremes -Taxon Summary	Western Shield Fauna Recovery Program
Heath Mouse ( <i>Pseudomys shortridgei</i> )	No	Action Plan for Australian Rodents	No
Western Mouse ( <i>Pseudomys occidentalis</i> )	No (draft?)	Action Plan for Australian Rodents	No
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	Yes – Interim Recovery Plan	Action Plan for Australian Birds - Coordinated Conservation Plan and Action plan	No
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	Yes - State	Action Plan for Australian Birds - Coordinated Conservation Plan and Action Plan	No
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis</i> )	No	Action Plan for Australian Birds - Taxon Summary	Research Plan for the Western Ground Parrot, Western Whipbird and Western Bristlebird.
Western Rosella (wheatbelt) ( <i>Platyercus icterotis</i> )	No	Action Plan for Australian Birds - Taxon Summary	No
Barking Owl (southern) ( <i>Ninox connivens</i> )	No	Action Plan for Australian Birds - Taxon Summary	No
Malleefowl ( <i>Leipoa ocellata</i> )	National Recovery Plan for Malleefowl	Action Plan for Australian Birds - Coordinated Conservation Plan and Action Plan	No
Western Wheatbelt Birds	Some	Action Plan for Australian Birds - Coordinated Conservation Plan	No
Flora and fauna of granite outcrops Eg. <i>Teyl</i> spp., <i>Caladenia hoffmanii</i> subsp. <i>graniticola</i> , <i>Daphnia jollyi</i>	Some	N/A	No
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	No	N/A	Salinity Action Plan Biological Survey of the Agricultural Zone
Threatened Flora on roadsides Eg. <i>Acacia auratiflora</i> , <i>Grevillea involucreta</i>	Few	N/A	Roadside Conservation Strategies (Roadside Conservation Committee and Shires)
Species or Group	Specific Recovery Plan	General Recovery Plan (Action Plans)	Species or Group
Threatened flora of lowland communities	Few	N/A	Eg. Lake Bryde Recovery Catchment
Priority 1 and 2 flora	No	N/A	No
Threatened Flora (general)	No	N/A	District Recovery Teams
<i>Acacia auratiflora</i>	Yes IRP	N/A	No
<i>Acacia depressa</i>	No	N/A	No
<i>Acacia lanuginophylla</i>	No	N/A	No
<i>Acacia leptalea</i>	No	N/A	No
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	No	N/A	No
<i>Allocasuarina tortiramula</i>	No	N/A	No
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	No	N/A	No
<i>Banksia sphaerocarpa</i> var. <i>dolichostyla</i>	No	N/A	No

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<i>Bentleya spinescens</i>	No	N/A	No
<i>Boronia revoluta</i>	No	N/A	No
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	No	N/A	No
<i>Caladenia hoffmanii</i>	No	N/A	No
<i>Calectasia arnoldii</i>	No	N/A	No
<i>Conostylis lepidospermoides</i>	No	N/A	No
<i>Conostylis misera</i>	No	N/A	No
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	No	N/A	No
<i>Daviesia spiralis</i>	No	N/A	No
<i>Drakaea isolata</i>	Yes IRP	N/A	No
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	No	N/A	No
<i>Eremophila subterretifolia</i>	No	N/A	No
<i>Eremophila veneta</i>	Yes IRP	N/A	No
<i>Eremophila verticillata</i>	Yes IRP	N/A	No
<i>Eucalyptus merrickiae</i>	No	N/A	No
<i>Eucalyptus olivacea</i>	No	N/A	No
<i>Eucalyptus steedmanii</i>	No	N/A	No
<i>Goodenia integerrima</i>	No	N/A	No
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	No	N/A	No
<i>Grevillea involucreta</i>	No	N/A	No
<i>Grevillea scapigera</i>	Yes RP	N/A	No
<i>Lechenaultia pulvinaris</i>	No	N/A	No
<i>Muehlenbeckia horrida</i> subsp. <i>abditata</i>	Yes IRP for TEC in which it is a component	N/A	No
<i>Myoporum cordifolium</i>	No	N/A	No
<i>Orthrosanthus muelleri</i>	Yes IRP	N/A	No
<i>Ricinocarpos trichophorus</i>	No	N/A	No
<i>Stylidium merrallii</i>	No	N/A	No
<i>Thelymitra psammophila</i>	No	N/A	No
<i>Thelymitra stellata</i>	No	N/A	No
<i>Tribonanthes purpurea</i>	No	N/A	No
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	No	N/A	No
<i>Verticordia staminosa</i> var. <i>erecta</i>	No	N/A	No

Appropriate species recovery actions

Species or Group	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Western Barred Bandicoot ( <i>Perameles bougainville bougainville</i> )	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocation; Other – captive breeding & monitoring; Fire management; Research.	Subregionally extinct, predator control, translocation of sufficient numbers
Chuditch ( <i>Dasyurus geoffroii</i> )	vii, i, x, xiv, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring; Fire management.	Predator control
Numbat ( <i>Myrmecobius fasciatus</i> )	vii, i, x, xiv, xii, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring and captive breeding; Research; Fire management.	Predator control, particularly cats, translocation of sufficient numbers
Bilby ( <i>Macrotis lagotis</i> )	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring & captive breeding; Fire management; Research.	Subregionally extinct, predator control particularly cats, translocation of sufficient numbers,
Boodie ( <i>Bettongia lesueur lesueur</i> )	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves;	Subregionally extinct, predator

		Translocations; Fire management; Research.	control, translocation of sufficient numbers
Banded Hare-wallaby ( <i>Lagostrophus fasciatus fasciatus</i> )	vii, i, x, xiv, ix, xii	Revegetation; Habitat retention through reserves; Translocations; Fire management; Research.	Subregionally extinct, predator control, translocation of sufficient numbers
Woylie ( <i>Bettongia penicillata ogilbyi</i> )	vii, i	Revegetation; Habitat retention through reserves;	
Tammar Wallaby ( <i>Macropus eugenii derbianus</i> )	vii, i, x, xiv, ix	Revegetation; Habitat retention through reserves; Translocations; Other – monitoring; Fire management.	Subregionally extinct?, lack of survey data, predator control
Quenda ( <i>Isoodon obesulus fusciventer</i> )	vii, i, ii, x	Revegetation; Habitat retention through reserves and on private lands.	Subregionally extinct?, predator control
Red-tailed Phascogale ( <i>Phascogale calura</i> )	i, ii, vii, ix, x	Habitat retention through reserves and on private land; Feral animal control; Fire management; Translocation.	Lack of survey data, predator control
Common Brushtail Possum ( <i>Trichosurus vulpecula</i> )	vii, i	Revegetation; Habitat retention through reserves.	Predator control, particularly cats
Heath Mouse ( <i>Pseudomys shortridgei</i> )	vii, i, xiv, ix	Revegetation; Habitat retention through reserves; Other - survey and monitoring; Fire management.	Lack of knowledge of distribution. Predator control, particularly cats
Western Mouse ( <i>Pseudomys occidentalis</i> )	i, vii, iii, ix, xii	Habitat retention through reserves; Feral animal control; Habitat retention on other lands; Fire management; Research.	Lack of knowledge of distribution. Predator control, particularly cats
Thick-billed Grasswren (western) ( <i>Amytornis textilis textilis</i> )	x, i, iii, vii, xiv	Translocations; Habitat retention through reserves and on other state lands; Feral animal control; Other - survey and monitoring.	Subregionally extinct
Carnaby's Cockatoo ( <i>Calyptorhynchus latirostris</i> )	i, ii, iii, xiv, xii, xiv	Habitat retention through reserves, on private lands and on other State lands; Other - protect known nesting trees and breeding areas, survey & captive breeding; Research; Other - public awareness program.	Lack of survey data on breeding and habitat areas
Western Whipbird (western mallee) ( <i>Psophodes nigrogularis</i> )	i, iii, ii, viii, xiv, xii	Habitat retention through reserves, on other state lands and on private lands; Revegetation; Other – monitoring; Research.	Lack of survey data

## Mallee 2

Species or Group	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Western Rosella (wheatbelt) ( <i>Platycercus icterotis</i> )	xiv, xii, xiv, i, ii, iii, xiv	Other – monitoring; Research; Other - promote community nestbox program; Habitat retention through reserves, on private lands and on other state lands; Other - mitigate food limitations.	Lack of knowledge on habitat requirements
Barking Owl (southern) ( <i>Ninox connivens</i> )	i, iii, ii, xii, xiv, xiii, viii, vii	Habitat retention through reserves, on other state lands and on private lands; Research; Other – survey; Capacity building with the community, landholders, industry and institutions to extend and promote habitat management.	Lack of survey data
Malleefowl ( <i>Leipoa ocellata</i> )	ix, vii, i, iii, ii, xiv	Fire management; Feral animal control; Habitat retention through reserves, on private land and on other state lands; Other - survey and monitoring & captive breeding.	Lack of survey data, lack of resources to manage fire regimes
Western Wheatbelt Birds	i, iii, ii, vii, v, xiii, viii, xiv	Habitat retention through reserves, on other state lands and on private lands; Feral animal control; Fencing; Capacity building with community, landholders, industry and institutions; Revegetation; Other - protect breeding hollows, survey & monitoring.	High degree of habitat loss and fragmentation; many valley floor woodland now threatened by salinity; providing sufficient incentives for agricultural land to be revegetated for habitat
Flora and fauna of granite outcrops Eg. <i>Teyl</i> spp., <i>Caladenia hoffmanii</i> ssp. <i>graniticola</i> , <i>Daphnia jollyi</i>	i, iii, ii, xi, vi, vii, ix, xiii, xii	Habitat retention through reserves, on other state lands and on private lands; Reinstatement of hydrology; Weed control; Feral animal control; Fire management; Capacity building with landholders; Research.	Competing use of water for supply purposes; loss of fringing vegetation in many instances.
450 flora species endemic to the agricultural zone and in danger of extinction due to rising saline groundwaters.	xi, x, xiv, i, iii, ii	Reinstatement of hydrology; Translocation; Other - germplasm storage; Habitat retention through reserves, on other state lands and on private lands.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Threatened Flora on roadsides Eg. <i>Acacia auratiflora</i> , <i>Grevillea involucreta</i>	iii, xiii, vi, v, x, viii	Habitat protection on other state lands; Capacity building with Shire officers; Weed control; Fencing; Translocation; Revegetation.	Competing land use; loss of permanent staff and increased use of contractors makes the education process more difficult
Threatened flora of lowland communities	xi, xiii, viii, x, xiv	Reinstatement of hydrology; Capacity building with landholders; Revegetation; Translocation; Other - germplasm storage.	Response to rising groundwater is unlikely to be of the magnitude required, lack of resources to collect and store sufficient germplasm, lack of resources to propagate and lack of suitable habitat to translocate sufficient numbers of all species.
Priority 1 and 2 flora	xiv	Other - additional survey work to locate new populations.	Insufficient qualified staff to undertake the extensive fieldwork required.

Species or Group	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
Threatened Flora (general)	General – xiv	Other - additional survey work to locate new populations.	General - Insufficient qualified staff and resources to undertake the extensive fieldwork required for survey, monitoring and management actions
<i>Acacia auratiflora</i>	iii, i, vii, v, xiii (Shire), x, xiv	Habitat protection on other state lands and reserves; Feral animal control; Fencing; Capacity building with the Shire; Translocation; Other – seed collection.	Refer to Threatened Flora above
<i>Acacia depressa</i>	i, iii, ii, xiii, vii, xiv	Habitat retention through reserves, on other state lands and on private lands; Capacity building with utility companies and the Shire; Feral animal control with fencing; Other - roadside markers.	Refer to Threatened Flora above
<i>Acacia lanuginophylla</i>	i, ii, iii, vii	Habitat retention through reserves, on private lands and on other state lands; Feral animal control.	Refer to Threatened Flora above
<i>Acacia leptalea</i>	iii, i, xiii, xiv	Habitat protection on other state lands and through reserves; Capacity building with Shire, and utility companies; Other - roadside markers.	Refer to Threatened Flora above
<i>Adenanthos pungens</i> subsp. <i>pungens</i>	i, xiv, x, xi, xiv	Habitat retention through reserves; Other - protection from mining & disease management <i>Phytophthora cinnamomi</i> ; Translocation; Reinstatement of hydrology; Other - seed collection.	Refer to Threatened Flora above
<i>Allocasuarina tortiramula</i>	i	Habitat retention through reserves.	Refer to Threatened Flora above
<i>Anigozanthos bicolor</i> subsp. <i>minor</i>	unknown		Refer to Threatened Flora above
<i>Banksia sphaerocarpa</i> var. <i>dolichostyla</i>	unknown		Refer to Threatened Flora above
<i>Bentleya spinescens</i>	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with Shire and utility companies; Other - (additional survey).	Refer to Threatened Flora above
<i>Boronia revoluta</i>	unknown		Refer to Threatened Flora above
<i>Caladenia bryceana</i> subsp. <i>bryceana</i>	unknown		Refer to Threatened Flora above
<i>Caladenia hoffmanii</i>	i, vii, xiv	Habitat retention through reserves; Feral animal control; Other - additional surveys.	Refer to Threatened Flora above
<i>Calectasia arnoldii</i>	i, xiv	Habitat retention through reserves; Other - additional surveys.	Refer to Threatened Flora above
<i>Conostylis lepidospermoides</i>	unknown		Refer to Threatened Flora above
<i>Conostylis misera</i>	unknown		Refer to Threatened Flora above
<i>Conostylis seorsiflora</i> subsp. <i>trichophylla</i>	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with the Water Corporation; Other - additional survey.	Small population size
<i>Daviesia spiralis</i>	unknown		Refer to Threatened Flora above
<i>Drakaea isolata</i>	i, iii, xiv	Habitat retention through reserves and on other state lands; Other - additional survey.	Refer to Threatened Flora above
<i>Eremophila denticulata</i> subsp. <i>denticulata</i>	unknown		Refer to Threatened Flora above

Mallee 2

Species or Group	Ecosystem Recovery Actions <sup>1</sup>	Recovery Description	Major Constraints
<i>Eremophila subteritifolia</i>	i, xi, xiv	Habitat retention through reserves; Reinstatement of hydrology; Other - seed collection.	Refer to Threatened Flora above
<i>Eremophila veneta</i>	i, iii, xiii, ix	Habitat retention through reserves and on other state lands; Capacity building with Westrail; Fire management.	Refer to Threatened Flora above
<i>Eucalyptus merrickiae</i>	unknown		Refer to Threatened Flora above
<i>Eucalyptus olivacea</i>	i, ii, ix	Habitat retention through reserves and on private lands; Fire management.	Refer to Threatened Flora above
<i>Eucalyptus steedmanii</i>	unknown		Refer to Threatened Flora above
<i>Goodenia integerrima</i>	unknown		Refer to Threatened Flora above
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	unknown		Refer to Threatened Flora above
<i>Grevillea involucrata</i>	iii, ii, i, xiii, xiv, v	Habitat protection on other state lands, on private lands and through reserves; Capacity building with utility companies; Other - roadside markers; Fencing.	Refer to Threatened Flora above
<i>Grevillea scapigera</i>	iii, x, vi, xii	Habitat protection on other state lands; Translocation; Weed control; Research by local community groups.	Refer to Threatened Flora above
<i>Lechenaultia pulvinaris</i>	i, vi, vii, ii	Habitat retention through reserves; Weed control; Feral animal control; Habitat protection on private lands.	Refer to Threatened Flora above
<i>Muehlenbeckia horrida</i> subsp. <i>abditata</i>	xi, i, x, xiii	Reinstatement of hydrology; Habitat retention through reserves; Translocation; Capacity building with adjoining landholders.	Refer to Threatened Flora above
<i>Myoporum cordifolium</i>	unknown		Refer to Threatened Flora above
<i>Orthrosanthus muelleri</i>	iii	Habitat protection on other state lands.	Refer to Threatened Flora above
<i>Ricinocarpus trichophorus</i>	unknown		Refer to Threatened Flora above
<i>Stylidium merrallii</i>	unknown		Refer to Threatened Flora above
<i>Thelymitra psammophila</i>	i, ix	Habitat retention through reserves; Fire management.	Refer to Threatened Flora above
<i>Thelymitra stellata</i>	iii, xiii, ix	Habitat protection on other state lands; Capacity building with the Shire; Fire management.	Refer to Threatened Flora above
<i>Tribonanthes purpurea</i>	iii, i, ii, v	Habitat protection on other state lands through reserves, and on other state lands; Fencing.	Refer to Threatened Flora above
<i>Verticordia staminosa</i> var. <i>cylindracea</i>	iii, ii, v, xi	Habitat protection on other state lands and on private lands; Fencing; Reinstatement of hydrology.	Refer to Threatened Flora above
<i>Verticordia staminosa</i> var. <i>erecta</i>	ii, v, xiv	Habitat protection on private lands; Fencing; Other - seed collection.	Refer to Threatened Flora above

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Community	Specific Recovery Plan	General Recovery Plan
Plant assemblages of the Bremer Range System - <i>Eucalyptus rhomboidea</i> ms and <i>E. eremophila</i> woodland on the side slopes of low ridges; <i>E. flocktoniae</i> woodland (with <i>E. salubris</i> , <i>E. salmonophloia</i> , <i>E. dundasii</i> and <i>E. tenuis</i> ) on broad flat ridges and side slopes; <i>E. flocktoniae</i> and/or <i>E. longicornis</i> woodland on saline soils on ridges and flats adjacent to large salt lake systems; <i>E. longicornis</i> and/or <i>E. salmonophloia</i> or, <i>E. georgei</i> subsp <i>georgei</i> or, <i>E. dundasii</i> woodland, on low areas; <i>E. livida</i> woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; <i>Acacia duriuscula</i> , <i>Allocasuarina globosa</i> , <i>E. georgei</i> subsp <i>georgei</i> and <i>E. oleosa</i> thickets on greenstone ridges with skeletal soils.	No	Wheatbelt Management Plan (draft)
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abdita</i> and <i>Tecticornia verrucosa</i> across the lake floor.	Yes - IRP	Wheatbelt Management Plan (draft)
Herblands and Bunch Grasslands on gypsum lunette dunes community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species <i>Danthonia caespitosa</i> , <i>Lawrenzia squamata</i> , <i>Maireana marginata</i> , <i>Podolepis rugosa</i> , <i>Senecio lautus</i> subsp. <i>maritimus</i> , <i>Asteridea chaetopoda</i> , <i>Atriplex paludosa</i> , <i>Halosarcia syncarpa</i> , <i>Scaevola spinescens</i> and <i>Stipa juncea</i> .	No	
<i>Eucalyptus aff. incrassata</i> mallee over low scrub on gypsum dunes.	No	Wheatbelt Management Plan (draft)

## Appropriate ecosystem recovery actions

Community	Ecosystem Recovery Actions <sup>1</sup>	Ecosystem Recovery Descriptions	Constraints/Priority locations
Plant assemblages of the Bremer Range System - <i>Eucalyptus rhomboidea</i> ms and <i>E. eremophila</i> woodland on the side slopes of low ridges; <i>E. flocktoniae</i> woodland (with <i>E. salubris</i> , <i>E. salmonophloia</i> , <i>E. dundasii</i> and <i>E. tenuis</i> ) on broad flat ridges and side slopes; <i>E. flocktoniae</i> and/or <i>E. longicornis</i> woodland on saline soils on ridges and flats adjacent to large salt lake systems; <i>E. longicornis</i> and/or <i>E. salmonophloia</i> or, <i>E. georgei</i> subsp <i>georgei</i> or, <i>E. dundasii</i> woodland, on low areas; <i>E. livida</i> woodland on lateritic tops or Allocasuarina thickets on greenstone ridges of lateritic breakaways; <i>Acacia duriuscula</i> , <i>Allocasuarina globosa</i> , <i>E. georgei</i> subsp <i>georgei</i> and <i>E. oleosa</i> thickets on greenstone ridges with skeletal soils.	iii, xiii	Habitat protection on other state lands; Capacity building with exploration and mining companies.	unknown
Unwooded freshwater wetlands of the southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abdita</i> and <i>Tecticornia verrucosa</i> across the lake floor.	xi, i, iii, ii, viii, xiv	Reinstatement of hydrology; Habitat retention through reserves, other state lands and on private lands; Revegetation; Other - monitoring of surface and groundwater.	Significant surface and groundwater management issues
Herblands and Bunch Grasslands on gypsum lunette dunes community is located on grey sandy-clay on the top of a lake edge dune and includes the herbaceous species <i>Danthonia caespitosa</i> , <i>Lawrenzia squamata</i> , <i>Maireana marginata</i> , <i>Podolepis rugosa</i> , <i>Senecio lautus</i> ssp. <i>maritimus</i> , <i>Asteridea chaetopoda</i> , <i>Atriplex paludosa</i> , <i>Halosarcia syncarpa</i> , <i>Scaevola spinescens</i> and <i>Stipa juncea</i> .	iii, xiii, xiv	Habitat protection on other state lands; Capacity building with a gypsum mining company; Other - seek vesting as a nature reserve.	Limited extent, only 3.5 ha known at present; the area is subject to a mining lease

Community	Ecosystem Recovery Actions <sup>1</sup>	Ecosystem Recovery Descriptions	Constraints/Priority locations
<i>Eucalyptus aff. incrassata</i> mallee over low scrub on gypsum dunes.	i, xii, xiii	Habitat retention through reserves; Research; Capacity building with a gypsum mining industry.	Only known from < 100 ha and likely to become extinct within 5 years if current threatening processes continue

<sup>1</sup>Appendix B, key h

For all the unreserved vegetation types listed (pages 443-4), the following recovery actions would generally apply: Habitat retention and protection through reserves, on other state lands and on private lands; reinstatement of hydrology; feral animal control; fire management; and capacity building with landholders.

### Subregion priority for off reserve conservation

There are major constraints (see Appendix C, rank 6) to achieve conservation outcomes due to the level of habitat loss and degree of fragmentation leaving insufficient resources across most of the landscape to support viable populations of many species; significant landscape scale threatening processes such as salinity (affecting up to 30% of the cleared landscape) and fox/cat predation, and competing land uses i.e. broadacre cropping, grazing and mining. However the significant areas of unallocated Crown land in the eastern portion of the subregion probably require limited off-park measures to maintain biodiversity values.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Incentives:** There are incentives for a range of on-ground actions through State, Federal and some other programs. These incentives generally involve revegetation and remnant vegetation fencing, but in some cases (State government in particular) may involve earthworks. Examples include:

- State funding through recovery catchments and other components of the Salinity Program, such as the Crown Reserves Program (refer to Wallace 2001 for summary);
- Land for Wildlife Program (managed by Department of Conservation & Land Management);
- Bushcare funding, through joint projects with State government (who contribute significant dollars) projects and regional NRM groups;
- The Search Project (State-Federal program), for example, significant funding of commercially prospective native species of regional provenance;

- Other NHT programs (National Landcare, Endangered Species).

Three main options also exist to derive a financial benefit from on-farm remnant vegetation:

- Land purchase by government agencies, Australian Bush Heritage fund, interested individuals through the Bush Brokers scheme etc.
- Land revaluation as unproductive, or differential rating by covenanting, and
- Gifting of the land to a tax conservation body for taxation deductions.

**Legislation:** Most relevant legislation is Wildlife Conservation Act and Conservation and Land Management Act. No "duty of care" legislation, and no evidence that such legislation is practicable.

**Institutional Reform:** The purchase of bushland by CALM is a very real contribution to helping to realign land use and free up money for landholders. This is a form of new tenure. Operation of regional NRM groups in a state of flux, but represents an on-going case of institutional reform. (See also recommendations in Frost *et al.* 2001 and Wallace 2001). Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

**Capacity Building with Landholders:** In September 1999 Bush Brokers was established with a formal Memorandum of Understanding by all partners. The MOU sets out a range of projects to be undertaken within the next twelve months. These include:

- A united base for promoting improvements to government policies, particularly subdivision policies and procedures so as to streamline the separation of bush from agricultural titles and placement on a separate title.
- A web site register of properties/ blocks currently for sale, and buyers seeking bushland.
- Research on the size of the bushland market, and the most cost-effective measures to stimulate that market.
- A case studies handbook of individuals and groups who have already bought bush.
- "Marketing Bushland" Information Seminars for rural agents.
- A "Marketing Bushland" component included in the accredited REIWA course.

**Local Government:** Draft Statement of Planning Policy made under Section 5AA of the *Town Planning and Development Act* (1928). This policy may be cited as the Draft Statement of Planning Policy: Environment and Natural Resources Policy. The purpose of this policy is to inform local governments and the Town Planning Appeals Tribunal of those aspects of State-level planning policy concerning the environment and natural resources which should be taken into account in planning decision-making. The policy will also guide the WAPC in undertaking its planning responsibilities, and in integrating and coordinating the activities of the many State agencies which influence the use and development of land. This policy includes a section on biodiversity

**Valuing Ecosystem Services & Tradable Rights:** Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

**Threat Abatement Planning:** Actual action is largely through CALM, and there are internal reports and policies on threats such as dieback, feral animal control, fire, etc. However, note also:

- CALM's salinity review (Wallace 2001).
- State Salinity Strategy (State Salinity Council 2000).
- Report of the Salinity Taskforce (Frost *et al.* 2001).
- Weed management strategies (Department of Conservation and Land Management 1999b; Department of Agriculture 2001; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2000a; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2000b; Agriculture and Resource Management Council of Australia and New Zealand *et al.* 2001);
- Local government dieback guidelines document (Lewis and Colquhoun 2000).

Also, specialist plans, for example, those related to management of locust control and interaction of control measures on conservation lands.

**Industry Codes of Practice:** Environmental Code of Practice – Extractive Industries (Environmental Protection Authority 1991). Environmental Management in the WA Mining Industry (Chamber of Mines and Energy of Western Australia 1993). Code of Practice for Timber Plantations in Western Australia. Roadside Conservation Committee – Code of Practice for Roadside Conservation in Road Construction and Road Maintenance. The aim of this code is to balance road design and road safety requirements with all other values associated with roadsides in each Shire.

**Environmental Management Systems & Ecological Sustainable Product Marketing:** The Wheatbelt Region of CALM is preparing an EMS to identify

values, threats, goals and prioritise management across the landscape.

**Capacity Building:** There is significant interaction between State agencies, regional NRM groups (eg. Avon Catchment Network), Greening Australia (WA) (for example, Living Landscapes) and Worldwide Fund for Nature (through Woodland Watch in particular). These groups are also interacting jointly and independently to contribute to capacity building amongst landholders. Other groups such as the Threatened Species Network and Malleefowl Preservation Society also make significant contributions to capacity building in the community.

**Other Planning Opportunities:** Examples include:

- Department for Planning and Infrastructure is developing relevant rural land use plans.
- Some local governments are acting together to produce joint programs – for example, Kondinin Bush Heritage Committee.
- Regional NRM planning processes continue.
- CALM's Wheatbelt Regional Plan in development.
- National Action Plan for Water Quality and Salinity in development.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Integration occurring in various ways. Examples include:

- Contribution to property planning by Land for Wildlife;
- Agwest Land Management (Department of Agriculture) includes soil survey, land capability assessment and farm planning.
- Catchment planning through recovery catchments (natural diversity, water resources and rural towns);
- Rapid Catchment Appraisal process managed by Department of Agriculture;
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

**Other:** Actual on-ground actions by Department of Conservation and Land Management represent the most significant single, focussed contribution to biodiversity conservation in the subregions.

## Feasible Opportunities for NRM Impediments or constraints to opportunities

Given opportunities and impediments/constraints are often different sides of the same issue, both are covered in this section.

A key constraint overall is the lack of resources – including human and infrastructure resources – for implementation. This point reflects the relative

importance of biodiversity conservation and environmental issues in general in the public and political mind. Unless there is much wider recognition that biodiversity conservation makes a vital contribution to each individual's quality of life, this situation is unlikely to change. See Burbidge and Wallace (1995) for a discussion of some of the relevant issues.

A second generic issue is that NRM is variously and poorly defined. This is a significant impediment to progress, and reflects a much wider lack of rigour in the NRM area, and the generally very poor understanding of the relevant socio-political processes. One example of these issues is documented in Wallace (submitted for publication).

A range of problems, opportunities and constraints in relation to salinity are dealt with in Wallace (2001). Many of these are relevant to the broader field of NRM.

**Incentives:** Potential changes in the taxation laws for philanthropy exist. It is important to note that in many important cases – such as salinity – it is not an incentive that is required, but technical solutions that are economically viable to implement. While the lack of technical solutions is a barrier, it is also an opportunity. CALM is, particularly in the case of revegetation, working hard to find economically viable technical solutions. Resources are an impediment to doing this faster. It is also essential to note that, if we do not develop economically viable solutions using regional plants and animals, there is a severe risk that new invasive weeds and pest animals (eg, through aquaculture and more aggressive grazing animals) will be introduced.

**Legislation:** Proposed re-writing of the Wildlife Conservation Act is a key opportunity for change. More effective legislation and regulation in relation to land clearing and drainage would assist to combat some existing threats. This is both an opportunity and a barrier. Note the existing MOU is being reviewed.

**Institutional Reform:** While institutional reform is an issue, even greater opportunities for progress lie in improving the current institutions and ensuring that they are staffed at a sufficient level and with appropriate people. Put simply, bad operators will still be bad irrespective of institutional reform, good operators will generally do comparatively well despite institutional structures. This does not deny the need for institutional reform in some cases. However, it has become clear that the recruitment, training and Subregions where specific NRM actions are a priority to pursue

There are major constraints (see Appendix C, rank 7) to implement effective NRM actions to achieve biodiversity outcomes.

management of an effective NRM “group” is a far more significant impediment to progress than institutional structures and arrangements. Institutional reforms that would help include:

- To minimise institutional change, and certainly to avoid more frequent structural change to organisations than 8-10 year timeframes without very good reason. Significant structural changes cause organisational inefficiencies that last for a minimum of three years.
- Only implement institutional reform where there is a clearly articulated and convincing case that there is a well-identified problem to be fixed and that the proposed reform has a high probability of success.
- Wherever practicable, appoint contract officers to minimum terms of five years.
- Reverse the current trend of increasing duplication of service delivery in the NRM area.

**Valuing Ecosystem Services & Tradable Rights:** Are following testing of these in the eastern states with great interest. Will await the outcome of work there.

**Threat abatement planning as part of NRM:** The environmental management system being developed by CALM for the subregions should, for these areas, provide a greatly improved platform for threat abatement planning. Wallace and Beecham (submitted for publication) present the generalised framework for this.

**Environmental Management Systems & Ecologically Sustainable Product Marketing:** See comment above under threat abatement.

**Capacity building:** The most important opportunity here is the need to re-define capacity building, and to more clearly state goals, objectives and strategies.

**Other planning opportunities:** To date there has been a tendency to over-plan, for example, there are a series of over-lapping planning processes for biodiversity conservation in the south-west. This has, and remains, a barrier. A key opportunity is to proceed implement plans and monitor their value in a more strictly “adaptive management” style than has been the practice to date.

**Integration with Property Management Planning, Catchment Planning and Landcare:** See comment under Other Planning above.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:**

Systematic vegetation survey and mapping of all vegetation remnants needs to be done to the sub-association level. At present little mapping has been done at this scale. To complement this approach we also require equivalent scale mapping of soil-landscape units to facilitate revegetation of cleared lands, and to provide an alternative biodiversity surrogate, particularly for small terrestrial vertebrates and invertebrates. A standardised database and GIS application is also essential for data querying and management.

**Systematic Fauna Survey:** Existing systematic fauna survey data is confined to vertebrates (but not birds) and selected invertebrate taxa. Information is sparse and has not been analysed yet (ca. 40 terrestrial quadrats and 20 wetland quadrats across subregion). Study quadrats were only positioned on widespread surface-types, and only 3 – 4 quadrats were sampled per surface-type, and few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates. Required - systematic fauna surveys of birds, small terrestrial mammals, reptiles and select invertebrate groups across the landscape; also measures of various habitat and landscape variables. A standardised database and GIS application is also essential for data querying and management. The assumption that vegetation characteristics can be used as habitat surrogates for fauna needs to be investigated more thoroughly in conjunction with vegetation and ecosystem mapping above. The continued use of the focal species approach (Lambeck 1997; Lambeck 1999) and a modified version (Lambeck 1998) for biodiversity conservation planning across the subregion requires further research and survey data to address the following:

- the validity of vegetation as a habitat surrogates for all fauna,
- the validity of using birds as indicators for all fauna,
- what constitutes a viable population (Lambeck 1998) and an understanding of metapopulation

dynamics for various flora and fauna species in a fragmented landscape.

**Floristic Data:** Although regional survey of flora has been completed, it is based on very sparse sampling (about 130 quadrats across subregion), quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. Required - floristic data for the structural vegetation mapping listed above. Whilst structural unit are easiest to map, it is important to also document the floristic variation within and between vegetation sub-associations, particularly for management purposes.

**Ecological and Life History Data:** Is critical to identifying priorities and appropriate management responses in the fragmented and largely cleared landscape of the subregion. Data on various population demographic parameters, resource requirements and landscape variables are required to model population viability for a range of species with different life history strategies. This is essential to ensure that management actions are of an appropriate magnitude to achieve the desired biodiversity conservation goals. There few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species. There are no data to provide a regional context on life-history (including population-trend) of most species, including foxes, except CWR mammals on Lake Magenta Nature Reserve. See also fauna survey point above.

**Other Priority Data Gaps Include:**

- Fire – A knowledge of fire regimes and histories for reserves and areas of remnant vegetation, and data on the effects of fire on flora and fauna based on their life history attributes. This information is essential if the role of altered fire regimes in biodiversity conservation is to be understood and managed.

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844	Hamilton-Brown, S. and Blyth, J.	(1999b).	Unwooded fresh water wetlands of the southern wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subspecies <i>abdita</i> and <i>Tecticornia verrucosa</i> across the lake floor: Interim Recovery Plan 1999-2002 (IRP No 48)	Department of Conservation and Land Management, Perth.	O
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382	Hopper, S.D., Harvey, M.S., Chappill, J.A., Main, A.R. and Main, B.Y.	(1996).	The Western Australian biota as Gondwanan heritage - a review. pp 1-46 in Gondwanan Heritage: Past, Present and Future of the Western Australian Biota ed by S.D.	Surrey Beatty & Sons, Chipping Norton.	B
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423	Keighery, G. and Lyons, M.	(2001a).	CALM Biodiversity Survey of the Agricultural Zone - June 2001 Status Report. Unpublished report.	Department of Conservation and Land Management, Western Australia.	R
847	Keighery, G.J.	(1984).	Cleistogamy in <i>Elatine gratioides</i> A. Cunn. (Elatinaceae). In: Western Australian naturalist. - Vol. 16	Western Australian Naturalists' Club	J
753	Kershaw, K., Holland, E. and Brown, A.	(1997).	Metallic flowered <i>Eremophila (Eremophila veneta</i> ms) Interim Recovery Plan 1996-1999 (IRP No 14) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O
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452	Lee, A.K.	(1995).	The Action Plan for Australian Rodents	Environment Australia - Biodiversity Group, Threatened Species and Communities Section	B
456	Lewis, S. and Colquhoun, I.	(2000).	Managing Phytophthora dieback: Guidelines for Local Government.	Dieback Working Group, Western Australia.	R
467	Main, B.Y.	(1996a).	Terrestrial invertebrates in south-west Australian forests: the role of relict species and habitats in reserve design.	Journal of the Royal Society of Western Australia, Vol 79: 277-280.	J
469	Main, B.Y.	(2000).	Habitat template for invertebrates on granite outcrops.	Journal of the Royal Society of Western Australia 83:139-147.	J
476	Mattiske Consulting Pty Ltd	(1995a).	A review of botanical values on a range of gypsum dunes in the wheatbelt of Western Australia. Final report for Australian Nature Conservation Agency Save the Bush Program 1993/94 Project SS6007 Part-A.	Prepared for Department of Conservation and Land Management, Western Australia.	R
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483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
763	Morris, K., Whisson, L., Burbidge, A. and Wallace, K.	(1993).	Draft Recovery Plan for the Western Mouse ( <i>Pseudomys occidentalis</i> )	Department of Conservation and Land Management	O
522	Muir, B.G.	(1977).	Biological survey of the Western Australian wheatbelt Part 2: Vegetation and habitat of Bendering Reserve.	Records of the Western Australian Museum Supplement No 3.	R
521	Muir, B.G.	(1978-1979).	Some nature reserves of the Western Australian wheatbelt Parts 1-28.	Department of Fisheries and Wildlife, Perth	O
532	Orell, P., and Morris, K.	(1994).	Chuditch Recovery Plan 1992-2001. WA Wildlife Management Program No. 13.	Department of Conservation and Land Management, Perth.	R
750	Phillimore, R., Papenfus, D., Bunny, F. and Brown, A.	(2001).	South Stirling Morning Iris ( <i>Orthrosanthus muelleri</i> ) Interim Recovery Plan 2001-2004 (IRP No 87)	Department of Conservation and Land Management	O
848	Phillimore, R., Stack, G. and Brown, A.	(2000).	Lonely hammer orchid ( <i>Drakaea isolata</i> ms) Interim Recovery Plan 2000-2003 (IRP No 81)	Department of Conservation and Land Management, Perth.	O
553	Pinder, A.M., Halse, S.A., Shiel, R.J. and McRae, J.M.	(2000).	Granite outcrop pools in south-western Australia: foci of diversification and refugia for aquatic invertebrates.	Journal of the Royal Society of Western Australia 83:149-161.	J
845	Raines, J.	(1994).	Wetlands of outstanding importance for the Register of the National Estate in south-west Western Australia. 1, nominations for wetlands of importance to specially protected birds as determined in the 1993 assessment. Part B	Royal Australasian Ornithologists Union, Perth	R
569	Roadside Conservation Committee	(1995).	Draft Code of Practice for Roadside Conservation in Road Construction and Road Maintenance.		O
572	Rose, P.W.	(1993).	Production of habitat hollows by wheatbelt eucalypts. Final report, Australian Nature Conservation Agency Save the Bush Research Grant 1991/92 - Project R053.	Department of Conservation and Land Management, Western Australia.	R
762	Rossetto, M., Dixon, K., Atkins, K. and Coates, D.J. for the Corrigin Grevillea Recovery Team	(undated).	Draft Recovery Plan for the Corrigin Grevillea ( <i>Grevillea scapigera</i> )	Department of Conservation and Land Management	O
574	Safstrom, R.	(1995).	Conservation values of small reserves in the central wheatbelt of Western Australia: A framework for evaluating the conservation values of small reserves.	Prepared for the Western Australian Department of Conservation and Land Management by Environs Consulting, Perth.	R
576	Safstrom, R., True, D. and Coates, A.	(1996).	Conservation and other values of selected Agricultural Area dams in the central wheatbelt of Western Australia.	Prepared for the Western Australian Department of Conservation and Land Management by Environs Consulting, Perth.	R
587	Saunders, D.A. and Ingram, J.A.	(1995).	Birds of Southwestern Australia: An atlas of changes in distribution and abundance of the wheatbelt fauna.	Surrey Beatty and Sons, Chipping Norton, NSW.	B
600	Short, J.	(1995).	Interim Recovery Plan for the Western Barred Bandicoot ( <i>Perameles bougainville</i> ) (unpublished).		R
615	Stack, G. and Brown, A.	(1999).	Orange-Flowered Wattle ( <i>Acacia auratiflora</i> ms) Interim Recovery Plan 1999-2002.	Department of Conservation and Land Management, Western Australia.	R
621	Start, A.N., Burbidge, A.A. and Armstrong, D.	(1994).	Woylie Recovery Plan Second Edition 1994-1995. WA Wildlife Management	Department of Conservation and Land Management, Perth.	R

			Program No. 15.		
759	Start, T., Burbidge, A. and Armstrong, D. for the Woylie Recovery Team	(1995).	Recovery Plan for the Woylie ( <i>Bettongia penicillata ogilbyi</i> )	Department of Conservation and Land Management	O
622	State Salinity Council	(2000).	Natural Resource Management in Western Australia: Salinity.	Government of Western Australia, Perth.	R
653	Wallace, K.J. (compiler).	(2001).	State Salinity Action Plan 1996: Review of the Department of Conservation and Land Management's programs: January 1997 to June 2000.	Department of Conservation and Land Management, Perth.	R
654	Wallace, K.J. and Beecham, B.C.	(undated).	Planning nature conservation in agricultural landscapes - a land manager's perspective.	Submitted to Ecological Management and Restoration.	O
655	Wallis, R. and Higham, A.	(1998).	Environment Western Australia 1998 State of the Environment Report.	Department of Environmental Protection, Western Australia.	R
700	Withers, P.C. and Edward, D.H.	(1997).	Terrestrial fauna of granite outcrops in Western Australia.	Journal of the Royal Society of Western Australia 80(3):159-166.	J
701	Withers, P.C. and Hopper, S.D. (eds)	(2000).	Management of Granite Outcrops Symposium.	Journal of the Royal Society of Western Australia 83(3).	J
704	Wooller S.J. and Moore S.A.	(2000).	Regional assessment of the wheatbelt of Western Australia: Central Wheatbelt.	Prepared for the Australian Heritage Commission, Murdoch University, Perth	R
707	Yates, C.J., Hobbs, R.J. and True, D.T.	(2000).	The distribution and status of eucalypt woodlands in Western Australia. Pp 86-106 In. R.H. Hobbs & C.J. Yates (eds). Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration.	Surrey Beatty & Sons, NSW	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 014, 020, 101, 102, 139, 146, 239, 259, 268, 269, 319, 341, 373, 378, 380, 381,

424, 485, 522, 750, 554, 562, 583, 652, 845 and 849 in Appendix A.

# Murchison 1 (*MUR1 – East Murchison subregion*)

MARK COWAN  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

The northern parts of the 'Southern Cross' and 'Eastern Goldfields' Terrains of the Yilgarn Craton. Characterised by its internal drainage, and extensive areas of elevated red desert sandplains with minimal dune development. Salt lake systems associated with the occluded Paleodrainage system. Broad plains of red-brown soils and breakaway complexes as well as red sandplains. Vegetation is dominated by Mulga Woodlands often rich in ephemerals; hummock grasslands, saltbush shrublands and Halosarcia shrublands. Arid climate, with mainly winter rainfall (200 mm). The subregional area for MUR1 is 7, 847, 996 ha.

### Dominant land use

(see Appendix B, key b)

(ix) Grazing – native pastures. This accounts for the vast majority of land use in the subregion – 85.47% (xi) UCL and Crown Reserves-11.34% (vii) Mining – Interest in nickel and gold mining are considerable, however most

mining leases still come under the pastoral lands act and as such are still required to be stocked. (xiii) Conservation- the majority of conservation estate in the subregion falls outside the IUCN I-IV categories – 1.4%

### Continental Stress Class

The Continental Stress class for MUR1 is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

Calcrete aquifers in the northern part of the subregion are known to support a wide range of subterranean aquatic fauna that are short range endemics. Our understanding of biogeography for these groups is very limited but work by Humphries and Harvey (2001) suggests that there is significant stygofauna in the Lake Way system, at Jundee, Lorna Glen and Cunyu.

Rare species for the subregion include, Great Desert Skink (*Egernia kintorei*), Mallee Fowl (*Leipoa ocellata*), Alexandra's Parrot (*Polytelis alexandrae*) and Mulgara (*Dasyercus cristicauda*).

### Vegetation Types That Have at Least 85% of Their Total Extent Confined to the Murchison 1 Subregion:

Beard Veg Code	Ecosystem Description
20	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)
105	Hummock grasslands, shrub steppe; mulga over soft spinifex
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex
223	Succulent steppe with open scrub; scattered mulga over saltbush & bluebush
311	Succulent steppe with open low woodland; mulga & <i>Acacia sclerosperma</i> with saltbush & bluebush
312	Succulent steppe with very open shrubs; very sparse mulga and <i>Acacia sclerosperma</i> over saltbush & bluebush
313	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & <i>A. victoriae</i> over bluebush
338	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia basedowii</i> & <i>Triodia</i> ?sp
339	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia scariosa</i> & <i>Triodia</i> ?sp
400	Succulent steppe with open low woodland; mulga over bluebush
417	Succulent steppe with open scrub; scattered wattles over saltbush
418	Low woodland; mulga, <i>Casuarina cristata</i> & cypress pine
484	Shrublands; jam thicket
485	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia basedowii</i>
504	Low woodland; mulga & red mallee
532	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; ?marble gum & red mallee mixed dwarf shrubs with <i>Triodia scariosa</i> & <i>Triodia</i> sp?
533	Low woodland; mulga & cypress pine
560	Mosaic: Shrublands; bowgada scrub/Succulent steppe; samphire
561	Succulent steppe with low woodland; mulga over saltbush

Beard Veg Code	Ecosystem Description
862	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>E. kingsmillii</i> ) over hard spinifex <i>Triodia basedowii</i>
863	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia scariosa</i> & <i>Triodia</i> sp?
865	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia scariosa</i> & <i>Triodia</i> sp?
1127	Mosaic: Saltbush & bluebush/samphire
2121	Mosaic: Open low woodland; mulga/Succulent steppe; saltbush & bluebush on greenstone
2902	Medium woodland; <i>Allocasuarina cristata</i> & goldfields blackbutt
2903	Medium woodland; Salmon gum, goldfield blackbutt, gimlet & <i>Allocasuarina cristata</i>

### Centres of Endemism:

The subregion is rich and diverse in both its flora and fauna however most species are wide ranging and usually occur in at least one, and often several, adjoining subregions.

The only subregional endemic species of vertebrate appears to be the Yellow-bellied Black Snake (*Pseudechis butleri*). It is likely that a number of subterranean aquatic fauna are endemics but currently only the following are identified:

- Family Diosaccidae (marine family): *Schizopera* sp. nov. 4 - known only from Lake Way and Lorna Glen; *Schizopera* sp. nov. 5 known only from Jundee and Lorna Glen
- Family Ameiridae (mostly a marine family): *Nitocrella* n. sp. 4 Lorna Glen

### Refugia:

Lake Barlee - An intermittent salt lake that fills approximately every 10 years and persists for about 1 year. Banded stilts (*Cladorhynchus leucocephalus*) breed there and estimates of around 200,000 nests have been reported. Burbidge and Fuller (1982) suggest that it may be the most important breeding site for this species. Other water birds are also known to breed there.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Eastern Goldfields (System 11), which includes a large component of Murchison 1, in the CTRC Green Book. Some recommendations, particularly those to do with acquisition of pastoral properties for conservation reserve

have been implemented, however other recommendations were not addressed. A review of outstanding recommendations was initiated in 1988 and culminated in the production of a report - Nature Conservation Reserves in the Eastern Goldfields, Western Australia, Report Submitted To EPA Red Book Task Force, 1990 (Henry-Hall *et al* 1990). This report made recommendations on a nature conservation reserve system for the southern and central Goldfields that incorporate MUR1. Most of the subregion is covered by a CALM Regional Management Plan (Department of Conservation and Land Management 1994b), that provides an overview of the region's biota, addresses land and wildlife conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of subregions, or even bioregions, individually (Department of Conservation and Land Management 1994b).

During the last 10 years significant areas of the region have been added to the Conservation estate. The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation. An unpublished report by Department of Conservation and Land Management - "Gascoyne - Murchison Strategy, Establishment and Management of a Conservation Reserve System" outlines the broad techniques to implement a CAR reserve system but also does not target any specific areas. An outline of this report is given in the article *Filling the Gaps* (McNamara *et al.* 2000).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name & Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Ballard WA058	B8	ii	iv	ii	iv, v (fox & cat predation)
Lake Barlee WA059	B8	ii	iv	ii	iv, v (fox & cat predation)
Lake Marmion WA060	B8	ii	iv	ii	iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of subregional significance in MUR1.

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	ii	iii-iv	ii	iv (particularly sheep), v (goats, rabbits), vi, x, vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in MUR1.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Subterranean fauna of the Paroo Sub-Basin of the Lake Way Basin. Calcrete formations near Wiluna (B. Humphreys pers. comm.).	V	N/A	iii-iv	iv	iii	xi, ix
Mount Jumbo Range vegetation complex, Laverton area, northeast goldfields (G. Keighery and N. Gibson pers comm.; Hall, <i>et al.</i> 1994-not definitive; Beard 1974b-not definitive)	V	21	iii	iv	ii	iv, v (goats, rabbits), vii
Mount Linden Range banded ironstone ridge vegetation complex (G. Keighery and N. Gibson pers comm.)	V	21	ii	iv	ii	iv, v (goats, rabbits), vii
Microbialite community of Harpers Lagoon. NNE of Kalgoorlie (R. Sarti pers. comm.)	V	41	ii-iii	iii-iv	i	iv
<i>Melaleuca</i> sp. nov. Low Closed to Open Forest Strand Community Near Wiluna (Blackwell and Trudgen 1980)	V	15	ii	vi	iii	vii
Calcyphytic casuarina acacia woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 7)	V	26	ii-ii	vi	iii	vii
Calcrete platform woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 8)	V	21	ii-iii	vi	iii	iv, v (goats)
Plain mixed halophyte low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 9)	V	32	ii-iii	vi	iii	iv, v (goats)
Silver saltbush ( <i>Atriplex bunburyana</i> ) low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 16)	V	31	ii-iii	vi	iii	iv
Mixed chenopod shrublands with mulga ( <i>Acacia aneura</i> ) overstorey of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 18)	V	22	ii-iii	vi	iii	iv
Mulga ( <i>Acacia aneura</i> ) shrublands with scattered chenopod low shrubs of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 19)	V	22	i-iii	vi	iii	iv
Mulga ( <i>Acacia aneura</i> ) drainage line shrublands/woodlands with chenopod understoreys of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 20)	V	22	ii-iii	vi	iii	iv

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Calcyphytic pearl bluebush ( <i>Maireana sedifolia</i> ) shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 21)	V	31	ii-iii	vi	iii	iv, ii, xii (impacts from mining)
Stony bluebush ( <i>Maireana</i> spp.) mixed shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 22)	V	31	ii-iii	vi	iii	iv, ii, xii (impacts by mining)
Upland small bluebush ( <i>Maireana</i> spp.) species shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 23)	V	31	ii-iii	vi	iii	iv
Granite hill mixed shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 25 .	V	32	ii-iii	vi	iii	v (goats)
Stony ironstone mulga ( <i>Acacia aneura</i> ) shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 28)	V	20	ii-iii	vi	iii	iv
Depot Springs stygofauna community		N/A	Unknown	vi	ii	x (water drawdown), potential for mining in the area

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	i	i	iii	v (foxes), vii; likely to be extinct in subregion
<i>Notoryctes typhlops</i>	V	i	ii-iii	ii	v (foxes & cats), vii
<i>Dasycercus cristicauda</i>	V	ii	iii	iii	v (foxes & cats), vii
<b>Schedule 1: Rare/likely to become extinct, Div 2 (Birds)</b>					
<i>Leipoa ocellata</i>	V	unknown	iii	iii	v (foxes, cats), iii, iv
<i>Polytelis alexandrae</i>	V	ii	iii	iii	vii, iv
<i>Acanthiza iredalei iredalei</i>	V	unknown	vi	ii	vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia kintorei</i>	V	i	ii	iii	v (foxes & cats), vii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	unknown	vi	ii	ii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Minuria tridens</i>	Commonwealth	unknown	vi	unknown	Unknown threatening processes
<i>Conospermum toddii</i>	V	iii	iii-iv	iii	vii, small pop
<i>Eucalyptus articulata</i>	V	iii	iii-iv	iii	vii
<b>PRIORITY 1</b>					
<i>Acacia ependunculata</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Apatophyllum macgillivrayi</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Baekea</i> sp Melita Station	1	unknown	vi	ii	vii, iv, v, vi
<i>Baekea</i> sp Sandstone	1	unknown	vi	ii	vii, iv, v, vi
<i>Calothamnus superbus</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Calytrix cresswellii</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Calytrix uncinata</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Calytrix verruculosa</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Dampiera plumosa</i>	1	unknown	vi	ii	vii, iv, v, vi
Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Eremophila annosocaula</i> ms	1	unknown	vi	ii	vii, iv, v, v
<i>Eremophila congesta</i> ms	1	unknown	vi	ii	vii, iv, v, vi
<i>Eremophila eversa</i> ms	1	unknown	vi	ii	vii, iv, v, vi
<i>Gnephosis intonsa</i>	1	unknown	vi	ii	vii, iv, v, vi

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<i>Goodenia lyrata</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Homalocalyx grandiflorus</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Hyalosperma stoveae</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Jacksonia</i> sp Cundelee	1	unknown	vi	ii	vii, iv, v, vi
<i>Millotia falcata</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Neurachne lanigera</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Philotheca deserti</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Philotheca tubiflora</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Ptilotus chortophytum</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Stenanthemum mediale</i>	1	unknown	vi	ii	vii, iv, v, vi
<i>Stenanthemum</i> sp Mt Clifford.	1	unknown	vi	ii	vii, iv, v, vi
<b>PRIORITY 2</b>					
<i>Acacia subrigida</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Dampiera ramosa</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Eremophila mirabilis</i> ms	2	unknown	vi	ii	vii, iv, v, vi
<i>Eucalyptus jutsonii</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Gonocarpus ephemerus</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Grevillea secunda</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Leucopogon breviflorus</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Malleostemon</i> sp Adelong	2	unknown	vi	ii	vii, iv, v, vi
<i>Micromyrtus serrulata</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Micromyrtus stenocalyx</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Newcastelia insignis</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Olearia mucronata</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Ptilotus tetrandrus</i>	2	unknown	vi	ii	vii, iv, v, vi
<i>Thryptomene</i> sp Queen Victoria Springs	2	unknown	vi	ii	vii, iv, v, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
8	Medium woodland; salmon gum & gimlet	X			L
10	Medium woodland; red mallee group		X		L
11	Medium woodland; coolibah ( <i>E. microtheca</i> )				H
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X	X		M
19	Low woodland; mulga between sandridges	X	X		L
20	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)	X	X		L
24	Low woodland; <i>Allocasuarina cristata</i>	X			L
28	Open low woodland; mulga				H
29	Sparse low woodland; mulga, discontinuous in scattered groups				M
39	Shrublands; mulga scrub	X			L
40	Shrublands; acacia scrub, various species				M

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
84	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				L
105	Hummock grasslands, shrub steppe; mulga over soft spinifex				H
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	X			M
109	Hummock grasslands, shrub steppe; <i>Eucalyptus youngiana</i> over hard spinifex	X			L
110	Hummock grasslands, shrub steppe; red mallee over spinifex <i>Triodia scariosa</i>				M
120	Succulent steppe with open low woodland; mulga & sheoak				L
125	Bare areas; salt lakes	X	X		L
128	Bare areas; rock outcrops	X	X		L
141	Medium woodland; York gum, salmon gum & gimlet		X		M
143	Medium woodland; York gum, salmon gum & <i>Allocasuarina cristata</i>				M
166	Low woodland; mulga & <i>Acacia victoriae</i>				L
169	Shrublands; mulga & minnieritchie scrub				L
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )				H
188	Shrublands; mulga & <i>Acacia sclerosperma</i> scrub				H
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub		X		M
204	Succulent steppe with open scrub; scattered mulga & <i>Acacia sclerosperma</i> over saltbush & bluebush				H
207	Hummock grasslands, shrub steppe; red mallee over hard spinifex				L
221	Succulent steppe; saltbush				M
223	Succulent steppe with open scrub; scattered mulga over saltbush & bluebush				H
240	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & bowgada over saltbush & bluebush				H
251	Low woodland; mulga & <i>Allocasuarina cristata</i>	X	X		L
267	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush				M
268	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> over saltbush & bluebush				H
311	Succulent steppe with open low woodland; mulga & <i>Acacia sclerosperma</i> with saltbush & bluebush				H
312	Succulent steppe with very open shrubs; very sparse mulga and <i>Acacia sclerosperma</i> over saltbush & bluebush				H
313	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & <i>A. victoriae</i> over bluebush				H
338	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia basedowii</i> & <i>Triodia ?sp</i>				H
339	Hummock grasslands, mixed sandplain; bowgada, sugarbrother, mallee, <i>Triodia scariosa</i> & <i>Triodia ?sp</i>				H
385	Shrublands; bowgada & jam scrub with scattered York gum		X		M
389	Succulent steppe with open low woodland; mulga over saltbush	X	X		M
395	Hummock grasslands, mixed sandplain; bowgada, mallee, heath and spinifex				M
400	Succulent steppe with open low woodland; mulga over bluebush				H
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub				L
411	Succulent steppe with open scrub; scattered bowgada & jam over saltbush				H
415	Succulent steppe with open scrub; scattered mulga & other wattle(s) over saltbush & bluebush		X		H
416	Low woodland; mulga mixed with cypress pine & york gum	X			L
417	Succulent steppe with open scrub; scattered wattles over saltbush	X	X		L
418	Low woodland; mulga, <i>Casuarina cristata</i> & cypress pine		X		M
420	Shrublands; bowgada & jam scrub				M
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM Purchased Lease	Priority
437	Shrublands; Mixed acacia thicket on sandplain	X	X		L
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush	X			M
460	Succulent steppe; bluebush with saltbush in depressions		X		L

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468	Medium woodland; salmon gum & goldfields blackbutt				L
480	Succulent steppe with open low woodland; mulga & sheoak over salt bush	X	X		L
481	Mosaic: Medium woodland; salmon gum & red mallee/Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>				L
483	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex; red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>	X	X		M
484	Shrublands; jam thicket	X	X		M
485	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia basedowii</i>		X		M
501	Medium woodland; goldfields blackbutt				L
502	Medium woodland; goldfields blackbutt & red mallee				M
504	Low woodland; mulga & red mallee		X		L
508	Succulent steppe with open scrub; scattered mulga over saltbush		X		L
520	Shrublands; <i>Acacia quadrimarginea</i> thicket				L
521	Medium woodland; salmon gum & red mallee	X	X		L
529	Succulent steppe with open low woodland; mulga & sheoak over bluebush		X		H
532	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; ?marble gum & red mallee mixed dwarf shrubs with <i>Triodia scariosa</i> & <i>Triodia</i> sp?				H
533	Low woodland; mulga & cypress pine		X		H
538	Shrublands; <i>Acacia brachystachya</i> scrub		X		L
540	Succulent steppe with open low woodland; sheoak over saltbush		X		L
547	Mosaic: Low woodland; mulga & bowgada/Succulent steppe; samphire				H
555	Hummock grasslands, mallee steppe; red mallee over spinifex <i>Triodia scariosa</i>		X		M
560	Mosaic: Shrublands; bowgada scrub/Succulent steppe; samphire				H
561	Succulent steppe with low woodland; mulga over saltbush				H
676	Succulent steppe; samphire				M
862	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>E. kingsmillii</i> ) over hard spinifex <i>Triodia basedowii</i>				H
863	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia scariosa</i> & T. sp?				M
865	Hummock grassland, mixed sandplain - scattered low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia scariosa</i> & T. sp?				H
936	Medium woodland; salmon gum		X		L
1127	Mosaic: Saltbush & bluebush/samphire				H
1239	Hummock grasslands, open medium tree & mallee steppe; marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> on sandplain				L
1271	Bare areas; claypans				L
1413	Shrublands; acacia, casuarina & melaleuca thicket		X		L
1446	Succulent steppe with scrub; mulga over bluebush				H
2081	Shrublands; bowgada and associated spp. scrub				L
2121	Mosaic: Open low woodland; mulga/Succulent steppe; saltbush & bluebush on greenstone				H
2902	Medium woodland; <i>Allocasuarina cristata</i> & goldfields blackbutt				H
<b>Beard Veg Assoc</b>	<b>Ecosystem Description</b>	<b>IUCN I-IV</b>	<b>Non-IUCN Reserve</b>	<b>CALM Purchased Lease</b>	<b>Priority</b>
2903	Medium woodland; Salmon gum, goldfield blackbutt, gimlet & <i>Allocasuarina cristata</i>				H
2904	Medium woodland; York gum, goldfield blackbutt, gimlet & <i>Allocasuarina cristata</i>				M
	Subterranean fauna of the Paroo Sub-Basin of the Lake Way Basin. Calcrete formations near Wiluna (B. Humphreys pers. comm.).			X	M
	Banded Ironstone Hills with <i>Dryandra arborea</i> . (A. Brown pers. comm.).				H
	Mount Jumbo Range vegetation complex, Laverton area, northeast goldfields (G. Keighery and N. Gibson pers comm.; Hall <i>et al.</i> 1994-not definitive; Beard 1974-not definitive)				H
	Mount Linden Range banded ironstone ridge vegetation complex (G. Keighery and N. Gibson pers comm.)				H
	Mt Gibson vegetation complex (G. Keighery and N. Gibson pers. comm.; Beard map).				H

	Microbialite community of Harpers Lagoon. NNE of Kalgoorlie (R. Sarti pers. comm.)			L
	<i>Melaleuca</i> sp. nov. Low Closed to Open Forest Strand Community Near Wiluna (Blackwell and Trudgen 1980)			?
	Calcyphytic casuarina acacia woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 7)	?		?
	Calcrete platform woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 8)			M
	Plain mixed halophyte low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 9)	X		M
	Silver saltbush ( <i>Atriplex bunburyana</i> ) low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 16)			M
	Mixed chenopod shrublands with mulga ( <i>Acacia aneura</i> ) overstorey of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 18)			M
	Mulga ( <i>Acacia aneura</i> ) shrublands with scattered chenopod low shrubs of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 19)			L
	Mulga ( <i>Acacia aneura</i> ) drainage line shrublands/woodlands with chenopod understoreys of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 20)			M
	Calcyphytic pearl bluebush ( <i>Maireana sedifolia</i> ) shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 21)			M
	Stony bluebush ( <i>Maireana</i> spp.) mixed shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 22)	X		M
	Upland small bluebush ( <i>Maireana</i> spp.) species shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 23)	X		L
	Granite hill mixed shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 25			M
	Stony ironstone mulga ( <i>Acacia aneura</i> ) shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 28)	X		M

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Use:** The primary issue is that pastoralism occupies more than 85% of the region and mining also has considerable interests.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data; level of degradation of much of the subregion is significant due to pastoral practices and the impacts of feral herbivores  
Bioregional and subregional priority for reserve consolidation

MUR is reservation class 2 (see Appendix D, and Appendix C, rank 4) with only 1.39% of the area in a conservation reserve (IUCN I-IV) At the subregional

level MUR1 has 1.82% in reserve (IUCN I-IV) while MUR2 has only 0.053% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 2 with possibility of changing to a higher primary classification is appropriate.

### Reserve management standard

In MUR, no feral predator programs are in place yet. Wildfire management facilities are limited by resources, except for fire breaks and fire-access tracks which are installed and maintained. Mining activities (exploration) are supervised (except for old exploration drill holes which often remain open). Feral herbivore grazing activities still pose a conservation risk in some areas. Therefore, the overall reserve management rank is (ii) (see Appendix C, rank 5).

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
		Black Range	Unallocated Crown Land	ii-iii
		Lake Mason	Unallocated Crown Land	ii-iii
		Burnerbinmah	Unallocated Crown Land	ii-iii
		Mt. Elvire	Unallocated Crown Land	ii-iii
		Goongarrie	Unallocated Crown Land	iii
C	Conservation Of Flora And Fauna And Water	Niagara Dam Nature Reserve	Nature Reserve	ii-iii
C	Timber-Sandalwood	Bullock Holes Timber Reserve	Section 5(g) reserve	ii-iii
A	Conservation Of Flora And Fauna	Queen Victoria Spring Nature Reserve	Nature Reserve	ii-iii
A	Conservation Of Flora And Fauna	Wanjarri Nature Reserve	Nature Reserve	iii
A	National Park	Goongarrie National Park	National Park	iii
C	Conservation Of Flora And Fauna	Mount Manning Nature Reserve	Nature Reserve	ii-iii
C	Conservation Of Flora And Fauna	Malcolm Dam	Nature Reserve	ii-iii

C	Conservation Of Flora And Fauna	De La Poer Range Nature Reserve	Nature Reserve	ii-iii
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<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

Species	Beard Vegetation Association or Ecosystem	Specific Recovery Plan	General Recovery Plan
Stygofauna	Calcrete aquifers	No	Goldfields Regional Management Plan
<i>Falco peregrinus</i>	Open woodlands, inland cliff and gorges	No	Goldfields Regional Management Plan
<i>Macrotis lagotis</i>	18 – Low woodland: mulga ( <i>Acacia aneura</i> ); 28 – Open low woodland: mulga; 29 – Sparse low woodland: mulga, discontinuous scattered groups	Recovery Plan for the Greater Bilby	1996 Action Plan for Australian Marsupials and Monotremes; Goldfields Regional Management Plan
<i>Leipoa ocellata</i>	20 – Low woodland: mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)	Recovery Plan for Mallee Fowl	The Action plan for Australian Birds 2000; Goldfields Regional Management Plan
<i>Polytelis alexandrae</i>	Mulga over spinifex, casuarina, <i>E. camaldulensis</i>	No	Goldfields Regional Management Plan
<i>Acanthiza iredalei iredalei</i>	Chenopod shrublands	No	The Action plan for Australian Birds 2000; Goldfields Regional Management Plan

Species	Beard Vegetation Association or Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Notoryctes typhlops</i>	18 - Low woodland: mulga ( <i>Acacia aneura</i> ); 84 - Hummock grasslands, open low tree & mallee steppe: marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills; 96 - Hummock grasslands, shrub steppe: acacia species (+grevillea) over <i>Triodia basedowii</i> often between sandridges; 134 - Mosaic: Hummock grasslands, open tree steppe-desert bloodwood and feathertop spinifex on sandhills/Hummock grasslands, shrub steppe-mixed shrubs over spinifex between sandhills.	No	1996 Action Plan for Australian Marsupials and Monotremes; Goldfields Regional Management Plan
<i>Dasycercus cristicauda</i>	18 - Low woodland: mulga ( <i>Acacia aneura</i> ); 39 - Shrublands: mulga scrub; 107 - Hummock grasslands, shrub steppe: mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	No	1996 Action Plan for Australian Marsupials and Monotremes; Goldfields Regional Management Plan
<i>Egernia kintorei</i>	39 - Shrublands: mulga scrub	A recovery Plan for the Great Desert Skink 2001-2011	The Action Plan for Australian reptiles; Goldfields Regional Management Plan
<i>Minuria tridens</i>	Nothing known about this plant	No	Goldfields Regional Management Plan
<i>Conospermum toddii</i>	39 - Shrublands: mulga scrub; 84 - Hummock grasslands, open low tree & mallee steppe: marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	No	Goldfields Regional Management Plan
<i>Eucalyptus articulata</i>	20 - Low woodland: mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6); 84 - Hummock grasslands, open low tree & mallee steppe: marble gum & mallee ( <i>E. youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills	No	Goldfields Regional Management Plan

There are no specific regional recovery plans for any of the above biota/systems however, in broad terms, they are covered under the Goldfields Regional Management Plan. Other Recovery Plans include National Recovery

Plan for Malleefowl; The Action Plan for Australian Birds, 2000; Action Plan for Australian Marsupials and Monotremes; and The Action Plan for Australian Reptiles.

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Macrotis lagotis</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. CWR species that is no longer extant in the subregion. Control of feral animals, notably foxes, as well as fire management are essential.
<i>Leipoa ocellata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Polytelis alexandrae</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Possibly control of feral predators as well as habitat degradation through grazing pressure and by feral herbivores.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, vii	Cessation of the loss of habitat through grazing of chenopod shrubland by sheep and rabbits.
<i>Notoryctes typhlops</i>	i, ii, iii, xii	Little is known of habitat requirements or general natural history for this species so further research is important to determine its true status.
<i>Dasycercus cristicauda</i>	i, ii, iii, vii, ix, xii	CWR species that requires specific fire age spinifex habitat. Predated upon by foxes and cats. Ecological research currently being conducted by D. J. Pearson (pers. comm.).
<i>Egernia kintorei</i>	i, ii, iii, vii, ix, xii	It is likely that reduction has occurred through direct predation (cats, foxes) as well as habitat alteration through changed fire regimes as well as grazing impacts.
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Minuria tridens</i>	xii	Research - nothing is known about this plant.
<i>Conospermum toddii</i>	i, ii, iii, vii, xii, xiii	habitat retention through reserves or on other State lands or on private lands. Invasive weeds may pose a threat. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus articulata</i>	i, iii, ix, xii	habitat retention through reserves or on other State lands or on private lands. Research into the effects of fire as well as the species general biology.

<sup>1</sup>Appendix B, key h

### Ecosystems and appropriate recovery actions

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Subterranean fauna of the Paroo Sub-Basin of the Lake Way Basin. Calcrete formations near Wiluna (B. Humphreys pers. comm.).	i, ii, iii, xi, xiii	Habitat retention and protection through reserves, on private land or on other state lands. Reinstatement of hydrology. Capacity building with industry and landholders.
Mount Jumbo Range vegetation complex, Laverton area, northeast goldfields (G. Keighery and N. Gibson pers comm.; Hall, <i>et al.</i> 1994-not definitive; Beard 1974b-not definitive)	i, ii, iii, v, vi, vii, ix, xiii	Habitat retention and protection through reserves, on private land or on other state lands. Fencing. Weed control. Feral animal control. Fire management. Capacity building with industry and landholders.
Mount Linden Range banded ironstone ridge vegetation complex (G. Keighery and N. Gibson pers comm.)	i, ii, iii, v, vi, vii, ix, xiii	Habitat retention and protection through reserves, on private land or on other state lands. Fencing. Weed control. Feral animal control. Fire management. Capacity building with industry and landholders.
Mt Gibson vegetation complex (G. Keighery and N. Gibson pers. comm.; Beard map).	i, ii, iii, v, vi, vii, ix, xiii	Habitat retention and protection through reserves, on private land or on other state lands. Fencing. Weed control. Feral animal control. Fire management. Capacity building with industry and landholders.
Microbialite community of Harpers Lagoon. NNE of Kalgoorlie (R. Sarti pers. comm.)	v, xiii	Fencing. Capacity building with industry and landholders.
<i>Melaleuca</i> sp. nov. Low Closed to Open Forest Strand Community Near Wiluna (Blackwell and Trudgen 1980)	i, ii, iii, ix	Habitat retention and protection through reserves, on private land or on other state lands. Fire management.
Calcyphytic casuarina acacia woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 7)	i, ii, iii, ix	Habitat retention and protection through reserves, on private land or on other state lands. Fire management.
Calcrete platform woodlands/shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 8)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Plain mixed halophyte low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 9)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Silver saltbush ( <i>Atriplex bunburyana</i> ) low shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 16)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Mixed chenopod shrublands with mulga ( <i>Acacia aneura</i> ) overstorey of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 18)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Mulga ( <i>Acacia aneura</i> ) shrublands with scattered chenopod low shrubs of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 19)	vii, v	Feral animal control. Fencing.
Mulga ( <i>Acacia aneura</i> ) drainage line shrublands/woodlands with chenopod understoreys of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 20)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Calcyphytic pearl bluebush ( <i>Maireana sedifolia</i> ) shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 21)	i, ii, iii, xiii, xii	Habitat retention and protection through reserves, on private land or on other state lands. Capacity building with industry and landholders. Research.
Stony bluebush ( <i>Maireana</i> spp.) mixed shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 22)	i, ii, iii, xiii, xii	Habitat retention and protection through reserves, on private land or on other state lands. Capacity building with industry and landholders. Research.

Community	Recovery Actions <sup>1</sup>	Recovery Descriptions
Upland small bluebush ( <i>Maireana</i> spp.) species shrublands of the north-east Goldfields (Pringle <i>et al.</i> 1994 - site type 23)	vii, v	Feral animal control. Fencing.
Granite hill mixed shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 25.	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Stony ironstone mulga ( <i>Acacia aneura</i> ) shrublands of the north-east Goldfields Survey by Pringle <i>et al.</i> 1994 - site type 28)	i, ii, iii, vii, v	Habitat retention and protection through reserves, on private land or on other state lands. Feral animal control. Fencing.
Depot Springs stygofauna community	i, ii, iii, xi, xiii	Habitat retention and protection through reserves, on private land or on other state lands. Reinstatement of hydrology. Capacity building with industry and landholders.

<sup>1</sup>Appendix B, key h

## Existing ecosystem recovery plans

There are no specific recovery plans for ecosystems at risk in MUR1, however the Goldfields Regional Management Plan is applicable in a general sense.

## Subregion priority for off reserve conservation

The priority for off park conservation in MUR1 is (ii) (see Appendix C, rank 6), indicating that a significant off park effort needed, however resource constraints and limited community capacity exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to mining and exploration activities.

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas already attempting to identify and implement ecologically sustainable practices through the EMU process developed by AgWA. Needs a greater level of support to be successful.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for MUR1 is (i) (see Appendix C, rank 7), indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Much of MUR 1 is severely degraded through past agricultural practices (primarily sheep grazing) and feral herbivores. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Regional survey of flora and vertebrate fauna has been published, but is based on very sparse sampling (Goldfields Regional Surveys conducted 1984 to 1995 including Burbidge *et al.* (1995), Dell *et al.* (1992), Dell *et al.* (1998), Hall *et al.* (1994), How *et al.* (1992) and McKenzie and Hall (1992)). Regional ecosystem mapping has been produced at the broad scale, 1:1000000 for Beard's vegetation, and 1:500000 for Landsystems by the Western Australian Dept. Agriculture (Payne *et al.* 1998, Pringle *et al.* 1994).

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse, quadrats only positioned on widespread surface-types, and only 3 – 4 quadrats per surface-type, few quadrats have been sampled on more than three occasions.

**Floristic Data:** Data is sparse, quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. Inventory sites were surveyed by the Departments of Agriculture and Land Administration in the Murchison rangelands for plant identification purposes. Condition sites were examined to see the effects of grazing on various plant species and the data set is essentially perennials and some other palatable species (Payne *et al.* 1987).

**Ecological and Life History Data:** There are few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate- and plant-species.

There are no data to provide a regional context on life-history (including population-trend) of any species, even rabbits.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, weed colonisation, fire, mineral-extraction on greenstone surfaces, changes in fire regime, water extraction etc.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
716	Blackwell, M.I. and Trudgen, M.E.	(1980).	Report on the flora and vegetation of the Lake Way Joint Venture uranium project area : together with an assessment of the impact of this project upon the landscape, flora and vegetation of this area and its regeneration potential		R
715	Burbidge, A.A and Fuller, P.J.	(1982).	Banded stilt at Lake Barlee, Western Australia	Emu. - Vol. 82 (1982) p. 212-215	J
130	Burbidge, A.A., Hall, N.J., Keighery, G.J. and McKenzie, N.L. (eds.)	(1995).	The biological survey of the eastern Goldfields of Western Australia. Part 12. Barlee-Menzies Study Area.	Records of the Western Australian Museum Supplement No. 49, 169-312. Perth, WA.	J
181	Cogger, H., Cameron, E., Sadlier, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
215	Dell, J., How, R.A. and Milewski, A.V.	(1992).	The biological survey of the eastern Goldfields of Western Australia. Part 6. Youanmi-Leonora Study Area.	Records of the Western Australian Museum Supplement No. 40, 1-63. Perth, WA.	J
216	Dell, J., How, R.A., Milewski, A.V. and Keighery, G.J.	(1998).	The biological survey of the eastern Goldfields of Western Australia. Part 7. Edjudina-Menzies Study Area.	Records of the Western Australian Museum Supplement No. 31, 1-137. Perth, WA.	J
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
332	Hall, N.J., McKenzie, N.L. and Keighery, G.J. (eds.)	(1994).	The biological survey of the eastern Goldfields of Western Australia. Part 10. Sandstone-Sir Samuel and Laverton-Leonora Study Areas.	Records of the Western Australian Museum Supplement No. 47, 1-166. Perth, WA.	J

332	Hall, N.J., McKenzie, N.L. and Keighery, G.J. (eds.)	(1994).	The biological survey of the eastern Goldfields of Western Australia. Part 10. Sandstone-Sir Samuel and Laverton-Leonora Study Areas.	Records of the Western Australian Museum Supplement No. 47, 1-166. Perth, WA.	J
354	Henry-Hall, N.J., Hopper, S.D., McKenzie, N.L. and Keighery, S.D.	(1990).	Nature Conservation Reserves in the Eastern Goldfields, Western Australia - Southern Two Thirds of CTCR System 11.	Report submitted to EPA Red Book Task Force.	R
389	How, R.A., Dell, J., Milewski, A.V. and Keighery, G.J.	(1992).	The biological survey of the eastern Goldfields of Western Australia. Part 7. Duketon-Sir Samuel Study Area.	Records of the Western Australian Museum Supplement No. 40, 67-131. Perth, WA.	J
402	Humphreys, W.F. and Harvey, M.S. (Ed's).	(2001).	Subterranean biology in Australia 2000.	Records of the Western Australian Museum, Supplement 64. Western Australian Museum, Perth	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
484	McAlpin, S.	(2001).	A Recovery Plan for the Great Desert Skink ( <i>Egernia kintorei</i> ) 2001-2011.	Arid lands Environment Centre.	R
491	McKenzie, N.L. and Hall, N.J. (eds.)	(1992).	The biological survey of the eastern Goldfields of Western Australia. Part 8. Kurnalpi-Kalgoorlie Study Area.	Records of the Western Australian Museum Supplement No. 41, 1-125. Perth, WA.	J
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscape. 15 (4) 43 - 49.	J
561	Pringle, H.J.R., Van Vreeswyk, A.M.E., and Gilligan, S.A.	(1994).	Technical Bulletin No 87. An inventory and condition survey of the north-eastern Goldfields, Western Australia.	Department of Agriculture, Perth.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 040, 065, 067, 075, 098, 101, 118, 166, 211, 235, 241, 258, 260, 268, 272, 278, 279, 313, 395, 406, 450, 459, 461, 507, 519, 526, 542, 560, 577, 584, 647, 650, 678, 680, 685, 686 and 718 in Appendix A.

# Murchison 2 (*MUR2 – Western Murchison subregion*)

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NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

Northern part of the 'Murchison' Terrains of the Yilgarn Craton. Mulga low woodlands, often rich in ephemerals (usually with bunch grasses), on outcrop and fine-textured Quaternary alluvial and eluvial surfaces (extensive hardpan washplains that dominate and characterise the subregion) mantling granitic and greenstone strata of the northern part of the Yilgarn Craton. Surfaces associated with the occluded drainage occur throughout with hummock grasslands on Quaternary sandplains, saltbush shrublands on calcareous soils and Halosarcia low shrublands on saline alluvia. Contains the headwaters of the Murchison and Wooramel Rivers, which drain the subregion westwards to the coast. Arid climate with bimodal rainfall that usually falls in winter. The subregional area is 7,847,996 ha.

### Dominant land use

(see Appendix B, key b)

Mainly (ix) grazing native pastures (96.2%), with lesser areas of (xi) UCL and Crown reserves (2.81%). (xiii) Conservation lands only constitute 0.06% of the subregion; a significant proportion of conservation estate in the subregion falls outside the IUCN I-IV categories. (vii) Mining interest in nickel and gold mining in particular are considerable, however most mining leases still come under the pastoral lands act and as such are still required to be stocked.

### Continental Stress Class

The Continental Stress Class for MUR2 is 3.

### Ecosystem Types That Have at Least 85% of Their Total Extent Confined to the Murchison 2 Subregion:

Beard Veg Code	Description
362	Mosaic: Shrublands; bowgada & minnieritchie scrub with scattered mulga/Scattered groups of saltbush/bluebush
300	Mosaic: Low woodland; mulga/Succulent steppe; saltbush & bluebush
305	Medium woodland over scrub; coolibah over bowgada
1125	Succulent steppe with scrub; <i>Acacia victoriae</i> & snakewood over saltbush & bluebush
1126	Low woodland; mulga & minnieritchie
1128	Mosaic: Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & bowgada over saltbush & bluebush/Succulent steppe; samphire
34	Shrublands; acacia scrub with scattered mulga
Beard Veg Code	Description
187	Succulent steppe with open scrub; scattered <i>Acacia victoriae</i> & snakewood over various species
261	Succulent steppe with low woodland; snakewood over saltbush & bluebush
288	Mosaic: Scattered low trees; mulga/Succulent steppe; sparse saltbush & bluebush on greenstone
306	Low woodland; <i>Casuarina ?obesa</i> (salt lake)
327	Shrublands; mulga, bowgada, <i>Acacia quadrimarginea</i> & minnieritchie scrub
340	Succulent steppe with scrub; bowgada scrub over various species
341	Low woodland over scrub; mulga over <i>Acacia sclerosperma</i> bowgada, <i>A. victoriae</i> & minnieritchie ( <i>A. grasbyi</i> )

Known special values in relation to landscape, ecosystem, species and genetic values

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Murchison Region (System 10) in the CTRC Green Book. It is only in the last 10 years that any significant areas of the region have been added to the Conservation estate. The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation.

An unpublished report by Department of Conservation and Land Management - "Gascoyne - Murchison Strategy, Establishment and Management of a Conservation Reserve System" outlines the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in the article Filling the Gaps (McNamara et al. (2000)).

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

### Rare Features:

- Calcrete aquifers in the eastern part of the subregion are known to support a wide range of subterranean aquatic fauna that are short range endemics. Our understanding of biogeography for these groups is currently very limited but work by Humphries et al. suggests that there is significant stygofauna in the Murchison system, at Austin Downs and Killara Stations.
- Rare fauna for the subregion include *Acanthiza iredalei iredalei*, *Dasyercus cristicauda* (Mulgara) and *Egernia stokesii badia*.
- Rare flora known for the subregion includes *Darwinia* sp. Carnamah (J Coleby-Williams 148).

**Centres of Endemism:**

- Calcrete aquifers in the eastern part of the subregion are known to support a wide range of subterranean aquatic fauna that are short range endemics. Our understanding of biogeography for these groups is very limited but work by Humphries *et al.* (2001) suggests that there is significant stygofauna in the Murchison system, at Austin Downs and Killara Stations.
- The elapid snake *Pseudechis butleri* is known to be regionally endemic.

**Refugia:**

- Wooleen Lake: A floodplain lake and associated marshes with samphire on the floor and lignum and *Eucalyptus camaldulensis* low open woodland around the margins. Important waterbird breeding habitat. Significant breeding area for Gull-billed Terns (*Gelochelidon nilotica*).
- Anneen Lake: A large saline or brackish lake and marsh with numerous islands and peninsulas. Significant breeding area for Gull-billed Terns (*Gelochelidon nilotica*) and Whiskered Terns (*Chidoias hybrida*). Refuge for other waterbirds.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Wooleen Lake (WA061)	B6	ii - iii	vi	iii	iv, v (goats, foxes, cats & rabbits)
Breberle Lake (WA057)	B6, B14	ii - iii	vi	iii	iv, v (goats, foxes, cats & rabbits)
Anneen Lake (WA056)	B8, B12	ii - iii	vi	iii	iv, v (goats, foxes, cats & rabbits), xii (nearby mining operations)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Mungawolagudgi Claypan (Muggon Station)	330,000mE 7,050,000mN	B6	ii, v (contains significant <i>Melaleuca uncinata</i> shrublands and vegetation types associated with dunes)	iii	iv	i	v (goats), x (increase inflow of sediments due to erosion of catchment)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e;

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Wooramel River	i	iii	ii	iv, v (goats, rabbits & foxes) vi (buffel grass, saffron thistle, thorn apple, mexican poppy), x
Murchison River	i	iii	ii	iv, v (goats, rabbits & foxes) vi (buffel grass, saffron thistle, thorn apple, mexican poppy), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no declared Threatened Ecological Communities (TECs) in MUR2.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability Rank <sup>4</sup>	Threatening Processes <sup>5</sup>
Subterranean fauna of the Murchison Basin. Calcrete formations north east of Cue (B. Humphreys pers. comm.).	V	N/A	iii	iv	iii	xi, ix
Mount Narryer and Jack Hills vegetation complexes (R. Shepherd, B. Barton pers. comm.);	V		ii	iv	i	iv, v (goats, rabbits, foxes), vii
Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	31	ii	iv	ii	iv, v (goats, rabbits, foxes), vii
Hardpan plain mulga shrubland with scattered chenopods (HMCS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	22	ii	iv	ii	iv, v (goats, rabbits, foxes), vii
<i>Melaleuca</i> wetlands and spinifex areas of the Lake System on Muggon Station (B. Barton, R. Shepherd pers. comm.)	V	15, 33	ii	v	ii	iv, v (goats, rabbits, foxes), x (hydrology change increasing sedimentation due to erosion in catchment)
Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	22	iii	iv	ii	iv, v (goats, rabbits), vii
Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	31	ii	iv	ii	iv, v (goats, rabbits), vii
Shrubland communities of lake frontages, Murchison area. Polelle Station good condition (A. Mitchell pers. comm.)	V		ii	vi	i	iv, v (goats, rabbits), x changed hydrology from erosional surfaces
Floodplains of the Carnarvon Basin, Wooramel and Gascoyne Rivers (Burbidge and McKenzie 1995; Wilcox and McKinnon 1992).	V	Variable	ii	iii	i	iv, v (goats, rabbits), vi (Buffel Grass), vii
Assemblages of the inland Granites (Murchison) (A. Brown, S. Hopper pers. comm.)	V	41	ii	iv	ii	iv, v (goats, rabbits),
Hardpan mulga ( <i>Acacia aneura</i> ) shrublands HPMS; Murchison River catchment (Curry 1994)	V	20	iii	iv	ii	iv, v (goats, rabbits), vii
Bluebush ( <i>Maireana</i> spp.) shrublands BLUS; Murchison River catchment (Curry 1994).	V	31	ii	iv	ii	iv, v (goats, rabbits), vii
Mixed halophytic shrublands MXHS; Murchison River catchment (Curry 1994) (R. Shepherd pers. comm.).	V	39	ii	iii	ii	iv, v (goats, rabbits), vii
Stony mulga ( <i>Acacia aneura</i> ) mixed shrubland SMMS; Murchison River catchment (Curry 1994)	V	21	iii	iv	ii	iv, v (goats, rabbits), vii
Saltbush ( <i>Atriplex</i> spp.) shrublands SALS; Murchison River catchment (Curry 1994) (R. Shepherd pers. comm.).	V	31	ii	iii	ii	iv, v (goats, rabbits), vii

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability Rank <sup>4</sup>	Threatening Processes <sup>5</sup>
Stony snakewood ( <i>Acacia xiphophylla</i> ) shrublands SWS; Murchison River catchment (Curry 1994).	V	21	ii	iv	ii	iv, v (goats, rabbits), vii
Calcrete shrubby grasslands CSHG; Murchison River catchment (Curry 1994).	V	37	iii	iv	ii	iv, v (goats, rabbits), vii
Non-calcareous shrubby grasslands NCSG; Murchison River catchment (Curry 1994).	V	37	iii	iii	ii	iv, v (goats, rabbits), vii
Creekline grassy shrublands CRGS; Murchison River catchment (Curry 1994).	V	37	ii	iii	ii	iv, v (goats, rabbits), vii
Calcrete Eucalypt woodlands of Murchison River catchment (Curry 1994).	V	8	iii	iv	ii	iv, v (goats, rabbits), vii
Assemblages of specific lake communities e.g. Lake Austin, Lake Annean (ANCA 1996 - Lake Annean) (R. Shepherd pers. comm.)	V	N/A	ii	vi	i	iv, v (goats, rabbits)
<i>Eucalyptus camaldulensis</i> woodlands that are Major Mitchell nesting sites on Berringarra and Milly Milly Stations along the Murchison River (N. McKenzie data) (P. Brown, R. Shepherd, B. Barton pers. comm.)	V	8	iii	vi	ii	iv, v (goats, rabbits), vii
Aquatic fauna assemblages of Fish Holes on Doolgunna Station. Possibly have endemic fish and turtles (K. Tinley pers. comm.). Fish since collected and sent to Museum now awaiting ID.	V	N/A	ii	vi	ii	v (Tilapia)
Assemblages of the perched lake at Weld Range (K. Tinley Pers. comm.)	V	N/A	ii	vi	i	Potential damage from cattle
Marloo land system Mitchell Grass floodplain, top end type Mia Mia Station (K. Tinley pers. comm.)		34	ii	vi	Unknown	iv, xii (erosion)
Merbla land system Unique treeless grassland (K. Tinley pers. comm.)		37	ii	vi	Unknown	iv, xii (erosion)
CWR Mammals. Extant species include <i>Dasyercus cristicauda</i> , Species extinct in subregion include <i>Macrotis lagotis</i> , <i>Pseudomys chapmani</i> .	E	N/A	i	ii	iii	v (cats, foxes), ii, vii, iv

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e;

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus cristicauda</i>	V	ii	iii	iii	v (foxes & cats), vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Leipoa ocellata</i>	V	ii	iii	iii	v (foxes & cats), iv
<i>Acanthiza iredalei iredalei</i>	V	ii	iv	ii	vii
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia stokesii badia</i>	E	ii	iii	ii	v (foxes & cats), iv

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Eremophila rostrata</i> ms	DRF	unknown	vi	iii	v (goats), iv, xii (mining)
<b>PRIORITY 1</b>					
<i>Baeckea</i> sp. Mount Barloweerie (JZ Weber 5079)	1	unknown	vi	iii	v (goats), iv
<i>Dicrastylis</i> sp. Cue (AA Mitchell 764)	1	unknown	vi	ii	v (goats), iv, vi
<i>Eremophila flaccida</i> subsp. <i>attenuata</i> ms	1	unknown	vi	ii	v (goats), iv, vi
<i>Eremophila micrantha</i> ms	1	unknown	vi	ii	iv, v, (goats), vi, vii
<i>Eremophila ringens</i> ms	1	unknown	vi	ii	v (goats), iv, vi
<i>Gnephosis cassiniana</i>	1	unknown	vi	iii	i, ii
<i>Goodenia berringbinensis</i>	1	unknown	vi	ii	v (goats), vi, vii
<i>Gunniopsis divisa</i>	1	unknown	vi	ii	v (goats), vi, vii
<i>Lepidium xylodes</i>	1	unknown	vi	ii	v (goats), iv, vi, vii
<i>Neotysonia phyllostegia</i>	1	unknown	vi	ii	iv, v (goats), vi, vii
<i>Philotheca citrina</i>	1	unknown	vi	ii	v (goats), iv, vii, iv
<i>Prostanthera petrophila</i>	1	unknown	vi	ii	v (goats), iv
<i>Ptilotus astrolasius</i> var. <i>luteolus</i>	1	unknown	vi	ii	iv, v (goats), vii, vi
<i>Ptilotus lazaridis</i>	1	unknown	vi	ii	iv, v, (goats), x
<i>Rhodanthe sphaerocephala</i>	1	unknown	vi	ii	iv, v (goats) vii, vi
<b>PRIORITY 2</b>					
<i>Melaleuca oldfieldii</i>	2	unknown	vi	ii	i, ii, iv, vi, vii, ix
<i>Persoonia brachystylis</i>	2	unknown	vi	ii	iv, v (goats), vi, vii
<i>Podotheca pritzelii</i>	2	unknown	vi	ii	i, ii, x, xi, iv, v (goats)
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	2	unknown	vi	ii	i, ii, iv, v (goats), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e;

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
11	Medium woodland: coolibah ( <i>E. microtheca</i> )				L
18	Low woodland; mulga ( <i>Acacia aneura</i> )	X	X	X	M
28	Open low woodland; mulga				H
29	Sparse low woodland; mulga, discontinuous in scattered groups			X	H
34	Shrublands; acacia scrub with scattered mulga				H
39	Shrublands; mulga scrub		X		H
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex			X	L
125	Bare areas; salt lakes			X	L
128	Bare areas; rock outcrops				L
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub				M
162	Shrublands; snakewood scrub			X	L
165	Low woodland; mulga & snakewood ( <i>A. ermaea</i> )				L
166	Low woodland; mulga & <i>Acacia victoriae</i>			X	H
167	Shrublands; <i>Acacia victoriae</i> & snakewood open scrub				L
169	Shrublands; mulga & minnieritchie scrub				H
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )				H
183	Low woodland; mulga, <i>Acacia victoriae</i> & snakewood				H
184	Shrublands; mulga & bowgada scrub				H
187	Succulent steppe with open scrub; scattered <i>Acacia victoriae</i> & snakewood over various species				H
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
188	Shrublands; mulga & <i>Acacia sclerosperma</i> scrub				H
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub			X	M
204	Succulent steppe with open scrub; scattered mulga & <i>Acacia</i>				H

	<i>sclerosperma</i> over saltbush & bluebush				
205	Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub	X		X	L
228	Shrublands; <i>Acacia quadrimarginea</i> scrub				M
229	Mosaic: Shrublands; bowgada and associated spp scrub/Shrublands; bowgada & grevillea scrub			X	L
240	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & bowgada over saltbush & bluebush			X	L
261	Succulent steppe with low woodland; snakewood over saltbush & bluebush			X	L
264	Low woodland; <i>Acacia victoriae</i> & snakewood				M
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe; saltbush & bluebush			X	H
267	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush				H
268	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> over saltbush & bluebush				H
269	Low woodland over scrub; mulga over bowgada scrub			X	H
288	Mosaic: Scattered low trees; mulga/Succulent steppe; sparse saltbush & bluebush on greenstone				H
300	Mosaic: Low woodland; mulga/Succulent steppe; saltbush & bluebush				H
305	Medium woodland over scrub; coolibah over bowgada				H
306	Low woodland; <i>Casuarina ?obesa</i> (salt lake)				H
325	Succulent steppe; saltbush & samphire				L
326	Low woodland over scrub; mulga over bowgada & minnieritche scrub				H
327	Shrublands; mulga, bowgada, <i>Acacia quadrimarginea</i> & minnieritche scrub			X	H
340	Succulent steppe with scrub; bowgada scrub over various species				H
341	Low woodland over scrub; mulga over <i>Acacia sclerosperma bowgada</i> , <i>A. victoriae</i> & minnieritche ( <i>A. grasbyi</i> )				H
352	Medium woodland; York gum				L
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges				L
361	Shrublands; bowgada & minnieritche scrub with scattered mulga			X	H
362	Mosaic: Shrublands; bowgada & minnieritche scrub with scattered mulga/Scattered groups of saltbush/bluebush	X			H
363	Shrublands; bowgada scrub with scattered cypress pine	X			L
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine				L
395	Hummock grasslands, mixed sandplain; bowgada, mallee, heath and spinifex				H
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub				H
415	Succulent steppe with open scrub; scattered mulga & other wattle(s) over saltbush & bluebush			X	L
420	Shrublands; bowgada & jam scrub				M
483	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex; red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>				L
676	Succulent steppe; samphire				L
1125	Succulent steppe with scrub; <i>Acacia victoriae</i> & snakewood over saltbush & bluebush			X	H
1126	Low woodland; mulga & minnieritche				H
1128	Mosaic: Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & bowgada over saltbush & bluebush/Succulent steppe; samphire				H
<b>Beard Veg Assoc</b>	<b>Ecosystem Description</b>	<b>IUCN I-IV</b>	<b>Non-IUCN Reserve</b>	<b>CALM-Purchased Lease</b>	<b>Priority</b>
2081	Shrublands; bowgada and associated spp. scrub	X	X	X	L
	Subterranean fauna of the Murchison Basin. Calcrete formations north east of Cue.				H
	Mount Narryer and Jack Hills vegetation complexes				H
	Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area				H
	Hardpan plain mulga shrubland with scattered chenopods (HMCS) of the Sandstone-Yalgoo-Paynes Find area				H
	<i>Melaleuca</i> wetlands and spinifex areas of the Lake System on Muggon Station			X	M
	Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area			X	L
	Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area			X	M
	Shrubland communities of lake frontages, Murchison area. Polelle Station good condition				H
	Floodplains of the Carnarvon Basin, Wooramel and Gascoyne Rivers				H
	Assemblages of the inland Granites (Murchison)			X	H

	Hardpan mulga ( <i>Acacia aneura</i> ) shrublands HPMS; Murchison River		X		H
	Bluebush ( <i>Maireana</i> spp.) shrublands BLUS; Murchison River catchment				H?
	Mixed halophytic shrublands MXHS; Murchison River catchment				L
	Stony mulga ( <i>Acacia aneura</i> ) mixed shrubland SMMS; Murchison River catchment		X		H
	Saltbush ( <i>Atriplex</i> spp.) shrublands SALS; Murchison River catchment			X	H
	Stony snakewood ( <i>Acacia xiphophylla</i> ) shrublands SSWS; Murchison River catchment			X	L
	Calcrete shrubby grasslands CSHG; Murchison River catchment				H?
	Non-calcareous shrubby grasslands NCSG; Murchison River catchment.				H?
	Creekline grassy shrublands CRGS; Murchison River catchment				H?
	Calcrete Eucalypt woodlands of Murchison River catchment				H
	Assemblages of specific lake communities e.g. Lake Austin, Lake Annean				H
	Eucalyptus camaldulensis woodlands that are Major Mitchell nesting sites on Berringarrah and Milly Milly Stations along the Murchison River				H
	<i>Eucalyptus ferriticola</i> over shrubs on drainage lines in Murchison e.g. Doolgunna Station			X	M
	Aquatic fauna assemblages of Fish Holes on Doolgunna Station. Possibly have endemic fish and turtles			X	L
	Assemblages of the perched lake at Weld Range				H
	CWR Mammals. Extant species include <i>Dasyercus cristicauda</i> , Species extinct in subregion include <i>Macrotis lagotis</i> , <i>Pseudomys chapmanii</i> .				H

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Use:** The primary issue in that pastoralism occupies more than 96% of the region and mining also has considerable interests.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data; level of degradation of the majority of the subregion is significant due to pastoral practices and the impacts of feral herbivores

### Bioregional and subregional priority for reserve consolidation

MUR is reservation class 2 (see Appendix D, and Appendix C, rank 4) with only 1.39% of area in conservation reserve (IUCN I-IV) At the subregional level MUR1 has 1.82% in reserve (IUCN I-IV) while MUR2 has only 0.053% in conservation reserve. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation so Class 1 is more appropriate for MUR2.

### Reserve management standard

The Reserve Management Rank is (i) (see Appendix C, rank 5), indicating that there is very limited management presence. Reserve management is limited to some fire access track maintenance and removal of goats to varying degrees. No feral predator baiting programs exist.

## Off reserve conservation

### Priority species or groups

Species	Beard Vegetation Association or Ecosystem	Recovery Plan?
Stygofauna	Calcrete aquifers	no
<i>Leipoa ocellata</i>	20 – Low woodland: mulga mixed with <i>Allocasuarina cristata</i> and <i>Eucalyptus</i> sp.	Recovery Plan for Mallee Fowl, The Action Plan for Australian Birds 2000
<i>Acanthiza iredalei iredalei</i> <i>Dasyercus cristicauda</i>	18 – Low woodland: mulga ( <i>Acacia aneura</i> ); 39 – Shrublands: mulga scrub; 107 – Hummock grasslands, shrub steppe: mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	The Action Plan for Australian Birds 2000 1996 Action Plan for Australian Marsupials and Monotremes
<i>Egernia stokesii badia</i>	205 – Shrublands: <i>Acacia sclerosperma</i> & bowgada scrub; 243 – Shrublands: bowgada & minnieritchie scrub; 365 – Shrublands: bowgada & jam scrub with scattered York gum and red mallee	The Action Plan for Australian Reptiles

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
Stygofauna	i, ii, iii	Protection of calcrete deposits from weeds and eutrophication. Habitat retention through reserves or on other State lands or on private lands.

<i>Leipoa ocellata</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. CWR species that is no longer extant in the subregion. Control of feral animals, notably foxes, as well as fire management are essential.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Dasyercus cristicauda</i>	i, ii, iii, vii, ix, xii	CWR species that requires specific fire age spinifex habitat. Predated upon by foxes and cats. Ecological research currently being conducted by D. J. Pearson.
<i>Egernia stokesii badia</i>	i, ii, v, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Baeckea</i> sp. Mt Barloweerie (JZ Weber 5079)	v (goats), iv	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Dicrasyllis</i> sp. Cue (AA Mitchell 764)	v (goats), iv, vi	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Eremophila flaccida</i> subsp. <i>attenuata</i> ms	v (goats), iv, vi	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats required.. Understanding of life history requirements for all rare flora very limited and requires additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eremophila micrantha</i> ms	iv, v (goats), vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Eremophila ringens</i> ms	v (goats), iv, vi	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eremophila rostrata</i> ms	v (goats), iv, xii (mining)	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Arrange protection from mining activities. Control of grazing by sheep and goats required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Gnephosis cassiniana</i>	i, ii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Demarcation of road and rail reserve populations.
<i>Goodenia berringinensis</i>	v (goats), vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Gunnopsia divisa</i>	v (goats), vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Lepidium xyloides</i>	v (goats), iv, vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Melaleuca oldfieldii</i>	i, ii, iv, vi, vii, ix	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Neotysonia phyllostegia</i>	iv, v (goats), vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Persoonia brachystylis</i>	iv, v (goats), vi, vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Philotheca citrina</i>	v (goats), iv, vii, iv	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Podotheca pritzelii</i>	i, ii, x, xi, iv, v (goats)	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and requires additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Prostanthera petrophila</i>	v (goats), iv	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Ptilotus astrolasius</i> var. <i>luteolus</i>	iv, v (goats), vii, vi	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Ptilotus lazaridis</i>	iv, v, (goats), x	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Rhodanthe sphaerocephala</i>	iv, v (goats), vii, vi	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Scholtzia</i> sp. Eradu (RD Royce 8016)	i, ii, iv, v (goats), vii	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as sheep, rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and requires additional research.

<sup>1</sup>Appendix B, key h.

There are no specific regional recovery plans for any of the above biota/systems. Most species of flora have broad discussion of actions required to assist recovery detailed in the publication Declared Rare and Poorly Known Flora in the Geraldton District (Patrick 2001).

Other Recovery Plans include: National Recovery Plan for Malleefowl; The Action Plan for Australian Birds, 2000; Action Plan for Australian Marsupials and Monotremes; The Action Plan for Australian Reptiles.

### Ecosystems and appropriate recovery actions

Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
11	Medium woodland; coolibah ( <i>E. microtheca</i> )	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
18	Low woodland; mulga ( <i>Acacia aneura</i> )	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
28	Open low woodland; mulga	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
29	Sparse low woodland; mulga, discontinuous in scattered groups	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
34	Shrublands; acacia scrub with scattered mulga	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
39	Shrublands; mulga scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
107	Hummock grasslands, shrub steppe; mulga and <i>Eucalyptus kingsmillii</i> over hard spinifex	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
125	Bare areas; salt lakes	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
128	Bare areas; rock outcrops	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

			building required with industry.
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
162	Shrublands; snakewood scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
165	Low woodland; mulga & snakewood ( <i>A. eremaea</i> )	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
166	Low woodland; mulga & <i>Acacia victoriae</i>	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
167	Shrublands; <i>Acacia victoriae</i> & snakewood open scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
169	Shrublands; mulga & minnieritchie scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
182	Low woodland; mulga & bowgada ( <i>A. ramulosa</i> )	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
183	Low woodland; mulga, <i>Acacia victoriae</i> & snakewood	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
184	Shrublands; mulga & bowgada scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
187	Succulent steppe with open scrub; scattered <i>Acacia victoriae</i> & snakewood over various species	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
188	Shrublands; mulga & <i>Acacia sclerosperma</i> scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
204	Succulent steppe with open scrub; scattered mulga & <i>Acacia sclerosperma</i> over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
205	Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
228	Shrublands; <i>Acacia quadrimarginea</i> scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
229	Mosaic: Shrublands; bowgada and associated spp scrub/Shrublands; bowgada & grevillea scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
240	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & bowgada over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
261	Succulent steppe with low woodland; snakewood over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
264	Low woodland; <i>Acacia victoriae</i> & snakewood	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe: saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
267	Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & <i>A. victoriae</i> over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
268	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
269	Low woodland over scrub; mulga over bowgada scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
288	Mosaic: Scattered low trees; mulga/Succulent steppe; sparse saltbush & bluebush on greenstone	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
300	Mosaic: Low woodland; mulga/Succulent steppe; saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
305	Medium woodland over scrub; coolibah over bowgada	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
306	Low woodland; <i>Casuarina ?obesa</i> (salt lake)	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
325	Succulent steppe; saltbush & samphire	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
327	Shrublands; mulga, bowgada, <i>Acacia quadrimarginea</i> & minnieritchie scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
340	Succulent steppe with scrub; bowgada scrub over various species	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
341	Low woodland over scrub; mulga over <i>Acacia sclerosperma bowgada</i> , <i>A. victoriae</i> & minnieritchie ( <i>A. grasbyi</i> )	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
352	Medium woodland; York gum	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
361	Shrublands; bowgada & minnieritchie scrub with scattered mulga	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
362	Mosaic: Shrublands; bowgada & minnieritchie scrub with scattered mulga/Scattered groups of saltbush/bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
363	Shrublands; bowgada scrub with scattered cypress pine	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
395	Hummock grasslands, mixed sandplain; bowgada, mallee, heath and spinifex	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
415	Succulent steppe with open scrub; scattered mulga & other wattle(s) over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
420	Shrublands; bowgada & jam scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
483	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex; red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
676	Succulent steppe: samphire	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
1125	Succulent steppe with scrub: <i>Acacia victoriae</i> & snakewood over saltbush & bluebush	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
1126	Low woodland; mulga & minnieritchie	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
1128	Mosaic: Succulent steppe with open scrub; scattered <i>Acaica sclerosperma</i> & bowgada over saltbush & bluebush/Succulent steppe: samphire	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
2081	Shrublands; bowgada and associated spp. scrub	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Subterranean fauna of the Murchison Basin. Calcrete formations north east of Cue.	i, ii, iii, xiii	Habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry.
	Mount Narryer and Jack Hills vegetation complexes	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Hardpan plain mulga shrubland with scattered chenopods (HMCS) of the Sandstone-Yalgoo-Paynes Find area	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	<i>Melaleuca</i> wetlands and spinifex areas of the Lake System on Muggon Station	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Shrubland communities of lake frontages, Murchison area. Polelle Station good condition	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Floodplains of the Carnarvon Basin, Wooramel and Gascoyne Rivers	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
	Assemblages of the inland Granites (Murchison)	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Hardpan mulga ( <i>Acacia aneura</i> ) shrublands HPMS; Murchison River	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Bluebush ( <i>Maireana</i> spp.) shrublands	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands.

	BLUS; Murchison River catchment		Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Mixed halophytic shrublands MXHS; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Stony mulga ( <i>Acacia aneura</i> ) mixed shrubland SMMS; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Saltbush ( <i>Atriplex</i> spp.) shrublands SALS; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Stony snakewood ( <i>Acacia xiphophylla</i> ) shrublands SSWS; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Calcrete shrubby grasslands CSHG; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Non-calcareous shrubby grasslands NCSG; Murchison River catchment.	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Creepline grassy shrublands CRGS; Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Calcrete Eucalypt woodlands of Murchison River catchment	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Assemblages of specific lake communities e.g. Lake Austin, Lake Annean	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	<i>Eucalyptus camaldulensis</i> woodlands that are Major Mitchell nesting sites on Berringarrah and Milly Milly Stations along the Murchison River	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control most particularly goats. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Aquatic fauna assemblages of Fish Holes on Doolgunna Station. Possibly have endemic fish and turtles	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
	Assemblages of the perched lake at Weld Range	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.
Beard Veg Code	Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Descriptions
	CWR Mammals. Extant species include <i>Dasyercus cristicauda</i> . Species extinct in subregion include <i>Macrotis lagotis</i> , <i>Pseudomys chapmanii</i> .	i, ii, iii, vii, vi, v, xiii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control. Weed control. Fencing of sensitive areas where there are heavy goat numbers, as exclosures. Capacity building required with industry.

<sup>1</sup>Appendix B, key h.

## Existing ecosystem recovery plans

There are no recovery plans that are relevant to ecosystems at risk in MUR2.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that significant off park effort is needed, resource constraints, and community capacity is limited.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Through the Gascoyne Murchison Strategy. Purchase of leases for conservation estate.

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly in relation to pastoral, mining and exploration activities.

**Environmental Management Systems and Ecologically Sustainable Product Marketing.**

**Integration With Property Management Planning, Catchment Planning and Landcare:** Through Land Conservation District Committees through the region.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by GMS. Needs a greater level of support to be successful.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. Conservation Through Reserves is limited by the presence of mining leases and tenements. There is a need to increase awareness of conservation values through education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for MUR2 is (i) (see Appendix C, rank 7), indicating that there are major constraints to implement effective NRM actions and achieve biodiversity outcomes. Much of MUR is severely degraded through past agricultural practices (primarily sheep & cattle grazing) and feral herbivores. Under the

### Sources

#### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
712	Burbidge, A. and McKenzie, N.	(1995).	Patterns in nature: the biodiversity of the Carnarvon Basin.	Landscape 11(2), 15-20	J
181	Cogger, H., Cameron, E.,	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation	R

pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Regional ecosystem mapping has been produced at the broad scale, 1:1 000 000 for Beard's vegetation, and 1:500 000 for Landsystems by the Western Australian Dept. Agriculture (Payne *et al.* 1998).

**Systematic Fauna Survey:** Data is very sparse. Few quadrats have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates. Fauna of wetlands and stygofauna are poorly understood or sampled.

**Floristic Data:** No regional survey of flora has been completed. Flora of wetlands has been poorly sampled. Inventory sites were surveyed by the Departments of Agriculture and Land Administration in the Murchison rangelands providing limited plant identification. Condition sites were examined to see the effects of grazing on various plant species and the data set is essentially perennials and some other palatable species (Payne *et al.* 1987).

**Ecological and Life History Data:** There are few detailed data on ecological requirements and life histories

of virtually all invertebrate species, plants, persisting CWR

mammals, uncommon vertebrate and plant species, and ecologically dominant plant species. There is little data to provide a regional context on population-trends for even ecologically significant specie, including rabbits, goats and foxes.

#### Other Priority Data Gaps Include:

- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation, fire, mineral-extraction on greenstone surfaces.

	Sadler, R. and Egger, P.			Agency, Canberra.	
719	Curry, P.J.	(1994).	An inventory and condition survey of the Murchison River catchment, Western Australia	Western Australian Department of Agriculture Technical bulletin 84, Perth	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
402	Humphreys, W.F. and Harvey, M.S. (Ed's).	(2001).	Subterranean biology in Australia 2000.	Records of the Western Australian Museum, Supplement 64. Western Australian Museum, Perth	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
537	Patrick, S.J.	(2001).	Declared Rare and Poorly Known Flora in the Geraldton District. Wildlife Management Program No. 26.	Department of Conservation and Land Management.	R
540	Payne, A.L., Curry, P.J., Spencer, G.F.	(1987).	An inventory and condition survey of rangelands in the Carnarvon Basin, Western Australia No. 73.	Western Australian Department of Agriculture.	R
542	Payne, A.L., Van Vreeswyk, A.M.E., Pringle, H.J.R., Leighton, K.A., and Hennig, P.	(1998).	Technical Bulletin No 90., An inventory and condition survey of the Sandstone-Yalgoo-Paynes Find area, Western Australia.	Agriculture Western Australia.	R
695	Wilcox, D.G. and McKinnon, E.A.	(1992).	A Report on the Condition of the Gascoyne Catchment.	Department of Agriculture, Western Australia.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 026, 067, 075, 094, 098, 101, 118, 137, 191, 241, 267, 268, 272, 273, 278, 279, 299, 357, 370, 371, 372, 381, 387, 395, 405, 406, 407, 419,

429, 450, 451, 459, 498, 507, 519, 526, 584, 641, 650, 679, 685 and 686 in Appendix A.

# North Kimberley 1 (NK1 – Mitchell subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

This is the dissected plateau of Kimberley Basin. Savannah woodland over high *Sorghum* grasses and hummock grasses on shallow sandy soils on outcropping Proterozoic siliceous sandstone strata. Savannah woodlands over high *Sorghum* grasses on red and yellow earths mantling basic Proterozoic volcanics. Riparian closed forests of *Melaleuca* and *Pandanus* occur along drainage lines. A prominent feature is the rugged sunken coastline with extensive Mangal occurring in estuaries and deep, sheltered embayments. Numerous small patches of monsoon rainforest are scattered through the district. The climate is dry hot tropical, sub-humid with high summer rainfall (1100 – 1500 mm annually). Areas of laterite upland with open forests and alluvial floors along major river valleys. Subregional area is 6, 079, 985 ha.

Broad scale vegetation mapping of the area describes the following components;

- Mangroves.
- *Eucalyptus* spp., *Eucalyptus miniata* (Northern woollybutt) and/or *Eucalyptus tetradonta* (Darwin stringybark) open-woodland with *Triodia bitextura* (curly spinifex) and *Sorghum* grasses (*Sorghum* spp.).
- *Eucalyptus tectifera* (Darwin box) and/or *Eucalyptus grandifolia* (large-leaved cabbage gum) and/or *Eucalyptus byrnesii* (fan-leaved bloodwood) woodland with *Sorghum* spp. (sorghum) and *Sehima nervosum* (white grass) tall grasses.
- *Eucalyptus miniata* (Darwin Northern woollybutt) grassy woodland.
- *Eucalyptus tetradonta* (Darwin stringybark) and *Eucalyptus miniata* (Darwin Northern woollybutt) and/or *Eucalyptus bleeseri* (rusty-barked bloodwood) woodland with *Sorghum* spp. tall-grasses.
- Semi-deciduous vine thickets on sandstone.

### Dominant land use

Landuses include: (ix) Grazing – Native pastures (see Appendix B, key b), (x) Aboriginal reserves, (xi) UCL and Crown reserves, and (xiii) Conservation.

### Continental Stress Class

NK1 has a Continental Stress Class of 6.

Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

Including:

- A sunken coastline with extensive coastal archipelagos from Buccaneer to Sir Graham Moore Island that form a microcosm of the subregion and present an opportunity to protect intact ecosystem. In particular Augustus Island (17,952 ha.) and Bigge Island (17,190 ha.) are large, near-coastal, uninhabited islands with no known feral animals and a diverse intact terrestrial fauna.
- Mound springs and swamp rainforest.
- Middle Osborn Island is a volcanic plug.
- There is tropical laterite flora. In particular the *Livistona eastonii* palm community, a palm dominated landscape, is unique in Western Australia.
- The flora and fauna of north-western margin is still intact.
- The Cape Bougainville rainforest on laterite and volcanics has no hoofed feral animals and is the largest single patch of rainforest in the Kimberley.
- Airfield Swamp on the Mitchell Plateau is a large perched paperbark forest wetland.
- The Prince Regent Lineament encompassing the Prince Regent River.
- Critical weight range mammal fauna persist in this subregion.
- There are animals of special interest such as the Golden Bandicoot (*Isodon auratus*), Scaly-tailed Possum (*Wyluda squamicaudata*), Monjon (*Petrogale burbidgei*), Nabarlek (*Peradorcas concinna*), Golden-backed Tree-rat (*Mesembriomys macrurus*), Kimberley Rock-rat (*Zyzyomys woodwardi*), Rough-scaled Python (*Morelia carinata*), Black Grasswren (*Amytornis housei*).
- The subregion is fox and rabbit free and essentially uninhabited.

### Centres of Endemism:

- There are a number of endemic vertebrates: Mammal species include Scaly-tailed Possum (*Wyluda squamicaudata*), Monjon (*Petrogale burbidgei*); a single bird species Black Grasswren (*Amytornis housei*); snake species *Ramphotyphlops howi*, *R. kimberleyensis*, *R. yampiensis*, Grey Whipsnake (*Demansia simplex*), Rough-scaled Python (*Morelia carinata*); dragon species *Diporiphora albilabris*, *D. convergens*, *D. superba*, *Pogona microlepidota*; gecko species *Diplodactylus mcmillani*, *Gehyra occidentalis*, *G. xenopus*, *Oedura filicipoda*, *O. gracilis*, *O. obscura*, *Pseudothecadactylus cavaticus*; skink species *Carlia johnstonei*, *Ctenotus burbidgei*, *C. ehmanni*, *C. mastigura*, *C. yampiensis*, *Cyclodomorphus maximus*, *Glaphyromorphus brongersmai*, *Lerista kalumburu*, *L. praefrontalis*, *L. walkeri*; frog species Javelin frog (*Litoria microbelos*), Cave-dwelling

frog (*L. cavernicola*), Fat Toadlet (*Uperoleia crassa*), Marbled Toadlet (*U. marmorata*), Small Toadlet (*U.*).

- Endemic plants include *Acacia kenneallyi*, *Acacia smeringa* (Packhorse Range), *Gossypium londonderryense* (Cape Londonderry), *Grevillea cravenii* (Princess May Range, Prince Regent Nature Reserve), *Grevillea donaldiana* (Sale River), *Grevillea maherae* (Mt Elizabeth), *Grevillea microstyla* (Bachsten Creek), *Typhonium peltandroides* (Grevillea Gorge, Beverley Springs), *Auranticarpa resinosa* (Hunter River – this species may be extinct) and *Hibbertia ledifolia*. The cycads, *Cycas basaltica* and *Cycas lane-poolei* appear to be endemic to this subregion.
- Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them. There is one rainforest endemic plant (*Hibiscus peralbus*).

#### Refugia:

The nature of this aspect is poorly known. 'Dry' rainforest patches, as well as swamp rainforests provide dry season refuges. Mangroves and riparian zones also provide refugia. Further research is required to define the extent to which this aspect may apply to sandstone country because of its ability to provide fire protection.

#### High Species and Ecosystem Diversity:

Sandstone communities may provide areas of high species and ecosystem diversity. Laterite rainforests are of note. Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that

are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. There has been some biological survey work published for the islands of the northwest Kimberley coast, the Prince Regent Nature Reserve and the Mitchell Plateau. These surveys occurred at greater than 20 years ago and there is a need to resample these areas for comparative purposes. Previous rainforest studies are applicable (McKenzie *et al* 1991).

Apart from specific survey work there has been no systematic review of biodiversity but on-going changes to the status of fauna (particularly mammals) are reported. There is reasonable evidence about continuing changes to vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Mitchell River System WA063	B1	iv	vi	iii	vii, iv
Prince Regent River System WA064	B1	iv	vi	iii	vii, iv
Yampi Sound Training Area WA115		iii	iii	iii	vii, iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Walcott Inlet System including Munja Lagoon and the lower reaches of the Isdell and the Charnley Rivers.	16°25'S 124°50'E	B4, B6	ii	iv	iv	ii	Unknown threatening processes

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Airfield Swamp – Mitchell Plateau	14°46'14"S, 125°49'02"E	B14	iv	iv	iv	ii	iv
Glauerts Lagoon – Mitchell Plateau		B5	iv	iv	iv	ii	iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv (feral herbivores), v, x, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Black Spring organic mound spring community.	E	2	iii	iv	iii	iv, vii, xii (fences require annual maintenance to exclude cattle)
Organic mound springs of the southern North Kimberley Bioregion.	V	2	ii	ii-iii	iii	iv, vii
Roe River Swamp Rainforest	V	2	Unknown	iv	iii	Unknown threatening processes, though cattle are likely to impacting community
Theda Soak Rainforest.	V	2	iii	iv	iii	iv, vii, xii (fences require annual maintenance to exclude cattle)
Walcott Inlet Rainforest Swamp.	V	2	Unknown	iv	iii	Unknown threatening processes, though cattle are likely to impacting community

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

There are many widespread vegetation types across this subregion that are threatened by changed fire regimes.

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	Unknown	iii	iii	vii
Rainforest patches of the Kimberley savannah generally. Example rainforest patches on the Mitchell Plateau and in the supratidal flats.	V	2	Unknown	iii	iii	iv, vii
Flora and fauna assemblages of upland swamps of the Kimberley. On laterite plateaus and sandstone [Airfield Swamp and Beverley Springs Station].	V	15, 38	Unknown	iv	ii	iv
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	ii	iii	ii	iv, vii
Invertebrate community in creek near Pago Mission.	V	N/A	Unknown	iv	iii	Unknown threatening processes
<i>Eucalyptus tectifica</i> community of the Gibb River and Mt Barnett regions.	V	10	ii, needs investigation	iii	ii	vii
<i>Eucalyptus jensenii</i> woodlands of Gibb River and Mt Barnett regions.	V	10	ii-iii, needs investigation	iii	ii	vii (changed fire regimes)
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	i	iv, vii

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Riparian communities dominated by <i>Phragmites karka</i> . Charley River on Beverley Springs Station.	V	43	ii, needs investigation	vi	i	iv, vii
Herbfields of sandstone pavements of NW Kimberley. Fire could be a threat where spinifex builds up.	V	38	Unknown	vi	i	vii (possibly fire but needs more work)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Isoodon auratus auratus</i>	V	Unknown	iii	ii	vii, v
<i>Mesembriomys macrurus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Sminthopsis butleri</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Falculcus frontatus whitei</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Erythrotriorchis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<i>Petrophassa smithii blaauwi</i>	V	Unknown	vi	Unknown	vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Caretta caretta</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Lepidochelys olivacea</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Chelonia mydas</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Dermochelys coriacea</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Eretmochelys imbricata</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Natator depressus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Mesembriomys gouldii</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<i>Rhinonictoris aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Chalcophaps indica yamashinai</i>	S3	Unknown	vi	Unknown	Unknown threatening processes
<i>Falco peregrinus</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<i>Tadorna radjah</i>	S4	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<i>Crocodylus porosus</i>	S4	Unknown	v	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK IN THE SUBREGION</b>					
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Dasyurus hallucatus</i>	Near threatened	Unknown	iii	ii	Unknown threatening processes
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Peradorcas concinna</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Petrogale burbridgei</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Wyulda squamicaudata</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Acacia paula</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Acacia vincentii</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Ailanthus triphysa</i>	1	Unknown	vi	Unknown	vii
<i>Colubrina asiatica</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Corchorus capsularis</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Didymoplexis pallens</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Euphorbia sarcostemmoides</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Fimbristylis pillifera</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Gossypium enthyle</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Gossypium marchantii</i>	1	Unknown	vi	Unknown	Unknown threatening processes

<i>Gossypium pilosum</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Hydrocotyle grammatocarpa</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Ondinea purpurea</i> subsp. <i>petaloidea</i>	1	Unknown	iv	Unknown	Unknown threatening processes
<i>Phyllanthus aridus</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Phyllanthus indigoferoides</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Ptilotus crispus</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Schizachyrium mitchelliana</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Thysanotus banksii</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Triumfetta saccata</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Triumfetta trisecta</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Typhonium peltandroides</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Acacia deltoidea</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Boronia filicifolia</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Cleome kenneallyi</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Erpodium australiense</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Eucalyptus fitzgeraldii</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Glycine albicans</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Gossypium pulchellum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Grevillea donaldiana</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Grevillea latifolia</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Lindernia macrosiphonia</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Minuria macrorhiza</i>	2	Unknown	vi	Unknown	Unknown threatening processes

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Myriophyllum callitrichoides</i> subsp. <i>striatum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Myriophyllum costatum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Pertusaria trachyspora</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Ricinocarpus marginatus</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Sauropus torridus</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Styliidium fimbriatum</i>	2	Unknown	vi	Unknown	No known threatening processes
<i>Styliidium rubriscapum</i>	2	Unknown	vi	Unknown	No known threatening processes
<i>Triumfetta rubiginosa</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following North Kimberley bioregion vegetation associations are not reserved within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
12	Medium woodland-tropical; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ).	7,274
43	Low forest; mangroves.	8,657
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum over ribbon grass ( <i>Chrysopogon</i> spp.).	47,170
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	17,443
75	Grasslands, curly spinifex, low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over <i>Triodia bitextura</i> .	1,193
125	Bare areas; salt lakes.	89
589	Mosaic: Hummock grasslands, grass steppe; curly spinifex ( <i>Triodia bitextura</i> ).	26
744	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia suberosa</i> and bauhinia ( <i>Bauhinia cunninghamii</i> ) over Mitchell and ribbon/blue grass ( <i>Astrelba</i> spp./ <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	4,249
754	Shrublands, pindan; <i>Acacia lumida</i> shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp) and curly spinifex ( <i>Triodia bitextura</i> ).	9,915
773	Grasslands, high grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) and Darwin box ( <i>Eucalyptus tectifica</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	10,672
800	Grasslands, high grass savannah woodland; Darwin stringybark and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over (upland tall grass and) curly spinifex ( <i>Triodia bitextura</i> ).	267,377
807	Grasslands, tall bunch grass savannah sparse low tree; acacia over grass on black soil.	1,346
808	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	5,255
814	Hummock grasslands, low steppe woodland; silver-leaved box ( <i>Eucalyptus pruinosa</i> ) and <i>Melaleuca</i> over <i>Plectrarchne</i> .	61,579
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	59,510
838	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and bloodwood ( <i>Eucalyptus polycarpa</i> ) over spinifex and tall upland grass.	3,579
902	Hummock grasslands, low tree steppe; scattered low rare eucalypts in open curly spinifex ( <i>Triodia bitextura</i> ).	11,322
907	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and bloodwood ( <i>Eucalyptus polycarpa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and tall upland grass.	10,954
914	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over kangaroo ( <i>Themeda australis</i> ) and white grass ( <i>Sehima nervosum</i> ).	4,312
8001	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus</i> spp.) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over curly spinifex ( <i>Triodia bitextura</i> ) on islands.	209,565

Poorly represented ecosystems subject to threat:

Black Spring Mound Community
Theda Soak Rainforest
Walcott Inlet Rainforest Swamp
Roe River Swamp Rainforest
Organic mound springs of the southern North Kimberley Bioregion
Savannah communities of which <i>Callitris intratropica</i> is a component
Mount Elizabeth Mounds
Rainforest patches anywhere in the tropical savannah of the Kimberley region where cattle/fire occur. Eg. Rainforests of the Mitchell Plateau and in the supratidal flats.
Flora and fauna assemblages of upland swamps of the Kimberley. On lateritic plateaux and sandstone [Airfield Swamp and Beverley Springs Station].
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Invertebrate community in creek near Pago Mission
<i>Eucalyptus tectifica</i> community of the Gibb River and Mt Barnett regions
<i>Eucalyptus jensenii</i> woodlands of Gibb River and Mt Barnett regions

Note: the lack of study in some areas precludes statements about the level of reservation required.

### Subregional constraints in order of priority

(see Appendix B, key g)

**Competing Land Uses:** Particularly pastoral production

**Land Prices:** For pastoral leases

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

### Bioregional and subregional priority for reserve consolidation

The North Kimberley bioregion has a ranking priority under the preliminary bioregional NRS priorities of 4 (see Appendix D, and Appendix C, rank 4). However this may need to be 3 due to the continued impact of inappropriate fire regimes and uncontrolled stock grazing. It can also be argued that there is a bias in the

reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often (or the most frequency x intensity). There is a lack of adequate data on the condition of the Berkeley subregion to compare this to the Mitchell subregion in terms of prioritising between the two.

### Reserve management standard

The bioregion is ranked at poor i) to fair ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. There is limited strategic aerial prescribed burning along with some opportunistic hand burns with the latter being confined to very small areas of the Mitchell subregion. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks particularly in valley systems and noticeably within the Mitchell subregion.

Estate	Rank <sup>1</sup>	Issues
<b>NATIONAL PARKS</b>		
Mitchell River	ii	Management ability is being developed. Currently one ranger on location during the tourist season. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring.
Lawley River	i	Remote and inaccessible. Issues have not been identified. Inappropriate fire regimes of note.
Drysdale River	i	No documentation of impacts over time. Biological survey undertaken in the 1970's. No knowledge of visitation.
<b>CONSERVATION PARKS</b>		
Laterite	ii	Location makes the park accessible. Small amount of biodiversity assessment being undertaken. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring.
Camp Creek	i	Rainforest monitoring being undertaken on the impact of stock grazing and fire. Stock impact occurring.
<b>NATURE RESERVES</b>		
Prince Regent River	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring. Biological survey undertaken in the 1970's

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Berkeley subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes.  
Gouldian Finch Recovery Plan.  
Draft Kimberley Region Management Plan (various strategies).

### Appropriate species recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Weed Control:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Feral Animal Control:** Removal of feral stock from conservation estate and management of stock on other

lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, traditional owners and the broader community. For example with mound springs the recovery actions would be (ix) fire management, (vii) feral animal control, and (vi) weed control.

### Existing ecosystem recovery plans

There are no existing recovery plans that are relevant to ecosystems at risk in NK1.

### Subregion priority for off reserve conservation

The priority for off park conservation in NK1 is (iii) (see Appendix C, rank 6), indicating that limited off park measures will result in significant conservation gains.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Environmental Management Systems:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committee.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives and an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management. such as making national parks accessible.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be a priority for the Mitchell subregion. This is because of differing and potentially competing land uses, the increase in multiple land uses and landscape threats. Whilst still important the Berkeley subregion has fewer stakeholders to deal with however research into issue identification for this subregion may change the priority. The rank for both subregions is (ii) (see Appendix C,

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 016, 018, 042, 094, 100, 118, 121, 132, 155, 163, 173, 197, 268, 286, 418, 436, 492, 494, 503, 551, 556, 592, 626, 634, 635, 636, 637, 648, 692 and 693 in Appendix A.

rank 7), indicating that there are significant constraints to integrate conservation as part of production or development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna sampling programme across the subregion to provide a basis for modeling species distribution/status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Information is lacking on the habitat requirements of fauna species.

### Other Priority Data Gaps Include:

- Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

# North Kimberley 2 (NK2 – Berkeley subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The subregion has medium rainfall and is less dissected than the Mitchell subregion. Also the upland of mainly Pentecost sandstones is more continuously mantled by (sandy) soils, and dominated by open savannah woodland. Savannah woodland of Northern woollybutt (*Eucalyptus miniata*) and Darwin stringybark (*Eucalyptus tetradonta*) over high Sorghum grasses and *Plectrachne schinzii* hummock grasses on shallow sandy soils on outcropping Proterozoic siliceous sandstone strata. There are also savannah woodlands on *Eucalyptus tectifica* - *E. grandifolia* alliance over high Sorghum grasses on red and yellow earths mantling basic Proterozoic volcanics. Riparian closed forests of *Melaleuca* and *Pandanus* occur along drainage lines. Extensive Mangal occurs in estuaries and sheltered embayments. There appear to be less small patches of monsoon rainforest in this subregion where they tend to be confined to near coastal areas. The climate is dry hot tropical, sub-humid with summer rainfall. The subregional area for NK2 is 2, 540, 149 ha.

Broad-scale vegetation mapping of the area describes the following components;

- Mangroves.
- *Eucalyptus* spp., *Eucalyptus miniata* (Northern woollybutt) +/- *Eucalyptus tetradonta* (Darwin stringybark) open-woodland with *Triodia bitextura* (curly spinifex) and *Sorghum* spp. (sorghum) grasses.
- Small areas of *Eucalyptus tectifica* (Darwin box) +/- *Eucalyptus grandifolia* (large-leaved cabbage gum) +/- *Eucalyptus byrnesii* (fan-leaved bloodwood) woodland with *Sorghum* spp. (sorghum) and *Sehima nervosum* (white grass) tall grasses. This association is primarily found in the Mitchell subregion.
- Very small areas of *Eucalyptus miniata* (Northern woollybutt) grassy woodland.
- *Eucalyptus tetradonta* (Darwin stringybark) and *Eucalyptus miniata* (Darwin Northern woollybutt) +/- *Eucalyptus bleeseri* (rusty-barked bloodwood) woodland with *Sorghum* spp. tall-grasses.
- *Melaleuca* spp. (paperbark and *Eucalyptus* spp. Low woodland with *Triodia bitextura* (curly spinifex) hummock grasses.
- Saline tidal mudflats +/- samphire.

### Dominant land use

(see Appendix B, key b)

- (x) Aboriginal reserves
- (ix) Grazing – Native pastures
- (xi) UCL and Crown reserves
- (xiii) Conservation

## Continental Stress Class

The Continental Stress Class for NK2 is 6.

## Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

- The subregion is fox and rabbit free and essentially uninhabited.
- Further studies and documentation is necessary with respect to this category.

### Centres of Endemism:

- The lack of study of this subregion no doubt contributes to an inability to make definitive statements concerning degrees of endemism amongst species and communities.
- The declared rare flora species *Eucalyptus ceracea* is endemic to the subregion.
- A small number of rainforest patches have been studied on the western side of the subregion within the Drysdale River National Park and the north-east coast. This infers that these rainforest patches would be important for invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

### Refugia:

Refugia are generally poorly known in the subregion. They could include 'Dry' rainforest patches (which provide dry season refuges), mangroves and riparian zones. Further research is required to define the extent to which this may apply to sandstone country because of its ability to provide fire protection.

### High Species and Ecosystem Diversity:

Sandstone communities may provide areas of high species and ecosystem diversity. Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTCR report in 1974 System 7 formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" which has itself been incorporated in a Departmental Draft Regional Management Plan. These reports were focused on non-production lands and those areas not likely to be

prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. A biological survey was undertaken of the Drysdale River National Park in

the 1970's. There is a need to resample in this area for comparative purposes. Previous rainforest studies are applicable (McKenzie *et al* 1991).

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Drysdale River WA062	B1	iii	iii	Unknown	vii, iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

No additional wetlands have been identified yet.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (feral herbivores), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Other ecosystems at risk

#### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in NK2.

#### Other ecosystems at risk

Little investigation has occurred into threatened ecosystems in this subregion. For rainforests, for example,

a level of threat is assumed because of their similarities to those found in the Mitchell subregion.

There are many widespread vegetation types across this subregion that are threatened by changed fire regimes.

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	Unknown	iii	iii	vii
Rainforest patches of the Kimberley savannah generally. Example rainforest patches on the Mitchell Plateau and in the supratidal flats.	V	2	Unknown	iii	iii	iv, vii
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	i	Unknown threatening processes

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Falcunculus frontatus whitei</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Erythrotriorchis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 4 (REPTILES)</b>					
<i>Caretta caretta</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Lepidochelys olivacea</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Chelonia mydas</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Dermochelys coriacea</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Eretmochelys imbricata</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Natator depressus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Chalcophaps indica yamashinai</i>	S3	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<i>Crocodylus porosus</i>	S4	Unknown	v	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK</b>					
<i>Dasyurus hallucatus</i>	Near threatened	Unknown	iii	ii	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Rhinonictoris aurantius</i>	S1	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda subclarescens</i>	Near threatened	Unknown	vi	Unknown	vii
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Eucalyptus ceracea</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Blumea pungens</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Grevillea latifolia</i>	2	Unknown	vi	Unknown	No known threatening processes
<i>Minuria macrorhiza</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Myriophyllum costatum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Utricularia aurea</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

The following North Kimberley vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
12	Medium woodland-tropical; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ).	7,274
43	Low forest; mangroves.	8,657
60	Grasslands, tall bunch grass savannah woodland, Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum over ribbon grass ( <i>Chrysopogon</i> spp.).	47,170
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon</i> spp.).	17,443
75	Grasslands, curly spinifex, low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over <i>Triodia bitextura</i> .	1,193
125	Bare areas; salt lakes.	89
589	Mosaic: Hummock grasslands, grass steppe; curly spinifex ( <i>Triodia bitextura</i> ).	26
744	Grasslands, tall bunch grass savannah sparse low tree; <i>Acacia suberosa</i> and bauhinia ( <i>Bauhinia cunninghamii</i> ) over Mitchell and ribbon/blue grass ( <i>Astrebla</i> spp./ <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	4,249
754	Shrublands, pindan; <i>Acacia tumida</i> shrubland with Northern woollybutt ( <i>Eucalyptus miniata</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) medium woodland over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	9,915
773	Grasslands, high grass savannah low tree; bloodwood ( <i>Eucalyptus</i> spp.) and Darwin box ( <i>Eucalyptus tectifica</i> ) over white grass ( <i>Sehima nervosum</i> ) and/or upland tall grass.	10,672
800	Grasslands, high grass savannah woodland; Darwin stringybark and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over (upland tall grass and) curly spinifex ( <i>Triodia bitextura</i> ).	267,377
807	Grasslands, tall bunch grass savannah sparse low tree; acacia over grass on black soil.	1,346
808	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	5,255
814	Hummock grasslands, low steppe woodland; silver-leaved box ( <i>Eucalyptus pruinosa</i> ) and <i>Melaleuca</i> over <i>Plectrachne</i> .	61,579
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	59,510
838	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and bloodwood ( <i>Eucalyptus polycarpa</i> ) over spinifex and tall upland grass.	3,579
902	Hummock grasslands, low tree steppe; scattered low rare eucalypts in open curly spinifex ( <i>Triodia bitextura</i> ).	11,322
907	Grasslands, high grass savannah woodland; ghost gum ( <i>Eucalyptus bella</i> ) and bloodwood ( <i>Eucalyptus polycarpa</i> ) over ribbon ( <i>Chrysopogon</i> spp.) and tall upland grass.	10,954
914	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over kangaroo ( <i>Themeda australis</i> ) and white grass ( <i>Sehima nervosum</i> ).	4,312
Beard Veg Assoc	Description	Area (Ha.)
8001	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus</i> spp.) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over curly spinifex ( <i>Triodia bitextura</i> ) on islands.	209,565

Poorly represented ecosystems subject to threat:

Black Spring Mound Community.
Theda Soak Rainforest.
Walcott Inlet Rainforest Swamp.
Roe River Swamp Rainforest
Organic mound springs of the southern North Kimberley Bioregion.
Savannah communities of which <i>Callitris intratropica</i> is a component.

Mount Elizabeth Mounds.
Flora and fauna assemblages of upland swamps of the Kimberley. On lateritic plateaux and sandstone [Airfield Swamp and Beverley Springs Station].
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Invertebrate community in creek near Pago Mission.
<i>Eucalyptus tectifica</i> community of the Gibb River and Mt Barnett regions.
<i>Eucalyptus jensenii</i> woodlands of Gibb River and Mt Barnett regions.

Note: the lack of study in some areas precludes statements about the level of reservation required.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

**Competing Land Uses:** Until joint management arrangements between Aboriginal groups and conservation agencies can be negotiated there continues to be a perception that conservation interest is a competitor for existing Aboriginal lands and land sought under native title.

## Bioregional and subregional priority for reserve consolidation

The North Kimberley has a ranking priority under the preliminary bioregional NRS priorities of 4 (see Appendix D, and Appendix C, rank 4). However this may need to be 3 due to the continued impact of inappropriate fire

regimes and uncontrolled stock grazing. There is a lack of adequate data on the condition of the Berkeley subregion to compare this to the Mitchell subregion in terms of prioritising between the two.

## Reserve management standard

The bioregion is ranked at poor (i) to fair (ii) (see Appendix C, rank 5). Apart from the donkey control program undertaken by the Department of Agriculture (WA) there are no concerted feral animal control programs in place. Limited strategic aerial prescribed burning along with some burning along with some opportunistic hand burns with the latter being confined to very small areas of the Mitchell subregion. Extent of other threatening processes, for example weeds, yet to be determined. Due to uncontrolled stock access, changes are occurring within parks particularly in valley systems and noticeably within the Mitchell subregion. The lack of work within the Drysdale River National Park (the only reserve within the Berkeley subregion) precludes definitive statements.

Estate	Rank	Issues
<b>NATIONAL PARKS</b>		
Mitchell River	ii	Management ability is being developed. Currently one ranger on location during the tourist season. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring.
Lawley River	i	Remote and inaccessible. Issues have not been identified. Inappropriate fire regimes of note.
Drysdale River	i	No documentation of impacts over time. Biological survey undertaken in the 1970's. No knowledge of visitation.
<b>CONSERVATION PARKS</b>		
Laterite	ii	Location makes the park accessible. Small amount of biodiversity assessment being undertaken. Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring.
Camp Creek	i	Rainforest monitoring being undertaken on the impact of stock grazing and fire. Stock impact occurring.
<b>NATURE RESERVES</b>		
Prince Regent River	i	Full extent of threatening processes (Fire, weeds, feral animals) need to be documented. Stock impact occurring. Biological survey undertaken in the 1970's.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Berkeley subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure are of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- Changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

## Existing species recovery plans

The Action Plan for Australian Bats  
 The Action Plan for Australian Birds 2000  
 Action Plan for Australian Marsupials and Monotremes  
 Gouldian Finch Recovery Plan.  
 Draft Kimberley Region Management Plan (various strategies).

## Appropriate species recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broadscale, hot, late dry-season burning in savannah.

**Industry Codes of Practice:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Environmental Management Systems:** Removal of feral stock from conservation estate and management of stock on other lands e.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals is necessary, especially cattle, donkeys and pigs.

## Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, traditional owners and the broader community.

## Existing ecosystem recovery plans

There are no relevant recovery plans for Ecosystems at Risk in NK2.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation in NK2 is (iii) (see Appendix C, rank 6), indicating that relatively limited off park effort will result in significant biodiversity gains.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** There is a concerted and coordinated effort by the Department of Agriculture in the control of donkeys. The investigation of further development of feasible actions within this subregion is warranted.

## Feasible opportunities for NRM

**Environmental Management Systems:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this; Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committees.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management, such as making national parks accessible.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

## Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

## Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management would be for the priority for the Mitchell subregion. This is because of differing and potentially competing land uses, the increase in multiple land uses and landscape threats. Whilst still important the Berkeley subregion appears to have fewer stakeholders to deal with however research into issue identification for this subregion may change the priority. The rank for both subregions is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation/regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the

subregion to provide a basis for modeling species distribution/status.

**Floristic Data:** Very sparse, some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Lacking on the habitat requirements of fauna species.

**Other Priority Data Gaps Include:**

Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 268, 418, 492, 551, 556, 592, 626, 634, 635, 636, 637, 648, 692 and 693 in Appendix A.

# Nullarbor 1 (*NUL1 – Nullarbor Northern Band subregion*)

BRAD BARTON AND MARK COWAN  
OCTOBER 2001

## Subregional description and biodiversity values

### Description and area

The Nullarbor bioregion extends over most of the onshore part of the Eucla Basin – an epeirogenic basin of cretaceous and tertiary sediments on an irregular basement predominantly of Precambrian granite and metamorphic rocks.

NUL1 is along the northern edge of the Bunda Plateau comprised primarily of the Carlisle Plain which has deeper soil profiles with a high proportion of red quartz rich sand mixed with loams and calcareous clays which is partly calcreted over calcareous sandstone. It is part of an old, now inactive paleodrainage system, which flows into the Nullarbor Karst. Landforms consist of salt lakes and major valley floors with lake derived dunes. Sand plains

with extensive seif dunes in the northern areas of the subregion, occasional outcropping (breakaways) and quartzite hills provide minor relief. Some Karst formations are found in the southern areas of NUL1.

Vegetation in the Northern sections of the subregion are primarily a Tree steppe of *Eucalyptus gongylocarpa*, Mulga and *E. youngiana* over hummock grassland dominated by *Triodia basedowii* on the aeolian sands, *Acacia*, dominates the colluvial soils with *Eremophila* and *Santalum* spp halophytes are confined to edges of salt lakes and saline drainage systems. Low woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (bluebush) are present in the central and southern areas of NUL1. Includes *Myoporum platycarpum* and *E. oleosa* in the east and west and woodlands dominated by *Acacia aneura* (Mulga). Climate is arid non-seasonal, with average rainfall of 150 – 200 mm. The subregional area for NUL1 is 5,442,741 ha.

### Dominant land use

Category	Description	Percentage of Subregion
x	Aboriginal Reserve	0.22%
xiii	Conservation Reserves	35.93%
ix	Grazing - Leasehold	5.56%
xi	Unallocated Crown Land and Crown Reserves	58.29%

### Continental Stress Class

The Continental Stress Class for NUL1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Special Features:

- The Nullarbor is the worlds largest Karst system, though very few caves occur in NUL1.
- Stygofauna and troglodites associated with the cave systems is also of significance.

- Wetlands of the Nullarbor region

#### Rare Vertebrates Include:

Princess Parrot (*Polytelis alexandrae*), Southern Marsupial Mole (*Notoryctes typhlops*) and the Sandhill Dunnart (*Sminthopsis psammophila*).

#### Centres of Endemism:

Stygofauna are generally endemic to individual systems as they have no means of dispersal and have evolved independently.

### Ecosystems That Have More Than 95% of Their Total Extent Within Nullarbor 1:

Code	Description
442	Low open woodland; mulga & <i>Allocasuarina cristata</i>
120	Succulent steppe with open low woodland; mulga & sheoak

#### Refugia:

Several caves in NUL1 may provide refugia evolutionarily relictual invertebrates such as Crustaceans, centipedes, cockroaches, ground (carabid) beetles, Orthopterans, Pseudoscorpions and spiders. Two vertebrate species that are also known to use the caves are the bat, *Chalinolobus morio*, and the Nullarbor population of the masked owl, *Tyto novaehollandiae* during good seasons (such as mouse

plagues) when it is thought that individuals move in from the South Australian or Western Australian populations.

#### High Species or Ecosystem Diversity:

Cave systems support very rich communities of troglobites and troglaphiles.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book. Recommendations for reservation by the CTRC in NUL1 (Great Victoria Desert Nature Reserve, Plumridge Lakes Nature Reserve) were implemented. The subregion is covered by the Department of CALM's Regional Management Plan (1994), that provides an overview of the regions biota, addresses land and conservation issues, but was written to cover a third of WA and therefore was generalised in its attention to detail. The reviews and strategies therein (for reserve development or management of weeds, feral animals, fire, mining, ecosystem rehabilitation & disease quarantine)

do not address the specific needs of the subregions, or even bioregions, individually (Department of Conservation and Land Management 1994).

In 1992, the Commonwealth Government commissioned a report on the suitability of the Nullarbor Region for World Heritage Listing. The report was submitted but not supported by the Western Australian Government and the recommendation did not progress.

The Spinifex Agreement – signed between the State of Western Australia and the Pila Nguru (Aboriginal Corporation) in 2001 will influence future biodiversity planning and management in NUL1.

## Wetlands

### Wetlands of National significance (DIWA listings)

No Wetlands of National Significance have been identified in NUL1.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Plumridge Lakes	Eastings 720 000 Northings 6740 000, Zone 52	B8	ii	iii	iv	i	v (rabbits, camels, foxes and cats)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Creek Bed Vegetation	iii	iv	ii	iv, vi, vii, v (foxes, cats, rabbits, goats)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in NUL1.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Wetlands of the Nullarbor region	V	41	ii	iii-iv	i	iv, v (rabbits camels), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Sminthopsis psammophila</i>	V	ii	ii-iii	iii	v (cats, foxes), vii
<i>Notoryctes typhlops</i>	V	ii	vi	ii	v (cats, foxes), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	V	ii-iii	vi	ii	v (cats, foxes), vii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>Priority 1</b>					
<i>Eremophila attenuata</i>	1	Unknown	vi	ii	iv, v (rabbits), vii, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )				L
20	Low woodland; mulga mixed with <i>Allocasuarina cristata</i> & <i>Eucalyptus</i> sp (e6?)	X			L
24	Low woodland; <i>Allocasuarina cristata</i>				L
84	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				L
85	Hummock grasslands, open low tree & mallee steppe; marble gum & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex on sandplain	X			L
110	Hummock grasslands, shrub steppe; red mallee over spinifex <i>Triodia scariosa</i>	X			L
120	Succulent steppe with open low woodland; mulga & sheoak	X			L
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush,	X			L
125	Bare areas; salt lakes				L
239	Hummock grasslands, open medium tree & mallee steppe; marble gum ( <i>E. gonglocarpa</i> ) & mallee ( <i>Eucalyptus youngiana</i> ) over hard spinifex <i>Triodia basedowii</i> between sandhills				L
251	Low woodland; mulga & <i>Allocasuarina cristata</i>	X			L
289	Succulent steppe; saltbush & bluebush				L
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush	X			L
442	Low open woodland; mulga & <i>Allocasuarina cristata</i>	X			L
540	Succulent steppe with open low woodland; sheoak over saltbush	X			L
676	Succulent steppe; samphire	X			L
1241	Succulent steppe; bluebush				L
1271	Bare areas; claypans	X			L
4623	Succulent steppe with low woodland; <i>Acacia papyrocarpa</i> over bluebush	X			M

## Subregional constraints in order of priority (see Appendix B, key g)

**Other Subregional Constraints:** These are primarily resource related in terms of management and research.

**Competing Landuses:** In particular prospective exploration and mining leases. Aboriginal Land Agreement (Spinifex) will in all likelihood work in favor of biodiversity conservation. There is a small area of pastoral leases in southwestern corner of subregion.

## Bioregional and subregional priority for reserve consolidation

Overall 16% of Nullarbor bioregion is reserved in IUCN I-IV reserves and the bioregion is reservation Class 5 (see

Appendix D, and Appendix C, rank 4). At the subregional scale NUL1 has 36% of its area in IUCN I-IV reserves while NUL2 has 4.7%. An IBRA reservation class of 5 is appropriate for NUL1.

## Reserve management standard

The reserve management standard for NUL1 is (ii) Fair (see Appendix C, rank 5). This indicates that biodiversity values and or management issues poorly identified and some resource degradation is occurring though retrievable. Wildfire management is non-existent, mining exploration activities are supervised and the impact of feral herbivores is unknown. Some grazing is done by domestic stock.

Class	Purpose	Name	Category	Reserve Management Rank <sup>1</sup>
A	Conservation of Flora and Fauna	Plumridge Lakes Nature Reserve	Nature Reserve	ii-iii
A	Conservation of Flora and Fauna	Great Victoria Desert Nature reserve	Nature Reserve	ii-iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

Species	Specific Recovery Plan	General Recovery Plan
<i>Polytelis alexandrae</i>	No	Action Plan for Australian Birds
<i>Notoryctes typhlops</i>	No	Action Plan for Australian Marsupials and Monotremes
<i>Sminthopsis psammophila</i>	Yes – RP in South Australia (Churchill, 2001)	Action Plan for Australian Marsupials and Monotremes

### Appropriate species recovery actions

Fire management (ix) is needed in NUL1 to reduce the impact of large intense, summer wildfires on habitat and

fauna populations. Further research (xii) required to determine species status, distribution and gain-increased knowledge of subregion. Feral animal control (vii) would assist with extant CWR species recovery.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Polytelis alexandrae</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary.
<i>Notoryctes typhlops</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Sminthopsis psammophila</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.

<sup>1</sup>Appendix A, key h.

### Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Wetlands of the Nullarbor region	No	No
Troglobites	No	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Wetlands of the Nullarbor region	i, iii, vii, xii	Habitat retention through reservation and protection on other state lands, further research and feral animal control.
Troglobites	xii, i, ii	Further research into species ecology, and habitat retention and protection on other lands.

<sup>1</sup>Appendix A, key h.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), which indicates that limited off park measures required, as a high percentage of NUL1 is in IUCN I-IV reserves. Mineral exploration and possible mine establishment and pastoral leases are considered the main conflicting land uses.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

**Industry Codes of Practice:** Mining industry and pastoral industry.

**Integration With Property Management Planning, Catchment Planning and Landcare.**

#### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands

**Institutional Reform:** Expansion of existing institutional reform.

**Threat Abatement Planning as Part of NRM:** e.g. Vegetation and threatened species management plans, pest management, and fire management plans.

**Capacity Building Required With Community, Landholders, Industry and Institutions.**

#### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act, Pastoral Land Boards activities and the negotiations with the Spinifex Land Agreement people. Conservation Through Reserves (CTR) is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

#### Subregions where specific NRM actions are a priority to pursue

The subregional NRM priority for NUL1 is (iv) (see Appendix C, rank 7), indicating NRM instruments are in place with some achieved biodiversity outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

Prior to the Bioregional survey in 1984 no comprehensive biological study of the Eucla Basin had ever been undertaken. Other Nullarbor work had been largely opportunistic or focused on individual species or taxonomic groups.

**Vegetation and Regional Ecosystem Mapping:** Vegetation mapping is at the 1:1 000 000 scale (Beard 1975a). Regolith mapping is available (Hamilton, Victoria) for Nullarbor bioregion. Regional survey of flora and vertebrate fauna for bioregion has been published, but is based on very sparse sampling. Extra vegetation site data has been collected during 2002 by the South Australian Department of Environment and Heritage for the preparation of 1:100 000 scale maps (not yet available).

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse. Bioregion survey had 80 quadrats across bioregion (WA and SA), including 10 in NUL1 in WA only. Quadrats only positioned on discrete vegetation units and surface types with more widespread land units replicated. All quadrats were sampled twice, Spring and Autumn 1984 (4 days and nights each sampling).

**Floristic Data:** Data is general and knowledge is incomplete. Bioregion survey had 80 quadrats across bioregion (WA and SA), including 10 in NUL1 in WA only. Quadrats only positioned on discrete vegetation units and surface types with more widespread land units replicated

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals and uncommon vertebrate and plant species. There is no

data to provide regional context on life history (including population trend) of any species apart from rabbits. Gilfillan (1999) provides some insight into rabbit population trend, albeit from two survey sites.

**Other Priority Data Gaps Include:**

- No quantitative data on the affect of exotic predators, weed colonisation, fire.
- No quantitative data for feral herbivores other than rabbits.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
172	Churchill, S.	(2001b).	Survey and Ecological study of the Sandhill Dunnart, <i>Sminthopsis psammophila</i> at Eyre Peninsula and the Great Victoria Desert.	National Parks and Wildlife SA.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
064	Beard, J.S.	(1975a).	Vegetation Survey of Western Australia - Nullarbor 1:1000000 Vegetation Series Explanatory Notes to Sheet 4.	University of Western Australia Press. Perth.	O
306	Gilfillan, S.	(1999).	Monitoring the impacts of changed rabbit numbers due to Rabbit Calicivirus Disease on native fauna and vegetation in the Stirling Range, Western Australia.	Department of Conservation and Land Management. National Rabbit Calicivirus Monitoring and Surveillance Program.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 040, 075, 081, 090, 098, 101, 166, 171, 181, 208, 241, 268, 271, 278, 370, 417, 507, 508, 519 and 673 in Appendix A.

## Nullarbor 2 (*NUL2 – Nullarbor Central Band subregion*)

BRAD BARTON, MARK COWAN AND KLAUS TIEDEMANN  
JANUARY 2002

### Subregional description and biodiversity values

#### Description and area

The Nullarbor bioregion extends over most of the onshore part of the Eucla Basin – an epirogenic basin of cretaceous and tertiary sediments on an irregular basement predominantly of Precambrian granite and metamorphic rocks.

Primarily NUL2 is a tertiary limestone plain with subdued arid karst features. Dominated by the Nullarbor Plain, which is wholly contained within the much larger Bunda Plateau. It has shallow calcareous soils, thinly mantling massive limestones. Small scale relief in the patterns of clay-filled depressions that alternate with rises of thin stony soils or bare limestone. Southern end of

several paleodrainage lines extend onto the Nullarbor Plain.

The Nullarbor Karst is one of the worlds largest karst systems. Extensive features are the shallow surface depressions (the dongas and ridge and corridor terrain). Other karst features include drip pits, rillenkarren, rundkarren, pavements, solution pans and rockholes. Larger surface karst features such as collapse dolines and blowholes are also present. The Nullarbor Plain is a vast and remarkably flat treeless plain determined by the combination of aridity and the calcareous soils. Bluebush - Saltbush steppe in central areas; low woodlands of *Acacia papyrocarpa* (Western Myall) over *Maireana sedifolia* (bluebush) are present in peripheral areas, including *Myoporum platycarpum* and *E. oleosa* in the east and west. The climate is arid non-seasonal, with an average rainfall of 150 – 200 mm. The subregional area is 10, 169, 146 ha.

#### Dominant land use

(see Appendix B, key b)

Category	Description	Percentage of Subregion
x	Aboriginal Reserve	0.05%
xiii	Conservation Reserves	4.46%
iii	Cultivation and Plantation	0.00%
ix	Grazing - Freehold	6.76%
ix	Grazing - Leasehold	54.07%
xv	Lakes and Major Watercourses	0.01%
xi	Unallocated Crown Land and Crown Reserves	34.65%

#### Continental Stress Class

The Continental Stress Class for NUL2 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- The Nullarbor is the worlds largest Karst system and NUL2 contains the majority of cave in this system. Caves of the Nullarbor Plains are considered to be of World importance. Nullarbor Bioregion has been considered for nomination as a World Heritage site, indicating its significance and uniqueness. Therefore, research and prudent management are particularly important in this subregion.
- Sub-fossil deposits in caves are very important in the reconstruction of past fauna composition.
- Stygofauna and troglodites associated with the cave systems is also of importance.
- Wetlands of the Nullarbor region
- The subregion represents the western extent of the range of the Southern Hairy-nosed Wombat (*Lasiorninus latifrons*) and it is Australia's largest and most secure population (T. Robinson pers. comm.).

#### Rare Vertebrates Include:

Slender-billed Thornbill (*Acanthiza iredalei iredalei*), Mulgara (*Dasyercus cristicauda*), and Nullarbor Quail-thrush (*Cincoloma cinnamomeum alisteri*).

#### Centres of Endemism:

- Stygofauna associated with underground aquifers are generally endemic to individual systems as they have no means of dispersal and have evolved independently.
- Beards Vegetation types 214, 448, 449, 461, 1241 (98%) and 4641 are all endemic to NUL2 (100%).

#### High Species and Ecosystem Diversity:

Nullarbor bioregion is considered to be relatively species poor ecosystem, however knowledge is incomplete.

#### Refugia:

Nullarbor Caves are refugia and are considered highly significant as they provide refuge for many evolutionarily relictual species. These include troglodites and

troglophiles of the following groups - Crustaceans, centipedes, cockroaches, ground (carabid) beetles, Orthopterans, Pseudoscorpions and spiders. Two vertebrate species that are also known to use the caves are the bat, *Chalinolobus morio*, and the Nullarbor population of the masked owl, *Tyto novaehollandiae* during good seasons (such as mouse plagues) when it is thought that individuals move in from the South Australian or Western Australian populations.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Deserts and Nullarbor Plain (System 12) in the CTRC Green Book. Recommendations for reservation by the CTRC in NUL2 (Great Victoria Desert Nature Reserve) were implemented. Further recommendations for two large Nature reserves on the Nullarbor Plain have not been implemented. The subregion is covered by the

Department of CALM's Goldfields Regional Management Plan (1994), and the South Coast Regional Management Plan, which both provide an overview of the region's biota, addresses land and conservation issues. However, the reviews and strategies within these documents (for reserve development or management of weeds, feral animals, fire, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion individually. Goldfields Regional Management Plan recommends the establishment of a CALM Act 5g Reserve around Homestead Cave within the subregion, but this has not been implemented (Department of Conservation and Land Management 1994).

In 1992, the Commonwealth Government commissioned a report on the suitability of the Nullarbor Region for World Heritage Listing. The report was submitted but not supported by the Western Australian Government and the recommendation did not progress.

## Wetlands

### Wetlands of National significance (DIWA listings)

No Wetlands of National Significance have been identified in NUL2.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Boonderoo	Eastings 629 000 Northings 6654 000, Zone 52	B6 - Lake gradually turns saline as water level drops.	ii, iii, iv, v	i	iii	iii	iv (grazing & trampling pressure from stock and feral animals), v (rabbits, camels, foxes and cats)
Hampton Scarp Rockholes	Between Burnabie and Madura Stations, along the escarpment separating Hampton and Nullarbor Bioregions. Eastings 280 000 Northings 6455 000, Zone 52	B17	ii	i	vi	i	iv (stock and feral animals), v (rabbits, foxes and cats)
Duck Pond – Arubiddy station	Eastings 778 000 Northings 6477 000, Zone 52	B6	ii	i	ii	i	iv (stock and feral animals), v (rabbits, foxes and cats)
Paleodrainage channel, Gunnadorah Station	Eastings 220 000 Northings 6624 000, Zone 52	B6	ii	i	ii	i	iv (grazing by stock and feral animals), v (rabbits, foxes and cats)
Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Cocklebiddy Cave – Nuytsland Nature Reserve	125 549 E, 31 580 S	B19	ii	iii	vi	i	iv (grazing by stock and feral animals), xii (compaction via public visitation), v (rabbits, foxes and cats)
Murra El Elevyn Cave – Nuytsland Nature Reserve	126 023 E, 32 025 S	B19	ii	iii	vi	i	xii (compaction via public visitation; man made earth bund surrounding cave entrance), v (rabbits, foxes and cats)
Tommy Grahams Cave – Nuytsland Nature Reserve	126 117 E, 32 057 S	B19	ii	iii	vi	i	xii (compaction via public visitation), v (rabbits, foxes and cats)
Mullamullang Cave	31 432' S 127 14' E	B19	ii	iv	vi	i	iv, xii (uncontrolled recreational use)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

There is no true riparian vegetation within NUL2.

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities in NUL2.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Wetlands of the Nullarbor region	V	41,42	i-ii	iii - iv (in some instances)	ii	iv, v (rabbits camels)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus cristicauda</i>	V	ii	vi	ii	v (cats, foxes), vii iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Acanthiza iredalei iredalei</i>	V	ii	vi	ii	iv (rabbits), vii
<i>Cinclsoma cinnamomeum alisteri</i>	V	Unknown	vi	ii	iv (rabbits), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 7 (ARACHNIDS)</b>					
<i>Tartarus mullamullangensis</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)
<i>Tartarus murdochensis</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)
<i>Troglodiplura lowryi</i>	V	Unknown	vi	ii	xii (habitat disturbance due to recreation)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Grevillea phillipsiana</i>	1	Unknown	vi	ii	iv, v (rabbits), vii
<i>Lepidium fasciculatum</i>	1	Unknown	vi	ii	iv, v (rabbits), vii
<i>Thysanotus baueri</i>	1	Unknown	vi	ii	iv, v (rabbits), vii
<b>PRIORITY 2</b>					
<i>Phlegmatospermum eremaeum</i>	2	Unknown	vi	ii	iv, v (rabbits), vii, vi (Ward's weed)

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non IUCN Reserve	CALM purchased lease	Priority
122	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over saltbush & bluebush,	X			L
214	Mosaic: Medium woodland: goldfield eucalypts/Succulent steppe with open low woodland; myoporium over saltbush				H
441	Succulent steppe with open low woodland; mulga & sheoak over bluebush				L
448	Succulent steppe; bluebush (in dongas)	X			H
449	Succulent steppe; bluebush with grassy depressions				H
461	Succulent steppe with open low woodland; <i>Acacia papyrocarpa</i> over bluebush				H
482	Medium woodland; merrit & red mallee				L
515	Shrublands; mallee scrub, blue mallee ( <i>Eucalyptus socialis</i> )				L
676	Succulent steppe; samphire				L
936	Medium woodland; salmon gum				L
1241	Succulent steppe; bluebush	X	X		M
4623	Succulent steppe with low woodland; <i>Acacia papyrocarpa</i> over bluebush	X			H
4641	Succulent steppe with open woodland; salmon gum & gimlet over bluebush				H

Subregional constraints in order of priority  
(see Appendix B, key g)

**Competing Landuses:** Particularly pastoral leases and associated activities.

**Other Subregional Constraints:** These are primarily resource related in terms of management and research.

Bioregional and subregional priority for reserve consolidation  
(see Appendix D, and Appendix C, rank 4)

Overall 16% of Nullarbor bioregion is reserved in IUCN I-IV reserves and the bioregion is reservation Class 5 (see Appendix D, and Appendix C, rank 4). At the subregional scale NUL1 has 36% of its area in IUCN I-

IV reserves while NUL2 has 4.7%. NUL2 is considered a higher primary classification, therefore should be upgraded to Class 3 as significant threatening processes exist (grazing, feral animals and changed fire regimes) and the reserve system is biased in terms of CAR.

Reserve management standard  
(see Appendix C, rank 5)

Rating for NUL2 is (ii) fair, indicating that biodiversity values and management issues poorly identified and some resource degradation is occurring, although it is thought to be retrievable. Wildfire management is non-existent; mining exploration activities are supervised; impact of feral herbivores is unknown. Some grazing from domestic stock is occurring in reserves.

Class	Purpose	Name	Category	Reserve Management Rank
A	Conservation of Flora and Fauna	Great Victoria Desert Nature reserve	Nature Reserve	ii - iii
A	Primitive Area for the Preservation and Study of Flora Fauna, Geological and Anthropological Features	Nuytsland Nature Reserve	Nature Reserve	ii - iii

## Off reserve conservation

### Priority species or groups

Species	Specific Recovery Plan	General Recovery Plan
<i>Acanthiza iredalei iredalei</i>	No	Action Plan for Australian Birds
<i>Dasyercus cristicauda</i>	Yes - Species monitored by the National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Cinlosoma cinnamomeum</i>	No	Action Plan for Australian Birds

### Appropriate species recovery actions

The general recovery actions applicable to all species in NUL2 might include: (i) habitat retention through reserves (implementation of management plan recommendation; (xiii) capacity building with community, landholders, and industry (concerning pastoral operations); fire management (ix) to reduce the

impact of large intense, summer wildfires on habitat and fauna populations; further research (xii) is required to determine species status, distribution and gain increased knowledge of subregion; feral animal control (vii) would assist with extant CWR species recovery. Insufficient resources to implement management activities is a major constraint.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Acanthiza iredalei iredalei</i>	vii, ix, xii	Feral predator control important, further research into species ecology and habitat requirements is needed. Fire management may be necessary
<i>Dasyercus cristicauda</i>	iii, vii, ix, xii	Habitat protection on other state lands, further research into the species ecology. Feral predator control and fire management are important.
<i>Cinlosoma cinnamomeum</i>	vii, ix, xii	Feral animal control (herbivores and predators), Fire management may be necessary

<sup>1</sup>Appendix B, key h

### Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Wetlands of the Nullarbor region	No local or regional action plan	No
Stygofauna	No local or regional action plan	No

### Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Stygofauna	xii, i, ii	Further research into species ecology, and habitat retention and protection on other lands.
Wetlands of the Nullarbor region	i, iii, vii, xii	Habitat retention through reservation and protection on other state lands, further research and feral animal control.

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6) which indicates that significant off park effort is required. There are significant conflicting land uses as much of NUL2 (60%) is utilised for grazing (pastoral leases).

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Industry Codes of Practice:** Particularly in relation to pastoral lease management and activities.

**Environmental Management Systems and Ecological Sustainable Product Marketing.**

**Integration with Property Management Planning, Catchment Planning and Landcare.**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands

**Institutional Reform:** Expansion of reform in pastoral and mining industries.

**Threat Abatement Planning as Part of NRM:** Vegetation and threatened species management plans, pest management and fire management plans.

**Capacity Building Required With Community, Landholders, Industry and Institutions.**

### Impediments or constraints to opportunities

A number of impediments exist, including the Land Administration Act and operations of the Pastoral Lands Board. Conservation Through Reserves (CTR) is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industries (mining, pastoral) and the public in general. Limited financial resources are also a major constraint.

## Subregions where specific NRM actions are a priority to pursue

(see Appendix C, rank 7)

The NRM rank for NUL2 has a rank of (iv), indicating that there are some constraints to integrate conservation into NRM. Some NRM instruments in place with some achieved biodiversity outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

Prior to the Bioregional survey in 1984 no complete study of the Eucla Basin had ever been undertaken. Other Nullarbor studies had been largely opportunistic or focused on individual species or taxonomic groups.

**Vegetation and Regional Ecosystem Mapping: Regolith** mapping is available (Hamilton, Victoria) for Nullarbor bioregion. Regional survey of flora and vertebrate fauna for bioregion has been published, but is based on very sparse sampling.

**Systematic Fauna Survey:** Data is confined to vertebrates and is sparse. Bioregion survey had 80 quadrats across bioregion (SA and WA) with 20 in NUL2. Quadrats only positioned on discrete vegetation units and surface types with more widespread land units replicated. All quadrats were sampled twice, Spring and Autumn 1984 (4 days and nights each sampling).

**Floristic Data:** Data is general and knowledge is incomplete. Bioregion survey had 80 quadrats across bioregion (SA and WA) with 20 in NUL2. Quadrats only positioned on discrete vegetation units and surface types with more widespread land units replicated.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals and uncommon vertebrate and plant species. There is no data to provide regional context on life history (including population trend) of any species apart from rabbits. Gilfillan (1999) provides some insight into rabbit population trend, albeit from two survey sites.

### Other Priority Data Gaps Include:

Quantitative data on the affect of exotic predators, weed colonisation, fire.

No quantitative data for feral herbivores other than rabbits. There is some quantitative data on the impact of grazing on vegetation systems on pastoral leases.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
231	Department of Conservation and Land Management	(1994b).	Goldfields Region Management Plan 1994-2004. Management Plan No. 27.	Department of Conservation and Land Management.	R
306	Gilfillan, S.	(1999).	Monitoring the impacts of changed rabbit numbers due to Rabbit Calicivirus Disease on native fauna and vegetation in the Stirling Range, Western Australia.	Department of Conservation and Land Management. National Rabbit Calicivirus Monitoring and Surveillance Program.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 040, 081, 098, 101, 133, 166, 181, 206, 207, 208, 209, 241, 268, 278, 417, 489, 490, 507, 508, 602 and 673 in Appendix A.

# Ord Victoria Plains 1 (*OVP1 – Ord subregion*)

GORDON GRAHAM  
AUGUST 2001

*Information from Western Australia and the Northern Territory has been listed separately in this synopsis as a result of different vegetation mapping protocols that have been used in the two jurisdictions and the associated difficulties in combining that information.*

## Subregional description and biodiversity values

### Description and area

#### *Western Australia:*

The bioregion shows level to gently undulating plains with scattered hills on Cambrian volcanics and Proterozoic sedimentary rocks; vertosols on plains and predominantly skeletal soils on hills. The overall vegetation is grassland with scattered bloodwoods (*Eucalyptus spp.*) and snappy gum (*Eucalyptus brevifolia*) with spinifex and annual grasses. The climate is dry hot tropical, semi-arid with summer rainfall. The subregional area is 2, 282, 600ha.

The lithological mosaic has three main components:

- (1) Abrupt Proterozoic and Phanerozoic ranges and scattered hills mantled by shallow sand and loam soils supporting *Triodia* hummock grasslands with sparse low trees.
- (2) Cambrian volcanics and limestone form extensive plains with short grass (*Enneapogon spp.*) on dry calcareous soils and medium-height grassland communities (*Astrelba spp.* and *Dichanthium spp.*) on cracking clays. Riparian forests of red river gum (*Eucalyptus camaldulensis*) fringe drainage lines.
- (3) In the southwest, Phanerozoic strata expressed as often lateritised upland sand plains with sparse trees. This component recurs as the Sturt Plateau Region in central Northern Territory.

The Ord subregion is comprised of a major river system draining low-lying plains and hilly tracts northwards via the Ord River. The average annual rainfall is between 500 and 800 mm. Phanerozoic strata of the Ord Basin strata have been well exposed, including sandstones, limestone and volcanics.

Broad scale vegetation mapping of the area describes the following components:

- *Eucalyptus microtheca* (coolibah) and/or *Eucalyptus spp.* +/- *Excoecaria parvifolia* (gutta percha) grassy low woodland.
- *Astrelba pectinata* (barley Mitchell grass) closed-tussock grassland +/- low trees.
- *Dichanthium fecundum* (curly bluegrass) and *Chrysopogon fallax* (golden beard grass) tussock grassland sparsely wooded with low trees.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia spp.* (spinifex) hummock grasses or sometimes a hummock grassland without trees.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) and/or *Triodia*

*bitextura* (curly spinifex) hummock grassland wooded with *Eucalyptus spp.* or *Bauhinia cunninghamii* (bauhinia) low trees.

- *Eucalyptus pruinosus* (silver box) +/- *Bauhinia cunninghamii* (bauhinia) low open-woodland +/- a shrub layer and tussock grasses or *Triodia spp.* (spinifex)
- *Eucalyptus spp.* grassy woodland
- *Eucalyptus terminalis* (desert bloodwood) low open-woodland with *Sehima nervosum* (white grass) and *Chrysopogon fallax* (golden beard grass) tussock grasses +/- *Triodia spp.* (spinifex).
- *Eucalyptus opaca* (plains bloodwood) and *Eucalyptus chlorophylla* (shiny-leaved box) sparse low-open woodland with tussock grasses or a *Triodia pungens* (soft spinifex), *Triodia intermedia* (winged spinifex) hummock grassland wooded with *Eucalyptus brevifolia*.
- *Triodia wiseana* (limestone spinifex) open-hummock grassland wooded with low trees of *Terminalia spp.* or *Adansonia gregorii* (boab).
- *Astrelba lappacea* (curly Mitchell grass) and/or *Astrelba pectinata* (barley Mitchell grass) tussock grassland sparsely wooded with *Acacia spp.* low trees.
- *Enneapogon purpurascens* (nine-awn grass) tussock grassland.
- *Eucalyptus spp.*, *Eucalyptus miniata* (Northern woollybutt) +/- *Eucalyptus tetradonta* (Darwin stringybark) open-woodland with *Triodia bitextura* (curly spinifex) and *Sorghum spp.* (sorghum) grasses.
- *Eucalyptus dampieri* (pindan bloodwood) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) hummock grassland sparsely wooded with low trees.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia bitextura* (curly spinifex) hummock grasses and/or tussock grasses.
- *Triodia wiseana* (limestone spinifex) and *Triodia intermedia* (winged spinifex) hummock grassland sparsely wooded with *Eucalyptus brevifolia* (snappy gum) low trees.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia bitextura* (curly spinifex) hummock grasses +/- *Enneapogon spp.* (nine-awn grass) short-tussock grasses or sometimes a grassland without trees.

#### *Northern Territory:*

The Ord subregion lies between the Victoria River District and the Ord River catchment, containing drainage for both catchments. It contains Cambrian

volcanics and sedimentary rocks from the Wiso and Ord Basins respectively. The climate is monsoonal with annual average rainfall varying from 400 to 800mm south to north. Elevation varies between 100 and 450m, with a minor range up to 400m separating the Victoria and Ord River catchments. Major drainage includes the West Baines and Negri Rivers and Stirling, Mistake and Blackfellow Creeks. Vegetation includes a variety of grassland (*Triodia* spp., *Enneapogon purpurascens*, *Chrysopogon fallax*, and *Dichanthium fecundum*) and low open woodland (*Eucalyptus terminalis* and *E. chlorophylla*) with grass understorey. Soils in the subregion are predominantly shallow loams, clays, and sands, with some deep loams covering the Ord Basin.

## Dominant land use

### *Western Australia:*

The dominant landuses are (ix) Grazing – Native pastures (see Appendix B, key b), (xi) UCL and Crown reserves, and (vii) Mining.

### *Northern Territory:*

No information supplied.

## Continental Stress Class

The Continental Stress Class for both the West Australian and Northern Territory components of OVP1 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

### *Western Australia:*

#### **Rare Features:**

- The structure of the Bungle Bungle range within the Purnululu National Park.
- The Osmand Ranges and the springs within them
- The enormous, man-made freshwater Lake Argyle. The islands within this lake have been previously described as providing an outdoor laboratory to investigate evolutionary processes and other changes over time. This has also been acknowledged with its Ramsar listing.
- Geology of interest associated with the Halls Creek Fault.

#### **Centres of Endemism:**

- A species of skink *Lerista bunglebungle* has been described within this subregion.
- Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### **Refugia:**

'Dry' rainforest patches provide dry season refuges. Riparian zones, whilst degraded, are important. Lake Argyle itself, with its river red gum (*Eucalyptus camaldulensis*) woodland is acknowledged as being important for birds. Further research is required to define

the extent to which various islands of vegetation such as springs function as refuges.

#### **High Species and Ecosystem Diversity:**

Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

#### *Northern Territory:*

#### **Endemism:**

Some endemism is associated with Bungle Bungle sandstone massif (e.g. *Lerista bunglebunglensis* and several plant species) (Woinarski 1992).

#### **Rare Features:**

Many localised rare species are associated with Bungle Bungle ranges (Woinarski 1992).

#### **Refugia:**

The Bungle Bungle massif is considered a significant refuge (Morton *et al.* 1995).

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

### *Western Australia:*

The CTCRC report in 1974 (System 7) formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" (Burbidge *et al.* 1991) which has itself been incorporated in a Departmental Draft Regional Management Plan (Portlock *et al.* 2001). These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. There have been specific flora and fauna studies of the Purnululu National Park and associated Conservation Park. Previous rainforest studies are applicable (McKenzie *et al.* 1991).

There has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. Flow-on effects and other factors (e.g. exotic predators) affect fauna. Work to date has been of a general nature.

### *Northern Territory:*

**Management Issues Paper Completed for NT** - General description of issues, and summary of information, but not a strategy for implementation of enhanced conservation management (Kraatz 2000).

**Reservation priorities identified for WA portion of bioregion (Burbidge *et al.* 1991)**

**Options considered for balancing increased alienation of lands for horticulture with enhanced reservation** - Part of inter-governmental EIS process for Lower Ord.

Recently established Ord Bonaparte Project will consider broad-scale management and planning issues - Project

only recently commenced, and ambit still somewhat unresolved.

## Wetlands

### Wetlands of National significance (DIWA listings)

*Western Australia:*

Name and Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Process <sup>4</sup>
Lake Argyle WA097	iii	vi	iii	xii (excessive siltation), iv, vi (extent of which has not been documented but including Parkinsonia)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

*Northern Territory:*

No information supplied.

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

*Western Australia:*

There have been no wetlands of subregional significance identified to date.

*Northern Territory:*

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Process <sup>6</sup>
Negri River	Not stated	B1	Not stated	iii	vi	Not stated	Not stated
Stirling Creek	Not stated	B2	Not stated	iii	vi	Not stated	Not stated
West Baines River	Not stated	B1	Not stated	iii	vi	Not stated	Not stated

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

*Western Australia:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral Creek Lines	i	iii	iii	vii, iv, v (feral herbivores), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

*Northern Territory:*

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Ephemeral Creek Lines	ii	iii	Not stated	vii, x (impoundments associated with the Ord Irrigation Area have drastically altered river flows, leading to major changes in riparian vegetation (Start and Handasyde 2002)), ix (likely to be increased salinity associated with expansion of Ord River scheme), vi (riparian systems have attracted many serious weed infestations, including noogoora burr, bellyache bush, castor oil plant), v (large numbers of feral animals, especially donkeys, degrading some parts of catchment), iv (A century of grazing pressure led to massive degradation (denudation of vegetation; extreme erosion) of riparian areas and alluvial basins in the Ord system. Large tracts of pastoral properties were compulsorily de-stocked; recovery has been gradual).

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

*Western Australia:*

There are no Threatened Ecological Communities (TECs) in OVP1.

*Northern Territory:*

No information supplied.

### Other ecosystems at risk

*Western Australia:*

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Widespread vegetation types and widespread threats such as changed fire regimes.	V	11	Unknown	vi	ii	Threats apply on a case by case basis
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	i	iv, vii
Fire sensitive plant assemblages on vertical sandstone surfaces.	V	43	Unknown	vi	i	vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Northern Territory:

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Monsoon rainforest patches generally	V	Not stated	Not stated	iii	Not stated	vii (degradation of rainforest patches by increased incidence and penetration of hot fires), vi (infestation of rainforest patches by a range of exotic weed species), v (pigs, cattle and buffalo)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Western Australia:

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Tadorna radjah</i>	S4 (State)	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus johnstoni</i>	S4 (State)	Unknown	vi	Unknown	Unknown threatening processes
<i>Crocodylus porosus</i>	S4 (State)	Unknown	vi	Unknown	Unknown threatening processes

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Lagorchestes conspicillatus</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

Northern Territory:

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	ii	iii	Not stated	vii, iv (vegetation change through extensive pastoralism)
<i>Malurus coronatus coronatus</i>	V	iii	iv	Not stated	x (impoundments may be improving habitat quality for this species), vi (many riparian areas in this subregion are now heavily infested with weeds. Studies currently underway to determine whether this is detrimental or beneficial for Purple-crowned Fairy-wren), iv (riparian areas are increasingly excluded from stock, providing some reverse of vegetation degradation, and improvement in habitat quality for PCFW).

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Western Australia:

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Nicotiana heterantha</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Blumea pungens</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Boronia minutipinna</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Eucalyptus ordiana</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Grevillea psilantha</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Livistona victoriae</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Triodia bunglensis</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Triumfetta aspera</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Blumea pungens</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

Northern Territory:

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<i>Platysace saxatilis</i>	V	iv	vi	Not stated	No known threatening processes, though it is a cliff face species susceptible to rock falls and other stochastic events

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Western Australia:

The following Ord Victoria Plains bioregion vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
41	Shrublands; tea tree ( <i>Melaleuca spp.</i> ) scrub.	1,028
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon spp.</i> ).	1,203

65	Grasslands, tall bunch grass savannah, sparse low tree, <i>Terminalia</i> spp; Mitchell grass ( <i>Astrelba pectinata</i> ).	39,750
77	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon</i> spp. and curly spinifex ( <i>Triodia bitextura</i> ).	7,139
78	Hummock grasslands, low tree steppe; eucalypts over soft spinifex ( <i>Triodia pungens</i> ).	357,813
81	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	86,874
101	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over soft spinifex ( <i>Triodia pungens</i> ).	362,198
116	Hummock grasslands, sparse low tree steppe; mixed low trees over <i>Triodia wiseana</i> .	21,101
117	Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ).	4,924
126	Bare areas: freshwater lakes.	105,231
157	Hummock grasslands, grass steppe; <i>Triodia wiseana</i> .	4,123
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex ( <i>Triodia pungens</i> ).	36,631
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly ( <i>Triodia bitextura</i> ) spinifex on sandplain.	2,853
700	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly ( <i>Triodia bitextura</i> ) spinifex between dunes.	30,921
703	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	26,604
705	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over spinifex and winged spinifex ( <i>Triodia intermedia</i> ).	86,201
706	Grasslands, tall bunch grass savannah, Mitchell and ribbon/blue grass ( <i>Astrelba</i> spp./ <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.).	19,421
707	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah ( <i>Eucalyptus</i> spp.) over ribbon/blue grass ( <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	75,759
709	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ) on stony laterite.	13,837
722	Shrublands, pindan; <i>Acacia</i> spp. and <i>Acacia eriopoda</i> shrubland with sparse low bauhinia ( <i>Bauhinia cunninghamii</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over ribbon grass ( <i>Chrysopogon</i> spp.) and curly spinifex ( <i>Triodia bitextura</i> ).	7,963
724	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. over winged spinifex ( <i>Triodia intermedia</i> ).	12,946
725	Hummock grasslands, shrub steppe; <i>Acacia</i> spp. and pindan wattle ( <i>Acacia tumida</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	129,346
726	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over Mitchell and ribbon/blue grass ( <i>Astrelba</i> spp./ <i>Chrysopogon</i> spp./ <i>Bothriochloa</i> spp.) on black soil.	23,356
727	Hummock grasslands, low open tree and shrub steppe; bloodwood ( <i>Eucalyptus</i> spp.), Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	122,210
728	Grasslands, short bunch grass savannah low tree and acacia thicket; bauhinia ( <i>Bauhinia cunninghamii</i> ) and <i>Acacia</i> spp. over <i>Aristida</i> spp. short grasses on river flats.	9,287
729	Hummock grasslands, low tree steppe; bauhinia? ( <i>Bauhinia cunninghamii</i> ) and beefwood? ( <i>Grevillea striata</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	16,344
730	Shrublands, pindan; <i>Acacia</i> spp. and <i>Acacia eriopoda</i> shrubland with sparse low bauhinia ( <i>Bauhinia cunninghamii</i> ) and <i>Grevillea</i> spp. over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	16,840
731	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	183,487
733	Hummock grasslands, shrub steppe; silverleaf box ( <i>Eucalyptus pruinosa</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	8,640
746	Hummock grasslands, low tree steppe; bloodwood ( <i>Eucalyptus</i> spp.) over <i>Triodia wiseana</i> .	47,806
802	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ) on basalt and dolerite.	76
<b>Beard Veg Assoc</b>	<b>Description</b>	<b>Area (Ha.)</b>
808	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	340
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	38,982
815	Grasslands, tall bunch grass savannah, sparse low tree, <i>Terminalia</i> spp.; Mitchell ( <i>Astrelba</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.) on basalt.	50,507
816	Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over arid short grass ( <i>Enneapogon</i> spp.).	95,137
818	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia inutilis</i> .	34,880
819	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and silverleaf box ( <i>Eucalyptus pruinosa</i> ) over <i>Aristida</i> spp. and ribbon grass ( <i>Chrysopogon</i> spp.) on sandy plains.	51,807
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	5,489
825	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and <i>Eucalyptus greeniana</i> over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on basalt.	24,010
827	Hummock grasslands, low tree steppe; <i>Terminalia</i> spp. over <i>Triodia wiseana</i> on limestone.	91,291
830	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. short grass / Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> / Grasslands; high grass savannah, white grass ( <i>Sehima nervosum</i> ).	175,560
831	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ) and <i>Triodia inutilis</i> .	404,315
833	Grasslands, short bunch grass savannah sparse low tree; scattered snappy gum ( <i>Eucalyptus brevifolia</i> ) over arid short grass on plains.	40,471
834	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrelba</i> spp.) and blue grass ( <i>Bothriochloa</i> spp.).	8,620
842	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus</i> spp.) over <i>Enneapogon</i> spp. short grass/Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ).	264,058
843	Hummock grasslands, grass steppe; curly spinifex ( <i>Triodia bitextura</i> ) on shale.	22,413
844	Grasslands, high grass savannah low tree; <i>Melaleuca</i> spp. over upland tall grass.	2,733

846	Grasslands.	95,905
847	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	74,988
848	Hummock grasslands, low tree steppe; Eucalypts over curly spinifex ( <i>Triodia bitextura</i> ) on laterite sand plains.	237,462
850	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrelba spp.</i> ) and blue grass ( <i>Bothriochloa spp.</i> ).	331,815
851	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ) on basalt and dolerite.	116,346
861	Grasslands, tall bunch grass savannah low tree; Darwin box ( <i>Eucalyptus tectifica</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Aristida spp.</i> and ribbon grass ( <i>Chrysopogon spp.</i> ) on sandy plain	118,346
868	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Enneapogon spp.</i> and curly spinifex ( <i>Triodia bitextura</i> ) on granite	12,901
872	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ) on basalt and dolerite.	3,574
873	Mosaic: Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon spp.</i> short grass on plains / Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ) and <i>Triodia wiseana</i> ; soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	80,306
875	Mosaic: Hummock grasslands, open low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ); soft spinifex ( <i>Triodia pungens</i> ) / Hummock grasslands, grass steppe; <i>Triodia wiseana</i> , winged spinifex ( <i>Triodia intermedia</i> ) on laterite.	251,753
876	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> and pindan wattle ( <i>Acacia tumida</i> ) over <i>Triodia spp.</i> and winged spinifex ( <i>Triodia intermedia</i> ) on sandplain.	54,369
878	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	68,717
879	Grasslands, short bunch grass savannah low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) over gulf feathertop wiregrass ( <i>Aristida pruinosa</i> ) short grasses on plains	69,299
881	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bauhinia ( <i>Bauhinia cunninghamii</i> ) over <i>Plectrachne spp.</i>	25,729
882	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	37,799
883	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus spp.</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	1,015
<b>Beard Veg Assoc</b>	<b>Description</b>	<b>Area (Ha.)</b>
894	Sedgeland; sedges with low tree savannah woodland; coolibah and Darwin box ( <i>Eucalyptus tectifica</i> ) over spinifex.	44,700
899	Mosaic: Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon spp.</i> short grass on plains/Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	51,028

The only ecosystem that is subject to some level of threat and is not reserved or is poorly represented is:

Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
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More work is required on the identification of threatened ecosystems within this subregion.

Northern Territory:

Veg Number	Description	Area (Ha.)
15	<i>E. tectifica</i> (Northern Box), <i>E. latifolia</i> (Round-leaved Bloodwood) woodland with Sorghum grassland understorey.	0
22	<i>E. terminalis</i> (Bloodwood), <i>E. chlorophylla</i> (Box) low woodland with <i>Sehima nervosum</i> (White Grass), <i>Chrysopogon fallax</i> (Golden Beard Grass) grassland understorey.	0
23	<i>E. pruinosa</i> (Silver Box) low woodland with <i>Eulalia aurea</i> (Silky Browntop), <i>Sehima nervosum</i> (White Grass) grassland understorey.	0
33	<i>E. dichromophloia</i> (Variable-barked Bloodwood) low open-woodland with <i>Plectrachne pungens</i> (Curly Spinifex) open-hummock grassland understorey.	0
37	<i>E. brevifolia</i> (Snappy Gum) low open-woodland with <i>Plectrachne pungens</i> (Curly Spinifex) hummock grassland understorey.	0
38	<i>E. brevifolia</i> (Snappy Gum) low open-woodland with <i>Triodia pungens</i> (Soft Spinifex) hummock grassland understorey.	0
88	<i>Triodia</i> (Spinifex) hummock grassland.	0
91	<i>Triodia wiseana</i> (Limestone Spinifex) hummock grassland with <i>Terminalia arostrata</i> (Nutwood) low open-woodland overstorey.	0
97	<i>Astrelba</i> (Mitchell Grass), mixed species grassland with scattered trees and shrubs.	0
98	<i>Chrysopogon fallax</i> (Golden Beard Grass), <i>Dichanthium fecundum</i> (Bluegrass) grassland.	0
99	<i>Enneapogon purpurascens</i> (Nine Awn Grass) grassland.	0

Subregional constraints in order of priority  
(see Appendix B, key g)

Western Australia:

**Economic Constraints:** Land prices for pastoral leases.

**Competing Land Uses:** Particularly for pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

Northern Territory:

No information supplied.

Bioregional and subregional priority for reserve consolidation

*Western Australia:*

The Ord Victoria Plains bioregion has a ranking priority under the preliminary bioregional NRS priorities of 3 (see Appendix D, and Appendix C, rank 4). It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often. The reserve selection process has also been biased in the past. For example the original interest in the Purnululu area was as a result of tourism

interest in the Bungle Bungle Range. Biological assessment of the area occurred later.

*Northern Territory:*

No information supplied.

## Reserve management standard

*Western Australia:*

The overall reserve management standard is fair (ii).

Estate	Rank <sup>1</sup>	Issues
<b>NATIONAL PARKS</b>		
Purnululu	ii	Regular cattle and donkey controls are implemented. Permanent ranger presence. Prescribed burning both aerial and hand undertaken.
<b>CONSERVATION PARKS</b>		
Purnululu	ii	Regular cattle and donkey controls are implemented. Permanent ranger presence. Prescribed burning both aerial and hand undertaken.
<b>OTHER RESERVES</b>		
Wolfe Creek Meteorite Crater	iii	No major environmental issues identified. Formalised campground. Ranger and volunteer campground host presence during the tourist season.

<sup>1</sup>Appendix C, rank 5

*Northern Territory:*

No information supplied.

## Off reserve conservation

## Priority species or groups

*Western Australia:*

- Threatening processes operate from the species to landscape level.
- Extinctions have occurred within the critical weight range mammals in this subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

*Northern Territory:*

No information supplied.

## Existing species recovery plans

*Western Australia:*

The Action Plan for Australian Bats  
 The Action Plan for Australian Birds 2000  
 Action Plan for Australian Marsupials and Monotremes  
 Gouldian Finch Recovery Plan.  
 Draft Kimberley Region Management Plan (various strategies).  
 Purnululu National Park Management Plan

*Northern Territory:*

No information supplied.

## Appropriate species recovery actions

*Western Australia:*

**Habitat Retention Through Reserves:** The continued implementation of reservation proposals is important.

**Weed Control:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Feral Animal Control:** Removal of feral stock from conservation estate and management of stock on other lands. E.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Capacity Building Required:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and

Aboriginal groups to optimise biodiversity and savannah productivity.

*Northern Territory:*

Species	Recovery Actions <sup>1</sup>	Recovery Description
<i>Erythrura gouldiae</i>	xii, ix, i	Capacity building with stakeholders - most Gouldian Finch occurrence is likely to be off-reserves; maintenance of these populations will require some input from landholders, in the form of improved pastoral and fire management. Fire management re-institution of fine-scale patchy early dry season burning reduction in extensive hot late dry season burns. Habitat retention through reserves - reservation of important sites may reverse vegetation change through grazing pressure.

Species	Recovery Actions <sup>1</sup>	Recovery Description
<i>Malurus coronatus coronatus</i>	xiii, v, i, vi, xiv	Capacity building with stakeholders - as above. Fencing – enclosure fencing of riparian strips. Habitat protection on private lands. Weed control impact of (major infestations of) weeds currently is unclear. Research underway. If detrimental, then major weed reduction may be required.
<i>Platysace saxatilis</i>	xiv, x	Research - into the status of the population and further survey required. Translocation - collection of propagation material and translocation to a Botanic Gardens would assist in protecting this species.

<sup>1</sup>Appendix B, key h.

## Ecosystems and appropriate recovery actions

### *Western Australia:*

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

### *Northern Territory:*

No information supplied.

## Subregion priority for off reserve conservation

### *Western Australia:*

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that a large off park effort is needed, resource constraints and limited community capacity.

### *Northern Territory:*

Major off-park issues relate to management of fire, ferals and weeds. Some integrative capacity exists among landholders (in the NT sector) through the Victoria River District Conservation Association (collection of landholders), and through coordinated feral control measures. The recently established Ord-Bonaparte Project may deliver further integrated management.

## Conservation actions as an integral part of NRM

### Existing NRM actions

#### *Western Australia:*

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and leaseholders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration With Property Management Planning, Catchment planning and Landcare:** Land Conservation

District Committees provide an opportunity for integration of land management activities.

### *Northern Territory:*

**Other:** Monitoring programs established on all pastoral leaseholds.

**Threat Abatement Planning:** Some regional fire management, monitoring and control through regional offices of Bushfires Council; Some catchment-wide weed management programs underway, but to be effective, this will need more resources and integration.

**Integration with Landcare, Catchment & Property Planning:** VRD Conservation Association (Landcare group) established and actively involved in some NRM issues. Some riparian enclosure fencing undertaken.

**Capacity Building with Stakeholders:** Project underway to educate landholders about PCFW and desirability of maintaining good quality riparian habitat.

## Feasible opportunities for NRM

### *Western Australia:*

**Threat Abatement Planning as Part of NRM:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this.

**Legislation:** Improved implementation of existing legislation.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Environmental planning across tenure (weeds, fire and feral animals).

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management (e.g. making national parks accessible).

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### *Northern Territory:*

**Threat Abatement Planning:** Scope for greater capacity for broad-scale management of fire, ferals and weeds.

**Incentives:** Possibility for conservation agreements on pastoral lands, including incentives to maintain lightly-grazed (water-remote) areas.

**Other Planning Opportunities:** Conservation planning for the Ord & Victoria bioregions proposed.

**Integration with Landcare, Catchment & Property Planning:** Some major pastoral landholders are proposing to work with conservation agencies to develop NRM planning on properties.

**Industry Codes of Practice:** Conservation plan for pastoral industry being formulated (NT sector).

## Impediments or constraints to opportunities

### *Western Australia:*

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### *Northern Territory:*

No information supplied.

## Subregions where specific NRM actions are a priority to pursue

### *Western Australia:*

Continued efforts are important amongst land managers for a more coordinated approach to land management would be for the priority. This is due to differing and potentially competing land uses, the increase in multiple land uses and landscape threats. The NRM rank for the bioregion is (ii) (see Appendix C, rank 7), which indicates significant constraints to integrate conservation as part of production or development system. Whilst data is limited it appears that the Ord subregion is a higher priority for action due to past deterioration than the South Kimberley Interzone subregion.

### *Northern Territory:*

Major NRM issues relate to management of fire, ferals and weeds. Some integrative capacity exists among landholders (in the NT sector) through the VRD Conservation Association (collection of landholders), and through coordinated feral control measures. The recently established Ord-Bonaparte Project may deliver further integrated management.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

### *Western Australia:*

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation and regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling program across the subregion to provide a basis for modeling species distribution or status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

### **Other Priority Gaps:**

- Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

### *Northern Territory:*

#### **Other Priority Data Gaps:**

- Monitoring to assess trends and responses to landscape-wide disturbance.
- Lack of detailed data on impacts of threats upon biodiversity; but some intensive studies on responses to grazing and to fire.

**Floristic Data:** No comprehensive systematic flora survey, but reasonable levels of more ad-hoc survey effort, especially on NT side of border.

**Systematic Fauna Survey:** No comprehensive systematic fauna survey, but reasonable levels of more ad-hoc survey effort, especially on NT side of border.

**Vegetation and Regional Ecosystem Mapping:** No vegetation mapping at scale better than 1: 1 million. Recent cross-border vegetation map integration (but at 1: 2 million scale). Land unit mapping at 1:100,000 scales for many NT properties.

## Sources

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
017	Anon.	(1995).	Purnululu National Park Management Plan 1995-2005.	Department of Conservation and Land Management.	R
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, Erythrura gouldiae	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
861	Kraatz, M.	(2000).	Managing for healthy country in the VRD.	Tropical Savannas CRC, Darwin.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R
556	Portlock, C., Graham, G., Done, C., Gilmour, J. and Williamson, J.	(2001).	Kimberley Region Draft Regional Management Plan. (Unpubl)	Department of Conservation and Land Management.	R
619	Start, A.N., and Handasyde, T.	(2002).	Using photographs to document environmental change: the effects of dams on the riparian environment of the lower Ord River.	Australian Journal of Botany 50, 465-480.	J
703	Woinarski, J.C.Z. (Ed.)	(1992).	A Survey of the Wildlife and Vegetation of Purnululu (Bungle Bungle) National Park and Adjacent Area.	Department of Conservation and Land Management.	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 018, 094, 100, 118, 173, 268, 551, 626, 634, 635, 636, 637, 648, 674, 692 and 693 in Appendix A.

# Ord Victoria Plains 2 (*OVP2 – South Kimberley Interzone subregion*)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The bioregion shows level to gently undulating plains with scattered hills on Cambrian volcanics and Proterozoic sedimentary rocks; vertosols on plains and predominantly skeletal soils on hills. The overall vegetation is grassland with scattered bloodwoods (*Eucalyptus spp.*) and snappy gum (*Eucalyptus brevifolia*) with spinifex and annual grasses. The climate is dry hot tropical, semi-arid with summer rainfall. The subregional area is 3, 540, 414ha.

The lithological mosaic has three main components:

- (1) Abrupt Proterozoic and Phanerozoic ranges and scattered hills mantled by shallow sand and loam soils supporting *Triodia* hummock grasslands with sparse low trees.
- (2) Cambrian volcanics and limestone form extensive plains with short grass (*Enneapogon spp.*) on dry calcareous soils and medium-height grassland communities (*Astrebla spp.* and *Dichanthium spp.*) on cracking clays. Riparian forests of red river gum (*Eucalyptus camaldulensis*) fringe drainage lines.
- (3) In the southwest, Phanerozoic strata expressed as often lateritised upland sand plains with sparse trees. This component recurs as the Sturt Plateau Region in central Northern Territory.

The eastern OVP2 subregion comprises a gently undulating, elevated erosional plain, drained southward into the desert by Sturt and Wolfe Creeks, and separated from the dissected valley of the Ord River by steep breakaways. Much of the plateau is covered by cracking clay plains developed over Antrim Plateau volcanics, although large areas are covered by thick laterite that has been partly dissected to form mesas, and is mainly covered by extensive desert sand plains. The subregion is more dissected at the western end, which is drained westwards by the headwaters of Christmas Creek, a tributary of the Fitzroy River. The South Kimberley Interzone subregion experiences a lower rainfall than the Ord subregion.

Broad scale vegetation mapping of the area describes the following components:

- *Astrebla pectinata* (barley Mitchell grass) closed-tussock grassland +/- low trees.
- *Eucalyptus microtheca* (coolibah) and/or *Eucalyptus spp.* +/- *Excoecaria parvifolia* (gutta percha) grassy low woodland.
- *Eucalyptus dampieri* (pindan bloodwood) low open-woodland with *Acacia spp.* Shrubs and *Triodia pungens* (soft spinifex) and *Triodia bitextura* (curly spinifex) hummock grasses.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia spp.* (spinifex) hummock grasses or sometimes a hummock grassland without trees.
- *Eucalyptus pruinosa* (silver box) +/- *Bauhinia cunninghamii* (bauhinia) low open-woodland +/- a shrub layer and tussock grasses or *Triodia spp.* (spinifex)
- *Acacia ancistrocarpa* (Fitzroy wattle) and/or *Acacia eriopoda* (pindan wattle) and/or *Acacia monticola* (red wattle) tall shrubland with *Triodia intermedia* (winged spinifex) and *Triodia pungens* (soft spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) and/or *Triodia bitextura* (curly spinifex) hummock grassland wooded with *Eucalyptus spp.* or *Bauhinia cunninghamii* (bauhinia) low trees.
- *Triodia pungens* (soft spinifex) and/or *Triodia schinzii* (feathertop spinifex) hummock grassland wooded with low trees and *Acacia spp.* Shrubs.
- *Eucalyptus terminalis* (desert bloodwood) low open-woodland with *Sehima nervosum* (white grass) and *Chrysopogon fallax* (golden beard grass) tussock grasses +/- *Triodia spp.* (spinifex).
- *Eucalyptus opaca* (plains bloodwood) and *Eucalyptus chlorophylla* (shiny-leaved box) sparse low-open woodland with tussock grasses or a *Triodia pungens* (soft spinifex), *Triodia intermedia* (winged spinifex) hummock grassland wooded with *Eucalyptus brevifolia*.
- *Triodia wiseana* (limestone spinifex) open-hummock grassland wooded with low trees of *Terminalia spp.* or *Adansonia gregorii* (boab).
- *Eucalyptus dampieri* (pindan bloodwood) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) hummock grasses.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia pungens* (soft spinifex) and/or *Triodia bitextura* (curly spinifex) hummock grasses and/or tussock grasses.
- *Acacia ancistrocarpa* (Fitzroy Wattle) and/or *Acacia eriopoda* (pindan wattle) open-shrubland with *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) hummock grasses.
- *Triodia pungens* (soft spinifex) and/or *Triodia intermedia* (winged spinifex) hummock grassland sparsely wooded with low trees.

## Dominant land use

The dominant land uses in OVP2 are (ix) Grazing – Native pastures (see Appendix B, key b), (x) Aboriginal reserves, (xi) UCL and Crown reserves.

## Continental Stress Class

The Continental Stress Class for OVP2 is 4

Known special values in relation to landscape, ecosystem, species and genetic values

### Paruku Wetland Complex:

Lake Gregory (which qualifies to be placed on the register as a wetland of international importance) is part of that complex. This lake is significant for a range of criteria under the Ramsar convention. This large inland lake is fed by the ephemeral Sturt Creek.

### Lake Willson:

This is an important drought refuge towards the west of the subregion fed by creeks starting in the Gardiner Range.

### Gardiner Range:

The Gardiner Range is a little studied area that has permanent springs within it.

### Grasslands:

In the east of the subregion there are vast tracts grassland on cracking soil plains.

### Centres of Endemism:

There are no endemic aspects yet identified (though there may be endemic *Triodia* sp.)

### Refugia:

The Paruku wetlands, Lake Willson and various soaks provide important refuges in this arid area.

### High Species and Ecosystem Diversity:

The Paruku wetlands are an area of high diversity for waterfowl.

## Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 (System 7) formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" (Burbidge *et al.* 1991) which has itself been incorporated in a Departmental Draft Regional Management Plan (Portlock *et al.* 2001). These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. Some limited documentation of Lake Gregory and its surrounds has occurred.

There has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. Flow-on effects and other factors (e.g. exotic predators) affect fauna. Work to date has been of a general nature.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Process <sup>4</sup>
Lake Gregory System WA096	iii	vi	ii	iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Process <sup>6</sup>
Lake Willson		B6	ii, iii, iv	iii	vi	ii	iv
Various soaks in the Gardiner Range		B17	ii	iii	vi	i, ii	vii, iv
Sturt Creek	Running from the Northern Territory Border to Lake Gregory	B2	ii	ii	iii	ii	iv, x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	ii	vii, iv, v (introduced herbivores), x

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in OVP2.

## Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Lake Wilson wetland community on edge of the Tanami Desert	V	42	Unknown	vi	i, ii	iv
Assemblages of the Lake Gregory Wetland System (Paruku Wetlands).	V	42	Unknown	iii	iii	iv
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the southern Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Widespread vegetation types and widespread threats such as changed fire regimes.	V	11	Unknown	vi	ii	Threats apply on a case by case basis

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	Unknown	vi	ii	vii, xii (possibly predation)
<b>Schedule 1; Rare/likely to become extinct, Div 2 (Birds)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii.	ii	vii
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Crocodylus johnstoni</i>	S4	Unknown	iv	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Lagorchestes conspicillatus</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Falco hypoleucos</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes
<i>Phaps histrionica</i>	Near threatened	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Trianthema kimberleyi</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Kohautia australiensis</i>	2	Unknown	vi	Unknown	No known threatening processes, plant is parasitic and can be hard to find

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

The following Ord Victoria Plains vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
41	Shrublands; teatree ( <i>Melaleuca spp.</i> ) scrub.	1,028
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon spp.</i> ).	1,203
65	Grasslands, tall bunch grass savannah, sparse low tree, Terminalia spp.; Mitchell grass ( <i>Astrelba pectinata</i> ).	39,750
77	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon spp.</i> and curly spinifex ( <i>Triodia bitextura</i> ).	7,139
78	Hummock grasslands, low tree steppe; eucalypts over soft spinifex ( <i>Triodia pungens</i> ).	357,813
81	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	86,874
101	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> over soft spinifex ( <i>Triodia pungens</i> ).	362,198
116	Hummock grasslands, sparse low tree steppe; mixed low trees over <i>Triodia wiseana</i> .	21,101
117	Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ).	4,924
126	Bare areas; freshwater lakes.	105,231
157	Hummock grasslands, grass steppe; <i>Triodia wiseana</i> .	4,123
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex ( <i>Triodia pungens</i> ).	36,631
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus spp.</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly ( <i>Triodia bitextura</i> ) spinifex on sandplain.	2,853
700	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>Eucalyptus spp.</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over soft ( <i>Triodia pungens</i> ) and curly ( <i>Triodia bitextura</i> ) spinifex between dunes.	30,921
703	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	26,604
705	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) and roughleaf bloodwood ( <i>Eucalyptus setosa</i> ) over spinifex and winged spinifex ( <i>Triodia intermedia</i> ).	86,201
706	Grasslands, tall bunch grass savannah, Mitchell and ribbon/blue grass ( <i>Astrelba spp./Chrysopogon spp./Bothriochloa spp.</i> ).	19,421
707	Grasslands, tall bunch grass savannah sparse low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah ( <i>Eucalyptus spp.</i> ) over ribbon/blue grass ( <i>Chrysopogon spp./Bothriochloa spp.</i> ) on black soil.	75,759
709	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> over winged spinifex ( <i>Triodia intermedia</i> ) on stony laterite.	13,837
722	Shrublands, pindan; <i>Acacia spp.</i> and <i>Acacia eriopoda</i> shrubland with sparse low bauhinia ( <i>Bauhinia cunninghamii</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over ribbon grass ( <i>Chrysopogon spp.</i> ) and curly spinifex ( <i>Triodia bitextura</i> ).	7,963
724	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> over winged spinifex ( <i>Triodia intermedia</i> ).	12,946
725	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> and pindan wattle ( <i>Acacia tumida</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	129,346
726	Grasslands, tall bunch grass savannah low tree; boab ( <i>Adansonia gregorii</i> ), bauhinia ( <i>Bauhinia cunninghamii</i> ) and beefwood ( <i>Grevillea striata</i> ) over Mitchell and ribbon/blue grass ( <i>Astrelba spp./Chrysopogon spp./Bothriochloa spp.</i> ) on black soil.	23,356

Beard Veg Assoc	Description	Area (Ha.)
727	Hummock grasslands, low open tree and shrub steppe; bloodwood ( <i>Eucalyptus spp.</i> ), Ranji bush ( <i>Acacia pyrifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	122,210
728	Grasslands, short bunch grass savannah low tree and acacia thicket; bauhinia ( <i>Bauhinia cunninghamii</i> ) and <i>Acacia spp.</i> over <i>Aristida spp.</i> short grasses on river flats.	9,287
729	Hummock grasslands, low tree steppe; bauhinia? ( <i>Bauhinia cunninghamii</i> ) and beefwood? ( <i>Grevillea striata</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	16,344
730	Shrublands, pindan; <i>Acacia spp.</i> and <i>Acacia eriopoda</i> shrubland with sparse low bauhinia ( <i>Bauhinia cunninghamii</i> ) and <i>Grevillea spp.</i> over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	16,840
731	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	183,487
733	Hummock grasslands, shrub steppe; silverleaf box ( <i>Eucalyptus pruinosa</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	8,640
746	Hummock grasslands, low tree steppe; bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Triodia wiseana</i> .	47,806
802	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and cabbage gum ( <i>Eucalyptus grandifolia</i> ) over mixed/white grass ( <i>Sehima nervosum</i> ) on basalt and dolerite.	76
808	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	340
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	38,982
815	Grasslands, tall bunch grass savannah, sparse low tree, <i>Terminalia spp.</i> ; Mitchell ( <i>Astrelba spp.</i> ) and blue grass ( <i>Bothriochloa spp.</i> ) on basalt.	50,507
816	Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over arid short grass ( <i>Enneapogon spp.</i> ).	95,137
818	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia inutilis</i> .	34,880
819	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and silverleaf box ( <i>Eucalyptus pruinosa</i> ) over <i>Aristida spp.</i> and ribbon grass ( <i>Chrysopogon spp.</i> ) on sandy plains.	51,807
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	5,489
825	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and <i>Eucalyptus greeniana</i> over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on basalt.	24,010
827	Hummock grasslands, low tree steppe; <i>Terminalia spp.</i> over <i>Triodia wiseana</i> on limestone.	91,291
830	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Enneapogon spp.</i> short grass / Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> / Grasslands; high grass savannah, white grass ( <i>Sehima nervosum</i> ).	175,560
831	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ) and <i>Triodia inutilis</i> .	404,315
833	Grasslands, short bunch grass savannah sparse low tree; scattered snappy gum ( <i>Eucalyptus brevifolia</i> ) over arid short grass on plains.	40,471
834	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrelba spp.</i> ) and blue grass ( <i>Bothriochloa spp.</i> ).	8,620
842	Mosaic: Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Enneapogon spp.</i> short grass / Hummock grasslands, open low tree-steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ).	264,058
843	Hummock grasslands, grass steppe; curly spinifex ( <i>Triodia bitextura</i> ) on shale.	22,413
844	Grasslands, high grass savannah low tree; <i>Melaleuca spp.</i> over upland tall grass.	2,733
846	Grasslands.	95,905
847	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	74,988
848	Hummock grasslands, low tree steppe; Eucalypts over curly spinifex ( <i>Triodia bitextura</i> ) on laterite sand plains.	237,462
850	Grasslands, tall bunch grass savannah, Mitchell ( <i>Astrelba spp.</i> ) and blue grass ( <i>Bothriochloa spp.</i> ).	331,815
851	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ) on basalt and dolerite.	116,346
861	Grasslands, tall bunch grass savannah low tree; Darwin box ( <i>Eucalyptus tectifica</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Aristida spp.</i> and ribbon grass ( <i>Chrysopogon spp.</i> ) on sandy plain	118,346

Beard Veg Assoc	Description	Area (Ha.)
868	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ) and short grass low tree savannah: snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over <i>Enneapogon spp.</i> and curly spinifex ( <i>Triodia bitextura</i> ) on granite	12,901
872	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia wiseana</i> and winged spinifex ( <i>Triodia intermedia</i> ) on basalt and dolerite.	3,574
873	Mosaic: Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon spp.</i> short grass on plains/Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ) and <i>Triodia wiseana</i> ; soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	80,306
875	Mosaic: Hummock grasslands, open low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ); soft spinifex ( <i>Triodia pungens</i> ) Hummock grasslands, grass steppe; <i>Triodia wiseana</i> , winged spinifex ( <i>Triodia intermedia</i> ) on laterite.	251,753
876	Hummock grasslands, shrub steppe; <i>Acacia spp.</i> and pindan wattle ( <i>Acacia tumida</i> ) over <i>Triodia spp.</i> and winged spinifex ( <i>Triodia intermedia</i> ) on sandplain.	54,369
878	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ) and winged spinifex ( <i>Triodia intermedia</i> ).	68,717
879	Grasslands, short bunch grass savannah low tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) over gulf feathertop wiregrass ( <i>Aristida pruinosa</i> ) short grasses on plains	69,299
881	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bauhinia ( <i>Bauhinia cunninghamii</i> ) over <i>Plectrachne spp.</i>	25,729
882	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over winged spinifex ( <i>Triodia intermedia</i> ).	37,799
883	Grasslands, curly spinifex ( <i>Triodia bitextura</i> ), low tree savannah; bloodwood ( <i>Eucalyptus spp.</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	1,015
894	Sedgeland; sedges with low tree savannah woodland; coolibah and Darwin box ( <i>Eucalyptus tectifica</i> ) over spinifex.	44,700
899	Mosaic: Grasslands, short bunch grass savannah low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Enneapogon spp.</i> short grass on plains/ Hummock grasslands, grass steppe; winged spinifex ( <i>Triodia intermedia</i> ).	51,028

The following ecosystems subject to some level of threat are either not reserved within the South Kimberley Interzone subregion or are poorly represented. Equally the lack of study in some areas precludes statements about the level of reservation:

Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.
Lake Wilson wetland community on edge of the Tanami Desert
Assemblages of the Lake Gregory Wetland System.

More work is required on the identification of threatened ecosystems within this subregion.

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Uses:** Particularly pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

### Bioregional and subregional priority for reserve consolidation

The Ord Victoria Plains bioregion has a ranking priority under the preliminary bioregional NRS priorities of 3

(see Appendix D, and Appendix C, rank 4). It can also be argued that there is a bias in the reserve system because some ecosystems not reserved are those that are being grazed and have been grazed the longest and are often burnt the most often. The reserve selection process has also been biased in the past. For example the original interest in the Purnululu area was as a result of tourism interest in the Bungle Bungle Range. Biological assessment of the area occurred later.

### Reserve management standard

The overall reserve management standard for OVP2 is ranked at fair (ii):

Estate	Rank <sup>1</sup>	Issues
<b>NATIONAL PARKS</b>		
Purnululu	ii	Regular cattle and donkey controls are implemented. Permanent ranger presence. Prescribed burning both aerial and hand undertaken.

Estate	Rank <sup>1</sup>	Issues
<b>CONSERVATION PARKS</b>		
Purnululu	ii	Regular cattle and donkey controls are implemented. Permanent ranger presence. Prescribed burning both aerial and hand undertaken.
<b>OTHER RESERVES</b>		
Wolfe Creek Meteorite Crater	ii	No major environmental issues identified. Formalised campground. Ranger and volunteer campground host presence during the tourist season.

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Extinctions have occurred within the critical weight range mammals in this subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on granivorous birds and savannah composition and structure is of concern.
- Changed grassland structures are of concern.
- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- There have been changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

### Existing species recovery plans

The Action Plan for Australian Bats  
 The Action Plan for Australian Birds 2000  
 Action Plan for Australian Marsupials and Monotremes  
 Gouldian Finch Recovery Plan.  
 Draft Kimberley Region Management Plan (various strategies).  
 Paruku Wetlands Management Plan

### Appropriate species recovery actions

**Habitat Retention Through Reserves:** The continued implementation of reservation proposals is important.

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid frequent, broad scale, hot, late dry-season burning in savannah.

**Weed Control:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Feral Animal Control:** Removal of feral stock from conservation estate and management of stock on other lands. E.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

### Ecosystems and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

### Subregion priority for off reserve conservation

The subregional priority for off park conservation for much of the subregion (ii) (see Appendix C, rank 6), indicating that a large off park effort needed, resource constraints and limited community capacity exists.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and lease holders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed. The last is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building:** Land Conservation District Committees established and provide a venue for discussion on conservation matters. Participation of all levels of government with Traditional owners in the management of Paruku wetlands.

*Integration with Property Management Planning, Catchment Planning and Landcare:* Land Conservation

District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. There has been some development in the co-ordination of multiple research initiatives and communication of this.

**Legislation: Improved implementation of existing legislation.**

**Threat Abatement Planning as Part of NRM:** Environmental planning across tenure (weeds, fire and feral animals) involving Traditional owners.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management. (e.g. making national parks accessible)

**Integration with Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

**Subregions Where Specific NRM Actions are a Priority to Pursue**

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R
714	Dostline, Peter	(1998).	Gouldian finch recovery plan, Erythrura gouldiae	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R

Continued efforts are important amongst land managers for a more coordinated approach to land management would be for the priority. This is due to differing and potentially competing land uses, the increase in multiple land uses and landscape threats. The NRM rank for the bioregion is (ii) (see Appendix C, rank 7), which indicates significant constraints to integrate conservation as part of production or development system. Whilst data is limited it appears that the Ord subregion is a higher priority for action due to past deterioration than the South Kimberley Interzone subregion.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation and regional ecosystem mapping are required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling program across the subregion to provide a basis for modeling species distribution or status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

### Other Priority Data Gaps:

- Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

No.	Author	Date	Title	Publication Details	Pub. Type
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
556	Portlock, C., Graham, G., Done, C., Gilmour, J. and Williamson, J.	(2001).	Kimberley Region Draft Regional Management Plan. (Unpubl)	Department of Conservation and Land Management.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 094, 100, 118, 173, 268, 333, 551, 626, 634, 635, 636, 637, 648, 674, 692 and 693 in Appendix A.

# Pilbara 1 (*PIL1 – Chichester subregion*)

PETER KENDRICK AND NORM MCKENZIE  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The Chichester subregion (PIL 1) comprises the northern section of the Pilbara Craton. Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* (formerly *Triodia pungens*) hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges. The climate is Semi-desert-tropical and receives 300mm of rainfall annually. Drainage occurs to the north via numerous rivers (e.g. De Grey, Oakover, Nullagine, Shaw, Yule, Sherlock). Subregional area is 9,044,560ha.

### Dominant land use

Grazing – native pastures (see Appendix B, key b), Aboriginal lands and Reserves, UCL & Crown Reserves, Conservation, and Mining leases.

### Continental Stress Class

Continental Stress Class for PIL1 is 4.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

Rare features include the Ripon Hills sinkhole, Meentheena Carbonate stromatolite fossils (also stromatolite fossils at North Pole and elsewhere), geological complexity of the Marble Bar – Nullagine mineral province.

#### Short Range Endemics

Generally very little is known about short range endemic invertebrates in the Pilbara.

#### Rare Vertebrates:

Include Schedule 1 species Mulgara (*Dasyercus cristicauda*), Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*), Bilby (*Macrotis lagotis*), Orange Leaf-nosed Bat (*Rhinonicteris aurantius*), and Princess Parrot (*Polytelis alexandrae*). Species listed under Schedule 4 of the WA Wildlife Conservation Act include Major Mitchell's Cockatoo (*Cacatua leadbeateri*), Peregrine Falcon (*Falco peregrinus*) and Pilbara Olive Python (*Liasis olivaceus barroni*). *Trichosurus vulpecula*

*arnhemensis* and other Critical Weight Range mammals, arid zone populations of Ghost Bat (*Macroderma gigas*), Northwestern Long-eared Bat (*Nyctophilus bifax daedalus*) and Little Northwestern Free-tailed Bat (*Mormopterus loriae cobourgensis*) are also significant in the subregion.

#### Rare Flora:

Species of subregional significance include *Livistona alfreddii* populations in the Chichester escarpment (Sherlock River drainage).

#### Centres of endemism:

Bioregional endemics include *Ningauai timealeyi*, an undescribed *Planigale*, *Dasykaluta rosamondae*, *Pseudomys chapmani*, *Pseudantechinus roryi*, *Diplodactylus savagei*, *Diplodactylus wombeyi*, *Delma elegans*, *Delma pax*, *Ctenotus rubicundus*, *Ctenotus* affin. *robustus*, *Egernia pilbarensis*, *Lerista zietzi*, *Lerista flammicauda*, *Lerista neander*, two or three undescribed taxa within *Lerista muelleri*, *Notoscincus butleri*, *Varanus pilbarensis*, *Acanthophis wellsi*, *Demansia rufescens*, *Ramphotyphlops pilbarensis*, and *Ramphotyphlops ganei*.

#### Refugia:

There are no known true Refugia in PIL1, however it is possible that calcrete aquifers in the upper Oakover system (Davis River) contain stygofauna.

#### High Species and Ecosystem Diversity:

- Hummock grassland reptile and small mammal communities.
- Cracking clay communities of the Chichester Range and Mungaroona Range.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 7) in the CTRC Green Book (Environmental Protection Authority 1974). Some but not all of these recommendations (with modification) were implemented over the following two years. A review of outstanding recommendations was initiated in 1988 and culminated in the production of a report (Henry-Hall *et al.* 1990). This report made recommendations on a nature conservation reserve system for Pilbara which incorporates PIL1. Management planning is underway for Millstream-Chichester National Park. Reserve requirements have not been addressed at a broad scale.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
De Grey, NK001WA	B1, B2, A6, A7, A8, B9	ii	iii	iv	iv (trampling by cattle & feral animals), v (cattle, pigs, donkey, camel and horses), vi (buffel grass and parkinsonia)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Carawine Gorge (Oakover River)	121° 15' E 21° 30' S	B17	ii, iii (Large permanent pools, large fish fauna, waterbirds)	iii	iv	ii	iv, v (cattle, donkey, camel), x (increased flow due to dewatering operations upstream), xii (camping on banks of pools)
Running Waters and Skull Springs (Davis River)	121° 10' E; 21° 40' S	B17	ii, iii (Permanent springs, large permanent pools, large fish fauna, waterbirds, aquatic vegetation)	iii	iv	ii	iv, v (trampling by cattle, donkey, camel), xii (camping along pools)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	i	iii	ii	iv, v (cattle, donkey, camel, horse), vi (buffel grass, parkinsonia, mesquite, mexican poppy), xii (erosion).

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in PIL1.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Heliotropium</i> , <i>Eragrostis</i> community on seepages near Mt Montagu, Chichester Range (Trudgen and Casson 1998)	V	36	Unknown	vi	ii	iv, v (cattle, donkey)
Cracking clay communities of the Chichester Range and Mungarooona Range (Trudgen and Casson 1998; S. van Leeuwen and P. Kendrick pers. comm.; Andrew Mitchell's reports). Chichester tablelands cracking clays, grazed heavily at times in the past, still sometimes by feral and station cattle. Usually high in the landscape, sometimes perched on hill tops and on plateaus.	V	36	Unknown	iv	ii	iv, v (cattle, donkey), xii (mining infrastructure)
Specific snakewood communities. Between Roy Hill and Marillana Stations (A. Mitchell pers. comm.) Will be in AgWA Pilbara rangelands report (in press).	V	23	Unknown	vi	ii-iii	iv, v (cattle)
Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Saltbush Shrublands (de Grey River west side) (A. Mitchell pers. comm.) Will be in AgWA Pilbara Rangelands report (in press).	V	39	Unknown	vi	ii-iii	iv, v (cattle)
Saltbush community of the duplex plains - Mosquito Creek series (Nullagine) (A. Mitchell pers. comm.) Will be in Pilbara Rangelands report (in press).	V	39	Unknown	vi	ii-iii	iv, v (cattle)
Invertebrate assemblages (Errawallana Spring type) Coolawanya Station. Geologically distinct. -213801, 1174625. Sherlock River system. Permanent spring-fed creek. Has atypical invertebrate community. (W. Kay, M. Smith, M. Scanlon, S. Halse). Priority 4 (b)	V	33	Unknown	iv	iii	iv, v (cattle)

Stygofauna of freshwater aquifers of the Pilbara region, Millstream type		N/A	iii	unknown	ii	xii (groundwater drawdown), ix
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<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyercus cristicauda</i>	V	Unknown	iii - iv	iii	v (foxes, cats and herbivores), vii
<i>Macrotis lagotis</i>	V	Unknown	iv	ii	v (cattle?, foxes, cats and herbivores), vii
<i>Rhinonictoris aurantius</i>	V	Unknown	iii	iii	xii (human disturbance)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Polytelis alexandrae</i>	V	Unknown	iii	ii	v (foxes, cats and herbivores), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Liasis olivaceus barroni</i>	V	Unknown	iv	iii	Not threatened, or likely to be.
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	Unknown	iv	ii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Ctenotus nigrilineatus</i>	P1	Unknown	vi	ii	Unknown threatening processes
<i>Burhinus grallarius</i>	P4	Unknown	iv	ii	v (foxes, cats, herbivores), vii
<i>Falco hypoleucos</i>	P4	Unknown	iv	ii	Unknown threatening processes
<i>Lagorchestes conspicillatus leichardti</i>	P3	Unknown	Possibly ii	ii	v (foxes, cats, and herbivores), vii
<i>Leggadina lakedownensis</i>	P4	Unknown	vi	ii	Unknown threatening processes
<i>Macroderma gigas</i>	P4	Unknown	iv	iii	xii (human disturbance)
<i>Neochima ruficauda subclarescens</i>	P4	Unknown	iv	ii	Unknown threatening processes
<i>Pseudomys chapmani</i>	P4	Unknown	iv	iii	Not threatened, or likely to be.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Acacia aphanoclada</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Acacia cyperophylla</i> var. <i>omearana</i>	1	Unknown	vi	Unknown	xii (tourism); iv
<i>Atriplex spinulosa</i>	1	Unknown	vi	Unknown	iv
<i>Fimbristylis</i> sp. Shay Gap (K Newbey 10293)	1	Unknown	vi	Unknown	iv, xii (mining)
<i>Goodenia omearana</i> ms	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Lepidium amelum</i>	1	Unknown	vi	Unknown	iv, xii (trampling)
<b>PRIORITY 2</b>					
<i>Dampiera atriplicina</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Euphorbia clementii</i>	2	Unknown	vi	Unknown	xii (mining)
<i>Euphorbia drummondii</i> subsp. Pilbara (BG Thomson 3503)	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Indigofera ixocarpa</i> ms	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Ischaemum albobilosum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Olearia fluvialis</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Olearia mucronata</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Paspalidium retiglume</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Ptilotus mollis</i>	2	Unknown	vi	Unknown	xii (mining)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
11	Medium woodland; coolabah ( <i>E. microtheca</i> )	0.0	0.0	0.0	H
18	Low woodland; mulga ( <i>Acacia aneura</i> )	0.0	0.0	0.0	H
28	Open low woodland; mulga	0.0	0.0	0.0	H
29	Sparse low woodland; mulga, discontinuous in scattered groups	0.0	0.0	0.0	H
39	Shrublands; mulga scrub	0.0	0.0	0.0	H
41	Shrublands; teatree scrub	0.0	0.0	0.0	H
43	Low forest; mangroves (Kimberley) or thicket; mangroves (Pilbara)	0.0	0.0	0.0	H
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	0.0	0.0	30090.7	L
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	14,165.7	0.0	56785.3	L
95	Hummock grasslands, shrub steppe; acacia & grevillea over <i>Triodia basedowii</i>	0.0	0.0	0.0	M
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	M
101	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex	0.0	0.0	0.0	M
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex	0.0	0.0	0.0	M
117	Hummock grasslands, grass steppe; soft spinifex	0.0	0.0	0.0	M
127	Bare areas; mudflats	0.0	0.0	0.0	H

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	0.0	0.0	0.0	H
136	Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	0.0	0.0	0.0	H
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	5,191.1	0.0	0.0	M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0.0	M/L
171	Hummock grasslands, low tree steppe; snappy gum over soft spinifex & <i>T. brizoides</i>	0.0	0.0	8913.9	M/L
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt	140,162.7	0.0	115414.6	M/L
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex	0.0	0.0	0.0	M/L
175	Short bunch grassland - savannah/grass plain (Pilbara)	22,929.7	0.0	0.0	H
177	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex <i>Triodia brizoides</i>	0.0	0.0	1610.8	M/L
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	0.0	0.0	0.0	M/L
179	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> & <i>A. victoriae</i> over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	M/L
188	Shrublands: mulga & <i>Acacia sclerosperma</i> scrub	0.0	0.0	0.0	H
190	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> & <i>A. trachycarpa</i> over hard spinifex <i>Triodia wiseana</i> , Very poor rocky country on gneiss	0.0	0.0	0.0	M
191	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, <i>Acacia pachycarpa</i> & <i>A. victoriae</i> over <i>T. pungens</i> & <i>T. brizoides</i>	0.0	0.0	0.0	L
192	Hummock grasslands, shrub steppe; kanji over <i>Triodia pulchella</i> & <i>T. brizoides</i> on basalt	0.0	0.0	27599.3	L
196	Hummock grasslands, shrub steppe; kanji over <i>Triodia wiseana</i> on hills of dolerite and shale	1,393.0	0.0	0.0	L
197	Sedgeland; sedges with scattered medium trees; coolabah over various sedges & forbes	0.0	0.0	0.0	H
198	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, <i>Acacia pachycarpa</i> & <i>A. victoriae</i> over <i>Triodia brizoides</i> on chert	0.0	0.0	0.0	L
562	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, open low tree-steppe; snappy gum over <i>T. wiseana</i>	0.0	0.0	0.0	M
569	Hummock grasslands, low tree steppe; bloodwood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	L
587	Mosaic: Hummock grasslands, open low tree-steppe; snappy gum over <i>Triodia wiseana</i> /Hummock grasslands, shrub-steppe; kanji over <i>T. pungens</i>	131,419.3	0.0	0.0	L
589	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; soft spinifex soft spinifex	0.0	0.0	0.0	H
601	Mosaic: Sedgeland; various sedges with very sparse snakewood/Hummock grasslands, shrub-steppe; kanji over soft spinifex	0.0	0.0	0.0	H
603	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex	0.0	0.0	0.0	L
607	Hummock grasslands, low tree steppe; snappy gum & bloodwood over soft spinifex & <i>T. wiseana</i>	16,184.4	0.0	0.0	L
609	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex/Hummock grasslands, open low tree steppe; snappy gum over <i>Triodia wiseana</i> lateritic crust	0.0	0.0	0.0	L
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
619	Medium woodland; river gum ( <i>E. camaldulensis</i> )	264.2	0.0	0.0	H
626	Hummock grasslands, shrub-steppe; kanji over soft spinifex & <i>T. brizoides</i>	19,771.1	0.0	0.0	L
629	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	771.5	0.0	0.0	H
640	Sedgeland; sedges with scattered medium trees; coolabah & river gum over various sedges	0.0	0.0	0.0	H

641	Medium woodland; coolabah & river gum	1,147.9	0.0	0.0	H
646	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i>	41.3	0.0	0.0	L
647	Hummock grasslands, dwarf-shrub steppe; <i>Acacia translucens</i> over soft spinifex	0.0	0.0	0.0	M
649	Sedgeland; Various sedges with very sparse snakewood	0.0	0.0	0.0	H
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>E. dichromophloia</i> ) & <i>E. setosa</i> over soft & curly spinifex on sandplain	0.0	0.0	0.0	H

### Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Uses:** Most of PIL 1 is used for grazing. Most valuable grazing land is along major rivers, especially De Grey/Oakover Rivers.

**Economic Constraints:** Relate to competing land use issue, as acquisition of reserve lands is very expensive in these areas.

**Other:** Lack of detailed fine scale biodiversity mapping to identify priorities for acquisition.

### Bioregional and subregional priority for reserve consolidation

PIL has 7.75% of its surface under some form of conservation tenure and therefore has a reservation class of 3 (see Appendix D, and Appendix C, rank 4). Within the bioregion, PIL1 has 6.56% of its area reserved, PIL2 has 0.79%, PIL3 has 14.10%, and PIL4 has 9.56%. The reservation class for PIL1 is appropriate.

### Reserve management standard

PIL1 contains one national park, one conservation park and one large nature reserve. Millstream-Chichester

National Park has seven resident CALM staff, in addition to 10 Ministry of Justice workers. Other areas have no resident staff. Mungaroona Nature Reserve has no road access to speak of.

**National Parks:** Reserve Management Rank is good (iii) (see Appendix C, rank 5). Millstream-Chichester National Park has a draft management plan, and has high level of ecological monitoring. Extensive weed control and rehabilitation operations, and fire management are underway. However, there are weed issues (buffel, ruby dock) that will be impossible to solve.

**Conservation Parks:** Reserve Management Rank is fair (ii). Meentheena has interim management guidelines, good feral herbivore control (Judas collar program for donkeys and regular aerial shooting), and some fire management, but no resident staff. Buffel grass is well established.

**Terrestrial Nature Reserves:** Reserve Management Rank is fair (ii). Mungaroona Nature Reserve is very difficult to access. No fire management, but occasional aerial shooting of feral herbivores. The area is rough country, so weed and grazing issues likely to be of minor importance.

## Off reserve conservation

## Priority species or groups

Species	Location	Beard Vegetation Association	Threatening Processes <sup>1</sup>
<i>Lagorchestes conspicillatus leichardti</i>	Middle Turner River (PIL 1)	95 – Hummock grasslands, shrub steppe: acacia & grevillea over <i>Triodia basedowii</i> ; 190 – Hummock grasslands, sparse shrub steppe: <i>Acacia bivenosa</i> & <i>A. trachycarpa</i> over hard spinifex <i>Triodia wiseana</i> , very poor rocky country on gneiss; 569 – Hummock grasslands, low tree steppe: bloodwood over soft spinifex & <i>T. wiseana</i> ; 607 – Hummock grasslands, low tree steppe: snappy gum & bloodwood over soft spinifex & <i>T. wiseana</i> .	v (fox), iv, vii
<i>Dasyercus cristicauda</i>	Sandy substrates with <i>Triodia</i> spp in PIL 1 and PIL 4. Possibly isolated pockets along Fortescue Valley (PIL 2)	93 – Hummock grasslands, shrub steppe: kanji over soft spinifex; 98 – Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. basedowii</i> ; 117 – Hummock grasslands, grass steppe: soft spinifex.	v (fox and cat), vii, iv
<i>Macrotis lagotis</i>	Northern and eastern margins of Bioregion (PIL 1), isolated areas in Fortescue valley (PIL 2)	18 – Low woodland: mulga ( <i>Acacia aneura</i> ); 93 – Hummock grasslands, shrub steppe: kanji over soft spinifex; 98 – Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. basedowii</i> ; 117 – Hummock grasslands, grass steppe: soft spinifex.	v (fox and cat), vii, iv
<i>Petrogale rothschildi</i>	Throughout Bioregion, in suitable habitat, PIL 1, PIL 2, PIL 3, PIL 4	11 – Medium woodlands: coolabahs ( <i>E. microtheca</i> ); 82 – Hummock grasslands, low tree steppe: snappy gum over <i>Triodia wiseana</i> ; 93 – Hummock grasslands, shrub steppe: kanji over soft spinifex; 98 – Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. basedowii</i> ; 111 – Hummock grasslands, shrub steppe: <i>Eucalyptus gamophylla</i> over hard spinifex; 117 – Hummock grasslands, grass steppe: soft spinifex; 152 – Hummock grasslands, grass steppe: soft and hard spinifex; 157 – Hummock grasslands, grass steppe: hard spinifex over <i>Triodia wiseana</i> ; 173 – Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. wiseana</i> on basalt; 174 – Hummock grasslands, shrub steppe: mixed shrubs over soft spinifex; 178 – Hummock grasslands, grass steppe: hard spinifex <i>Triodia basedowii</i> ; 190 – Hummock grasslands, sparse shrub steppe: <i>Acacia bivenosa</i> & <i>A. trachycarpa</i> over hard spinifex <i>Triodia wiseana</i> , very poor rocky country on gneiss; 216 – Low woodland: mulga (? with spinifex) on rises; 583 – Hummock grasslands, sparse shrub steppe: kanji & <i>Acacia bivenosa</i> over hard spinifex <i>Triodia basedowii</i> & <i>T. wiseana</i> ; 603 – Hummock grasslands, sparse shrub steppe: <i>Acacia bivenosa</i> over hard spinifex; 607 – Hummock grasslands, low tree steppe: snappy gum & bloodwood over soft spinifex and <i>T. wiseana</i> ; 619 – Medium woodland: river gum ( <i>E. camaldulensis</i> ), 641 – Medium woodland: coolabah & river red gum; 1162 – Hummock grasslands, grass steppe: hard spinifex <i>Triodia wiseana</i> & <i>T. basedowii</i> ; only where suitable rockpile or cliff habitat exists	v (fox), vii, iv (locally significant on granitic plains)

Species	Location	Beard Vegetation Associations	Threatening Processes <sup>1</sup>
<i>Rhinonictoris aurantius</i>	East Pilbara (Marble Bar/Nullagine area), lower Fortescue valley; PIL 1, PIL 2	82 - Hummock grasslands, low tree steppe: snappy gum over <i>Triodia wiseana</i> ; 98 - Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. basedowii</i> ; 152 - Hummock grasslands, grass steppe: soft and hard spinifex; 157 - Hummock grasslands, grass steppe: hard spinifex over <i>Triodia wiseana</i> ; 171 - Hummock grasslands, low tree steppe: snappy gum over soft spinifex & <i>T. brizoides</i> ; 569 - Hummock grasslands, low tree steppe: bloodwood over soft spinifex & <i>T. wiseana</i> ; 587 - Mosaic: Hummock grasslands, open tree steppe, snappy gum over <i>Triodia wiseana</i> /Hummock grasslands, shrub steppe: kanji over <i>T. pungens</i> ; 603 - Hummock grasslands, sparse shrub steppe: <i>Acacia bivenosa</i> over hard spinifex; 609 - Mosaic: Hummock grasslands, open tree steppe, bloodwood with sparse kanji shrubs over spinifex/Hummock grasslands, open tree steppe: snappy gum over <i>Triodia wiseana</i> lateritic crust; 619 - Medium woodland: river gum ( <i>E. camaldulensis</i> ); 641 - Medium woodland: coolabahs & river gum.	xii (human disturbance of disused mines)
<i>Macroderma gigas</i>	East Pilbara (Marble Bar/Nullagine area), lower Fortescue valley; PIL 1, PIL 3	82 - Hummock grasslands, low tree steppe: snappy gum over <i>Triodia wiseana</i> ; 98 - Hummock grasslands, shrub steppe: kanji over soft spinifex & <i>T. basedowii</i> ; 152 - Hummock grasslands, grass steppe: soft and hard spinifex; 157 - Hummock grasslands, grass steppe: hard spinifex over <i>Triodia wiseana</i> ; 171 - Hummock grasslands, low tree steppe: snappy gum over soft spinifex & <i>T. brizoides</i> ; 569 - Hummock grasslands, low tree steppe: bloodwood over soft spinifex & <i>T. wiseana</i> ; 587 Mosaic: Hummock grasslands, open tree steppe, snappy gum over <i>Triodia wiseana</i> /Hummock grasslands, shrub steppe: kanji over <i>T. pungens</i> ; 603 - Hummock grasslands, sparse shrub steppe: <i>Acacia bivenosa</i> over hard spinifex; 609 - Mosaic: Hummock grasslands, open tree steppe, bloodwood with sparse kanji shrubs over spinifex/Hummock grasslands, open tree steppe: snappy gum over <i>Triodia wiseana</i> lateritic crust; 619 - Medium woodland: river gum ( <i>E. camaldulensis</i> ); 641 - Medium woodland: coolabahs & river gum.	xii (human disturbance of disused mines; local barbed wire fencing)

<sup>1</sup>Appendix B, key e

## Species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions	Specific Recovery Plan	General Recovery Plan
<i>Lagorchestes conspicillatus leichardti</i>	i, iii, vii, ix, xii	Habitat retention and protection through reserves and on other state lands. Very few populations known, all on pastoral lease (Tabba Tabba). Require ongoing monitoring and some research, and possibly fire and feral (fox) management.	No. Occasional monitoring only	Recovery Plan for Australian Marsupials and Monotremes
<i>Dasyercus cristicauda</i>	ii?, iii, vii, ix, xii	Habitat protection on private property. Populations recently located by R. Teale. Feral predator control. Needs to be examined for basic documentation of distribution and abundance, and threatening processes. Possibly does not deserve its Schedule 1 status.	Yes - RP (draft), National Threatened Species Recovery team	Recovery Plan for Australian Marsupials and Monotremes
<i>Macrotis lagotis</i>	ii, vii, xii	Habitat protection on private property - status of Mulga Downs population is uncertain. Feral predator control. Needs to be examined for basic documentation of distribution and abundance, and threatening processes. Other populations appear to be secure	Yes - RP, National Threatened Species Recovery team	Recovery Plan for Australian Marsupials and Monotremes
Species	Recovery Actions <sup>1</sup>	Recovery Descriptions	Specific Recovery Plan	General Recovery Plan
<i>Petrogale rothschildi</i>	vii, xii	Local/regional recovery actions include predator control and population monitoring on Dampier Archipelago.	No	Recovery Plan for Australian Marsupials and Monotremes
<i>Rhinonictoris aurantius</i>	i, ii, xii, xiii	Habitat retention and protection through reserves and on private land. Status of population is uncertain. Apparent reliance upon disused mine workings in east Pilbara is of concern, given chances of re-mining. Mining industry needs to be involved in conservation.	No	Recovery Plan for Australian Bats
<i>Macroderma gigas</i>	i, iii, xii, xiii	Habitat retention and protection through reserves and on other state lands. Status of population is uncertain. Apparent reliance	No	Recovery Plan for Australian Bats

		upon disused mine workings in east Pilbara is of concern, given chances of re-mining. Mining industry needs to be involved in conservation.		
<i>Liasis olivaceus barroni</i>	None needed	Not threatened and should not be on list.	No	Recovery Plan for Australian Reptiles
<i>Falco peregrinus</i>	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.	No	Recovery Plan for Australian Birds
Various troglofaunas	i, iii, xii, xiii	Distribution and status largely unknown, but suspected to occur within sub-bioregion. Needs research, and protection on public and leased lands	No	No
Priority 1 and 2 species including: <i>Acacia aphanoclada</i> , <i>Acacia cyperophylla</i> var. <i>omearana</i> , <i>Atriplex spinulosa</i> , <i>Dampiera atriplicina</i> , <i>Euphorbia clementii</i> , <i>Euphorbia drummondii</i> subsp. Pilbara (BG Thomson 3503), <i>Fimbristylis</i> sp. Shay Gap (K Newby 10293), <i>Goodenia omearana</i> ms, <i>Indigofera ixocarpa</i> ms, <i>Ischaemum albavillosum</i> , <i>Lepidium amelum</i> , <i>Olearia fluvialis</i> , <i>Olearia mucronata</i> , <i>Paspalidium retiglume</i> , <i>Ptilotus mollis</i>	xii	Status of species is uncertain. Need to establish basic documentation of distribution, abundance, and threatening processes.	No	No

<sup>1</sup>Appendix B, key h

## Ecosystems

Ecosystem	Location	Threatening Processes <sup>1</sup>
<i>Heliotropium</i> , <i>Eragrostis</i> community on seepages near Mt Montagu, Chichester Range	PIL1	iv, v (cattle, donkey)
Cracking clay communities of the Chichester Range and Mungarooona Range.	PIL1	iv, v (cattle, donkey)
Specific snakewood communities. Between Roy Hill and Marillana Stations.	PIL1	iv, v (cattle)
Saltbush Shrublands (De Grey River west side)	PIL1	iv, v (cattle)
Saltbush community of the duplex plains - Mosquito Creek series (Nullagine)	PIL1	iv, v (cattle)
Invertebrate assemblages (Errawallana Spring type) Coolawanya Station.	PIL1	iv, v (cattle)
Troglofaunas (stygo- and terrestrial) populations	PIL 1, PIL 2, PIL 3	xi (pollution of ground-water), x (removal of groundwater through mine dewatering), xii (waster abstraction - Millstream)
Ecosystem	Location	Threatening Processes <sup>1</sup>
Various reptiles (new or restricted) <i>Ramphotyphlops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Ctenotus</i> aff. <i>robustus</i> <i>Lerista zietzi</i>	Mostly not monitored, and additional collections are needed	No indications that they are threatened
Wetlands of De Grey River (from confluence with Nullagine to sea)	PIL 1	iv, v (feral pigs. Pigs are present in the lower De Grey, and are spreading upstream. They are at high densities along the lower reaches, including mangrove areas)

<sup>1</sup>Appendix B, key e

## Existing ecosystem recovery plans and appropriate recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Action Descriptions	Specific Recovery Plan	General Recovery Plans
<i>Heliotropium</i> , <i>Eragrostis</i> community on seepages near Mt Montagu, Chichester Range	i, ii, iii, xi, vi, vii, xii	Habitat retention through reserves, on private lands and on other state lands. Feral animal control – herbivores. Weed control. Fire management. Research.	No	No
Cracking clay communities of the Chichester Range and Mungarooona Range.	i, ii, iii, xi, vi, vii, xii	Habitat retention through reserves, on private lands and on other state lands. Feral animal control – herbivores. Weed control. Fire management. Research, especially possible effects of mining infrastructure.	No	No
Specific snakewood communities. Between Roy Hill and Marillana Stations.	i, ii, iii, xi, vi, vii, xii	Habitat retention through reserves, on private lands and on other state lands. Feral animal control – herbivores. Weed control. Fire management.	No	No
Saltbush Shrublands (De Grey River west side)	i, ii, iii, xi, vi, vii, xii	Habitat retention through reserves, on private lands and on other state lands. Feral animal control – herbivores. Weed control. Fire management.	No	No
Saltbush community of the	i, ii, iii, xi, vi, vii,	Habitat retention through reserves, on private lands and on	No	No

duplex plains - Mosquito Creek series (Nullagine)	xii	other state lands. Feral animal control – herbivores. Weed control. Fire management.		
Invertebrate assemblages (Errawallana Spring type) Coolawanya Station.	i, ii, iii, xi, vi, vii, xii	Habitat retention through reserves, on private lands and on other state lands. Feral animal control – herbivores. Weed control. Fire management.	No	No
Troglofaunas (stygo- and terrestrial) populations	i, ii, iii, xi, xii, xiii	Habitat retention through reserves, on private lands and on other state lands. Reinstatement of hydrology. Further troglofauna research; Capacity building with mining industry.	No	No
Various reptiles (new or restricted) <i>Ramphotyphlops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Ctenotus</i> affin. <i>robustus</i> , <i>Lerista zietzi</i>	i, ii, iii, xii	Habitat retention through reserves, on private lands and on other state lands. Research.	No	Action Plan for Australian Reptiles
Wetlands of De Grey River (from confluence with Nullagine to sea)	i, ii, iii, xi, vi, ix, xii	Habitat retention through reserves, on private lands and on other state lands. Reinstatement of hydrology. Weed control. Fire management. Research.	No	No

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (iv) (see Appendix C, rank 6), indicating that limited off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** Vegetation management plans, pest management.

**Industry Codes of Practice:** Particularly within the mining industry.

**Environmental Management Systems and Ecologically Sustainable Product Marketing**

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

### Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board, Conservation Through Reserves is limited through mining leases and tenements. There is a need to increase awareness of conservation values through education of various industry (especially mining and pastoral) and the public in general. Limited financial resources are also a major constraint.

### Subregions where specific NRM actions are a priority to pursue

The NRM priority for PIL1 is (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development systems.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967). Quantitative subregional survey of vegetation has not been undertaken.

**Systematic Fauna Survey:** Quantitative subregional survey of fauna has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Quadrat-based floristic data is available from only some localities. Quantitative subregional survey of flora has not been undertaken.

**Ecological and Life History Data:** There is little detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (eg hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species (eg, native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass and ruby dock).

### Other Priority Data Gaps Include:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of the long term impact of mining below water tables, particularly with respect to leaving flooded voids subject to salination.
- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes.

## Sources

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
764	Baker, L.M. and Johnson, K.A.	(undated).	Draft Recovery Plan for the Mulgara ( <i>Dasyercus cristicauda</i> )	Conservation Commission of the Northern Territory	O
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
272	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority.	Environmental Protection Authority, Perth	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
354	Henry-Hall, N.J., Hopper, S.D., McKenzie, N.L. and Keighery, S.D.	(1990).	Nature Conservation Reserves in the Eastern Goldfields, Western Australia - Southern Two Thirds of CTCR System 11.	Report submitted to EPA Red Book Task Force.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
856	Tudgen, M. and Casson	(1998).	Flora and vegetation of Ore Bodies A and B in West Angela Hill area, and area surrounding these ore bodies and of the rail route options considered to link them to existing Robe River Iron Associates rail line.	Unpublished report	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 012, 021, 024, 025, 025, 094, 100, 118, 148, 173, 182, 245, 268, 281, 383, 387, 399,

407, 419, 493, 519, 625, 634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.

# Pilbara 2 (PIL2 – Fortescue Plains subregion)

PETER KENDRICK  
OCTOBER 2001

## Subregional description and biodiversity values

### Description and area

Alluvial plains and river frontage. Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of Mulga (*Acacia aneura*). An extensive calcrete aquifer (originating within a palaeo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput *Melaleuca* woodlands. Climatic conditions are semi desert tropical, with average rainfall of 300 mm, falling mainly in summer cyclonic events. Drainage occurs to the north-west. Subregional area is 2,041,914ha.

### Dominant land use

(see Appendix B, key b)

Grazing (ix) native pastures, (xi) UCL and Crown reserves, (xiii) Conservation, (x) Aboriginal land (lease).

### Continental Stress Class

The Continental Stress Class for PIL2 is 4.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

All are features associated with the Fortescue River.

- Millstream wetlands: Extensive permanent spring-fed streams, pools and river flow that extend for up to 40 kilometres or more below the springs. Large areas of wetland community, including large, deep (up to 2 km long and 15-m deep) riverine pools, springs, riffle streams, marshes and swamps. Extensive areas of cadjeput and river gum forest. A very diverse aquatic invertebrate community, particularly Odonata (dragon and damselflies), and a relatively large fresh water fish fauna. Supports large stands of *Livistona alfredii*, a species restricted mainly to the Fortescue valley around Millstream.
- Millstream aquifer: An extensive calcrete aquifer, lying between the Hamersley and Chichester Ranges, and formed through *in situ* deposition within an ancient river drainage basin. The present aquifer is approximately 400 square kilometres in area (and about 50 km long), with a thickness of calcrete greater than 30 metres. The aquifer is highly transmissive. The Fortescue River flows over part of the aquifer, and recharge is primarily during floods. Numerous springs discharge along the northern lip

of the aquifer, where either the Fortescue River or associated streams have eroded into the water-carrying calcrete. The aquifer is known to contain a stygofauna. Little is known of this fauna, due to lack of survey.

- Fortescue Marsh: An extensive, episodically inundated samphire marsh, approximately 100 km long and 10 km wide. Constricted at the western (downstream) end by the Goodiadarrie Hills, it is possible that the upper Fortescue is prevented from flowing through into the lower Fortescue drainage except in extreme rainfall events. These hills effectively separate the Fortescue into two separate drainages. The Fortescue Marsh represents the terminus for the upper Fortescue. Episodically supports immense water-bird breeding.

#### Short Range Endemics

Generally very little is known about short range endemic invertebrates in the Pilbara.

#### Rare Vertebrates

Includes: Bilby (*Macrotis lagotis*) and Orange Leaf-nosed Bat (*Rhinonictis aurantius*).

#### Rare Flora

Includes: *Eremophila pilosa* ms, *E. spongiocarpa* ms, *Goodenia pallida*, *Swainsona* sp. Millstream (AA Mitchell PRP 798), *Euphorbia drummondii* subsp. Pilbara (BG Thomson 3503), *Gonocarpus ephemerus* and *Ischaemum albobillosum*.

#### Centres of Endemism:

- Millstream aquifer: Almost certain to contain an endemic crustacean, and possibly other groups of stygofauna. Preliminary sampling strongly indicates this. There may also be a terrestrial troglofauna in the upper parts of the calcrete.
- Other calcrete deposits in the eastern parts of PIL2. Note that survey of troglofaunas in these localities is so far preliminary.

#### Refugia:

Note that Morton *et al.* (1995) do not list any refugia within PIL2. In my opinion, not listing the Millstream wetlands was an oversight on their part.

- Millstream wetlands: Large, permanent wetlands, including deep riverine pools, streams and springs provide season refuge for vertebrate species during dry periods, and climatic refuge for many invertebrates.
- Gorges of the Fortescue River, within the Chichester ranges. Deeply incised gorge features provide refuge from fire for plant species (*Terminalia*, *Erythrina*, *Ficus*).

#### High Species and Ecosystem Diversity:

- Odonata species at Millstream.

- Stygofaunal crustacean within calcrete environments, at Millstream and in the upper Fortescue.

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8) (Environmental Protection Authority 1975), in the 'Red Book' reports of 1976 – 1984. These recommendations were reviewed in 1993 (Environmental Protection Authority 1993). Reserve recommendations for PIL2 were that the Millstream area be reserved, and vested in the national Parks Authority. This was implemented, and the resulting national Park was amalgamated with the Chichester Range National Park. No other subregional or bioregional planning for biodiversity conservation has been attempted.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Fortescue Marshes, PIL002WA	B4, B6	ii	iii - iv	iii	iv (grazing & trampling by cattle), v (cattle, pigs, donkey, camel and horses), x (changed hydrology, possibly from Ophthalmia Dam)
Millstream Pools, PIL005WA	B1, B9, B17	ii	iv - v	iii	iv (historically heavy grazing), vi (date palms, cotton palms, buffel grass, parkinsonia, water fern and water lilies), xii (human impact through recreation along river; water abstraction via West Pilbara water supply)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Broad flood-out valleys on the middle Fortescue	Between Millstream and the Goodiadarrie Hills	2, B4, B6	ii (high-productivity seasonally inundated eucalypt grasslands, ephemeral pools and flood channels)	ii	iv	ii	iv, v (cattle), vi (buffel grass)
Gregory and Dogger Gorge, Fortescue River	Gorge of Fortescue, below Millstream	B2, B17	ii (deep gorge, with permanent pools and large stands of cajuput woodland)	ii	iii	ii	v (cattle), vi (date palms, parkinsonia and buffel grass), iv
Mulga Downs Fresh-water Lake	5 km S of Mulga Downs homestead	B6	ii (seasonal lake with emergent <i>Acacia coriacea</i> )	iii	iv	ii	v (cattle), iv

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Fortescue River	ii	iv	ii	iv (cattle, horse), v (donkey), vi (buffel grass, parkinsonia, mesquite, date palm, cotton palm, water fern and water lilies)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Ethel Gorge aquifer stygobiont community		N/A	iii	iii	ii	xii (groundwater drawdown)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
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Permanent wetland communities, Millstream.	-	15	iii	v	iii	vi
Fortescue Marsh saltbush community	-	39	iii	iv	iii	iv, x (Ophthalmia dam)
Perennial grassland communities in the Fortescue Valley	-	37	iii	vi	iii	iv, v (stock), xii (soil erosion)
Grove-intergrove mulga communities at Southern end of Northern apron of Hamersley Range	-	20	ii	vi	iii	iv, v (stock), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V	i	iii - iv	i	v (fox, cat, herbivores)
<i>Rhinonictes aurantius</i>	V	unknown	vi	ii	Unknown threatening processes
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Liasis olivaceus barroni</i>	V	iv	iv	iii	Not threatened, or likely to be. Shouldn't be on list, common, widespread, and not declining
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	ii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Ctenotus affinis uber johnstonei</i>	P2	Unknown	Unknown	Unknown	Unknown threatening processes
<i>Nososticta pilbara</i>	P2	iii	iv	ii	vi (Ceratopteris?)
<i>Ardeotis australis</i>	P4	iii	iv	ii	v (feral predators)
<i>Burhinus grallarius</i>	P4	iii	iv	ii	v (feral predators)
<i>Falco hypoleucos</i>	P4	iii	vi	ii	Unknown threatening processes
<i>Leioprotheron ahenius</i>	P4	iii	iv	ii	Unknown threatening processes
<i>Macroderma gigas</i>	P4	iii	vi	ii	xii (human disturbance; barbed wire)
<i>Neochima ruficauda subclarescens</i>	P4	iii	iv	ii	v (feral predators)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Eremophila pilosa</i> ms	1	Unknown	vi	i-ii	iv
<i>Eremophila spongiocarpa</i> ms	1	Unknown	vi	i-ii	No known threatening processes
<i>Goodenia pallida</i>	1	Unknown	vi	i-ii	No known threatening processes
<i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798)	1	Unknown	vi	i-ii	No known threatening processes
<b>PRIORITY 2</b>					
<i>Euphorbia drummondii</i> subsp. Pilbara (BG Thomson 3503)	2	Unknown	vi	i-ii	No known threatening processes
<i>Ischaemum albavillosum</i>	2	Unknown	vi	i-ii	No known threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )	0.0	0.0	0.0	H
18	Low woodland; mulga ( <i>Acacia aneura</i> )	0.0	0.0	0.0	H
28	Open low woodland; mulga	0.0	0.0	0.0	H
29	Sparse low woodland; mulga, discontinuous in scattered groups	2,649.6	0.0	0.0	L
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	0.1	0.0	0.0	M
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	0.0	0.0	0.0	M
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex	8,264.2	4682.4	0.0	L
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood and feathertop spinifex (on) sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills	0.0	0.0	0.0	H
151	Sedgeland; sedges with open low trees; coolibah over various sedges	0.0	0.0	0.0	H
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0.0	M
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt	0.0	0.0	0.0	M
175	Short bunch grassland - savannah/grass plain (Pilbara)	0.0	0.0	0.0	H
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	0.0	0.0	0.0	M
192	Hummock grasslands, shrub steppe; kanji over <i>Triodia pulchella</i> & <i>T. brizoides</i> on basalt	0.0	0.0	0.0	M
196	Hummock grasslands, shrub steppe; kanji over <i>Triodia wiseana</i> on hills of dolerite and shale	0.0	0.0	0.0	M
197	Sedgeland; sedges with scattered medium trees; coolibah over various sedges & forbes	0.0	0.0	0.0	H
198	Hummock grasslands, low open tree & shrub steppe; sparse snappy gum, <i>Acacia pachycarpa</i> & <i>A. victoriae</i> over <i>Triodia brizoides</i> on chert	0.0	0.0	0.0	M
199	Hummock grasslands, shrub steppe; mulga over soft spinifex <i>Triodia</i> on rises	0.0	0.0	0.0	M
216	Low woodland; mulga (?with spinifex) on rises	0.0	0.0	0.0	M
562	Mosaic: Low woodland; mulga in valleys/Hummock grasslands, open low tree-steppe; snappy gum over <i>T. wiseana</i>	0.0	0.0	0.0	M
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
607	Hummock grasslands, low tree steppe; snappy gum & bloodwood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	M
609	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex/Hummock grasslands, open low tree steppe; snappy gum over <i>Triodia wiseana</i> lateritic crust	0.0	0.0	0.0	M
629	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0.0	H
641	Medium woodland; coolibah & river gum	0.2	0.0	0.0	H
644	Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	H
645	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex	0.0	0.0	0.0	M

	& <i>T. wiseana</i>				
646	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i>	661.1	0.0	0.0	M
676	Succulent steppe; samphire	0.0	0.0	0.0	H

## Subregional constraints in order of priority

(see Appendix B, key g)

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and relatively productive.

**Competing Land Uses:** In particular prospective mining interests and pastoral values.

## Bioregional and subregional priority for reserve consolidation

PIL has 7.75% of its surface under some form of conservation tenure and therefore has a reservation class of 3 (see Appendix D, and Appendix C, rank 4). Within the bioregion, PIL1 has 6.56% of its area reserved, PIL2 has 0.79%, PIL3 has 14.10%, and PIL4 has 9.56%. However, there is considerable bias at the subregional level. A higher priority for reservation is appropriate to include riverine systems and wetlands in the reserve system in PIL2.

## Reserve management standard

PIL2 contains small portions of two national parks, Millstream-Chichester National Park and Karijini National Park. The two parks have seven resident CALM staff, in addition to 10 Ministry of Justice workers at Millstream-Chichester National Park and two to four Visitor Centre staff at Karijini National Park. There are no other areas of conservation estate.

**National Parks:** Reserve Management Standard Rank is good (iii) (see Appendix C, rank 5). Karijini National Park has a management plan, and ongoing weed control. Eradication of cattle, donkeys and horses is underway, as is fire management. Only small portions of the northern margins of Karijini National Park are within PIL2. Millstream-Chichester National Park has a draft management plan, has high level of ecological monitoring, extensive weed control and rehabilitation operations, fire management. However, both have weed issues (buffel, ruby dock) that will be impossible to solve. The Millstream wetlands of the park fall within PIL2.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of fauna and flora & Recreation	Karijini National Park	National Park	iii
A	Conservation of fauna and flora & Recreation	Millstream-Chichester National Park	National Park	iii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Threats/Info	Species Recovery Plan	General Recovery Plan
<i>Macrotis lagotis</i>	One recent record from Mulga Downs Station; a freshly dead animal found in mulga stands of the Fortescue valley by station staff doing a mill run. Possible that a viable population still lives in the Fortescue valley mulgas.	Yes – RP, National Threatened Species Recovery team	Action Plan for Australian Marsupials and Monotremes
<i>Rhinonicteris aurantius</i>	One record, from a road-killed animal collected from the North West Coastal Highway, close to the crossing on the Fortescue River. Probably resident in the Fortescue Gorge, upstream from the crossing. No other data, except that recent searches for the species did not find any at this locality (pers. comm., Kyle Armstrong, 2001)	No	Action Plan for Australian Bats
<i>Liasis olivaceus barroni</i>	Known mainly from rocky areas, particularly along water courses. It is not threatened, and should not be listed as such.	No	The Action Plan for Australian Reptiles
<i>Falco peregrinus</i>	Uncommon resident. Very little data apart from occasional sightings. No information on local population.	No	Action Plan for Australian Birds
<i>Petrogale rothschildi</i>	Local/regional recovery actions include predator control and population monitoring on Dampier Archipelago.	No	Action Plan for Australian Marsupials and Monotremes
<i>Bothriembryon</i> sp.	Scattered populations of an undescribed <i>Bothriembryon</i> species are found along the Fortescue, from Deep Reach to Gregory Gorge. An isolated outlier of a predominantly south western genus (nearest congeneric are in the gorges of the Hamersley Range), closely associated with the calcrete of the Millstream aquifer. Specimens also collected from calcretes at Weeli Wolli Springs. No conservation problems.	No	No
<i>Livistona alfredii</i>	Confined mainly to the Fortescue River valley, mostly	No	No

	near the Millstream aquifer. Also found in Duck Creek (Ashburton drainage), and at Tanberry (Sherlock drainage). Large population present at Millstream (hundreds of thousands of individuals), but are potentially threatened by weeds (date palms).		
Priority 1 and 2 species including: <i>Eremophila pilosa</i> ms, <i>Eremophila spongiorpa</i> ms, <i>Euphorbia drummondii</i> subsp. Pilbara (BG Thomson 3503), <i>Gonocarpus ephemerus</i> , <i>Goodenia pallida</i> , <i>Ischaemum albobillosum</i> and <i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798).	No data	No	No

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Macrotis lagotis</i>	i, vi, xii	Status of Mulga Downs population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Rhinonictus aurantius</i>	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Liasis olivaceus barroni</i>	None needed	Not threatened and should not be on list.
<i>Falco peregrinus</i>	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Eremophila pilosa</i> ms P1	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Eremophila spongicarpa</i> ms P1	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Euphorbia drummondii</i> subsp. Pilbara (BG Thomson 3503) P2	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Gonocarpus ephemerus</i> P2	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Goodenia pallida</i> P1	xii	Habitat retention through reserves or on other State lands or on private lands.
<i>Ischaemum albobilosum</i> P2	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.
<i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798) P1	xii	Status of population is uncertain. Needs to be examined for basic documentation of distribution and abundance, and threatening processes.

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Ecosystem	Location	Beard Veg Assoc	Specific Recovery Plan	General Recovery Plans
Permanent wetland communities, Millstream.	PIL2		No	No
Fortescue Marsh saltbush community	PIL2		No	No
Perennial grassland communities in the Fortescue Valley	PIL2		No	No
Grove-inter-grove mulga communities at Southern end of Northern apron of Hamersley Range	PIL2		No	No
Troglotaunas (stygo- and terrestrial) populations	PIL 1, PIL 2, PIL 3	No Beard Assoc numbers or NVIS numbers applicable to caves.	No	No
Various reptiles (new or restricted) <i>Ctenotus</i> aff. <i>uber johnstonei</i> , <i>Ramphotyphlops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Lerista zielzi</i>	Mostly not monitored, and additional collections are needed	Many and varied vegetation associations	No	No

<sup>1</sup>Appendix B, key e

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Actions
Permanent wetland communities, Millstream.	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Fencing stock away from riverine areas; Weed removal (particularly date palms, cotton palms, parkinsonia); Feral animal control (especially donkeys); Fire management, with specific fire program to encourage a mosaic fire/age distribution; Research into species distributions, requirements and threatening processes.
Fortescue Marsh saltbush community	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Fencing stock away from riverine areas; Feral animal control (especially donkeys); Fire management, with specific fire program to encourage a mosaic fire/age distribution; Research into species distributions, requirements and threatening processes.
Perennial grassland communities in the Fortescue Valley	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Fencing stock away from riverine areas; Feral animal control (especially donkeys); Fire management, with specific fire program to encourage a mosaic fire/age distribution; Research into species distributions, requirements and threatening processes.
Grove-inter-grove mulga communities at Southern end of Northern apron of Hamersley Range	i, ii, iii, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Feral animal control; Fire management, with specific fire program to encourage a mosaic fire/age distribution; Research into species distributions, requirements and threatening processes.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Actions
Troglofaunas (stygo- and terrestrial) populations	i, ii, iii, vii, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Research into species distributions, requirements and threatening processes, particularly troglofaunas.
Various reptiles (new or restricted) <i>Ctenotus</i> aff. <i>uber johnstonei</i> , <i>Ramphotyphlops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Lerista zietzi</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease); Feral animals; Fire management, with specific fire program to encourage a mosaic fire/age distribution; Research into species distributions, requirements and threatening processes.

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that there are a range of off park measures required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. pest management.

**Capacity Building:** In place through Land Conservation District Committees, local land-holder liaison.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands, especially pastoral and aboriginal leases.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements; includes resumption of high quality lands for reservation from existing pastoral leases.

**Threat Abatement Planning as Part of NRM:** e.g. pest management; particularly fox, and feral herbivore control on pastoral lands.

**Capacity Building:** Further capacity building in resource and pastoral industries, particularly possibility for joint or compatible management of pastoral leases owned by mining companies.

**Other Planning Opportunities:** Including local and State government planning for a CAR conservation reserve system.

### Impediments or constraints to opportunities

Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, let alone any further acquisitions. High value conservation areas are held under pastoral leases, and we can't afford to purchase them and therefore resumption is the only option. Impediments exist in operations of the Pastoral Lands Board (need to re-structure un-viable leases after reserve areas are removed). There is a need to increase awareness of conservation values through education of various industry (mining, pastoral) and the public in

general. Limited financial resources are also a major constraint. Weed control is a major cost, but is limited to a few species, in a relatively small area (Millstream wetlands).

### Subregions where specific NRM actions are a priority to pursue

PIL2 has an NRM priority of (i) (see Appendix C, rank 7), indicating that there are major constraints to implement effective NRM actions, especially in regards to the pastoral industry.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967). Quantitative subregional survey of vegetation has not been undertaken.

**Systematic Fauna Survey:** Quantitative subregional survey of fauna has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists, usually for industrial development. Quadrat-based floristic data is available from only a few localities.

**Ecological and Life History Data:** There are few detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species (e.g. native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush, ruby dock and water fern (*Ceratopteris thalictroides*)).

### Other Priority Data Gaps:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly

upon vertebrate communities, invertebrate communities, and non-vascular plants.

- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon

recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.

- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadler, R. and Egler, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
273	Environmental Protection Authority	(1975).	Conservation Reserves for Western Australia. Systems 4,8,9,10,11,12..	Environmental Protection Authority. Perth, Western Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 012, 021, 024, 094, 100, 118, 148, 165, 173, 182, 199, 201, 202, 268, 281, 383, 387, 399, 403, 407, 419, 493, 555, 620, 625, 634, 635, 636,

637, 638, 647, 648, 665, 668, 669, 683 and 699 in Appendix A.

## Pilbara 3 (*PIL3 – Hamersley subregion*)

PETER KENDRICK  
OCTOBER 2001

### Subregional description and biodiversity values

#### Description and area

PIL3 is the Southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west. Subregional area is 6,215,092ha.

#### Dominant land use

Dominant land uses are Grazing – (xi) (see Appendix B, key b), UCL and Crown reserves, (ix) native pastures, (xiii) conservation, (vii) mining, (i) urban.

#### Continental Stress Class

The Continental Stress Class for PIL3 is 6.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- Gorges of Hamersley Range, particularly those of Karijini National Park. Deeply incised gorges, up to 100m deep, containing extensive permanent spring-fed streams and pools. Contain relictual undescribed *Bothriembryon* sp., reptiles (*Lerista zietzi*), relictual populations of plants are highly likely. Spectacular exposures of banded iron formation, and many waterfalls and gorge features.
- Palm Spring, Duck Creek. Large stand of *Livistona alfredii* palms, growing along Duck Creek in the vicinity of a shallow calcrete aquifer and associated springs. Has a largely undescribed troglofauna associated with the calcrete.
- *Themeda* grasslands of Pilbara Region. Grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses (Hamersley Station grass plain).
- Red Hill Station mulga stands. Very isolated areas of mulga, in the extreme west of the subregion. No other biological information, as these patches have never been examined before.

#### Short Range Endemics

Generally very little is known about short range endemic invertebrates in the Pilbara.

#### Wetlands

#### Centres of Endemism:

- Calcrete deposits of PIL3, for troglofauna. Note that survey of troglofaunas in these localities is so far preliminary. Endemic radiations are however almost certain to be located. Area includes Newman and surrounds, localised aquifers in the Hamersley Range, and Duck Creek.

#### Refugia:

Note that Morton *et al.* (1995) list only the gorges of the Hamersley Range as refugia in PIL3.

- Gorges of the Hamersley Ranges. Permanent water and protected from fire. Provide refuge sites for humidophiles and fire intolerant species (e.g. *Callitris*, *Bothriembryon*).
- Calcrete deposits of PIL3, for troglofauna. Note that survey of troglofaunas in these localities is so far preliminary. Areas include the Newman area, localised aquifers in the Hamersley Range, Duck Creek.
- Mountain tops of the Hamersley Range. Provide refuge from fire for a large number of restricted flora species. e.g. *Daviesia eremaea*, *Thysanotus manglesianus*, *Stenanthemum petraeum*, *Eriachne semiciliata*.
- Permanent spring systems, such as Weeli Wolli and Palm Spring (Duck Creek).

#### High Species and Ecosystem Diversity:

- *Acacia*, *Triodia*, *Ptilotus*, *Corymbia*, and *Sida* species within the Hamersley Range.
- Stygofaunal crustacean fauna within calcrete environments. So far poorly known, but indications are for a significantly diverse fauna.

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8) (Environmental Protection Authority 1975), in the 'Red Book' reports of 1976–1984. These recommendations were reviewed in 1993 (Environmental Protection Authority 1993). Reserve recommendations for PIL3 were concerned with Karijini (then Hamersley Range) National Park. Hamersley Gorge and parts of Juna Downs (via land swaps) were added to the Karijini National Park, although the Dales Gorge area was not added to the park because of mining interests. The recommendation that the Palm Springs area of Duck Creek be examined as a potential reserve resulted in no recommendation for reservation. No other subregional or bioregional planning for biodiversity conservation has been attempted.

## Wetlands of National significance (DIWA listings)

Name & Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Karijini Gorges, PIL003WA	B17, B2	iv	iv	ii	vi (ruby dock just arrived), xii (recreational visitation has minimal impact)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Weeli Wolli Spring,	80 km NW of Newman, flows northward into the Fortescue Marsh	B2, B17	ii, iii (Large running spring wetlands, with associated stygofauna)	iii	iii-iv	iii	iv (grazing pressure), v (cattle), vi (buffel grass, date palms), xii (possible mining upstream, de-watering; tourism)
Palm Spring, Duck Creek	100 km WNW of Tom Price, flows westward into the Ashburton	B2, B17	ii, iii (Large running spring wetlands, with associated stygofauna. Outlying population of <i>Livistona alfredii</i> )	iii	iii-iv	iii	v (cattle), vi (buffel grass), xii (possible mining upstream, de-watering)
Mount Bruce coolibah claypan	Eastern foot of Mt Bruce, Karijini National Park	B14	ii (Unique community of <i>E. victrix</i> over ???)	iii	iv	iii	vi, vii, x (mine dewatering)
Springs and pools of the Robe River.	From 40 km E of Pannawonica, downstream to North West Coastal Highway.	B2, B17	ii (Running spring ecosystems, with large deep permanent pools. Possibly stygofauna in shingle of river bed)	ii	iii-iv	iii	iv (grazing pressure), v (cattle), vi (buffel grass, water fern <i>Ceratopteris thalictroides</i> ), xii (mining upstream, de-watering discharge)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Fortescue and Robe Rivers	ii (Buffel grass very common, permanent and semi-permanent pools affected by cattle and feral animals, mining impacts can be locally severe, major potential problems with acid leaching from pyritic shale waste dumps)	iv	ii	iv (grazing pressure, cattle, horse), v (donkey, horse), vi (buffel grass, date palm, water fern, ruby dock), x (mine de-watering; input to systems and drawdown around systems)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened Ecological Communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Themeda</i> grasslands of Pilbara Region. Grassland plains dominated by the perennial <i>Themeda</i> (kangaroo grass) and many annual herbs and grasses.	V	37, 38	ii - iii	iii	ii	iv, v (stock), vi, vii, x

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Grove/inter-grove mulga, eastern Hamersley Range	V	23, 24	ii	iii	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby dock), x (water shadow from linear infrastructure)
Valley floor mulga	V	23, 24	ii	iii	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby dock), vii (large fires killing big mulga stands), x (water shadow from linear infrastructure)
Lower-slope mulga	E	23	i	ii	iii	vii (frequent fires preventing regeneration)
Marillana Station dunefields, adjacent to the Hancock Ranges (dunes support some desert fauna elements such as <i>Ningui ridei</i> and <i>Ctenotus quattuordecimlineatus</i> )		43	Unknown	vi	i	vi (buffel grass), xii (mining infrastructure)
Coolibah Swamp, Mount Bruce, Karijini	V	9	iii	iii-iv	iii	iv (cattle), v (donkey, horse and cattle), vi (ruby

National Park						dock)
Munjina Claypan and associated mulga community	V	36	i	iii	ii	iv (cattle), vii, x (dewatering from mining)
Hill-top foras, Hamersley Range	V	32, 33	iii	iii-iv	iii	vii (frequent fires preventing regeneration, and deliberate burning of buffers)
All major ephemeral water courses	V	4	ii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass, ruby dock)
Wetland community, Weeli Wolli Spring	V	8, 9, 15	iii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass, ruby dock, date palm)
Wetland community, Palm Spring, Duck Creek	V	8, 9, 15	ii	iii	ii	iv (cattle), v (donkey, horse and cattle), vi (buffel grass)
Stygofauna communities, Ore Body 23	-	N/A	iii	vi	iii	x (dewatering from mining)
Other stygofauna associated with aquifers near mining below water table	-	N/A	unknown	vi	ii	x (dewatering from mining)
Lake Robinson-Coondewanna Flats	-		iii	vi	ii	iv, vii, xii (mining infrastructure), x (mine dewatering)
West Angelas Cracking-Clays		43	iii	iii	ii	i, iv
Coolibah-Lignum Flats		43	ii	iii	ii	iv, xii (ground water drawdown)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Rhinonicteris aurantius</i>	V	ii	vi	iii	Unknown threatening processes
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Liasis olivaceus barroni</i>	V	iii	iv	iii	Not threatened, or likely to be. Shouldn't be on list, common and widespread
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	ii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Rampholyphlops gaini</i>	P1	unknown	vi	ii	Unknown threatening processes
<i>Leiotherapon ahenius</i>	P4	iii	vi	ii	Unknown threatening processes
<i>Macroderma gigas</i>	P4	unknown	iv	ii	xii (barb-wire fences)
<i>Pseudomys chapmani</i>	P4	iii	iv	iii	Not threatened, or likely to be.
<i>Sminthopsis longicaudata</i>	P4	unknown	vi	i	v (possibly feral predators - cats)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Lepidium catapycnon</i>	V	iii	v	iii	No known threatening processes, disturbance specialist
<i>Thryptomene wittweri</i>	V	iii	v	iii	No known threatening processes
<b>PRIORITY 1</b>					
<i>Aluta quadrata</i>	1	Unknown	vi	i	xii (mine expansion; surveys being conducted to find locations of new populations)
<i>Barbula ehrenbergii</i>	1	Unknown	vi	i	Unknown threatening processes
<i>Calotis squamigera</i>	1	Unknown	vi	i	iv
<i>Eucalyptus</i> sp. Marandoo (M Trudgen 10362) aff. <i>coolibah</i> var. <i>rhodoclada</i>	1	iii	iv	i	No known threatening processes
<i>Goodenia lyrata</i>	1	Unknown	vi	i	iv
<i>Goodenia omearana</i> ms	1	Unknown	vi	i	iv (minimal)
<i>Gunnopsis</i> sp. Fortescue (M Trudgen 11019)	1	Unknown	vi	i	Unknown threatening processes
<i>Josephinia</i> sp. Marandoo (M Trudgen 1554)	1	Unknown	vi	i	Unknown threatening processes
<i>Mimulus clementii</i>	1	Unknown	vi	i	Unknown threatening processes
<i>Ptilotus trichocephalus</i>	1	Unknown	vi	i	Unknown threatening processes
<i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798)	1	Unknown	vi	i	Unknown threatening processes
<b>PRIORITY 2</b>					

<i>Acacia daweara</i>	2	Unknown	iv	iii	vii, xii (hybrid plant)
<i>Acacia effusa</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Dampiera metallorum</i> ms	2	Unknown	vi	i	Unknown threatening processes
<i>Dicladanthera glabra</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Gonocarpus ephemerus</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Hibbertia glaberrima</i>	2	Unknown	vi	i	No known threatening processes
<i>Indigofera ixocarpa</i> ms	2	Unknown	vi	i	Unknown threatening processes
<i>Olearia fluvialis</i>	2	Unknown	vi	i	No known threatening processes
<i>Olearia mucronata</i>	2	Unknown	vi	i	No known threatening processes
<i>Ptilotus mollis</i>	2	Unknown	vi	i	xii (mining)
<i>Rostellularia adscendens</i> subsp. <i>adscendens</i> var. <i>latifolia</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Spartothamnella puberula</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Stylidium weeliwoffi</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Thysanotus solitaster</i> ms	2	Unknown	vi	i	Unknown threatening processes
<i>Triodia biflora</i>	2	Unknown	vi	i	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
18	Low woodland; mulga ( <i>Acacia aneura</i> )	123,445.2	3,184.2	0.0	M
29	Sparse low woodland; mulga, discontinuous in scattered groups	21,016.8	1,015.4	0.0	M
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>	260,508.3	6,215.7	0.0	L
93	Hummock grasslands, shrub steppe; kanji over soft spinifex	0.0	0.0	0.0	M
94	Hummock grasslands, shrub steppe; kanji over soft spinifex between sand ridges	0.0	0.0	0.0	H
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	M
103	Hummock grasslands, shrub steppe; snakewood over soft spinifex & <i>T. wiseana</i>	12810.1	0.0	20,758.3	L
111	Hummock grasslands, shrub steppe; <i>Eucalyptus gamophylla</i> over hard spinifex	80.0	0.0	0.0	H
118	Hummock grasslands, grass steppe; spinifex <i>Triodia wiseana</i> , <i>T. basedowii</i> & <i>Triodia bitextura</i>	0.0	0.0	0.0	M
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	1222.3	0.0	5,238.7	M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	12,124.6	0.0	0.0	L
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>	11157.7	0.0	17,586.9	L
160	Shrublands; snakewood & <i>Acacia victoriae</i> scrub	0.0	0.0	0.0	H
162	Shrublands; snakewood scrub	0.0	0.0	0.0	H
163	Shrublands; eremophila and cassia dwarf scrub	0.0	0.0	0.0	H
169	Shrublands; mulga & minnieritchie scrub	32,426.2	0.0	0.0	L
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt	0.0	0.0	0.0	H
175	Short bunch grassland - savannah/grass plain (Pilbara)	2.4	0.0	0.0	H
178	Hummock grasslands, grass steppe; hard spinifex <i>Triodia basedowii</i>	1,946.2	0.0	0.0	M
181	Shrublands; mulga & snakewood scrub	3,488.8	0.0	0.0	M
264	Low woodland; <i>Acacia victoriae</i> & snakewood	0.0	0.0	3,444.4	M
565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex	0.0	0.0	0.0	M
567	Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & <i>T. basedowii</i>	189,578.0	1,715.8	0.0	L
568	Hummock grasslands, shrub steppe; mulga & snakewood over <i>Triodia wiseana</i>	0.0	0.0	0.0	H
569	Hummock grasslands, low tree steppe; bloodwood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	H
580	Mosaic: Shrublands; eremophila and cassia dwarf scrub/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0.0	H
583	Hummock grasslands, sparse shrub steppe; kanji & <i>Acacia bivenosa</i> over hard spinifex <i>Triodia basedowii</i> & <i>T. wiseana</i>	108,267.7	0.0	0.0	L
584	Open low woodland; <i>Eucalyptus</i> sp. aff. <i>aspera</i>	0.0	0.0	0.0	H
585	Mosaic: Shrublands; snakewood & <i>Acacia victoriae</i> scrub/Hummock grasslands, shrub-steppe; kanji over soft spinifex & <i>T. basedowii</i>	0.4	0.0	0.0	H
600	Sedgeland; sedges with open low tree savannah; <i>Eucalyptus</i> sp. aff. <i>aspera</i> over various sedges	0.0	0.0	0.0	H

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN	CALM-Purchased Lease	Priority
601	Mosaic: Sedgeland; various sedges with very sparse snakewood/Hummock grasslands, shrub-steppe; kanji over soft spinifex	0.0	0.0	0.0	H
603	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex	0.0	0.0	0.0	M
604	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex	0.0	0.0	0.0	H
605	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> & waterwood over soft spinifex	0.0	0.0	0.0	H
608	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches/Short bunch grassland - savannah /grass plain (Pilbara)	0.0	0.0	0.0	H
609	Mosaic: Hummock grasslands, open low tree steppe; bloodwood with sparse kanji shrubs over soft spinifex /Hummock grasslands, open low tree steppe; snappy gum over <i>Triodia wiseana</i> lateritic crust	0.0	0.0	0.0	H
612	Low woodland; <i>Eucalyptus</i> sp. aff. <i>aspera</i>	0.0	0.0	0.0	H
620	Hummock grasslands, shrub steppe; snakewood over soft spinifex	0.0	0.0	0.0	M
624	Hummock grasslands, shrub steppe; mulga over soft spinifex & <i>T. basedowii</i>	25,559.8	0.0	0.0	L
625	Shrublands; mulga & minnieritchie sparse groups	1,094.6	0.0	0.0	M
629	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.0	0.0	0.0	H
641	Medium woodland; coolibah & river gum	0.0	0.0	0.0	H
644	Hummock grasslands, open low tree steppe; mulga & snakewood over soft spinifex & <i>T. basedowii</i>	0.0	0.0	0.0	H
645	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex & <i>T. wiseana</i>	0.0	0.0	0.0	H
646	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i>	0.0	0.0	12,626.5	L
674	Hummock grasslands, shrub steppe; bowgada & snakewood over <i>Triodia basedowii</i>	0.0	0.0	0.0	H
1162	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i> & <i>T. basedowii</i>	0.0	0.0	0.0	H
1602	Mosaic: Shrublands; snakewood scrub/Hummock grasslands; grass steppe, hard spinifex <i>Triodia basedowii</i> & <i>T. wiseana</i>	0.0	0.0	0.0	H

### Subregional constraints in order of priority (see Appendix B, key g)

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and productive systems are of high value.

**Competing Land Uses:** In particular current and prospective mining interests and pastoral values.

### Bioregional and subregional priority for reserve consolidation

PIL has 7.75% of its surface under some form of conservation tenure and therefore has a reservation class of 3 (see Appendix D, and Appendix C, rank 4). Within the bioregion, PIL1 has 6.56% of its area reserved, PIL2 has 0.79%, PIL3 has 14.10%, and PIL4 has 9.56%.

However, there is considerable bias at the subregional level. Higher priority areas for reservation include bunch

grass plains and lowland mulga, particularly east of Karijini National Park.

### Reserve management standard

PIL3 contains virtually all of Karijini National Park and part of the Cane River Conservation Park. There are no other areas of conservation estate.

**National Park:** Reserve Management Rank (iii) (see Appendix C, rank 5). Karijini National Park has a management plan, ongoing weed control, and fire management has been implemented. Eradication of cattle, donkeys, horses is underway.

**Conservation Park:** Reserve Management Rank (ii). The Eastern half of Cane River Conservation Park is included in the subregion. Managed under Interim Management Guidelines. Weed and feral animal control is underway, and limited fire management is done. Biological inventory survey underway and 250 pit traps are installed.

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of fauna and flora & Recreation	Karijini National Park	National Park	iii
	Conservation of fauna and flora & Recreation	Cane River Conservation Park	Conservation Park	ii

<sup>1</sup>Appendix C, rank 5

## Off reserve conservation

## Priority species or groups and existing recovery plans

Species	Threats/Info	Specific Recovery Plans	General Recovery Plans
<i>Rhinonictus aurantius</i>	No records or other data confirm the presence of this species in PIL3. However, only brief surveys of gorge habitats within Karijini National Park or elsewhere in the Hamersleys have been conducted. It seems likely that this species may be present in PIL3, given that the species occurs in GAS1 and PIL1. Needs further survey.	No	Action Plan for Australian Bats
<i>Sminthopsis longicaudata</i>	No records or other data confirm the presence of this species in PIL3. However, no surveys of suitable habitats within Karijini National Park or elsewhere in the Hamersleys have been conducted. It seems likely that this species may be present in PIL3, given that it occurs in LSD1, GAS3 (???) and GAS1. Needs further survey.	No	Action Plan for Australian Marsupials and Monotremes
<i>Macroderma gigas</i>	Not uncommon; periodic records of individuals being tangled on barbed wire stock fences on stations near Karijini National Park. Few natural maternity roosts known. Removal or modification of fences required.	No	Action Plan for Australian Bats
<i>Pseudomys chapmani</i>	Widespread and abundant in PIL3. Not requiring any further management action	No	Action Plan for Australian Marsupials and Monotremes
<i>Liasis olivaceus barroni</i>	Known mainly from rocky areas, particularly along water courses. It is not threatened, and should not be listed as such. Not requiring any further management action.	No	The Action Plan for Australian Reptiles
<i>Ramphotyphlops gaini</i>	Known from very few collections, Pannawonica area. Not thought to be threatened but requires further survey.	No	The Action Plan for Australian Reptiles
<i>Falco peregrinus</i>	Uncommon resident. Very little data apart from occasional sightings. No information on local PIL3 population.	No	Action Plan for Australian Birds
<i>Leioprotheron ahenius</i>	Present in the Fortescue and Ashburton drainages. Probably not threatened, but requires more survey, and research into tolerance of disturbance from cattle.	No	No
<i>Livistona alfredii</i>	Confined mainly to the Fortescue River valley, mostly near the Millstream aquifer. Also found in Caves Creek (Ashburton drainage), and at Tanberry (Sherlock drainage). Large population present at Millstream (hundreds of thousands of individuals), but are potentially threatened by weeds (date palms).	No	No
<i>Acacia dawweana</i>	Little information on this species. Known to occur within Karijini National Park, but wider status and threatening processes are unknown.	No	No
<i>Acacia effusa</i>	Little information on this species. Known to occur within Karijini National Park, but wider status and threatening processes are unknown.	No	No
<i>Aluta quadrata</i>	No data	No	No
<i>Barbula ehrenbergii</i>	Very little information available on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
<i>Calotis squamigera</i>	No data	No	No
<i>Dampiera metallorum</i> ms	Many populations known within Karijini National Park, and outside National Park. Not uncommonly located on Hamersley hilltops (hilltop flora survey). No information on threatening processes, but a downgrading of status to P3 or P4 is warranted.	No	No

Species	Threats/Info	Specific Recovery Plans	General Recovery Plans
<i>Dicladanthera glabra</i>	Several populations known from near Karijini National Park, and several known from close to Karijini National Park. No information on threatening processes or wider status.	No	No
<i>Eucalyptus</i> sp. Marandoo (M Trudgen 10362) aff. <i>coolibah</i> var. <i>rhodoclada</i>	No data	No	No
<i>Gonocarpus ephemerus</i>	No data	No	No
<i>Goodenia lyrata</i>	No data	No	No
<i>Goodenia omearana</i> ms	No data	No	No
<i>Gunniopsis</i> sp. Fortescue (M Trudgen 11019)	No data	No	No
<i>Hibbertia glaberrima</i>	No data	No	No
<i>Indigofera ixocarpa</i> ms	Several populations known within Karijini National Park, and several outside National Park. No information on threatening processes or wider status.	No	No
<i>Josephinia</i> sp. Marandoo (M Trudgen 1554)	No data	No	No
<i>Lepidium catapycnon</i>	Many populations have been identified in the Hamersley Ranges, mainly as a result work done for the mining industry. DRF status is being reviewed. Populations are known within the Karijini National Park, as well as outside the National Park. Threatening processes are not known, but status is better than once thought.	No	No
<i>Mimulus clementii</i>	No data	No	No
<i>Olearia fluvialis</i>	Very little information on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
<i>Olearia mucronata</i>	Very little information available on this species. Known to occur within PIL3, but status and threatening processes are unknown.	No	No
<i>Ptilotus mollis</i>	Very little information on this species. Known to occur within the Channar mining area (south of Karijini National Park), but status and threatening processes are unknown.	No	No
<i>Ptilotus trichocephalus</i>	No data	No	No
<i>Rostellularia adscendens</i> subsp. <i>adscendens</i> var. <i>latifolia</i>	No data	No	No
<i>Spartothamnella puberula</i>	No data	No	No
<i>Stylidium weeliwoili</i>	No data	No	No
<i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798).	No data	No	No
<i>Thryptomene wittweri</i>	Very little information on this species. Recorded as occurring close to Karijini National Park (in adjacent pastoral lease), but status and threatening processes in PIL3 are unknown..	No	No
<i>Thysanotus solitaster</i> ms	No data	No	No
<i>Triodia biflora</i>	Very little information on this species. Known to occur within Karijini National Park, but status and threatening processes are unknown.	No	No

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	xii	Little data on status of Pilbara population. Unlikely that specific recovery actions are required.
<i>Sminthopsis longicaudata</i>	xii	Status of this species in PIL3 is uncertain. More survey work is required, as habitat appears highly suitable.
<i>Macroderma gigas</i>	xii, xiv	Status of population is uncertain. More survey work is required. Barbed wire fences are a known source of mortality.
<i>Pseudomys chapmani</i>	None required	Status of species is secure; widespread and abundant. No further action necessary.
<i>Rampholyphops gaini</i>	xii	Poorly known species, needs basic definition of range and status before other actions.
<i>Leiotherapon ahenius</i>	xii	Status of population is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.
Declared Rare and Priority 1 and 2 species including: <i>Acacia dawweana</i> , <i>Acacia effusa</i> , <i>Aluta quadrata</i> , <i>Barbula ehrenbergii</i> , <i>Calotis squamigera</i> , <i>Dampiera metallorum</i> ms, <i>Dampiera</i> sp. Mt Meharry (M Trudgen 1178), <i>Dicladanthera glabra</i> , <i>Eucalyptus</i> sp. Marandoo (M Trudgen 10362) aff. <i>coolibah</i> var. <i>rhodoclada</i> , <i>Goodenia lyrata</i> , <i>Goodenia omearana</i> ms, <i>Gunnipopsis</i> sp. Fortescue (M Trudgen 11019), <i>Hibbertia glaberrima</i> , <i>Indigofera ixocarpa</i> , <i>Josephinia</i> sp Marandoo (M Trudgen 1554), <i>Lepidium catapycnon</i> , <i>Mimulus clementii</i> , <i>Olearia fluvialis</i> , <i>Olearia mucronata</i> , <i>Ptilotus mollis</i> , <i>Ptilotus trichocephalus</i> , <i>Rostellularia adscendens</i> subsp. <i>adscendens</i> var. <i>latifolia</i> , <i>Spartothamnella puberula</i> , <i>Stylidium weeliwollii</i> , <i>Swainsona</i> sp. Millstream (AA Mitchell PRP 798, <i>Thryptomene wittweri</i> , <i>Thysanotus solitaster</i> ms, <i>Triodia biflora</i> .	xii	Status of species is uncertain. Needs basic documentation of distribution and abundance, and threatening processes.

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
<i>Themeda</i> grasslands of Pilbara Region. Grassland plains dominated by the perennial <i>Themeda</i> (kangaroo grass) and many annual herbs and grasses.	PIL3	No	No
Troglifaunas (stygo- and terrestrial) populations	PIL 1, PIL 2, PIL 3	No	No
Various reptiles (new or restricted) <i>Rampholyphops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Lerista zietzi</i>	Mostly not monitored, and additional collections are needed	No	Action Plan for Australian Reptiles
Grove/inter-grove mulga, eastern Hamersley Range	PIL3	No	No
Valley floor mulga	PIL3	No	No
Lower-slope mulga	PIL3	No	No
Marillana Station dunefields, adjacent to the Hancock Range	PIL3		
Coolibah Swamp, Mount Bruce, Karijini National Park	PIL3	No	No
Munjina Claypan and associated mulga community	PIL3	No	No
Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
Hill-top floras, Hamersley Range	PIL3	No	No
All major ephemeral water courses	PIL3	No	No
Ecosystem	Location	Specific Recovery Plans	General Recovery Plans
Wetland community, Weeli Wollli Spring	PIL3	No	No
Wetland community, Palm Spring, Duck Creek	PIL3	No	No
Stygofauna communities, Ore Body 23	PIL3	No	No
Other stygofauna associated with aquifers near mining below water table	PIL3	No	No
Lake Robinson-Coondewanna Flats	PIL3	No	No

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix B, key e

## Appropriate ecosystem recovery actions

Ecosystem	Recovery	Recovery Descriptions
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	Actions <sup>1</sup>	
<i>Themeda</i> grasslands of Pilbara Region. Grassland plains dominated by the perennial <i>Themeda</i> (kangaroo grass) and many annual herbs and grasses.	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Troglofaunas (stygo- and terrestrial) populations	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglofaunas.
Various reptiles (new or restricted) <i>Ramphotyphlops pilbarensis</i> , <i>Heteronotia planiceps</i> , <i>Ctenotus angusticeps</i> , <i>Lerista zietzi</i>	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Needs basic documentation of distribution and abundance, and threatening processes.
Grove/inter-grove mulga, eastern Hamersley Range	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Valley floor mulga	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Lower-slope mulga	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Marillana Station dunefields, adjacent to the Hancock Range	i, iii, v, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Needs basic documentation of distribution and abundance, and threatening processes.
Coolibah Swamp, Mount Bruce, Karijini National Park	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Munjina Claypan and associated mulga community	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.
Hill-top floras, Hamersley Range	i, ii, iii, v, vi, vii, ix, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Needs basic documentation of distribution and abundance, and threatening processes.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
All major ephemeral water courses	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms, cotton palms, parkinsonia. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Wetland community, Weeli Wolli Spring	i, ii, iii, v, vi, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Wetland community, Palm Spring, Duck Creek	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal, especially of date palms, cotton palms and parkinsonia. Feral animal control, especially of goats and donkeys. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.
Stygofauna communities, Ore Body 23	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglifaunas.
Other stygofauna associated with aquifers near mining below water table	i, ii, iii, viii, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Revegetation of mining areas, particularly waste dumps and decommissioned pits. Reinstatement of hydrology, especially around mining below water table situations in decommissioned pits. Research into species distributions, requirements and threatening processes, particularly troglifaunas.
Lake Robinson-Coondewanna Flats	i, ii, iii, v, vi, vii, ix, xi, xii	Habitat retention through reserves or on other State lands (including pastoral lease). Fencing to exclude stock. Weed removal. Fire management, with specific fire program to encourage a mosaic fire/age distribution. Reinstatement of hydrology. Needs basic documentation of distribution and abundance, and threatening processes.

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

Subregional priority for off park conservation is (iii) (see Appendix C, rank 6), indicating that there are a range of off park measures required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Industry Codes of Practice:** Particularly within the mining industry.

**Threat Abatement Planning:** Feral animal control, mainly feral herbivores.

**Capacity Building:** Revegetation of mining sites and decommissioned mining areas; Land Conservation District Committees are in place for local land-holder liaison.

**Other Planning Opportunities:** Fire management, especially buffer burning and wildfire suppression. Also some use of patch burning.

**Capacity Building:** Further capacity building in resource and pastoral industries, particularly possibility for joint or compatible management of pastoral leases owned by mining companies.

## Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands, especially pastoral and aboriginal leases, and mining areas.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements; includes resumption of high quality lands for reservation from existing pastoral leases. Also of concern is the practice of pastoral lease holders (mining companies) offering leased land to third parties (Aboriginal groups) for purposes other than those allowed on the lease, for political advantage.

**Threat Abatement Planning as Part of NRM:** e.g. pest management; feral herbivore control on pastoral lands.

**Industry Codes of Practice:** Are potentially powerful, because of the large size and power of the mining companies involved. They have huge resources, and can be a very strong positive influence, particularly when directed appropriately.

**Environmental Management Systems:** Can be very powerful, as per comments in industry codes of practice above.

**Other Planning Opportunities:** Including local and State government planning for a CAR conservation reserve system.

## Impediments or constraints to opportunities

Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, and resulting limitations on management of further acquisitions. Impediments exist in operations of the Pastoral Lands Board (need to re-structure un-viable leases after reserve areas are removed). Need to increase awareness of conservation values through education of various industry (particularly mining and pastoral) groups and the public in general. High value conservation areas are held under pastoral leases, and the Department can't afford to purchase them, therefore resumption becomes the only option. Control of feral herbivores and weeds are inadequate, for example there is not currently enough funding to undertake effective control within Karijini National Park.

Subregions where specific NRM actions are a priority to pursue

PIL3 has a NRM priority of (ii) (see Appendix C, rank 7), indicating that there are significant constraints to integrate conservation as part of production/development system.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Quantitative Fauna Survey:** Subregional survey has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been

examined in detail by botanists, usually for industrial development. Quadrat-based floristic data is available from relatively few localities.

**Ecological and Life History Data:** There are few details known on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There is little data to provide a regional context on population-trends for even ecologically significant species (e.g. native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush and ruby dock).

### Other Priority Data Gaps Include:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of the long term impact of mining below water tables, particularly with respect to leaving flooded voids subject to salination.
- Poor understanding of subregional troglofaunas, particularly stygofaunas associated with palaeo-drainage calcretes.

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519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 012, 024, 025, 026, 094, 118, 148, 173, 182, 248, 262, 268, 281, 383, 387, 407, 419, 493, 524, 555, 620, 625, 634, 635, 636, 637, 638, 647, 648 and 699 in Appendix A.

# Pilbara 4 (PIL4 – Roebourne synopsis)

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## Subregional description and biodiversity values

### Description and area

Quaternary alluvial and older colluvial coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. Climate is arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually. Subregional area is 2, 008, 983ha.

### Dominant land use

Grazing – native pastures (ix) (see Appendix B, key b), Aboriginal lands and Reserves (x), Conservation (xiii), Mining leases (vii), Urban (i).

### Continental Stress Class

The Continental Stress Class for PIL4 is 3.

Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

Off-shore islands of PIL4 are considered in the following groups; Dampier Archipelago, islands between Cape Preston and Onslow (as far west as Serrurier), islands between Cape Lambert and Hedland, islands off Poissonnier Point, and Bedout Island. PIL4 is interpreted to not include the Barrow, Lowendal or Montebello groups, or the Muiron islands, or islands west of Serrurier (i.e. those in Exmouth Gulf).

- Offshore islands, Dampier Archipelago (from Delambre to Eaglehawk). Geologically diverse (sand, limestone, basalt and granite, in various combinations). Vegetation generally *Spinifex longifolius* near beaches, and *Triodia* hummock grasslands elsewhere. Scattered *Acacia coriacea*, *A. bivenosa* and *A. pyrifolia*. *Ficus brachypoda*, *Brachychiton acuminatus* and *Terminalia canescens* associated with rockpiles. Large islands have *E. victrix* along ephemeral drainage lines. Maintained fox-free, through baiting. Legendre is the only large limestone island in this part of the

Pilbara, and appears to contain a limited karst system (small sinkholes occur on the island). Abundant mammal and reptile fauna, including Rothschild's Rock-wallaby (*Petrogale rothschildi*), Pale Field-rat (*Rattus tunneyi*), Water Rat (*Hydromys chrysogaster*), Pilbara Olive Python (*Liasis olivaceus barroni*). Dugongs (*Dugong dugon*) relatively common in inshore waters. Mixed sandy and rocky intertidal shores (tidal range up to 6m). Sea turtles (Loggerhead Turtle (*Caretta caretta*), Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*) and Flatback Turtle (*Natator depressus*)) are all breeding in these islands (all four on Delambre, Rosemary and Legendre). Note that Rosemary nesting beaches have been subject of 15 years of monitoring and tagging of nesting turtles.

Smaller islands support breeding seabirds, including Wedge-tailed Shearwater (*Puffinus pacificus*), Mangrove Heron (*Butorides striatus*), Reef Heron (*Egretta sacra*), Pied (*Haematopus longirostris*) and Sooty Oystercatchers (*Haematopus fuliginosus*), Silver Gull (*Larus novaehollandiae*), Fairy Tern (*Sterna nereis*), Caspian Tern (*Sterna caspia*), Crested Tern (*Sterna bergii*), Bridled Tern (*Sterna anaethetus*), White-bellied Sea Eagle (*Haliaeetus leucogaster*), Brahminy Kite (*Haliastur indus*), Osprey (*Pandion haliaetus*), Pelican (*Pelecanus conspicillatus*) (Keast and Cohen Islands) and Beach Stone Curlew (*Esacus neglectus*) (Enderby). Intense archaeological values; rock art, habitation sites, quarries, ethnographic sites. Local populations (Dampier Archipelago) of Brown Honeyeater (*Lichmera indistincta*) are probably sub-specifically distinct. Several historical sites; whaling (Malus), pearling camps (Gidley), graves (Eaglehawk, Dolphin, Enderby), abandoned pastoral homestead (West Lewis). Significant local mangroves include those on West Lewis, Legendre, Dolphin and Enderby. The surrounding waters are being considered as a marine reserve, and include diverse marine habitats, an abundant and diverse fish fauna, and diverse soft invertebrate (sponges, echinoderms etc) communities. Most islands have infestations of weeds, including kapok (most or all), buffel (most or all), prickly pear (two or three) and tamarisk (two islands).

- Offshore islands, Dampier to Onslow (from North East Regnard to Serrurier). Most are sandy, sometimes on a limestone base. Vegetation usually coastal species (*Spinifex longifolius*, *Acacia coriacea*, *A. bivenosa* etc), with some *Triodia* inland. Many seabird nesting records, including Pelicans (*Pelecanus conspicillatus*) (Little Rocky Island), Wedge-tailed Shearwater (*Puffinus pacificus*) and Pied Cormorants (*Phalacrocorax varius*). Mammal fauna includes Pale Field-rat (*Rattus tunneyi*), Little Red Kaluta (*Dasykaluta rosamondae*), Western Chestnut Mouse (*Pseudomys nanus*) (yet to be

determined whether it is the same subspecies found on Barrow) and Short-tailed Mouse (*Leggadina lakedownensis*) (Thevenard I, successfully translocated to Serrurier). Sea turtle nesting is known to occur, but details are sketchy. Dugongs (*Dugong dugon*) relatively common in inshore waters. Shores usually either sandy, with sand flat and/or limestone pavement intertidal. The exception to this pattern is Potter Island, which is predominantly banded iron formation (and unique among Pilbara islands in this regard). Potter has a relatively large reptile fauna and two mammals as well, being large, with more complex habitats, and close to the mainland. Feral animals (fox, cat) may be present on Carey Island, but appear to be absent from adjacent Potter Island. Most of the islands have small patches of mangal, while Potter and Carey have extensive mangrove areas. Buffel grass is present on many islands, while kapok bush is on some.

- Islands between Cape Lambert to Hedland. Many are sandy (Weerde, Downes, Ronsard), sometimes on a limestone base, while Depuch is almost entirely basalt. Vegetation usually coastal species (*Spinifex longifolius*, *Acacia coriacea*, *A. bivenosa* etc), with some *Triodia* inland on larger islands. Biological information poor. Some seabird nesting records, including Wedge-tailed Shearwater (*Puffinus pacificus*) (Sable and West Moore), Osprey (*Pandion haliaetus*) and Reef Heron (*Egretta sacra*) (West Moore) - no records for East Moore, Depuch, Ronsard, Reefs, Downes or Weerde Is). Mammal fauna poorly known, preliminary survey indicates that Water Rats (*Hydromys chrysogaster*) (tracks), and Pale Field-rat (*Rattus tunneyi*) may be present on West Moore. Cats were observed on Depuch in 1993. No sign of cats were observed in April 2000, although foxes were. Downes Island has a relatively large reptile fauna (8 species recorded), but only two native mammals (and both *Mus musculus* and *Rattus rattus*; there may also be foxes present). Sea turtle nesting is likely to occur, but no details are known. Dugongs (*Dugong dugon*) relatively common in inshore waters. Shores usually either sandy, with sand flat and/or limestone pavement intertidal. The exception to this pattern is Depuch Island, which is almost completely basalt rockpile (and unique in this regard). Depuch may have a relatively large reptile fauna, as it is large, contains sheltering habitats, and is close to the mainland. A local population of Rock-wallaby (*Petrogale lateralis*) is now extinct, due to fox predation. Contains an enormous amount of rock art, of high aesthetic quality. Contains an historic landing site, and historical graffiti.
- Islands off Poissonnier Point (Little Turtle and North Turtle) of unknown substrate. Nesting seabirds include Pelican (*Pelecanus conspicillatus*), Caspian Tern (*Sterna caspia*), Pied Cormorant (*Phalacrocorax varius*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*) (North Turtle - no records for Little Turtle). Levels of weed invasion and other values are unknown.
- Bedout Island. Sandy island on limestone substrate. High value seabird nesting island; >1000 Brown Booby (*Sula leucogaster*) pairs nesting, >1000 Common Noddy (*Anous stolidus*), >1000 Crested Tern (*Sterna bergii*), 500-1000 Lesser Frigatebird (*Fregata ariel*), 100-500 Masked Booby (*Sula dactylatra*), as well as Lesser Crested Tern (*Sterna bengalensis*), Roseate Tern (*Sterna dougallii*), Sooty Tern (*Sterna fuscata*), Silver Gull (*Larus novaehollandiae*) and White-bellied Sea Eagle (*Haliaeetus leucogaster*). Several of these do not nest elsewhere in the Pilbara. A small infestation of buffel grass is present around the navigation beacon.
- Burrup Peninsula. Geologically simple (mainly basalts, some granite and coastal sands), but with relatively high and complex relief. A few near-permanent fresh water rockholes, fed by seepages. Baited to control foxes, to protect a low density population of Rothschild's Rock-wallaby (*Petrogale rothschildi*) on the Burrup and on adjacent Dolphin Island. Olive Pythons (*Liasis olivaceus barroni*) from Hearsons Cove area are currently the subject of a radio-tracking study; this species is present all over the Burrup. Vegetation types generally distinct from mainland vegetation, and high level of flora endemism. Significant regional mangrove stands, particularly at Conzinc Bay, Cowrie Cove, Watering Cove, and adjacent to Dampier Salt Pond Zero intake. Intense archaeological values; very large rock art sites, some containing thousands of images. Many habitation sites, quarries, ethnographic sites. Several historical sites at the southern end, probably pearling camps. Significant weed infestation in disturbed sites (buffel grass and kapok bush).
- Cane River (Peedamulla) Swamp (Cyperaceae) Community. A unique community of seasonally inundated coolibah (*E. victrix*) over a mixed sedgeland comprised mainly of Cyperaceae, one of which may be undescribed (*Fimbristylis* sp. aff. *microcarya*), with *Cyperus scariosus*, *C. vaginatus*, *C. carinatus* and *C. blakeanus*. Relatively large in extent (approximately 500Ha), the swamp is threatened by grazing, erosion and weeds (buffel, mesquite). Longer term, changes in the flow patterns of the Cane River may also endanger the swamp.

#### Centres of endemism:

- Burrup Peninsula: Apparently a minor centre of endemism for terrestrial gastropods (family Camaenidae). At least six species, of which two or three are undescribed.

#### Short Range Endemics

Generally very little is known about short range endemic invertebrates in the Pilbara.

#### Refugia:

- Burrup Peninsula: Fire and evolutionary refuge for flora.
- Islands provide refuges for fauna. Several mammal or reptile species are restricted to islands of PIL4. These are either naturally occurring, or have been placed there. Naturally occurring include Western

Chestnut Mouse (*Pseudomys nanus*), Pale Field-rat (*Rattus tunneyi*), Little Red Kaluta (*Dasykaluta rosamondae*), Short-tailed Mouse (*Leggadina lakedownensis*), *Ctenotus angusticeps*, sea turtles (four species) and seabirds (nesting).

- Basalt rockpiles: As fire refuges.

#### High Species and Ecosystem Diversity:

- Burrup Peninsula: Provides high habitat diversity for plants, and displays high species diversity for Camaenid landsnails.

In 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Pilbara (System 8) (Environmental Protection Authority 1975), in the 'Red Book' reports of 1976 – 1984. Reserve recommendations in the Pilbara (including PIL4) included many reserve proposals for offshore islands, including the Dampier Archipelago and many islands between Onslow and Cape Keraudren. In 1993, the 'Red Book Status Report' reviewed the implementation of these recommendations (Environmental Protection Authority 1993). Most recommendations pertaining to islands had been implemented, including most of those relating to the declaration of reserves. Proposed B-class island reserves between Dixon Island and Cape Keraudren have not progressed. No other subregional or bioregional planning for biodiversity conservation has been attempted.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

## Wetlands

Wetlands of National significance (DIWA listings)

Name, Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
De Grey River, PIL001WA	B1, B2, A6, A7, A8, B9	ii	iii	ii	iv (grazing and trampling by cattle), v (cattle, pigs, donkey, camel and horses), vi, (buffel grass and parkinsonia)
Leslie (Port Hedland) Saltfields System, PIL004WA	C4, A8, A9, A7	iii	iv	ii	System is largely artificial. ix (expansion of saltfield and consequent increase in salinity of present Pond Zero)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Wetlands of subregional significance (in addition to the DIWA listed wetlands)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Permanent pools of coastal rivers: Turner, Yule, Sherlock, Harding, Maitland, Fortescue	Pools within 40 km of coast	A11, B2, B9, B17	Large perm. pools, springs, large fish fauna, water birds, invertebrates	ii	iii	iii	iv, v (cattle, donkey, camel), vi (buffel grass, mesquite, parkinsonia), x (decreased flow due to dam on Harding River), xii (camping on banks of pools, e.g. Miaree Pool)

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Mangroves (from Johnstone 1990 and pers. comm.): mouth of De Grey, Turner, Yule, Harding and Cane Rivers, Port Hedland, Balla Balla, Dixon Island, West Intercourse Island, Nickol Bay, Fortescue River delta, Maitland river delta, Robe river delta, Cossack to Harding delta complex, Sherlock Bay, Ronsard Island area.	various	A9	Several unique birds (sub-species or varieties, R Johnstone), incl. grey-morph yellow silveryeye and brown honeyeater, red mangrove herons at Cane River; limits of range for some species, including Shining flycatcher (Harding River), Redthroat	iii	iii-iv	iii	ix (via causeways, bunding, bridges, damming of Harding River), v (cattle, donkey, camel, from sheltering under trees), xi (urban and industrial, especially near ports and towns, also possibly bitterns outflows)
Cane River Swamp	Mouth of Cane River, 115 22.3'E 21 34.3' S		<i>E. victrix</i> over sedge (Cyperaceae) wetland. Episodically inundated.	ii	iii	iii	iv (grazing pressure), vi (buffel grass, mesquite, <i>Parkinsonia</i> ), x (change in hydrology due to erosion; also changes in Cane River outflow channel)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Fortescue River	ii (Buffel grass very common, permanent and semi-permanent pools affected by cattle and feral animals)	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
Maitland River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
Turner River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
De Grey River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
George River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
Nichol River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii
Sherlock River	ii	iii	ii	iv, v (cattle, sheep and horse), vi (buffel grass, parkinsonia, mesquite), iv, vi, vii, v (foxes, cats, rabbits and goats), iii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in PIL4.

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Mangrove communities that are at risk from mining and associated landuses and industry.	V	40	iii	iii	iii	ii, ix, x (loss of fresh water flushing from Harding Dam construction (monitoring to be confirmed)), xi (industrial pollution in Dampier and Port Hedland harbours (hydrocarbons, TBTs, sediment

						others), bitterns discharges, NO <sub>2</sub> emissions), xii (development and expansion of mining sites and infrastructure)
Rock pool communities, Burrup Peninsula: Calcareous (tufa) deposits, aquatic mollusc fauna of interest (undescribed species of molluscs).	V	33	Unknown	iii	ii	xi (industrial emissions)
Rock pile communities, Burrup Peninsula and Dolphin Island: Fauna is a mixture of Kimberley and Pilbara species, different to adjacent Chichester Range rockpile communities.	V	33	ii	iii	iii	ii, vi (buffel), xi (in dust emissions)
Roebourne Plains coastal grasslands, Sherlock Station and Roebourne Common, Airport Reserve (between Roebourne and Karratha), 7 Mile Creek.	V	36	ii	iii	iii	iv, vi (buffel, kapok, parkinsonia)
Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River.	V	9	ii	ii	iv	iv (cattle), vi (mesquite, buffel), x (gully erosion), xii (recreation)
Mount Salt, calcareous mound spring. Large calcareous mound, recently dry (possibly due to depression of local water table by mesquite weed).	V	41	ii	iv	iii	vi (mesquite has depressed local water table)
Roebourne Plains stony chenopod association.	V	31	ii	iii	ii	iv, v, vi (buffel)
Creekline communities dominated by <i>Cynanchum</i> aff. <i>floribundum</i> , east branch of Harding River, near Chichester escarpment.	V	8	ii	iii	ii	iv, v, vi (buffel)
Pilbara off-shore island communities (fauna and flora)	V	33, 24, 23,	ii	ii-iii	iii	vi (buffel grass, kapok bush)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Rhinonictis aurantius</i>	V	ii	iii (known to be declining at disturbed sites)	iii	xii (human disturbance associated with tourism, mining, scientific activity)
<i>Petrogale lateralis</i>	V	i	i (extinct on Depuch, possibly to be reintroduced from Calvert Range)	iii	v (fox, cat)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Caretta caretta</i>	E	Unknown	iii - iv	iv	xii (human disturbance), v (fox)
<i>Chelonia mydas</i>	V	Unknown	iii - iv	iv	xii (human disturbance), v (fox)
<i>Eretmochelys imbricata</i>	V	Unknown	iii - iv	iv	xii, human disturbance, v (fox)
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Natator depressus</i>	V	Unknown	iii - iv	iv	xii (human disturbance, including hunting), v (fox)
<i>Dermochelys coriacea</i>	V	Unknown	iii - iv	ii	xii (human disturbance)
<i>Ctenotus angusticeps</i>	V	iii	iii - iv	iii	xii (human disturbance, oil base), vi (buffel grass)
<i>Liasis olivaceus barroni</i>	V	iii	iv	ii	Not threatened, or likely to be. Shouldn't be on list, common, widespread, and not declining
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 1 (MAMMALS)</b>					
<i>Dugong dugon</i>	SP	iii	iii - iv	iii	xii (human disturbance, hunting)
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	Unknown	iv	ii	No known threatening processes
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Crocodylus porosus</i>	SP	iii	v	ii	xii (human disturbance)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Abutilon</i> sp. Onslow (F Smith sn 10.9.1961)	1	Unknown	vi	i - ii	Unknown threatening processes
<i>Goodenia omearana</i> ms	1	Unknown	vi	i - ii	xii (mining)
<i>Helichrysum oligochaetum</i>	1	Unknown	vi	i - ii	Unknown threatening processes
<i>Ptilotus appendiculatus</i> var. <i>minor</i>	1	Unknown	vi	i - ii	xii (industrial development), iv

<i>Ptilotus stipitatus</i>	1	Unknown	vi	i	Unknown threatening processes
<i>Terminalia supranitifolia</i>	1	Unknown	iv	ii	xii (industrial development), iv
<i>Fimbristylis aff. microcarya</i>	1	Unknown	ii	ii	iv (grazing pressure), vi (buffel grass, mesquite, parkinsonia), x (change in hydrology due to erosion: changes in Cane River outflow channel)
<b>PRIORITY 2</b>					
<i>Carpobrotus</i> sp. Thevenard Island (MR White 050)	2	Unknown	vi	i - ii	xii (Petroleum development), vi (buffel grass)
<i>Euphorbia clementii</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Gomphrena cucullata</i>	2	Unknown	vi	i	Unknown threatening processes
<i>Gomphrena pusilla</i>	2	Unknown	vi	i	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
11	Medium woodland; coolibah ( <i>E. microtheca</i> )				M
29	Sparse low woodland; mulga, discontinuous in scattered groups				M
43	Low forest: mangroves (Kimberley) or thicket: mangroves (Pilbara)		3,580.0		H
82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i>				M
93	Hummock grasslands, shrub steppe; kanji over soft spinifex		386.3		M
98	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. basedowii</i>			0.5	M
101	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex				M
117	Hummock grasslands, grass steppe; soft spinifex	7,444.8	7,851.7		L
125	Bare areas; salt lakes				L
127	Bare areas; mudflats		30,345.4		L
152	Hummock grasslands, grass steppe; soft & hard spinifex soft spinifex	1,508.5			M
157	Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>	0.1	10.5		M
Beard Veg Code	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve Ha	CALM-Purchased Lease	Priority
158	Hummock grasslands, shrub steppe; kanji over <i>Triodia basedowii</i>				M
173	Hummock grasslands, shrub steppe; kanji over soft spinifex & <i>T. wiseana</i> on basalt				M
175	Short bunch grassland - savannah/grass plain (Pilbara)		363.8		H
196	Hummock grasslands, shrub steppe; kanji over <i>Triodia wiseana</i> on hills of dolerite and shale				M
197	Sedgeland; sedges with scattered medium trees; coolibah over various sedges & forbes				H
583	Hummock grasslands, sparse shrub steppe; kanji & <i>Acacia bivenosa</i> over hard spinifex <i>Triodia basedowii</i> & <i>T. wiseana</i>				M
584	Open low woodland; <i>Eucalyptus</i> sp. aff. <i>aspera</i>	781.6			M
585	Mosaic: Shrublands; snakewood & <i>Acacia victoriae</i> scrub/Hummock grasslands, shrub-steppe; kanji over soft spinifex & <i>T. basedowii</i>	37667.1		63,455.3	L
587	Mosaic: Hummock grasslands, open low tree-steppe; snappy gum over <i>Triodia wiseana</i> /Hummock grasslands, shrub-steppe; kanji over <i>T. pungens</i>				M
589	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; soft spinifex soft spinifex	13,507.6	250.7		M
600	Sedgeland; sedges with open low tree savannah; <i>Eucalyptus</i> sp. aff. <i>aspera</i> over various sedges		1,036.2		H
601	Mosaic: Sedgeland; various sedges with very sparse snakewood/Hummock grasslands, shrub-steppe; kanji over soft spinifex		2,326.3		M
603	Hummock grasslands, sparse shrub steppe; <i>Acacia bivenosa</i> over hard spinifex				M
604	Hummock grasslands, shrub steppe; kanji & snakewood over soft spinifex		199.4		M
605	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> & waterwood over soft spinifex	276.4			M
606	Hummock grasslands, shrub steppe; <i>Acacia victoriae</i> & snakewood over soft spinifex				M
608	Mosaic: Shrublands; <i>Acacia victoriae</i> & snakewood scrub patches/Short bunch grassland - savannah/grass plain (Pilbara)				H
619	Medium woodland; river gum ( <i>E. camaldulensis</i> )				H
620	Hummock grasslands, shrub steppe; snakewood over soft spinifex				M
629	Mosaic: Short bunch grassland - savannah/grass plain (Pilbara)/Hummock grasslands, grass steppe; hard spinifex <i>Triodia wiseana</i>				H
640	Sedgeland; sedges with scattered medium trees; coolibah & river gum over various sedges				H
641	Medium woodland; coolibah & river gum				H
646	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i>				M

647	Hummock grasslands, dwarf-shrub steppe; <i>Acacia translucens</i> over soft spinifex				H
649	Sedgeland; Various sedges with very sparse snakewood				H
667	Hummock grasslands, shrub-steppe; scattered shrubs over <i>Triodia wiseana</i> & <i>T. sp. indet. aff. angusta</i>	19,948.6			M
670	Hummock grasslands, shrub steppe; scattered shrubs over <i>Triodia basedowii</i>				M
676	Succulent steppe; samphire		1,077.1		H
699	Shrublands, pindan; <i>Acacia eriopoda</i> shrubland with scattered low bloodwood ( <i>E. dichromophloia</i> ) & <i>E. setosa</i> over soft & curly spinifex on sandplain				H

### Subregional constraints in order of priority (see Appendix B, key g)

**Economic Constraints:** In terms of the cost of land acquisition as well as constraints in terms of implementing management. Most land is pastoral lease, and relatively productive. Aboriginal lands are probably not available for reservation, but pastoral leases held by mineral producers may be available.

**Competing Land Uses:** In particular prospective mining interests and pastoral values. Major resource developments are planned for coastal locations (including Cape Preston), and on some islands. Some islands (Legendre, West Intercourse, Dixon) are still nominated for future industrial development.

### Bioregional and subregional priority for reserve consolidation

PIL has 7.75% of its surface under some form of conservation tenure and therefore has a reservation class of 3 (see Appendix D, and Appendix C, rank 4). Within the bioregion, PIL1 has 6.56% of its area reserved, PIL2 has 0.79%, PIL3 has 14.10%, and PIL4 has 9.56%. The reservation class for PIL4 is appropriate.

### Reserve management standard

PIL4 contains parts of one national park, one conservation park and many island nature reserves. Millstream-Chichester National Park has resident staff, however, other areas have no resident staff. Island nature reserves vary from being visited on a weekly basis (Dampier Archipelago) to being visited perhaps once every 4 years (e.g. Bedout Island).

**National Parks:** Reserve Management Rank is good (iii) (see Appendix C, rank 5). Millstream-Chichester National Park has a draft management plan, has high level of ecological monitoring, extensive weed control and rehabilitation operations, fire management. However, has weed issues (buffel, ruby dock) that will be impossible to solve.

**Conservation Parks:** Reserve Management Rank is fair (ii). Cane River/Mount Minnie/Barlee Range has interim management guidelines, feral herbivore control is progressing, and a resident caretaker is looking after fences, roads and facilities, some fire management.

**Island Nature Reserves:** Reserve Management Rank is poor (i). Many have buffel grass (*Cenchrus ciliaris*) and kapok bush (*Aerva javanica*) on them, which appear to be rapidly spreading. Some predator control (foxes) is undertaken on islands with rock wallaby populations. Visitor use is problematic in some cases (weeds mainly, occasionally feral predators such as dogs and cats). Thevenard Island has an oil base and recreation accommodation development. These have contributed to spread of weeds (buffel grass) and feral animals (house mice). No attempt so far to manage fire on any islands. Fauna and flora reasonably well known, but not complete, particularly for islands between Cape Lambert and Port Hedland. Dampier Archipelago has management plan which is due to be rewritten. Increasing use by locals, tourists and charter operators could increase risk of feral introductions or spread of weeds. Airlie Island has an oil base which has contributed to spread of weeds (buffel), but control is taking place. Dampier Archipelago/Cape Preston proposed marine reserve in planning phase. Some uncontrolled camping and commercial operations on nature reserve islands (e.g. Regnards, Sholl, Steamboat, Serrurier). Lighting management is important on islands with infrastructure to protect nesting turtles (Thevenard, Airlie).

Class	Purpose	Name	Category	Reserve Management <sup>1</sup>
A	Conservation of fauna and flora & Recreation	Millstream-Chichester National Park	National Park	iii
	Conservation Park	Cane River/Mount Minnie/Barlee Range	Conservation Park	ii
	Conservation of fauna and flora	Many island nature reserves	Nature Reserve	i

<sup>1</sup>Appendix C, rank 5

### Off reserve conservation

#### Priority species or groups and existing recovery plans

Species	Location	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
<i>Macroderma gigas</i>	Low density occurrence in abandoned mines in vicinity of Pinderi Hills, and it may forage over the coastal plains.	xii (human disturbance of disused mines; barbed wire fencing on Karratha and Mount Welcome Stations (No reports of entangled bats yet))	No	Action Plan for Australian Bats
<i>Petrogale lateralis</i>	Recently extinct on Depuch Island	v (control of fox would be required, also possibly cats)	No	Action Plan for Australian

				Marsupials and Monotremes
<i>Petrogale rothschildi</i>	At present common throughout Pilbara. However, island populations are known to decline in presence of foxes.	v (fox control required on near-coastal islands). Foxes have been removed from islands in the eastern part of the Dampier Archipelago, including Dolphin, Angel, Gidley, Legendre and Hauy Islands over the last 12 – 15 years	No	Action Plan for Australian Marsupials and Monotremes
<i>Caretta caretta</i>	Loggerhead turtle known to nest on Delambre, Rosemary, Legendre but only in very low numbers	v (fox and cat predation of nests and young turtles); xii (human disturbance of nests). No hunting of adults is known. Prawn fishery probably kills unknown but significant number of adults (TEDs not applied in Nickol Bay or Onslow fisheries).	No	Action Plan for Australian Reptiles
<b>Species</b>	<b>Location</b>	<b>Threatening Processes<sup>1</sup></b>	<b>Specific Recovery Plan</b>	<b>General Recovery Plan</b>
<i>Chelonia mydas</i>	Green turtles nest on islands and occasionally on mainland beaches (Cape Preston, Cape Lambert, and possibly others)	Mainland breeding is disrupted by (v) feral predators (especially fox, also cat) taking eggs and hatchlings. Also reports of (xii) significant hunting of adults during nesting time by Aboriginal people. This occurred mainly at Munda, and that beach is now closed to the public. Minor hunting by boat by Thursday Island people. Mainland beaches are also disrupted by vehicles, which destroy nests. Township lighting (xii) is an issue, particularly at Hedland. Island populations are at risk from (v) fox and cat (where present), and to a much smaller extent by (xii) human interference. Industrial lighting is a significant issue for islands with oil bases (xii). Prawn fishery (xii) probably kills unknown but significant number of adults (TEDs not applied in Nickol Bay or Onslow fisheries). Small Greens Turtles are commonly found with 'floating turtle syndrome'; many appear to die from this condition, the cause of which is unknown.	No	Action Plan for Australian Reptiles
<i>Eretmochelys imbricata</i>	Hawksbill turtle known to nest on Delambre, Rosemary, Legendre, and others.	v (fox and cat predation of nests and young turtles), xii (human disturbance of nests). No hunting of adults is known. Prawn fishery probably kills unknown but significant number of adults (TEDs not applied in Nickol Bay or Onslow fisheries).	No	Action Plan for Australian Reptiles
<i>Natator depressus</i>	Flatback turtle known to nest on mainland beaches (Munda, Port Hedland, Wickham, Cape Preston), and islands (Delambre, Rosemary, Legendre, Thevenard).	Mainland breeding is disrupted by (v) feral predators (especially fox, also cat) taking eggs and hatchlings. Also reports of significant hunting (xii) of adults during nesting time by Aboriginal people. This occurred mainly at Munda, which is now closed to the public, and in Port Hedland. Township lighting (xii) is an issue, particularly at Hedland. Island populations are at risk from fox and cat (where present), and to a much smaller extent by human interference. Industrial lighting is a significant issue for islands with oil bases. Prawn fishery (xii) probably kills unknown but significant number of adults (TEDs not applied in Nickol Bay or Onslow fisheries).	No	Action Plan for Australian Reptiles
<i>Dermochelys coriacea</i>	An occasional visitor. May be at risk from fishing and shipping.	Reports of this species are very occasional, and there is no data on local threats of mortality.	No	Action Plan for Australian Reptiles
<i>Ctenotus angusticeps</i>	Airlie Island and Thevenard Islands	Airlie Island has an oil base facility and buffel grass, which is being controlled in a trial of broad-scale control for Pilbara islands (with success). A mainland population is known from Roebuck Bay, but the genetic status of these two populations is unknown.	No	Action Plan for Australian Reptiles

Species	Location	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
<i>Liasis olivaceus barroni</i>	Known from rocky areas on the mainland, particularly along water courses, and from the Burrup Peninsula, Dolphin and West Lewis Islands	This species is common and widespread in the Pilbara. It is not threatened, and should not be listed as such.	No	Action Plan for Australian Reptiles
<i>Dugong dugon</i>	Relatively common in inshore, protected waters	xii (low-level human hunting by TI community; some mortality from shipping, possibly also trawl fishery and small boats)	No	No
<i>Crocodylus porosus</i>	Recently (re)established in inshore marine and creek systems between Balla Balla and Cape Keraudren. Not likely to be breeding, due to lack of suitable fresh-water habitat.	Human populations have a very low tolerance of crocodiles. Several have been shot by landholders. Others have been trapped and relocated to crocodile farms. Limits of range are not likely to have been reached yet. Possible that crocodiles could extend as far as Exmouth Gulf (unconfirmed reports of tracks have been made).	No	Action Plan for Australian Reptiles
Priority 1 and 2 flora including: <i>Abutilon</i> sp. (Onslow (F Smith sn 10.9.1961), <i>Carpobrotus</i> sp. Thevenard I (MR White 050), <i>Helichrysum oligochaetum</i> , <i>Ptilotus appendiculatus</i> var. <i>minor</i> , <i>Terminalia supranitifolia</i> , <i>Fimbristylis</i> sp. aff. <i>microcarya</i>	Require more survey to confirm their conservation status.	Wide range of threatening processes	No	No

<sup>1</sup>Appendix B, key e

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Macroderma gigas</i>	xiv	No problem yet, but should be kept in mind that cattle fencing may cause problems. Ongoing monitoring is required.
<i>Petrogale lateralis</i>	vii, x	Translocation of desert animals to Pilbara islands is a possibility. Target island not yet decided.
<i>Petrogale rothschildi</i>	vii	Islands of Dampier Archipelago to be maintained fox-free.
<i>Caretta caretta</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands.
<i>Chelonia mydas</i>	i, ii, iii, vii	Retention of island reserves, and protection of other nesting locations on leasehold or other reserve lands. Likely that control of foxes and cats would contribute to recovery.
<i>Eretmochelys imbricata</i>	i, ii, iii, vii	Retention of island reserves, and protection of other nesting locations on leasehold or other reserve lands. Likely that control of foxes and cats would contribute to recovery.
<i>Natator depressus</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Likely that control of foxes and cats would contribute to recovery.
<i>Dermochelys coriacea</i>	xii	Monitoring and research needed. Little known about population, or use of WA waters.
<i>Ctenopus angusticeps</i>	i, ii, iii, xiii	Habitat retention through reserves or on other State lands or on private lands. Capacity building required with industry.
<i>Liasis olivaceus barroni</i>	none	No recovery actions required.
<i>Dugong dugon</i>	i, xii, xiv	Protection of habitat within Dampier Archipelago (Marine Park) and elsewhere. Research into hunting pressure required. Periodic monitoring from air needed.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Crocodylus porosus</i>	ii, xii, xiv	Protection of habitat on east Pilbara coasts. Monitoring of numbers present required. Determining breeding status required.
Priority 1 and 2 flora including: <i>Abutilon</i> sp. (Onslow (F Smith sn 10.9.1961), <i>Carpobrotus</i> sp. Thevenard I (MR White 050), <i>Helichrysum oligochaetum</i> , <i>Ptilotus appendiculatus</i> var. <i>minor</i>	xii	Further research of species is required.
<i>Terminalia supranitifolia</i>	i	Protection of habitat on Burrup Peninsula required. No other action necessary.
<i>Fimbristylis</i> sp. aff. <i>microcarya</i>	ii, v, vii, viii, xi, xiii	Fencing of cattle, and control of cattle if they become feral. Rehabilitation of land, especially in gullies and high erosion impact areas, and addition measures to control erosion. Capacity building with station owners and managers is required.

<sup>1</sup>Appendix B, key h

## Ecosystems and existing recovery plans

Ecosystem	Location	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
Mangrove communities that are at risk from mining and associated landuses and industry.	PIL4	ii, ix, x (loss of fresh water flushing from Harding Dam construction (monitoring to be confirmed)), xi (industrial pollution in Dampier and Port Hedland harbours (hydrocarbons, TBTs, sediment others), bitterns discharges, NO <sub>2</sub> emissions)), xii (development and expansion of mining sites and infrastructure)	No	No
Rock pool communities, Burrup Peninsula: Calcareous (tufa) deposits, aquatic mollusc fauna of interest (undescribed species of molluscs).	PIL4	xi (industrial emissions)	No	No
Rock pile communities, Burrup Peninsula and Dolphin Island: Fauna is a mixture of Kimberley and Pilbara species, different to adjacent Chichester Range rockpile communities.	PIL4	ii, xi (in dust. emissions)	No	No
Roebourne Plains coastal grasslands, Sherlock Station and Roebourne Common, Airport Reserve (between Roebourne and Karratha), 7 Mile Creek.	PIL4	iv, vi (buffel, kapok, parkinsonia)	No	No
Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River.	PIL4	iv (cattle), vi (mesquite, buffel), x (gully erosion)-recreation	No	No
Mount Salt, calcareous mound spring. Large calcareous mound, recently dry (possibly due to depression of local water table by mesquite weed).	PIL4	vi (mesquite has depressed local water table)	No	No
Roebourne Plains stony chenopod association.	PIL4	iv, v, vi (buffel)	No	No
Creekline communities dominated by <i>Cynanchum</i> aff. <i>floribundum</i> , east branch of Harding River, near Chichester escarpment.	PIL4	iv, v, vi (buffel)	No	No
Pilbara off-shore island communities (fauna and flora)	Islands are scattered all along the Pilbara coast	iv (Buffel grass rapidly colonising most islands. These islands will have greatly reduced flora communities within 10 years. Includes many unvested islands).	No	No
Ecosystem	Location	Threatening Processes <sup>1</sup>	Specific Recovery Plan	General Recovery Plan
Sea turtles (Greens and Flatbacks) at Munda	Coast, Munda, Cape Preston, Port Hedland, Pilbara islands (PIL 4)	xii (human predation of eggs and adults; human disturbance of eggs by vehicles), xi (light pollution from industrial facilities (iron ore mine at Cape Preston; town lights at Port Hedland)); v (feral predators - fox)	No	No
Wetlands of De Grey River (from confluence with Nullagine River to sea)	PIL4	i, ii (none of this wetland is reserved, all occurs on pastoral lease), iv (high stocking rates (cattle) because country is so productive), vi (significant weed problems within river valley), v (feral pigs a major concern, moving upstream from De Grey	No	No

		station), vii.		
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<sup>1</sup>Appendix B, key e

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Mangrove communities that are at risk from mining and associated landuses and industry.	i, ii, iii, xiii, xiv	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Ongoing monitoring of pollution and hydrology issues.
Rock pool communities, Burrup Peninsula. Calcareous (tufa) deposits, aquatic mollusc fauna of interest (undescribed species of molluscs).	xiv, xii	Research and monitoring.
Rock pile communities, Burrup Peninsula and Dolphin Island. Mixture of Kimberley and Pilbara species, different to adjacent Chichester Range rockpile communities.	i, ii, iii, vi, vii	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Buffel grass control. Feral predator control, mainly fox.
Roebourne Plains coastal grasslands, Sherlock Station and Roebourne Common, Airport Reserve (between Roebourne and Karratha), 7 Mile Creek.	i, ii, iii, vi, vii	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Buffel grass control. Feral predator control, mainly fox.
Peedamulla (Cane River) Swamp Cyperaceae community, near mouth of Cane River.	i, ii, iii, vi, vii	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Buffel grass control. Feral predator control, mainly fox.
Mount Salt, calcareous mound spring. Large calcareous mound, recently dry (possibly due to depression of local water table by mesquite weed).	i, ii, iii, vi, vii, xi	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Mesquite weed control. Feral predator control, mainly fox. Reinstatement of hydrology.
Roebourne Plains stony chenopod association.	i, ii, iii, vi, vii	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Buffel grass control. Feral predator control, mainly fox.
Creekline communities dominated by <i>Cynanchum</i> aff. <i>floribundum</i> , east branch of Harding River, near Chichester escarpment.	i, ii, iii, vi, vii	Habitat retention through reserves or on other State lands. Capacity building with mining companies. Buffel grass control. Feral predator control, mainly fox.
Pilbara off-shore island communities (fauna and flora)	vi	Buffel grass will dominate most island flora communities within decades, if not sooner. Impacts upon fauna (vertebrate and invertebrate) are unknown.
Sea turtles (Greens and Flatbacks) at Munda	xiv, xii	Research and monitoring.
Wetlands of De Grey River (from confluence with Nullagine River to sea)	i, ii, v, vi, vii	Protection from weeds, stock and feral herbivores. Fencing is required if lands remain under cattle production.

<sup>1</sup>Appendix B, key h

## Subregion priority for off reserve conservation

The priority for off park conservation in PIL4 is (iii) (see Appendix C, rank 6), indicating that a range of off park measures required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Threat Abatement Planning as Part of NRM:** e.g. pest management.

**Capacity Building:** In place through Land Conservation District Committees, local land-holder liaison.

### Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. Rural reconstruction, industry reconstruction, new tenure and management arrangements; includes resumption of high quality lands for reservation from existing pastoral leases.

**Threat Abatement Planning as Part of NRM:** e.g. Pest management; particularly fox, and feral herbivore control on pastoral lands.

**Capacity Building:** Further capacity building in resource and pastoral industries, particularly possibility for joint or compatible management of pastoral leases owned by mining companies.

**Other Planning Opportunities:** Including local and State government planning.

### Impediments or constraints to opportunities

Lack of funding to acquire lands on open market. Lack of funds to adequately manage our existing estate, let alone any further acquisitions. Impediments exist in operations of the Pastoral Lands Board (need to re-structure unviable leases after reserve areas are removed). Reserve acquisition is obstructed by poor use of industrial lands (e.g. large areas tied up in non-producing long term leases, while other high quality conservation areas are alienated to industrial purposes). Some high quality conservation areas are still in inappropriate industrial land use (e.g. Legendre Island). There is a need to increase awareness of conservation values through education of various industry (mining, pastoral) and the public in general. Limited financial resources are also a major constraint. High value conservation areas are held under pastoral leases, and we can't afford to purchase them, therefore resumption is the only option. Weed control is limited to a few species, in a few places – broad scale control of buffel grass on off-shore islands looks possible, but prohibitively expensive.

## Subregions where specific NRM actions are a priority to pursue

The NRM priority for PIL4 is (i-ii) (see Appendix C, rank 7), indicating that there are significant or major constraints to implement effective NRM actions and to integrate conservation as part of a production/development system. This is relevant primarily to the pastoral industry.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No environmental geology/regolith mapping at better than 1:250 000. No broad-scale soil mapping is available at finer scale than 1:2 000 000 (Bettenay *et al.* 1967).

**Quantitative Fauna Survey:** Subregional survey has not been undertaken.

**Floristic Data:** Subregional flora is poorly known, with few intensive studies. Only small areas have been examined in detail by botanists, usually for industrial development. Quadrat-based floristic data is available from only a few localities.

**Ecological and Life History Data:** There are few detailed data on ecological requirements and life histories of virtually all invertebrate species, plants, persisting CWR mammals, uncommon vertebrate and plant species, and ecologically dominant plant species (e.g. hummock grasses). There are little data to provide a regional context on population-trends for even ecologically significant species (e.g., native rodents, dasyurids, spinifex reptile communities, termites, ants, weeds such as buffel grass, kapok bush and ruby dock).

### Other Priority Data Gaps Include:

- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of changes to fire regimes in hummock grasslands, particularly upon vertebrate communities, invertebrate communities, and non-vascular plants.
- No assessment on the impact of global warming upon coastal and island communities, including increasing sea levels and possible increases in frequency and intensity of cyclonic events.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on coastal and island communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Inventory survey has been undertaken for most islands between the Dampier Archipelago and Onslow. However, islands between Cape Lambert and Hedland are still poorly known.

- Poor state of knowledge of sea turtle nesting away from locations where monitoring and/or tagging occurs. Many islands and mainland beaches are known to support nesting, but numbers and species are unknown.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
278	Environmental Protection Authority	(1993).	Conservation Reserves for Western Australia. Red Book Status Report. EPA Report 15.	Environmental Protection Authority. Perth, Western Australia.	R
273	Environmental Protection Authority	(1975).	Conservation Reserves for Western Australia. Systems 4,8,9,10,11,12..	Environmental Protection Authority. Perth, Western Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
418	Johnstone, R.E.	(1990).	Mangroves and Mangrove Birds of Western Australia.	Records of the Western Australian Museum, Supplement No 32.	J
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 023, 026, 028, 036, 037, 038, 039, 091, 094, 100, 111, 118, 122, 149, 150, 173, 181, 182, 242, 244, 246, 258, 268, 273, 278, 298, 383, 387,

407, 418, 419,463, 483, 492, 493, 504, 515, 534, 535, 536, 558, 559, 592, 595, 625, 634, 635, 636, 637, 638, 647, 648, 651 and 699 in Appendix A.

# Swan Coastal Plain 1 (*SWA1 – Dandaragan Plateau subregion*)

ANTHONY DESMOND  
NOVEMBER 2001

## Subregional description and biodiversity values

### Description and area

The plateau is bordered by Derby and Dandaragan Faults. Cretaceous marine sediments are mantled by sands and laterites. Characterised by *Banksia* low woodland, Jarrah - Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains. The climate is Warm Mediterranean and annual rainfall is 700 mm and the subregional area is 447,862 ha.

### Dominant land use

(see Appendix B, key b)

Dominant land use is mainly (iv) dry-land agriculture (92.6%), with lesser areas of (xiii) conservation (6.78%),

(xi) UCL and Crown reserves and (xiv) roads and other easements (0.43 % combined).

### Continental Stress Class

The Continental Stress Class for SWA1 is 2.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features:

- The rare vertebrates found in SWA1 include Peregrine Falcon (*Falco peregrinus*), Malleefowl (*Leipoa ocellata*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*), Chuditch (*Dasyurus geoffroi*), and Carpet Python (*Morelia spilota imbricata*).
- Large numbers of rare flora are recorded from the area.

### Ecosystem Types That Have at Least 85% of Their Total Extent Confined to SWA1 Subregion:

Beard Veg Assoc	Description
1015	Mosaic: Shrublands; scrub-heath on the Swan Coastal Plain 1 Shrublands; dryandra heath
1040	Medium woodland; York gum & <i>Casuarina obesa</i>
1036	Low woodland; <i>Banksia prionotes</i>
1027	Mosaic: Medium open woodland, jarrah & marri, with low woodland; banksia/Medium sparse woodland; jarrah & marri
1019	Medium sparse woodland; jarrah & marri
1020	Mosaic: Medium forest; jarrah-marri 1 Medium woodland; marri-wandoo
1038	Medium open woodland, eucalypts (e2?), with low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>
1039	Shrublands; mallee with scattered York gum

### High Species and Ecosystem Diversity:

The area exhibits a degree of floristic endemism however there are no specific significant centers of endemism are currently identified.

CTRC Red Book (Environmental Protection Agency 1983). Some, but not all of these recommendations were implemented (with modification) over the following ten years.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the Northern Sandheaths (System 5) which constitutes the northern section of SWA1 in the CTRC Green Book (Environmental Protection Agency 1974). Recommendations for reserves in the southern section of SWA1 were made in the recommendations for System 6 Country areas and were endorsed by Cabinet in the

The southern half of the subregion is covered by a CALM Regional Management Plan published in 1987 and updated in 1994 (Department of Conservation and Land Management 1994a). These documents provide an overview of biota, addresses land and wildlife conservation issues, but are generalised in attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not necessarily address the specific needs of the subregion.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Wannamal Lake System (SWA025WA)	B7, B13, B6	ii	iii	iii	ix, x (increased inundation), iv (grazing on private land), v (foxes, cats & rabbits), i, vi

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

There are no wetlands of subregional significance in SWA1.

### Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Moore River	i	iii	ii	ix, x (increased flow), i, ii, iv, v (foxes, rabbits & goats), vi (caster oil bush, wild oats, Victorian tea tree), iii, viii, xi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
<i>Banksia attenuata</i> woodland over species rich dense shrublands	E	30	iii-iv	iii	iii	i, ii, iii, vi, viii, xii (trampling by recreational users; occurrences nearly all less than 5 ha in area)
Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on slopes and ridges of chert hills of the Coomberdale Floristic Region (Griffin 1992)	E	30	ii	iii	iii	iv, v (goats, rabbits), vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Diatomite Lakes of the Dandaragan Plateau (E. Griffin & M. Freeman pers. comm.)	V	32	iii	iii	iii	xi, ix, xii (mining), x
Plant assemblages of the Wannamal Lake system (R. Shepherd pers. comm.)	V	32	ii	iii	iii	iv, v (goats, rabbits), vii
Critical Weight Range mammals (extant species include <i>Trichosurus vulpecula hypoleucus</i> , <i>Dasyurus geoffroi</i> ; subregionally extinct species, includes <i>Bettongia penicillata</i> , <i>Bettongia lesueur</i> , <i>Myrmecobius fasciatus</i> ).	V	NA	i	ii	iii	v (foxes, cats), ii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i>	V	i	iii	iii	v (foxes, cats), iii, iv
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	ii	ii	v (foxes & cats), vii
<i>Calyptorhynchus baudinii</i>	E	ii	ii	ii	v (foxes & cats), vii
<i>Leipoa ocellata</i>	V	ii	iii	iii	v (foxes & cats), iii, iv
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Falco peregrinus</i>	SP	iii	iv	ii	ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Morelia spilota imbricata</i>	SP	ii	iii	ii	i, ii, v (foxes & cats)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Chamaelucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	E	iii	iv	iii	i, ii, iv, v, vi, vii, viii, x, xii (road, rail, firebreak maintenance). Recent acquisition of two properties has contributes to a reduction of threats.
<i>Darwinia acerosa</i>	E	iii	iv	iii	i, ii, iv, vi, vii
<i>Drakaea elastica</i>	E	iii	iv	iii	i, ii, iv, vi, vii, xii (road, rail, firebreak maintenance)
<i>Dryandra mimica</i>	E	ii	iv	iii	i, ii, vi, vii, viii, xii (road, rail, firebreak maintenance)
<i>Eucalyptus dolorosa</i>	E	iii	iv	iii	i, ii, vii, xii (one, small population)
<i>Eucalyptus impensa</i>	E	iii	iv	iii	i, ii, vii, viii, xii (sand mining)
<i>Eucalyptus pruiniramis</i>	E	iii	iv	iii	i, ii, vii, viii, xii (road, rail, firebreak maintenance)
<i>Grevillea althoferorum</i>	E	ii	iv	iii	i, ii, vi, vii, viii, xii (road, rail, firebreak maintenance, small population size)
<i>Synaphea quartzitica</i>	E	i	ii	iii	i, ii
<i>Thelymitra stellata</i>	E	iii	iv	iii	i, ii, vi, vii, xii (gravel extraction and recreation use)
<i>Verticordia plumosa</i> var. <i>pleiobotrya</i>	E	ii	iii	iii	i, ii, iv, v, vi, vii, x, xii (road, rail, firebreak maintenance, exploitation, urbanisation)
<i>Acacia anomala</i>	V	ii	iii	iii	i, ii, iii, vi, vii, viii, xii (road, rail, firebreak maintenance, recreation use)
<i>Acacia forrestiana</i>	V	iii	iv	iii	i, vii, viii
<i>Daviesia dielsii</i>	V	iii	iv	iii	i, ii, vi, xii (road, rail, firebreak maintenance)
<i>Eleocharis keigheryi</i>	V	iii	iv	iii	i, ii, iv, v, vi, ix, x, xii (mowing)
<i>Ptychosema pusillum</i>	V	Unknown	Unknown	ii	i, ii, vi, vii, xii (road, rail, firebreak maintenance, restricted, small population)
<b>PRIORITY 1</b>					
<i>Dampiera tephrea</i>	1	iii	iv	ii	i, ii, vi, xii (road, rail, firebreak maintenance, limited knowledge)
<i>Eucalyptus annuliformis</i>	1	iii	iv	ii	i, ii, vii, xii (limited knowledge)
<i>Synaphea panhesya</i>	1	iii	iv	ii	i, ii, vi, viii, xii (road, rail, firebreak maintenance, recreational use)
<i>Verticordia huegellii</i> var. <i>tridens</i>	1	iii	iv	ii	i, ii, vi, xii (road, rail, firebreak maintenance)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

Beard Veg Assoc	Vegetation Association Description	IUCN I-IV	IUCN V-VI	CALM Purchased Lease	Priority
3	Medium forest; jarrah-marri				L
4	Medium woodland; marri & wandoo	X	X		L

7	Medium woodland; York gum ( <i>E. loxophleba</i> ) & wandoo				H
31	Shrublands; <i>Melaleuca thyooides</i> thicket with scattered York gum	X			M
37	Shrublands; teatree thicket	X			M
352	Medium woodland; York gum				H
125	Bare areas; salt lakes				L
142	Medium woodland; York gum & salmon gum				H
949	Low woodland; banksia	X			M
952	Shrublands; dryandra heath				H
988	Succulent steppe with thicket; <i>Melaleuca thyooides</i> over samphire				M
999	Medium woodland; marri	X			H
1015	Mosaic: Shrublands; scrub-heath on the Swan Coastal Plain 1 Shrublands; dryandra heath	X			H
1017	Medium open woodland; jarrah & marri, with low woodland; banksia	X			H
1019	Medium sparse woodland; jarrah & marri				H
1020	Mosaic: Medium forest; jarrah-marri 1 Medium woodland; marri-wandoo	X			H
1027	Mosaic: Medium open woodland; jarrah & marri, with low woodland; banksia 1 Medium sparse woodland; jarrah & marri	X			M
1030	Low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>	X			M
1031	Mosaic: Shrublands; hakea scrub-heath 1 Shrublands; dryandra heath	X			M
1035	Mosaic: Medium open woodland; marri 1 Shrublands; dryandra heath				H
1036	Low woodland; <i>Banksia prionotes</i>	X			H
1038	Medium open woodland; eucalypts (e2?), with low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>				H
1039	Shrublands; mallee with scattered York gum	X			L
1040	Medium woodland; York gum & <i>Casuarina obesa</i>	X			H
	<i>Banksia attenuata</i> woodland over species rich dense shrublands				H
	Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on slopes and ridges of chert hills of the Coomberdale Floristic Region (Griffin 1992)				
	Diatomite Lakes of the Dandaragan Plateau (E. Griffin & M. Freeman pers. comm.)	X			H
	Plant assemblages of the Wannamal Lake system (R. Shepherd pers. comm.)	X			H
	Critical Weight Range mammals (extant species include <i>Trichosurus vulpecula hypoleucus</i> , <i>Dasyurus geoffroi</i> ; subregionally extinct species, includes <i>Bettongia penicillata</i> , <i>Bettongia lesueur</i> , <i>Myrmecobius fasciatus</i> ).				H

While mapping and vegetation information is available at a smaller scale in the Swan bioregion than the 1:250,000 of John Beard's vegetation mapping, consistency has to be maintained with that which is available across the rest of Western Australia. However the inherent difficulties with this approach are recognised. Beard Vegetation mapping is problematic in the Swan Coastal Plain because it is both very diverse and often intensively studied. In many cases the Beard Vegetation Associations show considerable variation within the same unit and conversely density of cover dominant species may describe the same unit in several different ways.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Competing Land Use:** The primary issue in that agriculture occupies more than 92% of the subregion.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** Difficulties in identifying biodiversity values in some areas due to lack of resolution of data.

## Bioregional and subregional priority for reserve consolidation

SWA is reservation Class 4 (see Appendix D, and Appendix C, rank 4) because 10 - 15% of its area reserved (any tenure). SWA1 has 6.78% of the subregion in conservation

reserves. SWA2 has 10.74% of the subregion in conservation reserves. SWA1 has been extensively cleared

for agricultural purposes leaving a biased reserve system and salinity problems are ubiquitous so Class 1 is more appropriate. One reserve in the northern extremity and one in the southern extremity of SWA1 make the vast majority of the conservation estate.

## Reserve management standard

Many SWA reserves are becoming saline or are threatened by rising water tables. Wildfire management facilities are somewhat limited. Fire breaks and fire-access tracks are installed and maintained on reserves greater than 200 ha. Feral herbivore grazing activities now widespread (e.g. Callicivirus hasn't made an observable difference to rabbit numbers), and kangaroo grazing is significant in some areas. No feral predator control systems are in place except on Wannamal Nature Reserve. Therefore, the reserve management rank is (ii) (see Appendix C, rank 5).

## Off reserve conservation

### Priority species or groups

Species	Specific Recovery Plan	General Recovery Plan
<i>Falco peregrinus</i>	No	Action Plan for Australian Birds
<i>Leipoa ocellata</i>	Yes - Malleefowl Preservation Society have current Action Plan and ongoing research	Action Plan for Australian Birds
<i>Calyptorhynchus latirostris</i>	Yes - draft RP	Action Plan for Australian Birds
<i>Calyptorhynchus baudinii</i>	No	Action Plan for Australian Birds
<i>Dasyurus geoffroii</i>	Yes - RP	Action Plan for Australian Marsupials and Monotremes
<i>Morelia spilota imbricata</i>	No	Action Plan for Australian Reptiles
<i>Acacia anomala</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Acacia forrestiana</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	Yes - IRP	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Dampiera tephrea</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Darwinia acerosa</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Daviesia dielsii</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan

Species	Specific Recovery Plan	General Recovery Plan
<i>Drakaea elastica</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Dryandra mimica</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Eleocharis keigheryi</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Eucalyptus annuliformis</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Eucalyptus dolorosa</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Eucalyptus impensa</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Eucalyptus pruiniramis</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Grevillea althoferorum</i>	Yes - IRP	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Ptychosema pusillum</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Synaphea panhesya</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Thelymitra stellata</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Verticordia huegelii</i> var. <i>tridens</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan
<i>Verticordia plumosa</i> var. <i>pleiobotrya</i>	No	Declared Rare and Poorly Known Flora in the Moora District; Draft Swan Region Threatened Flora Management Plan

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Leipoa ocellata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Calyptorhynchus latirostris</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Calyptorhynchus baudinii</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Dasyurus geoffroii</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Morelia spilota imbricata</i>	x, vii, xii, i	Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves or on other State lands or on private lands.
<i>Acacia anomala</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fire management required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<b>Species</b>	<b>Recovery Actions<sup>1</sup></b>	<b>Recovery Descriptions</b>
<i>Acacia forrestiana</i>	i, ii, iii, v, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Fire management required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	i, ii, iii, vi, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Chamelaucium</i> sp. Gingin (N Marchant s.n. 4.11.88) [aff. <i>pauciflorum</i> ]	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Control of feral herbivores, rabbits in particular.
<i>Dampiera tephrea</i>	i, ii, iii, vi, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities.
<i>Darwinia acerosa</i>	i, ii, iii, vi, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Control of feral herbivores, rabbits in particular.
<i>Daviesia dielsii</i>	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities.
<i>Drakaea elastica</i>	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities and grazing.
<i>Dryandra mimica</i>	i, ii, iii, vi	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Protection from road maintenance activities.
<i>Eleocharis keigheryi</i>	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control

		of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities and grazing.
<i>Eucalyptus annuliformis</i>	i, ii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus dolorosa</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus impensa</i>	i, ii, iii, ix, vi, xii, xiv	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Pathogen control required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus pruiniramis</i>	i, ii, iii, ix, vi, xii, xiv	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Pathogen control required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Grevillea althoferorum</i>	v, vii, xiii	Habitat retention through reserves or on other State lands or on private lands. Fencing to protect populations from rabbits, chemical overspray and track maintenance activities. Understanding of life history requirements for all rare flora very limited and needs additional research. Education of community.
<i>Ptychosema pusillum</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Synaphea panhesya</i>	i, ii, iii, ix, vi, xii	Habitat retention through reserves or on other State lands or on private lands. Management of fire regime required. Control of various weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Thelymitra stellata</i>	v, vii, xiii	Habitat retention through reserves or on other State lands or on private lands. Fencing to protect populations from rabbits and track maintenance activities. Understanding of life history requirements for all rare flora very limited and needs additional research. Education of community.
<i>Verticordia huegellii</i> var. <i>tridens</i>	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities and grazing.
<i>Verticordia plumosa</i> var. <i>pleiobotrya</i>	i, ii, iii, vi, vii, xii, xiii	Habitat retention through reserves or on other State lands or on private lands. Control of weeds required. Understanding of life history requirements for all rare flora very limited and needs additional research. Protection from road maintenance activities, wildflower picking and grazing.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
<i>Banksia attenuata</i> woodland over species rich dense shrublands	No	No
Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on slopes and ridges of chert hills of the Coomberdale Floristic Region (Griffin 1992)	Yes - IRP	No
Diatomite Lakes of the Dandaragan Plateau (E. Griffin & M. Freeman pers. comm.)	No	No
Plant assemblages of the Wannamal Lake system (R. Shepherd pers. comm.)	No	No
Critical Weight Range mammals (extant species include <i>Trichosurus vulpecula hypoleucus</i> , <i>Dasyurus geoffroii</i> ; subregionally extinct species includes <i>Bettongia penicillata</i> , <i>Bettongia lesueur</i> .)	Yes – RPs for Chuditch and Woylie	Action Plan for Australian Marsupials and Monotremes

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Banksia attenuata</i> woodland over species rich dense shrublands	i, ii, iii, vi, viii, ix, xii	Habitat protection on private lands, through reserves and on other state lands; Weed control; Revegetation; Fire management; Research.
Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on slopes and ridges of chert hills of the Coomberdale Floristic Region (Griffin 1992)	ii, i, iii, xiii, v, vi, xiv, ix, xii, viii	Habitat protection on private lands, through reserves and on other state lands; Capacity building with landholders, Water Corporation; Fencing; Weed control; Other - survey and monitoring; Fire management; Research; Revegetation.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Diatomite Lakes of the Dandaragan Plateau (E. Griffin & M. Freeman pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, greater reservation needed of high priority areas. Habitat protection on state lands (UCL). Habitat protection on private lands. Fencing of sensitive areas where there are heavy goat and/or rabbit numbers (as exclosures). Weed control for critical habitats. Feral animal control. Mainly rabbits, goats and foxes. Fire management, especially of species with generations greater than 5-8 years.
Plant assemblages of the Wannamal Lake system (R. Shepherd pers. comm.)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, greater reservation needed of high priority areas. Habitat protection on state lands (UCL). Habitat protection on private lands. Fencing of sensitive areas where there are heavy goat and/or rabbit numbers (as exclosures). Weed control for critical habitats. Feral animal control. Mainly rabbits, goats and foxes. Fire management, especially of species with generations greater than 5-8 years.
Critical Weight Range mammals (extant species include <i>Trichosurus vulpecula hypoleucus</i> , <i>Dasyurus geoffroii</i> ; subregionally extinct species includes <i>Bettongia penicillata</i> , <i>Bettongia lesueur</i> .)	i, iii, ii, v, vi, vii, ix	Habitat protection through reserves, greater reservation needed of high priority areas. Habitat protection on state lands (UCL). Habitat protection on private lands. Fencing of sensitive areas where there are heavy goat and/or rabbit numbers (as exclosures). Weed control for critical habitats. Feral animal control. Mainly rabbits, goats and foxes. Fire management, especially of species with generations greater than 5-8 years.

<sup>1</sup>Appendix B key h.

### Subregion priority for off reserve conservation

The off park conservation priority is (ii) (see Appendix C, rank 6), indicating that a large off park effort is needed

and resource constraints and limited community capacity exist.

### Conservation actions as an integral part of NRM

#### Existing NRM actions

NRM Action <sup>1</sup>	Description	Effectiveness
Legislation	Soil conservation and land clearing legislation	Low. Not rigorously enforced, penalties ineffective.
Capacity Building	Bushcare Programme, leadership training for volunteer organizations.	Uptake low.
Other	Local Government strategies for controlling development and assessing proposals	Low to moderate. Frequently discussion of NRM is minimal.
Integration with Property Management Planning, etc.	Number of Land Conservation District Committees (e.g. Moore Catchment Council) and the Northern Agricultural Integrated Management Strategy (NAIMS) Regional NRM group (mixed Government, landholders and community representation) on enterprise activities. Moore Catchment Council showing good understanding of NRM. NAIMS is poorly representative and with limited capacity currently.	Low to moderate. Land Conservation District Committees largely inactive or focused

<sup>1</sup>Appendix B, key i

#### Feasible opportunities for NRM

**Legislation Including Duty of Care for Leasehold and Other Lands:** Requires more rigorous control.

**Institutional Reform:** Rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Valuing Ecosystem Services and Tradable Rights:** Carbon credits would provide impetus to new revegetation efforts.

**Other Planning Opportunities:** Including local government planning and national action plan for water quality and salinity.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Increasing the role of NRM in all agricultural activities.

#### Impediments or constraints to opportunities

A number of impediments and constraints exist including:

- The current role of Government Departments in NRM and policing of activities such as land clearing is fragmented and unclear. Departments who have responsibility for resource exploitation may also have resource protection roles.
- Penalties for undertaking activities such as land clearing are comparatively minor and do not have the support of the greater rural community.
- There is a need to increase awareness of conservation values through education of various

industries (mining, agricultural) and the public in general.

- Limited financial resources are also a major constraint.

Subregions where specific NRM actions are a priority to pursue

The NRM priority for SWA1 is (i) (see Appendix C, rank 7), which indicates that there are major constraints to achieve significant NRM outcomes. The subregion is in a similar situation to AW1 & MAL2.

## Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available for entire subregion. Vegetation map resolution is 1:250 000 at best.

**Systematic Fauna Survey:** Data is confined to vertebrates (except birds) and selected invertebrate taxa. Data is sparse (ca. 30 terrestrial quadrats and 10 wetland quadrats across subregion), quadrats were only positioned on 10 of the most widespread surface-types, and only 2 - 3 quadrats per surface-type, few quadrats

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
225	Department of Conservation and Land Management	(1994a).	Forest Management Plan 1994 - 2003.	Department of Conservation and Land Management	R
275	Environmental Protection Authority	(1983)	Conservation Reserves for Western Australia as recommended by the Environmental Protection Authority - 1983: the Darling System - system 6, Report 13.	Department of Conservation and the Environment, Perth.	R
271	Environmental Protection Authority	(1974).	Conservation Reserves in Western Australia - Report of the Conservation through Reserves Committee to the Environmental Protection Authority "CTRC Green Book".	Environmental Protection Authority, Perth.	R
283	Evans, R.	(in prep).	Swan Region Threatened Flora Management Plan.	Department of Conservation and Land Management	R
766	Evans, R. and English, V.	(1999).	Gingin wax ( <i>Chamelaucium</i> sp. Gingin) Interim Recovery Plan 1999-2002 (IRP No 27)	Department of Conservation and Land Management	O
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
757	Hamilton-Brown, S.	(2000).	Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region: Interim Recovery Plan 2000-2003 (IRP No 65)	Department of Conservation and Land Management	O
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program	Environment Australia, Canberra.	R

have been sampled on more than two occasions. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

**Floristic Data:** Although regional survey of flora has been completed, it is based on very sparse sampling (about 70 quadrats across subregion), and the quadrats were positioned on 10 most widespread surface-types.

**Ecology and Life History Data:** There few data on habitat requirements of virtually all invertebrate species, most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of most species, including feral species.

### Other Priority Data Gaps Include:

- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, fire, and mineral-extraction on gypsum surfaces.
- No monitoring of the effect of salinity on species composition of communities is in place, although 10 bench-mark quadrats are now established.

			Project Number 50.		
532	Orell, P., and Morris, K.	(1994).	Chuditch Recovery Plan 1992-2001. WA Wildlife Management Program No. 13.	Department of Conservation and Land Management, Perth.	R
538	Patrick, S.J. and Brown, A.P.	(2001).	Declared rare and poorly known flora in the Moora District (Western Australian Wildlife Management Program : 28).	Conservation & Land Management, Perth.	R
621	Start, A.N., Burbidge, A.A. and Armstrong, D.	(1994).	Woylie Recovery Plan Second Edition 1994-1995. WA Wildlife Management Program No. 15.	Department of Conservation and Land Management, Perth.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 026, 075, 094, 101, 118, 241, 267, 268, 270, 273, 276, 277, 309, 323, 324, 325, 335,

341, 369, 371, 387, 406, 412, 419, 429, 451, 459, 476, 526, 562, 578, 584, 685, 686 and 767 in Appendix A.

# Swan Coastal Plain 2 (*SWA2 – Swan Coastal Plain subregion*)

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## Subregional description and biodiversity values

### Description and area

The Swan Coastal Plain is a low lying coastal plain, mainly covered with woodlands. It is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. In the east, the plain rises to duricrusted Mesozoic sediments dominated by Jarrah woodland. The climate is Warm Mediterranean. Three phases of marine sand dune development provide relief. The outwash plains, once dominated by *C. obesa*-marri woodlands and *Melaleuca* shrublands, are extensive only in the south.

The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats, coastal limestone. Heath and/or Tuart woodlands on limestone, *Banksia* and Jarrah-*Banksia* woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvials. Includes a complex series of seasonal wetlands and also includes Rottnest, Carnac and Garden Islands etc. Rainfall ranges between 600 and 1000 mm annually and the climate is Mediterranean. The subregional area is 1, 333, 901 ha.

### Dominant land use

Mainly (iv) Cultivation – dry land agriculture (see Appendix B, key b), (xiii) Conservation, (xi) UCL and Crown reserves, (i) Urban, (ii) Rural residential, (iii) Cultivation – irrigated horticulture, agriculture and plantations, (v) Forestry-plantations, (xiv) Other – roads and other easements and infrastructure, and (viii) Grazing – Improved pastures. There are smaller areas of (vii) Mining, and (xii) Defence lands.

### Continental Stress Class

The Continental Stress Class for SWA2 is as 3, however, the southern half of the region is cleared to a similar degree to the Avon Wheatbelt (although there is a greater proportion of remnant vegetation in the northern third of the subregion). The value should be at least 2, or even 1.

### Known special values in relation to landscape, ecosystem, species and genetic values

**Rare Features:** There are Landscape features, such as Holocene dunes and wetlands. Several of the Threatened Ecological Communities, for example tumulus springs etc. are considered rare features. There are a large number of rare and threatened species and Ecological Communities – see listing later in Synopsis.

### Refugia:

Caves, tumulus springs, and thrombolite communities provide refugia for relictual species. Off-shore islands provide refugia for mammals, reptiles and sea birds from feral predators.

### High Species and Ecosystem Diversity:

The Swan Coastal Plain Subregion is part of the South West Botanical Province which has a very high degree of species diversity. Within the subregion there are areas of relatively high ecosystem or species diversity, notably on the eastern side of the coastal plain. For example, the Brixton Street Bushland has over 555 plant species recorded within its 126 ha.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the System Six - Swan Coastal Plain in the CTRC Green Book (Environmental Protection Authority 1974), and then Red Book (Department of Conservation and Environment 1983). Some, but not all, of these recommendations (with modification) were implemented over the following ten years.

All but the northern quarter of the subregion is covered by a CALM Regional Management Plan published in 1987 and updated in 1994 (Department of Conservation and Land Management 1994a). These documents provide an overview of biota, addresses land and wildlife conservation issues, but are generalised in attention to detail. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not necessarily address the specific needs of the subregion.

The Perth Metropolitan Area portion of the Swan Coastal Plain (approximately 20% of the whole subregion) has had a comprehensive study of the reservation status and protection requirements in the Perth's Bushplan/Bush Forever project (Western Australian Planning Commission 2000). This has identified regionally significant bushland for protection by reservation or within the statutory planning framework. This study was based on representation of vegetation complexes mapped by Heddle *et al.* (1980) which is at a finer scale than the Beard Vegetation Associations used in this state wide audit. There are proposals for a similar project to Bush Forever to be applied to other areas of the Swan Coastal Plain south of the Perth metropolitan region (System 6/part 1 update).

The South West Catchment Council's, South West Regional Strategy for Natural Resource Management working (2001) Bush & Biodiversity section identified poorly conserved vegetation associations and nodes of high value fauna conservation within the lower half of the SWA2 subregion. Other sections of the document deal with Waterways and Wetlands, Land Resources and

Coastal Environs. Strategic targets for implementation are yet to be developed.

Similar draft Natural Resource Management Strategy has been prepared (Swan Catchment), or is being prepared (Moore River as part of Northern Agricultural Catchment) for the central and northern areas of the subregion respectively.

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Barragup Swamp, SWA001WA	B14	iii	iii	iii	ix, x
Becher Point Wetlands, SWA002WA	B10, B14	iii	iv	iii	vi
Benger Swamp, SWA003WA	B10, B14	iii	iv	iii	vi (typha), v (pig, fox, cat, rat), xii (eutrophication, illegal harvesting, urban development), vii
Booragoon Lake, SWA004WA	B5, B14	iii	iv	iii	xii (eutrophication), x
Brixton Street Swamps, SWA005WA	B13	iii	iv	iii	vi, x vii
Chandala Swamp, SWA006WA	B14	iii	iii	iii	ix, xii (eutrophication), iv
Ellen Brook Swamps System, SWA007WA	B13	iii	iv	iii	v (fox), vii
Forrestdale Lake, SWA008WA	B8	iii	iii	iii	xii (eutrophication), x, vi (typha), xi
Gibbs Road Swamp System, SWA009WA	B14, B13	iii	iv	iii	xii (eutrophication), i, x, xi
Gugura Lake, SWA010WA	B7, B12	iii	iv	iii	x, ix, xi
Herdsmen Lake, SWA011WA	B5, B10, B15, B14	ii	iii	iii	xii (eutrophication), xi, vi (typha), v,
Joondalup Lake, SWA012WA	B5	iii	iii	iii	xii (eutrophication), vi (typha), xi, v,
Karakin Lakes, SWA013WA	B10	ii	iv	iii	iv, xii (eutrophication),
Lake McLarty System, SWA014WA	B12, B13, B14	iii	iv	iii	xii (eutrophication), vi (typha),
Lake Thetis, SWA015WA	B7	iii	iv	iii	xii (crushing stromatolites), x
Loch McNess System, SWA016WA	B5, B9, B15, B14, B19	iii	iv	iii	vi
McCarleys Swamp (Ludlow Swamp), SWA017WA	B14	iii	iii	iii	xi, x, xii (eutrophication),
Peel-Harvey Estuary, SWA018WA	A6, A7, A8	iii	iii	iii	xii (eutrophication), x (artificial outlet to sea), xii (urban and canal development, modification of tidal flats)
Perth Airport Woodland Swamps, SWA019WA	B10, B14, C5	iii	iv	iii	vii, vi, v, xi, i
Rottnest Island Lakes, SWA020WA	B7, B8, B12	iii	iii	iii	x, xii (eutrophication, disturbance to birds),
Spectacles Swamp, SWA021WA	B14, B10	iii	iv	iii	x, vi (typha),
Swan-Canning Estuary, SWA022WA	A6, A7, A8	iii	iii	iii	xii (eutrophication), xi, xii (urban development on shore, erosion of shore by boat wake/waves)
Thompsons Lake, SWA023WA	B8	iii	iv	iii	x, xii (eutrophication), vi, v (fox, cat)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Vasse-Wonnerup Wetland System, SWA024WA	B8, B11, A10	iii	iv	iii	x (flood gate management), vi (kikuyu, typha), xii (eutrophication, urban and canal development), v (fox, cat, rabbit)
Yalgorup Lakes System, SWA026WA	B7	iii	iv	iii	xii (eutrophication), x

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

Over a quarter of the Swan Coastal Plain land area from Wedge Island to Dunsborough is wetland. The Western Australian Water and Rivers Commission have prepared a comprehensive wetland atlas for the Swan Coastal Plain from Wedge Island to Dunsborough, including assessment of the preliminary management categories (into 3 categories: Conservation, Resource Enhancement and Multiple Use Wetland) for 4 700 basin and flat wetlands in the Wedge Island to Mandurah area (Hill *et al.* 1996a and Hill *et al.* 1996b).

Most of those wetlands described as Conservation Wetlands category and many in the Resource Enhancement category would warrant inclusion in this section as Wetlands of Subregional Significance. However the number of wetlands involved makes it impractical to include them all in this synopsis, and the wetland atlas should be used (Hill *et al.* 1996a and Hill *et al.* 1996b).

### Riparian zone vegetation

Most rivers in this subregion have the majority of their catchments in subregions to the east. They pass through the subregion on their way to the ocean.

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Hill River	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Moore River/Gingin Brook	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Swan River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Serpentine River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Murray River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Harvey River	i	iii	ii	i, ii, ix, x, iv, vi, v, xi
Collie River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Preston River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Capel River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi
Wellesley River	ii	iii	ii	i, ii, ix, x, iv, vi, v, xi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Aquatic root mat community number 1 of caves of the Swan Coastal Plain	CR	N/A	iii	ii	iii	x (declining groundwater levels – rainfall, extraction)
Communities of Tumulus Springs (Organic Mound Springs, Swan Coastal Plain)	CR	32 wetland	iii	iii	iii	x (declining groundwater levels – rainfall), ii, vii
<i>Eucalyptus calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils, Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 3a)	CR	8	ii	iv	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
<i>Eucalyptus calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands, Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 3c)	CR	8	ii	iv	iii	ii, v (rabbits, pigs), vi (Watsonia, bridle creeper, introduced monocots), vii, viii, xii (physical disturbance – vehicles)
Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Perth to Gingin Ironstone Association	CR	32	ii	iv	iii	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Sedgeland in Holocene dune swales of the southern Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 19)	CR	32 wetland	iii	iv	iv	ii, vi (grasses, Watsonia, bridle creeper), vii, v (rabbits), viii
Shrublands and Woodlands of the eastern side of the Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 20c)	CR	8	ii	iv	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii

Shrublands and Woodlands on Muchea Limestone	CR	32 wetland	ii	iv	iii	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Shrublands on southern Swan Coastal Plain Ironstones (Busselton area) (Community 10b, Gibson <i>et al.</i> 1994)	CR	32	ii	iii	iv	ii, iv, v (rabbits), vi (pasture grasses, Watsonia), vii, viii, x, xii (sand mining)
Stromatolite like community of coastal freshwater lakes (Lake Richmond)	CR	42	ii	iv	iii	ix, xi (increased nutrients)
Stromatolite-like microbialite community dependent on fresh ground water of coastal brackish lakes (Extant thrombolitic aragonite community of coastal brackish lakes formed by biologically influenced precipitation of a mineral phase and dominated by <i>Scytonema</i> and other cyanobacteria, and diatoms: Lake Clifton, Yalgorup) (Moore 1993)	CR	8	ii	iii	iii	ix, xi (increased nutrients)
<i>Banksia attenuata</i> and/or <i>Eucalyptus marginata</i> woodlands of the eastern side of the Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 20b)	E	30	ii	iii	iv	i., ii, v (rabbits), vi (grasses, Watsonia, bridle creeper, numerous other garden species resulting from rubbish dumping), vii, viii, x, xii (sand mining)
<i>Banksia attenuata</i> woodland over species rich shrublands (Gibson <i>et al.</i> 1994: type 20a)	E	32	iii	iii	iv	ii, v (rabbits), vi (grasses, vii, viii)
<i>Melaleuca huegelii</i> - <i>M. acerosa</i> shrublands of limestone ridges (Gibson <i>et al.</i> 1994: type 26a)	E	32 wetland	ii	iii	iv	xii (limestone mining), ii
Shrublands on dry clay flats (Gibson <i>et al.</i> 1994: type 10a)	E	32 wetland	ii	iv	iv	v (rabbits), vi (pasture grass)
Southern wet shrublands, Swan Coastal Plain (Community 2, Gibson <i>et al.</i> 1994)	E	12	ii	iv	iv	v (rabbits), vi (pasture grass), viii
<i>Callitris preissii</i> (or <i>Melaleuca lanceolata</i> ) forests and woodlands Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 30a)	V	32 wetland	iii	iii	iv	ii, vii, vi (Watsonia, bridle creeper), v (rabbits), viii
Dense shrublands on clay flats (Gibson <i>et al.</i> 1994: type 9)	V	8	ii	v	iv	v (rabbits, pigs), vi (Watsonia, pasture grasses), vii, viii
<i>Eucalyptus calophylla</i> - <i>Eucalyptus marginata</i> woodlands on sandy clay soils of the southern Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 3b)	V	9	ii	iii	iv	i., ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii, x, xii (sand mining)
Forests and woodlands of deep seasonal wetlands of the Swan Coastal Plain (Gibson <i>et al.</i> 1994: type 15)	V	32 wetland	ii	iii	iv	ii, v (rabbits), vi (grasses, Watsonia, bridle creeper), vii, viii
Herb rich saline shrublands in clay pans (Gibson <i>et al.</i> 1994: type 7)	V	32 wetland	ii	iv	iv	iv, v (rabbits), vi (pasture grasses), vii
Herb rich shrublands in freshwater clay pans (Gibson <i>et al.</i> 1994: type 8)	V	32 wetland	ii	v	iv	ii, v (rabbits, pigs), vi (Watsonia, introduced monocots), vii, viii, xii (physical disturbance - vehicles)
Shrublands on calcareous silts of the Swan Coastal Plain (Gibson <i>et al.</i> 1994: community type 18)	V	32 wetland	iii	iv	iv	ii, v (rabbits), vii
<b>Community</b>	<b>Status</b>	<b>NVIS<sup>1</sup></b>	<b>Condition<sup>2</sup></b>	<b>Trend<sup>3</sup></b>	<b>Reliability<sup>4</sup></b>	<b>Threatening Processes<sup>5</sup></b>
Stromatolite community of stratified hypersaline coastal lakes (Stromatolitic aragonite communities formed by <i>Glaeocapsa</i> and diatoms in stratified coastal hypersaline lakes) (Lake Thetis, 3 km SE of Cervantes) (Moore 1993)	V	N/A	iii	iv	iii	ix, xi (increased nutrients)
<i>Eucalyptus calophylla</i> woodlands on heavy soils of the southern Swan Coastal Plain	V	8	iii	iii	iii	i, vi, vii, viii ( <i>Phytophthora</i> ), v (rabbits), iv, xii (recreation)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Beard Veg Assoc	Name and Description	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
	Southern Swan Coastal Plain <i>Eucalyptus calophylla</i> woodlands on heavy soils	V	8	ii	iii	iv	v (rabbits), vi (pasture grass), vii, viii

	(Community 1b, Gibson <i>et al.</i> 1994)						
	<i>Callitris preissii</i> / <i>Melaleuca lanceolata</i> woodlands on saline soils (Rottnest) (B. Keighery pers comm.)	P1	12	iii	iv	iii	vii, v (rabbits), vi (grasses), viii
	<i>Casuarina obesa</i> association (Thomas Rd to Serpentine River, Swan Coastal Plain; No detailed information to assess if distinct community) (Gibson <i>et al.</i> 1994); A. Brown pers comm.)	P1	26	i	iii	ii	ii, ix, xii (ecosystem is almost all destroyed)
	Fairbridge Ironstone community (cemetery – Fairbridge Farm) (G. Keighery pers. comm.)	P1	32	unknown	vi	ii	xii (very little information on the ecosystem)
	Relictual mangrove community (Bunbury) (may not be considered a separate community type as is a possibly a geographic outlier) (J. Lane pers. comm.)	P1	40	iii	iv	ii	xii (edge of range), no known threatening processes
	<i>Banksia illicifolia</i> woodlands (Community 22, Gibson <i>et al.</i> 1994)	P2	30	iii	iii	iv	ii, vii, vi (grasses, v (rabbits), viii ( <i>Phytophthora</i> ))
	Deeper seasonal wetlands on sandy soils (Swan Coastal Plain) (Community 14, Gibson <i>et al.</i> 1994)	P2	32 wetland	iii	iii	iv	ii, vii, vi (grasses, <i>Watsonia</i> , bridle creeper), v (rabbits), viii
	Hypersaline microbial community 1 (Extant coastal hypersaline lakes microbialite community formed by <i>Apanothecae halophitica</i> , <i>Oscillatoria</i> sp./ <i>Spirulina</i> sp., <i>Botryococcus</i> and diatoms) (Government House Lake, Rottnest) (Moore 1993)	P2	N/A	iii	iv	iii	No known threatening processes
	Living microbial mats in hypersaline ponds (Extant hypersaline pond stromatolitic “Conophyton” like un lithified communities formed with little sediment incorporation by (?) <i>Phormidium hypersalinum</i> ) (Pamelup Pond, Lake Preston, Yalgorup) (Moore 1993)	P2	N/A	iii	ii	iii	x, i, ii
	<i>Acacia</i> shrublands on taller dunes (Community 29b, Gibson <i>et al.</i> 1994)	P3	32	iii	iii	iv	ii, vii, vi (grasses, <i>Watsonia</i> , bridle creeper), v (rabbits), viii

Beard Veg Assoc	Name and Description	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
	Coastal shrublands on shallow sands (Community 29a, Gibson <i>et al.</i> 1994)	P3	32	iii	iv	iv	ii, vii, vi (grasses, <i>Watsonia</i> , <i>bridle creeper</i> ), v (rabbits), viii
	<i>Eucalyptus haemotoxylon</i> - <i>Eucalyptus marginata</i> woodlands on Whicher foothills (Community 1a, Gibson <i>et al.</i> 1994)	P3	8	ii	ii	iv	ii, v (rabbits), vi (pasture grass), xii (occurs in very small areas)
	Low lying <i>Banksia attenuata</i> woodlands or shrublands (Community 21c, Gibson <i>et al.</i> 1994)	P3	30	iii	iv	iv	v (rabbits), viii
	Northern Spearwood shrublands and woodlands (Community 24, Gibson <i>et al.</i> 1994)	P3	28	iii	iii	iv	ii, vii, vi (grasses, <i>bridle creeper</i> ), v (rabbits), viii
	Northern Swan Coastal Plain <i>Banksia attenuata</i> - <i>Banksia menziesii</i> woodlands (Community 23b, Gibson <i>et al.</i> 1994)	P3	30	iii	iv	iv	ii, vii, vi (grasses, v (rabbits), viii, xii (ecosystem is not currently represented in reserve system)
	Quindalup <i>Eucalyptus gomphocephala</i> and/or <i>Agonis flexuosa</i> woodlands (Community 30b, Gibson <i>et al.</i> 1994)	P3	8		iii	iv	ii, v (rabbits), vi (bridle creeper, arum, pasture grass), vii, viii (borers, <i>Armillaria</i> ), x (ecosystem is not currently represented in reserve system)
	Southern Swan Coastal Plain <i>Eucalyptus gomphocephala</i> - <i>Agonis flexuosa</i> woodlands (Community 25, Gibson <i>et al.</i> 1994)	P3	8		iii	iv	ii, v (rabbits), vi (bridle creeper, arum, pasture grass), vii, viii (borers, <i>Armillaria</i> ), x, xii (mining)
999	Medium woodland; marri	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1136	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
968	Medium woodland; jarrah, marri & wandoo	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1182	Medium woodland; <i>Eucalyptus rudis</i> & <i>Melaleuca raphiophylla</i>	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
973	Low forest; paperbark ( <i>Melaleuca raphiophylla</i> )	E	15		iii	ii	i, ii, iv, v (rabbits), vi (pasture grasses), vii, xi, xii (intensive agriculture, horticulture, urban & semi rural developments)
15	Low forest; cypress pine	E	12		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)
1010	Medium open woodland; marri & tuart	E	8		iii	ii	i, ii, iv, vi (pasture grasses) vii, x, xii (intensive agriculture; horticulture; urban & semi rural developments)

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

Analysis of the pre-european and remaining extent of Beard's vegetation associations, shows that of the 41 vegetation associations that covered greater than 0.1% (i.e. 1 334 ha) of the subregion in pre-european times (i.e. covering in total over 99.6% of original area):

- Seven have less than 10% of the original area remaining, and so could be considered threatened. None of these have greater than 3.4% of the subregion pre-European area in CALM estate. These seven are listed at the end of the table above.
- The sum of the original area of these 7 vegetation associations was 257 655 ha. That is 19.3 % of the original vegetation in IBRA Subregion. Thus they were significant components of the original vegetation.

- The sum of the remaining area of these 7 vegetation associations = 19 334 ha (3.5 % of the remaining vegetation in IBRA Subregion)
- 2 of the 7 are mostly found in SWA2 (>70% of the remnants of this vegetation association are in SWA2). So conservation of these associations needs to be carried out in this subregion.
- 4 of the 7 are mostly found outside SWA2 (>70% of the remnants of this vegetation association are found in other subregions SWA2), and so there may be options for reservation and conservation in other subregions. However note that features, including floristics, of a Beard vegetation association may differ in different subregions, and so representation

of these in Swan Coastal Plain Subregion may be unique.

- There are 18 vegetation associations that have between 10% and 30% of the original area remaining, and so could be considered in the next

threatened group. Only 4 of these have >10% of the subregion pre-European area in CALM reserves. Nine of the 18 are mostly found in SWA2, only 1 of these has >10% in CALM reserves.

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Dasyurus geoffroii</i>	V	ii	v	iii	v (fox)
<i>Myrmecobius fasciatus</i>	V	i	iv	iii	v (fox)
<i>Pseudocheirus occidentalis</i>	V	ii	iii	iii	ii, v (fox), vii
<i>Setonix brachyurus</i>	V	i	v	iii	v (fox), vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iii	i, ii, vii
<i>Leipoa ocellata</i>	V	i	iv	iii	v (fox)
<i>Botaurus poiciloptilus</i>	V	i	iii	iii	i, ii, v, vii, ix, x
<i>Calyptorhynchus baudinii</i>	V	ii	iii	iii	i, ii, vii
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Pseudemidura umbrina</i>	CR	i	v	iii	v (fox), ii, vii, vi, x
<i>Ctenotus lanceolini</i>	V	iii	iv	iii	v (mice), xii (human disturbance)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 8 (CRUSTACEANS)</b>					
<i>Hurleya</i> sp. (WAM#642-97)	CR	Unknown	ii	iii	x (declining groundwater – rainfall)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 11 (NATIVE BEES)</b>					
<i>Leioproctus douglasiellus</i>	E	Unknown	vi	ii	ii, vii, vi
<i>Neopasiphae simplicior</i>	E	Unknown	vi	ii	ii, vii, vi
<b>Schedule 1: Rare/likely to become extinct, Div 13 (Moths)</b>					
<i>Synemon gratiosa</i>	E	Unknown	vi	ii	ii, vii, vi
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Arbanitis inornatus</i>	1	Unknown	vi	ii	ii, vii, vi
<i>Throscodectes xiphos</i>	1	Unknown	vi	ii	ii, vii, vi
<i>Ixobrychus flavicollis</i>	2	i	i	ii	i, ii, vii, ix (salinisation of streams has lead to lack of food source), x
<i>Ninox connivens connivens</i>	2	i	i	iii	i, ii, xii (logging practices, reduction in tree hollows)
<i>Tiliqua rugosa konovi</i>	2	iv	iv	ii	xii (human disturbance)
<i>Pseudonaja affinis exilis</i>	2	iv	iv	ii	xii (human disturbance)
<i>Leioproctus bilobatus</i>	2	Unknown	vi	ii	ii, vii, vi
<i>Austromerope poultoni</i>	2	Unknown	vi	ii	Unknown threatening processes
<i>Dasyornis broadbenti littoralis</i>	EX	i	i	i	Last record was approx 100 years ago.

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

In general, plant communities comprising of susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*) and can be considered as ecosystems at risk.

These fungi eliminate numerous species of structurally and floristically dominant plant families such as the Proteaceae and Myrtaceae from ecosystems.

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Brachysema papilio</i>	CR	ii	ii	iii	i, ii, v, vi, vii, viii, xii (roads; mining), iv
<i>Caladenia procera</i> ms	CR	iii	ii	iii	i, vii,
<i>Calytrix breviseta</i> subsp. <i>breviseta</i>	CR	ii-iii	v	iii	i, ii, iv, vi, vii, x, xii (roads; one population only)
<i>Darwinia</i> sp. Williamson (GJ Keighery 12717) [ <i>aff. apiculata</i> ]	CR	ii-iii	iii	iii	i, vii, viii, xii (mining)
<i>Epiblema grandiflorum</i> var. <i>cyaneum</i> ms	CR	iii	ii	iii	i, ii, iv, v, vi, vii, viii, ix, x, xi, xii (roads; recreation use)
<i>Grevillea althoferorum</i>	CR	iii	iv	iii	i, ii, vi, vii, viii, xii (roads)
<i>Grevillea curviloba</i> subsp. <i>curviloba</i>	CR	iii	iii	iii	i, ii (no recruitment), iv, v, vi, vii, viii, xi, xii (roads; small population size)
<i>Grevillea curviloba</i> subsp. <i>incurva</i>	CR	iii	iii	iii	i, ii (no recruitment), iv, v, vi, vii, viii, xi, xii

					(roads; small population size)
<i>Grevillea elongata</i>	CR	iii	v	iii	i, ii, v (rabbit), vi (pasture grasses), vii, viii
<i>Grevillea macculcheonii</i>	CR	i	v	iv	i, v (rabbit), viii
<i>Hemigenia ramosissima</i>	CR	ii	iv	iii	x, i, ii
<i>Lambertia echinata</i> subsp. <i>occidentalis</i>	CR	ii	ii	iv	i, v (rabbit), viii ( <i>Phytophthora</i> sp.)
<i>Petrophile latericola</i> ms	CR	iii	ii	iii	viii ( <i>Phytophthora</i> sp.), ii (no recruitment), vii
<i>Synaphea</i> sp. Pinjarra (R Davis 6578)	CR	ii	iii	iii	i, ii, iv, vi, vii, viii, x, xii (roads)
<i>Synaphea stenoloba</i>	CR	ii	iii	iii	i, ii, iv, vi, vii, viii, x, xii (roads)
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	CR	ii	iii	iii	i, ii, iv, v, vi, vii, viii ( <i>Phytophthora</i> sp.), x, xii (roads)
<i>Caladenia huegelii</i>	E	iii	iii	iii	i, ii, v, vi, vii, x, xii (roads etc, recreation and rubbish dumping)
<i>Centrolepis caespitosa</i>	E	iii	iii	iii	i, ii, vi, xii (recreation; species is very hard to locate)
<i>Chorizema varium</i>	E	iii	ii-iii	iii	iv, v, vii, xii (roads, recreation; species is not reserved), ii
<i>Darwinia</i> sp. <i>Muchea</i>	E	ii-iii	iii	iii	ii, iv, vi, vii, x
<i>Diuris purdiei</i>	E	iii	ii-iii	iii	i, ii, v, vi, vii, x, xii (roads; recreation use; species is naturally uncommon)
<i>Drakaea elastica</i>	E	ii-iii	iii	iii	i, ii, iv, vi, vii, xii (roads)
<i>Dryandra mimica</i>	E	iii	v	iii	viii ( <i>Phytophthora</i> sp.), i, ii, vi, vii, xii (roads)
<i>Dryandra nivea</i> subsp. <i>uliginosa</i>	E	iii	iii	iii	viii ( <i>Phytophthora</i> sp.), i, ii, v (rabbit), vi, vii, viii
<i>Hydatella dioica</i>	E	iii	iv	iii	i, ii, vi, ix, x, xii (small population size)
<i>Lepidosperma rostratum</i>	E	iii	iii	iii	i, ii, vi, vii, viii, x, xii (roads; found in area with high rate of bushland clearance for urbanisation)
<i>Macarthuria keigheryi</i>	E	iii	iv	iii	i, ii, vi, xii (roads)
<i>Paracaleana dixonii</i> ms	E	iii	ii	iii	i, ii, vii, xii (roads, powerlines)
<i>Thelymitra stellata</i>	E	iii	ii	iii	i, ii, vi, vii, xii (roads; gravel and other mining; small population size)
<i>Verticordia densiflora</i> var. <i>pedunculata</i>	E	ii	iv	iii	i, ii, v (rabbit), vi, vii, viii, xii (harvesting)
<i>Verticordia plumosa</i> var. <i>pleiobotrya</i>	E	ii	iii	iii	i, ii, iv, v, vi, vii, x, xii (roads; illegal harvesting)
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Verticordia plumosa</i> var. <i>vassensis</i>	E	iii	iii	iii	i, ii, v (rabbit), vi, vii, viii, xii (harvesting)
<i>Andersonia gracilis</i>	V	iii	iii	iii	ii, vi, viii, xii (roads etc. mining)
<i>Anigozanthos humilis</i> subsp. <i>chrysanthus</i>	V	iii	v	iii	vi, ix, xii (roads etc)
<i>Anigozanthos viridis</i> subsp. <i>terraspectans</i>	V	iii	iv	iii	xii (small populations; sandmining)
<i>Chamelaucium roycei</i> ms	V	iii	iv	iii	ii, v (rabbit), vi (pasture grass), vii, viii, xii (small population)
<i>Conospermum undulatum</i>	V	iii	iv	iii	i, ii, vi, vii, xii (roads etc)
<i>Diuris drummondii</i>	V	iii	iii	iii	ii, vi, vii, xii (recreation use)
<i>Diuris micrantha</i>	V	ii	iii	iii	v, vi, x, xii (roads; recreation use; species is very hard to locate)
<i>Drakaea micrantha</i> ms	V	iii	iii	iii	i, ii, vi, vii, x, xii (roads; small populations)
<i>Dryandra squarrosa</i> subsp. <i>argillacea</i>	V	ii	ii	iii	viii ( <i>Phytophthora</i> sp.), i, ii, v (rabbit), vi, vii
<i>Eleocharis keigheryi</i>	V	iii	iv	iii	i, ii, iv, v, vi, ix, x, xii (roads, mowing of airfield)
<i>Eucalyptus argutifolia</i>	V	iii	iv	ii	i, ii, vii, xii (roads, mining)
<i>Ptychosema pusillum</i>	V	ii	ii	ii	vii, i, ii, vi, xii (roads)
<i>Tetralia australiensis</i>	V	iii	v	iii	i, ii, vi, vii, xii (roads, gravel and other mining)
<b>PRIORITY 1</b>					
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant (GJ Keighery 5026)	1	iii	iv	ii	i, ii, vi, x, xii (roads etc)
<i>Amphibromus vickeryae</i>	1	iii	iv	iii	i, ii
<i>Andersonia ferricola</i> ms	1	iii	iv	ii	viii ( <i>Phytophthora</i> sp.), ii, v (rabbit), vii
<i>Billardiera</i> sp. <i>Seabird</i> (GJ Keighery 12977)	1	iii	iii	ii	i, ii, xii (roads; recreation; species is not

					found in current reserve system)
<i>Brachyscias verecundus</i>	1	iii	v	iii	vii, i, vi, viii
<i>Calandrinia</i> sp. Kenwick (GJ Keighery 10905) [aff. <i>composita</i> ]	1	ii	iii	ii	i, ii, vi, viii, ix, x, xii (roads; species is very hard to locate)
<i>Calothamnus</i> sp. Whicher (BJ Keighery & N Gibson 230)	1	iii	iv	ii	vii
<i>Carex tereticaulis</i>	1	unknown	vi	ii	xii (very little is known about the species)
<i>Dampiera tephrea</i>	1	iii	iv	ii	i, ii, vi, xii (roads etc)
<i>Eucalyptus mundijongensis</i> x	1	iii	iii	ii	i, ii, vi, xii (roads)
<i>Grevillea evanescens</i>	1	iii	v	ii	i, ii, vi, viii, xii (roads)
<i>Hakea oldfieldii</i>	1	iii	iv	iii	vii
<i>Malleostemon</i> sp. Cooljarloo (B Backhouse s.n. 16.11.88)	1	iii	iv	iii	xii (mining)
<i>Schoenus pennisetis</i>	1	iii	iv	ii	i, vi, x, xii (roads)
<i>Synaphea odocoileops</i>	1	iii	iv	iii	xii (species is not found in current reserve system)
<i>Tripterococcus paniculatus</i> ms	1	iii	iv	ii	i, ii, vi, xii (roads)
<b>PRIORITY 2</b>					
<i>Acacia benthamii</i>	2	iii	iv	ii	i, ii, viii, xii (roads etc)
<i>Amperea micrantha</i>	2	iii	iv	ii	xii (species is not found in current reserve system)
<i>Boronia capitata</i> subsp. <i>gracilis</i>	2	iii	iv	iii	i, ii, vii,
<i>Comesperma rhadinocarpum</i>	2	iii	iv	ii	i, ii, viii, ix, x, xii (roads, gravel extraction)
<i>Eucalyptus marginata</i> subsp. <i>elegantella</i>	2	iii	iv	ii	i, ii, vi, xii (roads)
<i>Grevillea manglesii</i> subsp. <i>ornithopoda</i>	2	iii	iv	ii	i, ii, vi, xii (recreation)
<i>Haloragis aculeolata</i>	2	iii	iv	ii	i, ii, vi, xii (roads)
<i>Isotropis cuneifolia</i> subsp. <i>glabra</i>	2	ii	iv	ii	i, ii, x, xii (roads)
<b>Species Name</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Trend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Mitreola minima</i>	2	iii	iv	ii	xii (edge of range)
<i>Phyllangium palustre</i>	2	iii	iv	ii	i, ii, ix, x,
<i>Schoenus capillifolius</i>	2	iii	iv	ii	i, ii, vi, ix, x,
<i>Schoenus loliaceus</i>	2	iii	iv	ii	No known threatening processes
<i>Stylidium rigidifolium</i>	2	iii	iv	ii	No known threatening processes
<i>Synaphea petiolaris</i> subsp. <i>simplex</i>	2	iii	iv	ii	No known threatening processes
<i>Trichocline</i> sp. Treeton (BJ Keighery & N Gibson 564)	2	iii	iv	ii	No known threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Reserves are needed to protect most of the occurrences of the listed TECs.

Analysis of the tables of SWA Beard vegetation associations provides the following:

Of the 53 vegetation associations that occurred in SWA2 subregion in pre-european times:

- 33 have less than 10% of the original area in CALM managed reserves, and so could be considered poorly reserved.
- 15 of these are mostly found outside SWA2 (>70% of the remnants of this vegetation association are found in other subregions), so there may be options

for reservation in other subregions. However, Beard's vegetation mapping includes a degree of heterogeneity within single units, especially floristic differences. The same Beard vegetation association may be different in another region. Therefore reserves in another region may not be fully representative of the variation within the unit.

- This leaves 18 poorly reserved vegetation associations that are mostly found in SWA2. These are shown in the table below.

Beard Veg Assoc	Veg Assoc description	Total current extent per Veg Assoc (ha)	% of total extent in IBRA Subregion	Pre-European Area (ha) in Subregion	Current Area in IBRA Subregion	% of pre-European Area remaining in Subregion	Area in IUCN Reserve	Area in IUCN Reserve %	Total Area in CALM Estate	Total Area in CALM Estate %	% of subregion pre-European area in CALM estate
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6	Low forest; cypress pine	0.0	0.0	2,786.7	0.0	0.0					0.0
1016	Mosaic: Low woodland; banksia/Shrublands; dryandra heath	595.1	100.0	1,789.0	595.1	33.3	0.0	0.0	0.0	0.0	0.0
1010	Medium open woodland; marri & tuart	93.2	100.0	1,423.3	93.2	6.5	0.0	0.0	0.0	0.0	0.0
1012	Mosaic: Medium open woodland; tuart / Low woodland; banksia	169.8	100.0	598.1	169.8	28.4	0.0	0.0	0.0	0.0	0.0
1013	Mosaic: Medium open woodland; marri / Shrublands; teatree thicket	114.3	100.0	547.0	114.3	20.9	0.0	0.0	0.0	0.0	0.0
1007	Medium woodland	4,976.3	100.0	4,976.3	4,976.3	100.0	0.0	0.0	2.1	0.0	0.0
1018	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree/Low woodland; <i>Casuarina obesa</i>	3,743.5	100.0	16,611.6	3,743.5	22.5	16.4	0.4	16.4	0.4	0.1
1008	Medium open woodland; marri	968.9	99.4	5,330.8	963.0	18.1	0.0	0.0	7.8	0.8	0.1
965	Medium woodland; jarrah & marri	6,071.2	30.2	2,121.4	1,836.4	86.6	21.6	1.2	21.6	1.2	1.0
1136	Medium woodland; marri with some jarrah, wandoo, river gum and casuarina	7,297.9	83.2	68,761.7	6,048.1	8.8	816.4	13.5	982.4	16.2	1.4

Beard Veg Assoc	Veg Assoc description	Total current extent per Veg Assoc (ha)	% of total extent in IBRA Subregion	Pre-European Area (ha) in Subregion	Current Area in IBRA Subregion	% of pre-European Area remaining in Subregion	Area in IUCN Reserve	Area in IUCN Reserve %	Total Area in CALM Estate	Total Area in CALM Estate %	% of subregion pre-European area in CALM estate
1001	Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	19,006.2	99.6	68,475.2	18,906.8	27.6	797.5	4.2	1,039.2	5.5	1.5
1009	Medium woodland; marri & river gum	2,678.0	99.0	8,764.5	2,650.5	30.2	2.8	0.1	139.9	5.3	1.6
1000	Mosaic: Medium forest; jarrah-marri/Low woodland; banksia/Low forest; teatree ( <i>Melaleuca Spp.</i> )	34,462.3	75.3	112,487.1	25,418.8	22.6	3,274.5	12.9	5,877.8	23.1	5.2
3048	Shrublands; scrub-heath on the Swan Coastal Plain	4,183.9	100.0	14,575.0	4,183.9	28.7	804.6	19.2	804.6	19.2	5.5
1949	Low woodland	38,686.2	100.0	132,945.8	34,011.7	25.6	8,302.1	24.4	8,302.1	24.4	6.2
1028	Medium woodland; river gum	358.4	100.0	1,309.9	358.4	27.4	114.6	32.0	114.6	32.0	8.7
6	Medium woodland; tuart & jarrah	26,364.9	90.5	76,214.5	18,397.7	24.1	2,662.5	14.5	6,936.7	37.7	9.1
1030	Low woodland; <i>Banksia attenuata</i> & <i>B. menziesii</i>	103,177.3	93.5	136,951.8	96,459.1	70.4	12,972.9	13.4	12,972.9	13.4	9.5

### Subregional constraints in order of priority (see Appendix B, key g)

**Irreplacibility and Economic Constraints:** High economic value of land close to cities and coast for urban and semi-rural subdivision has led to a high degree of land speculation.

**Competing Land Uses:** Major components of the landscape are covered by mines, mining tenements, exploration leases and to a lesser extent grazing.

### Bioregional and subregional priority for reserve consolidation

SWA is reservation Class 4d (see Appendix D, and Appendix C, rank 4) because 10 - 15% of its area reserved (any tenure). SWA1 has 6.78% of the subregion in conservation reserves. SWA2 has 10.74% of the subregion in conservation reserves. However, there are threatening processes including continuing land clearing, and impacts on small fragmented remnants which predominate in the central and southern zone of the subregion. There is also some bias in the reserve system in that 62% of vegetation associations have <10% in reserves, including several that covered significant area (>10%) of the pre-European vegetation. The distribution of remnant vegetation is uneven with the greatest clearing having occurred in the central and southern zone of the subregion. In particular the eastern side of the coastal plain has been extensively cleared.

Therefore, SWA2 warrants a higher Rank than 4d#, and a rank of 2 would probably be the most appropriate.

### Reserve management standard

Within SWA2 there are 65 nature reserves, 8 national parks and 2 conservation parks.

**Nature Reserves:** Reserve management standards is (i) Poor to (ii) Fair (see Appendix C, rank 5) for majority of

small reserves in the southern and central zone, (iii) Good, for larger reserves and those in the northern zone.

Approximately half of the nature reserves in this subregion are small (<100 ha), with 10 reserves being very small (< 10 ha) and only 8 reserves being greater than 1000 ha. In the southern and central zones of the subregion, the areas highly disturbed by urban development and intensive agricultural activities, nature reserves are frequently associated with protection of coastal plain wetlands or a small vegetated remnants surrounded by urban and semi rural land uses. The largest reserves are found in the northern zone, with all but two being greater than 700 ha. These reserves contain coastal and northern Sand Plain vegetation communities grading to low eucalypt woodlands which in season are used by commercial apiarists.

There are no resident staff for these reserves, management visitation varies greatly with urban wetland reserves often frequently visited and others restricted to a minimum of once per year. Only a small number of the nature reserves in this subregion have formal approved management plans or interim management guidelines. In the southern and central zone, because of their small size and wetland protection function most reserves have significant weed invasion especially *watsonia*, *arum*, *bridle creeper*, *kikuyu* as well as annual and perennial grasses.

Feral animals (foxes, rabbits and increasingly in the southern zone, pigs) in all but the largest reserves are not controlled. Significant problems impede the agency's ability to undertake control programs in urban and semi-urban environments. Across all areas of the subregion, *Phytophthora* disease is impacting on vegetation communities in the reserves.

In many of the smaller reserves understorey species composition is often depauperate and in a degraded state resulting from grass and other weed invasion (however some small reserves, including those on the heavy soils of the eastern coastal plain are able to retain the majority of the original species), grazing impacts (including from

kangaroos) and too frequent fires. Fire regimes based on biodiversity outcomes are generally absent, deliberately lit wildfires can and do occur frequently depending on the proximity of the reserve to urbanisation. Formalised biodiversity monitoring programs are absent.

**National Parks:** Reserve management standards range from (ii) Fair to (iii) Good for the majority of the parks, though a Tuart decline (which appears to be climate driven, but includes a very high impact from native borer infestation) has left significant parts of one national park and small areas in a further two of the 8 national parks in this subregion in a poor state. (Rank is (i) Poor, indicating that threatening processes are leading to permanent resource degradation)

Five of the eight parks have management plans which are being implemented, though targeted ecological monitoring programs are either absent or inadequate. Size ranges from 1059 ha to 26 965 ha, with 2 of the 8 parks primarily servicing the recreation and day visitor requirements of the Perth metropolitan area. Three parks have staff in residence. All but two (Lesueur National Park and Moore River National Park) are sited on the coastal or near coastal (within 3 km) zone of the subregion. Thus the overall diversity of vegetation communities contained within these reserves is limited.

Feral animal control (fox, rabbit) is undertaken but is hampered by their close proximity to urban areas. Salinity issues are generally not evident on the western side of the subregion but extensive use of ground and surface water resources may be impacting of the overall health of the vegetation in a number of these parks. Fungal diseases

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plans	General Recovery Plans
Threatened flora species of highly cleared areas of the swan coastal plain (SWA2) subregion (majority of species are off reserve)	Recovery Plans or Interim Recovery Plans exist for all CR ranked flora. RPs and IRPs do not exist for all non-critically endangered flora.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2.)
Threatened invertebrate species (bees and moth species) are only known from non-reserved land in the highly cleared areas of the swan coastal plain (SWA2) subregion	No RPs or IRPs exist for any of the ranked invertebrate fauna.	No

(*Phytophthora* sp, *Armillaria* sp) are present in all of the parks and Tuart decline (Borer *Phorocantha* spp) are currently significantly affecting much of Yalgorup National Park, as well as impacting on Neerabup and Yanchep National Parks. The southern and central zone parks often have high weed loads especially Arum lilies, bridle creeper and pasture grass species, often associated with riparian and moisture gaining sites.

Fire regimes are often dominated by the requirement to protect adjoining land values. In most parks formalised biodiversity monitoring programs are absent.

**Conservation Parks:** Reserve management standard is (ii) Fair, biodiversity values and issues are poorly identified, degradation is retrievable. Two Conservation Parks occur within the subregion.

A Management Plan is available for Leschenault Peninsula Conservation Park (Department of Conservation and Land Management 1998b). Neither of the Conservation Parks have resident staff. Size ranges from 27 ha to approx 1000 ha. Weed invasion along riparian habitats and pasture grass invasion along the boundaries is of concern. Fox and rabbit control is undertaken. Fire regimes, currently set at exclusion, are yet to be optimised for biodiversity outcomes. Formalised biodiversity monitoring programs are absent but vegetation assessment plots were established during the Swan Coastal Plain Vegetation project and could form the basis of a permanent monitoring program.

## Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
Threatened flora species of highly cleared areas of the swan coastal plain (SWA2) subregion (majority of species are off reserve)	i, ii, iii, vi, ix, v, vii, viii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Weed control. Reinstatement of hydrology. Fencing. Control of rabbits. Revegetation.
Threatened invertebrate species (bees and moth species) are only known from non-reserved land in the highly cleared areas of the swan coastal plain (SWA2) subregion	i, ii, iii, ix, vi	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Regrowth retention. Weed control.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plans	General Recovery Plans
Remnant vegetation complexes on the Abba Plains, including but not limited to the Busselton Ironstone TEC east of Busselton and subjected to extensive clearing for agriculture	Yes – IRP for Shrubland Association on Southern Swan Coastal Plain Ironstone (Busselton area) (Southern Ironstone Association); RPs and IRPs exist for flora and fauna species ranked CR	No
Agonis and/or tuart woodlands along coastal wetlands supporting populations of Western Ringtail Possum in the Busselton to Bunbury area threatened by urbanisation	Yes – IRP for <i>Pseudocheirus occidentalis</i> ; RPs and IRPs exist for flora and fauna species ranked CR	No
Upland Vegetation Communities (TECs)	Yes – IRP for Shrublands and Woodlands on Muchea Limestone; IRP for Eastern shrublands and woodlands (Swan Coastal Plain community 20c); IRP for <i>Eucalyptus calophylla</i> - <i>Kingia australis</i> woodlands on heavy soils; IRP for <i>Eucalyptus calophylla</i> - <i>Xanthorrhoea preissii</i> woodlands and shrublands.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2)
Wetland Vegetation Communities (TECs)	Yes – IRP for Community of Tumulus Springs (organic mound springs) of the Swan Coastal Plain; IRP for Shrublands and woodlands on Perth to Gingin ironstone.	Draft Swan Region Threatened Flora Management Plan provides recovery actions for all DRF flora within the Department of Conservation and Land Management's Swan Region (covering the central zone of SWA2)
Stromatolite Communities (TECs)	Yes – Draft IRPs for Lake Clifton and Lake Richmond Stromatolite Communities.	No
Cave Communities (TECs)	Yes – Draft IRP for Aquatic Root Mat Community and the Crystal Cave Crangonycyoid of Caves of the Swan Coastal Plain	No
Sedgeland Community (TEC)	Yes – IRP for Sedgelands and Holocene Dune Swales	No

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Remnant vegetation complexes on the Abba Plains, including but not limited to the Busselton Ironstone TEC east of Busselton and subjected to extensive clearing for agriculture.	i, ii, iii, v, vii, viii, ix, xiv	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves). Fencing. Control of rabbits. Revegetation. Fire Management. Other - minimise sand mining impacts.
Agonis and/or tuart woodlands along coastal wetlands supporting populations of Western Ringtail Possum in the Busselton to Bunbury area threatened by urbanisation.	i, ii, iii, vii, viii	Habitat retention and protection through reserves, on private lands and on other state lands. Feral animal control. Revegetation.

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Upland Vegetation Communities (TECs)	i, ii, iii, vi, ix, v, viii, xiii, vii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves and Commonwealth lands). Weed control. Fire Management. Fencing. Revegetation. Capacity building with friends groups, and Green Corps teams. Control of rabbits.
Wetland Vegetation Communities (TECs)	i, ii, iii, vi, xi, viii, xiii	Habitat retention and protection through reserves, on private lands and on other state lands (especially rail and road reserves and Commonwealth lands). Weed control. Reinstatement of hydrology. Revegetation. Capacity building with friends groups, and Green Corps teams.
Stromatolite Communities (TECs)	i, xi, xiii	Habitat retention through reserves. Reinstatement of hydrology. Capacity building with friends groups, and Green Corps teams.
Cave Communities (TECs)	i, xi, xii, xiv	Habitat retention through reserves. Reinstatement of hydrology. Research. Other – Emergency artificial watering of root mats.

<sup>1</sup>Appendix B, key h.

## Subregion priority for off reserve conservation

On average the subregion would rank (ii) (see Appendix C, rank 6), however areas of the south and east of the subregion would rank (i), and areas in the central zone could rank (iii) as there is a large population base and so there a large potential capacity to carry out off reserve works.

## Conservation actions as an integral part of NRM

### Existing NRM actions

#### Incentives:

There are incentives for a range of on-ground actions through State, Commonwealth and some other programs. These incentives generally involve remnant vegetation fencing under various programs; or provision of advice or assistance (Land for Wildlife, covenant program, and some NHT funded community projects).

Incentives for conservation on private property (such as rate rebates) are available through some Local Governments, as well as limited State and Commonwealth government rate and tax relief.

#### Legislation:

Existing legislation includes Wildlife Conservation Act, Conservation and Land Management Act and Environmental Protection Act.

Water use and conservation legislation has benefit to wetland and riparian biodiversity values. Soil conservation and land clearing legislation has influence on the retention of remnant vegetation and protection of biodiversity assets.

Statutory land planning legislation and policies, while designed to facilitate orderly development, is taking increased consideration of biodiversity values during that process, and is increasingly used to protect biodiversity assets (for example the Bush Forever project for the Perth metropolitan area).

#### Institutional Reform:

As noted above, statutory land planning is increasingly used to protect biodiversity assets, for example, State planning policy now requires Rural Planning Strategies and Schemes to address NRM issues.

Operation of regional NRM groups, and interactions with State and Commonwealth agencies, is currently in a state of evolution, but represents an on-going case of institutional reform. Some State agencies in NRM area have been restructured and re-oriented over the past 12 months, and this is continuing.

Increasing activity of some Local Governments in biodiversity management, including employment of specialist biodiversity and bushland management staff. However, not all councils involved and level of activity varies.

#### Valuing Ecosystem Services and Tradable Rights:

Limited application to date in Swan Coastal Plain Subregion. The aesthetic and social values of native vegetation and biodiversity are used to promote bush blocks in populated, coastal areas. Programs such as “Bush Brokers” deal with these values.

Similarly some semi-rural subdivisions in bushland areas use the same promotion. However poorly designed, or inappropriate subdivision of remnant vegetation, which may be promoted as protecting bushland, in fact results in decline in the values due to increased fragmentation and disturbance to bushland from fencing, firebreaks, building envelopes, grazing, and inappropriate bushland management.

Bushland is often retained as a visual or spatial buffer between land uses, including buffering noxious industry. This can result in retention of bushland that would otherwise be cleared. However, the usual situation is that due to the size, shape and configuration of these buffers some biodiversity values are lost.

#### Threat Abatement Planning as Part of NRM:

Several programs coordinated through CALM, and there are internal reports and policies relating to management of threats such as dieback, feral animal control, fire, etc. on lands managed by the Department. Some of this practice (e.g. dieback management) is taken up by industry, local government, and others.

Major programs include: feral animal control programs (Western Shield – limited cooperative participation by landholders); Also State government, multi-agency programs such as State Salinity Strategy; and State Weed Strategy.

Vegetation management plans are often required as condition of development through the statutory planning

or environmental assessment processes. However these are site based plans. Given that land clearing for development is a major threatening process on the swan coastal plain, more strategic, broad scale vegetation management planning is required to address this threat. The Bush Forever project (covering the swan coastal plain portion of the Perth metropolitan area, i.e. the central portion of the subregion) is an attempt to address this through the existing statutory planning and environmental assessment processes (Western Australian Planning Commission 2000).

#### **Industry Codes of Practice**

Some codes of practice and documentation of “best practice” exist that include consideration of biodiversity assets. Some of these are enforced through licensing or statutory processes. For example, codes of practice relating to mining and extractive industry, plantation management, as well as agricultural and development industries are relevant to the subregion.

#### **Capacity Building:**

There is significant interaction between State agencies, regional NRM groups, and other agencies and groups such as Greening Australia (WA) and Worldwide Fund for Nature. These groups are also interacting jointly and independently to contribute to capacity building amongst landholders and community groups. For example, the Skills for Nature Conservation training carried out by the EcoPlan project in conjunction with Greening Australia (WA) and the Swan Catchment Centre provide capacity building opportunities to community groups. Other groups such as the Threatened Species Network also make significant contributions to capacity building in the community.

The Department of Agriculture, Department of Conservation and Land Management and Water and Rivers Commission all contribute to community forums, workshops and education as part of increasing understanding processes and management actions available to landowners and community in relation to biodiversity issues; Weed action groups are supported by CALM and AgWA.

#### **Other Planning Opportunities:**

Local Government Rural Strategies and Town Planning schemes (for controlling development and assessing proposals) can now address biodiversity and environmental issues within an NRM context as a result of Western Australian Planning Commission requirements.

The Western Australian Planning Commission have several final and draft Statement of Planning Policies (SPPs) that provide for consideration of biodiversity issues in the statutory land use planning process. These include (but are not limited to): The Peel-Harvey Coastal Plain Catchment Policy (SPP No. 2); State Coastal Planning Policy (SPP No. 2.6); Gnarangara Mound Crown Land Policy (SPP No. 3); Basic Raw Materials (SPP No. 10); Agriculture and Rural Land Use Planning (SPP No. 11); and Environment and Natural Resources Policy (draft SPP).

Regional NRM strategies developed through the NHT2 (and National Action Plan for Salinity and Water Quality) process will include Biodiversity issues.

#### **Integration With Property and Catchment Management Planning:**

There are three Regional NRM groups covering the Swan Coastal Plain subregion (Northern Agricultural Catchment Council, Swan Catchment Council, and Southwest Catchment Council). These include a number of subregional NRM groups and Land Conservation District Committees within their boundaries. These groups have varying access to biodiversity expertise. Regional NRM groups are not fully representative and with limited capacity currently.

Integration occurring in various ways, examples include:

- Contribution to property planning by Land for Wildlife, and similar programs;
- Advice from other State agencies, for example Department of Agriculture advice on soil survey, land capability assessment and farm planning etc.
- Regional planning through State agency plans, NRM regional group plans
- Department for Planning and Infrastructure rural land use planning.

#### **Feasible opportunities for NRM**

##### **Incentives:**

There are opportunities to extend the availability of incentives for conservation on private property through rate and tax rebates or relief, additional subdivision rights, and assistance or advice programs (for example, rate relief is only available in a few local governments). Potential exists for changes in the taxation laws for philanthropy.

Similarly many incentive programs are “opt-in” - participants include only those who contact the program and volunteer to join. There is a potential for these programs to be more strategic and targeted, to the degree of lobbying or approaching owners of high conservation value lands.

Some potential for protection of remnant vegetation through marketing as conservation properties close to major city centres, however the high level of property speculation with expectation for maximum yield will limit uptake.

##### **Legislation:**

Proposed amendments in 2003 to State Environmental Protection Act relating to land clearing and environmental harm.

Proposed new State Biodiversity Conservation Act to replace the existing Wildlife Conservation Act. Consultation process commenced in late 2002.

Also more thorough and effective enforcement of all existing legislation is required.

##### **Institutional Reform:**

Some incentive options, such as tax incentives, rate relief, trading of development rights, require legislative or policy change to become fully effective.

Development of the emerging paradigm of regional delivery of NRM, facilitated through the NHT2 and NAPSWQ, may result in changes to the involvement of State agencies, community groups and the wider community in decision making, and implementation in relation to biodiversity conservation (including through development of Regional NRM Strategies).

While institutional reform is an issue, opportunities for progress lie in improving existing institutions and ensuring that they carry out their responsibilities effectively and are resourced at a sufficient level and staffed with appropriate people.

Some Local Governments are taking on an increased role in biodiversity management, including employment of specialist biodiversity and bushland management staff. Greater uptake by other Local Governments (and State agencies who manage lands with biodiversity values) is required.

#### **Valuing Ecosystem Services and Tradable Rights:**

Development of tradable development rights within the statutory land planning process, may provide options for conserving biodiversity values within the areas of the subregion with high property values and high levels of property speculation that might not otherwise be available.

#### **Threat Abatement Planning as Part of NRM:**

There is a need for the recognition of land clearing for urban development as a significant threatening process, followed by coordinated, biodiversity conservation focused, threat abatement planning.

There is a need for the extension of some State agency threat abatement programs (for example Western Shield) beyond lands under the immediate control of the agencies.

The state weed strategy needs to be resourced and implemented.

#### **Industry Codes of Practice:**

Increased development and adoption of codes of practice, and best practice, that benefits biodiversity conservation.

#### **Capacity Building:**

Facilitate greater community education/involvement in a range of areas in biodiversity conservation and NRM. This should be aimed at increasing the amount and effectiveness of on-ground effort by the community, as well as development of a constituency of support for biodiversity conservation in the wider community.

#### **Other Planning Opportunities:**

Some Local Governments have had improved inclusion of biodiversity issues in their statutory land planning processes, as well in management of land under their control. Greater uptake by other Local Governments is required.

There is potential for greater uniformity across councils, as well as for strategic pre-planning.

#### **Integration with Property Management Planning, Catchment Planning and Landcare:**

Increased or improved integration with property and catchment management planning.

Increased activity and influence of Regional NRM groups arising from new NHT2 and NAPSWQ arrangements, and increased focus by these groups on biodiversity issues.

#### **Impediments or constraints to opportunities**

A number of impediments exist including;

- Need to increase awareness of conservation values through education of public in general;
- Limited financial resources for agencies to effectively manage the range of issues within the subregion; high level of property speculation for assumed future urban or rural subdivision inflates land prices, a large part of this speculation is on bush blocks.

Subregions where specific NRM actions are a priority to pursue

SWA2 has an NRM priority of (i) (see Appendix C, rank 7), which indicates that there are major constraints to implement effective NRM actions due to the extent of past degradation, competing land uses, high property values, and urbanisation pressures.

#### **Data gaps**

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** There is no regolith mapping available and vegetation map resolution is 1:250 000 at best. Existing vegetation mapping (Beard) does not cover most southern ¼ of subregion. Few reserves have detailed vegetation mapping available.

**Systematic Fauna Survey:** Data is mainly confined to vertebrates and selected invertebrate taxa. There is not uniform coverage of survey and while there is some existing survey of invertebrate across subregion most of this has not been sorted identified or analysed yet. The existing invertebrate data indicates that there are significant species and groups of species within the subregion. Most reserves don't have long-term survey data on species presence or absence, even for vertebrates.

**Floristic Data:** There has been plot based floristic survey throughout the subregion. However this has been based on specific projects and is uneven in coverage, with the southern half of the subregion having better coverage. This has provided valuable information on Threatened Ecological Communities. However floristics in the northern half has not been as well surveyed, there may be other areas requiring additional survey, and a systematic and consolidated analysis of floristic data is required throughout.

**Ecological and Life History Data:** There few data on habitat requirements of virtually all invertebrate species,

most ephemeral plants, persisting CWR mammals, and uncommon vertebrate and plant species. There are no data to provide a regional context on life-history (including population-trend) of most species, including introduced or pest species.

**Other Priority Data Gaps Include:**

- No quantitative data on the effect of exotic predators, weed colonisation, fragmentation, fire, mineral-extraction.

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834	Department of Conservation and Environment	(1983).	Conservation reserves for Western Australia. The Darling System - System 6. Parts 1 and 2.	Report 13 Department of Conservation and Environment, Perth, Western Australia.	O
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R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 014, 072, 075, 087, 304, 371, 639 and 640 in Appendix A.

# Tanami Desert 1 (*TAN1 – Tanami 1 subregion*)

GORDON GRAHAM  
SEPTEMBER 2001

## Subregional description and biodiversity values

### Description and area

Mainly red Quaternary sandplains overlying Permian and Proterozoic strata that are exposed locally as hills and ranges. The sandplains support mixed shrub steppes of *Hakea spp.*, desert bloodwoods, *Acacia spp.* and *Grevillea spp.* over soft spinifex (*Triodia pungens*) hummock grasslands. Wattle scrub over soft spinifex (*T. pungens*) hummock grass communities occur on the ranges. Alluvial and lacustrine calcareous deposits occur throughout. In the north they are associated with Sturt Creek drainage, and support ribbon grass (*Chrysopogon spp.*) and Flinders grass (*Iseilema spp.*) short-grasslands often as savannas with river red gum. The climate is arid tropical with summer rain. Subregional area is 3, 214, 599ha.

### Dominant land use

The dominant land use is (xi) UCL and Crown reserves (see Appendix B, key b).

### Continental Stress Class

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Gregory System TAN001WA	B7, B8, B2	ii	vi	iii	iv, v (cattle), xii (substantial tree deaths have reduced availability of nesting material for water birds; possibly broadscale erosion in Northern Territory portion of catchment at least).

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

There are no Wetlands of Subregional Significance in TAN1.

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	Unknown	Unknown	ii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

The Continental Stress Class for TAN1 is 5.  
Known special values in relation to landscape, ecosystem, species and genetic values

There are no known special values within TAN1.

### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

The CTRC report in 1974 (System 7) formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" (Burbidge *et al.* 1991) which has itself been incorporated in a Departmental Draft Regional Management Plan (Portlock *et al.* 2001). These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion.

Apart from specific survey work there has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. The least is known about this bioregion out of all in the Kimberley.

## Ecosystems at risk

### Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in TAN1.

### Other ecosystems at risk

Ecosystem	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Process <sup>5</sup>
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the southern Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Widespread vegetation types and widespread threats such as changed fire regimes.	V	11	Variable	vi	ii	vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)</b>					
<i>Macrotis lagotis</i>	V (Comm.)	Unknown	vi	ii	vii, xii (possibly predation)
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E (Comm.) S1 (State)	Unknown	iii	ii	vii
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Falco hypoleucos</i>	Near threatened (Comm.)	Unknown	vi	ii	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened (Comm.)	Unknown	vi	ii	Unknown threatening processes
<i>Phaps histrionica</i>	Near threatened (Comm.)	Unknown	vi	ii	Unknown threatening processes
<i>Ardeotis australis</i>	Near threatened (Comm.)	Unknown	vi	ii	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

There are no declared rare or priority flora in TAN1.

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

The following Tanami bioregion vegetation associations are not reserved within the bioregion:

Beard Veg Assoc	Description	Area (Ha.)
78	Hummock grasslands, low tree steppe; eucalypts over soft spinifex ( <i>Triodia pungens</i> ).	669
91	Hummock grasslands, sparse tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	286,107
100	Hummock grasslands, shrub steppe; <i>Acacia delibrata</i> over soft spinifex ( <i>Triodia pungens</i> ).	59,458
101	Hummock grasslands, shrub steppe; <i>Acacia pachycarpa</i> over soft spinifex ( <i>Triodia pungens</i> ).	243,243
117	Hummock grasslands, grass steppe; soft spinifex ( <i>Triodia pungens</i> ).	12,840
Beard Veg Assoc	Description	Area (Ha.)
125	Bare areas; salt lakes.	27,411
133	Mixed short grass and spinifex.	50,789
134	Mosaic: Hummock grasslands, open low tree steppe; desert bloodwood? and feathertop spinifex ( <i>Plectrachne schinzii</i> ) on sandhills/Hummock grasslands, shrub steppe; mixed shrubs over spinifex between sandhills.	7,140
151	Sedgeland; sedges with open low trees; coolibah over various sedges.	164,045
155	Hummock grasslands, low tree steppe; eucalypts over soft spinifex ( <i>Triodia pungens</i> ) and feathertop spinifex ( <i>Plectrachne schinzii</i> ) between sandhills.	56,945
174	Hummock grasslands, shrub steppe; mixed shrubs over soft spinifex ( <i>Triodia pungens</i> ).	74,846
217	Hummock grasslands, steppe woodland; desert oak ( <i>Allocasuarina decaisneana</i> ) and soft spinifex ( <i>Triodia pungens</i> ).	63,343
218	Hummock grasslands, shrub steppe; corkwood ( <i>Hakea spp.</i> ) and <i>Acacia spp.</i> over soft spinifex ( <i>Triodia pungens</i> ).	1,915,600

848	Hummock grasslands, low tree steppe: eucalypts over curly spinifex ( <i>Triodia bitextura</i> ) on laterite sand plains.	349
849	Hummock grasslands, low tree steppe: snappy gum ( <i>Eucalyptus brevifolia</i> ) and bloodwood ( <i>Eucalyptus spp.</i> ) over soft spinifex ( <i>Triodia pungens</i> ).	571
895	Hummock grasslands, shrub steppe: mixed acacia over soft spinifex ( <i>Triodia pungens</i> ) (Tanami).	105,971
897	Spinifex, Mitchell grass ( <i>Astrelba spp.</i> ) and kangaroo grass ( <i>Themeda australis</i> ).	2,823
922	Hummock grasslands, low tree steppe: eucalypts over soft spinifex ( <i>Triodia pungens</i> ) and feather spinifex ( <i>Plectrachne schinzii</i> ) between sandhills.	17,402
1121	Mixed short grass and spinifex with scattered coolibah.	19,997
1271	Bare areas: claypans.	12,153
2175	Grass savannah on clay plains.	81,116

Poorly represented ecosystems subject to threat:

Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the southern Kimberley region.
Widespread vegetation types and widespread threats such as changed fire regimes.

Note: the lack of study in some areas precludes statements about the level of reservation required.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

## Bioregional and subregional priority for reserve consolidation

The Tanami bioregion has a ranking priority under the preliminary bioregional NRS priorities of 1 (see Appendix D, and Appendix C, rank 4). There are no reserves within the component of the bioregion within Western Australia. There is a lack of adequate data on the condition of the bioregion.

## Reserve management standard

There are no reserves within the Tanami bioregion.

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Tanami subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and vegetation composition and structure is of concern.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.

## Existing species recovery plans

The Action Plan for Australian Bats.  
The Action Plan for Australian Birds 2000.  
Action Plan for Australian Marsupials and Monotremes.  
Gouldian Finch Recovery Plan.

Draft Kimberley Region Management Plan (various strategies).

## Appropriate recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Further fire research is required.

**Weed Control:** Need to define weeds priorities. Resources required for already identified State and regional weed strategies.

**Capacity Building:** Need organisational responsibility for coordinating management efforts across tenure and management responsibilities. Local adoption of strategies. Capacity building in pastoral industry and Aboriginal groups to optimise biodiversity. Minimise loss of the mineral A horizon and protection of organic layers.

## Ecosystems, existing recovery plans and appropriate recovery actions

This is a general savannah issue and fire is the main driver in addressing this. The next most important may well be predation of fauna by cats and occasionally foxes. Actions that are required are linked to management research and better-coordinated efforts between Government agencies, Traditional owners and the broader community.

## Subregion priority for off reserve conservation

For much of the subregion the off park conservation priority is (ii) (see Appendix C, rank 6), indicating that a large off park effort is needed, resource constraints and limited community capacity exist.

## Conservation actions as an integral part of NRM

### Existing NRM actions

There are no existing NRM actions that have been identified in TAN1.

### Feasible opportunities for NRM

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost effective solutions.

**Legislation:** Improved implementation of existing legislation.

**Capacity Building:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

Subregions where specific NRM actions are a priority to pursue

Research is required on this issue.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation and regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale. As an initial step a review of the Beard vegetation mapping database is warranted

**Quantitative Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. An efficient methodology to undertake mapping needs to be designed.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

#### **Other Priority Data Gaps Include:**

Further research is required on the conservation status of many fauna and flora taxa as well as the effects of threatening processes such exotic predators (cats), stock (cattle, donkeys, camels and pigs), fire and weeds.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, <i>Erythrura gouldiae</i>	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
556	Portlock, C., Graham, G., Done, C., Gilmour, J. and Williamson, J.	(2001).	Kimberley Region Draft Regional Management Plan. (Unpubl)	Department of Conservation and Land Management.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 094, 100, 118, 173, 551, 626, 634, 635, 636, 637, 648, 692 and 693 in Appendix A.

# Victoria Bonaparte 1 (VB1 – Victoria Bonaparte 1 subregion)

GORDON GRAHAM  
AUGUST 2001

## Subregional description and biodiversity values

### Description and area

The Phanerozoic strata of the Bonaparte Basin in the north-western part are mantled by Quaternary marine sediments supporting Samphire - *Sporobolus* grasslands and mangal, and by red earth plains and black soil plains with an open savannah of high grasses. Plateau and abrupt ranges of Proterozoic sandstone, known as the Victoria Plateau, occur in the south and east, and are partially mantled by skeletal sandy soils with low tree savannahs and hummock grasslands. In the southeast are limited areas of gently undulating terrain on a variety of sedimentary rocks supporting low snappy gum over hummock grasslands and also of gently sloping floodplains supporting *Melaleuca minutifolia* low woodland over annual sorghums. The climate is dry hot tropical, semi-arid summer rainfall. There is no division into subregions in Western Australia. The northern part in WA comprises marine plains adjacent to the Arafura Sea with *Sporobolus* grasslands, mound springs with monsoon forest, and, on the seaward periphery, mangrove creeks and coastal dunes with vine thicket. In the south, red and black-soil plains with savannah woodlands, emergent quartz-sandstone ranges with tree-steppe over hummock grassland and limestone ranges with open-savannah vine thickets. The area of VB1 in Western Australia is 1, 932, 467ha.

Broad-scale vegetation mapping of the area describes the following components:

- Mangroves.
- Saline tidal mudflats +/- samphire.
- Coastal dune communities.
- *Eucalyptus microtheca* (coolibah) and/or *Eucalyptus* spp. +/- *Excoecaria parvifolia* (gutta percha) grassy low woodland.
- Mixed species tussock grasslands or sedgelands +/- emergent *Pandanus* spp. (screw palm).
- *Eucalyptus tectifera* (Darwin box) and/or *Eucalyptus* spp. Woodland with *Sorghum* spp. (sorghum) and *Sehima nervosum* (white grass) tussock grasses.
- *Eucalyptus tetradonta* (Darwin stringybark), *Eucalyptus miniata* (Darwin Northern woollybutt) +/- *Eucalyptus* spp. +/- *Livistona* spp. (fan palms) woodland with a ground layer of tussock grasses and *Triodia bitextura* (curly spinifex).
- *Eucalyptus terminalis* (desert bloodwood) low open-woodland with *Sehima nervosum* (white grass) and *Chrysopogon fallax* (golden beard grass) tussock grasses +/- *Triodia* spp. (spinifex).
- *Melaleuca* spp. (paperbark) and *Eucalyptus* spp. low woodland with *Triodia bitextura* (curly spinifex) hummock grasses.

- *Astrebla lappacea* (curly Mitchell grass) and/or *Astrebla pectinata* (barley Mitchell grass) tussock grassland sparsely wooded with *Acacia* spp. low trees.
- *Eucalyptus tetradonta* (Darwin stringybark) and *Eucalyptus miniata* (Northern woollybutt) +/- *Eucalyptus bleeseri* (rusty-barked bloodwood) woodland with *Sorghum* spp. tall-grasses.
- *Eucalyptus* spp., *Eucalyptus miniata* (Darwin Northern woollybutt) +/- *Eucalyptus tetradonta* (Darwin stringybark) open-woodland with *Triodia bitextura* (curly spinifex) and *Sorghum* spp. (sorghum) grasses.
- *Eucalyptus tectifera* (Darwin box) +/- *Eucalyptus* spp. woodland with *Chrysopogon* spp. (ribbon grass), *Sorghum* spp. (sorghum) and *Triodia bitextura* (curly spinifex) grassy understorey.
- *Eucalyptus brevifolia* (snappy gum) low open-woodland with *Triodia bitextura* (curly spinifex) hummock grasses +/- *Enneapogon* spp. (nine-awn grass) short-tussock grasses or sometimes a grassland without trees.

### Dominant land use

The dominant land use in VB1 is (ix) Grazing – Native pastures (see Appendix B, key b), (xi) UCL and Crown reserves and (xiii) Conservation.

### Continental Stress Class

The Continental Stress Class for VB1 is 4.

Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare Features Include:

- Extensive mangrove community of the False Mouths of the Ord.
- Ramsar listed wetlands of the Ord Floodplain and Lake Kununurra.
- Cambridge Gulf and associated river systems.
- 'Wet' tropical river of the lower Ord River since damming.
- The man-made wetlands of Lake Kununurra.
- Alluvial plain systems of the Ord and Weaber Plains.
- Black butcherbird population associated with the mangrove communities of the False Mouths of the Ord.
- The Devonian reef system of Ningbing Range with its particular vegetation associations (rainforest patches) and extensive cave systems.
- The coastal plain heading from Cape Domett to Northern Territory border. This is comprised of salt flats, grasslands, coastal creeks, rainforests on dune

ridges and rainforests associated with mound springs.

- A large flatback turtle rookery at Cape Domett.
- Very large *Miniopterus schreibersii* roost site within the gorges of the Cockburn Range.
- Fox and rabbit free and essentially uninhabited.

#### Centres of Endemism Include:

- An endemic isopod is found in the waters of Zebedee Springs.
- Rainforest patches are particularly important to invertebrates such as Camaenid land snails and annelids. Camaenid land snails have a large number of endemic species and some endemic genera showing strongly localised patterns of endemism. All the rainforest patches studied to date have endemic earthworm species associated with them.

#### Refugia:

Poorly known. 'Dry' rainforest patches, as well as swamp rainforests provide dry season refuges. Mangroves occur through riparian zones and provide refugia. Further research is required to define the extent to which this may apply to sandstone country because of its ability to provide fire protection. It is known that cypress (*Callitris intratropica*) is found on the plateau of the Cockburn Range and it is clear that the cliff sides of this range provide protection from fire. Further studies of the flora of this range are warranted.

#### High Species and Ecosystem Diversity:

Rainforests are defined by their vegetation associations and are resource centres for a variety of faunal taxa that are either directly linked to rainforests or are more widely ranging species that are dependent on them. Examples include fruit pigeons and flying foxes.

Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Lake Kununurra WA098	C1	iii	iv	iii	vi (119 introduced species of plant identified (Salvinia, Neem, Wild Passionfruit))
Ord Estuary System WA099	A6	iii	iii	iii	iv, vi (extent to be determined), x (changed hydrology)
Parry Floodplain WA100	B4	iii	iii	iii	vi (extent to be determined (Parkinsonia)), x, vii

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

The CTRC report in 1974 (System 7) formed the basis of the Department's publication "Nature Conservation Reserves in the Kimberley" (Burbidge *et al.* 1991) which has itself been incorporated in a Departmental Draft Regional Management Plan (Portlock *et al.* 2001). These reports were focused on non-production lands and those areas not likely to be prospective for minerals. Action statements and strategies in the draft regional management plan do not go to the scale of subregion or even bioregion. There is some limited, unpublished biological survey work for specific parcels of land (Cockburn Ranges, Lower Ord, Mirima National Park). Previous rainforest studies are applicable (McKenzie *et al.* 1991).

Apart from specific survey work there has been no systematic review of biodiversity but it is apparent that there are on-going changes to the status of fauna (particularly mammals) and plant taxa. There is reasonable evidence about continuing loss of species and changes to assemblages at the landscape level which are affecting vegetation structure (e.g. loss of shrub layer), composition (e.g. perennial vs. annual grasses), vegetation cover, leaf litter, and organics in the upper soil horizon. It is generally recognised that flow-on effects of changes in the physical components of the environment, vegetation structure changes and other factors (e.g. exotic predators) can have significant effects on fauna. Work to date has been of a general nature.

Research is underway through the CRC for Tropical Savannahs looking at the Ord River from the top of the catchment to the Cambridge Gulf. This work is systematically assessing the environmental characteristics of the riparian zone (Dr Tony Start). Whilst in its infancy the recently established Ord Bonaparte Project is expected to assess the sustainable development and management of this bioregion.

## Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

Name and Code	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Freshwater wetlands on Carlton Hill Station adjacent to the Ord River Nature Reserve.	TBD	B17	ii	iii	vi	i	iv, vii
Mound Springs of the Bonaparte coastal land.	TBD	B14	ii	iii	vi	ii	iv
Wetlands at the junction of the sand soils at the northern end of the subregion and the Bonaparte coastal land.	TBD	B14	ii	iii	iv	iii	iv, vii

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
All fringing vegetation of riparian zones	iii	iii	iii	vii, iv, v (feral herbivores), x, vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

## Threatened ecological communities (TECs)

There are no Threatened Ecological Communities (TECs) in VB1.

## Other ecosystems at risk

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Savannah communities of which <i>Callitris intratropica</i> is a component.	V	11	Unknown	iii	iii	vii
Rainforest patches of the Kimberley savannah generally. Example rainforest patches on the Mitchell Plateau and in the supratidal flats.	V	2	Unknown	iii	iii	iv, vii
Assemblages of permanent/ephemeral wetlands, damplands, and riparian habitat of the Kimberley region.	V	15, 38, 42	Unknown	iii	ii	iv, vii
Widespread vegetation types and widespread threats such as changed fire regimes.	V	11	Unknown	vi	ii	vii
Plant assemblages of sand plain seepage areas between/near sandstone ridges.	V	38	Unknown	vi	i	vii
Point Spring Rainforest	V (P1)	2	iii	v	iii	vi (wild passionfruit and grasses)
Rainforest and paperbark forest associated with mound springs and seepage areas of the Victoria Bonaparte coastal lands.	V (P1)	2	ii	iii	ii	iv, vi
Rainforest springs in False Mouths of the Ord. Carlton Hill Station/Ord River nature reserve.	V (P1)	2	ii	iii	ii	iv, vii
Vine thickets of limestone ranges: Ninbing Range	V	2	iii	iii	iii	vii
<i>Oryza australiensis</i> (wild rice) grasslands on alluvial flats of the Ord River	V	37	Unknown	vi	ii	vii, i
Invertebrate community of Zebedee Springs, El Questro Station	V	43	Unknown	vi	ii	xii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

## Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Erythrura gouldiae</i>	E	Unknown	iii	ii	vii
<i>Falcunculus frontatus whitei</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Erythrotriorchis radiatus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Malurus coronatus coronatus</i>	V	Unknown	vi	ii	vii, iv
<b>SCHEDULE 1; RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Caretta caretta</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Lepidochelys olivacea</i>	E	Unknown	vi	Unknown	Unknown threatening processes
<i>Chelonia mydas</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Dermochelys coriacea</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Eretmochelys imbricata</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<i>Natator depressus</i>	V	Unknown	vi	Unknown	Unknown threatening processes
<b>SCHEDULE 4; OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Crocodylus johnstoni</i>	S4 (State)	Unknown	iv	iii	Unknown threatening processes
<i>Crocodylus porosus</i>	S4 (State)	Unknown	v	iii	Unknown threatening processes
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Ardeotis australis</i>	Near threatened (Comm.)	Unknown	vi	Unknown	Unknown threatening processes
<i>Dasyurus hallucatus</i>	Near threatened (Comm.)	Unknown	iii	ii	Unknown threatening processes
<i>Falco hypoleucos</i>	Near threatened (Comm.)	Unknown	vi	Unknown	Unknown threatening processes
<i>Heteromunia pectoralis</i>	Near threatened (Comm.)	Unknown	vi	Unknown	Unknown threatening processes
<i>Macroderma gigas</i>	Near threatened (Comm.)	Unknown	vi	Unknown	Unknown threatening processes
<i>Neochmia ruficauda subclarescens</i>	Near threatened (Comm.)	Unknown	iii	iii	vii
<i>Rhinonictes aurantius</i>	S1 (State)	Unknown	vi	Unknown	Unknown threatening processes
<i>Chalcophaps indica yamashinai</i>	S3 (State)	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Species Name	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>PRIORITY 1</b>					
<i>Acacia setulifera</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Echinochloa kimberleyensis</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Fuirena nudiflora</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Goodenia durackiana</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<i>Trachymene oleracea</i>	1	Unknown	vi	Unknown	Unknown threatening processes
<b>PRIORITY 2</b>					
<i>Eucalyptus ordiana</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Fimbristylis laxiglumis</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Goodenia sepalosa</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Gossypium pilosum</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Livistona victoriae</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Myriophyllum callitrichoides</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Platysace rupestris</i>	2	Unknown	vi	Unknown	Unknown threatening processes
<i>Utricularia aurea</i>	2	Unknown	vi	Unknown	Unknown threatening processes

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

## Reservation priorities of ecosystems

The following Victoria Bonaparte vegetation associations are not reserved anywhere within the bioregion:

Beard Veg Types	Description	Area (Ha.)
61	Grasslands, tall bunch grass savannah woodland, coolibah over ribbon grass ( <i>Chrysopogon spp.</i> ).	3,164
73	Grasslands, short bunch grass savannah, grass; salt-water grassland ( <i>Sporobolus virginicus</i> ).	16,626
75	Grasslands, curly spinifex, low tree savannah woodland; scarlet gum ( <i>Eucalyptus phoenicea</i> ) and <i>Eucalyptus ferruginea</i> over <i>Triodia bitextura</i> .	520
126	Bare areas; freshwater lakes.	93,480
703	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over <i>Triodia intermedia</i> .	1,335
800	Grasslands, high grass savannah woodland; Darwin stringybark ( <i>Eucalyptus tetradonta</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over (upland tall grass and) curly spinifex ( <i>Triodia bitextura</i> ).	16,534
808	Grasslands, curly spinifex, low tree savannah; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	36,141
811	Grasslands, high grass savannah low tree; Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus terminalis</i> ) over white grass ( <i>Sehima nervosum</i> ) on rolling basalt country.	11,069
812	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus terminalis</i> ) and Northern woollybutt ( <i>Eucalyptus miniata</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	263,327
813	Grasslands, high grass savannah sparse tree; bauhinia ( <i>Bauhinia cunninghamii</i> ) and coolibah over blue ( <i>Bothriochloa spp.</i> ) and tall upland grasses on black soil plain.	10,647
816	Grasslands, short bunch grass savannah, low tree, Mt House box ( <i>Eucalyptus argillacea</i> ) and bloodwood ( <i>Eucalyptus terminalis</i> ) over arid short grass ( <i>Enneapogon spp.</i> ).	45,416
817	Grasslands, high grass savannah low tree; Terminalia ( <i>Terminalia spp.</i> ) over upland tall grass and blue grass ( <i>Bothriochloa spp.</i> ).	6,192
819	Grasslands, tall bunch grass savannah low tree; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and silver leaved box ( <i>Eucalyptus pruinosa</i> ) over <i>Aristida</i> and ribbon grass ( <i>Chrysopogon spp.</i> ) on sandy plains.	9,835
820	Grasslands, high grass savannah sparse low tree; snappy gum ( <i>Eucalyptus brevifolia</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on granite.	55,860
825	Grasslands, high grass savannah woodland; cabbage gum ( <i>Eucalyptus grandifolia</i> ) and <i>Eucalyptus greeniana</i> over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ) on basalt.	42,330
826	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	711
835	Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ) and <i>Eucalyptus greeniana</i> over spinifex and white grass ( <i>Sehima nervosum</i> ).	7,031
911	Grasslands, high grass savannah woodland; bloodwood ( <i>Eucalyptus terminalis</i> ) over upland tall grass and curly spinifex ( <i>Triodia bitextura</i> ).	43,183
915	Mosaic: Grasslands, high grass savannah woodland; Darwin box ( <i>Eucalyptus tectifica</i> ), <i>Eucalyptus confertiflora</i> and <i>E. greeniana</i> over spinifex, white ( <i>Sehima nervosum</i> ) and tall upland grass/Grasslands, high grass savannah low tree; terminalia and bauhinia ( <i>Bauhinia cunninghamii</i> ) over upland tall grass.	1,459
918	Hummock grasslands, low tree steppe; snappy gum ( <i>Eucalyptus brevifolia</i> ) over curly spinifex ( <i>Triodia bitextura</i> ).	1,503

Poorly represented ecosystems subject to threat:

Rainforest and paperbark forest associated with mound springs and seepage areas of the Victoria Bonaparte coastal lands.
Vine thickets of limestone ranges: Ninbing Range
<i>Oryza australiensis</i> (wild rice) grasslands on alluvial flats of the Ord River
Invertebrate community of Zebedee Springs, El Questro Station

Note: the lack of study in some areas precludes statements about the level of reservation required.

## Subregional constraints in order of priority

(see Appendix B, key g)

**Economic Constraints:** Land prices for pastoral leases.

**Competing Land Uses:** Particularly for pastoral production.

**Other:** Our knowledge of biodiversity patterns across the subregion's landscape does not have enough resolution to accurately define all acquisition priorities on the ground.

## Bioregional and subregional priority for reserve consolidation

The Victoria Bonaparte Bioregion has a ranking priority under the preliminary bioregional NRS priorities of 5 (see Appendix D, and Appendix C, rank 4). There are a number of significant outstanding reservation proposals that would move the priority toward 4 or further. These proposals would set aside significant areas of sandstone and quartzstone landscapes. The competing land use for pastoral activities also means that the reservation system has an inbuilt bias.

## Reserve management standard

(see Appendix C, rank 5)

The bioregion is ranked at poor (i) to fair (ii). No feral animal control programmes are in place. Limited strategic aerial prescribed burning along with some opportunistic hand burns occur. The extent of other threatening processes, for example weeds, are yet to be determined. Due to uncontrolled stock access, changes are occurring within parks

## Off reserve conservation

### Priority species or groups

- Threatening processes operate from the species to landscape level.
- Little is known of the status of critical weight range mammals in the Victoria Bonaparte 1 subregion.
- Action is required to identify appropriate fire regimes.
- The effect of fire and cattle on critical weight range mammals, granivorous birds and savannah composition and structure are of concern.
- Action is required to identify what is at risk and components of the biota at most risk then recommend and research appropriate management.
- Little is known of the distribution, status and impact of weed species.
- Changed grassland structures are of concern.

- There is evidence that changes have, and continue, to occur for the balance between annual and perennial grasses.
- Landscape level threatening processes also bring about changes to the organic profile layer in soils, water infiltration rates and surface flow velocity after rain.
- Impacts on rainforest patches of inappropriate fire regimes and specifically rainforest fire/cattle interaction is of concern.
- Changes to riparian zones due to the impact of changed fire regimes, grazing and the indirect effects from changed hydrology.

## Existing species recovery plans

The Action Plan for Australian Bats.

The Action Plan for Australian Birds 2000.

Action Plan for Australian Marsupials and Monotremes.

Gouldian Finch Recovery Plan.

Draft Kimberley Region Management Plan (various strategies).

## Appropriate species recovery actions

**Fire Management:** Move to biodiversity driven approaches to fire management strategies. Avoid broadscale, hot, late dry-season burning in savannah.

**Weed Control:** Need to define weeds priorities both in an agricultural resource sense and an environmental sense. Resources required for already identified State and regional weed strategies.

**Capacity Building:** There is a need for organisational responsibility in coordinating management efforts across tenure and management responsibilities. Local adoption of strategies is necessary. Capacity building in pastoral industry to optimise biodiversity and savannah productivity. Minimise loss of the mineral A horizon and protection of organic layers.

**Feral Animal Control:** Removal of feral stock from conservation estate and management of stock on other lands. E.g. close order husbandry of cattle herds to prevent overgrazing. Eradication of feral animals especially cattle, donkeys and pigs.

## Ecosystems

This is a general savannah issue and fire is the main driver in addressing this. The next most important, and linked, issue is grazing. Actions that are required are linked to management research and better coordinated efforts between Government agencies, the pastoral grazing industry, Traditional owners and the broader community.

## Existing ecosystem recovery plans

There are no current recovery plans for ecosystems at risk in VB1.

## Appropriate ecosystem recovery actions

For example, mound springs the recovery actions would be (ix) fire management, (vii) feral animals control, and (vi) weed control.

## Subregion priority for off reserve conservation

The subregional priority for off park conservation is (ii) fair (see Appendix C, rank 6), where a large off park effort needed, resource constraints and limited community capacity.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Legislation:** Pastoral lease inspections are undertaken by the Department of Agriculture and lease holders notified of any problems via the Pastoral Lands Board. Final scenario is that the Commissioner for Soil Conservation can institute formal proceedings if issues are not being addressed, though this step is rarely undertaken.

**Threat Abatement Planning as Part of NRM:** Concerted and coordinated effort by the Department of Agriculture in the control of donkeys.

**Capacity Building Required with Community, Landholders, Industry and Institutions:** Land Conservation District Committees established and provide a venue for discussion on conservation matters.

**Integration with Property Management Planning, Catchment Planning and Landcare:** Land Conservation District Committees provide an opportunity for integration of land management activities.

### Feasible opportunities for NRM

**Capacity Building Required with Community, Landholders, Industry and Institutions:** Research is needed on the mechanism and impacts of threatening processes. Outputs of this should assess potential cost/effective solutions. Coordination of multiple research initiatives and communication of this.

**Legislation:** Improved implementation of existing legislation.

**Environment Management Systems and Ecologically Sustainable Product Marketing:** Environmental planning across tenure (weeds, fire and feral animals) coordinated through Land Conservation District Committee.

**Capacity Building Required with Community, Landholders, Industry and Institutions:** Improved communication required between all stakeholders and an acknowledgement of differing land management objectives.

**Other Planning Opportunities:** Shire plan incorporating biodiversity objectives incorporating an acknowledgement of the worth of the natural environment e.g. tourism including the cost of management (e.g. making national parks accessible).

**Integration With Property Management Planning, Catchment Planning and Landcare:** Development of catchment and regional plans involving all stakeholders.

### Impediments or constraints to opportunities

A limited financial resource is a major constraint. The number of people available to implement strategies is a constraint. There is a need to increase awareness of conservation values throughout the community.

### Subregions where specific NRM actions are a priority to pursue

A more coordinated approach to land management is a priority for the Victoria Bonaparte 1 subregion. This is due to differing and potentially competing land uses, the increase in multiple land uses and landscape threats. Whilst still important, the subregion has fewer stakeholders to deal with, however research into issue identification for this subregion may change the priority. The NRM rank for VB1 is (ii) (see Appendix C, rank 7), indicating that significant constraints exist to integrate conservation as part of production or development system.

### Data gaps

Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Much finer scale (at 100,000:1 or better) vegetation and regional ecosystem mapping required for most of the widespread surfaces. This needs to align with soil maps and environmental geology maps and these do not yet exist at better than 1:250 000 scale.

**Systematic Fauna Survey:** No systematic quadrat based fauna and/or flora sampling programme across the subregion to provide a basis for modeling species distribution and status.

**Floristic Data:** Data is sparse. Some potential for adapting WARMS monitoring methodology.

**Ecological and Life History Data:** Data is lacking on the habitat requirements of fauna species.

### Other Priority Data Gaps:

- Further research is required on the conservation status of many fauna and flora taxa as well as the

effects of threatening processes such exotic predators (cats), stock (cattle, donkeys and pigs), fire and weeds.

- A better understanding is required of coastal and near coastal hydrological processes. This is of

particular significance for the Ord Floodplain Ramsar site.

## Sources

### References cited

No.	Author	Date	Title	Publication Details	Pub. Type
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R
714	Dostine, Peter	(1998).	Gouldian finch recovery plan, Erythrura gouldiae	Parks & Wildlife Commission of the Northern Territory, Darwin	R
258	Duncan, A., Barry Baker, G. and Montgomery, N.	(1999).	The Action Plan for Australian Bats.	Environment Australia.	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
495	McKenzie, N.L., Johnston, R.B. and Kendrick, P.G. (Eds.)	(1991).	Kimberley Rainforests of Australia.	Surrey Beatty and Sons.	B
556	Portlock, C., Graham, G., Done, C., Gilmour, J. and Williamson, J.	(2001).	Kimberley Region Draft Regional Management Plan. (Unpubl)	Department of Conservation and Land Management.	R

R = Report; J = Journal article; O = Other.

### Other relevant publications

See reference numbers 018, 094, 100, 118, 132, 173, 258, 268, 418, 455, 492, 519, 551, 595, 619, 626, 634,

635, 636, 637, 648, 674, 692, 693 and 702 in Appendix A.

# Warren (*WAR – Warren*)

ROGER HEARN, KIM WILLIAMS AND SARAH COMER  
JANUARY 2002

## Subregional description and biodiversity values

### Description and area

Dissected undulating country of the Leeuwin Complex, Southern Perth Basin (Blackwood Plateau), South-West intrusions of the Yilgarn Craton and western parts of the Albany Orogen with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* and Banksia woodlands and heaths. The climate is moderate Mediterranean. The bioregion is not further divided into subregions and the area is 1, 027, 639ha.

### Dominant land use

(see Appendix B, key b)

Mainly grazing (improved pastures), cultivation (irrigated horticulture), and conservation, with lesser but significant areas of forestry (native forests and plantations), rural residential, mining, and easements for roads, power lines etc.

### Continental Stress Class

The Continental Stress Class for WAR is 5. However, the estimate supplied for data for the number of threatened flora is incorrect and if the number of threatened flora species are included, the combined stress level for the threatened species attribute at 3. Therefore the Continental Stress Class is 3, not 5. Biophysical naturalness attribute weights grazing heavily but ignores introduced disease processes - this does not take into account major impacts of *Phytophthora* on a major part of the vascular flora and most of the vegetation associations in the region, all which have major Proteaceous, Ericaceous and Myrtaceous elements. The Australian Dryland Salinity Assessment 2000 identifies large tracts of the region as at risk (National Land and Water Resources Audit 2001). Current downstream impacts of Salinity (for example the Kent River discharge basin and Owingup Swamp are not accounted for). Extensive loss through clearing in the important Scott River group of communities and those along the Leeuwin Naturaliste Ridge likewise appear to be missed (division of subregions based on geology and soils would have detected this element).

periods of the ice ages. As such it contains refugia with relict taxa of a wetter milder era with groups and species of vascular and cryptic flora and invertebrates normally associated with the rainforests/*Nothofagus* forests of South-Eastern Australia, these species now missing from

## Known special values in relation to landscape, ecosystem, species and genetic values

### Rare Features:

Notable values include the tall forests (Karri, Jarrah and the Tingles), the limestone systems with its cave fauna and the mound forming microbial associations in the west of the region, its relictual Gondwanan arachnid fauna including the tingle *Moggridgea* and Torndirrup's *Austrarchaea mainae* as well as other Gondwanan relics such as *Dardarus* sp. millipedes, *Cynotelopus notabilis* and velvet worms. A number of Critical Weight Range vertebrates also persist in the region, including Southern Brown Bandicoot (*Isodon obesulus*), Chuditch (*Dasyurus geoffroii*), Brush-tailed Phascogale (*Phascogale tapoatafa*) and others. Rare birds include the Western Whipbird (*Psophodes nigrogularis oregon*) and several cockatoos and parrots.

### Centres of Endemism:

The South-west of WA is considered to be a biodiverse area of the world for vascular plants with levels of endemism of between 75 and 80%. Lyons *et al.* (2000) reviewed the vascular flora of the Warren Bioregion and found the level of endemism at about 4%, most of the taxa occurring in more than one bioregion. The endemics were not uniformly distributed across the region (Lyons *et al.* 2000). Concentrations were noted for the Scott River Plains, the Leeuwin Naturaliste Ridge and the area around Walpole (Lyons *et al.* 2000). Similar concentrations of local endemics (species with ranges of less than 100km) were found during the RFA analysis of the South-West Forest Region (Commonwealth and Western Australian Governments 1999).

The aquatic fauna of the bioregion shows a similar, if not stronger pattern of endemism than the flora (Trayler *et al.* 1996). The freshwater cray genus *Engaewa* is endemic to the bioregion. The invertebrate fauna shows similar patterns with a significant endemic fauna in the forests and wetlands of the region.

### Refugia:

Despite the impacts of climate fluctuations through the quaternary on the South-West, this bioregion primarily exists because it has to a large extent been buffered against the complete intrusion of the eremean. It is a narrow coastal strip and south to south west slopes rising to the darling plateau that have benefited from proximity to the southern ocean and the rain bearing weather systems that have trailed the coast even during the dries

the rest of the State. For example, Tingle forests provide habitat for relictual invertebrates (*Moggridgea* and velvet worms (Oncophora) and a range of like relict taxa) and peat/organic wetlands are home to relictual and other aquatic invertebrates. There are limestone cave and karst

features supporting endemic invertebrate fauna on the west coast, and the subregion contains the state's richest area for bryophytes (many of which are normally associated with rainforests).

#### High Species or Ecosystems Diversity:

High rainfall, and low evapotranspiration of the bioregion makes it unique (along with parts of the adjacent Southern Jarrah Forest (JF2)) in WA. The climate is such that the landscape is characterised by high forests, perennial rivers and wetland systems.

As a result of the climatic processes acting on its ancient landscape that have shaped the biota of the South Western corner of WA through the quaternary (and in particular the ice ages) speciation has been rampant and a highly endemic biota has emerged. This region, with its suites of endemics in its vascular flora (Myrtaceae, Rutaceae, Proteaceae, Papilionaceae, Restionaceae, Sterculiaceae, etc. (see Lyons *et al.* 2000). Similar patterns are being discovered for its invertebrate fauna (Horwitz 1997b, Storey 1998).

#### Existing subregional or bioregional plans and/or systematic reviews of biodiversity and threats

In 1974 and 1975 the Conservation Through Reserves Committee (CTRC) made recommendations for reserves within the in the CTRC Green and Red Books, as did the System 6 study of 1981 (Environmental Protection Authority 1975; Environmental Protection Authority 1983). Some but not all of these recommendations (with modification) were implemented over the following years.

The southern and western parts of the subregion are covered by a CALM Regional Management Plan published in 1994, that provides an overview of biota,

## Wetlands

### Wetlands of National significance (DIWA listings)

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Blackwood River (Lower Reaches) and Tributaries System, WAR001WA	B1, B2	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, deer, horses, cats & rabbits), vi (Watsonia, East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), ix, x, xi (herbicides and fertilisers from agricultural and plantation landuses), xii (plantation harvesting and return to traditional agriculture on several significant holdings; Illegal Tea-Tree cutting for bean sticks, cray pots and brush fencing).
Broke Inlet System, WAR002WA	A10, B1, B2, B6, B10, B13, B15	iii & iv	iv	iii	v (foxes, pigs, cats & rabbits), vi (Watsonia, East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), xii (Mining - adjacent mining tenements if allowed to be developed could impact on lake and groundwater).

addresses land and wildlife conservation issues, but was generalised in its approach. The reviews and strategies therein (for reserve system development or management of weeds, fire, feral animals, mining, ecosystem rehabilitation & disease quarantine) do not address the specific needs of the subregion, or even the bioregion (Department of Conservation and Land Management 1994a).

South West Forests Regional Forest Agreement throughout 1997 and 1998 reviewed all but Eastern parts of the Warren Bioregion against National CAR criteria and developed a reserve system and agreed strategies to conform to National Biodiversity Conservation Objectives (Lamont *et al.* 1997; Mattiske and Havel 1997; Atkins 1997; Christensen 1997; Commonwealth and Western Australian Governments 1999). The Forest Management Plan (draft) was released in 2002 and further develops the CAR reserve system established in the RFA process (Department of Conservation and Land Management and the Conservation Commission 2002).

The South West Regional Strategy for Natural Resource Management was released as a working draft in January 2001 (South West Catchment Council 2002a). The Bush & Biodiversity section based on the same data sets used for this Biodiversity Audit identified poorly conserved vegetation associations and nodes of high value fauna conservation. Other sections of the document deal with Waterways and Wetlands, Land Resources and Coastal Environs. The final draft in March 2002 establishes strategic targeted recommendations for implementation within the NRM Region and are relevant to the bioregion (South West Catchment Council 2002b).

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Cape Leeuwin System, WAR003WA	B10, B17	ii, iii & iv	ii, iii & iv	iii	i, v (foxes, pigs, deer, horses, cats & rabbits), vi (Watsonia, Exotic Grasses, Blue Gums, various clovers and allies), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), ix, x, xi (herbicides and fertilisers from agricultural and plantation landuses), xii (plantation harvesting and return to traditional agriculture on several significant holdings; Illegal Tea Tree cutting for bean sticks, cray pots and brush fencing).
Dogerup Creek System, WAR004WA	B1, B4, B5, B15, B2, B10	ii, iii & iv	ii, iii & iv	iii	i (now notionally controlled but potential exists for large holding (Sandy Peak) West of system (hydrologically up stream) being cleared for a number of purposes), v (pigs, foxes, cats & rabbits), vi (Watsonia, Arum Lilly, Exotic Grasses, Victorian Tea Tree, <i>Pelargonium</i> spp.), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), x (development of road access to Sandy Peak and possible power to Windy Harbour), xii (Mining - adjacent mining tenements if allowed to be developed could impact on lake and groundwater).
Gingilup – Jasper Wetland System, WAR005WA	B5, B10, B13, B14, B15	ii, iii & iv	ii, iii & iv	iii	i (now controlled but impacts still surfacing from recent clearings especially at Scott River), v (pigs, foxes, cats & rabbits), vi (Watsonia, Arum Lilly, Exotic Grasses, various clovers and allies), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), x, xi (herbicides and fertilisers from agricultural and plantation landuses), xii (Plantation harvesting and return to traditional agriculture on several significant holdings; Illegal Tea Tree cutting for bean sticks, cray pots, wildflower industry and brush fencing; Mining - adjacent mining tenements when developed could impact on Lake Jasper, Lake Wilson and Lake Smith and groundwater and associated ephemeral wetlands – also acid sulfides associated with ore body).
Maringup Lake System, WAR006WA	B5, B15	iv	iv	iii	v (pigs, foxes, cats & rabbits), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), xi (herbicides from agricultural and plantation landuses), xii (Mining - adjacent mining tenements if allowed to be developed could impact on lake and groundwater).
Mt Soho Swamps, WAR007WA	B15	iii & iv	iv	iii	v (pigs, foxes, cats & rabbits), vi (East Coast Wattles, Exotic Grasses, Blue Gums, various clovers and allies, tagasaste), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent forests and heaths), xii (upslope erosion filling important swamps).
Owingup Swamp System, WAR008WA	B1, B5, B10, B14	ii, iii	iii & iv	iii	i, v (foxes, cats & rabbits), vi (Typha, Exotic Grasses, various clovers and allies), vii, viii ( <i>Phytophthora</i> sp. dieback in adjacent heaths), ix (salinity from affected Kent River), xi (herbicides and fertiliser from agricultural and plantation landuses).

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

### Wetlands of Subregional significance (in addition to the DIWA listed wetlands)

Name and Components	Location	Special Values <sup>1</sup>	Description <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Scott River and Gingilup Wetland Systems	AMG (AGD84) 348300, 6206100	ii, v	B2, B13	i	iii	iii	i, ii, iv, v (rabbits, pigs), vi (pasture grass, watsonia), vii, viii ( <i>Phytophthora</i> sp.), x, xi (fertilizer runoff), xii (intensive agriculture/horticulture).
Bolghinup Lake Swamp (Black Point)	AMG (AGD84) 365900, 6190000	ii, v	B10, B13	iii – iv	iv	iii	vii, viii ( <i>Phytophthora</i> sp.), xii (Recreation)

Name and Components	Location	Special Values <sup>1</sup>	Description <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Charley - Donnelly Estuary Wetland System	AMG (AGD84) 385000, 6186100	ii, v	A5, B1, B2, B4, B9, B10, B13, B15, B17	iii – iv	iv	iii	v (foxes, pigs), vi (Arum Lilly, Blackberry, Watsonia, Typha), vii, viii ( <i>Phytophthora</i> sp.), ix, x (altered flow regimes of river affecting river and riparian vegetation), xi (fertiliser load runoff from agricultural lands upstream)
Lower Warren River System (including the Meerup River)	AMG (AGD84) 400000, 6172000	ii, v	A5, A11, B1, B2, B4, B9, B10, B13, B15, B17	iii – iv	iv	iii	v (foxes, pigs), vi (Blackberry, Golden Dodder, Watsonia, Typha), vii, viii ( <i>Phytophthora</i> sp.), ix (Salinity of river due to upstream clearing), x (altered flow regimes of river affecting river and riparian vegetation), xi (fertiliser load runoff from agricultural lands adjacent and upstream).
Deep River/Walpole River/Lower Frankland River and Walpole Nornalup Inlet Wetland System	AMG (AGD84) 475000, 6127000	ii, v	A4, A5, A6, A11, B1, B2, B4, B9, B10, B13, B15, B17	ii (Frankland) - iii (Walpole) - iv (Deep)	iv	iii	v (foxes, pigs), vi (Blackberry, Watsonia, Typha, Victorian Ti Tree), vii, viii ( <i>Phytophthora</i> sp.), ix (Salinity of river – upstream clearing primarily on the Frankland River), x (altered flow regimes of river affecting river and riparian vegetation – upstream clearing), xi (fertiliser load runoff from agricultural lands adjacent and upstream primarily on the Frankland and the Walpole Rivers)
Bow River and Irwin Inlet Wetland System	AMG (AGD84) 496000, 6128000	ii, v	A5, A6, A11, B2, B4, B9, B10, B13, B15, B17	i – ii (Lower parts of catchment and river) – iv (headwaters of the Bow and its floodplains)	iv	iii	v (foxes, pigs), vi (Blackberry, Watsonia, Typha, Exotic grasses and other pasture species), vii, viii ( <i>Phytophthora</i> sp.), x (altered flow regimes of river affecting river and riparian vegetation – down stream agricultural clearing), xi (fertiliser load runoff from agricultural lands of lower parts of River)
Kordabup River/Parry Inlet Wetland System	AMG (AGD84) 513000, 6126000	ii, v	A5, A6, A11, B2, B4, B9, B10, B13, B15, B17	i - ii – iii	iv	iii	i, ii, vi (Blackberry, Watsonia, Typha, Exotic grasses and other pasture species), vii, viii ( <i>Phytophthora</i> sp.), x (altered flow regimes of river affecting river and riparian vegetation – up stream agricultural clearing), xi (fertiliser load runoff from agricultural lands)

Name and Components	Location	Special Values <sup>1</sup>	Description <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Denmark River/Wilson Inlet Wetland System	AMG (AGD84) 536000, 6128000	ii, v	A5, A6, B2, B4, B10, B13, B17	i – ii	iv	iii	i, ii, vi (Blackberry, Watsonia, Typha, Gorse, Exotic grasses and other pasture species), vii, viii ( <i>Phytophthora</i> sp.), ix (upstream clearing primarily on the Hay River, but also to some extent on the Denmark have affected the character of the estuarine waters and Denmark River), x (altered flow regimes of river and affecting opening of the bar), xi (fertiliser load runoff from agricultural lands adjacent and upstream primarily on the Hay River and the lower parts of the Denmark River)
Frenchman Bay /Vancouver Peninsular Wetland System	AMG (AGD84) 585000, 6116000	ii, v	A5, A11, B2, B10, B13, B17	ii	iv	iii	ii, vi (Exotic grasses and other pasture/domestic species), vii, viii ( <i>Phytophthora</i> sp.)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

## Riparian zone vegetation

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Margaret River	i	iii	iii	i, ii, vi (blackberry, Arum Lilly, pasture species), vii, x, xi, xii (recreation use; water diversion and storage upstream), iii, viii
Blackwood River	i – ii	iii	iii	i, ii, vi, vii, ix, x, xi, xii (recreation use; water diversion and storage upstream on freshwater tributaries), iii, viii
Scott River	i	iii	iii	i, ii, vi (Arum Lilly, blackberry, pasture species), vii, ix, x, xi (eutrophication), xii (mining), viii
Donnelly River (lower reaches in the WAR)/Barlee Brook/Beedalup Brook	i - ii (agricultural zones); ii - iii (forested zone)	iii - iv	iii	i, ii, v (pigs), vi (Arum Lilly, blackberry, pasture species), vii, ix, x, xi, xii (recreation use; water diversion and storage upstream on main River and on freshwater tributaries), viii
Warren River	i - ii	iii	iii	i, ii, v (pigs, horses, deer), vi (Blackberry, Golden Dodder, Pasture species), vii, ix, x, xi, xii (recreation use; eutrophication; water diversion and storage upstream on freshwater tributaries and in farm dams), viii
Gardner River/Canterbury River	ii – iii	iii - iv	iii	i, ii, vi (blackberry, Victorian Tea Tree, pasture species), vii, x, xi, xii (recreation use; water diversion), viii
Shannon River	iii – iv	iv	iii	v (pigs, horses, deer), vi (blackberry, Victorian Tea Tree, pasture species), vii, viii
Inlet River	iii – iv	iv	iii	vii, viii
Deep River/Weld River	iii – iv	iv	iii	v (pigs, horses, deer), vii, xii (recreation use), viii
Walpole River	ii – iii	iv	iii	i, ii, vi (blackberry, pasture species), vii, x, xi, xii (recreation use; proposed water storage and diversion), viii
Frankland River	i - ii	iii	iii	i, ii, v (pigs, horses, deer), vi (blackberry, pasture species), vii, ix, x, xi, xii (recreation use; water diversion and storage upstream on freshwater tributaries and in farm dams), viii
Bow River	i – ii (agricultural zone); ii – iii (natural landscape upstream)	iv	iii	i, ii, vi (blackberry, pasture species), vii, ix, x, xi, xii (proposed water storage and diversion), viii
Kent River/Styx River	i - ii	iii - iv	iii	i, ii, vi (blackberry, pasture species, gorse), vii, ix, x, xi, xii (proposed water storage and diversion), viii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Ecosystems at risk

### Threatened ecological communities (TECs)

Plant communities dominated by or composed of susceptible species are threatened by dieback (*Phytophthora cinnamomi*).

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Subregion	Threatening Processes <sup>5</sup>
Aquatic Root Mat Community Number 1 of Caves of the Leeuwin Naturaliste Ridge	CR	N/A	iv	vi	iii	WAR	vii, x, xi (ground water nutrient loads)
Aquatic Root Mat Community Number 2 of Caves of the Leeuwin Naturaliste Ridge	CR	N/A	iv	vi	iii	WAR	vii, x, xi (ground water nutrient loads)
Aquatic Root Mat Community Number 3 of Caves of the Leeuwin Naturaliste Ridge	CR	N/A	iv	vi	iii	WAR	vii, x, xi (ground water nutrient loads)

Aquatic Root Mat Community Number 4 of Caves of the Leeuwin Naturaliste Ridge	CR	N/A	iv	vi	iii	WAR	vii, x, xi (ground water nutrient loads)
Scott River Ironstone heaths Scott River area (N. Gibson and M. Lyons pers. comm.)	EN	28, 38	iii	iii	iii	WAR	i, ii, vi (pasture grass), vii, viii, xii (roadside disturbance)
Rimstone pools, algal nodules and cave structures formed by microbial activity on marine shorelines Extant marine shoreline stromatolitic community formed by inorganic precipitation of a mineral phase and with microbial control over morphology by various cyanobacteria: (Sea Cliffs, Augusta, Black Point) (Moore 1993)	EN	41	iii	iv	ii	WAR	vi (arum, kikuyu), x, xi (surface water nutrient loads)
Mt Lindesay - Little Lindesay Vegetation Complex	EN	29, 43	ii	iv	iii	WAR	viii, vii
<i>Calothamnus graniticus</i> heath on south west coastal granites (Meelup) (Keating and Trudgen 1986); N. Gibson, M. Lyons pers. comm.)	VN	32	iv	iv	ii	WAR/JF2	vii

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Other ecosystems at risk

Plant communities dominated by or composed of susceptible species are threatened by dieback (*Phytophthora cinnamomi*).

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Subregion	Threatening Processes <sup>5</sup>
Aquatic invertebrate communities of peat swamps (Storey 1998, A. Storey pers. comm.)	EN	42	i - ii	iii	iii	WAR/JF2	vii, ix, x, xi
<i>Reedia spathacea</i> peat swamps or the Warren Region (C. Tauss, N. Gibson, G. Keighery)	NE/VU	42, 43	ii	iii	ii	WAR/JF2	v (pigs), vii, xii (urban development)
Relictual peat community (eg Lake Surprise) (South Coast Region pers. comm.)	P1	42	ii	iii	iii	WAR/JF2	vii, ix, x, xi, xii (mining)
<i>Taxandria linearifolia</i> , <i>Acacia pulchella</i> thicket (Rosa Glen variant). South of Margaret River. (A. Weston pers. comm.)	P2	28	iii	vi	ii	WAR	vi (lotus reed)
<i>Melaleuca lanceolata</i> forests, Leeuwin Naturaliste Ridge (A. Weston, N. Gibson pers. comm.)	P2	15	ii	vi	ii	WAR	ii, vii, xii (recreation site development)
Sphagnum communities of the Tingle Forest (only 3 known occurrences - Walpole area) (G. Wardell-Johnston data; R. Hearn pers. comm.)	P2	43	i	iii	iii	WAR	vii, x, xii (climate change)
Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Subregion	Threatening Processes <sup>5</sup>
Basalt association (Black Point - near Augusta) (R. Hearn pers. comm.)	P2	30	ii - iii	iii- iv	ii	WAR	vii, vii
Saprolite association/Palusmont wetlands (Walpole Inlet) (R. Hearn pers. comm.; V. and C. Semeniuk data)	P2	6, 38	iii	iii	iv	WAR	x, xii (urban development)
Grasslands of the South Coast (R. Hearn and T. Macfarlane, pers. comm.)	P2	37	i - iii	iv	iii	WAR	vi, vii
Southern Granite community (eg Muirillup Rock, Northcliffe; subset of wheatbelt granites; insufficient information to distinguish discrete community type/s at this point) (N. Marchant pers. comm; I. Bayly data)	P2	28	i - iv	ii - iv	ii	WAR/JF2	v (pigs), vii, viii, xii (recreation users and tourists)
Cryptogams associated with <i>Trymalium floribundum</i> and <i>Chorilaena quercifolia</i> in the karri forests of south-western WA (R. Hearn and T. Macfarlane, pers. comm.)	P3	16	ii - iii	ii	iii	WAR/JF2	vii
Naturally brackish/saline coastal lakes in the south west region (S. Halse pers. comm.)	NE	26,40, 39	i - iii	iii	ii	JF2/WAR	ix, x, xi
Aquatic invertebrates associated with permanent freshwater/brackish pools (S. Halse pers. comm.)	NE	42	i - iii	iii	ii	JF2/WAR	ix, x, xi
Diatom assemblages of south-west rivers (John 1998)	NE	42	i - iii	iii	ii	WAR/JF2	ix, x, xi

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
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SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 1 (MAMMALS)					
<i>Parantechinus apicalis</i>	E	i	i	iii	xii (climate change)
<i>Dasyurus geoffroii</i>	V	iii	v	iii	v (fox)
<i>Pseudocheirus occidentalis</i>	V	iii	iii	iii	i., ii, v (fox) vii, xii (logging)
<i>Setonix brachyurus</i>	V	iii	v	iii	v (fox), vii
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)					
<i>Pezoporus wallicus flaviventris</i>	E	i	i	iii	v (foxes), vii. This species has no known populations in subregion, but WAR is part of it's former range.
<i>Atrichornis clamosus</i>	V	i	i	iv	vii. This species has no known populations in subregion, but WAR is part of it's former range.
<i>Cacatua pastinator pastinator</i>	V	ii	iii	iii	i, xii (illegal culling)
<i>Calyptorhynchus baudinii</i>	V	iii	iii	ii	ii, vii, ix
<i>Dasyornis longirostris</i>	V	ii	iii	iii	v (fox) vii
<i>Botaurus poiciloptilus</i>	V	ii	iii	iii	vii, ix
<i>Leipoa ocellata</i>	V	i	i	iii	v (foxes, cats, rabbits), vii
<i>Psophodes nigrogularis oregon</i>	V	ii	iii	iii	i., ii, v (fox), vii
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 4 (FROGS)					
<i>Geocrinia alba</i>	CR	ii	iii	iv	i., ii, iv, v (pigs) vii, viii, x
<i>Spicospina flammocaerulea</i>	V	iii	iv	iv	vii, xii (physical damage to swamps; mining; collection for illegal trade), v (pigs), x (siltation; construction of dams), viii, xi (chemical and surfactant)
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 6 (SNAILS)					
<i>Austroassiminea lethia</i>	V	iii	vi	i.	x
SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 7 (ARACHNIDS)					
<i>Austrarchaea mainae</i>	V	iii	iv	ii	vii

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 3 (REPTILES)</b>					
<i>Aspidites ramsayi</i>	P1	i	vi	iii	i, ii, v (foxes and cats), vii (this is not a forest species)
<b>OTHER SPECIES AT RISK WITHIN THE SUBREGION</b>					
<i>Daphnia occidentalis</i>	P1	ii	vi	ii	iv, xii (sand mining), vii
<i>Calamoecia elongata</i>	P1	ii	vi	ii	x (altered drainage), xii (roadworks)
<i>Moggridgea</i> sp. Tingle	P1	i	vi	ii	vii
<i>Arbanitis inornatus</i> ,	P1	i	iii	iii	i, ii, x, xii (extremely long lived 30-40 years+)
<i>Kawaniphila pachomai</i>	P1	i	vi	ii	xii (housing developments)
<i>Ninox connivens connivens</i>	P2	i	ii	iii	xii (logging practices, reduction in tree hollows ), loss of small mammal fauna
<i>Ixobrychus flavicollis</i>	P2	ii	ii	ii	i, ii, v, vii, ix, x
<i>Bothriembryon irvineanus</i>	P2	i	vi	ii	i, ii, iv, xii (tourism)
<i>Austromerope poultoni</i>	P2	i	vi	ii	i, xii (logging; mining); vii (this species has only been found from pitfall traps and never been seen alive)
<i>Fibulacampus bisetosus</i>	P2	i	vi	ii	xii (recreational activity)
<i>Engaewa walpolea</i>	P2	i	vi	ii	vii, x, xi, xii (urban development), trampling

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Declared rare and priority flora

Susceptible plant species are threatened by dieback (*Phytophthora cinnamomi*).

Species	Status	Condition <sup>1</sup>	Tend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>DECLARED RARE FLORA</b>					
<i>Leptomeria dielsiana</i>	X	i	vi	i.	xii (last seen in 1957 – presumed extinct)
<i>Isopogon uncinatus</i>	CR	ii	v	iv	vii, viii ( <i>Phytophthora</i> sp.)
<i>Rhacocarpus webbianus</i>	CR	i	v	iii	xii (recreation)
<i>Adenanthos x cunninghamii</i>	E	iii	iv	iii	ix (small number of individuals), viii ( <i>Phytophthora</i> sp.)
<i>Banksia brownii</i>	E	ii	iv		vii, viii ( <i>Phytophthora</i> sp.)
<i>Boronia exilis</i>	E	iii	iv	iii	ii, vii, viii
<i>Caladenia excelsa</i>	E	iii	iv	ii	ii, v (rabbits), vi (pasture grass), vii, xi (roadside disturbance)
<i>Caladenia huegelii</i>	E	iii	iv	iii	ii, v (rabbit), vi (pasture grass), vii, xii (roadside disturbance)
<i>Caladenia winfieldii</i>	E	ii	v	iv	iv, v (pigs), vii, x, xii (timber harvesting)
<i>Darwinia ferricola</i> ms	E	iii	iii	ii	ii, vii, viii ( <i>Phytophthora</i> sp.), xi (roadside disturbance)
<i>Dryandra nivea</i> subsp. <i>uliginosa</i>	E	iii	iii	ii	i, ii, vii, viii ( <i>Phytophthora</i> sp.), xii (roadside disturbance)
<i>Grevillea brachystylis</i> subsp. <i>australis</i>	E	iii	iv	iii	i, ii, vii, viii ( <i>Phytophthora</i> sp.)
<i>Kennedia macrophylla</i>	E	iii	iv	iii	ii, vii, xii (urban development)
<i>Lambertia orbifolia</i> subsp. Scott River Plains	E	iii	iv	ii	ii, vii, viii ( <i>Phytophthora</i> sp.)
<i>Sphenotoma drummondii</i>	E	i - ii	iii - iv	iii	vii, viii ( <i>Phytophthora</i> sp.)
<i>Verticordia plumosa</i> var. <i>vassensis</i>	E	iii	iii	iii	ii, v (rabbits), vi (watsonia), vii, viii ( <i>Phytophthora</i> sp.), x, xii (roadside disturbance)
<i>Asplenium obtusatum</i> subsp. <i>northlandicum</i>	V	iii	iv	iii	xii (restricted distribution)
<i>Banksia verticillata</i>	V	ii - iii	iv		vii, viii ( <i>Phytophthora</i> sp.)
<i>Caladenia harringtoniae</i>	V	ii	iii	ii	vii
<i>Diuris drummondii</i>	V	ii - iii	iii	iii	v (pigs), vii, ix, x,
<i>Drakaea micrantha</i> ms	V	iii	iii	iii	vii, xii (roadside disturbance, small number of populations)
<i>Kennedia glabrata</i>	V	iii	iv	iii	iv, v (pigs), vii, xii (recreation)
<i>Laxmannia jamesii</i>	V	iii	iv	ii	xii (small number of individuals)
<i>Meziella trifida</i>	V	iii - iv	iv	ii	x
<i>Microtis globula</i>	V	i	ii	iii	vii, x
<b>Species</b>	<b>Status</b>	<b>Condition<sup>1</sup></b>	<b>Tend<sup>2</sup></b>	<b>Reliability<sup>3</sup></b>	<b>Threatening Processes<sup>4</sup></b>
<i>Pleurophascum occidentale</i>	V	iii	iv	iii	vii, xii (climate change)
<b>PRIORITY 1</b>					
<i>Andersonia redolens</i> ms	1	ii	iii	iii	vii, viii ( <i>Phytophthora</i> sp.)
<i>Austrofestuca littoralis</i>	1	ii	iv	i	vi (marrum grass)
<i>Caladenia evanescens</i>	1	i	ii	ii	vii, x
<i>Deyeuxia inaequalis</i>	1	i	iii	ii	vi (agricultural), vii
<i>Eriochilus scaber</i> subsp. <i>orbifolia</i> ms	1	i	iii	ii	vii
<i>Grevillea manglesioides</i> subsp. <i>ferricola</i>	1	iii	v	ii-iii	xii (mining – now ceased), i, ii, vii,

					viii ( <i>Phytophthora</i> sp.), xii (roadside disturbance)
<i>Haloragis tenuifolia</i>	1	iii	iv	ii	ii, v (rabbit), vii, viii ( <i>Phytophthora</i> sp.)
<i>Philydrella pygmaea</i> subsp. <i>minima</i>	1	iii	vi	ii	x
<i>Pterostylis</i> aff. <i>turfosa</i>	1	i	iv	iii	vii, xii (known from one collection only)
<i>Schoenus indutus</i>	1	iii	vi	ii	iv
<i>Selliera radicans</i>	1	ii - iii	iv	iii	x, xi
<i>Andersonia redolens</i> ms	1	ii	iii	iii	iv
<b>PRIORITY 2</b>					
<i>Acacia mooreana</i>	2	iii	iv	ii	vii,
<i>Acacia subracemosa</i>	2	iii	iv	ii	vii,
<i>Alexgeorgea ganopoda</i>	2	iii	iv	iii	vii, x, xii (road works)
<i>Amperea protensa</i>	2	iii	iv	iii	xii, x
<i>Andersonia auriculata</i>	2	ii	iii	iii	vii, viii ( <i>Phytophthora</i> sp.)
<i>Anthocercis sylvicola</i>	2	iii	iv	iii	ii (lack of recruitment), vii
<i>Caladenia abbreviata</i>	2	iii	iv	ii	vii
<i>Calothamnus</i> sp. Scott River [aff. <i>crassus</i> ]	2	iii	v	ii	x
<i>Calymperastrum latifolium</i>	2	ii	iv	iii	xii (low numbers; climate change)
<i>Chamaexeros longicaulis</i>	2	iii	iv	ii	xii (low recruitment)
<i>Chamelaucium floriferum</i> subsp. <i>floriferum</i>	2	iii	iv	ii	xii, xiii
<i>Chordifex isomorphus</i>	2	iii	iv	ii	i, vi, vii, x
<i>Chordifex jacksonii</i>	2	iii	iv	ii	ix, x
<i>Conospermum quadripetalum</i>	2	iii	vi	ii	No known threatening processes
<i>Acacia mooreana</i>	2	iii	iv	ii	vii, x
<i>Diuris heberlei</i>	2	iii	iv	ii	x, xii (recreation)
<i>Drepanocladus aduncas</i>	2	ii	iv	iii	vii, x
<i>Drepanocladus fluitans</i>	2	ii	iv	ii	v (pigs), vii, x
<i>Drosera binata</i>	2	i - ii	iii	iii	vii, viii ( <i>Phytophthora</i> sp.)
<i>Dryandra sessilis</i> var. <i>cordata</i>	2	iii	iv	ii	ii (lack of recruitment)
<i>Eucalyptus virginiae</i> ms	2	iii	iii - iv	ii	xii (small number of individuals and populations)
<i>Fabronia hampeana</i>	2	iii	vi	i.	xii (climate change)
<i>Hakea tuberculata</i>	2	iii	vi	ii	vii, i
<i>Hemianandra australis</i> ms	2	iv	iv	iii	No known threatening processes
<i>Hybanthus volubilis</i>	2	iii	iv	ii	vii
<i>Juncus melanthus</i> ms	2	i	vi	ii	x, xi, ix
<i>Leptomeria furtiva</i> ms	2	iii	vi	ii	xii (plant is very hard to find for surveying)
<i>Melaleuca incana</i> subsp. <i>Gingilup</i>	2	iii	iv	ii	vii, xii (recreation)
<i>Melaleuca ringens</i>	2	iii	iv	iii	vii
<i>Schizaea rupestris</i>	2	ii	iii	iii	x
<i>Schoenus fluitans</i>	2	iii	iii	ii	x, xi, ix
<i>Schoenus loliaceus</i>	2	iii	iii	ii	x, xi, ix
<i>Sphagnum novozelandicum</i>	2	i	iii	iii	x, xi, ix, vii
<i>Spyridium spadiceum</i>	2	iii	vi	ii	ii
<i>Thomasia quercifolia</i>	2	iii	vi	iii	vii, x, xii (climate change)
<i>Trichocline</i> sp. Treeton	2	iii	vi	ii	x, ix

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Beard Vegetation Association description	IUCN Reserve I-IV	Non IUCN Reserve	CALM Purch Leases	Reserve Priority	Notes
969	Mosaic: Medium forest: jarrah-marri/Low forest: jarrah	1%	6%		H	Area is essentially that land east and west of Denmark considered suitable for agriculture and consequently extensively cleared or alienated; a few pockets remain and should be sought for reservation or protected from clearing
977	Low forest: teatree & casuarina	1%	44%		M	Area is essentially that land North of Denmark considered suitable for agriculture and consequently extensively cleared or alienated; reservation of most of the CALM managed State Forest component of this as Mt. Lindesay National Park (mostly part of JF2) in the near future will secure important landscapes including the TEC and its large suite of rare and endemic species

1116	Tall forest; jarrah ( <i>E. marginata</i> )	1%	99%		L	Difficult to map units, most occurrences within Jarrah and Karri ecotypes, most existing areas contained within the CALM managed estate, and no longer available for chipwood production
1132	Medium forest; marri	0%	59%		M	Difficult to map units, most occurrences within Jarrah and Karri ecotypes, most existing areas contained within the CALM managed estate, and no longer available for chipwood production
1138	Low forest; jarrah & marri	6%	0%		H	Area near Margaret River essentially alienated and cleared – little capacity to reserve additional areas but some control at planning level may be possible
1157	Tall forest; jarrah & marri	0%	96%		L	Difficult to map units within the jarrah forest, but the majority is protected within SF, part to become Nature Reserve with planned tenure changes

### Subregional constraints in order of priority

(see Appendix B, key g)

**Other:** RFA reserve recommendations already in process of being implemented, and will include the above reserve consolidation priorities where feasible with existing tenures.

#### Irreplacibility, Limited Opportunity to Meet CAR Criteria, Economic Constraints and Competing Land Uses:

Major components of the landscape are covered by mines, mining tenements and exploration leases and most land is already cleared.

### Bioregional and subregional priority for reserve consolidation

WAR is reservation Class 5 (see Appendix D, and Appendix C, rank 4). With current proposed reservation from UCL and State Forest to various Conservation Reserve tenures, most types within the bioregion will be reserved to the extent possible, only minor additions being possible, these mostly at the expense of areas earmarked for water storage and delivery infrastructure, and mining, and these probably only to accommodate threatened species.

### Reserve management standard

The Warren subregion contains 25 nature reserves and 14 national parks. There are no conservation parks within this subregion, although Regional Forest Agreement CAR reserves and Government proposals for additional national parks are in the early stages of implementation (new reserves have been excluded from this discussion).

**Nature Reserves:** Reserve management standard is (ii) fair (see Appendix C, rank 5) as biodiversity values and or management issues are poorly identified, resource degradation is occurring though retrievable. Nature Reserves vary in size from 12 ha to 4300 ha. The majority (20) of these reserves are small (<100 ha). The reserves are not distributed evenly across the subregion, with a noticeable absence of Nature Reserves in the central part of the subregion (the main forest belt). There are no resident staff for these reserves, management visitation is generally limited to minimum of once per year. Very few of these reserves have formal approved management plans or interim management guidelines.

Their small size and often remnant vegetation function has resulted in most reserves having significant weed invasion, especially pasture grasses, clovers and associated weed species. Feral animals (foxes, rabbits and increasingly in the western section, pigs) are not controlled in all but the largest reserves. In all parts of the subregion, *Phytophthora* disease is impacting on vegetation communities in the reserves. This is compounded by the seasonal inundation many of the reserves experience. In the very small reserves understory species composition is often depauperate and in a degraded state resulting from feral and native animal grazing impacts, extended fire frequencies and grass invasion from surrounding farmlands.

**National Parks:** Reserve management standard is (iii) Good for all parks except Scott which is (ii) fair as a result of pathogen (*Phytophthora*) and feral pig impacts. Warren contains eleven national parks in their entirety and the major portions of three others (Leeuwin Naturaliste, Mt Frankland and Shannon National Parks). The parks range in size from 50 ha to approx 117 000 ha. Three parks are less than 1000 ha, six less than 5000 ha, four less than 10 000 ha and one greater than 100 000ha. Management plans exist for Leeuwin Naturaliste (Frewer and Western Australian Department of Conservation and Land Management 1989), Shannon (Walker and Western Australian Department of Conservation and Land Management 1987), D'Entrecasteaux (Walker and Western Australian Department of Conservation and Land Management 1987) and Walpole Nornalup (Annear *et al.* 1992) National Parks. Staff reside at Leeuwin Naturaliste, Walpole Nornalup, Torndirrup and William Bay National Parks, and the other parks are serviced on a needs basis from the nearest CALM office.

Primary factors impacting on conservation values are: 1) linear design of Sir Mitchell and in parts, Leeuwin Naturaliste and William Bay National Parks. Sir James Mitchell National Park is effectively two strips of roadside vegetation each approx 100m in width, in places abutting state forest, and elsewhere is cleared farmland. Leeuwin Naturaliste is restricted to 150m width at its narrowest points and is comprised of numerous fragmented reserves. William Bay is two reserves joined by a 100m wide by 5 km long coastal strip. 2) Semi rural land developments and an intensification of agricultural practices on adjoining lands is impacting on surface water flows into the Leeuwin Naturaliste and Scott National Park. 3) Regular and routine feral animal (fox, some limited rabbit) control undertaken in all of the National

Park. Declared weeds and selected environmental weeds are subjected to annual control programs in the most accessible areas. Spread of some weeds (especially African thistle) is being exacerbated by high recreational visitor numbers in Leeuwin Naturaliste National Park. Both feral animal and weed control programs are constrained by funding limitations and for some parks proximity to urban developments. Fire regimes are strongly influenced

by high visitation numbers and protection of adjoining land uses in parks close to urban and semi rural developments. The development and implementation of fire regimes consistent with biodiversity goals is absent from all of these parks.

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Specific Recovery Plan	General Recovery Plan
<i>Dasyurus geoffroi</i>	Yes - RP	Action Plan For Australian Marsupials and Monotremes; Forest Management Plan (draft)
<i>Pseudocheirus occidentalis</i>	Yes - IRP	Action Plan For Australian Marsupials and Monotremes; Forest Management Plan (draft)
<i>Setonix brachyurus</i>	No	Action Plan For Australian Marsupials and Monotremes; Forest Management Plan (draft)
<i>Atrichornis clamosus</i>	Yes - RP	Action Plan for Australian Birds; Forest Management Plan (draft)
<i>Psophodes nigrogularis oberon</i>	No	Action Plan for Australian Birds; Forest Management Plan (draft)
<i>Calyptorhynchus baudinii</i>	No	Action Plan for Australian Birds; Forest Management Plan (draft)
<i>Pezoporus wallicus flaviventris</i>	Yes - IRP	Action Plan for Australian Birds; Forest Management Plan (draft)
<i>Dasyornis longirostris</i>	No	Action Plan for Australian Birds; Forest Management Plan (draft)
<i>Spicospina flammocaerulea</i>	Yes - RP	Action Plan for Australian Frogs; Forest Management Plan (draft)
Large numbers of P1 and P2 on freehold land and non Conservation estate	No	Declared rare and poorly known flora in the Southern Forest (Warren) Region (currently in preparation); Forest Management Plan (draft)

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Dasyurus geoffroi</i>	xii, xiv, x	Research about the impact of fire regimes on diet; Research into effects of foxes and fox baiting; Population and habitat monitoring; Further surveys on distribution and habitat requirements, especially in eastern part of subregion. Other - Maintenance of adequate refuge and den logs; Rehabilitation after mining; Prevention of further clearing, especially in riparian areas. Captive breeding and translocations.
<i>Pseudocheirus occidentalis</i>	ii, iii, xiv, x, xiii	Conservation on public lands managed by CALM. Other - Research into impacts of logging and minimise impacts of land developments; Management of injured, displaced or nuisance possums. Translocations into areas of fox control. Capacity building with community and landholders including education, liaison and communication.
<i>Setonix brachyurus</i>	ix, vii, xii	Fire management. Feral animal control – foxes and pigs. Survey reported occurrences especially on the Swan Coastal Plain to determine presence or absence. Further surveys of southern jarrah forest and south coast populations to establish population size, extent of emigration and immigration and assess range of habitat types used by Quokkas.
<i>Atrichornis clamosus</i>	ix, vii, iii, x, xii, xiii	Fire management at Two People's Bay, Waychincup National Park, Many Peaks Nature Reserve and Gull Rock Nature Reserve. Feral animal control. Habitat protection on other state lands. Translocations. Research to monitor population numbers. Capacity building and publicity with community, education groups and sponsors.
<i>Psophodes nigrogularis oberon</i>	xii	Research to survey of all known subpopulations; Assessment of taxonomic of populations in WA; Monitoring of subpopulations in relation to changing post fire age and a fox control programme; Research of microhabitat requirements.
<i>Calyptorhynchus baudinii</i>	xii, xi	Research - Develop repeatable population monitoring technique and monitor in different areas of the birds' range. Other – Help orchardists develop non-lethal damage control measures, and make shooting of birds illegal.

<i>Pezoporus wallicus flaviventris</i>	xii, xiv, x	Research to survey all known populations; Monitoring of subpopulations in relation to changing post fire age and fox control programme; Research into micro-habitat requirements and breeding success. Prepare IRP. Evaluation of the use of translocation for this species.
<i>Dasyornis longirostris</i>	xii, x	Research to survey known subpopulations; Monitoring of subpopulations in relation to post fire age; Research microhabitat requirements. Evaluation of translocation for management of species.
<i>Spicospina flammocaerulea</i>	xii, ix, xiii	Research into development of predictive models for calling activity; Search for new populations; Monitoring of population size. Fire management, especially prevention of burning in population areas. Capacity building with private landholders.
Large numbers of P1 and P2 on freehold land and non Conservation estate	i, ii, iii, vi, ix, xii, xiii	Habitat retention and protection through reserves, on private lands and on other state lands. Weed control. Fire management. Research. Capacity building required with community, landholders, industry and institutions.

<sup>1</sup>Appendix B, key h.

## Ecosystems and existing recovery plans

Ecosystem	Specific Recovery Plan	General Recovery Plan
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation.	No	Forest Management Plan (draft)
Remnant vegetation, specifically of poorly reserved complexes, on private property in the Scott River, Denmark Plains and Leeuwin Naturaliste Ridge	No	Declared rare and poorly known flora in the Southern Forest (Warren) Region (currently in preparation); Forest Management Plan (draft)
Scott River Ironstone heaths Scott River area	No	Declared rare and poorly known flora in the Southern Forest (Warren) Region (currently in preparation); Forest Management Plan (draft)
Mt Lindesay - Little Lindesay Vegetation Complex	No	Declared rare and poorly known flora in the Southern Forest (Warren) Region (currently in preparation); Forest Management Plan (draft)
Wetlands, rivers, cave rootmat communities and estuaries throughout the region	No	Forest Management Plan (draft)
All ecosystems within WAR	No	Declared rare and poorly known flora in the Southern Forest (Warren) Region (currently in preparation); Forest Management Plan (draft)

## Appropriate ecosystem recovery actions

Ecosystem	Recovery Actions <sup>1</sup>	Recovery Descriptions
Wetlands, rivers and estuaries throughout the region at risk from off reserve upstream landuse, past and current, salinisation, eutrophication and inundation.	xiii, xi, xiv	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas. Reinstatement of hydrology. Other – Change in landuse upstream.
Remnant vegetation, specifically of poorly reserved complexes, on private property in the Scott River, Denmark Plains and Leeuwin Naturaliste Ridge.	i, ii, iii	Habitat retention and protection through reserves, on private land and on other state lands, with options for covenanting or acquisition being explored.
Mt Lindesay - Little Lindesay Vegetation Complex	xiv	Mt Lindesay - Little Lindesay Vegetation Complex is being prepared for Phosphite treatment to harden the community/repair the community from the effects of <i>Phytophthora</i> dieback disease.
Scott River Ironstone heaths Scott River area	xiii	Capacity building is required to integrate community and Government NRM action to abate the threat, reverse trends.
Wetlands, rivers, cave rootmat communities and estuaries throughout the region.	xiii	Capacity building is required to integrate community and Government NRM action to abate threats and reverse trends in upstream areas.
All ecosystems within WAR	vi, vii	All ecosystems within WAR generally face two major threats: Weeds – work with other agencies and the community to resource environmental weed control programs on and off reserve; assess potential of exotic taxa as weeds and develop control programs for those considered threats. Feral animals – maintain and expand existing baiting and control programs; develop techniques for cats, rabbits, etc. and integrate these into farm planning and community schemes.

<sup>1</sup>Appendix B, key h.

## Subregional constraints in order of priority

The off park conservation rank for WAR is (iv) (see Appendix C, rank 6), which indicates that limited off park measures are required.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Incentives:** Farm forestry sharefarm schemes; Remnant vegetation fencing under various programs; establishment of perennial crops and revegetation on farms as part of salt and water management actions.

**Institutional Reform:** Hardwood timber industry restructure via the RFA/post RFA process; State Planning policy now requires Rural Planning Strategies and Schemes to address NRM issues.

**Threat Abatement Planning as Part of NRM:** Coast Care planning; feral animal control programs (Western Shield – limited cooperative participation by landholders); State Weed Strategy.

**Industry Codes of Practice:** The Plantation industry code of practice; move to a range of Agricultural codes as facilitated by Department of Agriculture.

**Environmental Management Systems:** EMS for forest management (harvesting) developed.

**Capacity Building:** Department of Agriculture, Department of Conservation and Land Management, and Water and Rivers Commission all contribute to community forums, workshops and education as part of increasing understanding processes and management actions available to landowners and community in relation to salt and water issues; Weed action groups are supported by the Departments of Conservation and Land Management and Agriculture.

**Other Planning Opportunities:** Regional NRM strategies (e.g. South West Catchments Council) include or will include (eg SCRIPT) biodiversity issues; Shire Rural Strategies and Town Planning schemes now addressing biodiversity and environmental issues within an NRM context as a result of Ministry for Planning and Infrastructure requirements.

**Integration With Property Management Planning:** Some application at this stage mostly associated with water/salt management in eastern agricultural zone; some input to planning stage of development proposals through Ministry for Planning and Infrastructure and Local Government referrals.

### Feasible opportunities for NRM

**Incentives:** Extend Landcare and revegetation funding options to landowners. Explore options in tax or rate

relief for owners for returning or protecting native vegetation.

**Institutional Reform:** Finalise reservation actions pending for many years. Explore options in tax or rate relief for owners for returning or protecting native vegetation. Facilitate greater input from State agencies to developing Regional NRM Strategies. Staff agencies with sufficient capable people who understand and are able to plan and implement NRM actions.

**Threat Abatement Planning as Part of NRM:** Extend resourcing of preparation of catchment plans. Coast access planning and coastal management plans extended.

**Industry Codes of Practice:** During development of codes, develop systems to contain impacts of industry to owner/operator land.

**Capacity Building:** Facilitate greater community education and involvement in a range of areas in conservation biology and NRM.

**Other Planning Opportunities:** Continued development of Regional NRM strategies; Input to Shire Rural Strategies and Town Planning.

## Impediments or constraints to opportunities

**Economic Constraints:** Limited financial resources are a major constraint.

**Other:** Lack of resourcing with agency staff trained in conservation biology and NRM – numbers capability and resourcing.

## Subregions where specific NRM actions are a priority to pursue

Warren has an NRM priority of (iii) (see Appendix C, rank 7), indicating that NRM instruments are in place with some achieved biodiversity outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** Vegetation mapping under several different systems (Beard 1979e) is available at a resolution of 1:100000 or 1:250000, whilst the mapping by Mattiske and Havel (1998a and 1998c) is available at a resolution of 1:50 000 and published at 1:250 000. The mapping for these systems is based on (informed and attributed) structural types or (informed and attributed) underlying geomorphic/landscape relationships with vegetation communities present. Both have strengths and weaknesses in development of a CAR reserve system.

Community identification based on floristics has been done for most of the bioregion (see Mattiske and Havel 1997) but complexity of pattern on the landscape (hence

cost of mapping) has prevented vegetation and ecosystem mapping based on the community types delineated, although localised areas have been mapped at the more detail local scale.

#### Systematic Fauna Survey:

No systematic fauna surveys (vertebrate or invertebrate) have been conducted across the bioregion. Some areas have preliminary survey data for a range of taxa, but this effort is only a start in resolving conservation issues and conservation taxa. The area has been identified as a significant area for relict taxa and their habitat, in particular for invertebrates (Main 1996; Horwitz 1997a; Horowitz 1997b), but targeted survey and assessment has only just begun.

#### Floristic Data:

Regional survey of vascular flora has been mostly completed, but it is based on sampling quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. There are a range of sample designs dependent on the objectives of the individual studies that combined can be considered to be the Regional Survey. Studies have been done on the distinctive tingle trees (Wardell-Johnson and Williams 1996 and Wardell-Johnson *et al.* 1995), frogs (Wardell-Johnson and Roberts 1993 and Wardell-Johnson *et al.* 1995), Warren and South coast wetlands (Lyons *et al.* 2000) and Scott River National Park (Gibson *et al.* 2001 and Gibson *et al.* 2000). Some gaps were identified during the RFA study of the South-West forests and additional plots & quadrats established (see summary by Mattiske and Havel 1997).

Regional survey of the non-vascular flora has not been undertaken. However based on the collections made by a number of local botanists and enthusiasts and those made by international and interstate bryologists, the bioregion (and WA) has a severely depleted moss and liverwort flora compared to equivalent community types in Tasmania, Victoria and New South Wales. Climate change and land management under a changing climatic regime place a large part (that usually associated with rainforest and wet forest ecotypes) of this remaining flora at risk.

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No.	Author	Date	Title	Publication Details	Pub. Type
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029	Atkins, K.J.	(1997).	Conservation statements for threatened flora within the Regional Forest Agreement region for Western Australia.	Canberra.	R

Both qualitative and quantitative macro fungi assessment work has been undertaken in the Tingle, Karri and South Coast heath and Jarrah forests, but it is not comprehensive across the region (Bougher 1997).

Rare flora surveys and monitoring are ongoing, but the work is limited by resources. Status of many taxa remains in doubt and it is likely that many of the P1 and P2 taxa listed in this document will end up listed as Endangered or Vulnerable.

#### Ecological and Life History Data:

Limited accessible data on population ecology and biology of persisting CWR mammals. Generally less for all other vertebrates, particularly the uncommon ones.

No accessible data on habitat requirements, life histories, ecology or distributions of virtually all invertebrate species.

Limited accessible data on population ecology and biology of the vascular flora of the bioregion limiting decision making on conservation status of and conservation management of the many rare and priority taxa. Likewise communities as reflected by the flora.

#### Other Priority Data Gaps:

- No consistent regolith mapping available at better than 1:250000 scale.
- No quantitative data on the affect of exotic predators, weed colonisation, fragmentation & farm clean-up, mineral-extraction on heavy metals, etc.
- Fire effect/response data is limited to few communities and taxa.
- An understanding of the effect of salinity/inundation on species and communities (including saline wetlands) is limited or lacking.
- Detailed *Phytophthora* mapping lacking for most of the region. Detail data on impacts on individual species and communities limited.
- Mapped location of Peat Communities absent.

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R = Report; J = Journal article; O = Other.

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371, 376, 379, 382, 386, 404, 408, 411, 414, 424, 480, 482, 502, 510, 543, 550, 562, 570, 571, 573, 594, 596 818, 820 and 821 in Appendix A.

# Yalgoo (*Yal*)

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## Subregional description and biodiversity values

### Description and area

This Bioregion has been extended westwards to the boundary of the South-west Botanical Province so that it now includes the Toolong Plateau of the southern Carnarvon Basin. This region is an interzone between South-western Bioregions and Murchison. It is characterised by low woodlands to open woodlands of *Eucalyptus*, *Acacia* and *Callitris* on red sandy plains of the Western Yilgarn Craton and southern Carnarvon Basin. The latter has a basement of Phanerozoic sediments. Mulga, *Callitris-E. salubris*, and Bowgada open woodlands and scrubs on earth to sandy-earth plains in the western Yilgarn Craton. The subregion is particularly rich in ephemerals. The climate is arid to semi-arid warm Mediterranean and subregional area is 4, 858, 849ha.

### Dominant land use

(see Appendix B, key b)

Grazing – native pastures. This accounts for the majority of land use in the subregion –76.97%.

Conservation- a significant proportion of conservation estate in the subregion falls outside the IUCN I-IV categories – 10.23%

UCL and Crown Reserves-9.35%

Mining – Interest in mining (gold in particular but also nickel and uranium) is considerable, however most

mining leases still come under the pastoral lands act and as such are still required to be stocked.

### Continental Stress Class

The Continental Stress Class of Yalgoo is 4. Continental Stress class should probably be considered 3, as the situation is similar to MUR1. Stress Class calculations were influenced by one large reserve (Toolong Nature Reserve) located on the northern periphery of the Region.

### Known special values in relation to landscape, ecosystem, species and genetic values

#### Rare features:

- Talling Peak Ironstone and jaspilite range - unique landform and vegetation complexes. For example *Eriostemon sericeus* and *Thryptomene decussata* low shrublands.
- Banded Ironstone Mt Gibson ranges. Contains a significant number of endangered flora.
- Warradagga Rock. Granite outcrop with endangered flora and invertebrates in ephemeral ponds.
- Mt Singleton Ranges. Number of endangered flora with some unusual vegetation types.

#### Rare Vertebrates:

Include: Western Spiny-tailed Skink (*Egernia stokesii badia*), Carnaby's Cockatoo (*Calyptorhynchus latirostris*) and Slender-billed Thornbill (*Acanthiza iredalei*).

#### Rare Flora:

Include: *Acacia vassalii*, *Darwinia masonii*, and *Eucalyptus crucis* subsp. *praecipua*.

### Ecosystem Types Have at Least 85% of Their Total Extent Confined to the Yalgoo Subregion:

Beard Veg Code	Description
248	Shrublands; bowgada scrub with scattered red mallee & <i>Eucalyptus</i> sp.
337	Mosaic: Shrublands; bowgada scrub/Hummock grasslands, mixed sandplain - open red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>
357	Medium woodland over scrub; York gum over bowgada & jam ( <i>Acacia acuminata</i> )
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges
363	Shrublands; bowgada scrub with scattered cypress pine
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine
412	Succulent steppe with scrub; teatree ( <i>Melaleuca thyioides?</i> ) over samphire
414	Succulent steppe with open scrub; scattered bowgada & jam over saltbush & bluebush
416	Low woodland; mulga mixed with cypress pine & york gum
419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket
Beard Veg Code	Description
434	Shrublands; <i>Acacia quadrimarginea</i> & jam scrub with scattered York gum & <i>Allocasuarina huegelliana</i>
683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire

**Centres of Endemism:**

The region is rich and diverse in flora and fauna however most species are wide ranging and usually occur in at least one, and often several, adjoining regions.

**Refugia:**

Morton *et al* (1995) do not list any refugia in YAL, but potential for freshwater pools to be described as refugia for species requiring more mesic conditions.

**Existing bioregional plans and/or systematic reviews of biodiversity and threats**

In 1974 the Conservation Through Reserves Committee (CTRC) made recommendations for one reserve within the Yalgoo subregion in the CTRC Green Book (Conservation Through Reserves Committee 1974) This recommendation was implemented however it is widely recognised that this constitutes insufficient information and planning and requires further work.

In 2000 a report on the Biodiversity of the Southern Carnarvon Basin was published. This included a paper on reserve system gaps (McKenzie *et al.* 2000). The survey included Toolonga Nature Reserve in the far northern end of YAL, and therefore has some relevance to the Region.

The State Government's policy statement, Managing the Rangelands, broadly outlines the need to implement a CAR reserve system although no specific areas are targeted for reservation.

An unpublished report by Department of Conservation and Land Management on the Gascoyne - Murchison Strategy (Establishment and Management of a Conservation Reserve System) outlines the broad techniques to implement a CAR reserve system but does not target any specific areas. An outline of this report is given in the more comprehensive Filling the Gaps (McNamara *et al.*, 2000).

**Wetlands****Wetlands of National significance (DIWA listings)**

Name and Code	Description <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Thundelarra Lignum Swamp WA109 (YAL001WA)	B13	iii	vi	iii	iv, v (goats, foxes, cats & rabbits)
Wagga Wagga Salt Lake WA110 (YAL002WA)	B8, B12	ii	vi	iii	v (goats, foxes, cats & rabbits)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

**Wetlands of Subregional significance (in addition to the DIWA listed wetlands)**

Name	Location	Description <sup>1</sup>	Special Values <sup>2</sup>	Condition <sup>3</sup>	Trend <sup>4</sup>	Reliability <sup>5</sup>	Threatening Processes <sup>6</sup>
Lake Moore	6 740 000m N, 580 000m E	B8	ii	iii	vi	i	iv, v (goats and sheep), x (hydrology changes due to degradation of surrounding vegetation types increasing runoff and siltation)
Lake Monger	6 730 000 m N, 480 000m E	B8	ii	iii	vi	i	iv, v (goats and sheep), x (hydrology changes due to degradation of surrounding vegetation types increasing runoff and siltation)

<sup>1</sup>Appendix B, key d; <sup>2</sup>Appendix B, key c; <sup>3</sup>Appendix C, rank 2; <sup>4</sup>Appendix C, rank 3; <sup>5</sup>Appendix C, rank 1; <sup>6</sup>Appendix B, key e

**Riparian zone vegetation**

Name	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
Murchison River	ii	iii	ii	iv, v (goats, foxes, rabbits), vi
Greenough River	ii	iii	ii	iv, v (goats, foxes, rabbits), vi

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

**Ecosystems at risk****Threatened ecological communities (TECs)**

There are no Threatened Ecological Communities (TECs) in YAL.

**Other ecosystems at risk**

Community	Status	NVIS <sup>1</sup>	Condition <sup>2</sup>	Trend <sup>3</sup>	Reliability <sup>4</sup>	Threatening Processes <sup>5</sup>
Tallering Peak vegetation complexes. Ironstone range. Threatened by mining (E.P. Branch).	V	32	iii	iv	iii	xii (mining), v (goats)
Mt Gibson vegetation complex (G. Keighery and N. Gibson pers. comm.; Beard map).	V	21	ii-iii	iv	iii	iv, v (goats, rabbits), vii

Mt Singleton vegetation complex, Ninghan Station (A. Chant pers. comm.).		43	ii	ii	iii	v (goats), iv, vii
Plant assemblages dominated by <i>Acacia grasbyi</i> (miniritchie). Very widespread but only regenerates where no grazing (domestic or feral including rabbits) e.g. regeneration at Yuin mine reserve (J. Stretch pers. comm.).	V	21	ii	iii	ii	iv, v (goats, rabbits), vii
Sago Bush on narrow drainage lines of Tindelarra Land System. Narrow bands of alluvial soils that are degraded (J. Stretch pers. comm.).	V	31	i	iii	ii	iv, v (goats, rabbits), vii
Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	31	ii	iii	ii	iv, v (goats, rabbits), vii
Drainage tract acacia shrubland (DRAS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	21	ii	iii	ii	iv, v (goats, rabbits), vii
Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	22	ii	iii	ii	iv, v (goats, rabbits), vii
Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	V	31	ii	iii	ii	iv, v (goats, rabbits), vii
Lignum dominated plant assemblages of swamps of the Midwest e.g. at Thundelarra, Barnong Stations and Muggon (K. Tinley pers. comm.).	V	32	iii	iii	ii	iv, v (goats, rabbits), vii
Plant assemblages of high diversity landscapes and unusual landforms of Lake Wooleen	V	32	iii	iii	ii	iv, v (goats, rabbits), vii
Plant assemblages of high diversity landscapes and unusual landforms of silty sandy clay dunes on Muggon. Mt Gibson vegetation complex from NUR1 (p5).	V	32	iii	iii	ii	iv, v (goats, rabbits), vii
Invertebrate assemblages of Granite pools	V	NA	iii	iii	ii	iv, v (goats, rabbits), x (increased siltation due to grazing)
Critical weight range mammals (locally extinct species <i>Dasyurus cristicauda</i> , <i>Dasyurus geoffroi</i> , <i>Isoodon auratus</i> )	E	NA	i	ii - iii	iii	v (fox, cat), vii, iv

<sup>1</sup>Appendix B, key f; <sup>2</sup>Appendix C, rank 2; <sup>3</sup>Appendix C, rank 3; <sup>4</sup>Appendix C, rank 1; <sup>5</sup>Appendix B, key e

## Species at risk

### Fauna

Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 2 (BIRDS)</b>					
<i>Calyptorhynchus latirostris</i>	E	ii	iii	iv,	ii, v (foxes & cats), xii (poaching of nests)
<i>Acanthiza iredalei iredalei</i>	V	ii	iii	ii	vii
<i>Leipoa ocellata</i>	V	ii	iii	iii	v (foxes & cats), ii, iv
Species	Status	Condition <sup>1</sup>	Trend <sup>2</sup>	Reliability <sup>3</sup>	Threatening Processes <sup>4</sup>
<b>SCHEDULE 1: RARE/LIKELY TO BECOME EXTINCT, DIV 3 (REPTILES)</b>					
<i>Egernia stokesii badia</i>	E	ii	iii	ii	v (foxes & cats), ii
<b>SCHEDULE 4: OTHER SPECIALLY PROTECTED FAUNA. DIVISION 2 (BIRDS)</b>					
<i>Cacatua leadbeateri mollis</i>	SP	iii	iv	ii	ii, iv, xii (poaching of nests)
<i>Falco peregrinus</i>	SP	iii	iv	ii	ii

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

### Declared rare and priority flora

Species Name	Status	Condition	Trend	Reliability	Threatening Processes
<b>DECLARED RARE FLORA</b>					
<i>Eremophila viscida</i>	CR	ii	vi	iii	xii (thought to be fire disturbance opportunist)
<i>Acacia unguicula</i>	E	Unknown	vi	iii	v (goats), iv
<i>Acacia vassalii</i>	E	Unknown	vi	iii	i, ii, vi
<i>Darwinia masonii</i>	E	Unknown	vi	iii	xii (mining), v (goats) iv
<i>Eucalyptus crucis</i> subsp. <i>praecipua</i>	E	Unknown	vi	ii	v (goats), iv
<b>PRIORITY 1</b>					
<i>Acacia cerastes</i>	1	Unknown	vi	iii	v (goats), iv
Genus sp. Yalgoo (JM Ward s.n. 11/7/1999)	1	Unknown	vi	ii	v (goats), iv
<i>Micromyrtus</i> sp. Ninghan (MG Corrick 9332)	1	Unknown	vi	ii	v (goats), iv, ii, vii
<i>Sauropus</i> sp. Woolgorong (M Officer s.n. 1998)	1	Unknown	vi	iii	v (goats), iv

10/8/94)					
<b>PRIORITY 2</b>					
<i>Hyalosperma stoveae</i>	2	Unknown	vi	ii	v (goats), iv, vii
<i>Lepidium merrallii</i>	2	Unknown	vi	ii	v (goats), iv, vii
<i>Melaleuca oldfieldii</i>	2	Unknown	vi	ii	i, ii, iv, vi, vii, ix
<i>Persoonia pentasticha</i>	2	Unknown	vi	ii	i, ii, iv, vi, v (goats), ix
<i>Stenanthemum poecilum</i>	2	Unknown	vi	ii	iv, v (goats)

<sup>1</sup>Appendix C, rank 2; <sup>2</sup>Appendix C, rank 3; <sup>3</sup>Appendix C, rank 1; <sup>4</sup>Appendix B, key e

## Analysis of appropriate management scenarios

### Reservation priorities of ecosystems

Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
10	Medium woodland; red mallee group				H
18	Low woodland; mulga ( <i>Acacia aneura</i> )				M
19	Low woodland; mulga between sandridges				M
36	Shrublands; thicket, acacia-casuarina alliance ?species				M
39	Shrublands; mulga scrub				M
40	Shrublands; acacia scrub, various species	X			H
41	Shrublands; teatree scrub				L
120	Succulent steppe with open low woodland; mulga & sheoak				M
125	Bare areas; salt lakes		X		L
128	Bare areas; rock outcrops				L
141	Medium woodland; York gum, salmon gum & gimlet	X			H
142	Medium woodland; York gum & salmon gum				H
169	Shrublands; mulga & minnieritchie scrub	X			L
202	Shrublands; mulga & <i>Acacia quadrimarginea</i> scrub				H
204	Succulent steppe with open scrub; scattered mulga & <i>Acacia sclerosperma</i> over saltbush & bluebush				H
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
205	Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub				H
206	Shrublands; bowgada & grevillea scrub	X			L
221	Succulent steppe; saltbush				H
228	Shrublands; <i>Acacia quadrimarginea</i> scrub				H
240	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & bowgada over saltbush & bluebush				H
243	Shrublands; bowgada & minnieritchie scrub				H
248	Shrublands; bowgada scrub with scattered red mallee & <i>Eucalyptus</i> sp.				H
256	Low woodland; York gum, and cypress pine (adjacent to e6pMLI)	X			L
266	Mosaic: Shrublands; bowgada scrub/Succulent steppe; saltbush & bluebush				M
268	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> over saltbush & bluebush				H
269	Low woodland over scrub; mulga over bowgada scrub				H
314	Succulent steppe with open woodland; york gum over saltbush				H
321	Mosaic: Shrublands; <i>Acacia sclerosperma</i> & bowgada scrub/Succulent steppe; saltbush & bluebush				M
326	Low woodland over scrub; mulga over bowgada & minnieritchie scrub			X	H
337	Mosaic: Shrublands; bowgada scrub/Hummock grasslands, mixed sandplain - open red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>	X			L
352	Medium woodland; York gum				H
355	Shrublands; bowgada & jam scrub with scattered York gum & red mallee		X		H
357	Medium woodland over scrub; York gum over bowgada & jam ( <i>Acacia acuminata</i> )				H
358	Shrublands; bowgada & <i>Acacia quadrimarginea</i> on stony ridges			X	H
361	Shrublands; bowgada & minnieritchie scrub with scattered mulga				H
362	Mosaic: Shrublands; bowgada & minnieritchie scrub with scattered mulga/Scattered groups of saltbush/bluebush	X			L
363	Shrublands; bowgada scrub with scattered cypress pine	X		X	L
364	Shrublands; bowgada scrub with scattered eucalypts & cypress pine	X	X	X	L

365	Shrublands; bowgada & jam scrub with scattered York gum & red mallee		X	X	M
374	Shrublands; bowgada scrub with scattered York gum				H
380	Shrublands; scrub-heath on sandplain				M
383	Shrublands; <i>Acacia rostellifera</i> scrub-heath				H
385	Shrublands; bowgada & jam scrub with scattered York gum				H
389	Succulent steppe with open low woodland; mulga over saltbush				L
404	Shrublands; bowgada & <i>Acacia murrayana</i> scrub				H
405	Shrublands; <i>Acacia sclerosperma</i> , bowgada & jam scrub				H
406	Shrublands; acacia, casuarina, <i>Eucalyptus eudesmioides</i> , <i>Banksia ashbyi</i> & other mixed species thicket				L
411	Succulent steppe with open scrub: scattered bowgada & jam over saltbush				H
412	Succulent steppe with scrub; teatree ( <i>Melaleuca thyioides?</i> ) over samphire				H
414	Succulent steppe with open scrub; scattered bowgada & jam over saltbush & bluebush				H
415	Succulent steppe with open scrub; scattered mulga & other wattle(s) over saltbush & bluebush			X	H
416	Low woodland; mulga mixed with cypress pine & york gum	X			H
Beard Veg Assoc	Ecosystem Description	IUCN I-IV	Non-IUCN Reserve	CALM-Purchased Lease	Priority
419	Shrublands; bowgada, jam and <i>Melaleuca uncinata</i> thicket		X	X	H
420	Shrublands; bowgada & jam scrub	X	X	X	H
423	Shrublands; <i>Acacia</i> scrub-heath unknown spp				H
434	Shrublands; <i>Acacia quadrimarginea</i> & jam scrub with scattered York gum & <i>Allocasuarina huegeliana</i>				H
437	Shrublands; Mixed acacia thicket on sandplain	X			L
483	Hummock grasslands, mixed sandplain - open mallee over sparse dwarf shrubs with spinifex; red mallee & mixed sparse dwarf shrubs over <i>Triodia basedowii</i>	X		X	H
533	Low woodland; mulga & cypress pine				L
551	Shrublands; <i>Allocasuarina campestris</i> thicket				L
631	Succulent steppe with woodland and thicket; york gum over <i>Melaleuca thyioides</i> & samphire		X		L
676	Succulent steppe; samphire			X	L
683	Succulent steppe with open scrub; scattered <i>Acacia sclerosperma</i> & snakewood over samphire				H
686	Medium woodland; York gum & red mallee			X	H
687	Shrublands; bowgada & jam scrub with scattered <i>Allocasuarina huegeliana</i> & York gum				H
863	Hummock grassland, mixed sandplain - sparse low trees over sparse dwarf shrubs with spinifex; red mallee over mixed dwarf shrubs with <i>Triodia scariosa</i> & T. sp?				H
936	Medium woodland; salmon gum				L
1063	Medium-Low woodland; York gum & cypress pine ( <i>Callitris columellaris</i> )	X			L
1198	Mosaic: Succulent steppe with thicket; <i>Melaleuca thyioides</i> over samphire/Shrublands; bowgada open scrub				H
1241	Succulent steppe; bluebush				L
2081	Shrublands; bowgada and associated spp. scrub	X	X		L
2685	Shrublands; <i>Acacia quadrimarginea</i> & jam scrub on greenstone				H
	Tallering Peak vegetation complexes. Ironstone range.				H
	Mt Singleton vegetation complex, Ninghan Station				?
	Plant assemblages dominated by <i>Acacia grasbyi</i> (minirtchie).	X			M
	Sago Bush on narrow drainage lines of Tindelarra Land System.	X			H
	Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)				H
	Drainage tract acacia shrubland (DRAS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)				H
	Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)				H
	Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)				H
	Lignum dominated plant assemblages of swamps of the Midwest e.g. at Thundelarra, Barnong Stations and Muggon Station (K. Tinley pers. comm.).	X		X	H
	Plant assemblages of high diversity landscapes and unusual landforms of Lake Wooleen	X		X	H
	Plant assemblages of high diversity landscapes and unusual landforms of silty sandy clay dunes on Muggon. Mt Gibson vegetation complex p. 13 MUR1	X		X	L
	Invertebrate assemblages of Granite pools	X			H



## Subregional constraints in order of priority (see Appendix B, key g)

**Competing Land Uses:** Pastoralism occupies more than 76% of the region and mining also has considerable interests.

**Economic Constraints:** In terms of the cost of land and the cost of subsequent management.

**Other:** There are difficulties in identifying biodiversity values in most areas due to lack of resolution of data; level of degradation of the region is significant due to pastoral practices and the impacts of feral herbivores

## Bioregional and subregional priority for reserve consolidation

YAL is reservation class 4 (see Appendix D, and Appendix C, rank 4) with only 11.6% of area in conservation reserve (IUCN I-IV). Acquisitions of pastoral leases in the bioregion may increase the percentage of land in reserve. No subregions exist within YAL. The current reserve system is highly biased in terms of CAR criteria and is not comprehensive or representative in terms of ecosystem representation. The reserve system is heavily biased with one very large reserve (Toolonga Nature Reserve) in the extreme northern end of the subregion

## Off reserve conservation

### Priority species or groups and existing recovery plans

Species	Ecosystem (Beard Vegetation Association)	Specific Recovery Plan	General Recovery Plan
<i>Leipoa ocellata</i>	10 – Medium woodland: red mallee group; 19 – Low woodland: mulga between sandridges; 141 – Medium woodland: York gum, salmon gum & gimlet; 142 – Medium woodland: York gum & salmon gum	Malleefowl Preservation Society have current Action Plan and ongoing research	The Action plan for Australian Birds 2000
<i>Cacatua leadbeateri mollis</i>	19 – Low woodland: mulga between sandridges; 141 – Medium woodland: York gum, salmon gum & gimlet; 936 – Medium woodland: salmon gum; 686 – Medium woodland: York gum & red mallee	No	The Action plan for Australian Birds 2000 (Eastern state subspecies, though western form discussed)
<i>Calyptorhynchus latirostris</i>	19 – Low woodland: mulga between sandridges; 141 – Medium woodland: York gum, salmon gum & gimlet; 936 – Medium woodland: salmon gum; 686 – Medium woodland: York gum & red mallee	Yes - IRP	The Action plan for Australian Birds 2000
<i>Acanthiza iredalei iredalei</i>	240 – Succulent steppe with open scrub: scattered <i>Acacia sclerosperma</i> & bowgada over saltbush & bluebush; 266 – Mosaic: Shrublands, bowgada scrub/Succulent steppe, saltbush & bluebush; 268 – Succulent steppe with open scrub: scattered <i>Acacia sclerosperma</i> over saltbush and bluebush; 412 – Succulent steppe with scrub: teatree ( <i>Melaleuca thyioides</i> ) over samphire	No	The Action plan for Australian Birds 2000
Species	Ecosystem (Beard Vegetation Association)	Specific Recovery Plan	General Recovery Plan
<i>Egernia stokesii badia</i>	169 – Shrublands: mulga & minnieritchie scrub; 326 – Low woodland over scrub: mulga over bowgada & minnieritchie; 361 – Shrublands: bowgada & minnieritchie scrub with scattered mulga	No	The Action Plan for Australian Reptiles
<i>Acacia cerastes</i>	Unknown	No	No
<i>Acacia unquicula</i>	11 – Medium woodland: coolibah ( <i>E. microtheca</i> )	No	No
<i>Acacia vassalii</i>	Unknown	No	No

constituting over 80% of the reserved area. Therefore, Class 2 is more appropriate.

## Reserve management standard

Toolonga Nature Reserve management rank is fair (ii) (see Appendix C, rank 5). Management actions are limited. No fire beaks or fire access tracks installed. Access is extremely limited to majority of reserve. No feral control programs are currently in place although goat numbers expected to be minimal due to lack of available water.

Kadji Kadji Timber Reserves management rank is poor (i). Management actions are limited. No fire beaks or fire access tracks are installed. No feral control program in place or knowledge of extent of problem. Grazing lease held over part of area.

Other areas under CALM management rank fair (ii). All other areas are pastoral leases or Unallocated Crown Land (ex pastoral lease). Management actions are limited. Fire breaks and fire access tracks are maintained. Control of goats (to varying extents) and reduction of sheep numbers carried out. No feral predator control programs in place.

<i>Darwinia masonii</i>	3 – Medium forest: jarrah-marri	No	No
Genus sp. Yalgoo (JM Ward s.n. 11/7/1999)	Unknown	No	No
<i>Hyalosperma stoveae</i>	Unknown	No	No
<i>Lepidium merrallii</i>	Unknown	No	No
<i>Melaleuca oldfieldii</i>	Unknown	No	No
<i>Micromyrtus</i> sp. Ninghan (MG Corrick 9332)	Unknown	No	No
<i>Persoonia pentasticha</i>	Unknown	No	No
<i>Sauropus</i> sp. Woolgorong (M Officer s.n. 10/8/94)	Unknown	No	No
<i>Stenanthemum poecilum</i>	12 – Medium woodland-tropical: stringybark ( <i>E. tetradonta</i> ) & woollybutt ( <i>E. miniata</i> )	No	No
<i>Eucalyptus crucis</i> subsp. <i>praecipua</i>	6 – Medium woodland: tuart & jarrah	No	No
CWR mammals	Various	Yes some have RPs or IRPs	The Action Plan for Australian Marsupials and Monotremes

### Appropriate species recovery actions

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Falco peregrinus</i>	i, ii, iii	Habitat retention through reserves or on other State lands or on private lands.
<i>Cacatua leadbeateri mollis</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure
<i>Calyptorhynchus latirostris</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure
<i>Leipoa ocellata</i>	i, ii, iii, vii	Habitat retention through reserves or on other State lands or on private lands. Control of foxes and cats. Reduction in habitat degradation through grazing pressure.
<i>Acanthiza iredalei iredalei</i>	i, ii, iii, vii	The loss of habitat through grazing of chenopod shrubland by sheep and rabbits needs to be addressed. Habitat retention through reserves or on other State lands or on private lands.
<i>Egernia stokesii badia</i>	i, ii, iii, xii	Little is known of habitat requirements or general natural history for this species so further research is important to determine its true status
<i>Acacia cerastes</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and requires additional research.
<i>Acacia unguicula</i>	i, ii, iii, vii, ix, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores (goats) required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Acacia vassalii</i>	xii	Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Darwinia masonii</i>	i, ii, iii, vii, xii,	Habitat retention through reserves or on other State lands or on private lands. Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats required. Understanding of life history requirements for all rare flora very limited and needs additional research.
Genus sp. Yalgoo (JM Ward s.n. 11/7/1999)	i, ii, iii, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Feral animal control. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Hyalosperma stoveae</i>	xii, vii	Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.

Species	Recovery Actions <sup>1</sup>	Recovery Descriptions
<i>Lepidium merrallii</i>	xii, vii	Investigation of disturbance requirements for regeneration required. Control of herbivores such as rabbits and goats may be required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Melaleuca oldfieldii</i>	i, ii, iii, vii, xii	Habitat retention and protection through reserves, on private lands and on other state lands. Control of herbivores such as rabbits and goats may be required. Investigation of disturbance requirements for regeneration required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Micromyrtus</i> sp. Ninghan (MG Corrick 9332)	i, ii, iii, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats required. Investigation of disturbance requirements for regeneration required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Persoonia pentasticha</i>	i, ii, iii, vii, xii,	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats may be required. Investigation of disturbance requirements for regeneration required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Sauropus</i> sp. Woolgorong (M Officer s.n. 10/8/94)	i, ii, iii, vii, xii	Habitat retention through reserves or on other State lands or on private lands. Control of herbivores such as rabbits and goats required. Investigation of disturbance requirements for regeneration required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Stenanthemum poicilum</i>	i, ii, iii, vi, viii, xii	Habitat retention through reserves or on other State lands or on private lands. Weed control. Control of herbivores such as rabbits and goats required. Investigation of disturbance requirements for regeneration required. Understanding of life history requirements for all rare flora very limited and needs additional research.
<i>Eucalyptus crucis</i> subsp. <i>praecipua</i>	i, ii, iii, vi, viii, xii	Habitat retention through reserves or on other State lands or on private lands. Weed control. Revegetation. Understanding of life history requirements for all rare flora very limited and needs additional research.
CWR mammals	x, vii, xii, i	Reintroduction to previous areas of habitat. Control of feral predators such as foxes and cats. Research into threatening processes other than ferals (e.g. fire regime). Habitat retention through reserves.

<sup>1</sup>Appendix B, key h.

## Ecosystems and appropriate recovery actions

Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Description
Tallering Peak vegetation complexes. Ironstone range. Threatened by mining, see internal file (E.P. Branch).	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Mt Singleton vegetation complex, Ninghan Station (A. Chant pers. comm.).	xii, xiv, v, vii	Regular monitoring is occurring. Closing of water points in the Mt Singleton area. Fencing as exclosures. Feral animal control (goats).
Plant assemblages dominated by <i>Acacia grasbyi</i> (miniritchie). (J. Stretch pers. comm.).	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime. The Narloo block (Narloo, Pt Yuin & Twin peaks) contains extensive areas of <i>A. grasbyi</i> habitat recently added to conservation estate.
Sago Bush on narrow drainage lines of Tindelarra Land System. (J. Stretch pers. comm.).	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime. Large areas of Tindelarra land system on Narloo block. Not sure about area.
Stony bluebush mixed shrubland (SBMS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Ecosystem Description	Recovery Actions <sup>1</sup>	Recovery Description
Drainage tract acacia shrubland (DRAS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Alluvial plain snakewood chenopod shrubland (ASWS) of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Breakaway footslope chenopod low shrubland of the Sandstone-Yalgoo-Paynes Find area (Payne <i>et al.</i> 1998)	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly

		goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Lignum dominated plant assemblages of swamps of the Midwest e.g. at Thundelarra, Barnong Stations and Muggon Station. (K. Tinley pers. comm.)	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Plant assemblages of high diversity landscapes and unusual landforms of Lake Wooleen	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.
Plant assemblages of high diversity landscapes and unusual landforms of silty sandy clay dunes on Muggon.	vii, ix, i, v	Removal of grazing pressure by stock, goats and rabbits; Fire management; Habitat retention through reserves; Fencing of sensitive areas (as exclosures).
Mt Gibson vegetation complex from MUR1 p. 19.		
Invertebrate assemblages of Granite pools	i, iii, v, vi, vii, xii	Habitat protection through reserves. More reservation needed of high priority areas; Habitat protection on state lands (pastoral leases); Fencing of sensitive areas (as exclosures) where there are heavy goat numbers; Weed control for critical habitats; Feral animal control, mainly goats and foxes; Research into threatening processes, particularly effect of change in fire regime.

<sup>1</sup>Appendix B, key h.

## Existing ecosystem recovery plans

There are no specific regional recovery plans for any of the above biota or systems. Most species of flora have broad discussion of actions required to assist recovery detailed in the publication Declared Rare and Poorly Known Flora in the Geraldton District (Patrick 2001). Other Recovery Plans include; National Recovery Plan for Malleefowl (Benshemesh 2000); The Action Plan for Australian Birds 2000 (Garnett and Crowley 2000); Action Plan for Australian Marsupials and Monotremes (Maxwell *et al.* 1996); The Action Plan for Australian Reptiles (Cogger 1993).

## Subregion priority for off reserve conservation

The bioregional priority for off park conservation is (ii) (see Appendix C, rank 6), indicating that there is a significant off park effort needed, resource constraints exist, and there is limited community capacity.

## Conservation actions as an integral part of NRM

### Existing NRM actions

**Institutional Reform:** Through the Gascoyne Murchison Strategy; Purchase of leases for conservation estate.

**Threat Abatement Planning as Part of NRM:** e.g. vegetation management plans and pest management.

**Industry Codes of Practice:** Particularly in relation to pastoral, mining and exploration activities.

### Environmental Management Systems and Ecologically Sustainable Product Marketing

**Integration with Property Management Planning, Catchment Planning and Landcare:** Through Land Care District committees through the region.

## Feasible opportunities for NRM

**Legislation:** Including duty of care for leasehold and other lands.

**Institutional Reform:** e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements.

**Other Planning Opportunities:** Including local government planning and National Action Plan for Water Quality and Salinity.

**Environmental Management Systems and Ecologically Sustainable Product Marketing:** Some pastoral areas are attempting to identify and implement ecologically sustainable practices through the EMU process developed by the Regional Environmental Management Program of Gascoyne-Murchison Strategy. Requires a greater level of support to be successful.

## Impediments or constraints to opportunities

A number of impediments exist including the Land Administration Act and operations of the Pastoral Land Board. Both the act and the Pastoral Land Board have requirements of Pastoral Leases that may not be consistent with conservation. Conservation through reserves is limited by the presence of mining leases and tenements. There is a need to increase awareness of conservation values through education of major industries (mining, agricultural) and the public in general. Limited financial resources are also a major constraint.

## Subregions where specific NRM actions are a priority to pursue

Yalgoo has an NRM priority of (i) (see Appendix C, rank 7) indicating that there are major constraints to implement effective NRM actions to achieve biodiversity outcomes. Grazing by sheep, cattle, feral goats, rabbits and the effects of fire has altered significant parts of vegetation communities within YAL. Certain preferred

and sensitive landscapes are severely degraded and will require rehabilitation programs of decadal time scales. Under the pastoral lands act leases are still required to maintain certain stock levels that do not necessarily fit with conservation values. Pastoral Industry reform is essential to achieve desired conservation outcomes.

## Data gaps

### Gaps in data needed for the identification of biodiversity values and management responses

**Vegetation and Regional Ecosystem Mapping:** No regolith mapping available. Regional ecosystem mapping has occurred at the broad scale; 1:1 000 000 for Beard's vegetation types and 1:500 000 for land systems by Department of Agriculture (Payne et al., 1998).

**Systematic Fauna Survey:** No data except for Toolonga Nature Reserve in the north western periphery of the subregion (Burbidge et al., 1980) and the White Wells area in the southern periphery (Burbidge et al., 1989). Reserves don't have long-term survey data on species presence or absence, even for vertebrates. Wetland survey has been minimal.

**Floristic Data:** Data is sparse, quadrats positioned on widespread surface-types as well as some of the localised substrates of particular interest. Department of Agriculture monitoring system offers quantitative

information on spatial shifts within vegetation communities. Wetland survey has been minimal.

**Ecological and Life History Data:** There is little data on habitat requirements of virtually all invertebrate species, most ephemeral plants and uncommon vertebrate and plant species. There is no data to provide a regional context on life-history (including population-trend) of any species, even goats, foxes and rabbits.

#### Other Priority Data Gaps Include:

- No quantitative data on the effect of exotic predators, weed colonisation.
- No quantitative data on the effect of mineral extraction, pastoralism on landscape processes. Department of Agriculture has had monitoring sites installed since 1958 throughout Yalgoo. Rangeland survey provides a quantitative benchmark for reassessment by Department of Agriculture pastoral inspectors.
- No quantitative data on the impact of exotic herbivores on aquatic systems, or other communities, especially effects on invertebrate and non-vascular plant communities.
- No quantitative data on the impact of weed colonisation (especially buffel grass) on riverine and other grassland communities, particularly upon recruitment of perennial species, and consequent effects on invertebrate and vertebrate communities.
- Poor understanding of the long-term impact of mining below water tables, particularly with respect to leaving flooded voids subject to salination.
- Poor understanding of subregional troglofaunas, particularly stygofauna associated with palaeo-drainage calcretes.

## Sources

## References cited

No.	Author	Date	Title	Publication Details	Pub. Type
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R
142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R
181	Cogger, H., Cameron, E., Sadler, R. and Egger, P.	(1993).	The Action Plan for Australian Reptiles.	Australian Nature Conservation Agency, Canberra.	R
190	Conservation Through Reserves Committee	(1974).	Conservation Reserves in Western Australia. Systems 1, 2, 3, 4, 5, 8, 9, 10, 11, 12. Report of the Conservation Through Reserves Committee to the Environmental Protection Authority.	Department of Conservation and Environment (WA).	R
298	Garnett, S.T. and Crowley, G.M.	(2000).	The Action Plan for Australian Birds.	Environment Australia, Canberra.	R
483	Maxwell, S., Burbidge, A.A. and Morris, K. (eds).	(1996).	The 1996 Action Plan for Australian Marsupials and Monotremes. Wildlife Australia Endangered Species Program Project Number 50.	Environment Australia, Canberra.	R
710	McKenzie, N.L., Halse, S.A. and Gibson, N.	(2000).	Some gaps in the reserve system of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement No. 61: 511-546.	R
498	McNamara, P., Brandis, T and Hopkins, A.	(2000).	Filling the gaps.	Landscape. 15 (4) 43 - 49.	J
519	Morton S.R., Short, J. and Barker, R.D. with an Appendix by Griffin, G.F. and Pearce, G.	(1995).	Refugia for Biological Diversity in Arid and Semi Arid Australia. Biodiversity Series, Paper No 4. Biodiversity Unit.	Department of Environment Sport and Territories. Canberra	R
537	Patrick, S.J.	(2001).	Declared Rare and Poorly Known Flora in the Geraldton District. Wildlife Management Program No. 26.	Department of Conservation and Land Management.	R
542	Payne, A.L., Van Vreeswyk, A.M.E., Pringle, H.J.R., Leighton, K.A., and Hennig, P.	(1998).	Technical Bulletin No 90., An inventory and condition survey of the Sandstone-Yalgoo-Paynes Find area, Western Australia.	Agriculture Western Australia.	R

R = Report; J = Journal article; O = Other.

## Other relevant publications

See reference numbers 026, 065, 075, 090, 094, 098, 101, 110, 118, 127, 137, 142, 181, 190, 191, 241, 267, 268, 272, 273, 278, 279, 298, 299, 357, 371, 372, 381,

387, 391, 395, 405, 406, 407, 419, 429, 450, 451, 459, 483, 498, 507, 519, 526, 542, 584, 641, 650, 679, 685, 709 and 710 in Appendix A.

# Appendix A

## References

Ref No.	Author	Date	Title	Publisher and Location	J, B, R, O	Subregion
001	Abbot, I. and Black, R.,	(1978).	An Ecological reconnaissance of four islands in the Archipelago of the Recherche, Western Australia.	Journal of the Royal Society of WA, Vol 60, part 4, p115-128.	J	ESP2,
002	Abbot, I. and Burbidge, A. A.	(1995).	The Occurrence of mammal species on the Islands of Australia: A Summary of existing knowledge.	CALMScience 1(3)	J	ESP1,
006	Abbott, I.	(2000).	Improving the conservation of threatened and rare mammal species through translocation to islands: case study Western Australia.	Biological Conservation 93: 195 - 201.	J	ESP2,
005	Abbott, I.	(1999).	The avifauna of the forests of south-west Western Australia: changes in species composition, distribution, and abundance following anthropogenic disturbance.	CALMScience, Supplement 5.	J	COO1,
004	Abbott, I.	(1981).	Mondrain Island, Archipelago of the Recherche, Western Australia, Seabird islands	Corella.- Vol. 5.	J	ESP2,
003	Abbott, I.	(1981).	Woody Island, Archipelago of the Recherche, Western Australia, Seabird islands	Corella.- Vol. 5	J	ESP2,
008	Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers	(2000b).	Weeds of National Significance Bitou Bush and Boneseed ( <i>Chrysanthemoides monilifera</i> ssp. <i>rotundata</i> and <i>monilifera</i> ) Strategic Plan.	National Weeds Strategy Executive Committee, Launceston.	R	AW1, AW2, MAL2,
007	Agriculture & Resource Management Council of Australia & New Zealand, Australian & New Zealand Environment & Conservation Council and Forestry Ministers	(2000a).	Weeds of National Significance Bridal Creeper ( <i>Asparagus asparagoides</i> ) Strategic Plan.	National Weeds Strategy Executive Committee, Launceston.	R	AW1, AW2, MAL2,
009	Agriculture and Resource Management Council of Australia and New Zealand, Australian and New Zealand Environment and Conservation Council and Forestry Ministers	(2001).	Weeds of National Significance Blackberry ( <i>Rubus fruticosus</i> L. agg) Strategic Plan.	National Weeds Strategy Executive Committee, Launceston.	R	AW1, AW2, MAL2,

010	Agriculture Western Australia	(1999).	Scott Coastal Plain: a strategy for a sustainable future: Bulletin 4381.	Scott Coastal Plain Steering Committee for Agriculture Western Australia	R	JF2, WAR,
011	Allen, A.D.	(1993).	Outline of the geology and hydrogeology of Cape Range, Carnarvon Basin, Western Australia. In Humphreys, W. H. (ed), The biogeography of Cape Range, Western Australia.	Records of the Western Australian Museum, Supplement No. 45. Perth, WA.	B	CAR1,
012	Allen, G.R.	(1982).	A field guide to inland fishes of Western Australia.	Western Australian Museum. Perth, Western Australia.	B	PIL1, PIL2, PIL3, GAS1, GAS3,
013	Ambrose, S.J.	(1985).	White-browed Scrubwren <i>Sericornis frontalis</i> Research at Eyre.	Eyre Bird Observatory Report No. 3 (1981-1983). RAOU Report No. 9.	R	HAM,
014	ANCA	(1996).	A directory of important wetlands in Australia. - 2nd ed.	Australian Nature Conservation Agency, Canberra.	B	AW1, AW2, MAL2, ESP1, ESP2, MAL1, SWA2, JF2, WAR, COO1,
015	Andersen, A.N. and Burbidge, A.H.	(1992).	An overview of the ant fauna of Cape Arid National Park, Western Australia	Journal of the Royal Society of Western Australia 75: 41-46	J	ESP2,
833	Annear, R., Gillard, J., Metcalf, V., Smith, V., Sutton, A., Wardell-Johnson, G., Grant, R. and Western Australian Department of Conservation and Land Management	(1992).	Walpole-Nornalup National Park management plan, 1992-2002	Department of Conservation and Land Management, Perth.	O	WAR,
019	Anon.	(undated)	Cheyne Bay Coastal Survey. Cape Riche to Pallinup River.		O	ESP1,
020	Anon.	(undated)	Code of Practice for timber plantations in Western Australia.	Adopted by Department of Conservation and Land Management and Australian Forest Growers.	O	AW1, AW2, MAL2,
018	Anon.	(1999).	Management Program for the Saltwater Crocodile <i>Crocodylus porosus</i> and the Freshwater Crocodile <i>Crocodylus johnstoni</i> in Western Australia. (Unpubl.)	Department of Conservation and Land Management.	R	NK1, NK2, CK1, CK2, CK3, DL1, DL2, OVP1, VB1,
017	Anon.	(1995).	Purnululu National Park Management Plan 1995-2005.	Department of Conservation and Land Management.	R	OVP1,
016	Anon.	(1981).	Biological Survey of Mitchell Plateau and Admiralty Gulf, Kimberley, Western Australia.	A Western Australian Museum Publication, Perth.	R	NK1,
021	Anstee, S. and Armstrong, K.	(2001).	The effect of familiarity and mound condition in translocations of the western pebble-mound mouse, <i>Pseudomys chapmani</i> , in the Pilbara region of Western Australia.	Wildlife Research, 28: pp 135-140.	J	PIL1, PIL2,
022	Apache Energy	(1997).	Varanus Island Operations Environmental Management Plan (draft).	Apache Energy Ltd.	R	CAR1,
023	Aplin, K.P.	(1998).	Three new blindsnakes (Squamata, Typhlopidae) from northwestern Australia.	Records of the Western Australian Museum 19: 1-12.	J	CAR1, PIL4,
025	Aplin, K.P. and Donnellan, S.C.	(1999).	An extended description of the Pilbara Death Adder, <i>Acanthophis wellsi</i> Hoser (Serpentes: Elapidae), with notes on the Desert Death Adder, <i>A. pyrrhus</i> Boulenger, and identification of a possible hybrid zone.	Records of the Western Australian Museum 19: 277-298.	J	CAR1, PIL1, PIL3,
024	Aplin, K.P. and Donnellan, S.C.	(1993).	A new species of blindsnake, genus <i>Ramphotyphlops</i> (Typhlopidae, Squamata), from northwestern Australia, with a redescription of <i>R. hamatus</i> , Storr 1981.	Records of the Western Australian Museum 16: 243-256. <i>R. pilbaraensis</i> (PIL1 + PIL4) and <i>R. hamatus</i> (PIL3, PIL2 + GAS1)	J	PIL1, PIL2, PIL3, GAS1,

026	Aplin, K.P. and Smith, L.A.	(2001).	Checklist of the frogs and reptiles of Western Australia.	Records of the Western Australian Museum, Supplement No. 63: pp 51-74.	B	GS1, GS2, LSD1, LSD2, GS3, YAL, CAR1, CAR2, PIL1, PIL3, PIL4, SWA1, MUR2, GAS1, GAS3, GSD2,
027	Armstrong, R.	(1998).	Western Shield - Bringing Back Wildlife from the Brink of Extinction. Fox and Rabbit Control Workshop Proceedings.	A project of the South Coast Regional Initiative.	R	ESP1,
028	Astron Environmental	(2000).	Cane River Wetland. An assessment of erosion at the Cane River Wetland: Interim report.	Unpublished report prepared for Central Agricultural and Pastoral Aboriginal Corporation. Karratha, Western Australia.	R	PIL4,
727	Atkins, K.J.	(undated)	Interim Wildlife management guidelines for Wyalcatchem Foxglove ( <i>Pityrodia scabra</i> )	Department of Conservation and Land Management	O	COO3,
029	Atkins, K.J.	(1997).	Conservation statements for threatened flora within the Regional Forest Agreement region for Western Australia.	Canberra.	R	JF2, WAR,
030	Australian Geographical Society	(undated)	The Archipelago of the Recherche		O	ESP2,
031	Australian Heritage Commission	(1997).	Australian Heritage Commission Interim Listing on the Register of the National Estate for Cape Range, it's karst and stygofauna.	National Estate Data Base Place Report 4 March 1997. Decision to list 18 Feb 1997.	O	CAR1,
032	Baczocha, N. and Start, A.N.	(1997).	Status and ecology of the dibbler, ( <i>Parantechinus apicalis</i> ) in Western Australia. 1996 Annual Report.	Department of Conservation and Land Management. Unpublished Report to Environment Australia.	R	ESP1,
764	Baker, L.M. and Johnson, K.A.	(undated)	Draft Recovery Plan for the Mulgara ( <i>Dasyurus cristicauda</i> )	Conservation Commission of the Northern Territory	O	GSD2, PIL1, GVD1, GVD2,
033	Bamford, M.	(1988).	Habitat preference and morphometrics of some of the reptiles of Eyre.	Eyre Bird Observatory Report no. 4, (1984/1985). RAOU Report No. 38.	R	HAM,
034	Bamford, M.J.	(1982).	Bobtail Research at Eyre.	Eyre Bird Observatory Report 1979-1981. RAOU Report No 3.	R	HAM,
035	Bamford, M.J., Davies, S.J.J.F. and Lad, P.G.	(1991).	Biological survey of Kangaroo Hills and Calooli Timber Reserves, Coolgardie, Western Australia.	Unpublished report.	R	COO3,
036	Bancroft, K.P. and Sheridan, M.W.	(2000).	The major marine habitats of the proposed Dampier Archipelago/Cape Preston marine conservation reserve.	Department of Conservation and Land Management, Fremantle.	R	CAR1, PIL4,
037	Bancroft, K.P. and Sheridan, M.W.	(2000).	The major marine habitats of the proposed Montebello/Barrow Island marine conservation reserve.	Department of Conservation and Land Management, Fremantle.	R	CAR1, PIL4,
038	Bancroft, K.P., Davidson, J.A. and Looker, O.	(2000).	Marine wildlife distribution in the proposed Montebellos/Barrow Islands and Dampier Archipelago/Cape Preston marine conservation reserves.	Department of Conservation and Land Management, Fremantle.	R	CAR1, PIL4,
039	Bancroft, K.P., Sheridan, M.W. and Davidson, J.A.	(2000).	Developing a broadscale habitat map of the Montebello/Barrow Islands and the Dampier Archipelago/Cape Preston regions.	Department of Conservation and Land Management, Fremantle.	R	CAR1, PIL4,
040	Barker, W.R. and Greenslade, P.J.M.	(1982).	Evolution of the Flora and Fauna of Arid Australia.	Peacock Publications in association with Australian Systematic Botany Society and ANZAAS South Australian Division Inc.	B	MUR1, GAS2, NUL1, NUL2, GVD1, GVD2, GVD3,
041	Barrett, G. (ed)	(1991).	A Biological Survey of Victoria Rock Nature Reserve.	Goldfields Naturalists Club, Kalgoorlie WA.	R	COO3,
042	Barrett, R.L., Barrett, M.D., Start, A.N. and Dixon, K.W.	(2001).	Flora of the Yampi Sound Defence Training Area, Derby, Western Australia.	Australian Heritage Commission.	R	NK1,

789	Barrett, S.	(2000).	Montane heath and thicket of the South West Botanical Province, above approximately 900 m above sea level (eastern Stirling Range montane heath thicket community) Interim Recovery Plan 1999-2002 (IRP No 52)	Department of Conservation and Land Management, Perth.	O	ESP1
043	Barrett, S.	(1996).	Biological survey of mountains of southern Western Australia.	Department of Conservation and Land Management.	R	ESP1, ESP2, MAL1, JF2, WAR,
046	Bayly, I.	(1997).	Invertebrates of temporary waters in gnammas on granite outcrops in Western Australia.	Journal of the Royal Society of Western Australia. 80:167-172.	J	AW1, AW2, COO1,
045	Bayly, I.	(1992).	Freshwater havens.	Landscape 7:49-53.	J	AW1, AW2, MAL1, COO1,
047	Baynes, A.	(1990).	The mammals of Shark Bay, Western Australia. In Research in Shark Bay (Eds) P.F. Berry, S.D. Bradshaw, B.R. Wilson.	Western Australian Museum, Perth.	B	GS1, CAR2,
048	Baynes, A. and Jones, B.	(1993).	The mammals of Cape Range peninsula, north-western Australia. In Humphreys, W. F. (ed.), The Biogeography of Cape Range, Western Australia.	Records of the Western Australian Museum 45: pp 207-225.	J	CAR1,
821	Beard, J.S.	(1979e).	The vegetation of the Albany & Mt. Barker areas, Western Australia [kit] : map and explanatory memoir, 1:250,000 series	Vegmap	O	JF2, WAR
079	Beard, J.S.	(1980e).	The vegetation of the Corrigin area, Western Australia.	Vegmap Publications, Applecross.	O	AW1, AW2, MAL2, JF2,
059	Beard, J.S.	(1972e).	The vegetation of the Southern Cross area, Western Australia.	Vegmap Publications, Sydney.	O	AW1,
069	Beard, J.S.	(1976e).	Vegetation Survey of Western Australia. The Vegetation of the Geraldton Area, Western Australia. 1:250,000 series.	Vegmap Publications: Applecross.	O	GS2,
081	Beard, J.S.	(1990).	Plant Life of Western Australia.	Kangaroo Press, Kenthurst NSW.	B	GD1, GD2, NUL1, NUL2, GVD1, GVD2, GVD3, CR1, COO2,
080	Beard, J.S.	(1981).	Vegetation Survey of Western Australia - Swan 1:1000000 Vegetation Series Explanatory Notes to Sheet 7.	University of Western Australia Press. Perth	O	COO3, COO2, AW2,
725	Beard, J.S.	(1978).	Vegetation Survey of Western Australia, 1:250,000 series. The Vegetation of the Kalgoorlie area Western Australia.	Vegmap Publications, Sydney.	O	COO2,
055	Beard, J.S.	(1969).	The Vegetation of the Boorabbin and Lake Johnston areas W.A.	Proceedings of the Linnean Society N.S.W. 93: 239-69	O	COO2,
053	Beard, J.S.	(1968a).	Drought effects in the Gibson Desert.	Journal of the Royal Society of Western Australia 51: 39-50.	O	GD1, GD2, CR1,
054	Beard, J.S.	(1968b).	Vegetation survey of Western Australia: Great Sandy Desert, explanatory notes to sheet 2.	University of Western Australia Press, Perth	O	GD1, GD2, GSD2,
049	Beard, J.S.	(1972a).	The vegetation of the Hyden area, Western Australia.	Vegmap Publications, Sydney.	O	AW1, MAL2,
060	Beard, J.S.	(1972f).	The vegetation of the Newdegate & Bremer Bay areas, Western Australia.	Vegmap Publications, Sydney.	O	MAL2, ESP1,
056	Beard, J.S.	(1972b).	Vegetation Survey of Western Australia 1:250000 series - Jackson.	Vegmap publications, Applecross, W.A.	O	COO2,
057	Beard, J.S.	(1972c).	Vegetation Survey of Western Australia 1:250000 series - Kalgoorlie.	Vegmap publications, Applecross, W.A.	O	COO2, COO3,
058	Beard, J.S.	(1972d).	Vegetation Survey of Western Australia 1:250000 series - Southern Cross.	Vegmap publications, Applecross, W.A.	O	COO2,
061	Beard, J.S.	(1973b).	The vegetation of the Ravensthorpe area, Western Australia.	Vegmap Publications, Perth.	O	MAL2, ESP1,
050	Beard, J.S.	(1973a).	Vegetation Survey of Western Australia. 1:250 000 Series. The Vegetation of the Esperance and Malcolm Area.	Map and Explanatory Memoir. Vegmap Publications, Applecross.	O	ESP2, MAL1,
822	Beard, J.S.	(1974d).	Forrest Map Scale 1:250 000	J.S. Beard	O	JF1, JF2,
062	Beard, J.S.	(1974a).	Vegetation Survey of Western Australia - Great Victoria Desert 1:1000000 Vegetation Series Explanatory Notes to Sheet 6.	University of Western Australia Press. Perth.	O	GVD1, GVD2, GVD3, CR1,
063	Beard, J.S.	(1974b).	Vegetation survey of Western Australia: Great Victoria Desert, explanatory notes to sheet 3.	University of Western Australia Press, Perth	O	GD1, GD2,
082	Beard, J.S.	(1975b).	Pilbara. Explanatory notes for Sheet 5, 1:1,000,000 Series, Vegetation Survey of Western Australia.	University of W.A. Press. Perth.	O	GAS1, GAS3,
064	Beard, J.S.	(1975a).	Vegetation Survey of Western Australia - Nullarbor 1:1000000 Vegetation Series Explanatory Notes to Sheet 4.	University of Western Australia Press. Perth.	O	COO3, NUL1,
071	Beard, J.S.	(1976g).	The vegetation of the Ajana Area Western Australia. Vegetation Survey of Western Australia.	National Library of Australia.	O	GS2,
065	Beard, J.S.	(1976a).	The Vegetation of the Murchison 1:1000000 Map Sheet 6	Vegetation Survey of Western Australia, University of Western Australia Press, Perth.	O	GS1, GS2, YAL, CAR2, GAS1, MUR1, GAS2,
068	Beard, J.S.	(1976d).	The vegetation of the Perenjori area, Western Australia.	Vegmap Publications, Applecross.	O	AW1,

066	Beard, J.S.	(1976b).	The Vegetation of the Shark Bay & Edel Area Western Australia.	Vegetation Survey of Western Australia. National Library of Australia.	O	GS1, CAR2,
067	Beard, J.S.	(1976c).	Vegetation Survey of Western Australia - Murchison 1:1000000 Vegetation Series Explanatory Notes to Sheet 6.	University of Western Australia Press. Perth	O	MUR1, MUR2, GAS2, GAS3,
083	Beard, J.S.	(1976h).	Vegetation Survey of Western Australia. The Vegetation of the Dongara Area, Western Australia. 1:250,000 series.	Vegmap Publications: Applecross.	O	GS2, GS3,
070	Beard, J.S.	(1976f).	Vegetation Survey of Western Australia. The Vegetation of the Perenjori Area, Western Australia. 1:250,000 series.	Vegmap Publications, Applecross.	O	GS2,
074	Beard, J.S.	(1979d).	The vegetation of the Albany/Mount Barker area, Western Australia.	Vegmap Publications, Applecross.	O	AW2, ESP1, JF2, WAR,
051	Beard, J.S.	(1979a).	The vegetation of the Moora and Hill River areas, Western Australia.	Vegmap Publications, Applecross.	O	AW1, AW2,
073	Beard, J.S.	(1979c).	The vegetation of the Perth area, Western Australia.	Vegmap Publications, Applecross.	O	AW2,
052	Beard, J.S.	(1979b).	The vegetation of the Pinjarra area, Western Australia.	Vegmap Publications, Applecross.	O	AW2,
075	Beard, J.S.	(1980a).	A new phytogeographic map of Western Australia.	Western Australian Herbarium Research Notes 3, 37-58.	J	ESP1, GS1, GD1, GD2, LSD2, HAM, GS3, YAL, CAR2, SWA1, SWA2, MUR1, MUR2, GAS2, GAS3, JF1, JF2, WAR, COO2, COO3, NUL1, GVD1, GVD2, GVD3, CR1,
076	Beard, J.S.	(1980b).	The vegetation of the Bencubbin area, Western Australia.	Vegmap Publications, Applecross.	O	AW1,
077	Beard, J.S.	(1980c).	The vegetation of the Dumbleyung area, Western Australia.	Vegmap Publications, Applecross.	O	AW2, MAL2, JF2,
078	Beard, J.S.	(1980d).	The vegetation of the Kellerberrin area, Western Australia.	Vegmap Publications, Applecross.	O	AW1, AW2, JF2,
072	Beard, J.S.	(1979 to 1981).	Vegetation Survey of Western Australia. 1:250 000 Series and 1:1 000 000 Series. Assorted Maps and Explanatory Memoirs.	Vegmap Publications, Applecross.	O	SWA2,
084	Beard, J.S. and Sprenger, B.S.	(1984).	Geographical data from the vegetation survey of Western Australia. Vegetation Survey of Western Australia. Occasional Paper No 2.	Vegmap Publications, Applecross.	O	ESP1, ESP2, COO2, COO3, AW2,
086	Beard, J.S. and Webb, M.J.	(1974c).	Vegetation survey of Western Australia. Great Sandy Desert. 1:1,000,000 Vegetation Series. Explanatory Notes, and Sheet 2.	University of Western Australia Press, Perth.	O	LSD1, GAS3, CR1,
087	Beard, J.S., Beeston, G.R., Harvey, J.M. and Hopkins, A.J.M.	(in press).	The vegetation of Western Australia. 1:3,000,000 Map with Explanatory Memoir. Second Edition.	CALMScience Special Publication.	O	ESP1, ESP2, JF2, WAR, SWA2,
717	Bellchambers, K. and Johnson, K.A.	(1991).	The Recovery Plan for the Greater Bilby <i>Macrotis lagotis</i>	Endangered Species Programme and the Conservation Commission of the Northern Territory, Alice Springs	R	MUR1, AW1, AW2, GSD2, MAL2, PIL1, PIL2, CR1, GAS3,
089	Bellgard, S.E., Crane, C.E., and Shearer, B.L.	(1995).	The impact of <i>Phytophthora megasperma</i> in Cape Arid National Park.	Unpublished Report to Department of Conservation and Land Management.	R	ESP2,
090	Benshemesh, J.	(2000).	National Recovery Plan for Malleefowl.	Department of Environment and Heritage, South Australia.	R	AW1, AW2, MAL2, GS1, GS2, GS3, GD1, GD2, HAM, CAR2, MUR1, MUR2, GAS2, COO2, COO3, NUL1, CR1, COO1, SWA1, ESP1, ESP2, YAL, JF2, GVD1, GVD2,
091	Bettenay, E., Churchward, H.M., McArthur, W.M. and Northcote, K.H.	(1967).	Atlas of Australian Soils. Explanatory data for Sheet 6, Meekatharra - Hamersley Range area. Commonwealth Scientific and Industrial Research Organisation, and Melbourne University Press.	Cambridge University Press, London and New York.	O	LSD1, LSD2, CAR1, PIL1, PIL2, PIL3, PIL4, GAS1, GAS3, GSD2,
093	Black, S., Burbidge, A.A., Brooks, D., Green, P., Humphreys, B., Kendrick, P., Myers, D., Shepherd, R. and Wann, J.	(2000b).	Cameron's Cave Troglitic Community Interim Recovery Plan, 2000-2003. Interim Recovery Plan No. 76.	Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management.	R	CAR1,
092	Black, S., Burbidge, A.A., Brooks, D., Green, P., Humphreys, B., Kendrick, P., Myers, D., Shepherd, R. and Wann, J.	(2000a).	Cape Range Remipede Community Interim Recovery Plan, 2000-2003. Interim Recovery Plan No. 75.	Western Australian Threatened Species and Communities Unit, Department of Conservation and Land Management.	R	CAR1,
716	Blackwell, M.I. and Trudgen, M.E.	(1980).	Report on the flora and vegetation of the Lake Way Joint Venture uranium project area : together with an assessment of the impact of this project upon the landscape, flora and		R	MUR1,

			vegetation of this area and its regeneration potential			
094	Blakers, M., Davies, S.J.J.F. and Reilly, P.N.	(1985).	The Atlas of Australian Birds. Royal Australasian Ornithologists Union.	Melbourne University Press.	B	GS1, GS2, LSD1, LSD2, GS3, YAL, CAR1, PIL1, PIL2, PIL3, PIL4, SWA1, NK1, NK2, CK1, CK2, CK3, DL1, DL2, MUR2, GAS1, GAS3, GSD1, GSD2, OVP1, OVP2, VB1, TAN1,
778	Blyth, J.	(1996).	Night parrot ( <i>Pezoporus occidentalis</i> ) Interim Recovery Plan for Western Australia 1996 to 1998 (IRP No 4)	Department of Conservation and Land Management, Perth.	O	GSD2, CR1,
095	Bougher, N.L.	(1997).	The effect of key disturbances on fungi in the south west forest region of Western Australia.	A report to the Commonwealth and Western Australian governments.	R	JF2, WAR,
096	Brandis, A., Hill, T., Keighery, G.J., and Tippett, J.	(1985).	Dieback in the Cape Arid National Park and other areas of concern.	Department of Conservation and Land Management.	R	ESP2,
097	Brooker, B.	(1999).	The range and habitat characteristics of the Thick-billed Grasswren <i>Amytornis textilis</i> in the Shark Bay region.	Department of Conservation and Land Management.	R	GS1, CAR2,
100	Brooker, M.I.H. and Kleinig, D.A.	(1994).	Field guide to eucalypts Northern Australia.	Inkata Press.	B	PIL1, PIL2, PIL4, NK1, NK2, CK1, CK2, CK3, DL1, DL2, GAS3, GSD1, OVP1, OVP2, VB1, TAN1,
099	Brooker, M.I.H. and Kleinig, D.A.	(1994).	Field Guide to Eucalypts. Vol. 3.	Encarta Press, Melbourne.	B	GD1, GD2, GAS2,
098	Brooker, M.I.H. and Kleinig, D.A.	(1990).	Field Guide to Eucalypts. Vol. 2.	Encarta Press, Melbourne.	B	GD1, GD2, LSD2, YAL, MUR1, MUR2, GAS2, JF1, JF2, WAR, COO2, COO3, NUL1, NUL2, GVD1, GVD2, GVD3, ESP1,
101	Brown, A., Thomson-Dans, C., and Marchant, N. (eds).	(1998).	Western Australia's Threatened Flora.	Department of Conservation and Land Management.	B	AW1, AW2, MAL2, ESP1, ESP2, MAL1, GS1, GS2, GD1, GD2, LSD2, GS3, YAL, CAR2, SWA1, MUR1, MUR2, GAS2, JF2, WAR, COO1, COO2, COO3, NUL1, NUL2, GVD1, GVD2, GVD3,
102	Brown, J.M.	(1989).	Regional variation in kwongan in the central wheatbelt of south-western Australia.	Australian Journal of Ecology 14:345-355.	J	AW1, AW2, MAL2,
103	Brown, P., Chapman, A. and Mitchell, D.	(1996).	The Great Chuditch Hunt and Vertebrate Survey- Part 1: The Yellowdine Area 23-29 April 1995.	Department of Conservation and Land Management Unpublished Report.	R	COO2,
105	Buckley, R.C.	(1982).	Use and conservation of central Australian dunefields.	Biological Conservation 22: 197-205	J	GD1, GD2, CR1,
104	Buckley, R.C.	(1981).	Soils and vegetation of Central Australian sand ridges.	1: Introduction Australian Journal of Ecology 6: 345-351	J	GD1, GD2, CR1,
106	Bullen, R. and McKenzie, N.L.	(2001).	Bat airframe design: flight performance, stability and control in relation to foraging ecology.	Australian Journal of Zoology 49, 1-27.	J	COO2,
107	Bunting, J.A. and Boegli, J.C. (Ed).	(1977).	Minigwal, Western Australia : Western Australia Geological Survey,1:250 000.	Geological Series Explanatory Notes.	O	GVD1, GVD2, GVD3,
712	Burbidge, A.H. and McKenzie, N. L.	(1995).	Patterns in nature: the biodiversity of the Carnarvon Basin.	Landscape 11(2), 15-20	J	CAR2, MUR2,
108	Burbidge, A., Halse, S., Lane, J., Haberly, B. and Pearson, G.	(1993).	Report on a survey of the Recherche Cape Barren Goose.	Unpublished Report, ANCA, Canberra.	R	ESP1,
109	Burbidge, A., Hopper, S.D. and Coates, D.J.	(1979).	Pollen loads of New Holland Honeyeaters at Qualup, Western Australia.	Western Australian Naturalist 14: 126-128.	J	ESP1,
715	Burbidge, A.A and Fuller, P.J.	(1982).	Banded stilt at Lake Barlee, Western Australia	Emu. - Vol. 82 (1982) p. 212-215	J	MUR1,
110	Burbidge, A.A, Fuller, P.J. and Cashin, K.	(1980).	The Wildlife of the Proposed Toolonga Nature Reserve, Shark Bay Shire, Western Australia. Report No. 39.	Department of Fisheries and Wildlife Western Australia.	R	YAL,
728	Burbidge, A.A, Harvey, M. and Main, B.Y.	(1999).	Minnivale Trapdoor Spider Interim Recovery Plan 1998-2000 (IRP No 19)	Department of Conservation and Land Management	O	AW1,
111	Burbidge, A.A.	(In prep).	Offshore Island seabird breeding database.	Unpublished data, held at WA Wildlife Research Centre, Perth.	R	PIL4,
114	Burbidge, A.A.	(1989).	Australian and New Zealand Islands: Nature Conservation Values and Management, Proceedings of a Technical Workshop, Barrow Island, Western Australia, 1985.	Department of Conservation and Land Management.	R	GS1, GS2, GS3, CAR2,
113	Burbidge, A.A.	(1989).	The value of Western Australian islands as biological reservoirs and the development of management priorities. In: Australian and New Zealand islands: nature conservation values and	Department of Conservation and Land Management, Perth.	B	ESP2,

			management, ed by Andrew Burbidge. Occasional paper 2/89.			
112	Burbidge, A.A.	(1976).	Nuytsland Nature Reserve, Western Australia Department of Fisheries and Wildlife.	Swans. - Vol. 6, no. 3.	J	ESP2, HAM,
117	Burbidge, A.A. and Fuller, P.J.	(2000).	The breeding seabirds of Shark Bay, Western Australia.	CALMscience. 3, 109-124.	J	GS1, CAR2,
116	Burbidge, A.A. and Fuller, P.J.	(1991).	Effects of fire on birds in the Gibson Desert: some preliminary results.	CALM Occasional Paper 1/91	J	GD1, GD2, CR1,
115	Burbidge, A.A. and Fuller, P.J.	(1979).	Mammals of the Warburton Region, Western Australia.	Records of the Western Australian Museum 8: 57-74	J	GD1, GD2, CR1,
118	Burbidge, A.A. and McKenzie, N.L.	(1989).	Patterns in the modern decline of Western Australia's vertebrate fauna: Causes and conservation implications.	Biological Conservation, 50, 143-198.	J	AW2, GS1, GS2, GD1, GD2, LSD1, LSD2, GS3, YAL, CAR1, CAR2, PIL1, PIL2, PIL3, PIL4, SWA1, NK1, NK2, CK1, CK2, CK3, DL1, DL2, MUR1, MUR2, GAS1, GAS2, GAS3, COO1, COO2, COO3, GSD1, GSD2, OVP1, OVP2, VB1, TAN1,
119	Burbidge, A.A. and McKenzie, N.L.	(1979).	Environment. In: The Wildlife of some existing and proposed reserves in the Gibson, Little Sandy and Great Victoria deserts.	Western Australian Wildlife Research Bulletin 8. 7-15	J	GD1, GD2, CR1,
120	Burbidge, A.A. and McKenzie, N.L. (Ed's)	(1983).	Wildlife of the Great Sandy Desert, Western Australia. Wildlife Research Bulletin No. 12, Western Australian Wildlife Research Centre.	Department of Fisheries and Wildlife, Perth.	B	LSD1, DL2, GSD1, GSD2,
121	Burbidge, A.A. and McKenzie, N.L. (Eds.).	(1978).	The Islands of the North-west Kimberley. Western Australia.	Wildlife Research Bulletin Western Australia No. 7.	J	NK1,
122	Burbidge, A.A. and Prince, R.	(1972).	The fauna, flora and planned use of the Dampier Archipelago.	Report No. 11, Department of Fisheries and Fauna, Western Australia, Perth.	R	PIL4,
123	Burbidge, A.A. and Roberts, J.D.	(2002).	Sunset Frog ( <i>Spicospina flammocaerulea</i> ) Recovery Plan. WA Wildlife Management Program No. 35.	Department of Conservation and Land Management, Perth.	R	JF2, WAR,
124	Burbidge, A.A. and Van Leeuwin, S.	(1990).	The Hill River Project and the proposed Conservation Reserve at Lesueur Occasional Paper 1/90.	Department of Conservation and Land Management.	R	GS3,
125	Burbidge, A.A. and Wallace, K.J.	(1995).	Practical methods for conserving biodiversity. Pp 11-26 in Conserving Biodiversity: Threats and Solutions, Ed by R.A. Bradstock, T.D. Auld, D.A. Keith, R.T. Kingsford, D. Lunney and D.P. Sivertsen.	Surrey Beatty and Sons Pty Limited, Chipping Norton.	B	AW1, AW2, MAL2,
126	Burbidge, A.A., and de Tores, P.	(1998).	Western Ringtail Possum ( <i>Pseudocheirus occidentalis</i> ) Intrim Recovery Plan 1997-1999. Interim Recovery Plan No. 17.	Department of Conservation and Land Management, Perth.	R	JF1, JF2, WAR, AW1, SWA2, ESP1
127	Burbidge, A.A., Dixon, K.W. and Fuller, P.J.	(1989).	The Flora and Fauna of vacant Crown land at White Well, Shire of Dalwallinu, Western Australia. Technical Report No. 24.	Department of Conservation and Land Management.	R	YAL,
128	Burbidge, A.A., Fuller P.J. and McCusker, A.	(1978).	The Wildlife of the Proposed Wandana Nature Reserve, near Yuna, Western Australia. Report No. 32.	Department of Fisheries and Wildlife Western Australia.	R	GS2,
129	Burbidge, A.A., Haberley, B., Halse, S., Lane, J., and Pearson, G.	(1993).	How many geese are enough? Department of Conservation and Land Management.	Landscape. - Vol. 9, no. 1.	J	ESP2,
130	Burbidge, A.A., Hall, N.J., Keighery, G.J. and McKenzie, N.L. (eds.)	(1995).	The biological survey of the eastern Goldfields of Western Australia. Part 12. Barlee-Menzies Study Area.	Records of the Western Australian Museum Supplement No. 49, 169-312. Perth, WA.	J	MUR1,
131	Burbidge, A.A., Johnson, K.A., Fuller, P.J. and Southgate., R.	(1988).	Aboriginal knowledge of the mammals of the central deserts of Australia.	Australian Wildlife Research 15: 9-39	J	GD1, GD2, CR1,
132	Burbidge, A.A., McKenzie, N.L. and Kenneally, K.F.	(1991).	Nature Conservation Reserves in the Kimberley Western Australia.	Department of Conservation and Land Management.	R	NK1, NK2, CK1, CK2, CK3, DL1, DL2, GSD1, OVP1, OVP2, VB1, GSD1, TAN1,

133	Burbidge, A.A., McKenzie, N.L., Chapman, A. and Lambert, P.M.	(1976).	The Wildlife of Some existing and proposed reserves in the Great Victoria and Gibson Deserts Western Australia.	Wildlife Research Bulletin West. Aust. Number 5.	R	NUL2, GVD1, GVD2, GVD3,
134	Burbidge, A.H.	(1999).	Western ground parrot interim recovery plan.	Eclectus Vol 6:23-26.	J	JF2, WAR,
135	Burbidge, A.H. and Boscacci, L.J.	(1989).	A Spring Reconnaissance Survey of the Flora and Fauna of the Southern Beekeepers Reserve Technical Report No. 22.	Department of Conservation and Land Management.	R	GS3,
136	Burbidge, A.H., Blyth, J., Danks, A., Gillen, K. and Newbey, B.	(1997).	Western ground Parrot. Interim Recovery Plan 1996 to 1999.	Department of Conservation and Land Management.	R	ESP1, JF2, WAR, ESP2,
137	Burbidge, A.H., Harvey, M.S. and McKenzie, N.L.	(2000).	Biodiversity of the southern Carnarvon Basin.	Department of Conservation and Land Management, Western Museum & Environment Australia. Records of the Western Australian Museum Supplement No. 61.	J	GS1, GS2, YAL, CAR2, MUR2,
139	Burgman, M.A.	(1988).	Spatial analysis of vegetation patterns in southern Western Australia: implications for reserve design.	Australian Journal of Ecology 13:415-429.	J	AW1, AW2, MAL2,
138	Burgman, M.A.	(1984).	A study of virgin mallee and mallee-heath vegetation between Ravensthorpe and Cape Arid under consideration for release for agricultural development: interim report	Western Australia Department of Fisheries and Wildlife.	R	ESP2,
713	Burne, Robert V.	(1991-1992)	Lilliput's castles: stromatolites of Hamelin Pool	Landscape. - Vol. 7 (2)	J	CAR2,
140	Burrows, N., Ward, B. and Robinson, A.	(1991).	Fire behavior in spinifex fuels on the Gibson Desert Nature Reserve, Western Australia.	Journal of Arid Environments 20: 189-204	J	GD1, GD2,
141	Burrows, N.D.	(1990).	Report on field trip to the Gibson Desert Nature Reserve in relation to RRP 60/90: Mammal Decline in Western Australia.	CALM Unpublished Report.	R	GD1, GD2,
144	Cale, B.	(2002).	Muir's Corella ( <i>Cacatua pastinator pastinator</i> ) Recovery Plan 2000-2009. WA Wildlife Management Program (Draft).	Department of Conservation and Land Management, Perth.	R	JF2, WAR,
142	Cale, B.	(2000a).	Carnaby's Black-Cockatoo ( <i>Calyptorhynchus latirostris</i> ). Draft Recovery Plan Recovery Plan No. //.	Department of Conservation and Land Management.	R	ESP1, COO2, AW1, AW2, SWA1, ESP2, YAL, GS2, GS3, JF1, JF2, MAL2,
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747	Evans, R. and Brown, A.	(1999).	Wongan Gully Wattle ( <i>Acacia pharangites</i> ) Interim Recovery Plan 1999-2002 (IRP No 20)	Department of Conservation and Land Management	O	AW2,
766	Evans, R. and English, V.	(1999).	Gingin wax ( <i>Chamelaucium</i> sp. <i>Gingin</i> ) Interim Recovery Plan 1999-2002 (IRP No 27)	Department of Conservation and Land Management	O	SWA1, JF1,
745	Evans, R. and English, V.	(1999).	Green Hill <i>Thomasia</i> ( <i>Thomasia</i> sp. <i>Green Hill</i> ) Interim Recovery Plan 1999-2002 (IRP No 26)	Department of Conservation and Land Management	O	AW2, JF1, GS3,
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827	Evans, R., Stack, G. and English, V.	(1999).	Scott River <i>boronia</i> ( <i>Boronia exilis</i> ) Interim Recovery Plan 1999-2002 (IRP No 41)	Department of Conservation and Land Management, Perth.	O	JF2,
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711	Halse, S.A., Shiel, R.J., Storey, A.W., Edward, D.H.D., Lansbury, I., Cale, D.J. and Harvey, M.S.	(2000).	Aquatic invertebrates and waterbirds of wetlands and rivers of the southern Carnarvon Basin, Western Australia.	Records of the Western Australian Museum Supplement 61, 217-267	R	CAR2,

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340	Hamilton, B., Klemm, V. et al.	(in prep).	Needs Assessment for Prioritising River Values in WA.	Waterways WA.	O	ESP1, ESP2, MAL1, COO1,
765	Hamilton-Brown, S.	(2002).	Herbaceous plant assemblages on bentonite lake beds (Vegetation Types 1, 2, 3 & 7) and margins (Vegetation Types 4, 5 & 6) of the Watheroo-Marchagee region Interim Recovery Plan 2002-2007 (IRP No 108).	Department of Conservation and Land Management	O	AW2,
854	Hamilton-Brown, S.	(2002).	Lesueur-Coomallo floristic community A1.2 Interim Recovery Plan (IRP No 106) 2002-2007	Department of Conservation and Land Management, Perth.	O	GS3,
744	Hamilton-Brown, S.	(2002).	Plant assemblages of the Inering System Interim Recovery Plan 2002-2007 (IRP No 107)	Department of Conservation and Land Management	O	AW1,
743	Hamilton-Brown, S.	(2002).	Plant assemblages of the Moonagin System Interim Recovery Plan 2002-2007 (IRP No 105)	Department of Conservation and Land Management	O	AW1,
757	Hamilton-Brown, S.	(2000).	Heath dominated by one or more of <i>Regelia megacephala</i> , <i>Kunzea praestans</i> and <i>Allocasuarina campestris</i> on ridges and slopes of the chert hills of the Coomberdale floristic region: Interim Recovery Plan 2000-2003 (IRP No 65)	Department of Conservation and Land Management	O	AW2, SWA1,
736	Hamilton-Brown, S.	(2000).	Plant assemblages of the Billeranga System Interim Recovery Plan 2000-2003 (IRP No 71)	Department of Conservation and Land Management	O	AW1,
737	Hamilton-Brown, S.	(2000).	Plant assemblages of the Koolanooka System Interim Recovery Plan 2000-2003 (IRP No 73)	Department of Conservation and Land Management	O	AW1,
758	Hamilton-Brown, S. and Blyth, J.	(2000).	Perched wetlands of the wheatbelt region with extensive stands of living sheoak ( <i>Casuarina obesa</i> ) and paperbark ( <i>Melaleuca strobophylla</i> ) across the lake floor (occurrences other than at Toolibin Lake) Interim Recovery Plan 2000-2003 (IRP No 66)	Department of Conservation and Land Management	O	AW2,
811	Hamilton-Brown, S. and Blyth, J.	(1999b).	<i>Acacia rostellifera</i> low forest with scattered <i>Eucalyptus camaldulensis</i> on Greenough River alluvial flats: Interim Recovery Plan 1999-2002 (IRP No 47)	Department of Conservation and Land Management, Perth	O	GS2,
844	Hamilton-Brown, S. and Blyth, J.	(1999b).	Unwooded fresh water wetlands of the southern wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subspecies <i>abditata</i> and <i>Tecticornia verrucosa</i> across the lake floor: Interim Recovery Plan 1999-2002 (IRP No 48)	Department of Conservation and Land Management, Perth.	O	AW1, MAL2,
341	Hamilton-Brown, S. and Blyth, J.	(2001b).	Ecological communities (WA Agricultural Areas Interim Recovery Plans (prep.) 1998-2001. Final report to the National Heritage Trust.	Department of Conservation and Land Management, Western Australia.	R	AW1, AW2, MAL2, GS2, GS3, SWA1,
741	Hamilton-Brown, S. and Blyth, J.	(2001a).	Unwooded Fresh Water Lakes of the Southern Wheatbelt of Western Australia, dominated by <i>Muehlenbeckia horrida</i> subsp. <i>abditata</i> and <i>Tecticornia verrucosa</i> across the lake floor and, <i>Muehlenbeckia horrida</i> subsp. <i>abditata</i> Interim Recovery Plan 2001-2006 (IRP No 92).	Department of Conservation and Land Management	O	AW1, MAL2,
767	Hamilton-Brown, S. and English, V.	(1999).	Split-leaved <i>Grevillea</i> ( <i>Grevillea althoferorum</i> ) Interim Recovery Plan 1999-2002 (IRP No 42)	Department of Conservation and Land Management	O	SWA1, JF1, GS3,
342	Hamilton-Smith, E., Kiernan, K. and Spate, A.	(1998).	Karst management considerations for the Cape Range karst province Western Australia: A report prepared for the Department of Environmental Protection.	Department of Environmental Protection.	R	CAR1,
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345	Hart, Simpson and Associates Pty Ltd.	(1990).	Rudall Project: Environmental Studies. Rehabilitation to 1990.	A report prepared for CRA Exploration Pty Ltd.	R	LSD1,
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349	Harvey, M.S. and Main, B.Y.	(undated)	The status of the trapdoor spider <i>Teyl</i> sp. B.Y. Main 1953/356, 1984/13 ( <i>Teyl</i> Species "C"). A report to the Department of Conservation and Land Management.	Department of Conservation and Land Management, Western Australia.	R	AW1, AW2, MAL2,
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	M.R., Hunt. G.S. and Lee, D.C.		Cape Range. Western Australia. pp 129-144. In W. F. Humphreys (ed), The Biogeography of Cape Range, Western Australia.			
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352	Hearn, R.W., Macfarlane, T.D. and Brown, A.	(In Prep).	Declared rare and poorly known flora in the Southern Forest (Warren) Region: Western Australian wildlife management program (in prep).	Department of Conservation and Land Management, Perth.	R	JF2, WAR,
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779	Herford, I., Gillen, K., Lloyd, M., Hine, C., McCaw, L., Keighery, G.J. and Allan, J.	(1999).	Stirling Range National Park and Porongurup National Park management plan	Department of Conservation and Land Management, Perth.	O	ESP1,
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361	Hodgkin, E.P. and Clark, R.	(1989).	Estuaries and coastal lagoons of south Western Australia. Stokes Inlet and other estuaries of the Shire of Esperance.	Environmental Protection Authority. WA Estuarine Series 5.	R	ESP1,
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784	Holland, E., Brown, A. and Kershaw, K.	(1999).	Dwarf Spider Orchid ( <i>Caladenia bryceana</i> subsp. <i>bryceana</i> ms) Interim Recovery Plan 1999-2002 (IRP No 39)	Department of Conservation and Land Management, Perth.	O	ESP1, JF2,
853	Holland, E., Brown, A. and Kershaw, K.	(1999).	Hinged dragon orchid ( <i>Caladenia drakeoides</i> ms) Interim Recovery Plan (IRP No 29) 1999-2001	Department of Conservation and Land Management, Perth.	O	GS3,
730	Holland, E., Brown, A. and Kershaw, K.	(1999).	Hinged Ddragon Orchid ( <i>Drakonorchis drakeoides</i> ms) Interim Recovery Plan (IRP No 29)	Department of Conservation and Land Management	O	AW1, AW2
752	Holland, E., Evans, R. and Brown, A.	(1999)	Mountain Paper Heath ( <i>Sphenotoma drummondii</i> ) Summary of Actions 1999-2002 (IRP No 98)	Department of Conservation and Land Management	O	AW2,
801	Holland, E., Evans, R. and Brown, A.	(1999).	Mountain Paper Heath ( <i>Sphenotoma drummondii</i> ) Summary of Actions 1999-2002 (IRP No 98)	Department of Conservation and Land Management, Perth.	O	ESP1
813	Holland, E., Kershaw, K. and Brown, A.	(1997).	Small flowered <i>Conostylis</i> ( <i>Conostylis micrantha</i> ) Interim Recovery Plan 1996-1999 (IRP No 29)	Department of Conservation and Land Management, Perth	O	GS2,
755	Holland, E., Kershaw, K. and Brown, A.	(1996).	Dwarf rock wattle ( <i>Acacia pygmaea</i> ) Interim Recovery Plan 1996-1999 (IRP No 9) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O	AW2,

756	Holland, E., Kershaw, K. and Brown, A.	(1996).	Mogumber bell ( <i>Darwinia carnea</i> ) Interim Recovery Plan 1996-1999 (IRP No 10) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O	AW2, JF1,
754	Holland, E., Kershaw, K. and Brown, A.	(1996).	Red snakebush ( <i>Hemiandra gardneri</i> ) Interim Recovery Plan 1996-1999 (IRP No 8) In: Interim recovery plans 4-16 for Western Australian critically endangered plants and animals.	Department of Conservation and Land Management	O	AW1
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368	Hopkins, A.J.M.	(1981).	Studies on Middle Island in the Recherche Archipelago, Western Australia. Department of Fisheries and Wildlife.	Swans. - Vol. 11, no. 2.	J	ESP2,
370	Hopkins, A.J.M., Beeston, G.R., Harvey, J.M., Lemin, H and Shepherd, D.P.	(in press).	A database on the vegetation of Western Australia. Stage I.	Department of Agriculture, Western Australia. Technical Publication.	O	ESP2, GD1, GD2, MUR2, GAS2, COO2, COO3, NUL1, GVD1, GVD2, GVD3,
371	Hopkins, A.J.M., Coker, J., Beeston, G.R., Bowen, P. and Harvey, J.M.	(1996).	Conservation Status of Vegetation Types throughout Western Australia, Australian Nature Conservation Agency National Reserves Systems Co-operative Program Project No N703 Final Report May 1996.	Department of Conservation and Land Management, Western Australia and Department of Agriculture, Western Australia.	R	AW1, AW2, MAL2, ESP2, GS2, YAL, SWA1, GS3, SWA2, MUR2, JF2, WAR, COO2, Intro
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374	Hopkins, K.	(2000).	Recommendations for the Management of Wetlands of the Manypeaks Region.	Water and Rivers Commission.	R	ESP1,
375	Hopkinson, K.	(2001).	Recommendations for the Management of the Wetlands of the Mortijinup Lakes.	Water and Rivers Commission, Albany.	R	ESP2,
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384	Horwitz, P.	(1997a).	A review of knowledge on the effect of key disturbances on aquatic invertebrates and fish in the south-west forest region of Western Australia.	A report to the Commonwealth and Western Australian governments for the Western Australian Regional Forest Agreement	R	JF2, WAR,
385	Horwitz, P.	(1997b).	Comparative endism and richness of the aquatic invertebrate fauna in peatlands and shrublands of far south-western WA.	Memoirs of the Museum of Victoria 56(2):313-321.	J	JF2, WAR,

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387	How, R.A., Cooper, N.K. and Bannister, J.L.	(2001).	Checklist of the mammals of Western Australia.	Records of the Western Australian Museum, Supplement No. 63: pp 91-98.	B	GS1, GS2, LSD1, LSD2, GS3, YAL, CAR1, CAR2, PIL1, PIL2, PIL3, PIL4, SWA1, MUR2, GAS1, GAS3, GSD2,
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389	How, R.A., Dell, J., Milewski, A.V. and Keighery, G.J.	(1992).	The biological survey of the eastern Goldfields of Western Australia. Part 7. Duketon-Sir Samuel Study Area.	Records of the Western Australian Museum Supplement No. 40, 67-131. Perth, WA.	J	MUR1,
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394	Humphreys, W.F.	(1999).	Characterising the subterranean aquatic fauna of the Lake Way Basin. Unpublished report funded under the Bankwest Landscape Conservation Visa Card Trust Fund Grants.	Museum of Natural Science, Western Australian Museum. 14pp.	R	GAS2,
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393	Humphreys, W.F.	(1994).	The subterranean fauna of the Cape Range coastal plain, northwestern Australia.	Report to the Australian Heritage Commission and the Western Australian Heritage Committee, Western Australian Museum. pp 202.	R	CAR1,
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398	Humphreys, W.F.	(1999c).	Effects of research diving on the physico-chemical profile of Bundera Sinkhole, an anchialine remipede habitat at Cape Range, Western Australia.	Journal of the Royal Society of Western Australia, 82: pp 99-108.	J	CAR1,
396	Humphreys, W.F.	(1999a).	Physico-chemical profile and energy fixation in Bundera Sinkhole, an anchialine remipede habitat in north-western Australia.	Journal of the Royal Society of Western Australia, 82: pp 89-98.	J	CAR1,
397	Humphreys, W.F.	(1999b).	The distribution of Australian cave fishes.	Records of the Western Australian Museum 19: pp 469-472.	J	CAR1,
400	Humphreys, W.F. (Editor).	(1993).	The biogeography of Cape Range, Western Australia.	Records of the Western Australian Museum, Supplement No. 45. Perth, WA.	J	CAR1,

401	Humphreys, W.F. and Adams, M.	(1990).	The Subterranean aquatic fauna of the North West Cape Peninsula Western Australia.	Records of the Western Australian Museum 15, 4: pp 383-411.	J	CAR1,
402	Humphreys, W.F. and Harvey, M.S. (Ed's).	(2001).	Subterranean biology in Australia 2000.	Records of the Western Australian Museum, Supplement 64. Western Australian Museum, Perth	R	GAS1, GAS3, MUR1, MUR2,
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404	Hundi, N., Smith, R.A. and Mauger, G.W.	(2001).	Salinity Risk Assessment of Moberup Subcatchment- Land Use Impacts Report (Unpublished) LUI 1.	Waters and Rivers Commission.	R	JF2, WAR,
405	Hussey, B.J.M	(1995).	Inspection of STB Projects in the Southern Pastoral Area of WA.	Department of Conservation and Land Management.	R	GS1, YAL, CAR2, MUR2,
406	Hussey, B.J.M., Keighery, G.J. Cousens, R.D., Dodd, D. and Lloyd, S.G.	(1997).	Western Weeds A Guide to the Weeds of Western Australia.	The Plant Protection Society of Western Australia (Inc.) Perth	B	GS1, GS2, LSD2, GS3, YAL, CAR2, SWA1, MUR1, MUR2, GAS2, COO2, COO3,
407	Hutchins, J.B.	(2001).	Checklist of the fishes of Western Australia.	Records of the Western Australian Museum, Supplement No. 63: pp 9-50.	J	LSD1, YAL, CAR1, PIL1, PIL2, PIL3, PIL4, MUR2, GAS1, GAS3, GSD2,
408	Institute for Regional Development	(2001).	Coastal Environs in the South West NRM Region. Technical Report #4 South West Regional Strategy for Natural Resource Management.	South West Catchments Council, Bunbury.	R	JF2, WAR,
410	IUCN	(1994).	1994 IUCN Red List Categories.	Prepared by the IUCN Species Survival Commission. IUCN, Gland.	O	ESP1, MAL1, HAM, COO1,
409	IUCN	(1980).	The World Conservation Strategy.	(IUCN, UNEP, WWF: Gland)	O	ESP1, MAL1, HAM, COO1,
411	Jaensch, R.P.	(1993).	A survey of frogs in wetlands on the south coast of Western Australia.	Report to Department of Conservation and Land Management.	R	ESP1, JF2, WAR,
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413	James, C.D. and Saunders, D.A	(2001).	A framework for terrestrial biodiversity targets in the Murray-Darling Basin.	CSIRO Sustainable Ecosystems and Murray-Darling Basin Commission, Canberra.	R	AW2,
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503	Miles, J.M. and Burbidge, A.A.	(1975).	A Biological Survey of The Prince Regent River Reserve North-West Kimberley, Western Australia. In August, 1974.	Department of Fisheries and Wildlife Western Australia Wildlife Research Bulletin No 3.	J	NK1,
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763	Morris, K., Whisson, L., Burbidge, A. and Wallace, K.	(1993).	Draft Recovery Plan for the Western Mouse ( <i>Pseudomys occidentalis</i> )	Department of Conservation and Land Management	O	MAL2,
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517	Morse, J.	(1999).	Natural History of the Central Ranges Region Western Australia.	Consultancy Report to Ngaanyatjara Council.	R	CR1,
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530	Newbey, K.R., Dell, J., How, R.A. and Hnatiuk, R.J.	(1984).	The biological survey of the eastern Goldfields of Western Australia. Part 2. Widgiemooltha-Zanthus Study Area.	Records of the Western Australian Museum Supplement No. 18, 21-158. Perth, WA.	R	COO3, COO2,
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849	Phillimore, R. and Brown, A.	(2001).	Whorled eremophila ( <i>Eremophila verticillata</i> ) Interim Recovery Plan 2001-2004 (IRP No 99)	Department of Conservation and Land Management, Perth.	O	MAL2,
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815	Phillimore, R. and English, V.	(2001).	Long-leaved myrtle ( <i>Hypocalymma longifolium</i> ) Interim Recovery Plan 2001-2004 (IRP No 88)	Department of Conservation and Land Management, Perth	O	GS2,
733	Phillimore, R., and Brown, A.	(2000).	Phalanx <i>Grevillea</i> ( <i>Grevillea dryandroides</i> subsp. <i>dryandroides</i> ) Interim Recovery Plan 2000-2003 (IRP No 64)	Department of Conservation and Land Management	O	AW1, AW2,
734	Phillimore, R., and English, V.	(2000).	Narrow Curved-leaf <i>Grevillea</i> ( <i>Grevillea curviloba</i> subsp. <i>incurva</i> ) Interim Recovery Plan 2000-2003 (IRP No 67)	Department of Conservation and Land Management	O	AW1, AW2, GS3,
812	Phillimore, R., Brown, A., Kershaw, K., Holland, E. and English, V.	(2000).	Elegant spider orchid ( <i>Caladenia elegans</i> ms) Interim Recovery Plan 2000-2003 (IRP No 63)	Department of Conservation and Land Management, Perth	O	GS2,

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740	Phillimore, R., Holland, E., Kershaw, K. and Brown, A.	(2001).	Granite Tetraetheca ( <i>Tetraetheca deltoidea</i> ) Interim Recovery Plan 2001-2004 (IRP No 89)	Department of Conservation and Land Management	O	AW1,
742	Phillimore, R., Papenfus, D. and English, V.	(2001).	Silky Eremophila ( <i>Eremophila nivea</i> ) Interim Recovery Plan 2001-2004 (IRP No 101)	Department of Conservation and Land Management	O	AW1,
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848	Phillimore, R., Stack, G. and Brown, A.	(2000).	Lonely hammer orchid ( <i>Drakaea isolata</i> ms) Interim Recovery Plan 2000-2003 (IRP No 81)	Department of Conservation and Land Management, Perth.	O	MAL2,
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561	Pringle, H.J.R., Van Vreeswyk, A.M.E., and Gilligan, S.A.	(1994).	Technical Bulletin No 87. An inventory and condition survey of the north-eastern Goldfields, Western Australia.	Department of Agriculture, Perth.	R	MUR1, GAS2, GVD1, GVD2,
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782	Robinson, C.J. and Coates, D.J.	(1995).	Declared Rare and Poorly Known Flora in the Albany District	Australian Nature Conservation Agency, Canberra.	R	ESP1,
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			D.			
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607	Smith, L.A. and Johnstone, R.E.	(1978).	Amphibians and Reptiles. In: The Wildlife of some existing and proposed reserves in the	Western Australian Wildlife Research Bulletin 8: 31-33.	J	GD1, GD2, CR1,

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614	South West Regional Strategy for Natural Resource Management	(2001)	Bush & Biodiversity: Working draft January 2001	South West Catchment Council.	R	SWA2, JF1,
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616	Stack, G. and English, V.	(1999).	Blunt Wattle ( <i>Acacia aprica</i> ms) Interim Recovery Plan 1999-2002.	Department of Conservation and Land Management, Western Australia.	R	AW1, AW2, GS3,
731	Stack, G. and English, V.	(1999).	Prostrate Flame Flower ( <i>Chorizema humile</i> ) Interim Recovery Plan 1999-2002 (IRP No 31)	Department of Conservation and Land Management	O	AW1, GS2, GS3,
748	Stack, G. and English, V.	(1999).	Quartz Loving Synaphea ( <i>Synaphea quartzii</i> ca) Interim Recovery Plan 1999-2002 (IRP No 50)	Department of Conservation and Land Management	O	AW2, GS3,
746	Stack, G. and English, V.	(1999).	Rough Emu Bush ( <i>Eremophila scaberula</i> ) Interim Recovery Plan 1999-2002 (IRP No 28)	Department of Conservation and Land Management	O	AW2, JF1,
852	Stack, G. and English, V.	(1999).	Spiral fruited wattle ( <i>Acacia cochlocarpa</i> subsp. <i>Cochlocarpa</i> ms) Interim Recovery Plan (IRP No 24) 1999-2002	Department of Conservation and Land Management, Perth.	O	GS3,
826	Stack, G., Evans, R. and English, V.	(1999).	Trigwell's rulingia ( <i>Rulingia</i> sp. Trigwell Bridge) Interim Recovery Plan 1999-2002 (IRP No 33)	Department of Conservation and Land Management, Perth.	O	JF2,
617	Start, A.N.	(1998).	Dibbler, <i>Parantechinus apicalis</i> , Interim Recovery Plan 1998-2000. Interim Recovery Plan No. 18.	Department of Conservation and Land Management.	R	ESP1, JF2, WAR, GS3,
618	Start, A.N. and Burbidge, A.A.	(1995).	Interim wildlife management guidelines for Gilbert's potoroo ( <i>Potorous tridactylus gilberti</i> ).	Department of Conservation and Land Management, Perth.	R	JF2, WAR,
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621	Start, A.N., Burbidge, A.A. and Armstrong, D.	(1994).	Woylie Recovery Plan Second Edition 1994-1995. WA Wildlife Management Program No. 15.	Department of Conservation and Land Management, Perth.	R	JF2, WAR, AW2, SWA1,
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623	State Salinity Council	(1998).	Western Australia Salinity Action Plan: Draft Update 1998.	Government of Western Australia, Perth	R	JF2, WAR,
828	State Salinity Council of Western Australia	(2000).	Salinity: natural resource management in Western Australia. The salinity strategy Salinity actions: a guide for land managers	State Salinity Council of Western Australia	O	JF1,
819	Storey, A.W.	(1998).	Assessment of the nature conservation values of the Byenup-Muir peat swamp system, southwestern Australia: physicochemistry, aquatic macroinvertebrates and fishes: report prepared for Department of Conservation and Land Management	Wetlands Research and Management	R	WAR,
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629	Storr, G.M.	(1987).	Birds of the Eucla Division of Western Australia.	Records of the Western Australian Museum Supplement No. 27.	J	HAM,
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627	Storr, G.M.	(1981).	Birds of the north-eastern interior of Western Australia.	Records of the Western Australian Museum Supplement 9. 65-100.	J	GD1, GD2, CR1,
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## Appendix A

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635	Storr, G.M., Smith, L.A. and Johnstone, R.E.	(1986).	Snakes of Western Australia.	Western Australian Museum.	B	LSD1, LSD2, CAR1, PIL1, PIL2, PIL3, PIL4, NK1, NK2, CK1, CK2, CK3, DL1, DL2, GAS1, GAS3, GSD1, GSD2, OVP1, OVP2, VB1, TAN1,
634	Storr, G.M., Smith, L.A. and Johnstone, R.E.	(1983).	Lizards of Western Australia II. Dragons and Monitors.	Western Australian Museum.	B	LSD1, LSD2, CAR1, PIL1, PIL2, PIL3, PIL4, NK1, NK2, CK1, CK2, CK3, DL1, DL2, GAS1, GAS3, GSD1, GSD2, OVP1, OVP2, VB1, TAN1,
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851	Streamtec Ecological Consultants and Martinick, W.G. and Associates	(1988).	Gairdner Range project: aquatic survey 1988: prepared for W.G. Martinick and Associates Pty Ltd	Streamtec	R	GS3,
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650	Van Vreeswyk, A.M.E. and Godden, P.T.	(1998).	Pastoral Resources and the management in the Sandstone- Yalgoo-Paynes Find area, Western Australia.	Agriculture Western Australia	R	YAL, MUR1, MUR2,
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808	Walker, D.I.	(1990).	Seagrass in Shark Bay, Western Australia. In: "Research in Shark Bay: Report of the France-Australe Bicentenary Expedition Committee." (Eds. P.F. Berry, S.D. Bradshaw, B.R. Wilson)	Western Australian Museum, Perth. p.101-6	B	CAR2,
809	Walker, D.I.	(1989).	Regional studies - seagrass in Shark Bay, the foundations of an ecosystem. In: "Biology of Seagrasses. A treatise on the biology of seagrasses with special reference to the Australian region." (Eds. A.W.D. Larkum, A.J. McComb, S.A. Shepherd) (Aquatic Plant Studies 2)	Elsevier, Amsterdam. p.182-210	B	CAR2,
652	Wallace, K.J.	(undated)	Confusing Means with Ends - A Manager's Reflections on Experience in Agricultural Landscapes of Western Australia.	Submitted to Ecological Management and Restoration.	O	AW1, AW2, MAL2,
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654	Wallace, K.J. and Beecham, B.C.	(undated)	Planning nature conservation in agricultural landscapes - a land manager's perspective.	Submitted to Ecological Management and Restoration.	O	AW1, AW2, MAL2,
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660	Wardell-Johnson, G., Inions, G., Annels, A.	(1989).	A floristic classification of the Walpole-Nornalup National Park, Western Australia.	Forest Ecology and Management. - Vol. 28:259-279.	J	JF2, WAR,
661	Wardell-Johnson, G., Roberts, J.D.	(1993).	Biogeographic barriers in a subdued landscape: the distribution of the <i>Geocrinia rosea</i> (Anura: Myobatrachidae) complex in south-western Australia.	Journal of Biogeography. - Vol. 20:95-108.	J	JF2, WAR,
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664	Water and Rivers Commission	(2002).	State Water Conservation Strategy (Western Australia) (DRAFT).	Water and Rivers Commission.	R	JF2, WAR,
665	Water and Rivers Commission	(1999).	Millstream water reserve Water Source Protection Plan. West Pilbara Water Supply Scheme.	Water resource Protection Series, Water and Rivers Commission Report WRP 32. Perth, WA.	R	PIL2,
667	Water and Rivers Commission. Policy and Planning Division.	(1999).	Esperance Water Reserve: water source protection plan: Esperance town water supply.	Water resource protection series.	R	ESP2,
666	Water and Rivers Commission. Policy and Planning Division.	(1997).	Esperance region water resources review and development plan: summary report.		R	ESP2,
668	Water Authority	(1992).	Millstream environmental management program.	Water Authority of Western Australia. Perth, WA.	R	PIL2,
669	Water Corporation	(2001).	West Pilbara water supply scheme. Water resource management operation strategy.	Infrastructure Planning Branch, Water Corporation. Perth, WA.	R	PIL2,
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673	Watkins, D. and Jaensch, R.	(1997).	Wetlands of the Nullarbor and Hampton Bioregions, Collation of data on wetlands for potential listing in the "Directory of Important Wetlands in Australia".	Report to the Department of Conservation and Land Management, unpublished.	R	NUL1, NUL2,
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689	Western Australian Planning Commission	(2000).	Bush Forever. Keeping Bush in the city.	Two volumes, Government of Western Australia.	R	SWA2,
690	Weston, A., Hopkins, A.	(1989).	Survey of the Eastern Group islands of the Recherche Archipelago report submitted to the W.A. Heritage Committee		R	ESP2,
691	Weston, A.S.	(1974).	The effects of the Summer 1972-73 fire on the biota of Middle Island (Recherche Archipelago WA).	Unpublished manuscript.	R	ESP2,
692	Wheaton, T. (Ed.)	(1994).	Plants of the Northern Australian Rangelands.	NT Department of Lands, Housing and Local Government.	B	NK1, NK2, CK1, CK2, CK3, DL1, DL2, GSD1, OVP1, OVP2, VB1, TAN1,
693	Wheeler, J.R. (Ed), Rye, B.L., Kock, B.L. and Wilson, A.J.G.	(1992).	Flora of the Kimberley Region.	Department of Conservation and Land Management.	B	NK1, NK2, CK1, CK2, CK3, DL1, DL2, GSD1, OVP1, OVP2, VB1, TAN1,

694	White, S.	(1989).	Report on the geomorphic development and history of the Karst features of the Cape Range, North West Cape, Western Australia. Appendix 7. In W.F. Humphreys 1989. Status of Relict Cave Fauna of Cape Range, Western Australia, Especially the Schizomida Arachnida.	Unpublished report to ANP and WS,	B	CAR1,
695	Wilcox, D.G. and McKinnon, E.A.	(1992).	A Report on the Condition of the Gascoyne Catchment.	Department of Agriculture, Western Australia.	R	GAS3, CAR2, MUR2,
696	Wilkins, P. and Gilfillan, S.	(in prep).	The South Coast Macro Corridor Project.	Department of Conservation and Land Management South Coast Regional Office, Albany.	O	ESP1, ESP2, MAL1, COO1,
697	Williams, J., Spence, T. and Bowler, S.W.	(1958-1968).	Selected reports on the islands of the Recherche Archipelago.	Department of Fisheries and Fauna.	R	ESP2,
698	Williams, K., Horan, A., Wood, S. and Webb, A.	(2001).	Declared rare and poorly known flora in the Central Forest Region: Western Australian wildlife management program 33.	Department of Conservation and Land Management, Perth.	R	JF1, JF2, WAR,
699	Wilson, S.K. and Knowles, D.G.	(1988).	Australia's Reptiles. A photographic reference to the terrestrial reptiles of Australia.	Collins, Sydney.	B	LSD1, LSD2, CAR1, PIL1, PIL2, PIL3, PIL4, GAS1, GAS3, GSD2,
700	Withers, P.C. and Edward, D.H.	(1997).	Terrestrial fauna of granite outcrops in Western Australia.	Journal of the Royal Society of Western Australia 80(3):159-166.	J	AW1, AW2, MAL2,
701	Withers, P.C. and Hopper, S.D. (eds)	(2000).	Management of Granite Outcrops Symposium.	Journal of the Royal Society of Western Australia 83(3).	J	AW1, AW2, MAL2,
702	Woinarski, J.C.Z. (ed).	(1992).	The wildlife & vegetation of Purnululu (Bungle Bungle) National Park and adjacent area.	Wildlife Research Bulletin No. 6. Dept. of Conservation & Land Management, Perth.	J	VB1
703	Woinarski, J.C.Z. (Ed.)	(1992).	A Survey of the Wildlife and Vegetation of Purnululu (Bungle Bungle) National Park and Adjacent Area.	Department of Conservation and Land Management.	R	OVP1,
704	Wooller S.J. and Moore S.A.	(2000).	Regional assessment of the wheatbelt of Western Australia: Central Wheatbelt.	Prepared for the Australian Heritage Commission, Murdoch University, Perth	R	AW1, AW2, MAL2,
705	Wyrwoll, K.H., Kendrick, G.W. and Long, J.A.	(1993).	The geomorphology and late Cenozoic geomorphological evolution of the Cape Range - Exmouth Gulf region.		R	CAR1,
706	Yager, J. and Humphreys, W.F.	(1996).	Lasionectes exleyi, sp. Nov., the first remiped crustacean recorded from Australia and the Indian Ocean, with a key to the world species.	Invertebrate Taxonomy 10: pp 171-187.	J	CAR1,
707	Yates, C.J., Hobbs, R.J. and True, D.T.	(2000).	The distribution and status of eucalypt woodlands in Western Australia. Pp 86-106 In. R.H. Hobbs & C.J. Yates (eds). Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration.	Surrey Beatty & Sons, NSW	B	AW1, AW2, MAL2,
709	Youngson, W.K. and McKenzie, N.L.	(1977).	The Wildlife of the Proposed Karroun Hill Nature Reserve, Western Australia. Report No 30.	Department of Fisheries and Wildlife. Western Australia.	R	YAL, COO2,

R = Report; J = Journal article; O = Other

# Appendix B

## Keys

- a. Data gaps (priority data needs relative to existing information)
- (i) Survey information – vegetation/regional ecosystem mapping
  - (ii) Survey information – systematic fauna survey
  - (iii) Floristic data
  - (iv) Ecological and life history data e.g. habitat requirements for threatened species - describe
  - (v) Other - describe e.g. salinity threat.
- b. Dominant land use categories
- (i) Urban, includes industrial, airfields
  - (ii) (a) Rural residential; (b) Mining (the combined BRS data provided can not be easily split between the two)
  - (iii) Cultivation – irrigated horticulture, agriculture, plantations and intensive production
  - (iv) Cultivation – dry land agriculture
  - (v) Forestry-plantations
  - (vi) Forestry-native forests, state forests, timber reserves
  - (vii) Grazing – Improved pastures, dryland
  - (viii) Grazing – Native pastures
  - (ix) Traditional Indigenous uses includes Aboriginal reserves
  - (x) UCL and Crown reserves
  - (xi) Native forest outside of public lands-essentially ungrazed by domestic stock
  - (xii) Defense lands and reserves
  - (xiii) Conservation
  - (xiv) Reservoirs
  - (xv) Other – describe. Includes other waterbodies, mangroves and water courses
- c. Wetlands of subregional significance
- (i) Wetlands are identified in State or Territory lists of important wetlands
  - (ii) Significant for the maintenance of ecological processes at a subregional scale (refers to criteria 2 in DIWA)
  - (iii) Important for breeding, feeding, roosting, moulting or nursery areas, or refugia for animal taxa (refers to criteria 3 in DIWA)
  - (iv) Supports significant number of plant and animal taxa including migratory species (refers to criteria 4 in DIWA)
  - (v) Contains rare or threatened species/ecosystems (refers to criteria 5 in DIWA)

## d. Wetland Classes (from "A Directory of Important Wetlands in Australia", ANCA 1996)

**Coastal Wetlands**

A1	Not Applicable
A2	Not Applicable
A3	Not Applicable
A4	Rocky marine shores; includes rocky offshore islands, sea cliffs
A5	Sand, shingle or pebble beaches; includes sand bars, spits, sandy islets
A6	Estuarine waters; permanent waters of estuaries and estuarine systems of deltas
A7	Intertidal mud, sand or salt flats
A8	Intertidal marshes; includes salt-marshes, salt meadows, saltings, raised salt marshes, tidal, brackish and freshwater marshes
A9	Intertidal forested wetlands; includes mangrove swamps, nipa swamps, tidal freshwater swamp forests
A10	Brackish to saline lagoons and marshes with one or more relatively narrow connections with the sea
A11	Freshwater lagoons and marshes in the coastal zone
A12	Non tidal freshwater forested wetlands

**Inland Wetlands**

B1	Permanent rivers and streams; includes waterfalls
B2	Seasonal and irregular rivers and streams
B3	Inland deltas (permanent)
B4	Riverine floodplains; includes river flats, flooded river basins, seasonally flooded grassland, savannah and palm savannah
B5	Permanent freshwater lakes (>8ha); includes large oxbow lakes
B6	Seasonal/intermittent freshwater lakes (>8ha), floodplain lakes
B7	Permanent saline/brackish lakes
B8	Seasonal/intermittent saline lakes
B9	Permanent freshwater ponds (>8ha), marshes and swamps on inorganic soils; with emergent vegetation and waterlogged for at least most of the growing season
B10	Seasonal/intermittent freshwater ponds and marshes on inorganic soils; includes sloughs, potholes; seasonally flooded meadows, sedge marshes
B11	Permanent saline/brackish marshes
B12	Seasonal saline marshes
B13	Shrub swamps; shrub-dominated freshwater marsh, shrub carr, alder thicket on inorganic soils
B14	Freshwater swamp forest; seasonally flooded forest, wooded swamps; on inorganic soils
B15	Peatlands; forests, shrub or open bogs
B16	Alpine and tundra wetlands; includes alpine meadows, tundra pools, temporary waters from snow melt
B17	Freshwater springs, oases and rock pools
B18	Geothermal wetlands
B19	Inland, subterranean karst wetlands

## Human-Made Wetlands

C1	Water storage areas; reservoirs, barrages, hydro electric dams, impoundments (generally >8ha)
C2	Ponds, including farm ponds, stock ponds, small tanks (generally <8ha)
C3	Aquaculture ponds, fish ponds, shrimp ponds
C4	Salt exploitation; salt pans, salines
C5	Excavations; gavel pits, borrow pits, mining pools
C6	Wastewater treatment; sewage farms, settling ponds, oxidation basins
C7	Irrigated land and irrigation channels; rice fields, canals, ditches
C8	Seasonally flooded arable land, farm land
C9	Canals

## e. Threatening Processes

- (i) Broad scale vegetation clearing
- (ii) Increasing fragmentation, loss of remnants and lack of recruitment
- (iii) Firewood collection
- iv) Grazing pressure
- (v) Feral animals - list in order of significance
- (vi) Exotic weeds - list in order of significance
- (vii) Changed fire regimes
- (viii) Pathogens
- (ix) Changed hydrology- Salinity
- (x) Changed hydrology- other, e.g. altered flow regimes affecting riparian vegetation
- (xi) Pollution
- (xii) Other – describe

## f. NVIS Major Vegetation Sub-groups

- 1) Cool Temperate Rainforest
- 2) Tropical and sub-tropical rainforest + dry rainforest
- 3) Eucalyptus tall open forest and Eucalyptus forests with a dense broad leaved understorey (wet sclerophyll)
- 4) Eucalyptus forests with a shrubby understorey
- 5) Eucalyptus forests with a grassy understorey
- 6) Eucalyptus forests with a heath understorey
- 7) Tropical eucalypt forest and woodlands with a annual grassy understorey
- 8) Eucalyptus woodlands with a shrubby understorey
- 9) Eucalyptus woodlands with a grassy understorey
- 10) Low tropical eucalyptus forests and woodlands
- 11) Tropical mixed spp forests and woodlands
- 12) Callitris forests and woodlands
- 13) Brigalow (*Acacia harpophylla*) forests and woodlands
- 14) Other *Acacia* forests and woodlands
- 15) *Melaleuca* forests and woodlands
- 16) Other forests and woodlands
- 17) Alpine and sub-alpine woodlands, shrublands, sedgeland and herbfields
- 18) Arid eucalyptus low open woodlands with hummock grass
- 19) Arid eucalyptus low open woodlands with tussock grass
- 20) Mulga (*Acacia aneura*) woodland and low open woodland
- 21) Mixed species arid acacia woodlands and shrublands
- 22) Arid acacia low open woodlands and shrublands with chenopods
- 23) Arid acacia low open woodlands and shrublands with hummock grass
- 24) Arid acacia low open woodlands and shrublands with tussock grass
- 25) Other low open woodlands and shrublands with tussock grass
- 26) *Casuarina* and *Allocasuarina* forests and woodlands
- 27) Mallee eucalyptus low open woodlands
- 28) Tall shrublands
- 29) Mallee heath and shrublands

- 30) Heath + Banksia woodlands and shrublands
- 31) Chenopod shrublands
- 32) Other shrublands
- 33) Spinifex Hummock Grasslands
- 34) Mitchell Grass (Astrebla) tussock grasslands
- 35) Blue Grass (Dicanthium) and Tall Bunch Grass (Chrysopogon) tussock grasslands
- 36) Other tussock grasslands
- 37) Other Grasslands
- 38) Herbland, Sedgeland and Rushland
- 39) Mixed Chenopod, Samphire and Forblands
- 40) Mangroves, tidal mudflat and coastal samphire
- 41) Bare areas, rock, sand, claypan, salt lakes and lagoons
- 42) Freshwater lakes
- 43) Unclassified native vegetation
- 44) Not natural

g. Subregional Constraints to Consolidate NRS

- (i) Irreplacibility i.e. very few options remain to conserve ecosystem / landscape
- (ii) Limited opportunity remains to meet CAR criteria in terms of comprehensiveness and representativeness
- (iii) Economic constraints e.g. land prices
- (iv) Competing land uses- describe
- (v) Other - describe

h. Species/Ecosystem Recovery Actions

- (i) Habitat retention through reserves
- (ii) Habitat protection on private lands
- (iii) Habitat protection on other state lands
- (iv) Regrowth retention
- (v) Fencing
- (vi) Weed control
- (vii) Feral animal control
- (viii) Revegetation
- (ix) Fire management
- (x) Translocation
- (xi) Reinstatement of hydrology
- (xii) Research
- (xiii) Capacity building required with community, landholders, industry and institutions (specify)
- (xiv) Other – describe

i. NRM Actions

- i) Incentives
- ii) Legislation including duty of care for leasehold and other lands
- iii) Institutional reform e.g. rural reconstruction, industry reconstruction, new tenure and management arrangements
- iv) Valuing ecosystem services, tradable rights
- v) Threat abatement planning as part of NRM e.g. vegetation management plans, pest management
- vi) Industry codes of practice,
- vii) Environmental management systems, ecological sustainable product marketing
- viii) Capacity building required with community, landholders, industry and institutions (specify)
- ix) Other planning opportunities including local government planning and National Action Plan for Water Quality and Salinity.

- x) Integration with property management planning, catchment planning and Landcare.
- xi) Other –describe

# Appendix C

## Rankings

1. Reliability Rank
  - (i) Anecdotal
  - (ii) Qualitative
  - (iii) Quantitative and qualitative
  - (iv) Quantitative
  
2. Rank - Condition
  - (i) Degraded (Recovery unlikely in medium term)
  - (ii) Fair (Recovery requires significant management intervention)
  - (iii) Good (Recovery would occur in short term with minimum intervention)
  - (iv) Near pristine
  
3. Rank – Trend in status/condition
  - (i) Extinction e.g. targeted research has not observed species in recent times or no record in last 20 years
  - (ii) Status/condition rapidly declining e.g. < 10 year time frame
  - (iii) Status/condition declining
  - (iv) Status/condition static
  - (v) Status/condition improving
  - (vi) Unknown
  
- 4i. Rank – NRS ( Bioregional Priority 1-5)

Refer Table 1

The draft classification in Appendix 1 is based only on extent reserved (adequacy) and level of vegetation cover remaining at a subregional level.

Review this classification of priority bioregions for reserve consolidation and change to a higher primary classification (1-5) if:

  - (i) Significant threatening processes exist
  - (ii) The reserve system is highly biased in terms of C.A.R. criteria and is not comprehensive or representative in terms of ecosystem representation

Or, to a lower priority if:

  - (i) No perceived significant threatening processes
  - (ii) There is limited opportunity remaining to consolidate the reserve system

Note reasons for any change to classification.
  
- 4ii Rank – NRS (Subregional Priority a,b,c )

i.e. priority within bioregion with (a) being highest priority eg. if 4<sup>i</sup> was 5 and 4<sup>ii</sup> was c the subregional rank is 5c

5. Rank – Reserve management standards
  - i) Poor e.g. high visitor impact and/or other threatening processes that are not managed and are leading to permanent resource degradation in a number of parks.
  - ii) Fair e.g. Biodiversity values and or management issues are poorly identified; resource degradation is occurring though retrievable.
  - iii) Good e.g. major biodiversity issues effectively managed
  - iv) Very good e.g. high proportion of parks have park management plans, ecological monitoring programs in place and key biodiversity issues are being addressed.
  
6. Rank – Off park conservation
  - (i) Major constraints to achieve conservation outcomes e.g. due to level of habitat loss, landscape condition
  - (ii) Significant off park effort needed, resource constraints, limited community capacity
  - (iii) Relatively limited off park measures will result in significant biodiversity gains
  - (iv) Range of off park measures required, capacity exists and some achieved biodiversity outcomes
  - (v) Off park measures significantly in place
  
7. Rank - NRM
  - i) Major constraints to implement effective NRM actions to achieve biodiversity outcomes e.g. structural reform needed owing to extent of past degradation, land capability, property size, social and economic disruption
  - ii) Significant constraints to integrate conservation as part of production/development system
  - iii) Identified capacity for conservation to be integrated into NRM to achieve significant biodiversity outcomes
  - iv) NRM instruments in place with some achieved biodiversity outcomes
  - v) Conservation outcomes well integrated into production/development systems

## Appendix D

Preliminary Bioregional National Reserve System Priorities based on reservation extent & vegetation cover only (Cummings and Hardy 2001). Western Australian bioregions are italicised.

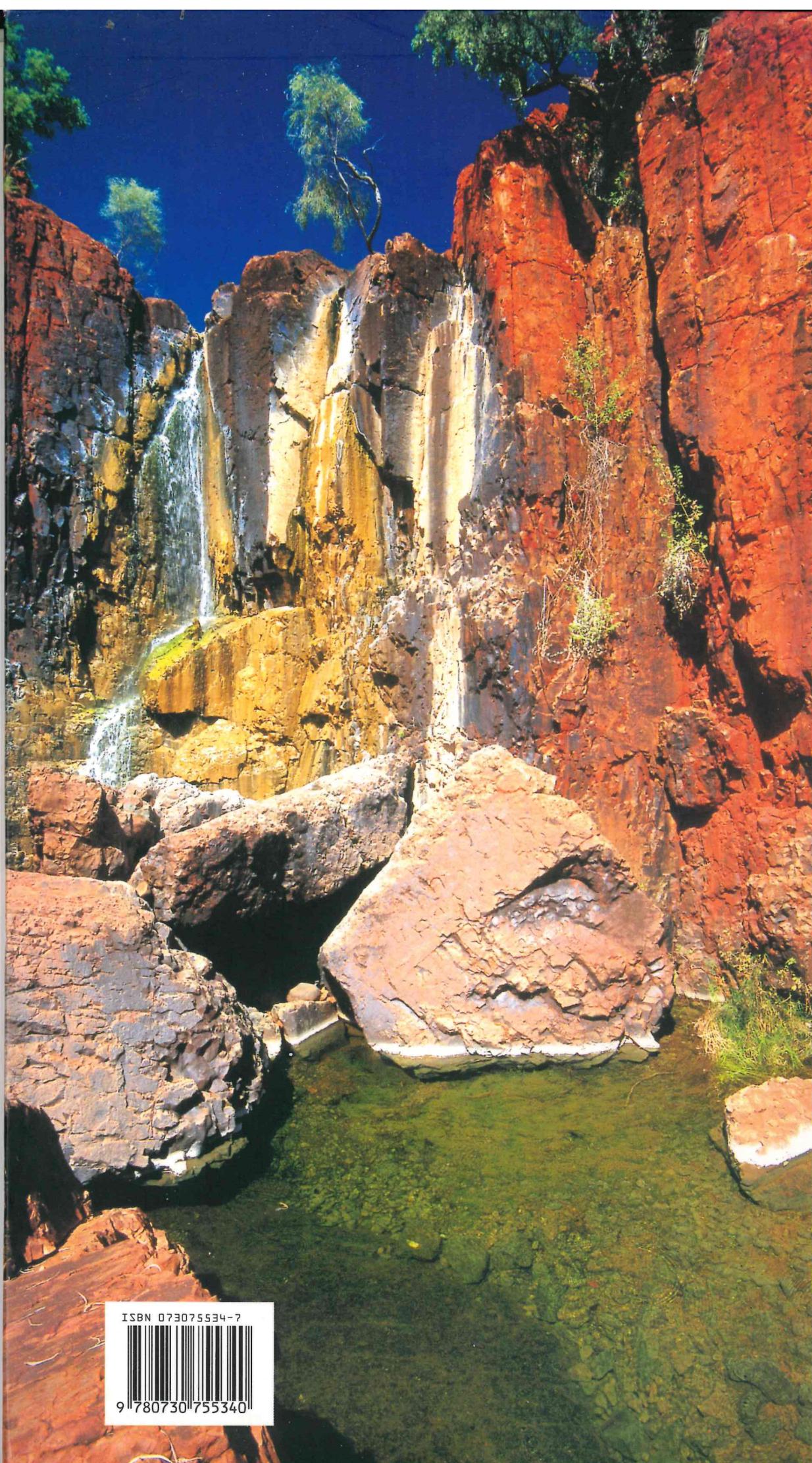
Category	Attributes	IBRA Regions
1	IBRA Reservation Class1 (<2%) and <30% of native vegetation cover remaining (All subregions)	<i>AW</i> , CA, CK, TNM, VVP
1	IBRA Reservation Class1 and >30% of native vegetation cover remaining (All subregions)	<i>CR, DL</i> , FIN, STU, <i>TAN</i>
1	IBRA Reservation Class1 (<2%) and <30% of native vegetation cover remaining, and > 50% IBRA region Reservation Class #	NSS
1	IBRA Reservation Class1 (<2%) and >30% of native vegetation cover remaining, and > 50% IBRA region Reservation Class #	BBN, BHC, BRT, CP, DRP, GFU, GUC, MGD, NAN
2	IBRA Reservation Class 2 (2-5%) and <30% of native vegetation cover remaining (All subregions)	
2	IBRA Reservation Class 2 and >30% of native vegetation cover remaining (All subregions)	DAB
2	IBRA Reservation Class 2 and <30% of native vegetation cover remaining, and > 50% IBRA region NRS Class #	
2	IBRA Reservation Class 2 and >30% of native vegetation cover remaining, > 50% IBRA region NRS Class #	ARC, BBS, DMR, EIU, FLB, <i>GSD</i> , GUP, <i>JF, LSD</i> , MII, ML, <i>MUR</i> , RIV
3	IBRA Reservation Class 3 (5-10%) and <30% of native vegetation cover remaining (All subregions)	
3	IBRA Reservation Class 3 and >30% of native vegetation cover remaining (All subregions)	DEU, TSE
3	IBRA Reservation Class 3 and <30% of native vegetation cover remaining, and > 50% IBRA region NRS Class #	NCP, SCP, VM
3	IBRA Reservation Class 3 and >30% of native vegetation cover remaining, > 50% IBRA region NRS Class #	CHC, CMC, <i>COO</i> , EYB, <i>GAS</i> , MAC, NET, <i>OVP, PIL</i> , SEQ, STP
4	IBRA Reservation Class 4 (10-15%) and <30% of native vegetation cover remaining (All subregions)	
4	IBRA Reservation Class 4 and >30% of native vegetation cover remaining	BEL, <i>HAM</i> , TNS, <i>YAL</i>
4	IBRA Reservation Class 4 and <30% of native vegetation cover remaining, and > 50% IBRA region NRS Class #	<i>GS</i>
4	IBRA Reservation Class 4 and >30% of native vegetation cover remaining, > 50% IBRA region NRS Class #	<i>CAR</i> , GAW, <i>GD</i> , MDD, <i>NK</i> , SEH, <i>SWA, VB</i>
5	IBRA Reservation Class 5 (>15%) and <30% of native vegetation cover remaining (All subregions)	SEC
5	IBRA Reservation Class 5 and >30% of native vegetation cover remaining (All subregions)	AA, DAC, KIN, NNC, PCK, SB, TCH, TSR, TWE, <i>WAR</i>
5	IBRA Reservation Class 5 and <30% of native vegetation cover remaining, and > 50% IBRA region NRS Class #	KAN, MAL, <i>NUL</i>
5	IBRA Reservation Class 5 and >30% of native vegetation cover remaining, > 50% IBRA region NRS Class #	ARP, CYP, <i>ESP</i> , FLI, <i>GVD</i> , SSD, TIW, WT

# Appendix E

## Acronyms

Acronym	Description
AgWA	Department of Agriculture of Western Australia
ANCA	Australian Nature Conservation Agency (now known as Environment Australia)
BDAC	Biodiversity Advisory Committee
CALM	Department of Conservation and Land Management
CAR	<i>Comprehensiveness</i> - includes the full range of communities recognised by an agreed national scientific classification at appropriate hierarchical levels. <i>Adequacy</i> - the maintenance of ecological viability and integrity of populations, species and communities. <i>Representativeness</i> - those sample areas that are selected for inclusion in reserves should reasonably reflect the biotic diversity of the communities
CP	Conservation Park
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTR	Conservation Through Reserves
CWR	Critical Weight Range (used to refer to mammals approximately 35g to 5.5kg mean adult body weight that have experienced modern decline)
DEP	Department of Environmental Protection
DIWA	Directory of Important Wetlands in Australia
DRF	Declared Rare Flora
EA	Environment Australia
EIS	Environmental Impact Statement
EMS	Environmental Management System
EMU	Ecosystem Management Unit
EPA	Environmental Protection Agency
EPBC	Environmental Protection and Biodiversity Conservation (used in reference to the Act of Federal Parliament 1999)
GIS	Geographic Information Systems
GMS	Gascoyne Murchison Strategy
IBRA	Interim Biogeographic Regionalisation for Australia (version 5.1 is used for this document)
IMG	Interim Management Guidelines
IPA	Indigenous Protected Area
IRP	Interim Recovery Plan
IUCN	International Union for Conservation of Nature and Natural Resources (now the World Conservation Union)
IUCN categories I - IV	Areas of land formally protected for nature conservation values, including strict nature reserve/wilderness (managed for science or wilderness), national park (managed for ecosystem conservation and recreation), natural monuments (managed for conservation of specific natural features) and habitat/species management areas (managed mainly for conservation through management intervention)
IUCN categories V & VI	Areas of land formally protected for nature conservation values, including protected landscaped seascapes (managed mainly for landscape or seascape conservation and recreation) and managed resource protected areas (managed mainly for the sustainable use of natural ecosystems)

Acronym	Description
LCDC	Land Conservation District Committee
MOU	Memorandum of Understanding
NAIMS	Northern Agricultural Integrated Management Strategy
NAPSWQ	National Action Plan for Salinity and Water Quality
NFF	National Farmers Federation
NGO	Non-Government Organisation
NHT	Natural Heritage Trust
NLWRA	National Land and Water Resources Audit
NP	National Park
NR	Nature Reserve
NRM	Natural Resource Management
NPNCA	National Parks and Nature Conservation Authority (now known as the Conservation Commission)
NRS	National Reserve System
NT	Northern Territory
NVIS	National Vegetation Inventory System
REIWA	Real Estate Institute of Western Australia
RFA	Regional Forest Agreement
RP	Recovery Plan
SAP	Salinity Action Plan
SPP	Statement of Planning Policies
TEC	Threatened Ecological Community
TFRT	Threatened Flora Recovery Team
UCL	Unallocated Crown Land
WA	Western Australia
WA039 (etc)	Labeling system for wetlands in Western Australia to be cross referenced with the Directory of Important Wetlands in Australia
WAM	Western Australian Museum
WAPC	Western Australian Planning Commission
WARMS	Western Australian Rangelands Monitoring System
WRC	Water and Rivers Commission (now the Department of Environment)
WWF	World Wildlife Fund



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