



# South Australian Arid Lands Biodiversity Strategy



**Volume 3** Flinders and Olary Ranges Conservation Priorities

**SOUTH AUSTRALIAN ARID LANDS  
NATURAL RESOURCES MANAGEMENT REGION**

A partnership between

The Department for Environment and Heritage and  
South Australian Arid Lands Natural Resources Management Board



Australian Government



Government  
of South Australia

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# Introduction

The **South Australian Arid Lands Biodiversity Strategy** has been developed by the South Australian Arid Lands Natural Resources Management Board (SAAL NRM Board) and the South Australian Department for Environment and Heritage (DEH).

The South Australian Arid Lands Natural Resources Management Region covers over 520,000 km<sup>2</sup>, almost 53% of the State. The landscapes and biodiversity of this huge region are diverse and complex. Planning for biodiversity conservation at such large scales requires a landscape-based system of classifying the land surface. The landscape classification system used for this strategy is the Interim Biogeographic Regionalisation for Australia (IBRA) regions. The IBRA bioregions of the SAAL NRM region are the Stony Plains, Flinders Lofty Block, Broken Hill Complex, Channel Country, Simpson – Strzelecki Dunefields, Finke and Gawler.

The Strategy consists of six documents. Volume one is the South Australian Arid Lands Natural Resources Management Region Biodiversity Strategy: Region-wide Priority Actions. It identifies the region-wide goal for biodiversity conservation and sets resource condition targets that will enable us to measure our success in achieving this goal, and details a comprehensive suite of management action targets and strategies that must be implemented regionally to achieve this goal.

The five bioregional documents are separate volumes, and identify conservation priorities for each of the bioregions in the South Australian Arid Lands. These are:

- *Volume 2 Channel Country Conservation Priorities*
- *Volume 3 Flinders and Olary Ranges Conservation Priorities*
- *Volume 4 Gawler Conservation Priorities*
- *Volume 5 Sandy Deserts Conservation Priorities*
- *Volume 6 Stony Plains Conservation Priorities*

This document, **South Australian Arid Lands Biodiversity Strategy – Volume 3 Flinders and Olary Ranges Conservation Priorities** has two sections. Section one describes the bioregion's natural attributes, land uses and the major threats to biodiversity. Section two sets out the priority actions for biodiversity conservation for the bioregion over the next five years. This document is one of five bioregional biodiversity strategies that, together, contribute to the South Australian Arid Lands Biodiversity Strategy.

The conservation priorities described here have been identified in the SAAL portion of the Flinders Lofty Block and Broken Hill Complex bioregions. The Flinders and Olary Ranges encompasses the southern and northern Flinders, and stretches across the Olary Ranges to the New South Wales border. The entire South Australian component of the Broken Hill Complex bioregion, and the majority of the three semi-arid IBRA subregions – Northern Flinders, Central Flinders and Olary Spur of the Flinders Lofty Block bioregion are within the SAAL NRM region.

# Bioregional framework

The Interim Biogeographic Regionalisation of Australia (IBRA) establishes a hierarchy of ecosystem classification for which the physical, climatic and biological characteristics are described.

## Bioregions:

are continental scale (1:1,000,000) ecosystems that range in size from one to 20 million hectares. They are distinguished from adjacent regions by their broad physical and biological characteristics. They may include more than 30 landforms and 50 vegetation associations. Seven bioregions, or parts thereof, occur in the SAAL NRM Region.

## Subregions:

are sub-continental scale (1:500,000) ecosystems that range in size from 100,000 to seven million hectares. They occur within IBRA bioregions and may include up to 15 landforms and 30 vegetation associations.

## Landsystems:

are regional scale (1:250,000) ecosystems that range in size from 2,000 to five million hectares. They occur within IBRA subregions and may include up to five landforms and 10 vegetation associations.

## Vegetation communities:

are local scale (1:100,000) ecosystems that range in size from five to 5,000 hectares and are based on a single landform and vegetation community.



### Continental ecosystem:

Flinders Lofty Block IBRA – Series of high quartzite hogback ridges with shallow loamy soils, and intervening plains with red duplex soils.

IBRA Bioregion  
Continental Ecosystem  
1:1,000,000



### Sub-continental ecosystem:

Northern Flinders IBRA subregion – Low ridges and hills supporting open woodlands, Acacia shrublands, chenopod low shrublands and grasslands. The high quartzite and granite ridges support spinifex grasslands with Mallee and Yacca.

IBRA Subregion  
Sub-continental Ecosystem  
1:500,000



### Regional ecosystem:

Regional ecosystem: Freeling landsystem – High rugged dissected plateau with shallow soils. Sequences of Red Gum gorges, Cypress Pine escarpments and plateaus, undulating plains with Red Mallee and Red Box woodlands over Spinifex and grasses

Landsystem  
Regional Ecosystem  
1:250,000



### Local ecosystem:

River Red Gum woodland along watercourses.

Vegetation Community  
Local Ecosystem  
1:100,000

## Who is this strategy for?

This strategy is designed to address the needs of three main stakeholder groups:

- The SAAL NRM Board, Government and other investors
- Scientists, technicians, and NRM support staff
- Land managers

### **SAAL Board, Government and other investors**

The focus audience for this strategy is the SAAL NRM Board, State and Federal Government Departments with responsibility for biodiversity conservation, and other organisations currently investing, or wishing to invest, in conserving the biodiversity of the South Australian Arid Lands. The 20-year targets represent clear statements of intent about biodiversity conservation priorities in the Flinders and Olary Ranges and how they will be managed. Monitoring and evaluating progress against the identified performance information will contribute to regional reporting on biodiversity conservation efforts.

The 5-year actions provide specific direction for targeting investment. In most instances, the actions can be implemented as new projects, or as part of existing projects currently undertaken by the SAAL NRM Board, Government Departments and other stakeholders. Responsibility for delivering each action has not been detailed. Ultimately, the SAAL NRM Board and Government are responsible for the ongoing process of working with other stakeholders to deliver each action.

### **Scientists, technicians, and NRM support staff**

The strategy also has two main uses for biologists, ecologists, NRM support staff and others involved in biodiversity conservation and NRM projects and programs.

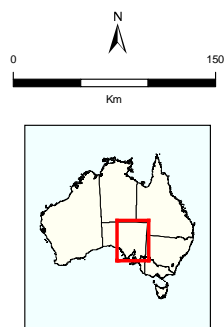
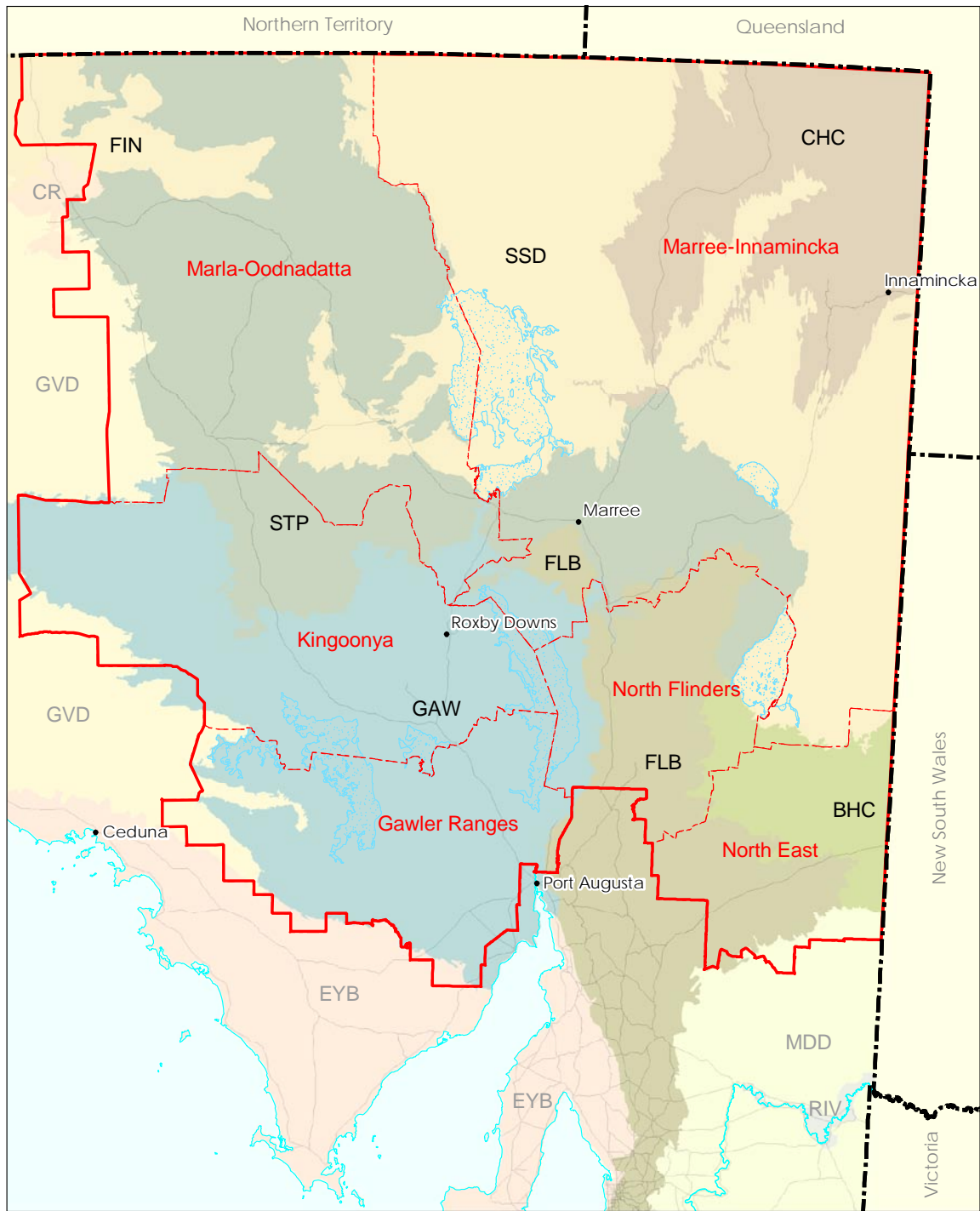
1. It provides a set of priorities for biodiversity conservation in the Flinders and Olary Ranges. Technical staff can confidently structure existing or new projects to deliver the actions identified for each conservation priority.
2. It identifies practical strategies for direct involvement by land managers. Technical staff can use these strategies to structure and develop engagement and extension programs to build capacity of land managers to achieve effective biodiversity conservation goals.

### **Land managers**

For the land managers of the Flinders and Olary Ranges, this document clearly sets out the biodiversity conservation priorities for the bioregion, and describes the activities that need to be undertaken to address these priorities. The document also suggests practical strategies and actions that land managers can undertake on their own land, as part of their day-to-day operations, to maintain and improve biodiversity on their country.



# South Australian Arid Lands NRM region – IBRA bioregions



## Bioregion

- |                            |                                     |  |
|----------------------------|-------------------------------------|--|
| Broken Hill Complex (BHC)  | Gawler (GAW)                        | South Australian Arid Lands NRM Region         |
| Channel Country (CHC)      | Great Victoria Desert (GVD)         | South Australian Arid Lands NRM Group Boundary |
| Central Ranges (CR)        | Murray Darling Depression (MDD)     | Salt Lake                                      |
| Eyre Yorke Block (EYB)     | Riverina (RIV)                      | Major Road                                     |
| Finke (FIN)                | Simpson-Strzelecki Dunefields (SSD) | State Border                                   |
| Flinders Lofty Block (FLB) | Stony Plains (STP)                  | Locality                                       |



## SECTION 1

# FLINDERS AND OLARY RANGES DESCRIPTION

IBRA subregions

Major landforms

Major land uses

Threats to biodiversity



Photo: River Red Gum *Eucalyptus camaldulensis* (L. Edmunds)



# Flinders and Olary Ranges description

*Covering an area of 64,028 km<sup>2</sup> of South Australia, the Flinders and Olary Ranges represent 6.5% of the State\*.*

The most striking feature of the Flinders and Olary Ranges is the mountain ranges of the Flinders, extending from Crystal Brook in the south to the edge of the arid gibber plains in the north. The ranges and valleys have their origin in the pattern of sedimentation and folding that took place between 1,000 and 500 million years ago. Known as the Adelaide Geosyncline, the landscape we see today is the result of the different rates of erosion of this fold belt.

The elevation of the Flinders Ranges significantly influences the local climate, producing a corridor of moister habitat through the semi-arid part of South Australia and extending into the arid north. These ranges provide a corridor for the dispersal of species with wetter climate affinities into semi-arid rangelands. The ranges have also been viewed as a series of evolutionary refuges for native species during alternating dry and humid periods.

In the Olary Ranges, to the north and east of the Adelaide Geosyncline, the Willyama Inlier is the primary geological feature. The Willyama Inlier is on the margin of, and forms part of, a large area of basement rock beneath Lake Frome (Curnamona Craton). In New South Wales, the exposed basement contains the mineral rich rocks of the Barrier Range. This basement rock is also exposed in the north-eastern Flinders Ranges (Mount Painter Inlier).

The Flinders and Olary Ranges lie in a south to north transition zone from winter to summer dominant rainfall. Mallee communities typify southern parts, responding mostly to cool season rains, whereas Mitchell Grass communities typify the northern area, showing most response to warm season rains. The southern arid zone is characterised by chenopod shrubland, which covers nearly half of the region and usually responds to rain at any time of the year. Occurring predominantly on plains, chenopod shrublands are variously dominated by Bladder Saltbush, Low Bluebush, Pearl Bluebush, Black Bluebush and Cottonbush. These low chenopod communities often form a mosaic with other communities such as low woodland, shrubland and ephemeral grassland. In sandier country, Sandhill Wattle and Mulga overstorey with mixed shrub or tussock grass understorey variously dominate vegetation communities. Species diversity is highest in the ranges and drainage lines where there is greater habitat variety. In the steeper parts of the ranges, the inaccessibility limits native and introduced herbivore populations.

\* Bioregions and subregions are the reporting unit for assessing the status of native ecosystems, their protection in the national reserve system and for use in the monitoring and evaluation framework in the Australian Government's current Natural Resource Management initiatives. The IBRA boundaries presented in this report are provisional and unpublished and will not be officially recognised until IBRA version 7 is released in 2009. Monitoring and evaluation in the Flinders and Olary Ranges will be consistent with national guidelines and fit the national monitoring and evaluation framework.

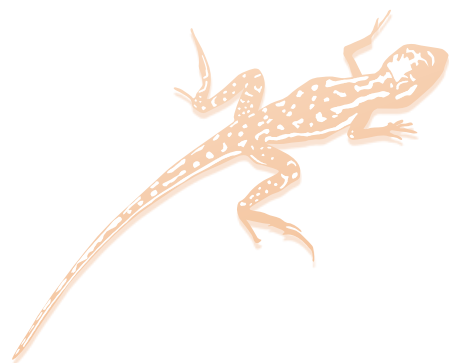


The northern Flinders Ranges form part of a series of arid ranges habitats extending from central Australia through the MacDonnell Ranges, Musgrave Ranges, Breakaways, Stuart Range, Denison and Davenport Ranges and Willouran Range. Species such as the Little Woodswallow, Painted Firetail, Finlayson's Cave Bat and Euro take advantage of this chain of suitable habitat.

Flinders Grey Mallee, White Cypress Pine low woodlands and hummock grasslands are common along the central quartzite spine of the ranges, while mallee communities dominated by Beaked Red Mallee and White Mallee are found on lower slopes and valleys in the central and northern ranges. Curly Mallee is also found on the slopes of the northern Flinders Ranges and, in the Flinders and Olary Ranges, mixed shrubland variously dominated by Elegant Wattle, Dead Finish, Emu-bush and Senna are widespread on lower shaley and rocky hills. These species also occur with Mulga, forming low open woodland.

The Olary Ranges have linear ridge/valley topography with inter-montane basins. This is similar to the Flinders Ranges, however being topographically lower influences climate less. Mixed mallee communities dominate hills and plains in the western Olary Ranges, with chenopod low shrublands and non-eucalypt woodlands more common in the eastern part.

Drainage lines provide significant habitat and dispersal corridors for species throughout the region. These areas generally support a similar level of species diversity to the mountain habitat because of the higher moisture levels, nutrient availability and habitat complexity. River Red Gums characterise most drainage lines with a variable understorey including rushes and sedges in moist areas and Inland Teatree, Elegant Wattle, Boobialla and Lemon-scented Grass in the drier parts.



# IBRA subregions

Seven IBRA subregions occur within the SAAL component of the Flinders Lofty Block and Broken Hill Complex bioregions. Detailed descriptions of landsystems of the Flinders Lofty Block and Broken Hill Complex bioregions can be found in the District Plans published by the Central Flinders, Northern Flinders, North East Pastoral, and Marree Soil Conservation Boards.

## Flinders Lofty Block bioregion Broken Hill Complex bioregion

### Olary Spur (FLB3)

Hogback ridges with Mallee in the south to Mulga shrublands in the west. Gentle footslopes and plains dominated by chenopod shrublands.

**Total Area:** 17,373 km<sup>2</sup>.

**Landsystems:** Antro; Ballara; Beltimore; Benda; Bimbowrie; Carrick; Dlorah; Eringa; Milang; Oakvale; Olary; Oopina; Orama; Oratan; Oulnina; Panormina; Pearce; Southern Cross and Starlight.

### Northern Flinders (FLB5)

Low ridges and hills supporting open woodlands, Acacia shrublands, chenopod low shrublands and grasslands. The high quartzite and granite ridges support Spinifex grasslands with Mallee and Yacca.

**Total Area:** 18,392 km<sup>2</sup>.

**Landsystems:** Alerumba; Anzac; Aroona; Arrowie; Billy Creek; Burr; Etina; Fitton; Freeling; Gammon; Grindstone; Hemming; Kunoith; Lennard; Mandarin; Morris; Mundawatina; Munyallina; Myrtle; Paradise; Parara; Roebuck; Saltia; Stirrup Iron; Thomas; Umberatana; Upalinnia; Wertaloonia; Willawertina; Willouran; Wilyerpa; Woolnough and Yankaninna.

### Central Flinders (FLB6)

High quartzite hogback ridges with Mallee over Yacca and Spinifex. Intervening plains and lowlands with degraded woodlands, Acacia shrublands and chenopod shrublands.

**Total Area:** 9,564 km<sup>2</sup>.

**Landsystems:** Alerumba; Anzac; Bagalowie; Beltimore; Burr; Eke; Etina; Hemming; Kunoith; Milang; Orama; Panormina; Parachilna; Parara; Pearce; Saltia; Stirrup Iron; Upalinnia; Wilpena and Wilyerpa.

### Barrier Range (BHC1)

Subdued topography of low hills, calcrete mantles and alluvial fans at the eastern end of Olary Ranges, supporting shrublands and woodlands.

**Total Area:** 3,800 km<sup>2</sup>.

**Landsystems:** Antro; Ballara; Benagerie; Bimbowrie; Eringa; Mundi and Wompinie.

### Barrier Range Outwash (BHC4):

Alluvial plains of chenopod shrublands and woodlands dotted with small ephemeral swamps

**Total Area:** 5,088 km<sup>2</sup>.

**Landsystems:** Antro; Ballara; Benagerie; Corona; Eurinilla; Lockhart; Mundi and Wompinie.

### Bimbowrie (BHC5):

Uplands of acid igneous rock supporting Acacia shrubland with alluvial plains and valleys of chenopod shrublands.

**Total Area:** 2,779 km<sup>2</sup>.

**Landsystems:** Antro; Ballara; Benda; Bimbowrie; Olary; Pearce and Wompinie.

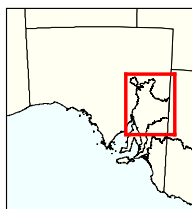
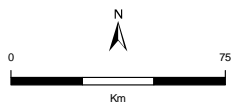
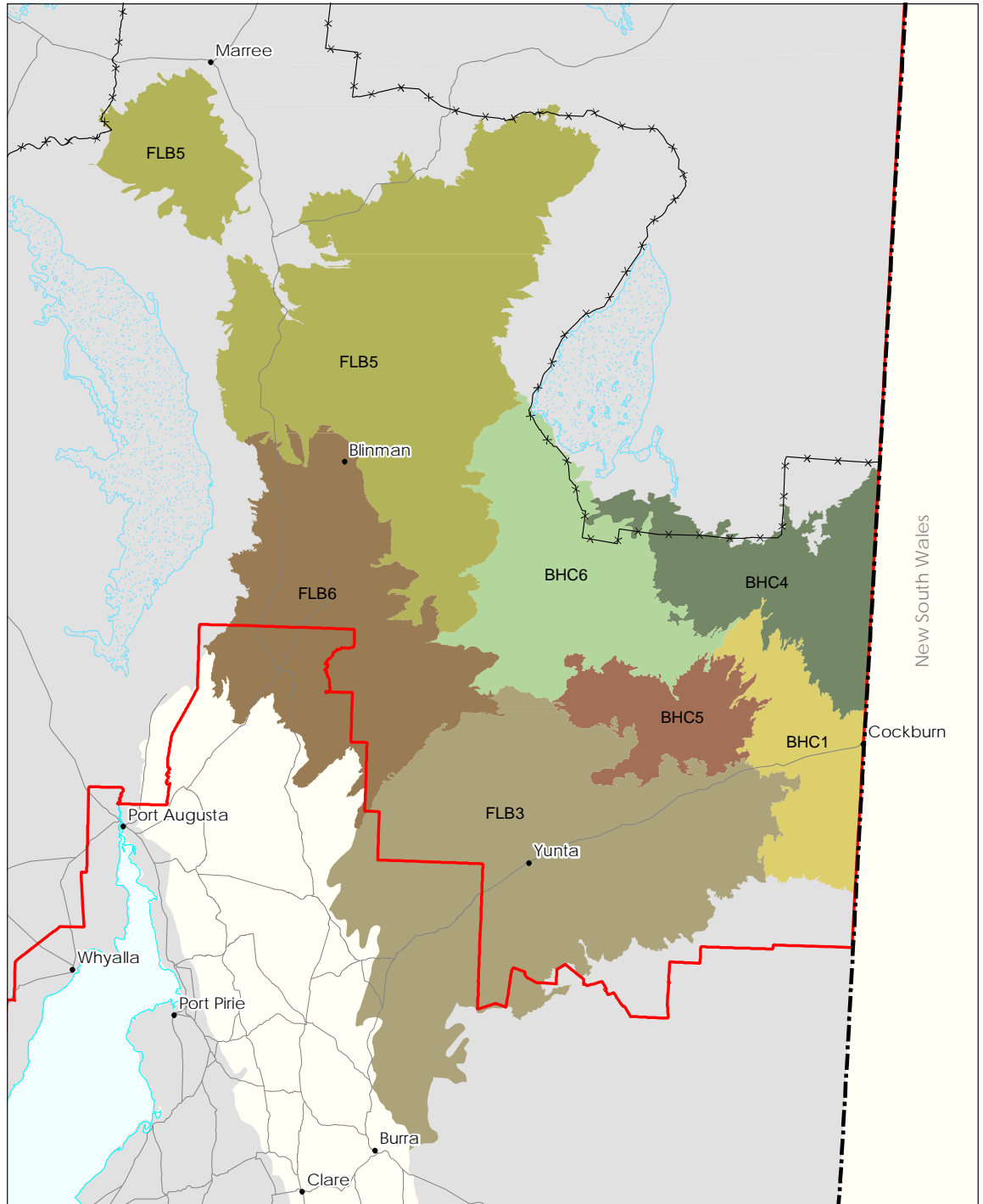
### Telechie Plains (BHC6):

Gently inclined alluvial plain of sandy red duplex soils, developing sand sheets in the north and dominated by shrublands.

**Total Area:** 7,033 km<sup>2</sup>.

**Landsystems:** Antro; Ballara; Benagerie; Glen Warwick; Orama; Pearce; Sandyoota; Siccus; Telechie; Wompinie and Wyambana.

## Flinders and Olary Ranges – IBRA subregions



### Subregion

- Barrier Range (BHC1)
- Barrier Range Outwash (BHC4)
- Bimbowrie (BHC5)
- Telechie Plains (BHC6)
- Olary Spur (FLB3)
- North Flinders (FLB5)
- Central Flinders (FLB6)

- South Australian Arid Lands NRM Region
- Salt Lake
- Dog Fence
- Major Road
- State Border
- Locality



# Major landforms

*There are three major landforms in the Flinders and Olary Ranges.*

## **Drainage lines and floodplains**

Ephemeral watercourses and floodplains draining into four surface water basins: Lake Frome, Lake Torrens, Lower Murray and Willochra Creek.

Subregions: FLB3; FLB5; FLB6; BHC1; BHC4; BHC5 and BHC6.

## **Plains and rises**

Relatively flat areas, characterised by alluvial plains and plains of sandy red duplex soils, red cracking clays, calcareous soils and deeper duplex soils when associated with ranges.

Subregions: FLB3; FLB5; FLB6; BHC1; BHC4; BHC5 and BHC6.

## **Ranges and hills**

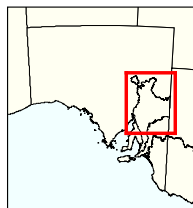
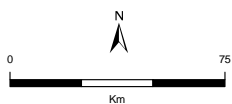
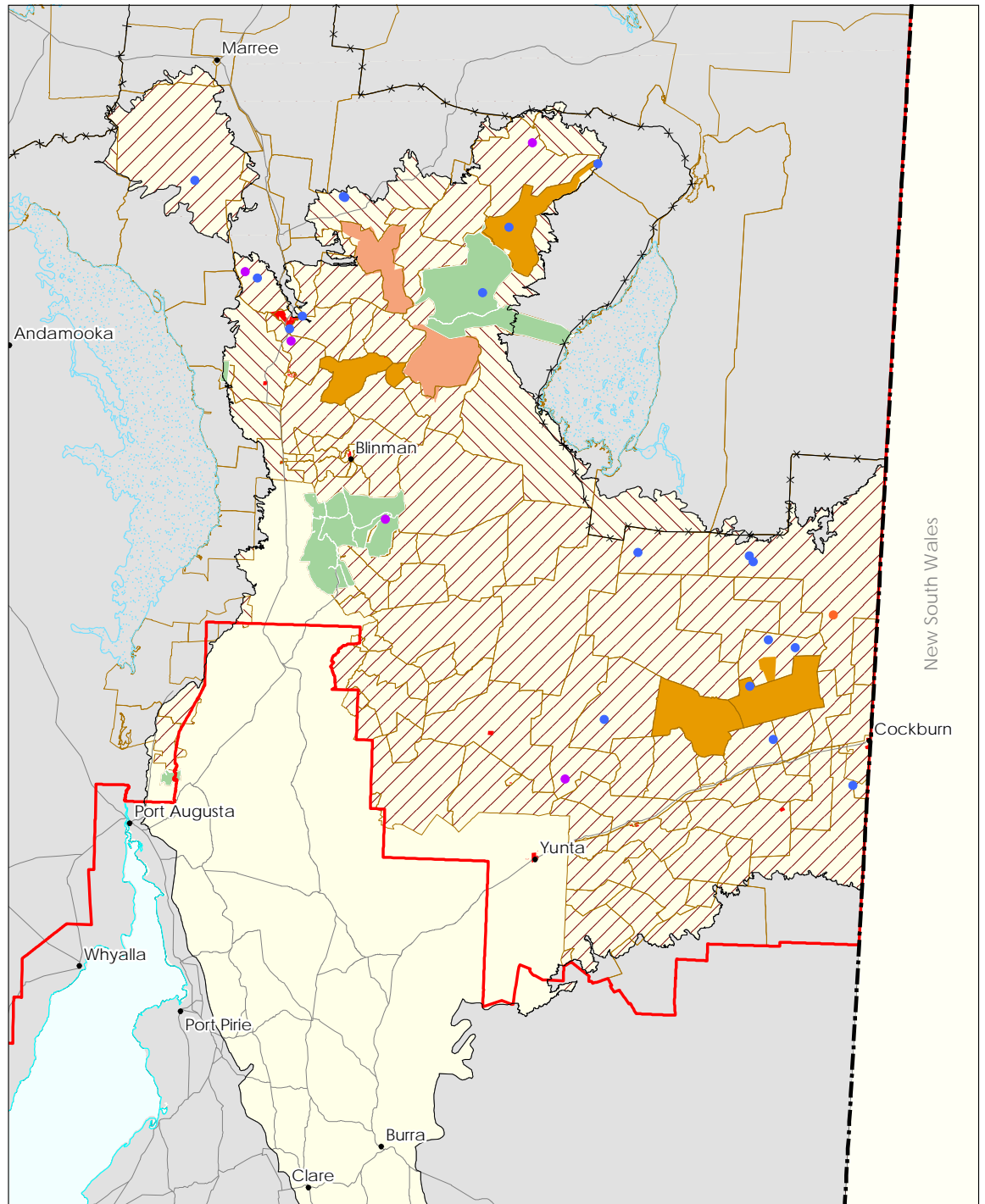
Hills and low ranges, generally below 700 m in altitude with semi-arid species dominating the vegetation. The higher parts of the Flinders are characterised by quartzite hogback ridges with shallow loamy soils, mostly over 700 m elevation and summits over 900 m.

Subregions: FLB3; FLB5; FLB6; BHC1 and BHC5.

Conservation priorities have been grouped under each landform.



## Flinders and Olary Ranges – land use



### Land use

- Pastoral Station
- Mainly Cattle
- Mainly Sheep
- DEH Managed Area
- Indigenous Protected Area
- Pastoral lease managed primarily for conservation

### Major Mining Activity

- Operating
- Prospect
- Resource
- Crown Lands Act Reserves

Broken Hill Complex and Flinders Lofty Block Bioregions

South Australian Arid Lands NRM Region

Salt Lake

Dog Fence

Major Road

State Border

Locality

# Major land uses

*There are four major land uses in the Flinders and Olary Ranges.*

## **Pastoralism and cereal cultivation**

The main land use is pastoralism for wool production, although an increasing number of landholders are now grazing cattle due to low wool prices. There is also a goat grazing case study being undertaken on one pastoral lease. On the southern margin, substantial areas are under miscellaneous lease, perpetual lease or freehold title. Whilst some areas have been cleared for cultivation, only a very small percentage of this area is regularly cropped.

## **Conservation**

In the Northern Flinders Ranges subregion, the Vulkathunha-Gammon Ranges National Park is the highest profile conservation area. Adjacent are the Nantawarrina Indigenous Protected Area and the privately managed Arkaroola. Warraweena and Pinda Spring are both privately managed pastoral leases that contribute to conservation in the region through destocking and managing feral animals. In addition, several pastoral lessees are managing individual paddocks primarily for conservation. Mount Serle has recently been proclaimed an Indigenous Protected Area. The Ediacara Conservation Reserve has been dedicated primarily for the protection of fossils of international importance.

The Flinders Ranges National Park is mainly in the Central Flinders subregion. Bunkers Conservation Reserve, a privately managed reserve, is dedicated primarily to the conservation of the Yellow-footed Rock-wallaby.

In the Broken Hill Complex bioregion, the recent purchase of Bimbowrie Pastoral Lease by the Department for Environment and Heritage and the private acquisition of Boolcoomata for conservation purposes represent the only conservation areas in this bioregion in South Australia.

## **Tourism**

The Flinders Ranges are a major nature-based tourism destination in South Australia with Wilpena Pound, Brachina and Parachilna Gorges, Gammon Ranges and Arkaroola among the most visited sites. Increased public interest in the Flinders Ranges has also made it profitable for pastoral businesses to diversify into tourism. Nature-based tourism activities include bushwalking, astronomy, cycling, geology, fossils, camping and 4WD experiences. Also of great appeal are the heritage, cultural and historical sites. Tourism covers all types of land tenure. The Olary Ranges attract far less tourism than the Flinders, though conservation areas such as Bimbowrie and Boolcoomata may enhance the interest in ecotourism.

## **Mining**

The most significant mining activities in the Flinders Lofty Block bioregion are the Leigh Creek coal fields and Beverley uranium mine. Smaller scale operations include mining magnesite at Myrtle Springs, zinc and lead at Puttapa, talc at Mount Freeling, gold at Teetulpa and barite at Willow Springs. In the Broken Hill Complex bioregion, extensive exploration has been undertaken in and around the Olary Ranges over the last decade although no extraction has commenced. Honeymoon uranium mine, an in situ leaching operation north of Cockburn, is likely to commence operation in the near future.



# Threats to biodiversity

*There are many threats to biodiversity in the Flinders and Olary Ranges. Some are specific to particular areas, or act primarily within the Flinders and Olary Ranges, whilst others extend across multiple bioregions or jurisdictions.*

The impacts of these threats also vary with time. The main threats to biodiversity in the Flinders and Olary Ranges include:

## **Excessive total grazing pressure**

The combined effects of excessive grazing pressure from domestic stock and feral and native herbivores.

**Impact:** Reduction in recruitment of some native plant species (decreasers); increase in recruitment of some unpalatable native plant species (increasers); loss of native animals due to competition for resources; reduction in habitat quality; increased soil erosion and increased spread of weeds and disease.

## **Alteration to natural water flows**

Restrictions to natural flow or flooding regimes of a watercourse due to diversions or the construction of artificial flow barriers and storage areas, including seismic lines, tracks, roads, borrow pits, dams and other infrastructure.

**Impact:** Change in ecosystem structure; disruption of dispersal mechanisms of aquatic species; loss of refuges and increased soil erosion and salinity.

## **Competition for resources by pest plants and animals**

Introduced fauna and flora species compete with native species for resources.

**Impact:** Reduction in recruitment and density of native plants and animals; change in species composition of ecosystems and potential loss of native plants and animal species.

## **Excessive predation**

Hunting and consumption of native animals by introduced carnivores.

**Impact:** Change in species composition of ecosystems and potential loss of native animals.

## **Altered fire regimes**

Changes to intensity, season and frequency of fire from the previous regime under which the ecosystem evolved.

**Impact:** Change in ecosystem structure and habitat value and loss of local populations of plants and animals.

## Mechanical disturbance

Changes to the vegetation cover as a consequence of human activity that leaves the soil exposed.

**Impact:** Loss of habitat and reduction in habitat value for native species; increased potential spread of weeds and increased native species and increased soil erosion.

## Pollution

Reduction in quality of ground and/or surface water as a consequence of human activity.

**Impact:** Loss of native species and decline in habitat value in and surrounding waterholes.

## Climate change

Changes in rainfall patterns and increase in temperature.

**Impact:** Reduction in the geographic range of species; changes in the location, structure and composition of habitats and ecosystems; increased risk of extinction of already vulnerable species and expansion of invasive species.

### European impact on the Flinders and Olary Ranges and implications for biodiversity

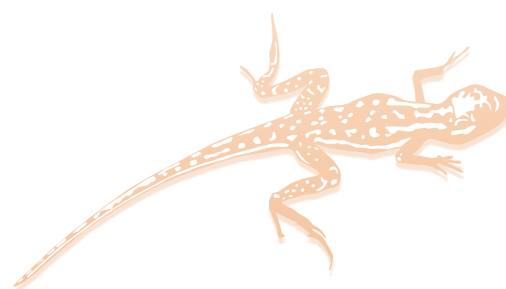
The semi-arid environment of the Flinders and Olary Ranges is particularly fragile. Much of the region was taken up for pastoral production in the mid to late 1800s. Stocking rates were among the highest in Australia during the early pastoral years. The arrival and persistence of foxes, rabbits, feral cats, goats and donkeys has contributed to the further degradation of these ecosystems. Many small to medium-sized mammals and some birds and reptiles had all but disappeared from the region by 1900.

Fifty native mammal species were likely to have occurred in the Flinders and Olary Ranges prior to European settlement and around half of these had become extinct within 50 years of settlement. The greatest impact was borne by small to medium-sized mammals weighing between 50 grams and five kilograms (Critical Weight Range).

The most likely causes for Critical Weight Range extinctions are:

- Competition with and impact of introduced herbivores.
- Competition with and impact of introduced predators.
- Changed fire frequency, intensity and extent.

Critical Weight Range mammals in arid Australia are highly dependent on drought refuges. These are relatively rare and fertile habitats that provide small remnant populations with sufficient food, shelter and water resources to survive drought.







## Section 2

# CONSERVATION PRIORITIES

### Identifying conservation priorities

Biodiversity exists at three levels - genes, species and ecosystems - and occurs at a variety of scales, from square metres to thousands of square kilometres. At each of these levels, it is necessary to identify thresholds where species, ecosystems or landscapes are recognised as priorities for targeted investment. Conservation priorities addressed by this strategy include:

**Threatened species;** Identified as Critically Endangered, Endangered or Vulnerable under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

**Endemic species;** Identified as occurring only within a single bioregion.

**Threatened ecological communities;** Identified as Critically Endangered, Endangered or Vulnerable under the Australian Government's Environment Protection and Biodiversity Conservation Act 1999, or identified in Neagle (2003) An Inventory of the Biological Resources of the Rangelands of South Australia.

**Significant ecological processes;** Significant ecological processes are those identified as being significant in maintaining the viability of species, communities, ecosystems or landscapes.

**Other species or communities considered to be at risk** but not currently listed under the Commonwealth Government's Environment Protection and Biodiversity Conservation Act 1999.

Conservation priorities have been presented within this strategy as either significant ecological processes or groupings of species and ecological communities that share a common set of conservation requirements at similar spatial scales. Individual conservation priorities have been grouped under the major landforms in the region.

### Mapping conservation priorities at multiple scales

This strategy follows the method of Brandle (1998), and uses broad landform patterns to group vegetation communities and categorise the landscape. Vegetation communities, landsystems, subregions and IBRA bioregions are all categorised by the dominant landform at their respective scales. Whilst the distribution of biodiversity correlates strongly with landforms within bioregions, ecological processes, disturbance regimes and land use influence the distribution of biodiversity within the landscape.

Landform	Conservation priority	
Drainage lines and floodplains	River Red Gum woodland on drainage lines and floodplains and floodplains	<b>Threatened ecological community</b> <ul style="list-style-type: none"> <li>River Red Gum woodland</li> </ul>
	Permanent and semi-permanent streams and waterholes and waterholes	<b>Significant ecological process</b> <ul style="list-style-type: none"> <li>Ecological response to surface water</li> </ul>
	Significant and endemic species in drainage lines	<b>Nationally threatened fauna</b> <ul style="list-style-type: none"> <li>Flinders Ranges Purple-spotted Gudgeon (<i>Mogurnda clivicola</i>)</li> </ul> <b>Endemic Fauna</b> <ul style="list-style-type: none"> <li>Streambank Froglet (<i>Crinia riparia</i>)</li> </ul>
Plains and rises	Significant bird species in chenopod shrubland	<b>Nationally threatened fauna</b> <ul style="list-style-type: none"> <li>Thick-billed Grasswren (<i>Amytornis textilis modestus</i>)</li> <li>Slender-billed Thornbill (<i>Acanthiza iredalei iredalei</i>)</li> </ul>
	Bullock Bush tall shrubland and significant plant species on alluvial plains	<b>Threatened ecological community</b> <ul style="list-style-type: none"> <li>Bullock Bush tall shrubland</li> </ul> <b>Nationally threatened flora</b> <ul style="list-style-type: none"> <li>Murray Swainson-pea (<i>Swainsona murrayana</i>)</li> </ul>
	Plains-wanderer in sparse grassland and mixed grassland/herbland	<b>Nationally threatened fauna</b> <ul style="list-style-type: none"> <li>Plains-wanderer (<i>Pedionomus torquatus</i>)</li> </ul>
	Mulga and Needle Wattle low woodlands on low dunes and sand plains	<b>Threatened ecological communities</b> <ul style="list-style-type: none"> <li>Mulga woodland on sand plains</li> <li>Needle Wattle woodland on sand plains</li> </ul>
Ranges and hills	Ecological communities on high ranges	<b>Threatened ecological communities</b> <ul style="list-style-type: none"> <li><i>Eucalyptus flindersii</i> mallee</li> <li><i>Eucalyptus intertexta</i> woodland</li> <li><i>Allocasuarina verticillata</i> woodland</li> <li><i>Triodia</i> spp. grassland</li> </ul> <b>Nationally threatened flora</b> <ul style="list-style-type: none"> <li>Desert Greenhood (<i>Pterostylis xerophila</i>)</li> <li><i>Dodonaea subglandulifera</i></li> <li>Menzel's Wattle (<i>Acacia menzeli</i>)</li> </ul> <b>Endemic flora</b> <ul style="list-style-type: none"> <li>Arkaroola Wattle (<i>Acacia confluens</i>)</li> <li>Baratta Wattle (<i>Acacia barattensis</i>)</li> <li><i>Eucalyptus goniocalyx</i> ssp. <i>exposa</i></li> <li>Flinders Ranges Ixodia (<i>Ixodia flindersica</i>)</li> <li>Nectar Brook Wattle (<i>Acacia spooneri</i>)</li> <li>Quorn Wattle (<i>Acacia quornensis</i>)</li> <li>Sandalwood Emubush (<i>Eremophila santalina</i>)</li> </ul>
	Yellow-footed Rock-wallaby on ranges and hills	<b>Nationally threatened fauna</b> <ul style="list-style-type: none"> <li>Yellow-footed Rock-wallaby (<i>Petrogale xanthopus xanthopus</i>)</li> </ul>
	Significant and endemic plant species on low ranges and hills	<b>Nationally threatened flora</b> <ul style="list-style-type: none"> <li>Balcanoona Wattle (<i>Acacia araneosa</i>)</li> <li>Slender Bell-fruit (<i>Codonocarpus pyramidalis</i>)</li> <li>Small-leaved Xerothamnella (<i>Xerothamnella parvifolia</i>)</li> </ul>

# Drainage lines and floodplains

These landforms are characterised by ephemeral watercourses that drain into four surface-water basins. The majority of these watercourses drain into Lake Frome in the north-east. Surface water from the south-eastern margin of the Olary Spur and Barrier Range drains into the Lower Murray, whilst drainage lines on the southern margins of the Central Flinders flow into the Willochra Creek drainage basin. On the western side of the Central and Northern Flinders, drainage is westerly into Lake Torrens.

River Red Gums (*Eucalyptus camaldulensis*) are the predominant overstorey species along major drainage lines, being replaced by River Box (*Eucalyptus largiflorens*) in the north-east of the Barrier Range Outwash subregion. Minor watercourses tend to be dominated by Elegant Wattle (*Acacia victoriae*) tall shrubland over chenopods, grading into low shrubland associated with the more saline terminal flood-outs. Ephemeral swamps tend to be dominated by a variety of woodlands, tall shrublands or tall grasslands.

## Significance of drainage lines and floodplains

Drainage lines, floodplains and swamps provide significant habitat for many terrestrial and aquatic species that would otherwise not occur within the Flinders and Olary Ranges. River Red Gums are the most striking feature of drainage lines in the region, providing significant habitat for a range of species and functioning as corridors for the movement of species through the landscape. Very few fauna species are restricted entirely to drainage lines, with species composition being driven primarily by the composition and structure of adjacent vegetation types. The north – south variation in vegetation is less significant in these landforms. Compositional changes along the length of individual drainage lines are much greater.

Along drainage lines, permanent and near-permanent waterholes act as refuges for aquatic species, enabling them to survive extended dry periods. These areas are also important for water-dependent terrestrial species. Consequently, many of these waterholes are critical for maintaining the diversity of species in the region.

## Major vegetation communities

### Woodland

River Box (*Eucalyptus largiflorens*) low open woodland over Desert Spinach (*Tetragonia eremaea*), Wild Turnip (*Brassica tournefortii*) and Buckbush (*Salsola tragus*) and other ephemeral herbs along stream channels and in swamps.

River Red Gum (*Eucalyptus camaldulensis*) +/- Northern Cypress Pine (*Callitris glaucophylla*) woodland over +/- Inland Paper-bark (*Melaleuca glomerata*) +/- Elegant Wattle (*Acacia victoriae*) +/- Broughton Willow (*Acacia salicina*) and grasses and ephemeral herbs along larger watercourses.

Coolibah (*Eucalyptus coolabah*), River Cooba (*Acacia stenophylla*) +/- Broughton Willow (*Acacia salicina*), low open woodland over Lignum (*Muehlenbeckia florulenta*) and grasses and ephemeral herbs along drainage lines, particularly in the plains north of the Flinders Ranges.

### Shrubland

Nitrebush (*Nitraria billardiarei*), Spiny Saltbush (*Rhagodia spinescens*) and Black Bluebush (*Maireana pyramidata*) +/- Old-man Saltbush (*Atriplex nummularia* spp. *nummularia*) low shrubland on slightly saline terminal flood-outs.

Elegant Wattle (*Acacia victoriae*) tall open shrubland over Black Bluebush (*Maireana pyramidata*), Spiny Saltbush (*Rhagodia spinescens*) and Bottlewashers (*Enneapogon* spp.) and Bindyi (*Sclerolaena* spp.) along minor drainage lines in footslopes and plains.

## Chenopod shrubland

Cottonbush (*Maireana aphylla*), Black Bluebush (*Maireana pyramidata*) +/- Spiny Saltbush (*Rhagodia spinescens*) low sparse shrubland over Bindyi (*Sclerolaena* spp.) and Mulga Grass (*Aristida contorta*) and Neverfail (*Eragrostis setifolia*) on run-on areas, flood-outs and minor stream channels.

Black Bluebush (*Maireana pyramidata*), Spiny Saltbush (*Rhagodia spinescens*), Bladder Saltbush (*Atriplex vesicaria*) and Low Bluebush (*Maireana astrotricha*) open chenopod shrubland with emergent Elegant Wattle (*Acacia victoriae*) over ephemeral herbs, grasses and Bindyi (*Sclerolaena* spp.) along minor stream channels and floodplains.

Samphire (*Tecticornia* spp.) and Pop Saltbush (*Atriplex holocarpa*) low shrubland on frequently inundated saline flats.

## Herbland

Sunrays and Everlasting Daisies (*Rhodanthe* spp.) +/- Bottlewashers (*Enneapogon* spp.) and Bindyi (*Sclerolaena* spp.) low herbland associated with gypseous soils adjacent to salt lakes.

## Grassland

Swamp Cane-grass (*Eragrostis australasica*) +/- Lignum (*Muehlenbeckia florulenta*) tall grassland over annual saltbush (*Atriplex* spp.) and ephemeral herbs in non-saline swamps.



### Nationally threatened fauna

- Flinders Ranges  
Purple-spotted Gudgeon  
(*Mogurnda clivicola*)



### Endemic fauna

- Streambank Froglet  
(*Crinia riparia*)



### Threatened ecological communities

- River Red Gum woodland  
on drainage lines

Tree-lined watercourses and springs provide suitable habitat for skinks, geckoes, legless lizards and frogs, including the Streambank Froglet. The Streambank Froglet is endemic to the Flinders Ranges and occurs in suitable streams and springs along the length and breadth of the ranges. Accumulated leaf litter provides cover for lizards, goannas and snakes. The large Carpet Python, which is now extremely rare, and the smaller Stimson's Python, rest in tree hollows and rock crevices and during warm weather move around on the ground at night to hunt. Over recent years, there has been an increase in the number of python sightings in some parts of the Flinders Ranges. These increases may be linked to a decrease in fox numbers following the release of Rabbit Haemorrhagic Disease (RHD) and fox baiting programs.



## Managing the biodiversity of drainage lines and floodplains – practical ways that land managers can help

The main driver of biological activity in the arid areas is water. When the amount or intensity of rainfall over the Flinders and Olary bioregion results in water runoff, surface water converges into drainage lines and eventually, if the flows are large enough, onto floodplains. These areas hold more water for longer periods and are more productive than the surrounding landscape. Drainage lines and floodplains are often the focus for pest plants, camping by humans and grazing of both native and introduced herbivores. These pressures contribute to the reduced recruitment of perennial shrub and tree species, negative impacts on waterhole wildlife through increased pollution and increased water use.

Practical strategies that land managers can use on drainage lines and floodplains to help retain biodiversity include:

- Promote biodiversity by fencing off springs to reduce total grazing pressure and associated impacts.
- Especially after heavy rains, reduce total grazing pressure to enable recruiting or emerging plants and trees to establish.
- Maximise vegetation cover to help slow water runoff and promote water infiltration after rains. This has other flow-on benefits including:
  - Greater infiltration of water into the soil increases plant growth.
  - Increased vegetation cover protects the soil from erosion and reduces sediment in runoff waters.
  - Lower flows along drainage lines are less likely to scour and erode banks of watercourses.
- Control feral herbivores and pest plants in collaboration with neighbours and the SAAL NRM Board.

## Conservation priority

### River Red Gum woodland on drainage lines and floodplains

River Red Gum (*Eucalyptus camaldulensis*) woodland occurs along drainage lines in most ephemeral watercourses throughout the semi-arid zone of the southern rangelands in South Australia. Usually a linear feature along drainage lines, it sometimes covers more extensive areas on floodplains.

This ecological community is associated with all major watercourses in the Flinders Ranges, although becoming patchier in the Olary Spur subregion. In the Broken Hill Complex bioregion, it is occasionally with the major watercourses draining east from the Flinders Ranges to Lake Frome, and occasionally along creek lines emanating from the Olary Ranges. Understorey composition varies widely. Around permanent water, sedges and rushes are common, whilst on some alluvial flood-outs White Cypress-pine and Inland Teatree are present. Acacia, chenopod shrublands and open tussock grasslands are variously dominant in the understorey.

Major threats include competition from environmental weeds such as Pepper Tree (*Schinus molle*) in the Olary Ranges, and Oleander (*Nerium oleander*) and Wheel Cactus (*Opuntia robusta*) in the Flinders Ranges. Excessive grazing has also altered the species composition, relative abundance and state of the physical environment across the entire range of the ecological community. The understorey is usually heavily modified, and in some places, excessive grazing has severely reduced River Red Gum regeneration. Within the Flinders Ranges, groundwater processes may also be affecting the survival of River Red Gum trees. The maintenance and improvement of this woodland community requires the development of strategies, including the reduction of total grazing pressure, to promote regeneration of both River Red Gum and associated understorey.

### 20-year target

The maintenance or improvement of the viability of River Red Gum woodland on drainage lines within the Flinders and Olary Ranges.

### 5-year performance information

- Percentage of potential area occupied by River Red Gum woodland on drainage lines within IBRA subregions.
- Condition of individual occurrences of River Red Gum woodland on drainage lines within IBRA subregions.

### 5-year actions

- Determine the current extent and condition of River Red Gum woodlands on drainage lines by IBRA subregion.
- Identify the potential area of occupancy of River Red Gum woodlands on drainage lines by IBRA subregion.
- Identify and, where possible, quantify the disruption, and sources of disruption, of key ecological processes supporting individual occurrences of River Red Gum woodlands on drainage lines.
- Rank individual occurrences of River Red Gum woodland along drainage lines within IBRA subregions for viability, based on size, condition and landscape context.
- Support land managers to improve River Red Gum woodlands on drainage lines.



## Conservation priority

### Permanent and semi-permanent streams and waterholes

Permanent and semi-permanent streams and waterholes are an important resource to the pastoral industry as well as providing significant terrestrial and aquatic habitat and fauna refuge areas. The Flinders Lofty Block bioregion supports a much larger number of permanent and semi-permanent streams and waterholes than the Broken Hill Complex where they are largely restricted to the Bimbowrie subregion .

Most permanent and semi-permanent streams and waterholes in the Flinders and Olary Ranges are supplied by groundwater. Major threats to water quality are nutrient enrichment, pollution, erosion and sedimentation, excessive water extraction and diversion, and infiltration of saline groundwater. Many aquatic and riparian habitats in the region have benefited from the control of introduced herbivores, management of tourism impacts and improved management of water extraction.

Limited information is available on species reliant on habitats provided by Flinders Ranges streams, and further research is needed on the hydrogeological characteristics, location of waterholes and habitat requirements of individual species.

### 20-year target

The maintenance or improvement of the biodiversity values of permanent and semi-permanent streams and waterholes.

### 5-year performance information

- Number of permanent and semi-permanent waterholes managed for biodiversity values.

### 5-year actions

- Establish criteria for scoring the condition of permanent and semi-permanent waterholes.
- Undertake biological surveys and identify biodiversity values, and prioritise permanent and semi-permanent waterholes along drainage lines.
- Identify the extent and intensity of threatening processes that reduce biodiversity value of permanent and semi-permanent waterholes.
- Develop conceptual models to describe groundwater processes that support waterholes in the Flinders and Olary Ranges.
- Support land managers to maintain and improve biodiversity values of priority permanent and semi-permanent waterholes.
- Undertake targeted restoration of permanent and semi-permanent waterholes, based on condition, biodiversity value and linkage requirements.

## Conservation priority

### Significant and endemic species in drainage lines

The Flinders Ranges Purple-spotted Gudgeon (*Mogurnda clivicola*) is one of seven fishes represented in the northern Flinders Ranges, of which five are native and two introduced. Very little is known about the distribution and habitat requirements of the other six species or any population trends.

The Flinders Ranges Purple-spotted Gudgeon is the only known species in the Flinders Ranges to be a habitat specialist. Specific to spring-fed rocky-bottomed streams, approximately 4,000 individuals live in Balcanoona Creek and nearby streams. A potential threat to the sustainability of native fishes in the Flinders Ranges is the invasion of the introduced Mosquito Fish (*Gambusia holbrooki*). Mosquito Fish are known to be in Spencer Gulf, Lake Torrens and Lake Eyre drainage systems, although they have not yet been recorded in the Flinders Ranges.

The Streambank Froglet (*Crinia riparia*) is endemic to South Australia and restricted to the Flinders and Gammon Ranges, found under rocks and stones in intermittently flowing streams. Because of the seasonality of the rain and periodic flooding, the tadpoles of these frogs have sucker mouthparts and a streamlined, flattened profile adapted to hold on to rocks even in canyons where water can sometimes flow very rapidly.

Global climate change is a potential threat to many of Australia's frogs. Changes in local weather conditions, including different rainfall patterns and temperatures can affect the ecology of frogs by forcing populations to alter habitat use and spawning times. Since frogs rely on water to breed, any reduction or change in rainfall could reduce frog reproduction and recruitment through premature drying of breeding pools. Generally drier conditions may also result in higher adult mortality from increased internal water loss through the frog's permeable skin.

Current research also shows that many chemicals contained in pesticides, surfactants and fertilisers are harmful to frogs and more studies are required.

### 20-year target

The maintenance or improvement of the viability of the Purple-spotted Gudgeon and Streambank Froglet in the Flinders and Gammon Ranges.

### 5-year performance information

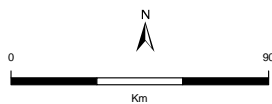
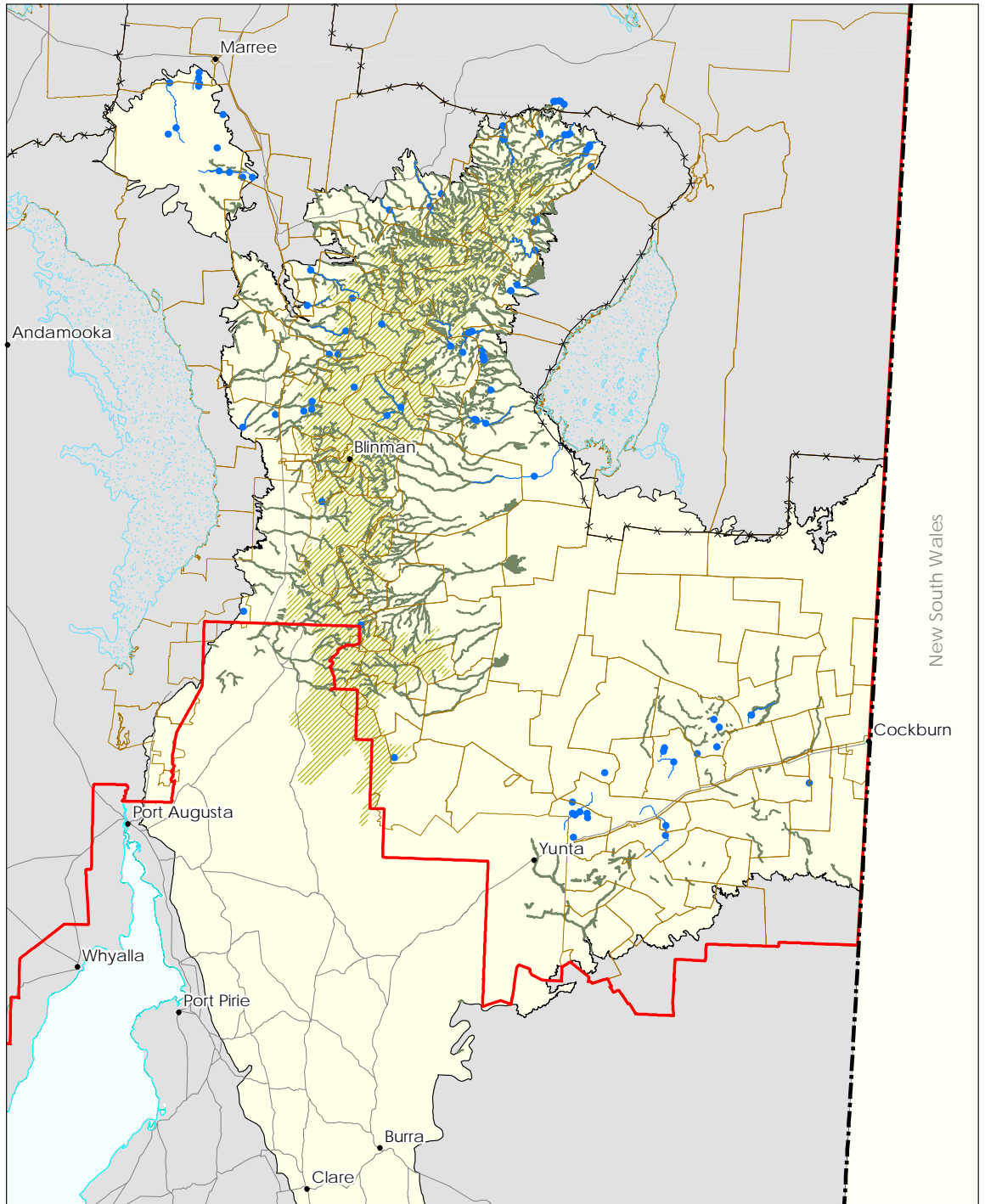
- Percentage of potential habitat occupied by the Purple-spotted Gudgeon and Streambank Froglet in the Flinders and Gammon Ranges.
- Number and viability of subpopulations of the Purple-spotted Gudgeon and Streambank Froglet.

### 5-year actions

- Verify existing subpopulations and undertake surveys for new subpopulations.
- Identify critical and potential habitats.
- Determine and manage the impact of tourism and introduced herbivores on habitat condition.
- Develop conceptual model of the processes associated with the surface water – groundwater interaction of creeks supporting these species.
- Establish an ex-situ population of Purple-spotted Gudgeon.
- Assess the current distribution of the Mosquito Fish (*Gambusia holbrooki*) within the Flinders Ranges and develop a risk management strategy.



# Conservation priorities for drainage lines and floodplains



Mapped conservation priorities provide an indication of the potential distribution

## Conservation priorities

- Significant and endemic species in drainage lines
- River Red Gum woodland on drainage lines and floodplains
- Permanent and semi-permanent streams
- Permanent and semi-permanent waterholes
- Broken Hill Complex and Flinders Lofty Block Bioregions
- South Australian Arid Lands NRM Region
- Pastoral Station
- Salt Lake
- Dog Fence
- Major Road
- State Border
- Locality



## Plains and rises

This landform is characterised by alluvial plains with sandy red duplex soils, red-cracking clays, plains with calcareous soils, and deeper duplex soils associated with ranges. This landform is typical of the Barrier Range Outwash, Telechie Plains and Barrier Range subregions, and important, but less dominant, in the Northern Flinders, Central Flinders, Olary Spur and Bimbowrie subregions.

Chenopod shrublands are common and extensive in this landform, variously dominated by Bladder Saltbush (*Atriplex vesicaria*), Low Bluebush (*Maireana astrotricha*), Pearl Bluebush (*M. sedifolia*), Black Bluebush (*M. pyramidata*) and Cottonbush (*M. aphylla*). These chenopod shrublands often form a mosaic with other communities such as low woodland, low shrubland and ephemeral grassland. In sandier country, Sandhill Wattle (*Acacia ligulata*), Hop-bush (*Dodonaea* spp.) and Mulga (*Acacia aneura*) variously dominate the overstorey, with a chenopod or hummock grass (*Triodia* spp.) understorey.

### Significance of plains and rises

Plains and rises are highly productive areas mainly supporting chenopod shrublands that respond to rain at any time of the year. Historically, this landform has been highly modified by clearance for agriculture along the southern margin of the region, and by stocking at rates that would now be considered unsustainable. Land condition varies significantly across the region, with some areas near water highly altered. Plains and rises generally support low species diversity, yet provide critical habitat for a number of threatened plants and animals, including Needle Wattle (*Acacia carneorum*), Plains-wanderer (*Pedionomus torquatus*), Thick-billed Grasswren (*Amytornis textilis modestus*) and Slender-billed Thornbill (*Acanthiza iredalei iredalei*).

### Major vegetation communities

#### Woodland

Black Oak (*Casuarina pauper*) +/- Bullock Bush (*Alectryon oleifolius*) low woodland over Sennas (*Senna artemisioides* spp.) and chenopods (*Maireana* spp./*Atriplex* spp.) and Bindyi (*Sclerolaena* spp.) on footslopes and sandy to clay loam soils.

Mulga (*Acacia aneura*), Western Myall (*Acacia papyrocarpa*) low open woodland over Flat-stalk Senna (*Senna artemisioides* ssp. *petiolaris*) and chenopods (*Atriplex* spp./*Maireana* spp.) and Bindyi (*Sclerolaena* spp.) on dunes and sand plains in the west.

Mulga (*Acacia aneura*) low open woodland over Bottlewashers (*Enneapogon* spp.) and Pop Saltbush (*Atriplex holocarpa*) and ephemeral herbs on sandy plains and rises.

#### Mallee

White Mallee (*Eucalyptus dumosa*), Red Mallee (*Eucalyptus socialis*) +/- False Sandalwood (*Myoporum platycarpum*) open mallee over Tar Bush (*Eremophila glabra*), Broad-leaved Senna (*Senna artemisioides* ssp. *coriacea*) and Narrow-leaved Hop Bush (*Dodonaea viscosa* ssp. *angustissima*) and Spinifex (*Triodia irritans*) on sandy plains and rises.

Yorrell (*Eucalyptus gracilis*) Red Mallee (*Eucalyptus oleosa*) +/- White Mallee (*Eucalyptus dumosa*) open mallee over Sennas (*Senna artemisioides* spp.) and chenopods (*Atriplex* spp./*Maireana* spp.) and Sand Twinleaf (*Zygophyllum aurantiacum*) on sand or loamy plains.

Photo: Chenopod shrubland

In the Flinders and Olary Ranges, the Short-beaked Echidna (*Tachyglossus aculeatus*) is widespread but uncommon, occurring wherever its staple food of ants and termites is available. It also consumes ant and termite eggs, larvae and pupae by licking them from ant nests or termite mounds with its long sticky tongue after breaking in using its strong front claws and snout. Echidnas are capable swimmers, able to cross streams and survive floods.

Whilst a number of small to medium-sized mammals in the Flinders and Olary region have become extinct, the Echidna has managed to remain widespread. This could be explained by its long sharp spines interspersed with coarse hair on its back, enabling it to protect itself from predators. Echidnas less than one year old are, however, susceptible to predation by foxes, as their spines are not sufficiently developed and foxes can sniff out the young animals concealed in their nest while the adults are out feeding. Population growth of the Echidna is extremely slow due to laying only one egg per year.

Their characteristic diggings range from simple nose pokes and shallow pits to deeper excavations. Recent work in western New South Wales has found that these foraging pits provide ideal microhabitat for seed germination. The soil is less dense and the pits trap water, litter and nutrients. These studies show the importance of Echidna foraging as resource traps in arid and semi-arid areas, contributing to the ecological functioning of these ecosystems.

Recently, there has been an increase in Echidna sightings in some parts of the Flinders and Olary Ranges. This increase may be linked to a decrease in fox numbers following the release of Rabbit Haemorrhagic Disease (RHD) and fox baiting programs.

## Shrubland

Sandhill Wattle (*Acacia ligulata*) and Narrow-leaved Hopbush (*Dodonaea viscosa* ssp. *angustissima*) open shrubland with emergent Black Oak (*Casuarina pauper*) over Senna (*Senna artemisioides* ssp. *petiolaris*) +/- Sandhill Cane-grass (*Zygochloa paradoxa*) on sand dunes and sand plains.

Elegant Wattle (*Acacia victoriae*) +/- Harlequin Emu Bush (*Eremophila duttonii*) +/- Flat-stalk Senna (*Senna artemisioides* ssp. *petiolaris*) +/- Dead Finish (*Acacia tetragonophylla*) open shrubland over chenopods (*Maireana* spp./*Atriplex* spp.) and grasses and Bindyi (*Sclerolaena* spp.) on plains, footslopes and rises east of the ranges.

## Chenopod shrubland

Poverty Bush (*Sclerolaena divaricata*) and Ball Bindyi (*Dissocarpus paradoxus*) low open shrubland with ephemeral herbs and grasses on gilgai and low lying areas.

Bindyi (*Sclerolaena* spp.) and Bottle Washers (*Enneapogon* spp.) and Ward's Weed (*Carrichtera annua*) very low open shrubland on plains.

Bladder Saltbush (*Atriplex vesicaria*) and Low Bluebush (*Maireana astrotricha*) +/- Black Bluebush (*Maireana pyramidata*) open chenopod shrubland over grasses and Bindyi (*Sclerolaena* spp.) on plains and rises.

Low Bluebush (*Maireana astrotricha*) +/- Black Bluebush (*Maireana pyramidata*) +/- Bladder Saltbush (*Atriplex vesicaria*) open chenopod shrubland over grasses and Bindyi (*Sclerolaena* spp.) on plains with red duplex soils.

Bladder Saltbush (*Atriplex vesicaria*), Oodnadatta Saltbush (*Atriplex nummularia* ssp. *omissa*), Low Bluebush (*Maireana astrotricha*) and Black Bluebush (*Maireana pyramidata*) open chenopod shrubland over grasses and Bindyi (*Sclerolaena* spp.) on slightly saline stony plains.

## Grassland

Mitchell Grass (*Astrebla pectinata*) low open grassland over Poverty Bush (*Sclerolaena divaricata*), Long-spined Poverty Bush (*Sclerolaena longicuspis*) and grasses and daisies on highly erodible clay soils on plains.

Mitchell Grass (*Astrebla pectinata*) and Ray Grass (*Sporobolus actinocladus*) low open grassland over Bonefruit (*Osteocarpum acropterum*) and Bindyi (*Sclerolaena* spp.) on stony plains.

## Managing the biodiversity of plains and rises – practical ways that land managers can help

The plains and rises of the Flinders and Olary bioregion provide a mosaic of habitat for a wide range of native animals. Due to their extensive nature, plains and rises are also significant in supporting the pastoral industry within the region.

Practical strategies that land managers can use on plains and rises to help retain biodiversity include:

- Identify a threshold of grazing intensity that results in both perennial and annual plants, not being grazed below a certain height or biomass. This will then enable the plant to seed and also a rapid plant response when beneficial rains fall.
- Manage total grazing pressure to maintain enough plant cover to protect the soil surface. This includes the management of both domestic and feral animals.
- Align access tracks and fence lines away from slopes and onto less erosion prone soil types where possible.
- Avoid grading windrows along tracks, and install water diversion banks at strategic locations along tracks if necessary.
- Avoid locating water points on lighter sand plain areas that may have potential for instability. Where possible, locate water points on the leeward side of rises, as this decreases erosion potential.
- Control feral herbivores and pest plants in collaboration with neighbours and the SAAL NRM Board.





## Conservation priority

### Significant bird species in chenopod shrubland

Two threatened bird species, the Thick-billed Grasswren (*Amytornis textilis modestus*) and the western subspecies of the Slender-billed Thornbill (*Acanthiza iredalei iredalei*), inhabit chenopod shrublands.

The Thick-billed Grasswren has been recorded in the Northern Flinders, Olary Spur and Bimbowrie subregions. Presumed to be extinct in New South Wales, the population in the Broken Hill Complex bioregion represents the eastern extent of this subspecies' range. Its main range is in the Stony Plains bioregion, with small populations remaining in the Gawler bioregion.

Recent sightings of the Slender-billed Thornbill have confirmed its presence in the Bimbowrie subregion of the Broken Hill Complex bioregion. This is the eastern extent of its distribution. Historical records of this species show it is also present within the Flinders Ranges and as far south as Peterborough in the Mid North. In the SAAL region, this subspecies has also been recorded in the Gawler bioregion and on breakaway tablelands in the Stony Plains bioregion.

Both the Thick-billed Grasswren and Slender-billed Thornbill are extremely shy and occupy chenopod shrublands, particularly those dominated by Saltbush (*Atriplex* spp.) and Bluebush (*Maireana* spp.). The major threat to these species is the loss of shrub cover resulting from excessive total grazing pressure. Reduction in vegetation cover and lack of recruitment may result in increased predation from cats and foxes.

### 20-year target

The maintenance or improvement of the viability of significant bird species in chenopod shrublands in the Flinders and Olary Ranges.

### 5-year performance information

- Percentage of potential habitat occupied by significant bird species in chenopod shrubland in the Flinders and Olary Ranges.
- Number and viability of populations of significant bird species in chenopod shrubland in the Flinders and Olary Ranges.

### 5-year actions

- Determine area of occupancy and relationship between habitat and distribution and abundance of significant bird species in chenopod shrubland.
- Identify and where possible, quantify the disruption and sources of disruption of key ecological processes supporting individual populations of significant bird species in chenopod shrubland.
- Identify potential habitats in the Flinders and Olary Ranges for significant bird species in chenopod shrubland.
- Rank populations of significant bird species in chenopod shrubland within IBRA subregions for viability, based on size, threats and landscape context.
- Support land managers to improve the viability of significant bird species in chenopod shrubland in controlling feral animals and overabundant native herbivores and promoting appropriate grazing practices.

Photo: White-fronted Chat *Epthianura albifrons*



## Conservation priority

### **Bullock Bush tall shrubland and significant plant species on alluvial plains**

Bullock Bush (*Alectryon oleifolius* ssp. *canescens*) tall shrubland on alluvial plains is a widespread ecological community of semi-arid and arid regions of South Australia and western New South Wales. It is also in the Gawler bioregion. In the Flinders and Olary Ranges, this ecological community occurs in all IBRA subregions, often in groves in open grassland, shrubland, or open low woodland. Despite its widespread distribution, there is little evidence of Bullock Bush regeneration, and understorey is often degraded. Excessive grazing, primarily by rabbits, goats and domestic stock, contributes to the degradation of this ecological community. The reduction in rabbit numbers from Rabbit Haemorrhagic Disease (RHD) appears to have brought about an improvement in the condition of this ecological community. However, the extent and significance of this apparent improvement is unknown.

The Murray Swainson-pea (*Swainsona murrayana*) grows on heavy soils. It is a slender herb, found in depressions where water pools and is often associated with bluebush. In South Australia, this species is restricted to the Flinders and Olary Spur subregions and the South Australian parts of the Broken Hill Complex bioregion. The South Australian population is geographically isolated from populations in Victoria, New South Wales and Queensland.

The Murray Swainson-pea requires further investigation to assess its status in the region.

### **20-year target**

The maintenance or improvement of the viability of Bullock Bush tall shrubland and significant plant species on alluvial plains within the Flinders and Olary Ranges.

### **5-year performance information**

#### **Bullock Bush tall shrubland**

- Percentage of potential area occupied by Bullock Bush tall shrubland on alluvial plains within IBRA subregions.
- Condition of individual occurrences of Bullock Bush tall shrubland on alluvial plains within IBRA subregions.

#### **Significant plant species**

- Percentage of potential habitat occupied by significant plant species on alluvial plains in the Flinders and Olary Ranges.
- Number and viability of populations of significant plant species on alluvial plains in the Flinders and Olary Ranges.

## 5-year actions

### Bullock Bush tall shrubland

- Determine the current extent and condition of Bullock Bush tall shrubland on alluvial plains by IBRA subregion.
- Identify the potential area of occupancy of Bullock Bush tall shrubland on alluvial plains by IBRA subregion.
- Identify and, where possible, quantify the disruption, and sources of disruption, of key ecological processes supporting individual occurrences of Bullock Bush tall shrubland on alluvial plains.
- Rank individual occurrences of Bullock Bush tall shrubland on alluvial plains within IBRA subregions for viability, based on size, condition and landscape context.
- Support land managers to improve Bullock Bush tall shrubland on alluvial plains in controlling feral animals and overabundant native herbivores and promoting appropriate grazing practices.

### Significant plant species

- Determine area of occupancy and relationship between habitat and distribution and abundance of significant plant species on alluvial plains.
- Identify and, where possible, quantify the disruption, and sources of disruption, of key ecological processes supporting individual populations of significant plant species on alluvial plains.
- Identify potential habitats within the Flinders and Olary Ranges for significant plant species on alluvial plains.
- Rank populations of significant plant species on alluvial plains within IBRA subregions for viability, based on size, threats and landscape context.
- Support land managers to improve the viability of significant plant species on alluvial plains in controlling feral animals and overabundant native herbivores and promoting appropriate grazing practices.



Photo: Tesselated Gecko *Diplodactylus tessellatus*

## Conservation priority

### Plains-wanderer in sparse grassland and mixed grassland/herbland

The Plains-wanderer (*Pedionomus torquatus*) is a distinctive quail-like nomadic ground bird. The Plains-wanderer is sedentary in suitable habitat, and is one of the most difficult species to observe in the field due to its cryptic plumage and nocturnal habits. Few records exist in South Australia, although it has been recorded as an occasional visitor to the Gawler, Stony Plains, Simpson – Strzelecki Dunefields and Channel Country bioregions. Habitat structure rather than species composition is important, as it inhabits naturally sparse grasslands and mixed grasslands/herblands that have bare ground and widely spaced low plants, with the bulk of remaining standing vegetation less than five centre metres high.

The primary habitat stronghold for this species is in the open grasslands of Victoria and New South Wales, with South Australia thought to represent only secondary habitat, and whilst it has been recorded in several SAAL bioregions, it is unclear whether it is a permanent resident. It is, therefore, important to identify critical habitat and determine the status of known populations in the SAAL region to ensure the species' continued viability.

### 20-year target

The maintenance or improvement of the viability of the Plains-wanderer in sparse grassland and mixed grassland/herbland within the Flinders and Olary Ranges.

### 5-year performance information

- Percentage of potential habitat occupied by the Plains-wanderer in sparse grassland and mixed grassland/herbland in the Flinders and Olary Ranges.
- Number and viability of populations of the Plains-wanderer in sparse grassland and mixed grassland/herbland in the Flinders and Olary Ranges.

### 5-year actions

- Determine area of occupancy and relationship between habitat and distribution and abundance of the Plains-wanderer in sparse grassland and mixed grassland/herbland within the Flinders and Olary Ranges.
- Identify and, where possible, quantify the disruption, and sources of disruption, of key ecological processes supporting individual populations of the Plains-wanderer in sparse grassland and mixed grassland/herbland.
- Identify potential habitats in the Flinders and Olary Ranges for the Plains-wanderer in sparse grassland and mixed grassland/herbland.
- Rank populations of the Plains-wanderer in sparse grassland and mixed grassland/herbland within IBRA subregions for viability, based on size, threats and landscape context.
- Support land managers to improve the viability of the Plains-wanderer in sparse grassland and mixed grassland/herbland in controlling feral animals and overabundant native herbivores and promoting appropriate grazing practices.



## Conservation priority

### Mulga and Needle Wattle low woodlands on low dunes and sand plains

Mulga (*Acacia aneura*) low woodland and Needle Wattle (*Acacia carneorum*) low woodland occur on low dunes and sand plains. Mulga low woodland is limited to the few areas of sand plains on the eastern and western margins of the Northern and Central Flinders Ranges and the northern extent of the Barrier Range Outwash subregions. It also occurs in the Gawler, Finke, Simpson – Strzelecki Dunefields, Stony Plains, and Channel Country bioregions. Needle Wattle low woodland occurs predominantly in the Broken Hill Complex bioregion, although it does extend into the northern part of the Olary Spur subregion, and into New South Wales between Broken Hill and Menindee and north towards Tibooburra.

Needle Wattle grows primarily on sandy plains and alluvial soils along watercourses, and can be the locally dominant vegetation form. It reproduces vegetatively and grows in colonies of up to a few hundred plants. As a result, this ecological community generally is a component of other vegetation communities such as open grasslands, shrublands, and open low woodlands on sandy plains.

Both ecological communities are primarily threatened by inhibited regeneration due to excessive total grazing pressure. Whilst cattle are known to graze mature Mulga, rabbits are the most significant component of total grazing pressure as they favour this sandy habitat. Rabbits burrowing in these communities may cause increased erosion, which can be exacerbated by stock if the area is close to watering points. Anecdotal evidence suggests that the reduction in rabbit numbers from RHD has allowed increased recruitment of these ecological communities. However, the extent and significance of this improvement is unknown.

### 20-year target

The maintenance or improvement of the viability of Mulga and Needle Wattle low woodlands on low dunes and sand plains in the Flinders and Olary Ranges.

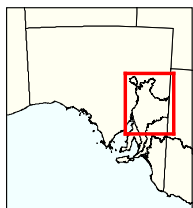
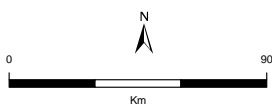
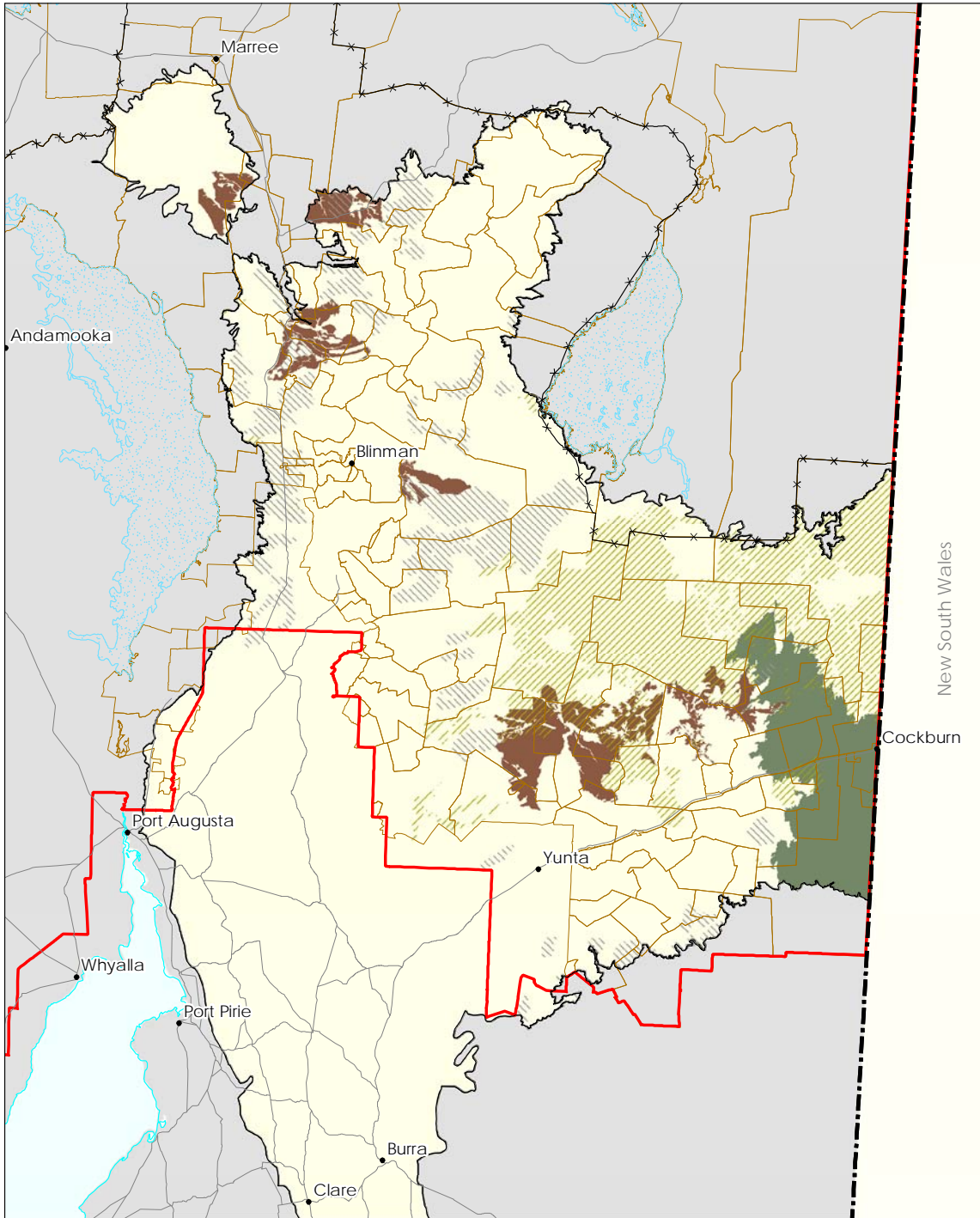
### 5-year performance information

- Percentage of potential area occupied by Mulga and Needle Wattle low woodlands on low dunes and sand plains within IBRA subregions.
- Condition of individual occurrences of Mulga and Needle Wattle low woodlands on low dunes and sand plains within IBRA subregions.

### 5-year actions

- Determine the current extent and condition of Mulga and Needle Wattle low woodlands on low dunes and sand plains by IBRA subregion.
- Identify the potential area of occupancy of Mulga and Needle Wattle low woodlands on low dunes and sand plains by IBRA subregion.
- Identify and where possible, quantify the disruption and sources of disruption of key ecological processes supporting individual occurrences of Mulga and Needle Wattle low woodlands on low dunes and sand plains.
- Rank individual occurrences of Mulga and Needle Wattle low woodlands on low dunes and sand plains within IBRA subregions for viability, based on size, condition and landscape context.
- Support land managers to improve Mulga and Needle Wattle low woodlands on low dunes and sand plains.

# Conservation priorities for plains and rises



Mapped conservation priorities provide an indication of the potential distribution

## Conservation priorities

- Significant bird species in chenopod shrubland
- Plains-wanderer in sparse grassland and mixed grassland/herbland
- Mulga and Needle Wattle low woodlands on low dunes and sand plains
- Bullock Bush tall shrubland and significant plant species on alluvial plains
- Broken Hill Complex and Flinders Lofty Block Bioregions
- South Australian Arid Lands NRM Region
- Pastoral Station
- Salt Lake
- Dog Fence
- Major Road
- State Border
- Locality



## Ranges and hills

This landform is characterised by a series of high quartzite hogback ridges and softer rocks, such as shales, siltstone and limestone and occurs in the Flinders Ranges, Olary Spur, and Bimbowrie subregions.

The height of the Flinders Ranges significantly influences the local climate, creating an area of moister, more temperate habitat in the semi-arid and arid north. This enables species with more temperate climatic requirements to extend their distribution northwards towards Hawker. Further north, these more temperate habitats occur as smaller isolated areas on the highest ridges and plateaux as far north as Freeling Heights and the Mawson Plateau.

The Olary Ranges, a low easterly trending upland branching off the Flinders Ranges, does not have the elevation to significantly alter local climate. The Olary Ranges is dominated by rounded low hills of gneissic granite, with minor metamorphosed sediments.

### Significance of ranges and hills

The ranges provide habitat for many species that would otherwise not survive in the arid climate. The ranges are the most species-rich landform due to higher rainfall and more complex physical structure. The Biological Survey of the Flinders Ranges identified 23 plant, four bird, three reptile and one frog species that have southern affinities north of Hawker. These populations are viewed as population isolates, or relicts, from a much wetter period and contribute to the significance of the Flinders Ranges. This landform is likely to be the most severely affected by predicted temperature increases and lower effective rainfall associated with climate change.

The ranges also support species found in other arid ranges in central Australia. This includes at least eight plant, two bird, one reptile and one mammal. One bird, the Little Woodswallow (*Artamus minor*), may be a nomadic visitor to the Flinders Ranges, dispersing south from central Australia along the western breakaways of the stony deserts and the Stuart Range and across the Willouran Ranges. The Painted Firetail (*Emblema pictum*) probably has some resident populations that may periodically intermix with populations along this same corridor.

A number of species are more closely associated with the mallee belt that runs to the east and west of the Flinders Ranges, with relationships with the Gawler and Olary Ranges and into the Barrier Ranges in New South Wales. The best known of these is the Yellow-footed Rock-wallaby, with a distribution from the Gawler Ranges across to the Olary Spur in South Australia and the Coturaundee Ranges in New South Wales. Four plant species, the Slender Bell-fruit (*Codonocarpus pyramidalis*), the Flinders Ranges Corkwood (*Hakea ednieana*), Curly Mallee (*Eucalyptus gillii*) and Silver Wattle (*Acacia rivalis*), and the southern subspecies of the Masked Rock Skink (*Egernia margaretae* ssp. *personatus*) are shared with arid ranges in western New South Wales.



## Major vegetation communities

### Woodland

Mulga (*Acacia aneura*) low open woodland over Elegant Wattle (*Acacia victoriae*), Rock Fuchsia Bush (*Eremophila freelingii*), Dead Finish (*Acacia tetragonophylla*), Rock Sida (*Sida petrophila*) +/- Lobed Hop Bush (*Dodonaea lobulata*) and daisies and grasses on rocky hills.

Gum-barked Coolibah (*Eucalyptus intertexta*) +/- Northern Cypress Pine (*Callitris glaucophylla*) low open woodland over Narrow-leaved Hop Bush (*Dodonaea viscosa* ssp. *angustissima*) and Flat-stalk Senna (*Senna artemisioides* ssp. *petiolaris*) and grasses on rocky rises.

Northern Cypress Pine (*Callitris glaucophylla*) +/- Yorrell (*Eucalyptus gracilis*) +/- Red Mallee (*Eucalyptus socialis*) low open woodland over Mealy Saltbush (*Rhagodia parabolica*), Curry Bush (*Cassinia laevis*), Lobed Hop Bush (*Dodonaea lobulata*) and Mulla Mulla (*Ptilotus obovatus*) on rocky slopes.

Drooping Sheoak (*Allocasuarina verticillata*) +/- Slaty Sheoak (*Allocasuarina muelleriana*) open woodland over Sword Sedges (*Lepidosperma* spp.) on southern ranges and internal slopes of Wilpena Pound.

### Mallee

Red Mallee (*Eucalyptus socialis*) +/- Yorrell (*Eucalyptus gracilis*) +/- White Mallee (*Eucalyptus dumosa*) open mallee over Broom Bush (*Eremophila scoparia*), Flat-stalk Senna (*Senna artemisioides* ssp. *petiolaris*) +/- Tar Bush (*Eremophila glabra*), Spinifex (*Triodia irritans*) and chenopods (*Maireana* spp./*Atriplex* spp.) and Bindyi (*Sclerolaena* spp.) on ranges and low hills.

Flinders Grey Mallee (*Eucalyptus flindersii*) +/- Northern Cypress Pine (*Callitris glaucophylla*) open mallee over Broombush (*Melaleuca uncinata*); and Grass Tree (*Xanthorrhoea quadrangulata*) and Iron Grass (*Lomandra multiflora* ssp. *dura*) on rocky hills in the Flinders Ranges.

Curly Mallee (*Eucalyptus gillii*) +/- Red Mallee (*Eucalyptus socialis*) open mallee over Dead Finish (*Acacia tetragonophylla*) +/- Balcanoona Wattle (*Acacia araneosa*), Spinifex (*Triodia* sp.) and chenopods (*Maireana* spp.) and Bindyi (*Sclerolaena* spp.) on low calcareous hills in the northern Flinders Ranges.

Red Mallee (*Eucalyptus socialis*), Yorrell (*Eucalyptus gracilis*) +/- False Sandalwood (*Myoporum platycarpum*) +/- Northern Cypress Pine (*Callitris glaucophylla*) open mallee over Rock Sida (*Sida petrophila*), Narrow-leaved Hop Bush (*Dodonaea viscosa* ssp. *angustissima*), Spinifex (*Triodia irritans*) and Bindyi (*Sclerolaena* spp.) and grasses on loamy soils in ranges and hills.

Mallee Box (*Eucalyptus porosa*) +/- Peppermint Box (*Eucalyptus odorata*) +/- Northern Cypress Pine (*Callitris glaucophylla*) open mallee over Curry Bush (*Cassinia laevis*), Clammy Daisy Bush (*Olearia decurrens*) and Spinifex (*Triodia irritans*) and grasses on low hills in the southern Flinders Ranges.

## Shrubland

Elegant Wattle (*Acacia victoriae*), Dead Finish (*Acacia tetragonophylla*) tall open shrubland over Sennas (*Senna artemisioides*), Rock Fuchsia Bush (*Eremophila freelingii*), Lobed Hop Bush (*Dodonaea lobulata*), Rock Sida (*Sida petrophila*), Shrubby Twinleaf (*Zygophyllum aurantiacum*) and Bindyi (*Sclerolaena* spp.) and grasses on rocky ranges and low shaley hills.

Rock Sida (*Sida petrophila*), Mulla Mulla (*Ptilotus obovatus*) low very sparse shrubland over Rock Ferns (*Cheilanthes* spp.) on rocky slopes.

## Chenopod shrubland

Pearl Bluebush (*Maireana sedifolia*), Black Bluebush (*Maireana pyramidata*) open chenopod shrubland over Bindyi (*Sclerolaena* spp.), Ward's Weed (*Carrichtera annua*) and grasses and daisies on footslopes and stony rises with shales and ironstone.

## Grassland

Lemon Scented Grass (*Cymbopogon ambiguus*), Balcarra Spear Grass (*Austrostipa nitida*), and Bottlewashers (*Enneapogon* spp.) low open tussock grassland on slopes of ranges and low shaley hills.

Spinifex (*Triodia irritans*), Lemon Scented Grass (*Cymbopogon ambiguus*) and Balcarra Spear Grass (*Austrostipa nitida*) hummock grassland on ranges and granite hills.

Bottlewashers (*Enneapogon* spp.) and Limestone Copperburr (*Sclerolaena obliquicuspis*) low open tussock grassland with emergent +/- Dead Finish (*Acacia tetragonophylla*) on calcareous shales and siltstones of hills.

Spinifex (*Triodia* spp.) open hummock grassland with a variety of occasional emergent, including Wattles (*Acacia* spp.), Grass Tree (*Xanthorrhoea quadrangulata*), Northern Cypress Pine (*Callitris glaucophylla*) and Mallee (*Eucalyptus* spp.) on rocky ridges in the southern Flinders Ranges.

### Triodia Hummock grassland

*Triodia* hummock grass is a significant plant community in the Flinders and Olary Ranges. A tough dome-shaped plant, *Triodia* provides important habitat for many species. The Short-tailed Grasswren (*Amytornis merrotsyi*) is endemic to the Flinders and Gawler Ranges, and is associated with *Triodia* hummock grass with or without overstorey. In the Flinders Ranges, the Short-tailed Grasswren has been recorded in the north-eastern Flinders Ranges, from the Gammon Ranges in the north to Belton and Dutchman's Stern in the south. All sites where this species has been recorded are characterised by a dense cover of *Triodia* with a shrub, mallee or low woodland overstorey.

## Managing the biodiversity of ranges and hills – practical ways that land managers can help

The elevation of the Flinders Ranges significantly influences the local climate. The increased rainfall over this landform supports a number of threatened and endemic species that would otherwise be unable to survive in the region. This landform has a number of permanent freshwater springs and is an important catchment area for the surrounding rivers, streams, floodplains and lakes.

Practical strategies that land managers can use in ranges and hills to help retain biodiversity include:

- Where possible, provide water for livestock by piping water away from major waterholes or springs and away from the rugged ranges and hills onto more accessible plains.
- Consider fencing off springs to promote recruitment of native plant species and reduce impact caused by the trampling and grazing of stock or feral herbivores.
- Locate stock water points well away from slopes to minimise the risk of erosion caused by the development of stock pads.
- Align access tracks and fence lines away from slopes and onto less erosion prone soil types where possible.
- Avoid grading windrows along tracks and install water diversion banks at strategic locations along tracks if necessary.
- Implement total grazing management strategies.
- Control feral herbivores and pest plants in collaboration with neighbours and the SAAL NRM Board.



### Reptiles of hill slopes and high rocky ridges

A characteristic reptile group is found on hill slopes and high rocky ridges. This distinctive group of species occupies the variety of low woodland, mallee and shrubland types in the Flinders Ranges, particularly where there are hummock grasses in the understorey. Two species are confined to rock slab range environments: the Tawny Dragon (*Ctenophorus decresii*) and the Masked Rock Skink (*Egernia margaretae* ssp. *personatus*). Others such as the Spinifex Snake Lizard (*Delma butleri*), Spinifex Slender Bluetongue (*Cyclodomorphus melanops*) and Jewelled Gecko (*Diplodactylus elderi*) depend on the presence of *Triodia*. This large assemblage is composed of at least two distinctive groups which are combined at many sites because of the presence of rock slab, *Triodia* and mallee in the ranges. Most other species are characteristic of woodlands though some, like the Nobbi Dragon (*Amphibolurus nobbi*), are rarely found away from mallee.



Photo: Tawny Dragon *Ctenophorus decresii*



## Conservation priority

### Ecological communities on high ranges

The high ranges occur along the spine of the Flinders Ranges and are characterised by four major vegetation communities:

- *Eucalyptus flindersii* mallee over shrubland and low open hummock grassland – an endemic vegetation association restricted to the highest elevations.
- *Eucalyptus intertexta* woodland with low shrubland understorey – common in the central and northern high ranges.
- *Allocasuarina verticillata* woodland over low sparse sedgeland – restricted to the internal slopes of Wilpena Pound.
- *Triodia* spp. grassland with emergent low open woodland on quartzite.

These vegetation communities support populations of 10 threatened and endemic species that occur only in the Flinders Ranges in this habitat or along drainage lines running out of the ranges. Distribution is patchy across the high ranges. Both Flinders Ranges Oak-bush (*Allocasuarina muelleriana* ssp. *alticola*) and Sandalwood Emubush (*Eremophila santalina*), endemic to the Southern, Central and North Flinders subregions, are found in most high elevation areas.

Four species are restricted to the high ranges in the Northern Flinders subregion. *Dodonaea subglandulifera* and Desert Greenhood (*Pterostylis xerophila*) are both considered threatened. *Dodonaea subglandulifera* is endemic to South Australia, with three subpopulations in the Gammon Ranges, representing the northern limit of its distribution. The Desert Greenhood has been recorded at two sites in the Northern Flinders subregion and in the Gawler bioregion. Arkaroola Wattle (*Acacia confluens*) and Flinders Ranges Ixodia (*Ixodia flindersica*) are endemic to the Northern Flinders subregion.

Menzel's Wattle (*Acacia menzeli*) is endemic to South Australia, with isolated populations in the Flinders Ranges, Murray Mallee and Mount Lofty Ranges. The Flinders Ranges populations in the Northern Flinders and Central Flinders are considered relicts.

The Baratta Wattle (*Acacia barattensis*), Nectar Brook Wattle (*Acacia spoonerij*), Quorn Wattle (*Acacia quornensis*), and *Eucalyptus goniocalyx* ssp. *exposa* are endemic to the Central and Southern Flinders Ranges.

Vegetation communities in the northern Flinders Ranges have become fragmented due to a gradual climatic drying forcing these communities higher in the ranges. This natural fragmentation has resulted in many of the species present within the ranges being considered as relicts from a much wetter time.

The most serious current threat to these vegetation communities is from excessive grazing, particularly by goats and rabbits. Fire may also be important for the vegetation communities, and further investigation into appropriate fire regimes is necessary.



## 20-year target

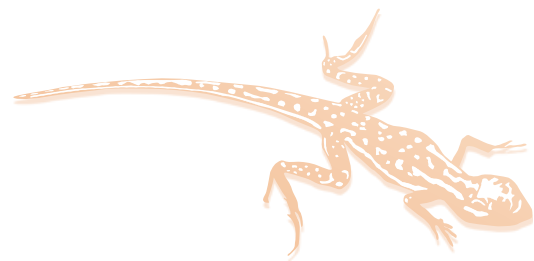
The maintenance and improvement of the extent and condition of ecological communities on high ranges within the Flinders and Olary Ranges.

## 5-year performance information

- Condition of individual occurrences of each ecological community on high ranges within IBRA subregions.
- Number and viability of populations of significant and endemic plant species on high ranges within the Flinders and Olary Ranges.

## 5-year actions

- Undertake surveys of significant and endemic plant species on high ranges.
- Identify and where possible, quantify the disruption and sources of disruption of key ecological processes supporting individual populations of significant and endemic plant species on high ranges.
- Evaluate threatened and endemic species as surrogates for assessing condition of ecological communities on high ranges.
- Rank individual occurrences of ecological communities on high ranges within IBRA subregions, based on size, condition, significant and endemic species, and landscape context.
- Investigate the role of fire in maintaining ecological communities and significant and endemic plant species on high ranges.
- Maintain goat control programs and other herbivore control programs as required.



## Bounceback

Bounceback is a major conservation project aiming to protect and restore the semi-arid environments of the Flinders, Gawler and Olary Ranges of South Australia.

Since the mid-1800s, excessive grazing, weed infestation and introduced predators have had a combined damaging effect on the fragile environment of semi-arid ranges of South Australia. As early as 1900, many small to medium sized mammals and some reptiles had all but disappeared. Even when stock was removed from the National Parks, threatened species continued to decline because there was little regeneration of native plant communities or improvement in soil conditions and animal habitats.

In response, National Parks and Wildlife South Australia initiated the Bounceback Program to protect the native species that have persisted in the region and to enable the reintroduction of some species that have become locally extinct. Activities in the National Parks include removal of foxes and feral goats, destruction of rabbit warrens, regeneration of native plant species, protection of habitats, and monitoring programs. In areas surrounding the parks, the focus is on control of wheel cactus, feral goats and rabbits, removal of foxes and protection of endangered species.

Since its inception in the early 1990s as a targeted operation focused on reducing threats to Rock-wallaby populations in the Olary and Flinders Ranges, Bounceback has evolved into a broadscale recovery project incorporating specific conservation objectives across reserves, private landholdings and pastoral properties.

Ecological recovery in this semi-arid environment will be a slow process, but Bounceback is already showing some positive results. Within the national parks, achievements include a major reduction in the number of feral goats and rabbits, an increase in the number of Yellow-footed Rock-wallabies, a trial reintroduction of the Brush-tailed Bettong to the Flinders Ranges National Park, and land reclamation with saltbush.

Bounceback has grown significantly over the years, in both its geographic spread and the activities being undertaken. It brings together people managing National Parks, private sanctuaries, pastoral properties and Indigenous Protected Areas. In this way the program creates an integrated approach to restoring the fragmented ecosystems, controlling pest plants and animals, and increasing the diversity of species in the semi-arid ranges.

Bounceback is managed and delivered by the South Australian Department for Environment and Heritage in partnership with numerous individuals, agencies, organisations, volunteer groups and research institutions. Significant resourcing and support has been provided through the SA Arid Lands NRM Board with the incorporation of Bounceback into the NRM Plan and Investment Strategy as a key initiative for conservation in the region.

Many partnerships have been developed to help implement, guide or resource the Bounceback project, including:

- Landholders throughout the project area
- Rangelands INRM Group
- SA Arid Lands NRM Board
- Sporting Shooters Association of Australia (Hunting and Conservation Branch)
- Conservation Volunteers Australia
- Adnyamathanha community
- Greening Australia
- Arkaroola Sanctuary
- Warraweena Private Conservation Park (Wetlands and Wildlife)
- Adelaide Zoo
- Flinders University
- University of Adelaide
- University of South Australia
- Nature Foundation SA
- Scientific Expedition Group
- Rural Solutions South Australia
- Yellow-footed Rock-wallaby Preservation Association

## Conservation priority

### Yellow-footed Rock-wallaby on ranges and hills

The Yellow-footed Rock-wallaby (*Petrogale xanthopus xanthopus*) inhabits high mountain ranges and hills in the Northern and Central Flinders Ranges and Bimbowrie subregions. Yellow-footed Rock-wallabies also occur in the Southern Flinders subregion, Gawler bioregion, western New South Wales and central western Queensland.

The draft South Australian Recovery Plan for the Yellow-footed Rock-wallaby identifies that in the Flinders Ranges, the majority of colonies are on sandstone, while in the Olary Ranges volcanic rock granite-porphry areas are preferred. All habitats are structurally and topographically complex, providing shelter from the summer heat and protection from predators.

This species has suffered serious decline in both distribution and abundance across much of its South Australian range. The Flinders Ranges are the stronghold for this species where seven distinct management units have been identified, and the Bimbowrie subregion supports two more. Management units have been defined as all colonies, either extant or with evidence of historical occupation, that occur within eight kilometers, the known dispersal distance of animals. Hence, gene flow between colony sites is considered to only potentially be occurring within management units and not between them.

The decline of this once widespread species has been linked to excessive hunting prior to 1919, when the species became formally protected. Since the 1930s, predation from foxes and competition from herbivores have been identified as major threats. The diet of goats overlaps with that of Yellow-footed Rock-wallabies, especially during extended dry periods, when goats also compete for and foul water sources. To a lesser extent, rabbits and Euros also compete for food.

Implementation of a landscape scale threat abatement program in 1992 has improved population sizes within colonies across parts of its range. However, this program does not extend across the entire range.

### 20-year target

Yellow-footed Rock-wallabies are present in no less than 75% of potential colony sites within all management units.

### 5-year performance information

- Percentage of potential colony sites occupied per management unit.

### 5-year actions

- Undertake, in partnership and collaboration with land managers, targeted threat abatement activities in priority management units and review criteria for transition from recovery to maintenance of Yellow-footed Rock-wallaby populations within individual management units.
- Strategically sample the Yellow-footed Rock-wallaby population for genetic diversity and review management unit boundaries.
- Strategically sample priority Yellow-footed Rock-wallaby populations for demographic indicators of viability.
- Conduct broad scale surveys to assess population trends in selected management units.

## Conservation priority

### Significant and endemic plant species on low ranges and hills

Three significant species have been recorded in the Flinders and Olary Ranges on lower ranges and hills.

- Balcanoona Wattle (*Acacia araneosa*)
- Slender Bell-fruit (*Codonocarpus pyramidalis*)
- Small-leaved Xerothamnella (*Xerothamnella parvifolia*)

Both the Balcanoona Wattle and Small-leaved Xerothamnella are restricted to the northern Flinders Ranges. The Small-leaved Xerothamnella is restricted to a small area near Moro Gorge on Wertaloona Station where it grows on sandy loams and sandy clays on the rocky slopes in low open woodlands dominated by Black Oak (*Casuarina pauper*) or Curly Mallee (*Eucalyptus gillii*). In 1993, seven sites supporting 523 plants were identified in an area of approximately 30 hectares, and whilst goats did not appear to be grazing on this species, they may be the primary factor limiting its regeneration.

Balcanoona Wattle grows primarily with Mulga (*Acacia aneura*) and Curly Mallee in a very restricted geographic area in the Mandarin landsystem between Balcanoona and Arkaroola. The restricted distribution and natural rarity of this species has resulted in a conservation rating of threatened and at risk of extinction.

Slender Bell-fruit is found infrequently on low hills across much of the Flinders and Olary Ranges. It is now thought to be restricted to South Australia and presumed extinct in New South Wales. It grows in a range of vegetation communities including grasslands and woodlands.

The primary threat to Slender Bell-fruit is excessive grazing from goats, rabbits and domestic stock, which limits recruitment. It is not clear what contribution kangaroos make to total grazing pressure on this species. Recruitment has occurred in trials on Manners Well Station where all grazing herbivores were excluded. It is thought that fire may be significant for seed germination. Many of the currently known populations have a very sparse understorey unlikely to support fire which may limit germination events.

However, there are also several populations with *Triodia* hummock grass dominated understorey. One of these populations is on the Black Range with hundreds of individuals that appear to have germinated in response to a fire.

### 20-year target

The maintenance or improvement of the viability of significant and endemic plant species on low ranges and hills within the Flinders and Olary Ranges.

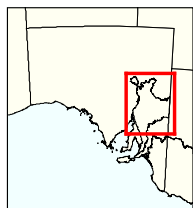
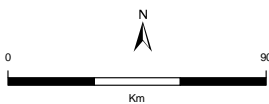
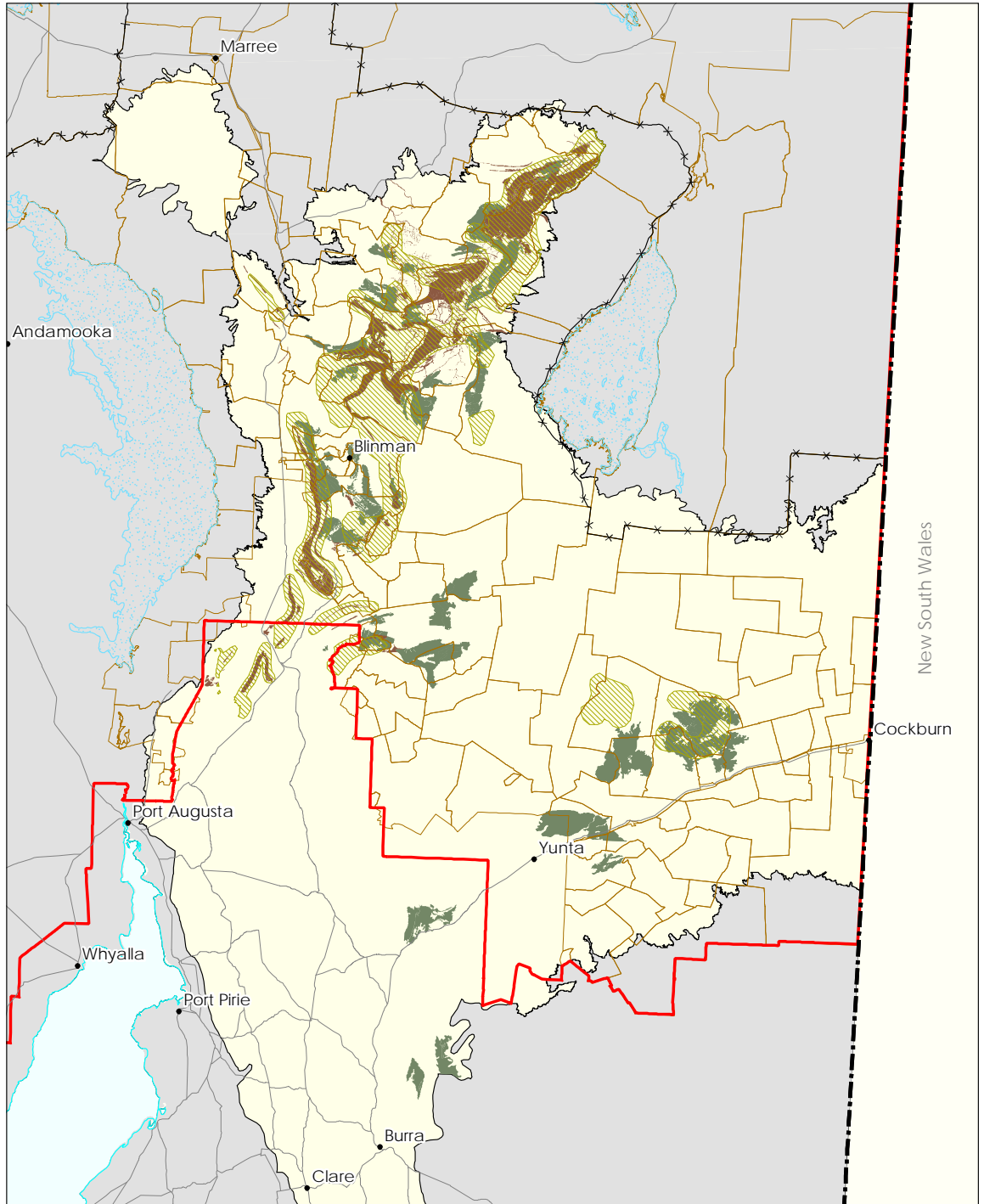
### 5-year performance information

- Percentage of potential area occupied by significant and endemic plant species on low ranges and hills within IBRA subregions.
- Number and viability of populations of significant and endemic plant species on low ranges and hills within IBRA subregions.

### 5-year actions

- Determine area of occupancy and relationship between habitat and distribution and abundance of significant and endemic plant species on low ranges and hills.
- Identify and where possible, quantify the disruption and sources of disruption of key ecological processes supporting individual populations of significant and endemic plant species on low ranges and hills.
- Identify potential habitats in the Flinders and Olary Ranges for significant and endemic plant species on low ranges and hills.
- Rank populations of significant and endemic plant species on low ranges and hills within IBRA subregions for viability, based on size, threats and landscape context.
- Support land managers to improve the viability of significant and endemic plant species on low ranges and hills.

# Conservation priorities for ranges and hills



Mapped conservation priorities provide an indication of the potential distribution

## Conservation priorities

- Ecological communities on high ranges
- Yellow-footed Rock-wallaby on ranges and hills
- Significant and endemic plant species on low ranges and hills
- Broken Hill Complex and Flinders Lofty Block Bioregions
- South Australian Arid Lands NRM Region
- Pastoral Station
- Salt Lake
- Dog Fence
- Major Road
- State Border
- Locality



# Monitoring and evaluation

The Flinders and Olary Ranges Conservation Priorities aim to facilitate conservation actions across the bioregion. The SAAL NRM Board and support partners will coordinate and support the delivery of these actions, guided by statutory mechanisms. The SAAL NRM Board will monitor and report on the implementation of the Flinders and Olary Conservation Priorities.

Both the SAAL NRM Board and the Department for Environment and Heritage are jointly responsible for evaluating the effectiveness of this plan which contributes to the SAAL NRM Plan and *No Species Loss – A Nature Conservation Strategy for South Australia*.

DEH will produce a public report on overall progress towards the conservation priorities as part of the five year review and evaluation of the South Australian Arid Lands Biodiversity Strategy in 2014.

## Monitoring and reporting information

Landform	Priority	Targets	Performance information
Drainage lines and floodplains	River Red Gum woodland on drainage lines and floodplains	The maintenance or improvement of the viability of River Red Gum woodland along drainage lines within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential area occupied by River Red Gum woodland along drainage lines within IBRA subregions.</li> <li>Condition of individual occurrences of River Red Gum woodland along drainage lines within IBRA subregions.</li> </ul>
	Permanent and semi-permanent streams and waterholes	The maintenance or improvement of the biodiversity values of permanent and semi-permanent streams and waterholes	<ul style="list-style-type: none"> <li>Number of permanent and semi-permanent waterholes managed for biodiversity values.</li> </ul>
	Significant and endemic species in drainage lines	The maintenance or improvement of the viability of the Purple-spotted Gudgeon and Streambank Froglet in the Flinders and Gammon Ranges	<ul style="list-style-type: none"> <li>Percentage of potential habitat occupied by the Purple-spotted Gudgeon and Streambank Froglet in the Gammon Ranges.</li> <li>Number and viability of subpopulations of the Purple-spotted Gudgeon Streambank Froglet in the Gammon Ranges.</li> </ul>

Landform	Priority	Targets	Performance information
Plains and rises	Significant bird species in chenopod shrubland	The maintenance or improvement of the viability of significant bird species in chenopod shrublands within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential habitat occupied by significant bird species in chenopod shrubland within the Flinders and Olary Ranges.</li> <li>Number and viability of populations of significant bird species in chenopod shrubland within the Flinders and Olary Ranges.</li> </ul>
	Bullock Bush tall shrubland and significant plant species on alluvial plains	The maintenance or improvement of the viability of Bullock Bush tall shrubland on alluvial plains within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential area occupied by Bullock Bush tall shrubland on alluvial plains within IBRA subregions.</li> <li>Condition of individual occurrences of Bullock Bush tall shrubland on alluvial plains within IBRA subregions.</li> </ul>
		The maintenance or improvement of the viability of significant plant species on alluvial plains within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential habitat occupied by significant plant species on alluvial plains within the Flinders and Olary Ranges.</li> <li>Number and viability of populations of significant plant species on alluvial plains within the Flinders and Olary Ranges.</li> </ul>
	Plains-wanderer in sparse grassland and mixed grassland/herbland	The maintenance or improvement of the viability of the Plains-wanderer in sparse grassland and mixed grassland/herbland within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential habitat occupied by the Plains-wanderer in sparse grassland and mixed grassland/herbland within the Flinders and Olary Ranges.</li> <li>Number and viability of populations of the Plains-wanderer in sparse grassland and mixed grassland/herbland within the Flinders and Olary Ranges.</li> </ul>
	Mulga and Needle Wattle low woodlands on low dunes and sand plains	The maintenance or improvement of the viability of Mulga and Needle Wattle low woodlands on low dunes and sand plains within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential area occupied by Mulga and Needle Wattle low woodlands on low dunes and sand plains within IBRA subregions.</li> <li>Condition of individual occurrences of Mulga and Needle Wattle low woodlands on low dunes and sand plains within IBRA subregions.</li> </ul>
Ranges and hills	Ecological communities on high ranges	The maintenance and improvement of the extent and condition of ecological communities on high ranges within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Condition of individual occurrences of each ecological community on high ranges within IBRA subregions.</li> <li>Number and viability of populations of significant and endemic plant species on high ranges within the Flinders and Olary Ranges.</li> </ul>
	Yellow-footed Rock-wallaby on ranges and hills	Yellow-footed Rock-wallabies are present in no less than 75% of potential colony sites within all management units	<ul style="list-style-type: none"> <li>Percentage of potential colony sites occupied per management unit.</li> </ul>
	Significant and endemic plant species on low ranges and hills	The maintenance or improvement of the viability of significant and endemic plant species on low ranges and hills within the Flinders and Olary Ranges	<ul style="list-style-type: none"> <li>Percentage of potential area occupied by significant and endemic plant species on low ranges and hills within IBRA subregions.</li> <li>Number and viability of populations of significant and endemic plant species on low ranges and hills within IBRA subregions.</li> </ul>

# Glossary

**Alluvial Plain:** An extensive stream-laid deposit that may include gravel, sand, silt and clay; typically forming floodplains that develop alluvial soils. The alluvial deposit of a stream generated from a gorge upon a plain or of a tributary stream at its junction with the main stream.

**Arid:** Refers to climates or regions that lack sufficient crop production or extensive sown pastures. Usually defined as a climate with annual average rainfall less than 250 mm (10 inches).

**Biodiversity:** The variety of life forms: the different plants, animals and micro-organisms; the genes they contain; and the ecosystems they form.

**Bioregion:** Extensive (continental scale) regions distinguished from adjacent regions by their broad physical and biological characteristics.

**Calcareous:** A substance containing calcium carbonate. When applied to a rock name, it implies that as much as 50% of the rock is calcium carbonate.

**Calcrete:** A conglomerate of gravel and sand cemented by calcium carbonate.

**Conservation:** The protection, maintenance, management, sustainable use, restoration and enhancement of the natural environment.

**Decreaser Species:** A species that decreases in abundance in areas of high grazing pressure, generally in proximity to water.

**Degradation:** Degradation of land is the decline in the quality of the natural resources of the land resulting from human activities on the land.

**Dispersal:** The movement of organisms between locations, especially relating to the movement from birth site or breeding sites.

**Duplex:** Soils with abrupt and significant changes in texture (e.g. loam over clay) in their profile.

**Ecological Community:** A characteristic suite of interacting species adapted to particular conditions of soil, topography, water availability and climate.

**Ecological Processes:** Dynamic interactions that occur among and between biotic (living) and abiotic (non-living) components of the environment.

**Ecosystem:** A dynamic complex of plant, animal, fungal and micro-organism communities and the associated non-living environment interacting as an ecological unit.

**Endemic:** Exclusively native to a specified region or site.

**Feral:** A domesticated species that has escaped the ownership, management and control of people and is living and reproducing in the wild.

**Fire Regime:** The intensity, frequency and extent of fire.

**Fragment:** Restricted areas of habitat surrounded by areas of mostly destroyed habitat (most relevant to modified and highly modified landscapes).

**Fragmentation/Fragmented Landscapes:** The division or separation of natural areas by the clearance of native vegetation for human land uses, isolating remnants and species and affecting genetic flow.

**Gene:** The functional unit of heredity; the part of the DNA molecule that encodes a single enzyme or structural protein unit.

**Genetic Diversity:** The variability in the genetic makeup among individuals and populations within a single species.

**Gilgai:** A natural soil formation occurring extensively in inland Australia, characterised by an undulating surface sometimes with mounds or depressions caused by the swelling and cracking of clays during alternating wet and dry seasons.

**Habitat Diversity:** The number of different types of habitats within a given area.

**Habitat:** The physical place or type of site where an organism, species or population naturally occurs together with the characteristics and conditions, which render it suitable to meet the lifecycle, needs of that organism, species or population.

**Hogback Ridge:** Parallel remnant ridges of rock that project upwards off a rocky bench.

**IBRA Region:** Interim Biogeographic Regionalisation for Australia regions.

**IBRA Subregion:** A subdivision of a bioregion based on broad physical and biological characteristics; a system of related and interconnected landsystems within an IBRA region.



**Igneous:** Igneous rocks are formed by solidification of cooled magma (molten rock).

**Increaser Species:** A species that increases in abundance in areas of high grazing pressure, generally in proximity to water.

**Indicator:** A measure against which some aspects of performance can be assessed.

**Invasive Species:** Any animal pest, plant or disease that can adversely affect native species and ecosystems.

**Landform:** Any of the numerous features that make up the surface of the earth, such as plain, plateau and canyon.

**Landscape:** A heterogeneous area of land or sea that is of sufficient size to achieve positive results in the recovery of species or ecological communities, or in the protection and enhancement of ecological and evolutionary processes.

**Landsystem:** A group of local ecological communities derived from a landscape pattern of related and interconnected local ecosystems within a subregion.

**Native Species:** A plant or animal species that occurs naturally in South Australia.

**Protected Area:** An area of land and/or sea specifically dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.

**Refuge:** A region, or habitat, where organisms are able to persist during a period in which most of the original geographic range becomes uninhabitable.

**Remnant:** Areas (generally small) of native plant communities that are found in otherwise cleared landscapes.

**Restoration:** Assisting the recovery of ecological systems to a state in which the viability of species and ecological communities, and ecosystem function, are improved.

**Runoff:** The portion of precipitation not absorbed into or detained upon the soil and which becomes surface flow.

**Semi-arid:** Refers to climates or regions which lack sufficient rainfall for regular crop production. Usually defined as a climate with annual rainfall between 250 mm and 375 mm.

**Species Diversity:** Variability (richness and abundance) of biota in an area. An index of community diversity that takes into account both species richness and the relative abundance of species.

**Species:** A group of organisms capable of interbreeding with each other but not with members of other species.

**Subspecies:** Distinct geographical ranges of interbreeding natural populations of species that are reproductively isolated and possess distinguishing characteristics from other populations of the same species.

**Sustainable Use:** The use of components of biological diversity in a way and at a rate that does not lead to the long term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

**Sustainable:** The use of resources or components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations.

**Tableland:** An elevated and generally level region of considerable extent.

**Terrestrial:** Land-based biodiversity including inland aquatic ecosystems such as rivers, streams, lakes, wetlands, springs, groundwater and groundwater dependent ecosystems, and the native inland aquatic species in these areas.

**Threat Abatement:** Eliminating or reducing a threat.

**Threatened Species or Ecological Communities:** A species or ecological community that is vulnerable or endangered.

**Threatening Processes:** The dominant limiting factors and constraints to the ongoing conservation of biodiversity.

**Vegetation Association:** A stable plant community of definite composition presenting a uniform appearance and growing in more or less uniform habitat conditions.

**Viability:** The likelihood of long-term survival of the example/population of a particular ecosystem or species.

# Abbreviations

DEH	South Australian Department for Environment and Heritage
DWLBC	South Australian Department for Water Land and Biodiversity Conservation
EPBC	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
GAB	Great Artesian Basin
IBRA	Interim Biogeographic Regionalisation of Australia
NPW	National Parks and Wildlife
NRM	Natural Resources Management
PIRSA	Primary Industries and Resources South Australia
SAAL	South Australian Arid Lands

## Further reading

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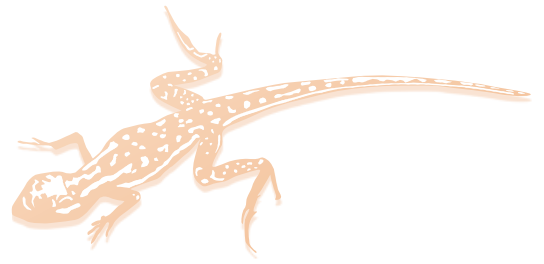
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