

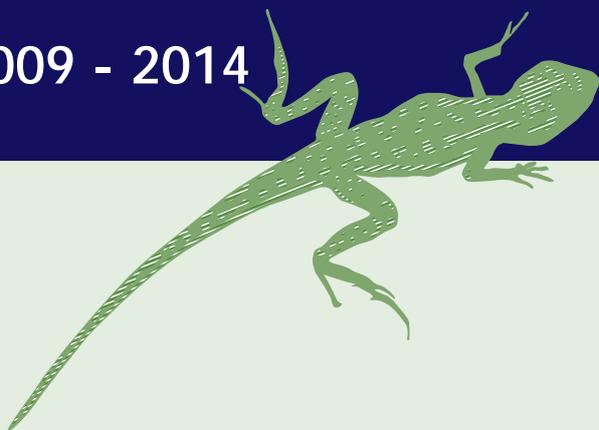


# REGIONAL RECOVERY PLAN

for Threatened Species and Ecological Communities  
of Adelaide and the Mount Lofty Ranges, South Australia



2009 - 2014



Department  
for Environment  
and Heritage



Australian Government



Government  
of South Australia

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### **Cover design and photography**

Cover design by DEH Corporate Communications Branch. Beautiful firetail (*Stagonopleura bella*) photo by David Paton. Restored grey box (*Eucalyptus microcarpa*) grassy woodland photo by David Robertson (from *Restoration of Grassy Woodland – Watiparinga Reserve Management Plan 1999*).

### **Disclaimers**

The opinions expressed in this document are the views of the authors and do not necessarily reflect those of the Department for Environment and Heritage, South Australia.

This recovery plan sets out the actions necessary to stop the decline of, and support the recovery of, threatened species and ecological communities in the planning area. The Australian Government is committed to acting in accordance with the plan and to implementing the plan as it applies to Commonwealth areas.

The plan has been developed with the involvement and cooperation of a broad range of stakeholders, but the making or adoption of this plan does not necessarily indicate the commitment of individual stakeholders to undertaking any specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge and a review of the analyses contained in this plan.

### **Citation**

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A Recovery Plan prepared under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

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## Executive Summary

### Background to this plan

Traditionally, recovery plans have been prepared for individual species or groups of species (multi-species plans). However, a more strategic and integrated approach to threatened species recovery and threat abatement is being explored through regional pilot projects such as this one.

A detailed review of over 500 regionally threatened flora and vertebrate fauna species (excluding invertebrate fauna and marine species occurring approximately below the high water mark) resulted in the inclusion of 203 species and subspecies in this plan. Eighteen threatened terrestrial ecological communities occurring in the AMLR were also reviewed and prioritised, including three ecological communities listed under the EPBC Act. Marine species (occurring approximately below the high water mark) and invertebrate species have been excluded from this planning process.

A key element of this recovery plan is to attempt increased integration of regional scale threat abatement activities for improved threatened species and ecological community recovery. Hence, unlike most traditional multi-species recovery plans, management actions have not been devised for individual species, but rather across species. Management actions have been derived from a series of species-based analyses (e.g. relating to threats, knowledge gaps and impediments to recovery).

This plan has been prepared aiming to comply with the revised guidelines for preparing a recovery plan for adoption under the EPBC Act.<sup>19</sup>

This plan is aligned with relevant State and regional planning documents, including:

- No Species Loss, A Nature Conservation Strategy for South Australia 2007-2017<sup>10</sup>
- Natural Resources Management Plan for the AMLR Region<sup>1</sup>
- Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges<sup>13</sup>, and
- Other threatened species and ecological community recovery plans.

This plan is divided into three parts:

- The main body of the plan, which includes the background to the plan and the region, a summary of the planning methodology, summarised results of the prioritisation and threat analysis processes, proposed management objectives and actions.
- The appendices to the plan (contained on the accompanying CD) are divided into two parts. Appendices Part A includes supplementary information, detailed analyses results and planning methodology. Appendices Part B includes profiles (with information, map and photo) for each of the 203 species in the plan for users requiring more specific information.

### Background to the region

The AMLR is a complex and biologically diverse region covering 780,626 hectares. The regional boundary adopted for this plan is based on biogeographical features, derived from the Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges.<sup>13</sup> The region crosses NRM regional boundaries, incorporating the Adelaide and AMLRNRMB area and the western flank of the SA Murray Darling Basin NRM Board (SAMDBNRMB) region.

The AMLR supports nine broad structural vegetation groups: Heathy Open Forest, Heathy Woodland, Grassy Woodland, Mallee, Grassland, Riparian, Wetland, Shrublands and Coastal. Over 450 native fauna species and 1500 native vascular plant species have been recorded in the region.<sup>13</sup>

The habitats of the AMLR, and the plants and animals that use them are isolated from similar higher-rainfall habitats in the south-east and south-west of the continent. The woodland and forest habitats of the AMLR are effectively an island surrounded by ocean to the south and west and the more arid woodland and mallee habitats to the north and east. As a result, the region supports a number of species and subspecies which are endemic or have the core of their State's distribution within the region.

## Plan methodology

A custom planning model was devised for this plan incorporating a series of information reviews and analyses in relation to species inclusion, threat analysis, species prioritisation, ecological community prioritisation, knowledge gaps and impediments to recovery. There are several limitations acknowledged in the plan relating to the analyses.

## The threatened species and ecological communities

Many species have become extinct in the AMLR region, and a range of threatened species that may still be extant are considered 'functionally extinct'. The species and subspecies included in this plan are considered threatened and are currently declining or have already declined to critical levels, where they are at risk of becoming either locally extinct or for endemics extinct across their whole range.

Of the 130 flora species and 73 fauna species included in this plan, 18 are endemic to the AMLR (including subspecies). Thirty five of the species in this plan are listed as nationally threatened under the EPBC Act, and 149 species are listed as threatened under the *National Parks and Wildlife Act 1972* (NPW Act)<sup>14</sup>. Fifty of the species are not listed as threatened under State or National legislation.

Most of the species included in this plan have restricted and/or fragmented distributions within the AMLR. Some species have wider distributions within the AMLR, but their populations are considered to be declining. Many others have small population sizes and/or a limited number of sub-populations. Many species are considered disjunct from the remainder of their ranges, or are part of a limited distribution within the State.

Not all threatened species which occur in AMLR that have a legislative conservation rating have been selected to be included in this plan. Due to the regional focus of the plan, entire ranges for many included species are not covered in the analysis or proposed management.

The plan incorporates a review and prioritisation of 18 recognised threatened ecological communities occurring within the AMLR, including three ecological communities listed as nationally threatened under the EPBC Act.

The species and communities included in this plan are listed at the end of this executive summary.

## Management priorities

### Regional threats

The species and ecological communities included in this plan are subject to a wide range of threats, which are collectively contributing to decline. Species have initially become threatened because of historical actions, in particular the vast clearance of native vegetation. Species continue to suffer the prolonged stress of past threats, notably the fragmentation and isolation of populations and reduced population sizes. This makes them more vulnerable to threats currently operating in the region.

The most significant direct threats to flora and fauna species include climate change, drought and severe weather, weed invasion, grazing and disturbance by stock, water management and use, residential and commercial development and inappropriate fire regimes. In addition, predation impacts on fauna species ranked relatively high in the threat analysis.

### Prioritisation

All terrestrial species included in this plan have been prioritised for recovery action. Individual flora and fauna species have been separately prioritised into six 'Vulnerability Groups', and further spatially refined into 'Sub-regional Landscape' (SRL) priorities.

The Fleurieu SRL is particularly rich in threatened flora species and includes a high proportion of endemic species (not occurring in any other SRL within the AMLR). The Southern Coastline and the Foothills/Hillsface SRLs, while relatively small SRLs, are also relatively rich in threatened flora and fauna species.

A dominant proportion of AMLR threatened flora species included in this plan are associated with Wetland vegetation communities, followed by Heathy Woodland communities. For fauna species, the dominant associations are with Grassy Woodland and secondly Heathy Woodland communities.

### Knowledge gaps

Nearly half of all threatened species included in this plan have been identified as having a poor level of knowledge, particularly in terms of population status, distribution and level of decline. The level of knowledge is generally very poor for wetland threatened flora species and grassy woodland threatened fauna species. There is an urgent need to address knowledge gaps and clarify the conservation status of these species.

### Ecological communities

Three threatened ecological communities listed on the EPBC Act are present within the AMLR - peppermint box grassy woodland of SA, iron-grass natural temperate grassland of SA and swamps of the Fleurieu Peninsula. Other communities have also been identified as high priority for recovery, including a critical need to better determine their distribution and conservation status. These include *Banksia marginata* grassy low woodland, *Eucalyptus microcarpa* grassy low woodland, *Eucalyptus dalrympleana* ssp. *dalrympleana* Open forest and *Themeda triandra*/*Danthonia* spp. Tussock grassland.

### Habitat re-establishment planning

There is an urgent need for habitat re-establishment for threatened species and the priorities proposed in this plan can inform the planning of those actions. However, further strategic planning is required incorporating this plan's species-based analyses with landscape-scale analyses using restoration planning principles.

### Impediments to recovery

Significant organisational-related impediments to threatened species recovery have been identified. These issues involve recovery capacity and funding, knowledge-base management systems and community engagement. Recovery management must address these impediments concurrent with threat abatement actions and habitat re-establishment planning.

## **Recovery strategies**

The long-term aim of the plan is to reduce the probability of threatened species and ecological communities of the AMLR region becoming extinct in the wild, and to maximise species' viability.

Threatened species and ecological community recovery for the AMLR region requires *urgent and sustained* action under five broad strategic management themes:

1. Abatement of current direct threats
2. Habitat re-establishment
3. Impediments to recovery
4. Stakeholder engagement, and
5. Ex-situ conservation.

The objectives and management actions proposed under the five strategic management themes attempt to set a realistic management framework over the next five years.

This *initial* phase of regional recovery aims to:

- Increase recovery resources, capacity and coordination
- Improve planning strategies to reflect regional priorities and address information gaps
- Increase the current level of priority threat abatement activities
- Contribute to developing the information base and systems necessary to enhance recovery of threatened species and ecological communities
- Continue developing and refining prioritisation systems, and
- Complement and inform other relevant regional biodiversity planning processes.

A recovery management framework has been devised which consists of 52 management actions developed to meet 14 recovery objectives. Forty-three performance criteria have been developed to assist in tasking and measuring the achievement of actions.

## Costs and evaluation

The total funding to implement this plan from the 2009-10 to 2014-15 financial year is estimated to be \$10,164,680. However, it is likely that costs have been underestimated due to the difficulty in comprehensively costing all site-specific management requirements for the numerous species and communities included in this plan. Funds to implement this plan will be sought from State and Commonwealth governments and other sources. Progress towards achieving the recovery objectives in this plan will be reported against the performance criteria and as required by management and funding arrangements.

## Threatened flora included in this plan

Scientific name	Common name	AUS	SA	AMLR*	Life form
<i>Acacia gunnii</i>	Ploughshare Wattle		R	V	Shrub
<i>Acacia menzeli</i>	Menzel's Wattle	V	V	V	Shrub
<i>Acacia pingulifolia</i>	Fat-leaf Wattle	E	E	E	Shrub
<i>Acacia resinocarpa</i>	Resin Wattle	V	V	E	Shrub
<i>Adiantum capillus-veneris</i>	Dainty Maiden-hair		V	V	Fern
<i>Allocasuarina robusta</i>	Mount Compass Oak-bush	E	E	E	Shrub
<i>Amphibromus pithogastus</i>	Plump Swamp Wallaby-grass			T	Grass
<i>Asterolasia muricata</i>	Rough Star-bush		R	V	Shrub
<i>Austrostipa echinata</i>	Spiny Spear-grass		R	T	Grass
<i>Austrostipa oligostachya</i>	Fine-head Spear-grass		E	E	Grass
<i>Boronia parviflora</i>	Swamp Boronia		R	V	Shrub
<i>Brachyscome diversifolia</i>	Tall Daisy		E	E	Herb
<i>Caladenia argocalla</i>	White Beauty Spider-orchid	E	E	E	Orchid
<i>Caladenia behrii</i>	Pink-lip Spider-orchid	E	E	E	Orchid
<i>Caladenia bicallata</i> ssp. <i>bicallata</i>	Western Daddy-long-legs		R	E	Orchid
<i>Caladenia colorata</i>	Coloured Spider-orchid	E	E	E	Orchid
<i>Caladenia gladiolata</i>	Bayonet Spider-orchid	E	E	E	Orchid
<i>Caladenia ovata</i>	Kangaroo Island Spider-orchid	V	E	E	Orchid
<i>Caladenia rigida</i>	Stiff White Spider-orchid	E	E	E	Orchid
<i>Caladenia valida</i>	Robust Spider-orchid		E	E	Orchid
<i>Caladenia vulgaris</i>	Plain Caladenia		R	E	Orchid
<i>Caleana major</i>	Large Duck-orchid		V	V	Orchid
<i>Callistemon teretifolius</i>	Needle Bottlebrush			V	Shrub
<i>Calochilus campestris</i>	Plains Beard-orchid		R	E	Orchid
<i>Calochilus cupreus</i>	Copper Beard-orchid		E	E	Orchid
<i>Calochilus paludosus</i>	Red Beard-orchid		V	E	Orchid
<i>Centrolepis glabra</i>	Smooth Centrolepis		R	T	Herb
<i>Correa calycina</i> var. <i>calycina</i>	Hindmarsh Correa	V	V	V	Shrub
<i>Correa eburnea</i>	Deep Creek Correa		V	V	Shrub
<i>Corybas dentatus</i>	Finniss Helmet-orchid	V	E	E	Orchid
<i>Corybas expansus</i>	Dune Helmet-orchid		V	E	Orchid
<i>Corybas unguiculatus</i>	Small Helmet-orchid		R	E	Orchid
<i>Crassula sieberiana</i>	Sieber's Crassula		E	E	Herb
<i>Cryptostylis subulata</i>	Moose Orchid		V	E	Orchid
<i>Cullen parvum</i>	Small Scurf-pea		V	E	Herb
<i>Dampiera lanceolata</i> var. <i>intermedia</i>	Aldinga Dampiera		E	E	Shrub
<i>Daviesia pectinata</i>	Zig-zag Bitter-pea		R	E	Shrub
<i>Dianella longifolia</i> var. <i>grandis</i>	Pale Flax-lily		R	V	Lily
<i>Dipodium pardalinum</i>	Leopard Hyacinth-orchid		V	V	Orchid
<i>Diuris behrii</i>	Behr's Cowslip Orchid		V	V	Orchid
<i>Diuris brevifolia</i>	Short-leaf Donkey-orchid		E	E	Orchid
<i>Eleocharis atricha</i>	Tuber Spike-rush		V	E	Rush
<i>Eremophila gibbifolia</i>	Coccid Emubush		R	V	Shrub
<i>Eucalyptus cneorifolia</i>	Kangaroo Island Narrow-leaf Mallee			V	Mallee
<i>Eucalyptus paludicola</i>	Mount Compass Swamp Gum	E	E	E	Mallee
<i>Eucalyptus phenax</i> ssp. <i>compressa</i>	Kangaroo Island Mallee		R	V	Mallee
<i>Euphrasia collina</i> ssp. <i>osbornii</i>	Osborn's Eyebright	E	E	V	Herb
<i>Gahnia radula</i>	Thatch Saw-sedge		R	E	Sedge
<i>Gastrodia sesamoides</i>	Potato Orchid		R	E	Orchid
<i>Glycine latrobeana</i>	Clover Glycine	V	V	V	Herb
<i>Glycine tabacina</i>	Variable Glycine		V	E	Herb
<i>Gratiola pumilo</i>	Dwarf Brooklime		R	E	Herb
<i>Haloragis brownii</i>	Swamp Raspwort		R	T	Herb
<i>Haloragis myriocarpa</i>			R	E	Herb
<i>Helichrysum rutidolepis</i>	Pale Everlasting		E	E	Herb

Scientific name	Common name	AUS	SA	AMLR*	Life form
<i>Hibbertia tenuis</i>			E	E	Shrub
<i>Hydrocotyle crassiuscula</i>	Spreading Pennywort		R	V	Herb
<i>Juncus amabilis</i>			V	V	Rush
<i>Juncus prismatocarpus</i>	Branching Rush		E	E	Rush
<i>Juncus radula</i>	Hoary Rush		V	T	Rush
<i>Lagenophora gracilis</i>	Slender Bottle-daisy		V	V	Herb
<i>Leionema hillebrandii</i>	Mount Lofty Phebalium		R	V	Shrub
<i>Logania minor</i>	Spoon-leaf Logania			T	Shrub
<i>Luzula flaccida</i>	Pale Wood-rush		V	T	Rush
<i>Lycopodiella lateralis</i>	Slender Clubmoss		R	T	Clubmoss
<i>Lycopodiella serpentina</i>	Bog Clubmoss		E	E	Clubmoss
<i>Lycopodium deuterodensum</i>	Bushy Clubmoss		E	E	Clubmoss
<i>Maireana decalvans</i>	Black Cotton-bush		E	E	Shrub
<i>Mazus pumilio</i>	Swamp Mazus		V	E	Herb
<i>Melaleuca squamea</i>	Swamp Honey-myrtle		R	V	Shrub
<i>Microtis atrata</i>	Yellow Onion-orchid		R	E	Orchid
<i>Microtis rara</i>	Sweet Onion-orchid		R	E	Orchid
<i>Montia fontana</i> ssp. <i>chondrosperma</i>	Waterblinks		V	V	Herb
<i>Neopaxia australasica</i>	White Purslane		R	V	Herb
<i>Olearia glandulosa</i>	Swamp Daisy-bush		V	E	Shrub
<i>Olearia pannosa</i> ssp. <i>pannosa</i>	Silver Daisy-bush	V	V	V	Shrub
<i>Oreomyrrhis eriopoda</i>	Australian Carraway		E	V	Herb
<i>Orbanche cernua</i> var. <i>australiana</i>	Australian Broomrape		R	E	Herb
<i>Paracaleana disjuncta</i>	Black-beak Duck-orchid		E	E	Orchid
<i>Paracaleana minor</i>	Small Duck-orchid		V	E	Orchid
<i>Phyllanthus striaticaulis</i>	Southern Spurge			V	Herb
<i>Podolepis muelleri</i>	Button Podolepis		V	E	Herb
<i>Potamogeton ochreateus</i>	Blunt Pondweed		R	T	Herb
<i>Prasophyllum australe</i>	Austral Leek-orchid		R	V	Orchid
<i>Prasophyllum fecundum</i>	Self-pollinating Leek-orchid		R	E	Orchid
<i>Prasophyllum fitzgeraldii</i>	Fitzgerald's Leek-orchid			E	Orchid
<i>Prasophyllum murfetii</i>		CE	E	E	Orchid
<i>Prasophyllum occultans</i>	Hidden Leek-orchid		R	E	Orchid
<i>Prasophyllum pallidum</i>	Pale Leek-orchid	V	R	V	Orchid
<i>Prasophyllum pruinatum</i>	Plum Leek-orchid		V	E	Orchid
<i>Pratia puberula</i>	White-flower Matted Pratia		V	E	Herb
<i>Prostanthera chlorantha</i>	Green Mintbush		R	T	Shrub
<i>Prostanthera eurybioides</i>	Monarto Mintbush	E	E	E	Shrub
<i>Psilotum nudum</i>	Skeleton Fork-fern		E	E	Fern
<i>Pteris tremula</i>	Tender Brake		R	V	Fern
<i>Pterostylis arenicola</i>	Sandhill Greenhood	V	V	E	Orchid
<i>Pterostylis bryophila</i>	Hindmarsh Greenhood	CE	E	E	Orchid
<i>Pterostylis cucullata</i> ssp. <i>sylvicola</i>	Leafy Greenhood	V	E	E	Orchid
<i>Pterostylis curta</i>	Blunt Greenhood		R	V	Orchid
<i>Pterostylis falcata</i>			E	E	Orchid
<i>Pterostylis</i> sp. <i>Hale</i> (R.Bates 21725)	Hale Greenhood	E		E	Orchid
<i>Pterostylis uliginosa</i>			E	E	Orchid
<i>Pultenaea dentata</i>	Clustered Bush-pea		R	V	Shrub
<i>Pultenaea viscidula</i>	Dark Bush-pea			V	Shrub
<i>Ranunculus inundatus</i>	River Buttercup		R	T	Herb
<i>Ranunculus papulentus</i>	Large River Buttercup		V	E	Herb
<i>Schizaea bifida</i>	Forked Comb-fern		V	E	Fern
<i>Schizaea fistulosa</i>	Narrow Comb-fern		V	E	Fern
<i>Schoenus discifer</i>	Tiny Bog-rush		R	E	Rush
<i>Schoenus latelaminatus</i>	Medusa Bog-rush		V	T	Rush
<i>Senecio megaglossus</i>	Large-flower Groundsel	V	E	E	Shrub
<i>Spiranthes australis</i>	Austral Lady's Tresses		R	E	Orchid
<i>Spyridium coactilifolium</i>	Butterfly Spyridium	V	V	V	Shrub
<i>Tecticornia flabelliformis</i>	Bead Samphire	V	V	V	Shrub
<i>Thelymitra circumsepta</i>	Naked Sun-orchid		E	E	Orchid
<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid	CE	E	E	Orchid
<i>Thelymitra cyanea</i>	Veined Sun-orchid		E	E	Orchid
<i>Thelymitra holmesii</i>	Blue Star Sun-orchid		V	V	Orchid
<i>Thelymitra inflata</i>	Plum Sun-orchid		V	V	Orchid
<i>Thelymitra mucida</i>			R	E	Orchid
<i>Thelymitra peniculata</i>	Peniculate Sun-orchid		V	V	Orchid
<i>Todea barbara</i>	King Fern		E	E	Fern
<i>Tricostularia pauciflora</i>	Needle Bog-rush		E	E	Rush

Scientific name	Common name	AUS	SA	AMLR*	Life form
<i>Trymalium wayi</i>	Grey Trymalium			V	Shrub
<i>Utricularia lateriflora</i>	Small Bladderwort		V	E	Herb
<i>Veronica derwentiana</i> ssp. <i>anisodonta</i>	Kangaroo Island Speedwell		R	E	Shrub
<i>Veronica derwentiana</i> ssp. <i>homalodonta</i>	Mt Lofty Speedwell		E	E	Shrub
<i>Viola betonicifolia</i> ssp. <i>betonicifolia</i>	Showy Violet		E	E	Herb
<i>Wurmba uniflora</i>	One-flower Nancy		E	E	Lily
<i>Xyris operculata</i>	Tall Yellow-eye		R	T	Herb

\* Unofficial regional conservation rating derived for the purposes of this plan only.

CE = Critically Endangered (AUS EPBC Act only); E = Endangered, T = Threatened, V = Vulnerable, R = Rare (in respective order of threat status). Note: 'Threatened' used only for regional threat rating.

### Threatened fauna included in this plan

Common name	Scientific name	AUS	SA	AMLR*	Class
Brown Toadlet	<i>Pseudophryne bibronii</i>		R	V	Amphibian
Australasian Bittern	<i>Botaurus poiciloptilus</i>		V	V	Bird
Baillon's Crake	<i>Porzana pusilla</i>			R	Bird
Bassian Thrush	<i>Zoothera lunulata halmaturina</i>		R	V	Bird
Beautiful Firetail	<i>Stagonopleura bella</i>		R	E	Bird
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>		V	E	Bird
Brown Quail	<i>Coturnix ypsilophora</i>		V	V	Bird
Brown Treecreeper	<i>Climacteris picumnus picumnus</i>			V	Bird
Brown-headed Honeyeater	<i>Melithreptus brevirostris pallidiceps</i>			U	Bird
Brush Bronzewing	<i>Phaps elegans</i>			U	Bird
Buff-banded Rail	<i>Gallirallus philippensis mellori</i>			V	Bird
Chestnut-rumped Heathwren *	<i>Hylacola pyrrhopygia parkeri</i>	E	E	V	Bird
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>			V	Bird
Crested Shrike-tit	<i>Falcunculus frontatus frontatus</i>		R	V	Bird
Diamond Firetail	<i>Stagonopleura guttata</i>		V	V	Bird
Fairy Martin	<i>Petrochelidon ariel</i>			U	Bird
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			V	Bird
Hooded Robin	<i>Melanodryas cucullata cucullata</i>		R	E	Bird
Horsfield's Bronze-cuckoo	<i>Chalcites basalts</i>			V	Bird
Jacky Winter	<i>Microeca fascinans fascinans</i>		R	V	Bird
Lewin's Rail	<i>Lewinia pectoralis pectoralis</i>		V	V	Bird
Little Wattlebird	<i>Anthochaera chrysoptera</i>			U	Bird
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	CE	E	E	Bird
Painted Button-quail	<i>Turnix varius</i>		R	V	Bird
Pallid Cuckoo	<i>Cacomantis pallidus</i>			V	Bird
Peregrine Falcon	<i>Falco peregrinus</i>		R	R	Bird
Red-capped Robin	<i>Petroica goodenovii</i>			V	Bird
Red-rumped Parrot	<i>Psephotus haematonotus</i>			U	Bird
Restless Flycatcher	<i>Myiagra inquieta</i>		R	E	Bird
Rufous Whistler	<i>Pachycephala rufiventris rufiventris</i>			U	Bird
Sacred Kingfisher	<i>Todiramphus sanctus sanctus</i>			U	Bird
Scarlet Robin	<i>Petroica boodang boodang</i>		R	V	Bird
Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>			R	Bird
Slender-billed Thornbill #	<i>Acanthiza iredalei rosinae</i>		V	V	Bird
Southern Emu-wren ^	<i>Stipiturus malachurus intermedius</i>	E	E	E	Bird
Southern Whiteface	<i>Aphelocephala leucopsis</i>			V	Bird
Spotless Crake	<i>Porzana tabuensis</i>		R	U	Bird
Spotted Quail-thrush	<i>Cinclosoma punctatum anachoreta</i>	CE	E	E	Bird
Tawny Frogmouth	<i>Podargus strigoides</i>			U	Bird
Tawny-crowned Honeyeater	<i>Glyciphila melanops</i>			U	Bird
Tree Martin	<i>Petrochelidon nigricans</i>			U	Bird
Varied Sittella	<i>Daphoenositta chrysoptera chrysoptera</i>			U	Bird
Whistling Kite	<i>Haliastur sphenurus</i>			U	Bird
White-browed Babbler	<i>Pomatostomus superciliosus gilgandra</i>			U	Bird
White-fronted Chat	<i>Epthianura albifrons</i>			U	Bird
White-naped Honeyeater	<i>Melithreptus lunatus</i>			U	Bird
White-winged Chough	<i>Corcorax melanorhamphos</i>		R	V	Bird
Yellow Thornbill	<i>Acanthiza nana</i>			U	Bird
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>			U	Bird
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>		V	V	Bird
Zebra Finch	<i>Taeniopygia guttata</i>			U	Bird
Climbing galaxias	<i>Galaxias brevipinnis</i>			V	Fish
Congolli	<i>Pseudaphritis urvillii</i>			V	Fish
Mountain galaxias	<i>Galaxias olidus</i>			V	Fish

Common name	Scientific name	AUS	SA	AMLR*	Class
Murray hardyhead	<i>Craterocephalus fluviatilis</i>	V		E	Fish
Pouched lamprey	<i>Geotria australis</i>			V	Fish
River blackfish	<i>Gadopsis marmoratus</i>			E	Fish
Short-headed lamprey	<i>Mordacia mordax</i>			V	Fish
Southern pygmy perch	<i>Nannoperca australis</i>			E	Fish
Yarra pygmy perch	<i>Nannoperca obscura</i>	V		E	Fish
Southern Brown Bandicoot	<i>Isodon obesulus obesulus</i>	E	V	V	Mammal
Western Pygmy-possum	<i>Cercartetus concinnus</i>			V	Mammal
Carpet Python	<i>Morelia spilota</i>		R	E	Reptile
Cunningham's Skink	<i>Egernia cunninghami</i>		E	V	Reptile
Eastern Water Skink	<i>Eulamprus quoyii</i>			V	Reptile
Five-lined Earless Dragon	<i>Tympanocryptis lineata lineata</i>			E	Reptile
Flinders Ranges Worm-lizard	<i>Aprasia pseudopulchella</i>	V		U	Reptile
Heath Goanna	<i>Varanus rosenbergi</i>		V	E	Reptile
Olive Snake-lizard	<i>Delma inornata</i>			V	Reptile
Pygmy Copperhead	<i>Austrelaps labialis</i>			V	Reptile
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>			V	Reptile
Tiger Snake	<i>Notechis scutatus</i>			V	Reptile
Yellow-bellied Water Skink	<i>Eulamprus heatwolei</i>		V	V	Reptile

\* Unofficial regional conservation rating derived for the purposes of this plan only.

CE = Critically Endangered (AUS EPBC Act only); E = Endangered, V = Vulnerable, R = Rare, U = Uncommon (in respective order of threat status). Note: 'Uncommon' used only for regional threat rating.

^ = MLR subspecies; # = St Vincent Gulf subspecies

### EPBC listed threatened ecological communities included in this plan

Ecological Community	AUS
Iron Grass ( <i>Lomandra effusa</i> - <i>L. multiflora</i> ssp. <i>dura</i> ) Natural Temperate Grassland of SA	CE
Peppermint Box ( <i>Eucalyptus odorata</i> ) Grassy Woodland of SA	CE
Swamps of Fleurieu Peninsula	CE

CE = Critically Endangered (EPBC Act only)

### Other threatened ecological communities included in this plan

Ecological Community*	SA*
<i>Banksia marginata</i> Grassy Low Woodland	E
<i>Eucalyptus dalrympleana</i> ssp. <i>dalrympleana</i> Open Forest	E
<i>Eucalyptus microcarpa</i> Grassy Low Woodland	E
<i>Eucalyptus odorata</i> +/- <i>E. leucoxylon</i> Grassy Low Woodland	E
Freshwater wetlands e.g. <i>Triglochin procerum</i> Herbland	E
<i>Leptospermum lanigerum</i> Closed Shrubland	E
<i>Lomandra effusa</i> Tussock Grassland	E
<i>Melaleuca squamea</i> +/- <i>Leptospermum continentale</i> Closed Scrubland	V
<i>Themeda triandra</i> +/- <i>Danthonia</i> spp. Tussock Grassland	E
<i>Callitris preissii</i> +/- <i>E. leucoxylon</i> Grassy Low Woodland	V
<i>Eucalyptus fasciculosa</i> +/- <i>E. leucoxylon</i> Heathy Woodland	V
<i>Eucalyptus ovata</i> +/- <i>E. viminalis</i> ssp. <i>cygnetensis</i> +/- <i>E. camaldulensis</i> Low Woodland	V
<i>Gahnia filum</i> Sedgeland	V
<i>Eucalyptus viminalis</i> ssp. <i>cygnetensis</i> and/or <i>E. viminalis</i> ssp. <i>viminalis</i> Woodland	V
<i>Allocasuarina verticillata</i> Grassy Low Woodland	V
<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> +/- <i>E. odorata</i> Grassy Low Woodland	V
<i>Eucalyptus porosa</i> Woodland	#
<i>Melaleuca halmaturorum</i> Shrubland/ Low Open Forest	#

\*Source: Provisional List of Threatened Ecosystems of South Australia (DEH 2005).<sup>8</sup>

Note: some community classifications overlap with EPBC-listed communities in above table.

E = Endangered; V = Vulnerable; # Conservation concern but more detailed assessment required.

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## 1. Introduction

### 1.1 Background

Recovery plans are important management documents that enable recovery activities related to threatened species and ecological communities to be approached within a planned and logical framework. Three types of recovery plans are recognised:

- Single entity recovery plans for a relatively small number of high priority or unique species or communities
- Group plans for multiple species and/or communities often with a common link, such as common threats or habitat needs, and
- Regional recovery plans that incorporate recovery and threat abatement priorities for threatened species and communities within a region. This represents a new style of recovery planning.

Whilst the traditional approach to recovery planning for single species has seen many successful programs implemented for threatened species, it has long been recognised that there are a number of limitations to this approach. Single species recovery plans can fail to integrate broader natural resource management issues (particularly at the regional scale), and account for ecological interactions occurring between species within a system. Single species recovery plans also fail to identify likely benefits or negative impacts to other threatened species associated with the proposed recovery actions. The time and resources required to develop individual plans, collate the necessary information and undertake stakeholder consultations can be significant.

There has been a recent shift to develop regional multi-species plans, particularly for plants. South Australian examples include: the *Recovery Plan for 15 Nationally Threatened Plant Species on Kangaroo Island, SA*<sup>34</sup>; *Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of SA 2007-2012*<sup>31</sup>; *SA Murray Darling Basin Threatened Flora Recovery Plan*<sup>28</sup> and *Draft Recovery Plan for Twenty-three Threatened Flora Taxa on Eyre Peninsula, SA 2007-2012*<sup>30</sup>. Such plans focus on a selected subset of species that do not necessarily overlap in range or requirements, but which are considered as warranting priority attention within a region.

For most regional multi-species plans, the process adopted to select target species primarily uses legislative conservation ratings. Because these ratings are set at a much broader geographical level, these plans may neglect the needs of other important species which may be regionally more significant in terms of conservation status, threats and distribution.

This plan is the result of an Australian Government funded pilot project to test the feasibility (from an ecological and legislative perspective) of an integrated regional recovery and threat abatement plan approach. Other similar projects have progressed elsewhere in Australia, primarily in the Border Ranges region of northern NSW/southern QLD and at Lord Howe Island, NSW.<sup>14,15</sup>

This plan represents the first attempt in SA to assess and prioritise threatened species across multiple taxa within a region, and provide a framework for their recovery planning and management. The plan also incorporates the region's threatened ecological communities. It is hoped that this approach will foster a more holistic understanding of the species and ecological communities at risk within the region, and provide more effective and efficient means to promote their recovery. This five year plan represents an *initial* stage of regional recovery only.

The plan is divided into three parts:

- The main body of the plan, and
- The appendices to the plan (contained on the accompanying CD) which are divided into two parts. Appendices Part A includes supplementary information, detailed analyses results and planning methodology. Appendices Part B includes profiles for each of the 203 species in the plan for users requiring more specific information.

### 1.2 Scope of this Plan

This recovery plan specifically addresses 203 threatened species and 18 threatened ecological communities in the AMLR region of SA. The region in the context of this plan crosses NRM boundaries and matches that of the draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges<sup>13</sup> (see Section 3.1).

The 203 threatened species consist of 130 flora species and 73 vertebrate fauna species. A summary of the taxa groups included in this plan is shown in Table 1 and Table 2. Marine species (occurring approximately below the high water mark) and invertebrate species have been excluded from this planning process.

It is important to note that not all threatened species which occur in AMLR, that have a legislative conservation rating, have been selected to be included in this plan. The selection of species for inclusion in the plan was based on a review of all flora and vertebrate fauna species considered at priority risk in the AMLR region (see Section 4.1). A list of the species that were reviewed for inclusion but excluded from the plan is provided in Appendices Part A. The inclusion process should be subject to ongoing review upon implementation of this plan.

The 35 species listed as nationally threatened under the Commonwealth's EPBC Act are included in the plan (refer to Table 3). However, an additional 11 EPBC listed species that are recorded as present in the region were excluded from the plan because the records are erroneous, they are considered extinct or functionally extinct (occurs very infrequently or exists in extremely low numbers but is not considered to form a viable, breeding population) or their distribution is very peripheral to the region. Thirty of the included EPBC listed species also have a rating in SA under the *National Parks and Wildlife Act 1972* (NPW Act). The plan includes a further 149 NPW Act listed species, and 50 species without a Commonwealth or State rating.

**Table 1. Summary of fauna classes included in this plan**

	Amphibian	Bird	Freshwater Fish	Mammal	Reptile
# species	1	50	9	2	11

**Table 2. Summary of flora life forms included in this plan**

	Club moss	Fern	Grass	Herb	Lily	Mallee	Orchid	Rush/Sedge	Shrub
# species	3	6	3	27	2	3	47	9	30

**Table 3. Summary of legislative status for species covered by this plan**

	National (EPBC Act)				State (NPW Act)			
	CE	E	V	Total	E	V	R	Total
<b>Fauna</b>	2	3	3	<b>8</b>	5 (4)	10 (9)	13 (13)	<b>28 (26)</b>
<b>Flora</b>	3	11	13	<b>27</b>	42 (26)	38 (30)	41 (40)	<b>121 (96)</b>
<b>Total</b>	<b>4</b>	<b>14</b>	<b>16</b>	<b>35*</b>	<b>47 (30)</b>	<b>48 (39)</b>	<b>54 (53)</b>	<b>149 (122)</b>

CE = Critically Endangered (EPBC Act only), E = Endangered, V = Vulnerable, R = Rare (NPW Act only)

Note: The numbers in brackets represent the number of species with a State rating that do not have a National rating. A further 53 species (45 fauna, 8 flora) have neither a National or State rating. This table does not include the SA Fisheries Management Act 2007 which lists 3 freshwater fish species included in this plan as 'Protected'.

Eighteen of the species or subspecies in the plan are endemic to the AMLR region. The distributions of the remaining species extend into other regions of SA and/or interstate. This plan only deals with species' populations within the AMLR region. The species included in this plan were categorised according to the AMLR distribution relative to their broader distribution (Table 4).

The following additional EPBC Act listed species that were known or presumed to historically reside or visit the AMLR region are recognised: glossy black-cockatoo *Calyptorhynchus lathami* (Kangaroo Island, possible visitor to Fleurieu Peninsula); pygmy blue-tongue lizard *Tiliqua adelaidensis* (once occurred on the Adelaide Plains); swift parrot *Lathamus discolor* (irregular visitor or now vagrant, breeds only in Tasmania); the SA mainland subspecies of Tammar Wallaby *Macropus eugenii eugenii* (once occurred on Fleurieu Peninsula). Whilst these species have not been incorporated into this planning process, the recommended actions in this plan should benefit them, should there be opportunity for their return to the region in the future.

The plan considers 18 threatened ecological communities that occur within the AMLR, including the ecological communities listed or nominated as nationally threatened under the EPBC Act.

**Table 4. Conservation/distribution significance of the threatened species included in the plan**

State significance	Definition	Flora*	Fauna*
<b>AMLR endemic</b>	A species that occurs only in AMLR and not found elsewhere in the State or interstate. May include targets that previously had a wider distribution prior to decline.	15	3
<b>State endemics &amp; non-endemics</b>	<b>Disjunct</b> A species that occurs as a distinct population or occurrence of a community in the region isolated from other populations or occurrences in other regions (at least approximately 150km apart, and including Kangaroo Island).	95 (15)	15 (1)
	<b>Limited</b> A species whose AMLR distribution is more or less contiguous across one to three adjacent regions.	17 (14)	23 (1)
	<b>Peripheral</b> A species that has a small proportion of its distribution in the region, with the majority of the distribution occurring in adjacent region or regions.	3 (3)	3 (1)
	<b>Widespread</b> A species that occurs across many (more than four) regions.	0	29

\* Includes subspecies. The numbers in brackets represent State endemics, i.e. species ranging outside of the AMLR region but occurring only within SA. Note: distribution categories adapted from Groves (2003)<sup>24</sup>, based on database records post 1983.<sup>12</sup>

This plan was prepared to satisfy the requirements of the EPBC Act and is required to be reviewed after a period of five years following adoption. However, specific management actions are proposed relating to the need for ongoing updating and reviewing of the species inclusion and prioritisation processes developed in this plan, as further information and improved databases becomes available. It is recognised that this planning approach will not meet the specific requirements of all threatened species or communities and there will continue to be a need for both sub-regional scale planning and single or multi-species recovery plans, in many cases.

### 1.3 Limits to the Use of this Plan

It is recognised that there will be a variety of potential users of this plan with specific information requirements. A range of analyses are presented in this plan that could potentially be presented in a number of different combinations, not all of which could be included in the plan. Consequently with implementation adjunct products will be developed to present a greater range of plan outputs.

Users of the information presented in this plan and associated products need to carefully consider the caveats provided, particularly concerning the threat analysis and species prioritisation. In addition, the prioritisation of threatened ecological communities was limited by the lack of knowledge concerning community classification, distribution and status, which also prevented more detailed analyses. Related to this is the use of "Broad Vegetation Groups" as generalised habitat descriptors. It is envisaged that this classification process can be refined as new knowledge is gained through implementing several management actions proposed in this plan.

This plan has been developed to directly integrate with the Draft AMLR Biodiversity Conservation Strategy. While this plan may be partially used as a stand-alone document to inform strategies for landscape restoration priorities, it is the future integration of planning processes that will better contribute to informing landscape restoration.

Full implementation of this plan will involve development of more sophisticated tools which will also assist in achieving some of the community engagement and knowledge-base related actions. Importantly, such tools will be able to present updated analysis results, as knowledge of species and threats is improved and conservation ratings are revised.

As discussed above, this plan does not include all legislatively 'listed' threatened species occurring in the AMLR. Other constraints to the use of this plan are mostly related to challenges in devising comprehensive and measurable management objectives and actions, outlined in Section 7.

## 1.4 Regional Planning & Management Overview

This recovery plan contributes to the objectives of the following strategies and plans:

- *National Strategy for the Conservation of Australia's Biological Diversity*<sup>3,16</sup>
- *State Natural Resources Management Plan 2006*<sup>17</sup>
- *No Species Loss: A Nature Conservation Strategy for South Australia 2007-2017*<sup>10</sup>
- *A Biodiversity Conservation Strategy for Adelaide and the Mount Lofty Ranges (Draft)*<sup>13</sup>, and
- *Creating a Sustainable Future: A Natural Resources Management Plan for the Adelaide and Mount Lofty Ranges Region*<sup>1</sup>.

A diagrammatic representation showing the relationship of this plan with other State and regional planning documents is presented in Appendices Part A. Key planning documents relevant to the implementation of this plan are further described in Appendices Part A.

Development of this plan coincided with the development of the *Biodiversity Conservation Strategy for Adelaide and the Mount Lofty Ranges* by SA DEH, and the *Natural Resources Management Plan for the Adelaide and Mount Lofty Ranges* by the AMLR NRM Board. This provided the opportunity for integration between the three planning processes. In particular, the planning area, sub-regional stratification and broad vegetation groups adopted for this plan are consistent with those in the Draft Biodiversity Conservation Strategy. The strategy includes fundamental vegetation analysis and proposes regional restoration strategies and priorities. Importantly, this plan presumes that implementation of the Biodiversity Strategy will drive landscape restoration planning and management within the AMLR. This plan is intended to complement and not duplicate the regional NRM and Biodiversity Strategy planning processes, by enabling more comprehensive planning to be undertaken for threatened species at a level of detail which is not practicable in these plans. Additional implementation planning will be required in the future to incorporate the 'coarse filter' elements of landscape restoration plans and 'fine filter' elements of threatened species plans, such as this one (see Section 5.5).

Information contained within this plan has been sourced from existing recovery plans, action plans, threat abatement plans, other relevant publications, unpublished literature, electronic sources and personal communication with regional experts.

National, State and regional species-specific recovery plans and action statements (and various other documents with management recommendations) exist for a number of the threatened species included in this plan. A summary of the existing recovery and action plan documents for species included in this plan is shown in Table 5 below, with further details (by species) provided in Appendices Part A.

**Table 5. Number and status of existing recovery plans, action plans and conservation advices for species and ecological communities included in this plan**

	National	State	Interstate/ NZ	Regional (AMLR)	Regional (non- AMLR)	EPBC Sprat/Con Advice	Action Plan
<b>Current</b>	1 (1)	1 (1)	7 (4)	6 (1)	6 (1)	33 (33)	25 (4)
<b>In prep</b>	2 (2)						
<b>Draft</b>	6 (6)	1 (1)			2 (1)		
<b>Not current</b>	1 (1)	3 (3)	4 (3)		3 (1)		
<b>Total</b>	<b>10 (10)</b>	<b>5 (5)</b>	<b>11 (7)</b>	<b>6 (1)</b>	<b>11 (3)</b>	<b>33 (33)</b>	<b>25 (4)</b>

Notes:

- Numbers outside of brackets represent the number of threatened species/ecological communities covered by existing plans. The numbers in brackets represent the number of individual plans (i.e. some plans cover multiple species).
- Within a recovery plan category (National, State, Interstate, Regional), only the most current version of a recovery plan has been included in the count (i.e. a plan is only counted in the 'Not current', 'Draft' or 'In prep' categories if it has not been replaced by a more recent version). Plans have been classed as 'Not Current' if they expire by July 2008.
- Some species have plans in more than one category (i.e. a species with a regional plan, may also have a National, State, Interstate, and/or other regional plan).
- The 'EPBC Sprat/Con Advice' category refers to the AGDEWHA Species Profile and Threats Database, and conservation and listing advices. The count for this category includes the three nationally listed ecological communities.
- The 'Action Plan' category refers to taxon outlines, summaries and action statements, from national and South Australian Action Plans (it does not include action statements from interstate). The Native Fish Strategy for the Murray Darling Basin 2003-2013 includes recovery actions for a number of the freshwater fish included in this plan, but has not been included in this assessment.

As stated above, this plan is not intended to replace any current single-species recovery plans but rather provide an integrated context in which recovery of those taxa will occur in the AMLR. The current single-species recovery plans should be referred to for more detailed specific information and recovery actions.

Several formal threatened species and ecological community recovery programs are in existence within the AMLR. The majority of these programs are funded through the AMLRNRMB, and secondly the SAMDBNRMB. Relevant programs include:

- Mount Lofty Ranges Southern Emu-Wren & Fleurieu Peninsula Swamps Recovery Program
- Southern Brown Bandicoot Recovery Program
- Lofty Block Threatened Orchid Recovery Program
- Threatened Plant Action Group
- Urban Forest Biodiversity Program
- Hindmarsh Tiers Biodiversity Project
- Peppermint Box Grassy Woodlands and Iron-grass Grasslands Recovery Program (commenced in 2008, funded by AGDEWHA and DEH), and
- South Australian Murray Darling Basin Threatened Flora Recovery Program.

These programs are delivered by a range of government agencies, NGOs and community groups. A detailed list of projects and stakeholders is provided in Appendices Part A.

As previously mentioned, this plan does not cover the marine environment and does not include invertebrates or coastal species or habitats below the high water mark. SA's coastal, estuarine and marine programs are shaped by a number of other State and national strategies and policies.

## 2. Legislative Context

### 2.1 State and National Legislation

There are various Acts of Parliament relevant to this plan that either protect native animals and plants directly, protect the habitats and areas that support them, or integrate conservation objectives with other land management uses. The principal Acts are described below. Other relevant legislation is described in Appendices Part A.

#### 2.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The Commonwealth EPBC Act regulates actions that may result in a significant impact on nationally listed threatened species and ecological communities. An action that is likely to have a significant impact on any of the nationally listed species or ecological communities in this plan must be referred to the Australian Government Minister for the Environment, Heritage and the Arts for assessment.

All species listed under the Act are recognised as Matters of National Environmental Significance. The Minister may require recovery plans to be prepared for any threatened species and ecological communities listed under the EPBC Act. It is also possible for the Minister to adopt plans prepared by State and territory government agencies, provided that they meet the requirements for adoption under the EPBC Act.

Further details on EPBC recovery plan requirements are described in Appendices Part A. This includes details on how this plan addresses some important requirements, such as identifying habitat critical to survival of species and community consultation.

#### 2.1.2 *National Parks and Wildlife Act 1972*

The State's *National Parks and Wildlife Act 1972* (NPW Act) provides for: the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters), the development of park management plans, the protection of all native plants and animals and the eggs of protected animals (unless listed in Schedule 10 or declared by regulation to be unprotected), the listing of threatened species (schedules 7, 8, 9) and regulation of the use of approved wildlife through a permit system. The threatened species schedules are regularly reviewed. The most recent revision of the schedules was gazetted in February 2008. The schedules do not currently include freshwater fish or ecological communities.

### 2.1.3 *Native Vegetation Act 1991*

The State's Native Vegetation Act 1991 (NV Act) regulates the clearance of native vegetation in SA. Generally it prohibits broad-scale clearance of native vegetation and imposes strict penalties for illegal clearance. Native vegetation can only be cleared legally where the NV Act permits such clearance, either under the exemptions in the regulations of the NV Act or through seeking the approval of the Native Vegetation Council (by submitting a clearance application). The exemptions are designed to permit certain clearance for safety, land use or management reasons (e.g. the establishment of firebreaks, tracks and fence lines). In most situations, clearance of native vegetation requires approval from the Native Vegetation Council (NVC), including clearance under many of the exemptions.

The NV Act is also the legislative basis for the Heritage Agreement Scheme. Private Land and some types of public land can be formally protected for conservation purposes under Heritage Agreements. A Heritage Agreement is an agreement between a landholder and the State Government for the protection in perpetuity of a particular area of native vegetation. In signing the agreement the landowner becomes eligible to receive financial assistance for the management of the land, a rate rebate on the Heritage Agreement land and fencing assistance if required.

## 2.2 International Obligations

There are a number of international agreements and conventions that are relevant to this plan, including the Convention on International Trade in Endangered Species, Convention on Biological Diversity, Agreements and Convention on Migratory Species and the Ramsar Convention on Wetlands. Further details on these international agreements are described in Appendices Part A.

All of the actions identified in this plan are consistent with Australia's obligations under these agreements. In addition, the implementation of Australia's international environmental responsibilities is not affected by this plan.

## 3. Planning Area Description

### 3.1 Overview of the AMLR Region

The AMLR region, as defined in this plan, covers a total area of 780,626 hectares. The region is based on ecological boundaries, rather than administrative boundaries, consistent with the *Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges*. The region is bounded on the west by the Gulf St Vincent and on the south by the Southern Ocean (Figure 1). In the context of this plan the region does not include marine areas, or coastal areas below the high water mark. Most of the region falls within the jurisdiction of the AMLRNRMB while the eastern flanks fall within the SAMDBNRMB region.

The AMLR region covers diverse landscapes and topography. The Mount Lofty Ranges, a well-defined stretch of ancient uplands and hills, forms the spine of the region, extending from the Barossa Valley in the north to Cape Jervis on the Fleurieu Peninsula. These higher areas (up to 700 metres) are flanked on their west and east by escarpments, undulating foothills, and low-lying areas including outwash plains and flats. Coastal landscapes include cliffs, dunes and sheltered tidal zones.<sup>13</sup>

The AMLR experiences a Mediterranean climate, characterised by hot, dry summers and cool, wet winters.<sup>13</sup> Across the region there is significant variation in both temperature and rainfall, with a general trend of increasing rainfall from west to east. This is largely a result of variation in topography. Areas adjacent to Mount Lofty receive the highest average annual rainfall, with Stirling receiving an average rainfall over 1100 mm per annum.<sup>38</sup> The combination of relatively high rainfall and hilly topography in the AMLR is uncommon in the State. Areas to the north and west of the AMLR receive the lowest average annual rainfall; Edinburgh on the northern Adelaide Plains receives an average of 440mm per annum.<sup>38</sup>

The AMLR contains a large number of ephemeral and permanent watercourses, draining from the uplands onto the plains, both west to Gulf St Vincent and east and south-east to the Murray River and Lake Alexandrina. There are eight large reservoirs in the region supplying drinking water to Adelaide and surrounding residential areas.<sup>13,22</sup>

The AMLR comprises land under a variety of tenures and land uses including housing, industry, conservation, forestry, horticulture (viticulture, orchard fruits and vegetable crops), mining, recreation and agriculture (stock grazing, dairy cattle and cropping). The region includes some of the State's most fertile and productive soils, supporting a significant agricultural industry. The region also includes some of the most important tourism areas for SA, such as the city of Adelaide, the Adelaide Hills, the Barossa Valley and Victor Harbor.<sup>22</sup>

Figure 1. The Adelaide and Mount Lofty Ranges planning region



There are 139 public conservation areas including National Parks, Conservation Parks, Conservation Reserves, Recreation Parks, Local Forest Reserves and Native Forest Reserves in the AMLR; and over 440 Heritage Agreements protecting native vegetation on private land.<sup>13</sup> The key agencies that manage areas designated for conservation include DEH, Forestry SA (FSA) and SA Water (SAW). The AMLR region encompasses 28 city and rural local government areas (five partially). The primary land management agencies and their administrative areas are listed in Appendices Part A. There is also Commonwealth-owned land used for a variety of purposes including railways and defence.

The AMLR is the focal point for urban development in SA and is the most densely populated region in SA. The metropolitan area of Adelaide supports over one million people, and the surrounding peri-urban area of the MLR supports over 100,000 people.<sup>13,22</sup>

The AMLR Region includes parts of five overlapping Aboriginal Nations: Kurna, Ngadjuri, Ngarrindjeri, Peramangk, and Nganguraku. For further information on each Nation, refer to the Four Nations NRM Governance Group Consultation and Engagement Protocols.<sup>21</sup>

### 3.2 Biodiversity Overview

The following information is sourced from the Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges<sup>13</sup>, unless otherwise referenced. For an historical development context, also refer to the 'Chronological Snapshot of the AMLR Region' section in Appendices Part A.

#### **The AMLR region was naturally biologically rich**

Prior to European settlement, the AMLR was typified by eucalypt forests and woodlands. The dominant vegetation type in the region was woodland communities with grassy understoreys, which covered over one third of the region. Native grasslands were present on the low-lying plains to the east and west of the Mount Lofty Ranges.

Open forests and woodlands with shrub-dominated understoreys covered approximately a quarter of the region. Drier open heathy woodlands were common and were found in the northern parts of the ranges and on the Fleurieu Peninsula. Taller heathy open forests were less common and were restricted to the high-rainfall, high-elevation areas of the central ranges and the southern Fleurieu Peninsula.

A variety of shrubland vegetation types were also present in the region, although their distribution was restricted, covering only two per cent of the region. Shrublands included both arid-style chenopod shrublands on near-coastal plains and high-rainfall sclerophyllous shrublands on the infertile soils of the Fleurieu Peninsula.

Mallee was found on the periphery of the region, in the far north and the far east of the AMLR. This mallee was more typical of regions adjacent to the AMLR than the AMLR proper, and was connected to expansive distributions of mallee in the mid-north and the Murray mallee.

A variety of riparian and wetland vegetation types are found in the region. Riparian vegetation was particularly widespread, covering approximately 15 per cent of the region prior to European settlement. Wetlands were more restricted, covering only two per cent of the region.

Coastal vegetation was found along the coastline adjacent to Gulf St Vincent and the Southern Ocean. This vegetation covered approximately four per cent of the region at the time of European settlement. Coastal vegetation types represented in the region included samphire shrublands, mangrove forests, and sand dune and cliff vegetation.

The AMLR was naturally species rich, with a large proportion of SA's native species found in the region. At the time of European settlement, over 450 fauna species were found in the region and over 1,500 flora species. There would also have been a diverse range of invertebrates, soil micro-biota and non-vascular flora.

#### **The region has experienced significant change and remnant vegetation is now highly fragmented**

Over the past 170 years, the AMLR region has changed dramatically. Vegetation clearance has been extensive and only 12 per cent of the original native vegetation of the region remains. Vegetation remnants exist as mostly isolated patches of various sizes and conditions embedded in a matrix of urban and agricultural land uses. Approximately 90 per cent of vegetation remnants are less than 31 hectares in size and half of those (45 per cent) are less than six hectares.<sup>37</sup>

Some large remnants remain in the AMLR; these are typically heathy open forest or woodland remnants on infertile soils. The largest native vegetation remnants in the AMLR include Deep Creek Conservation Park and the Scott Creek CP/Mount Bold Reservoir complex.

The remnant vegetation reflects the selective and disproportionate clearance patterns. Areas of productive soils that were most suitable for agricultural production, i.e. the grassy woodlands and grasslands were most extensively cleared, with approximately eight per cent and less than one per cent (respectively) of their pre-European extent remaining. Approximately 25 per cent of the original heathy/shrubby vegetation of the region remains, although some shrublands that were found on the Adelaide Plains have been extensively cleared. The most dominant vegetation type in the region is now heathy woodland, which has replaced the more extensively cleared grassy woodland as the dominant vegetation type.

Approximately one quarter of the remnant vegetation in the AMLR (24 000 ha) is managed for conservation in formal protected areas. These areas predominantly contain heathy open forest and woodland, as they are typically located on infertile soils or steep, inaccessible areas that were not suitable for agricultural use.<sup>1</sup> Grassy ecosystems are under-represented in protected areas in the AMLR.

#### **The AMLR remains a biodiversity hotspot**

Despite widespread clearance, the region still represents a broad range of vegetation types, ecological communities and ecosystems, including wet heathy (sclerophyll) open forests, drier heathy woodlands, grassy woodlands, grasslands, mallee, wetlands and various coastal and estuarine ecosystems.

This diversity of vegetation types supports a wide range of flora and fauna. Over 450 native fauna species have been recorded from the region, including over 75 per cent of the bird species recorded within SA (including a number of oceanic bird species that may only be occasional visitors to the AMLR). The region also supports approximately 1500 native vascular plant species.

In recognition of the wide diversity of native species, the high levels of endemism and significant threats, the Mount Lofty Ranges was identified (with Kangaroo Island) as one of 15 national biodiversity hotspots in Australia by the Australian Government in 2003.

#### **The forests of the Mount Lofty Ranges form an island of habitat**

The eucalypt forests and woodlands of the region represent an outlier of their wider distribution, forming an 'island' separated from the cores of their distribution in eastern Australia by an expanse of semi-arid mallee and dry woodland. Reflecting this, many of the plants and animals that are found in the region represent populations that are isolated from the cores of their distribution, or are present at the very edges of their distribution.

#### **The AMLR contains nationally significant habitats**

The AMLR includes nationally significant wetlands, including critically endangered wetlands of the Fleurieu Peninsula that provide habitat for many significant species, and Barker Inlet which provides habitat for a number of migratory bird species of international significance.

The region also includes nationally threatened ecological communities, including swamps of the Fleurieu Peninsula, peppermint box grassy woodland and iron grass natural temperate grasslands. These communities are listed as Critically Endangered. Numerous other threatened ecological communities have been identified and prioritised in this plan.

#### **The biodiversity of the AMLR is in a state of decline and degradation**

Most remnant vegetation in the AMLR is modified to some extent. Many remnants are degraded and in fair or poor condition, and typified by high levels of weed invasion, grazing impacts, reduced native species diversity, and outbreaks of other threats such as dieback. The remaining vegetation in the best condition in the AMLR tends to be the larger remnants of heathy open forest or woodland, which have not been as heavily or extensively modified as other vegetation types.

Much of the remnant vegetation in the region has a trend of ongoing or active decline. This trend of decline includes the larger remnants of heathy open forest or woodland which have remained in relatively good condition until this time.

The fragmented landscape has affected species' ability to move freely and disperse across the landscape, utilise seasonal food resources, and take refuge from disturbance events (such as wildfire). For many species, the reduction and fragmentation of vegetation means that there is insufficient habitat and/or fragments are too small and isolated to support viable populations.<sup>1</sup>

While habitat and connectivity requirements differ for different species, the degree of fragmentation means that physical connections between remnant vegetation is extremely low. Edge effects are also important as habitat quality is generally lower at a patch's periphery due to disturbance effects of neighbouring (highly modified) systems.<sup>37</sup>

### The AMLR has many declining and threatened species

The widespread vegetation clearance in the AMLR has led to extensive declines in most native species of the region. Many species have become extinct since European settlement, including nine mammal species, three reptile species and 17 bird species. A number of other species are considered to be functionally extinct in the region, most notably a number of threatened bird species. These species now occur only very infrequently in the AMLR and their ecological role in the region has been lost. Some threatened flora species have not been recorded within the region within the last 25 years – it is likely that many of these species no longer exist within the AMLR.

Many of the resident native species of the AMLR have declined in abundance and/or distribution since European settlement. Approximately 90 extant native fauna and 290 extant native flora species of the AMLR are included on threatened species lists at a State or National level (this does not include species that are probably extinct but are still listed). The AMLR also contains a large number of species that are declining but are not yet recognised legislatively as ‘threatened’, including a large number of woodland bird species.

### 3.3 Threats Overview

All of the species in this plan are subject to a wide range of threats, which are collectively contributing to species decline. In line with IUCN<sup>26</sup> definitions, the direct threats are those that are currently impacting or have the potential to impact within the next five years (i.e. the intended duration of the plan).

The direct threats assessed for the species and broad vegetation groups in this plan are described below in the following sub-sections. There are ten broad threat categories which are in most cases further broken down into sub-categories specific to the AMLR region.

It is acknowledged that some threats are poorly understood, unable to be controlled or considered of low overall importance to the successful recovery of species, and hence have not been assessed. Some threats that are currently considered low priority may be ‘emerging’ threats, and will be more important in the future. It is also likely that some threats remain unknown. In consideration of this, threatened species recovery usually includes ex-situ conservation related actions in conjunction with threat abatement, survey and research actions, particularly for priority threatened species. Such actions may involve a range of measures (e.g. propagule collection and storage, captive breeding or translocation).

It is acknowledged that some species are so critically endangered that best efforts to counteract current and potential threats will not improve their status or even guarantee their long-term survival. The terms ‘extinction threshold’ and ‘extinction debt’ are often used to describe this situation, whereby actions that may result in local or total species extinctions may have already occurred, with the species only surviving due to the time lag in the extinction process.<sup>20,36</sup>

Many species are at continued risk of decline because populations are small, recruitment is low, and habitat remnants are small in size, fragmented, degraded and isolated (see Section 3.4). Investment in threat management therefore needs to be combined with strategic and large-scale habitat re-establishment over the longer-term (see Section 7).

There are inextricable links between many threats, further complicated by the potential for threats to operate synergistically and antagonistically. For example, grazing of stock may alter habitat conditions (e.g. damage understorey vegetation) and cause nutrient enrichment of soils, in turn promoting weed invasion and contributing to the pollution of waterways. Also, the impacts of grazing are likely to be exacerbated during periods of drought. Therefore, there are difficulties in assigning threat ratings and using results of a threat assessment to directly inform management priorities. Threat categories, which are considered highly interactive with other threats, and/or have a high level of assessment uncertainty due to lack of knowledge, have been flagged in various summary tables in subsequent sections.

Population growth is perhaps one of the most fundamental underlying ‘drivers’ of threats to biodiversity. In the AMLR region, its effect will almost certainly increase in the future. For example, in 2005 SA’s population was 1.54 million. The State government’s target population by 2050 is 2 million (with an interim target of 1.64 million by 2014).<sup>23</sup> Much of this population growth will be in and around Adelaide, and will influence the impact of many direct threats to species and ecological communities in the AMLR (e.g. agricultural intensification, recreation, water management and use, residential development and pollution).

The threat assessment methodology and results are shown in Sections 4.4 and 5.3 respectively. Additional details are presented in the Appendices Part A. Further species-specific threat information is provided in the regional species profiles in Appendices Part B.

### 3.3.1 Agriculture

This broad category includes threats from farming, e.g. cropping, grazing, market gardening, orchards, aquaculture; and the effects of agricultural expansion, intensification and change in agricultural land use. Specific threat categories assessed in the plan are:

#### **Grazing & Disturbance by Stock**

This threat category covers the impacts of grazing from farmed stock (e.g. cattle, sheep, goats, deer, and alpaca). Grazing by native and other (non-domesticated) exotic herbivores is covered in Section 3.3.6.

The impacts of this threat overlap with several disturbance-related threat categories particularly 'Water Management & Use', 'Inappropriate Fire Regimes' and 'Weed Invasion'.

Grazing can have both positive and negative effects on habitats. Positive effects include stimulation of meristematic growth in native grasses following the removal of plant biomass. In altered agricultural landscapes, where native herbivores are lacking and nutrient levels are high, livestock grazing may have a positive benefit in controlling weed abundance to the benefit of native grasses. Complete exclusion of stock grazing (in the absence of other herbivores) can result in the overgrowth of vegetation (commonly weeds) and effectively alter the habitat conditions which support threatened species. Vegetation that is not subject to any form of disturbance may therefore suffer a reduction in native species diversity over time. It is recognised that appropriate grazing regimes may have a place in the management of some habitat types, e.g. grassy woodlands and wetlands. However, implementing grazing as a management tool requires complementary research and monitoring.

Negative effects of livestock grazing include changes to vegetation structure and composition, and changes to the physical and chemical properties of soil. Unlike native herbivores, most domestic stock are hard-hoofed and cause significantly more damage to soil structure from compaction, and damage to native plant populations by trampling. The increase in nutrients from manure may be detrimental to some vegetation types and affect the quality of nearby surface waters. Of particular concern in the AMLR is the inappropriate grazing of wetland and riparian habitats. Regular grazing of areas, particularly during the active growing season and when seedlings are present can significantly reduce reproductive success and recruitment of threatened plants.

A reduction or removal of understorey habitat (e.g. native shrubs, herbs and grasses) can reduce foraging and nesting sites, reduce shelter, and subsequently increase the risk of predation of native fauna. The other major influence of livestock grazing is its interaction with weed invasion. Livestock grazing can exacerbate weed spread through seed dispersal, soil and vegetation disturbance, and nutrient enrichment. The intensity of positive or negative effects of grazing is related to vegetation type, stocking rate, seasonal timing of grazing and climatic effects such as drought.<sup>5</sup>

#### **Agricultural Intensification**

This category has only been assessed at the broad vegetation group level. The impacts of this threat overlap with the threat categories of 'Pollution & Poisoning', 'Incompatible Site Management', 'Water Management & Use' and 'Weed Invasion'.

The AMLR continues to experience changes in land use patterns associated with the growing human population. In addition to ongoing urbanisation of the region, there is a shift towards smaller rural blocks and more intensive agricultural operations (e.g. cropping, improved pastures, vineyards, market gardens, orchards and aquaculture). Related threats include: high chemical input (e.g. fertiliser, herbicide, pesticide, fungicide) causing nutrient enrichment or poisoning; legal and illegal removal of native vegetation or indirect loss of vegetation, fauna, fungi and micro-organisms from associated impacts (e.g. related to chemical use, centre pivot irrigation, agricultural management practices); degradation of surrounding areas (e.g. spread of olives from orchards); the displacement of threatened resident fauna (because habitats are no longer suitable); and threats related to high water use (covered by Section 3.3.7). Intensive agricultural operations are generally of monoculture form, with little structural and compositional diversity, reducing the likelihood of these areas supporting native fauna. The replacement of pasture with crop, and the seasonal change in cover associated with crop harvesting, impact on the ability of these areas to function as habitat (a particular threat for grassland reptile species of the Adelaide Plains). This category is not intended to cover stock grazing, which is covered above.

### 3.3.2 Biological Resource Use

This broad category covers threats from consumptive use of 'wild' biological resources including both deliberate and unintentional effects.

#### **Illegal Hunting or Collection**

This sub-category includes the killing or capture of threatened animals, collection of threatened animal products, and the gathering/harvesting of threatened plants (or associated fungi) for commercial, recreational, subsistence, research, persecution or cultural reasons.

Removal of individuals has the potential to directly impact upon total population numbers, reduce genetic variability within populations and reduce the ability of threatened species to successfully reproduce. This is a particular issue for species that already have seriously low numbers, where each individual is extremely important to the survival of the species. Past illegal collection is thought to have contributed to the decline and extinction of sub-populations of some orchid species. Native orchids are at particular risk from illegal collection due to their small size and attractive flowers. Illegal capture of birds and reptiles and the collection of eggs for the wildlife trade is a potential threat. The exact locations of species are not provided within this plan, in an attempt to provide protection against the threat of illegal collection. Persecution may be an issue for the carpet python, tiger snake and pygmy copper head. Illegal fishing and accidental by-catch are issues for some protected native fish (see also fishing & harvesting of aquatic resources).

#### **Firewood Harvest/ Rock Removal**

Legal and illegal harvest of dead and live timber for firewood, and removal of rocks from the landscape (e.g. 'tidying up' of agricultural paddocks, moss rocks for landscaping), reduce the availability of habitat for fauna and the invertebrates on which they feed, and can alter micro-habitat conditions for native flora. In addition, at the ecosystem level, woody debris and its decomposition plays an important role in nutrient cycles, and its presence is likely to be a factor in determining the 'health' of remnants.<sup>5</sup>

Removal of woody debris reduces the foraging and perching sites available for birds and may reduce the availability of hollow-nesting sites. Birds of grassy woodland systems, such as the hooded robin require structural complexity in habitats provided by fallen timber.<sup>5</sup> Fallen timber and rocks are a key habitat component for a number of the small reptiles.

Other indirect impacts of firewood collection include the spread of weeds and pathogens (e.g. *Phytophthora*).<sup>5</sup> The loss of woody debris can also lead to increased competition for the remaining hollows, particularly where they are used by introduced species.<sup>5</sup>

The level of impact of this threat in the AMLR remains unclear. Management guidelines for firewood collection exist at the national and State levels to encourage the maintenance of essential habitats and biodiversity.<sup>2,9</sup>

#### **Fishing & Harvesting of Aquatic Resources**

The removal of aquatic resources can reduce food and habitat availability for threatened species. For example, fishing may reduce the food supply for threatened wetland birds. Current NPW Act threatened species schedules do not reflect the threatened status of the freshwater fish included in this plan; however some species are afforded a level of protection under *the Fisheries Management Act 2007*. Without further controls, threatened fish populations risk further decline. See also 'Removal of Snags'.

### 3.3.3 Climate Change, Drought & Severe Weather

This category includes the threat of long-term climatic change which may be linked to global warming, and other severe climatic/weather events, e.g.

- Droughts - periods during which rainfall is below the normal range of variation (severe lack of rain, loss of surface water sources)
- Temperature extremes - periods during which temperatures are outside the normal range of variation (heat waves, cold spells), and
- Storms & flooding - extreme precipitation and/or wind events (thunderstorms, hailstorms, dust storms, landslides), and higher storm surges along coastal margins.

Over the next 25 years, the region is expected to experience a drying and warming trend, with temperatures predicted to rise by up to 1.5°C and rainfall predicted to decrease by up to 10 per cent.<sup>4,33</sup> Rainfall is likely to become less reliable and rainfall patterns are likely to change, e.g. spring rainfall is expected to drop and more extreme rainfall events.<sup>1,33</sup>

Climate change has the capacity to be a major direct threat to biodiversity and exacerbate a range of existing threats. The issue of climate change is much bigger than can be dealt with in this plan. Within the next five years (i.e. the life of this plan) the likely immediate effects whether due to changing climate or cyclic events will be related to drying trends. The threat assessment in this plan has been based on the presumption that the region will continue to experience dry conditions; and that species with narrow or water-dependent habitat requirements will be most affected. Due to the lack of regional-specific quantitative data, this was a qualitative assessment based on a 'best guess' approach and thus should only be used as an indication of possible impact. Some initial modelling work has been done however significantly more work is required to accurately predict the impact of climate change scenarios on individual species. DEH and the University of Adelaide have formed a collaborative partnership to further progress this work, which should be used to inform implementation and future plan reviews.

Given the small size and isolated (sometimes single) known occurrences of species in this plan, stochastic weather events and prolonged drought conditions could potentially extirpate vulnerable populations or habitats. Unlike the other assessed threats, drought and severe weather is largely uncontrollable, and the cause is not human related, unless linked to the phenomenon of 'climate change'.

While native species have evolved to cope with large year-to-year climatic variability and change over long time spans, they have limited capacity to adapt over the predicted short timeframes. This is especially in relation to the decrease in annual average rainfall, and increase in average annual temperature and number of extreme hot days. Species and ecological communities with specific and water-related habitat requirements, and species on the edge of their geographic range (temperate outliers) are considered at particular risk.

Small population sizes, habitat fragmentation, limited ranges, and/or complex ecological interrelationships may further reduce the species ability to adapt to climate change. Many of the other threats may also increase in frequency and severity with climate change (e.g. weed invasion, water management and use and inappropriate fire regimes).<sup>31</sup>

In the coastal zone, potential impacts of climate change include sea level rise, changes in the frequency, intensity and patterns of storm events and associated storm surges and flooding, which could make already degraded coastal areas even more vulnerable. Beaches are likely to recede and fore dunes and cliffs erode.<sup>1</sup> Salt marsh complexes are particularly vulnerable to sea level rise if barriers (such as levee banks) prevent species migration (a particular issue for the bead glasswort, included in this plan). Even very small sea level changes will impact on the salt marshes if they cannot retreat. In the region, this is compounded by geological subsidence which exacerbates sea level rise.<sup>6</sup>

The capacity for habitat shifting (e.g. coastal habitats to retreat in response to sea level rise, inland habitats to shift in response to a changing climate) is limited by the developed nature of the region, small land parcels, varying land tenure, and the timeframes involved. 'Biodiversity corridors' have been proposed to aid in facilitating species movement in response to climate change, however species' response to climate change is poorly understood and there remain significant challenges ahead to model, predict and best manage the impacts.

Land-use impacts related to management activities to sequester carbon will also require significant planning resources in the future to consider impacts on threatened species and communities.

As the threat analysis results in this plan highlight, climate change will be a very significant issue for many threatened species and ecological communities over the medium and longer term. Further, as a threat it directly interacts with (and will exacerbate) other significant threats in the region, requiring considerable management and planning resources to address.

### 3.3.4 Energy Production & Mining

This broad category includes threats related to the production of non-biological resources. Energy production operations (e.g. wind farms, desalination plants) were not identified as a specific threat but could pose a threat in the future.

#### **Mining & Quarrying**

Isolated mining and quarrying operations (rock, sand and salt) exist in the AMLR and the potential exists for further mining activity in the region. Current operations directly threaten some of the plants, animals and ecological communities covered by this plan. Mining activities near AMLR waterways is a threat to some freshwater fish.

### 3.3.5 Human Intrusions & Disturbance

This category covers threats from human activities associated with non-consumptive uses of biological resources.

#### **Recreational Activities and Site Disturbance**

The use of natural environments for recreation, work, research and other activities, can destroy and disturb habitats and species. Examples of recreational activities include walking, dog walking, hiking, rock-climbing, camping, bird watching, horse riding, mountain biking, motorbike riding, off-road vehicle use and motor boating.

Specific threats include: destruction of, and physical damage to plants (e.g. trampling, crushing, uprooting); soil compaction; soil disturbance, affecting soil moisture and encouraging the establishment of weeds; degradation of habitats; disturbance of native fauna, sometimes causing them to vacate habitats; inadvertent introduction of weeds and pathogens. Populations on public land close to roads, tracks, and walking trails tend to be more susceptible to trampling by the general public.

### 3.3.6 Invasive & Other Problematic Species & Genes

This category covers non-native and native plants, animals and pathogens that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance. The introduction of biological controls and genetically modified organisms are not identified as particular threats in this plan but could pose issues in the future. The following sub-categories were assessed:

**Competition with honey bees; predation by European fox; predation by feral & uncontrolled cats; predation & disturbance by uncontrolled dogs; predation & competition by introduced birds; predation & competition by introduced fish; grazing & disturbance by rabbits; grazing & disturbance by (feral) deer and goats.**

Impacts include grazing (i.e. herbivory), trampling, predation, competition for resources and disturbance.

Introduced predators particularly cats (*Felis catus*) and foxes (*Vulpes vulpes*), have contributed to the decline and probably extinction of a number of the region's fauna species. Predators may take eggs, juveniles or adults. Small fauna species that live, forage or nest on or close to the ground, and survive in small isolated populations are most at risk.<sup>5</sup> The impact of fox and cat predation was particularly difficult to assess due to significant knowledge gaps concerning the actual impact of feral predators on threatened fauna populations.

In the AMLR, detailed information on the impacts of introduced predators such as foxes and cats is limited. It is possible that Black Rats (*Rattus rattus*) also play a role as nest predators, although their impact is unknown and has not been assessed. Given the highly urbanised character of parts of the AMLR, and the high incidence of companion animals, the importance of cat predation to some declining birds could be significant.<sup>5</sup> Domestic dogs (*Canis* spp.) are also identified as a potential disturbance or predator of some threatened fauna species. Introduced fish (e.g. *Gambusia holbrooki*) are known to predate on native fish species. The proliferation of exotic honey bees (*Apis* spp.) may affect the availability of nesting hollows for some threatened bird species.

The AMLR is subject to spatial and temporal variation in grazing pressure linked to climatic conditions. Several threatened species within this plan are susceptible to the impacts of grazing by introduced herbivores. The most severe impacts from introduced species are considered to be from rabbits (*Oryctolagus cuniculus*), but hares (*Lepus capensis europaeus*), feral deer (Cervidae family) and goats (*Capra hircus*) are also significant issues. Invertebrates also have impacts on some species (see category 'Disease & Insect Damage'). In many cases further investigation is needed to determine exactly which grazing animal is impacting on particular species.

#### **Disease & Insect Damage**

The nature and impact of disease affecting native wildlife, and the damage caused by invertebrates, is not well understood. Disease and insect damage can be a sign of a system 'out of balance'.

There are a number of diseases that have the potential to impact on native vegetation. These have been included under the broad threat category of *Phytophthora* (see below). The threat of *Phytophthora* has only been assessed at the broad vegetation group level, because the susceptibility of the threatened species in this plan is not known.

Toxoplasmosis (a disease carried by cats) is a possible but largely unknown threat to the southern brown bandicoot. The disease has been detected in Victorian populations (Long, *K pers. comm.*). Chytrid fungus is a possible threat to the brown toadlet. The introduced Portuguese millipede (*Ommatoiulus*

*moreletii*) can occur in plague numbers and may have significant consequences for litter decomposition and nutrient cycling (Mitchell, J. *pers comm.*).

Pink gums (*Eucalyptus fasciculosa*) and red gums (*E. camaldulensis*) in grassy woodland systems can be susceptible to insect attack. The poor condition of many *Correa calycina* var. *calycina* plants in the AMLR is considered to be due to insect damage.

The term dieback has been used to describe plants which are suffering from a combination of visible and physical factors for which causal factors are unknown but may include insect attack, increased soil nutrients, waterlogging, lack of available soil moisture, soil compaction and other factors. Further investigations are required to identify specific causal agents.

### ***Phytophthora***

Due to the lack of species-specific knowledge of *Phytophthora* susceptibility, the threat of *Phytophthora* has been assessed at the broad vegetation group level (based on expert opinion). However, in lieu of species-specific information on *Phytophthora* susceptibility, inference has been drawn about *Phytophthora* risk based on species' occurrence within two kilometres of known or suspected *Phytophthora* infestations (based on mapped infestations as at April 2008, see also Velzeboer et al. 2005).<sup>39</sup> This information has been included in the regional species profiles (Appendices Part B).

This category covers the impacts associated with *Phytophthora* and a number of other poorly known diseases that may be having an impact in the AMLR. *Phytophthora* is a microscopic soil and waterborne mould which attacks the root system causing disease and death of some native plant species. *Phytophthora* is native to South East Asia and is believed to have been introduced into Australia shortly after European settlement. It occurs throughout Australia in open forests, woodlands and heathlands. Of the 32 species of *Phytophthora* in Australia, *P. cinnamomi* is the most widespread and destructive species.<sup>5,29</sup>

Areas receiving 400mm or more average annual rainfall with poor draining and acidic to neutral soils (generally loam and clays) are typically considered at risk. There are several known infestations of *P. cinnamomi* in the AMLR, and based on rainfall and soil characteristics, most of the region (except for the far eastern boundary) has the potential for *Phytophthora* to become established (see Velzeboer et al. 2005).<sup>39</sup> The level of infestation and its impact vary significantly at local and regional scales. There are difficulties in identifying areas affected without soil testing.<sup>5</sup> Many recreational activities (e.g. bush-walking) can promote the spread of *Phytophthora*. Similarly, management activities including track maintenance or fire suppression works can pose a significant risk.

Species in SA which are highly susceptible to *Phytophthora* include the grass-tree (*Xanthorrhoea spp.*), *Banksia spp.*, Conebush (*Isopogon ceratophyllus*), many Fabaceae spp., *Acacia spp.*, heaths (Epacridaceae) and eucalyptus species belonging to the stringybark group (*Eucalyptus obliqua* and *E. baxteri*).<sup>5,29</sup>

The susceptibility of the threatened plants in this plan to *Phytophthora* is largely unknown, highlighting the need for further research. Even if the threatened plants are not directly susceptible, they could indirectly be at risk if the surrounding native vegetation is affected by the disease, modifying the structure and composition of plant communities. This also has the potential to affect threatened fauna habitat. The level of impact to fauna species occupying *Phytophthora* infected habitat will vary depending on their specific requirements and the level of infestation. For example, some *Banksia* species are an important nectar resource for honeyeater species at a particular time of year. In the fragmented landscape of the AMLR, small remnants of *Banksia* vegetation may be key sites, and their loss due to *Phytophthora* infestation would be detrimental to specific honeyeaters which utilise them.<sup>5</sup>

Management guidelines to abate the threat of *Phytophthora* have been developed at both State and national levels.<sup>18,29</sup> Control of *Phytophthora* is difficult, so current emphasis is to limit the spread of the pathogen. Known infestations in the AMLR have been mapped and *Phytophthora* 'Risk Management Zones' designated (though further work is required to refine the mapping to improve relevance to management).<sup>5,29</sup>

### **Grazing & Disturbance by Kangaroos**

The grazing regimes of native herbivores have altered with both increases and decreases in their abundance in particular areas. Generally, grazing by kangaroos appears to have increased from natural levels, primarily because more watering points (such as dams) are available, dingos have been excluded, and because they favour mixed habitats of remnant vegetation and cleared pasture. In high numbers, kangaroos can cause significant damage to plant populations by grazing and trampling.

### **Problematic Native Species (Other)**

This category includes native plants, animals (other than kangaroos), pathogens and other microbes that are 'out-of-balance' or 'released' directly or indirectly due to human activities.

There are a range of native species (indigenous or introduced to the region) considered to be having adverse impact in certain situations on threatened species or ecological communities in this plan:

- Coral fern (*Gleichenia microphylla*) is a declining native species in some wetlands. In others, a lack of disturbance has promoted its overgrowth, shading out smaller wetland flora. Some known native orchid populations have not been relocated since the exclusion of grazing and subsequent coral fern overgrowth.
- Warm conditions and nutrient inputs can promote algal overgrowth, impacting on wetland systems.
- The common brush-tail possum (*Trichosurus vulpecula*) is considered rare in SA. In AMLR however, it may compete with other native species for nest-hollows and is a known nest-predator.
- A number of native birds have benefited from the vast change to natural landscapes, e.g. corella (*Cacatua sanguinea*), noisy Miner (*Manorina melanocephala*) and rainbow lorikeet (*Trichoglossus haematodus*). These are generally aggressive species and have competitively excluded other native birds from otherwise suitable habitats.
- Some planted garden plants hybridize with indigenous plant species (e.g. *Grevillea rosmarinifolia* hybridizing with *G. lavandulacea*).
- Mistletoes (*Amyema* spp.) are parasitic plants that exist in balance in healthy natural ecosystems. Infestation of mistletoe can result in the death of the host tree; this is generally regarded as a secondary effect of vegetation already under stress.
- Native bluebells (*Billardiera heterophylla*) is a naturalised native plant from Western Australia that can spread rapidly after fire to the detriment of other vegetation.
- The Koala (*Phascolarctos cinereus*) is not considered to be indigenous to the AMLR. Indications are that numbers are increasing, with the potential to impact on the health of grassy woodland systems as has occurred on Kangaroo Island.
- Sea lettuce (*Ulva* sp.), a semi-aquatic species, can grow prolifically to the disadvantage of other aquatic and coastal species.
- Various non-local *Acacia* species grow well in the AMLR environment (particularly in coastal zones) and are considered environmental weeds (e.g. *Acacia baileyana* and *Acacia longifolia* ssp. *longifolia*).

### Weed Invasion

European settlement introduced many new species of plants to the Australian landscape. Climatic conditions in south-eastern Australia have favoured the establishment of plants of Mediterranean and southern African origin, and many of these are now common components of vegetation communities. Many introduced plants have become agricultural, horticultural and environmental weeds.<sup>5</sup>

Many weed species are impacting or have the potential to impact significantly on the growth, recruitment and survival of the species in this plan because of their ability to: invade and spread rapidly within native vegetation, persist for long periods of time (including in the soil seed bank), out-compete native plant species and suppress the growth and germination of native plants, change soil chemistry, and alter habitats.<sup>1</sup> They may also cause secondary impacts, which include the alteration of hydrological cycles, fire regimes and soil pH and nutrient levels.

One hundred and thirty environmental weeds are recognised for the AMLR including 11 Weeds of National Significance. Different weeds pose a different level of risk and this may vary depending on location and local conditions. Examples of significant weeds include gorse (*Ulex europaeus*), broom (*Cytisus scoparius*, *genista monspessulana*), blackberry (*Rubus* spp.), bridal creeper (*Asparagus asparagoides*), bridal veil (*Asparagus declinatus*), boneseed (*Chrysanthemoides monillifera* ssp. *monillifera*), olives (*Olea europaea*) and many grasses such as perennial veldt grass (*Ehrharta calycina*).<sup>5</sup> The risk of new weed incursions is ever present and should be a priority for management in event of occurrence. A list of the priority threatening weeds summarised by broad vegetation group is provided in Appendices Part A

Any weeds that alter characteristics of fauna habitats could be considered detrimental to declining species. Alterations can include the replacement of food plants, invasion of the ground layer and indirect effects such as the smothering of native vegetation. The effects of weeds on insect abundance and thus insectivorous species is not clear.<sup>5</sup>

Ironically, in certain situations, some weed species provide alternative food or shelter for fauna species and their removal can have negative consequences resulting in temporary or permanent loss of food or

shelter. In some locations weeds provide the only suitable habitat and without them fauna can be exposed to predation and lose nesting sites. Blackberries are the prime example, known to be used by bandicoots and some birds for shelter where surrounding areas are cleared. Elimination of the potential negative consequences of weed removal requires staged management, integrated with habitat restoration.<sup>5</sup>

### 3.3.7 Natural System Modifications

This category covers threats from actions that convert or degrade habitat in service of 'managing' natural or semi-natural systems, often to improve human welfare.

#### **Fire Management Activities**

Fire is a natural process and has an important role to play in maintaining ecosystem processes. The AMLR is a naturally fire prone area and has experienced a number of serious fire events, most notable the 1983 Ash Wednesday fires. Fire regimes in the region have been altered dramatically from pre-European times.<sup>5</sup>

In the densely populated AMLR region, wildfire is quickly suppressed to protect built assets and human life. Under natural regimes, grassy woodlands probably burnt every 3 to 5 years, but now these systems are hardly ever burnt (A. Prescott *pers. comm.*). Suppression of fire has meant a build up in fuel loads, which increases the risk of intense fires.

Fire management is how humans manage fire regimes, either through introducing fire (e.g. by prescribed burning) or by reducing the likelihood of bushfire starting and/or spreading. This category includes prescribed burning, and other activities undertaken to manage the threat or suppression of fire, i.e. slashing and clearing litter to reduce fuel loads and bulldozing of vegetation for fire breaks. Fire management activities can also directly affect threatened plant populations. There is also a risk of vehicles driving on or through threatened plant populations and/or habitat during fire management activities.

The timing, size and intensity of prescription burning are important to achieve species benefits (e.g. plant regeneration) and reduce possible negative impacts. Response and sensitivity to fire is species-specific. Available evidence suggests that single prescribed burns (limited extent, patchy, and which do not destroy canopy or kill trees) do not have major impacts on birds. However, single prescribed burns can be a problem in fragmented landscapes if the burn's extent covers habitat critical to the survival of species. Species recovery may be limited by their inability to disperse in and out of the burnt area.<sup>5</sup> Fire can reduce flowering and cause dense regeneration. Frequent burning, especially during flowering time could reduce reproductive success and recruitment. Burning could also increase the proliferation of fire-stimulated weeds. A strategic prescription burning program is implemented by the DEH, based on the best available ecological information. See also 'Inappropriate Fire Regimes'.

#### **Inappropriate Fire Regimes**

The term 'fire regime' refers to the interaction of fire intensity, interval, season and extent. Human-induced influences to fire regimes include landscape alteration and fragmentation of native vegetation, fire management practices (such as prescribed burning and fire suppression), accidental fire ignition and arson. Fire regimes have changed substantially since pre-European times, and it is not possible to reinstate them due to current land uses and landscape modification.

Fire can have a direct impact on a species or its habitat and result in long-term changes to species' habitat. However for many species, fire *per se* is not a threatening process, but inappropriate fire regimes may contribute to their decline through:

- Changes in composition and/or structure of vegetation, either through recruitment or lack of regeneration of fire-dependent plant species, or mortality of fire-sensitive plant species
- Increased weed invasion following fire
- Loss of woody debris, and in some situations hollows (fire also can enhance hollow development)
- Reduction in leaf litter, and
- Decline in invertebrate abundance (as a food resource).

The difficulty in assessing inappropriate fire regimes as a threat is that suppression of fire can be as detrimental as too frequent fires. Since little is known about the appropriate regime for different species particularly in fragmented landscapes, the potential for negative outcomes from management actions is high. A greater level of understanding is required to achieve effective management.<sup>5</sup>

The ecological effects of altered fire regimes are numerous and complex. For example, high frequency fire can disrupt the life cycles of plants and animals, alter the structure of habitat and obliterate fire

sensitive species of plants and animals from an area. Several fires in close succession can prevent plants and animals from returning to the area (particularly in fragmented landscapes such as the AMLR), and prevent soil seed set.<sup>1</sup> Species' life history traits have a strong influence on the ability to persist or recolonise after fire.<sup>5</sup>

Inappropriate fire regimes can pose a significant threat to threatened plant species that may rely on a fire event to regenerate. Fire events occurring either too often or too infrequently can severely impact upon the demography of threatened species populations. Similarly, ill-timed fire may potentially threaten populations by damaging flowering or germinating plants.

### **Incompatible Site Management**

This category includes a range of actions that convert or degrade habitat in service of managing natural systems to improve human welfare. Common actions include slashing, mowing, fencing, track development and herbicide use, constituting either legal or illegal incremental vegetation clearance. This category also includes impact associated with a lack of site management, a particular issue for coastal crown land and 'lifestyle' blocks; and inappropriate revegetation (e.g. over-planting grasslands/grassy woodlands, or using inappropriate species).

Incompatible site management may be intentional or may occur because land managers are unaware that their actions or lack of action threaten native species or represent 'inappropriate management'. For example, broad acre spraying is widely practised without knowledge or consideration of the off-target impacts. To complicate matters, slashing and mowing may have a role in the management of some modified ecosystems, though further research is needed. Recent studies suggest that an appropriate mowing regime may have beneficial effects (superior to those of a grazing treatment) for rare or threatened species.<sup>28,40</sup>

Some of the species in this plan occur in areas of mosaic farmland and are sensitive to agricultural expansion, intensification and change in agricultural land use (e.g. crops, vineyards and orchards) altering the already modified habitats on which they rely. Grassland ecosystems may be more susceptible to incompatible site management activities because they are less conspicuous and lack public profile. In the eastern flanks of the region, some grassland areas are being planted to tree crops such as olives, or other woody non-grassland tree species.

Some threatened species only occur, or have significant populations in areas managed for commercial forestry (pine and eucalypt plantations). The felling and inappropriate management of forestry plantations (e.g. firebreaks, herbicide use, vehicle tracks) can pose a significant threat for some threatened species.

There are a number of pending applications for the planting of blue gum and other timber plantations. Expansion of private forestry operations has the potential to impact on native vegetation (particularly wetlands), either directly, or indirectly through shading or alteration of hydrological regimes (included under the threat category 'Water Management & Use').

### **Removal of Snags**

Submerged wood and debris are removed from freshwater to improve conditions for boating. This activity results in the alteration and removal of aquatic habitats. Whilst this threat fits under the general category of incompatible site management, it has been assessed separately because it relates only to aquatic species.

### **Water Management & Use**

The impacts of this threat interact with several other threat categories particularly 'Climate Change, Drought & Severe Weather', 'Incompatible Site Management', 'Weed Invasion' and 'Grazing and Disturbance' categories.

The regulation of rivers and diversion of water for urban supplies, industry and agricultural production have significantly altered natural flow regimes. Up to 80% of the water flows in AMLR have been diverted (e.g. through reservoirs, dams, stormwater drains and levee banks), significantly reducing the downstream flows, and therefore the viability of ecosystems. A number of once permanent streams are now ephemeral.<sup>5</sup>

Groundwater extraction has resulted in the reduction and loss of aquifers and has contributed to rising saline water tables. Degradation of the vegetation cover and soil surface of catchments, associated with urbanisation and agriculture has disrupted the linkage between streams and their catchments and has led to nutrient and sediment run-off, decreasing water quality. The conversion of waterways to channels can accelerate water flows, exacerbates flooding and erosion and prevents the deposition of sediments on the floodplains and in wetland ecosystems.<sup>5</sup>

Water management and use have altered habitats at localised and large scales (e.g. drying of naturally damp areas and loss of pools). In addition to drying of habitat, reduced flow volume can lead to reduced flushing of salts, altered geomorphology (e.g. reduction in channel depth, encroachment of reeds), reduced aquifer recharge and direct ecological implications. Loss of water can also reduce the magnitude of particular flow events limiting the size of floods and the amount of wetted habitat.<sup>25</sup>

Species requiring wet or moist conditions, and with narrow habitat requirements will be most impacted by water management and use. Impacts will likely be more pronounced during dry seasons and extended drought periods where human use tends to exacerbate already low levels. Although hydrological changes have primarily impacted on wetland and riparian areas, impacts are also evident in other areas of the AMLR. Pink gums are showing signs of prolonged stress in some areas (A. Prescott *pers. comm.*).

Continued drought conditions over the next five years could see the local extinction of threatened freshwater fish populations in the AMLR. The recent prolonged period of low rainfall highlighted critical deficiencies in water management to maintain fish habitat in the Lower Murray region.<sup>25</sup>

Surface and groundwater use is controlled through Water Allocation Plans (WAP) for a large part of the AMLR region. The NRM Act requires that the water needs of the environment must be taken into account when determining the allocation of water for other users. Forestry is not currently considered as a water affecting activity, therefore associated water use is not factored into allocations. However, plantation forestry may alter hydrological conditions within wetlands and riparian zones by altering groundwater and surface water flow.<sup>35</sup>

A Water Quality Improvement Plan (WQIP) is being developed by the EPA, AMLRNRMB and other partners for the MLR watershed. The plan, which will be revised every seven years, will address the management of environmental values to protect and improve water quality. In 2008 a WQIP was finalised for the Port Waterways area.

As described above, SA's ambitious population targets will mean significant population increases in and around Adelaide. Therefore, water security and quality is a critical issue. Already scarce water resources are anticipated to become further stretched, and with the combined impact of climate change, water dependent species and ecosystems could suffer significant loss.

### 3.3.8 Pollution

This category covers threats from introduction of exotic and/or excess materials, including chemicals, solid rubbish or energy, from point and non-point sources.

#### **Pollution & Poisoning (chemical, solid waste and other)**

Pollution comes from point and non-point sources and includes: household sewage; garbage and solid waste; urban waste water; agricultural, industrial, mining, military, fire management and forestry effluents (e.g. toxic chemicals); air-borne pollutants (e.g. vehicle fumes, smoke from fires); discharge from waste treatment plants, septic systems, untreated sewage; application and run-off of fertilisers and pesticides; spills and leakage from fuel tanks and illegal disposal of waste.

Potential impacts include: fouling, sedimentation and nutrient loading of waterways, ground and surface water; damage to soils; poisoning (causing reduced vigour or death to wildlife); physical damage, entanglement or disturbance to wildlife and disruption to animal migration patterns.

This category includes off-target impacts caused to native species associated with the use of herbicides, fungicides and pesticides. It also includes the potential impacts of use of surfactants and fire retardants near waterways.

Pollution of waterways is identified as a threat to water skinks and some wetland birds included in this plan. The general use of farming chemicals is considered to threaten some reptile species.

### 3.3.9 Residential & Commercial Development

This category includes threats from human settlements or other non-agricultural land uses with a substantial footprint. As the AMLR region is the central focus of population growth and development in the State, threatened species that occur in areas not formally protected for conservation face ongoing risk from: housing and urban development (e.g. construction of buildings and associated infrastructure such as roads, utility lines and septic systems); commercial & industrial development (e.g. factories, power stations, airports, landfills); tourism & recreation related development (e.g. golf courses, sports fields, campgrounds); and other non-agricultural land uses with a substantial footprint.

This category is intended to cover the physical impact of potential development over the next five years. Impacts of other impacts associated with such developments are covered under other relevant threat categories such as 'Water Management & Use', 'Weed Invasion' or predation-related categories.

Native vegetation clearance has been restricted in SA since 1985, and is currently regulated under the NV Act. While this largely prevents the clearance of broad-scale remnant native vegetation in SA, legal and illegal incremental vegetation clearance for purposes including housing development, road and track construction and maintenance, firebreaks, and fencing is still a significant threat. Clearance of habitat critical to the survival of any of the species in this plan could have a significant impact on their long-term survival.

The assessment of the scope of this threat was informed by spatial analysis using treated and filtered species data and land development zone data; specifically rural living zones, vacant residential and deferred urban zones. Note, the impact of existing residential areas was not included in the analysis, as the objective was to mainly assess new and potential development in the near future.

### 3.3.10 Transportation & Service Corridors

This category includes threats from transport corridors and the vehicles that use them including associated wildlife mortality.

#### **Road, Rail & Utilities Maintenance Activities**

A number of significant plant populations occur along roadsides, near vehicle tracks on public land and along railway lines. Maintenance activities, such as road widening, grading, bituminising, stock-piling materials, trench digging, constructing turnout drains, vegetation trimming, slashing, and spraying herbicide can have severe impacts on these populations, which in most cases are already in a degraded state. These activities can also induce weed and pathogen incursion. The same threats apply to populations occurring within power, water and telecommunication easements. Note there is some interaction with the threat categories 'Incompatible site management' and 'Pollution' and 'Poisoning'.

#### **Road-kill**

Vehicle associated mortality is considered a low threat for most threatened fauna. However species like the Heath Goanna and Carpet Python which already have highly compromised populations in the AMLR and travel across fragmented landscapes are at significant risk. The Tawny Frogmouth is a common casualty of vehicles travelling at night.

## 3.4 Ecological Stresses Overview

Ecological stresses are degraded key ecological processes, caused by a range of threats. Importantly, for the AMLR, the broad-scale clearance of vegetation, a historical threat, is the fundamental cause of the majority of ecological stresses. However, there are complex inter-relationships between 'ecological stresses' and the threats which are the sources of stresses (see Appendices Part A). As described in Section 3.3, fundamental drivers of historical and current threats (such as population increase or land use policy) were not analysed in detail in this plan.

Vegetation clearance has resulted in the loss and fragmentation of habitat, leading to a range of serious stresses and which has also compounded many other direct threats:

- Decline in habitat condition and native species diversity;
- Local extinctions and reduced population sizes, at increased risk of stochastic extinctions;
- Disrupted dispersal and social and ecological interactions, due to reduced size and increased isolation of remnants;
- Loss of habitat mosaics which reduces ability of species to obtain their requirements in a wide range of conditions (e.g. spatially and temporally variable food resources, drought and fire refugia);
- Adverse effects of increased habitat edges (e.g. altered microclimate, vegetation structure, food availability, increased predation for fauna);
- Increase in pest incursions (weeds, predators, competitive species), resulting in further species loss and habitat degradation.<sup>5</sup>

The settlement and modification of the AMLR has also altered large-scale natural processes, including hydrological regimes and changes to the severity and extent of wildfire, affecting the condition of native vegetation in the region.<sup>13</sup>

Strategic, landscape-scale, and long-term habitat re-establishment programs will be required to curb further loss of species suffering the effects of ecological stresses (see Section 7).

## 4. Planning Approaches and Methods

As there are very few precedents for this style of threatened species recovery planning, a custom planning and analysis model was developed to prepare the plan. Primarily a species-based approach was used to complement existing broader ecosystem scale planning processes. The following sections summarise the methodology adopted. More details are provided in Appendices Part A.

### 4.1 Data Management & Species Inclusion Processes

A project database was devised, based on a data extract of all species records for the region from the DEH Biological Databases of South Australia (July 2007), updated with additional species data sourced from various other databases. Considerable work was undertaken validating and editing data (however, there remain major database reliability issues for threatened species – expanded on in Section 6). Filters were applied to the data to extract all ‘included’ species from the database using date, observer and spatial precision filter rules. The project database provided the foundation for the species selection and accompanying Geographic Information System (GIS) and associated analysis. Other databases and mapping tools were accessed to assess and describe inter-regional species distributions.

Species were chosen for inclusion in the plan using a systematic selection process, though due to data deficiency issues qualitative assessments were required from several regional experts to confirm presence, distributions or conservation status for several species. For flora species in particular, the process is also compromised by taxonomic uncertainty, which leads to difficulty in assessing distribution and regional conservation status. Numerous species were excluded on this basis (e.g. *Cardamine* spp. and many orchid species). In some cases species had to be excluded because data was not available (e.g. *Pterostylis* sp. *Rock ledges*), and time constraints precluded attaining comprehensive information for so many species. Implementation of this plan will involve ongoing reviewing of the inclusion process to account for taxonomic revisions, improved data and increased knowledge.

Whilst the process differed slightly for each taxonomic group, the principal criterion for inclusion was the species’ regional conservation status rating, adapted from existing rating systems with expert input. This meant that selected species were not limited to those with broader State or National legislative conservation ratings, but also included other species of regional concern. The ‘custom’ AMLR regional conservation rating was devised only for the purposes of this plan.

All known extant terrestrial vascular flora and vertebrate fauna (birds, mammals, reptiles, amphibians, freshwater fish) species with a high regional conservation status were considered for inclusion. Species were categorised into endemism classes (AMLR endemic, State endemic, non-endemic). State and non-endemics were further classified relative to their broader State distribution (e.g. disjunct, limited, widespread, peripheral). For flora species, preference was given to AMLR endemics and State endemics with significant AMLR population presence. Non-endemics were included if their regional conservation status was high and the AMLR population was considered significant but disjunct from other regional populations (Appendices Part A). As a general rule, all EPBC Act listed species and all NPW Act ‘Endangered’ species present in the AMLR region were included, unless the AMLR populations were very peripheral to their main distribution, or their presence could not be confirmed (that is, unreliable records or considered extinct or functionally extinct).

For freshwater fish, exotic and translocated species were excluded. Two EPBC listed species were included although their AMLR distributions are peripheral to the majority of their distribution.

For bird species, results from previous regional-specific project work<sup>5</sup> were used to complement existing regional threat ratings. In some cases expert opinion was used to adjust conservation ratings and decide on inclusion. Migratory non-breeders, vagrant and nomadic species that did not meet certain regional conservation rating and declining criteria were excluded.

Further details are outlined in Appendices Part A.

### 4.2 Species & Sub-regional Prioritisation

#### Regional Vulnerability Groups

Internationally, there is not one accepted method for species prioritisation. Methodology is dependent on many variables including project goals and scale. A custom system was devised, combining a categorical approach and numerical scoring using criteria appropriate to the level and quality of information available.

This process aimed to determine species' vulnerability to decline and to assist in determining threat abatement priority within the AMLR region. Rather than relying solely on legislative conservation status ratings to determine priority (which may not reflect the regional situation), the approach aimed to 'value-add' to existing ratings by capturing regional importance.

All terrestrial species were prioritised into six flora and fauna 'Regional Vulnerability Groups' (RVGs) (decreasing in priority from one to six), according to the following categories:

- Regional conservation status (AMLR region)
- Relative area of occupancy (AMLR region)
- Endemism & distribution (State)
- Habitat specialisation (flora)
- State (NPW Act) & National (EPBC Act) conservation status, and
- Residency - AMLR (fauna).

Vulnerability Group 1 for flora and fauna was further refined into sub-priorities.

The categories were equally weighted and were point-scored against assessable criteria (described in Appendices Part A). A sensitivity analysis using a selection of well-known 'benchmark' species was conducted to determine the relative influence of each category. Results were also assessed by expert opinion.

It is recognised that there are interrelationships in the categories and criteria used for this assessment. The results should be considered preliminary for many reasons, including data constraints to assess distribution characteristics, limited information to assess habitat specialisation and limits to the use of legislative threatened species ratings. It is envisaged that the system should be reviewed as actions proposed in this plan are funded and implemented.

#### Sub-regional landscape species prioritisation

The aim in this process was to spatially characterise species' distribution in relation to regional priority, to assist in targeting management. The AMLR region was stratified into eleven sub-regional 'landscapes' (SRL), defined by biogeographic characteristics including soils and geological landform mapping and pre-European vegetation patterns (Figure 2). The SRLs represent relatively distinct ecological units of the AMLR which were defined by the Draft AMLR Biodiversity Strategy.

For each species, the proportion of its distribution occurring in each SRL was calculated. Treated species presence data (500 metre grid cell presence from the filtered database extract) was used as a surrogate for population distribution. To determine the SRL population distribution proportion for each species, the number of occupied grid cells within each SRL was compared to the total number of grid cells the species occupied in the region. The SRL population distribution proportion was calculated as a percentage, and then classified into descriptive classes (All: 100 per cent; High: 50-100 per cent; Moderate: 20-50 per cent; Low: 10-20 per cent; Very Low: 1-10 per cent). The SRL population distribution proportion results were combined with the Regional Vulnerability Group results using a matrix to produce a final species SRL priority rating (Table 6).

**Table 6. Look-up matrix to determine Sub-regional Landscape species priority**

		Regional Vulnerability Group					
		1	2	3	4	5	6
SRL population proportion	ALL	VH	VH	VH	H	H	H
	HIGH	VH	VH	H	H	H	M
	MEDIUM	VH	H	H	H	M	M
	LOW	H	H	H	M	M	M
	VERY LOW	H	H	M	M	M	M

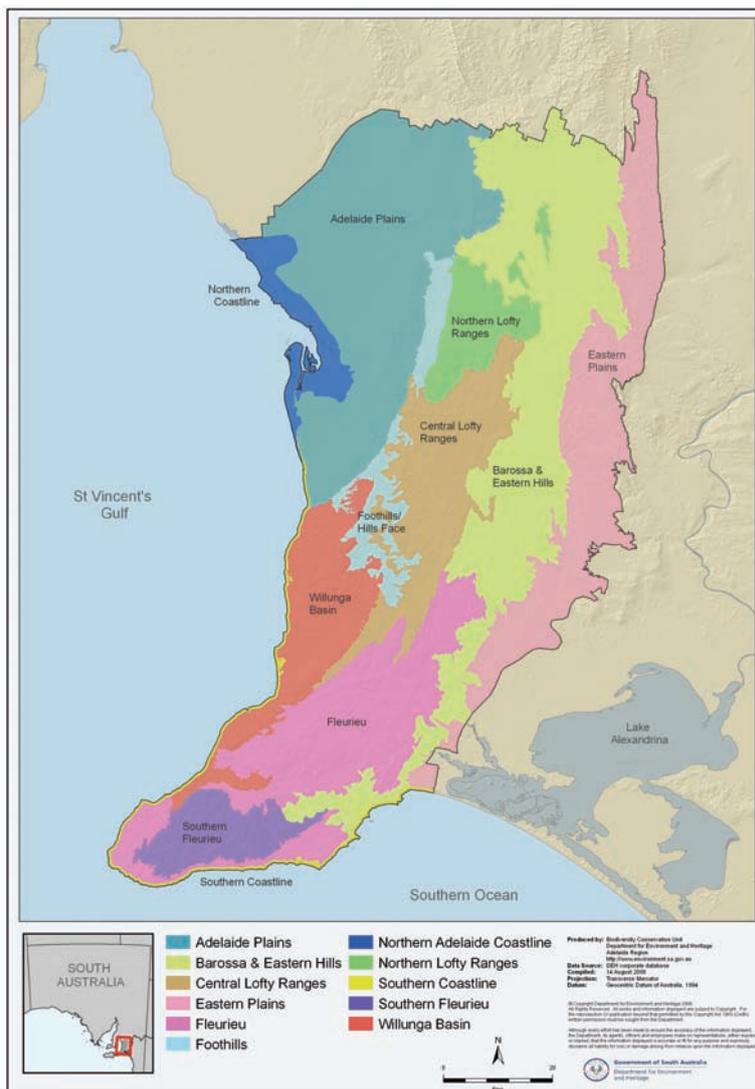
Note: VH= Very High; H=High; M=Medium

It is important to understand the ‘**ecological triage**’ (**priority-setting**) type principles adopted in this planning approach. The Regional Vulnerability Group analysis places priority on more vulnerable species through assessing a selected range of ecological risk factors. At this level, the approach does not make assumptions about the *potential success or the cost* of recovery for each species. However, the initial species selection process effectively does, by excluding species considered extinct or ‘functionally extinct’, though they may not be officially listed as extinct on any legislative schedules (indeed may still be listed as extant). For birds, this inclusion process places priority on residents, effectively stating there is less regional management control over migrants or vagrants and scarce resources should initially be devoted to ‘full-time’ residents (at least within the five year timeframe of this plan).

The SRL prioritisation process for species also implies considering potential success of recovery, in regards to conservation priority-setting. The process effectively uses the SRLs as management units to set spatial priorities, and presumes that recovery actions should be directed towards more regionally vulnerable species where their extant distributions (as best currently known) are more concentrated. However, all sub-populations of the most vulnerable species are high priority wherever they occur.

Due to challenges in determining extant area of occupancy for species currently declining but still relatively extensive compared to many other species (as is the case for many declining bird species) this approach will require continued refining. Implementation of this plan will require further finer-scale triage-type planning, particularly as knowledge concerning species’ extant distribution and sub-population status is improved and other impediments to recovery particularly relating to knowledge-base systems are addressed (see Section 6). A similar process will be required for threatened ecological vegetation communities. While they have been identified and prioritisation undertaken in this plan, more detailed sub-regional prioritisation could not be completed due to the inadequate level of knowledge concerning extant distributions.

Figure 2. Sub-regional Landscapes of the AMLR



### 4.3 Ecological Communities

This plan represents primarily a species-based approach to regional recovery planning, designed to complement existing regional conservation planning processes. Ecological community recovery management needs were addressed primarily in two ways:

1. **Analysing species 'habitat' preferences using 'Broad Vegetation Groups' (BVG) (consistent with the Draft AMLR Biodiversity Strategy and the NRM Plan). A threat analysis was also conducted on the BVGs.**

Nine BVGs have been identified within the AMLR region (Table 7 and Table 8, with full description in Appendices Part A). These broad ecological communities have been developed taking into consideration a range of biotic and abiotic parameters, such as climate, underlying geology, geomorphology, soils and the structure of the vegetation itself. Within each BVG, more specific vegetation associations are linked and were used to help determine the species' three BVG associations, in preferential order. Available literature and expert opinion was used to identify the three preferred species' BVG as a broad habitat descriptor.

2. **Identification and prioritisation of specific threatened ecological communities.** This process used a State level classification of threatened ecological communities in combination with mapped distributions to identify and prioritise 18 communities where the AMLR distribution is significant and under threat. Expert opinion was used to refine the prioritisation process. The results should be considered interim due to lack of knowledge concerning extant distribution and status, and the limitations in existing mapping data preventing more detailed analysis. The detailed assessment table and methodology is presented in Appendices Part A.

Table 7. Summary of sub-regional landscapes of the AMLR

SR Landscape	Landscape modification	Dominant BVG*	Major land use
Northern Lofty	Fragmented-Variiegated >30% vegetation	HW, RI, GW	Grazing Conservation Forestry
Central Lofty Ranges	Fragmented 10-30% vegetation	HF, RI	Peri-urban
Foothills/ Hills Face	Fragmented 10-30% vegetation	GW, RI	Peri-urban
Southern Fleurieu	Fragmented 10-30% vegetation	HF, HW, WE	Improved pastures Conservation
Fleurieu	Fragmented 10-30% vegetation	HW	Dairies Grazing
Eastern Plains	Presumed Fragmented >10% vegetation	GW	Grazing Cropping
Barossa and Eastern Hills	Presumed Fragmented >10% vegetation	GW, GR	Grazing Viticulture
Northern Adelaide/ Southern Coastline	Fragmented Coastal <30% vegetation	CO	Urban Horticulture/cropping
Adelaide Plains/ Willunga Basin	Relictual <10% vegetation	GW, HW	Urban Horticulture/cropping

Source: Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges.

Notes: \*Broad Vegetation Group: GR = Grassland; GW = Grassy Woodland; HF = Heathy Open Forest; HW = Heathy Woodland; CO = Coastal; WE = Wetland; MA = Mallee; RI = Riparian; SH = Shrubland

Table 8. Descriptions of Broad Vegetation Groups

BVG	Description	Area and distribution*
<b>Grassland</b>	A native grassland is dominated by native grasses and herbs, with few or no trees. All grasslands in the AMLR are tussock grasslands, having discrete clumps or tussocks of grasses, herbs or sedges.	5%. Located on plains either side of the spine of the AMLR.
<b>Grassy Woodland</b>	Grassy woodlands are woodlands with an understorey dominated by grasses, herbaceous species (e.g. daisies, lilies) and sedges, a scattered shrub layer and a discontinuous tree layer. The over-storey is typically dominated by eucalypts.	37%. Widespread. Wide arc either side of spine of AMLR, and on good soils in ranges.
<b>Heathy Woodland</b>	Similar to heathy open forest, heathy woodland has a dense understorey and mid-storey of a variety of low small-leaved (sclerophyllous) shrubs. These layers have high structural diversity, but contain fewer species than grassy woodlands.	15%. Widespread. Spine of AMLR, Fleurieu Peninsula
<b>Heathy Open Forest</b>	Heathy open forest has a canopy dominated by eucalypts, and a dense understorey comprising many species of low shrubs, generally with small sclerophyllous hard leaves.	7%. High-rainfall areas, central spine of AMLR
<b>Shrubland</b>	Shrubland is vegetation with an open to very dense layer of shrubs up to 2 m in height, with few or no trees. Shrubland types in the AMLR include coastal chenopod shrublands, low-rainfall open plains shrublands, and high-rainfall sclerophyllous shrublands.	2%. Restricted. Northern Adelaide Coastline, Northern Adelaide Plains, Fleurieu Peninsula.
<b>Mallee</b>	Mallee is a term used to describe vegetation with low, characteristically multi-stemmed trees. Mallee may have a grassy or shrubby understorey, or a mixture of both. The type of understorey is dependent upon soil and rainfall patterns.	2%. Peripheral. Northern and eastern boundaries of region. Some coastal.
<b>Riparian</b>	Riparian vegetation is vegetation found along watercourses and on flood plains. Riparian zones represent transition areas between land and water. The natural vegetation of these areas usually reflects the better soils and moist conditions found in the lower parts of the landscape.	15%. Widespread. Restricted to riparian zones.
<b>Wetland</b>	A number of wetland types are found in the AMLR, including freshwater wetlands especially in the lower Fleurieu Peninsula, and seasonal wetlands of the Adelaide Plains. Freshwater wetland vegetation in the AMLR is shrub-dominated and typically very dense. Note that estuarine creeks particularly of the south coast are considered under 'Coastal'; red gum wetlands along creeks featuring waterholes with fringing reeds are considered under 'Riparian'.	2%. Restricted. Primarily Fleurieu Peninsula and Adelaide Plains.
<b>Coastal</b>	Coastal vegetation is vegetation that is subject to the influences of coastal environments.	<4%. Restricted. Narrow coastal margin.

Source: Adapted from the Draft AMLR Biodiversity Strategy.

\* Area as a percentage of total remnant vegetation. Note, this figure should be treated with care. Mapping of grassy ecosystems is particularly problematic.

## 4.4 Threat Analysis

By virtue of their predicament, threatened species are more vulnerable to the numerous threats that are currently operating in or have the potential to impact in the region.

A threat analysis was performed on each species and each BVG with expert input to: identify the threats currently impacting or likely to have an impact on the species in the plan within the next five years; determine a regional rating for each threat impacting on each species; and assess overall regional threat priorities across all species. Further details on the threat analysis are presented in the Appendices Part A.

The threat analysis method followed the approach of The Nature Conservancy and Salafsky et al. (2003)<sup>7,32</sup> and was mostly performed within the Conservation Action Planning (CAP) Tool, developed by The Nature Conservancy. The first step was to categorise and define 'current direct threats', as opposed to 'ecological stresses', to facilitate developing relevant management actions. The second step was to rate the *Severity* and *Scope* of each threat for each species, based on the defined criteria. These ratings were combined to obtain an overall threat *Magnitude* rating of Low, Medium, High or Very High.

The threat categories adopted were consistent with the CAP hierarchical threat categories and IUCN-CMP Unified Classification of Direct Threats.<sup>7,26</sup> A regionally-relevant description of each assessed threat is presented above (Section 3.3).

Summarising threats across species and BVGs was performed outside of the CAP Tool, by allocating scores to the threat magnitude ratings (weighted according to the rating), summing the scores for each threat, and ranking the threats relative to the maximum threat score. This was performed separately within flora, fauna, freshwater fish groups and BVGs.

Many threats are closely inter-related and therefore difficult to assess as discrete issues for each species or BVG. There is also inadequate knowledge of the threats and the potential interactions between them. Further effort is required to establish a more clear understanding of the nature, extent and relative importance of threats at the species level. This will increase our capacity to effectively manage in an integrated manner with respect to both multiple species and multiple threats. Threats with particular knowledge gaps or threats that are very interactive with other threats have been flagged in the analysis summary tables. Even using defined criteria, ranking threats across multiple species is extremely difficult.

Many species are clearly suffering prolonged ecological stress associated with past threats (e.g. fragmentation and reduced population size resulting from *historical* broad-scale vegetation clearance). In accordance with this, 'vegetation clearance' was not assessed as a 'current direct threat'. Rather it was attempted to rigorously define and assess current direct threats and link these to ecological stresses to better understand how threats operate and thus contribute to more informed management. Direct threat-ecological stress linkages are detailed in Appendices Part A.

As described above, the threat analysis does not necessarily highlight or attempt to describe linkages in detail between direct threats and the underlying 'drivers' of indirect threats, e.g., population growth linkages to water management and use.

As described in Section 3.3, ex-situ conservation is often warranted for critically threatened species particularly where the threats are largely unknown and/or uncontrollable, and is therefore an important part of recovery management. Though the threat analysis methodology could not address species' ex-situ conservation needs specifically, relevant management actions have been incorporated in this plan.

The threat assessment has been performed at the regional scale only. At present there is incomplete information on the spatial distribution of the majority of threats in the AMLR to enable a finer-scale analysis (the exception being the threat class Residential Development as described in Section 3.3.9).

### 4.4.1 Key threatening processes

Under the EPBC Act a threatening process is defined as a Key Threatening Process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community. A process can be listed as a KTP if it could:

- Cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category)
- Cause an already listed threatened species or threatened ecological community to become endangered, or
- Adversely affect two or more listed threatened species or threatened ecological communities.

There are 17 KTPs listed under the EPBC Act, nine of which are considered relevant to the AMLR Region (excluding marine):

- Competition and land degradation by feral goats\*
- Competition and land degradation by feral rabbits\*
- Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)\*
- Infection of amphibians with chytrid fungus resulting in chytridomycosis\*
- Land clearance
- Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases
- Predation by feral cats\*
- Predation by the European red fox\*, and
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species\*.

KTPs marked with an asterisk have an approved or draft National Threat Abatement Plan (TAP). Other currently listed KTPs could be relevant to the AMLR in the future (e.g. reduction in the biodiversity of Australian native fauna and flora due to the cane toad and red imported fire ant). Once a threatening process is listed under the EPBC Act, a TAP can be put into place if it is shown to be 'a feasible, effective and efficient way' to abate the threatening process.

## 4.5 Community Engagement

### 4.5.1 Targeted engagement

A project-specific community engagement strategy was prepared in April 2007, identifying key stakeholders, consultation objectives and milestones for the project. Over 100 key stakeholders (government and non-government) were identified in the strategy, including relevant persons from surrounding regions. A list of the agencies and individuals consulted during this project is provided in Appendices Part A.

Targeted consultation occurred throughout the development of this plan and workshops were held with experts to obtain input regarding: the prioritisation criteria, species' inclusion, data vetting, species' distribution and ecology, and analysis of threats.

Prior to public exhibition of this plan, a one month preliminary comment period was undertaken targeting key State government and non-government stakeholders.

### 4.5.2 General community

A project website was established in May 2007, providing a platform for information dissemination. The project (and website) was concurrently promoted in existing conservation oriented newsletters (see Appendices Part A). Stakeholders were provided the opportunity to be included on the project's e-mail distribution list to receive project updates.

Further community input was sought during the statutory public exhibition phase. The draft plan was released for a formal three month comment period in late 2008.

### 4.5.3 Aboriginal community engagement

There are five Aboriginal Nations with interests in the planning area: Kurna, Peramangk, Ngarrindjeri, Ngadjuri and Nganguraku. After initial contact with the individual nations, the Four Nations NRM Governance Group (FNGG) was consulted to provide input into the plan. The FNGG consists of representatives from Kurna, Ngadjuri, Ngarrindjeri and the Peramangk Nations. A member on the FNGG also represents the Nganguraku Nation.

## 4.6 Benefits to Other Species/Ecological Communities

Many threat abatement actions may benefit other flora and fauna sharing a common distribution with the species included within this plan. Similarly, benefits to numerous species as a response to this plan will positively impact upon the vegetation communities in which the target species occur. Broader scale habitat restoration actions will also have benefits far beyond the focus of this plan. Focused research will

improve species' based knowledge, to the benefit of their future management, and may also have application in the management of closely related species.

However, different species have different management requirements, therefore multi-benefits cannot automatically be assumed by species-specific or habitat-scale management. In some instances actions to manage one species can have a negative impact on others. For example, fencing pockets of native vegetation may protect the structural integrity of native vegetation, however, in the absence of appropriate disturbance regimes, the habitat conditions may become altered, and may not be suitable for some species (e.g. overgrowth of shrubs, shading out ground-level species). It is also recognised that species composition may change over time in response to successional changes in habitat, that may occur naturally or as a result of a particular management regime. Hence, on-ground action needs careful consideration and should be undertaken with best knowledge of the complement of species occurring in an area.

Some of the species in the plan are regarded as 'flagship species', i.e. species with a public profile that may help to raise public awareness or financial support for conservation action.<sup>27</sup> In the AMLR, the southern brown bandicoot and southern emu-wren are two examples. However, as indicated above, flagship species should not be presumed to be de facto 'umbrella' species.

## 5. Summary of Analyses

### 5.1 Threatened Species

#### Regional Vulnerability Groups

Six groups representing regional vulnerability to decline were developed separately for flora and fauna species included in this plan. Table 15 and Table 16 present the species' Vulnerability Group membership, Sub-regional priority, preferred BVG, level of knowledge and regional threat ratings.

Group 1 represents higher priority species while Group 6 represents relatively lower priority species (note that this is in the context of all of these species being identified as regional recovery priorities). Due to uncertainty in the data and available information as described in Section 6, group membership should not be considered completely discrete or absolute. For example, in reality there may be insignificant differences between species vulnerability in adjacent groups. The results from this assessment are combined with a variety of other analyses and presented in the following sections.

#### Threatened flora species presence by Sub-regional Landscape

The Fleurieu Sub-regional Landscape is very species-rich (in terms of the threatened flora species included in this plan), having over half (54 per cent) of the flora species present (Table 9). The majority of these species are 'Wetland' species. Importantly, the Fleurieu SRL also has by far the highest number of SRL endemics. Some SRLs are relatively small but have comparatively high species occurrence, including Southern Coastline, Foothills/Hills Face and Central Lofty Ranges. The Southern Coastline also has relatively high SRL endemism.

**Table 9. Flora species Sub-regional Landscape presence**

Sub-regional Landscape	% area AMLR	# spp.	% spp.	SRL endemic	Species preferred BVG*
Fleurieu	13%	70	54%	22	WE, HW
Central Lofty Ranges	9%	47	37%	4	WE, HW, GW
Foothills/ Hills Face	3%	38	29%	5	HW, GW, WE
Barossa and Eastern Hills	22%	33	25%	1	WE, GW
Southern Fleurieu	4%	30	23%	2	WE
Northern Lofty Ranges	4%	27	21%	2	HW, GW
Southern Coastline	1%	18	14%	7	CO
Willunga Basin	7%	17	13%	1	GW
Eastern Plains	14%	15	12%	5	MA
Adelaide Plains	20%	10	8%	0	GW
Northern Adelaide Coastline	3%	2	2%	2	CO, GW

\*Most frequent species count by preferred Broad Vegetation Group: GW = Grassy Woodland; HF = Heathy Forest; HW = Heathy Woodland; CO = Coastal; WE = Wetland; MA = Mallee; RI = Riparian; SH = Shrubland.

## Threatened fauna species presence by Sub-regional Landscape

Compared to the flora species' distribution, in general fauna species are more evenly spread throughout the SRLs (Table 10). There is also much less SRL endemism compared to flora species. However, some SRLs are relatively small in area but have comparatively high species occurrence, including Southern Coastline, Foothills/Hills Face, Northern Lofty Ranges.

**Table 10. Fauna species Sub-regional Landscape presence (excluding fish)**

Sub-regional Landscape	% area AMLR	# spp.	% spp.	SRL endemic	Species preferred BVG*
Barossa and Eastern Hills	22%	50	78%	1	GW, HW
Willunga Basin	7%	50	78%	2	GW, HW
Fleurieu	13%	49	77%	0	GW, HW
Southern Fleurieu	4%	49	77%	0	GW, HW
Central Lofty Ranges	9%	48	75%	0	GW, HW
Adelaide Plains	20%	45	70%	0	GW, HW
Foothills/ Hills Face	3%	44	69%	0	GW, HW
Northern Lofty Ranges	4%	44	69%	0	GW, HW
Southern Coastline	1%	41	64%	0	GW, HW
Eastern Plains	14%	41	64%	0	GW
Northern Adelaide Coastline	3%	29	44%	0	GW

\*Most frequent species count by preferred Broad Vegetation Group: GW = Grassy Woodland; HF = Heathy Forest; HW = Heathy Woodland; CO = Coastal; WE = Wetland; MA = Mallee; RI = Riparian; SH = Shrubland

## 5.2 Ecological Communities

### 5.2.1 Threatened species associations with Broad Vegetation Groups

Table 11 and Table 12 present the Broad Vegetation Group (BVG) preferences in combination with Regional Vulnerability Group. Salient points include:

- Flora species are primarily associated with Wetland, followed by Heathy Woodland and thirdly Grassy Woodland BVGs. A high number of flora species in higher-ranking Vulnerability Groups are also 'Wetland' species.
- The majority of fauna species are associated with Grassy Woodland or secondly the Heathy Woodland BVG.

**Table 11. Summary of flora species Vulnerability Group and preferred Broad Vegetation Group**

	Vulnerability Group						Total (#)	Total (%)
	1	2	3	4	5	6		
WETLAND	14	5	8	9	4	2	42	32
HEATHY WOODLAND	8	7	4	4	4	3	30	23
GRASSY WOODLAND	4	2	2	2	2	4	18	14
COASTAL	4	1	4	2	-	1	12	9
RIPARIAN	4	2	1	2	-	-	9	7
MALLEE	1	1	3	2	1	1	9	7
HEATHY OPEN FOREST	3	-	1	-	2	1	7	5
SHRUBLAND	1	1	-	-	-	1	3	2
GRASSLAND	-	-	-	-	-	-	-	-

**Table 12. Summary of fauna species Vulnerability Group and preferred Broad Vegetation Group**

	Vulnerability Group						Total (#)	Total (%)
	1	2	3	4	5	6		
GRASSY WOODLAND	1	2	5	8	3	5	24	38
HEATHY WOODLAND	3	-	3	-	5	3	14	22
WETLAND	1	1	3	2	-	-	7	11
RIPARIAN	-	2	2	1	-	1	6	9
GRASSLAND	-	-	4	-	-	-	4	6
COASTAL	1	2	-	-	-	-	3	5
SHRUBLAND	-	-	-	1	2	-	3	5
HEATHY OPEN FOREST	-	-	1	-	-	1	2	3
MALLEE	-	-	-	1	-	-	1	2

### 5.2.2 Threatened ecological communities

As described, three ecological communities that occur within the AMLR region are nationally listed as critically endangered. For the Swamps of the Fleurieu Peninsula, formal recovery planning and management has been underway since 2003 (though for several years prior the Fleurieu Peninsula wetlands have been the focus of management as part of the southern emu-wren recovery program). Initial recovery planning processes have also commenced for the recently EPBC-listed peppermint box grassy woodlands and iron-grass grasslands communities. Currently a nomination for EPBC listing of grey box woodland (threatened within AMLR) is being considered.

The assessment undertaken to identify and prioritise specific threatened ecological communities within AMLR highlights many priority communities that are not currently being targeted as part of any formal recovery program (Table 13). Other than EPBC-listed ecological communities, priority threatened communities in AMLR include:

- *Banksia marginata* grassy low woodland (Very High priority)
- *Eucalyptus microcarpa* grassy low woodland (Very High priority)
- *Eucalyptus dalrympleana* ssp. *dalrympleana* open forest (Very High priority)
- *Themeda triandra* +/- *Danthonia* spp. tussock grassland (Very High priority)
- *Callitris preissii* +/- *Eucalyptus leucoxyton* grassy low woodland (High priority)
- *Gahnia filum* sedgeland (High priority)
- *Eucalyptus ovata* +/- *E. viminalis* ssp. *cygnetensis* +/- *E. camaldulensis* var. *camaldulensis*/ Low woodland (High priority), and
- *Eucalyptus fasciculosa* +/- *E. leucoxyton* heathy woodland (High priority)

Table 13. Threat assessment of Broad Vegetation Groups with associated threatened ecological communities

	Threats & rating summary*			State threatened ecological communities (as per DEH, 2005) <sup>8</sup>	AMLR RRP priority
	Very High	High	Medium		
<b>Grassy Woodland</b>	1	3,4,5	2,9,13,14,15	Banksia marginata Grassy Low Woodland Eucalyptus microcarpa Grassy Low Woodland Eucalyptus odorata +/- E. leucoxylo Grassy Low Woodland Callitris preissii +/- Eucalyptus leucoxylo Grassy Low Woodland Allocasuarina verticillata Grassy Low Woodland Eucalyptus leucoxylo ssp. pruinosa +/- E. odorata Grassy Low Woodland Eucalyptus porosa Woodland	Very High Very High Very High High Medium Medium Concern
<b>Wetland</b>	6	1,2,3	4,5,8,12,13,18	Freshwater wetlands e.g. Triglochin procerum Herbland Leptospermum lanigerum Closed Shrubland Melaleuca squamea +/- Leptospermum continentale Closed Shrubland Gahnia filum Sedgeland	Very High Very High Very High High
<b>Riparian</b>	1,6	2,3,19	7,8,10,12,13,14,19	Eucalyptus dalyrpleana ssp. dalyrpleana Open Forest Eucalyptus ovata +/- E. viminalis ssp. cygnetensis +/- E. camaldulensis var. camaldulensis Low Woodland Eucalyptus viminalis ssp. cygnetensis and/or E. viminalis ssp. viminalis Woodland	Very High High Medium +
<b>Grassland</b>	1	3,4	2,5,8,9,15	Lomandra effusa Tussock Grassland Themeda triandra +/- Danthonia spp. Tussock Grassland Eucalyptus fasciculosa +/- E. leucoxylo Heathy Woodland	Very High Very High High
<b>Coastal Shrubland</b>	1,2	4,7,10,11	3,5,6,9,14,15,17	Melaleuca halmaturorum Shrubland/ Low Open Forest	Concern
<b>Mallee</b>		2	3,4,17		
<b>Heathy O. Forest</b>		1,7	3,4,5,10,11,		
		1,2	3,4,5,9,12,16		

- 1: Weed invasion  
 2: Drought, climate change, severe weather  
 3: Grazing & disturbance by stock  
 4: Inappropriate fire regimes  
 5: Grazing & disturbance by kangaroos  
 6: Water management & use  
 7: Grazing & disturbance by rabbits  
 8: Incompatible site management  
 9: Firewood & rock removal  
 10: Residential & commercial development  
 11: Recreational activities & site disturbance  
 12: Grazing & disturbance by deer & goats  
 13: Agriculture intensification  
 14: Problematic native species (other)  
 15: Pollution & Poisoning (chemical & solid waste)  
 16: Disease or insect damage (Phytophthora)  
 17: Fire management activities  
 18: Predation & competition by introduced fish  
 19: Removal of snags

\*Note: excluded threats rated 'Low'. See Appendices Part A for prioritisation methodology.

## 5.3 Current Direct Threats

### Regional summary

Threat summary ratings for the species-based analysis are listed below in Table 14. As indicated, the threat analysis results for some categories should be interpreted with care due to threat interactions and significant knowledge gaps. Other limitations are described in Appendices Part A.

Threats that rank very highly across all three groups (flora, fauna and freshwater fish) include climate change (including drought & severe weather), water management and use, and grazing and disturbance by stock. Other relatively high-ranking threats across all three groups include residential and commercial development, recreational activities and incompatible site management. Weed invasion is a highly ranked threat across flora and fauna species.

The species-based threat results are presented in combination with sub-regional priority and other species analysis attributes in Table 15, Table 16. The threat results are also summarised and combined with links to the management objectives and actions in sections below.

Refer to the species profiles in Appendices Part B for additional species-specific threat-related information.

Current direct threats were also assessed for the defined BVGs. Summaries are presented in Table 13. Weed invasion is a significant threat to grassy woodland, riparian, grassland and coastal groups. Water management and use is also a significant threat to wetland and riparian vegetation groups. Climate change, drought & severe weather is an important threat to most groups, but particularly coastal communities. Other than managing direct threats to these communities, there are a number of other crucial management needs including addressing knowledge gaps, improving knowledge-base systems and increasing legislative protection (see Section 7).

Further threat analyses results including proposed priority BVG/species associations are presented in Section 5.5.

Table 14. Species-based threat analysis summary &amp; management links

Current direct threat category	FLORA	FAUNA*	FISH	Actions <sup>^</sup>
<b>Agriculture &amp; Aquaculture</b>				
Grazing & Disturbance by Stock <b>††</b> <b>Pb</b>	Medium-High	Very High	High	A1.3; A3.15
<b>Biological Resource Use</b>				
Firewood & Rock Removal	-	Medium-High	-	A1.6
Fishing & Harvesting of Aquatic Resources	-	-	Medium-High	A1.4; A1.20
Illegal Hunting or Collection	Low	Low	Medium-High	A4.2
<b>Climate Change, Drought &amp; Severe Weather</b>				
Climate Change, Drought & Severe Weather <b>††</b>	Very High	Very High	Very High	A3.19
<b>Energy Production &amp; Mining</b>				
Mining & Quarrying	Low	Low	Medium-High	A4.2
<b>Human Intrusions &amp; Disturbance</b>				
Recreational Activities & Site Disturbance	Medium-High	Medium	Medium-High	A1.5
<b>Invasive &amp; Other Problematic Species &amp; Genes</b>				
Competition with Honey Bees <b>Pb</b>	-	Low	-	
Disease & Insect Damage <sup>††</sup> <b>††</b> <b>Pb</b>	Low	Medium	Medium-High	A4.2; see note #
Grazing & Disturbance by Deer or Goats <b>Pb</b>	Low	Low	-	
Grazing & Disturbance by Kangaroos <b>††</b> <b>Pb</b>	Medium-High	Low	-	A1.8; A3.15
Grazing & Disturbance by Rabbits <b>††</b>	Medium	Medium-High	-	A1.9; A3.15
Predation & Disturbance by Uncontrolled Dogs	-	Medium	-	A1.12
Predation by Cats <b>††</b> <b>Pb</b>	-	Very High	-	A1.12; A3.22
Predation by Foxes <b>††</b> <b>Pb</b>	-	High	-	A1.10; A1.11; A3.16; A3.22
Predation & Competition by Introduced Birds	-	Low	-	
Predation & Competition by Introduced Fish	-	-	High	A1.4; A1.20
Problematic Native Species (Other) <b>Pb</b>	Low	Low	-	
Weed Invasion <sup>††</sup> <b>††</b>	Very High	High	-	A1.13; A1.14; A3.15
<b>Natural Systems Modifications</b>				
Fire Management Activities <b>††</b>	Low	Medium-High	-	A1.15
Inappropriate Fire Regimes <b>††</b> <b>Pb</b>	Medium-High	Very High	Low	A3.17; A3.15
Incompatible Site Management <b>Pb</b>	Medium-High	Medium	-	A1.16
Removal of Snags	-	-	Medium-High	A1.4; A1.20
Water Management & Use <b>††</b> <b>Pb</b>	High	High	Very High	A1.17; A1.19; A3.15
<b>Pollution</b>				
Pollution & Poisoning	Medium	Medium-High	Medium-High	A1.16
<b>Residential &amp; Commercial Development</b>				
Residential & Commercial Development	Medium-High	High	Medium-High	A1.21
<b>Transportation &amp; Service Corridors</b>				
Road, Rail & Utilities Maintenance Activities	Medium	Low	-	A1.22
Road-kill	-	Low	-	

**††** A threat category which is highly interactive with other threats, and therefore difficult to assess independently.

**Pb** A threat category with a high degree of assessment uncertainty due to lack of knowledge.

\* Fauna summary includes bird, reptile, amphibian and mammal species.

<sup>^</sup> Only most relevant actions indicated. See Section 7 for other related actions and performance criteria.

# Includes Phytophthora but assessed for Broad Vegetation Groups only. For species, see Actions A1.6; A1.7; A3.18.

+ See Appendices Part A for priority weed species

- Threat not relevant to the taxa group.















## 5.4 Species Knowledge Level Assessment

'Knowledge level' in this context of this plan is a general term referring to the level of regionally-relevant information known and/or available for threatened species. The findings are mostly qualitative, drawing on expert knowledge, the level of information accessible and general experience from developing this plan. Information in this section also overlaps with and links to content in Section 6 (Impediments to Recovery).

General categories have been used to describe knowledge; poor, some and fair. As an indication, 'poor' refers to a species which has very little information available on the regional sub-population status (for one reason many historical records have never been re-visited), life history, habitat requirements, regional distribution, abundance, reasons for decline and current threats.

### General knowledge level assessment

Common finding across all threatened species taxa:

- Institutional knowledge is very poor. Knowledge has been poorly captured and integrated in management agency documentation, databases and monitoring systems. Corporate information sources are disparate and inadequately documented.

Flora, reptiles & amphibians:

- In general, knowledge is extremely limited for most species.
- The most reliable and comprehensive field-based knowledge is held by a very limited number of individual experts within the AMLR region.
- There is an urgent requirement to re-locate historical observations to determine population status and to improve spatial precision of the recorded locality (this includes all reptile and amphibian species and a minimum of 30 per cent of identified flora species).

Birds and mammals:

- There is a greater level of knowledge in terms of species distribution, abundance and population status.
- There are a greater number of experts within the region.
- There are a much greater number of database species records relative to other taxa (however see Section 6 for database limitations).

### Fauna species - knowledge level

Knowledge level was determined through a combination of expert knowledge and information derived from previous published and unpublished project work. The majority of information about birds came from Cale (2005). See Appendices Part A for details on each species.

Overall, 44 per cent of RRP fauna species have a 'poor' level of knowledge, 41 per cent 'some' and 15 per cent 'fair' (Table 18). Note, this analysis for fauna is based on incomplete information and should be considered preliminary. Fauna species knowledge level analysed in relation to ecological community preference, shows the dominant grassy woodland species are generally poorly known. Similarly, knowledge is lacking for the heathy woodland, riparian and grassland fauna species.

Most of the threatened reptile species are particularly poorly known (especially in terms of their conservation status). A more detailed break-up of the fauna species knowledge level classification, by species priority and preferred BVG is presented below (Box 1).

A knowledge level analysis could not be undertaken for freshwater fish. For detailed information on the fish species included in this plan, refer to the Action Plan for South Australian Freshwater Fishes (2007).<sup>25</sup>

**Table 18. Fauna species summary management & knowledge level & BVG**

	# species*			Total (#)	Total (%)
	Poor *	Some ✓	Fair ✓✓		
GRASSY WOODLAND	10	9	5	24	38%
HEATHY WOODLAND	7	6	1	14	22%
WETLAND	1	5	1	7	11%
RIPARIAN	5	-	1	6	9%
GRASSLAND	3	1	-	4	6%
COASTAL	-	2	1	3	5%
SHRUBLAND	1	2	-	3	5%
HEATHY OPEN FOREST	1	1	-	2	3%
MALLEE	-	-	1	1	2%
<b>Total (#)</b>	28	26	10	<b>64</b>	
<b>Total (%)</b>	<b>44%</b>	<b>41%</b>	<b>15%</b>		

\* excluding freshwater fish

**Box 1. Fauna species knowledge level by Vulnerability Group and Broad Vegetation Group preference (based on first BVG preference only)****Higher priority fauna species (VG 1-3) with 'poor' level of knowledge:**

GRASSLAND: Brown Quail, Five-lined Earless Dragon, Olive Snake-lizard

GRASSY WOODLAND: Crested Shrike-tit, Spotted Quail-thrush

HEATHY OPEN FOREST: Pygmy Copperhead

HEATHY WOODLAND: Bassian Thrush, Brown Toadlet, Heath Goanna, Painted Button-quail

RIPARIAN: Carpet Python, Eastern Water Skink, Tiger Snake, Yellow-bellied Water Skink

WETLAND: Southern Grass Skink

**Higher priority fauna species (VG 1-3) with 'some' level of knowledge:**

COASTAL: Beautiful Firetail, Slender-billed Thornbill (St Vincent Gulf)

GRASSLAND: Flinders Worm Lizard

GRASSY WOODLAND: Cunningham's Skink, Diamond Firetail, Hooded Robin, Restless Flycatcher Yellow-tailed Black-Cockatoo

HEATHY WOODLAND: Chestnut-rumped Heathwren (MLR)

WETLAND: Australasian Bittern, Buff-banded Rail, Lewin's Rail

**Higher priority fauna species (VG 1-3) with 'fair' level of knowledge:**

COASTAL: Orange-bellied Parrot

GRASSY WOODLAND: Black-chinned Honeyeater

HEATHY WOODLAND: Southern Brown Bandicoot

WETLAND: Southern Emu-wren

**Lower priority fauna species (VG 4-6) with 'fair' level of knowledge:**

GRASSY WOODLAND: Brown Treecreeper, Scarlet Robin, White-browed Babbler, White-winged Chough

MALLEE: Western Pygmy-possum

RIPARIAN: Peregrine Falcon

**Flora species - management & knowledge level**

As there is more species and site-specific management occurring for threatened flora species compared to fauna species, knowledge was also determined through assessing the degree of management for each species. Management was defined as regional "active management focussed on the single species or its habitat", implying sub-population or site-specific knowledge of species status and distribution. See Appendices Part A for details on each species.

Overall, 43 per cent of RRP flora species in AMLR have a 'poor' level of management/knowledge, 40 per cent 'some' and 17 per cent 'fair' (Table 19). Flora species management/knowledge level analysed in relation to ecological community preference, shows the dominant wetland species are particularly poorly known. The second dominant community association, heathy woodland species, have a slightly higher level of management/ knowledge.

A more detailed break-up of the flora species knowledge level classification, by species priority and preferred BVG is presented below (Box 2).

**Table 19. Flora species summary management & knowledge level & BVG**

	# species			Total (#)	Total (%)
	Poor *	Some ✓	Fair ✓✓		
WETLAND	25	16	1	42	<b>32</b>
HEATHY WOODLAND	8	16	6	30	<b>23</b>
GRASSY WOODLAND	5	6	7	18	<b>14</b>
COASTAL	6	4	2	12	<b>9</b>
RIPARIAN	4	4	1	9	<b>7</b>
MALLEE	3	2	4	9	<b>7</b>
HEATHY OPEN FOREST	2	4	1	7	<b>5</b>
SHRUBLAND	3	-	-	3	<b>2</b>
GRASSLAND	-	-	-	-	<b>-</b>
<b>Total (#)</b>	56	52	22	<b>130</b>	
<b>Total (%)</b>	<b>43%</b>	<b>40%</b>	<b>17%</b>		

**Box 2. Flora species knowledge level by Vulnerability Group and Broad Vegetation Group preference (based on first BVG preference only)****Higher priority flora species (VG 1-3) with a 'poor' level of management and knowledge:**

COASTAL: *Austrostipa echinata*, *Maireana decalvans*, *Orobanche cernua* var. *australiana*, *Podolepis muelleri*

GRASSY WOODLAND: *Austrostipa oligostachya*

HEALTHY WOODLAND: *Caladenia vulgaris*, *Calochilus paludosus*, *Eucalyptus paludicola*, *Veronica derwentiana* ssp. *anisodonta*, *Paracaleana disjuncta*

MALLEE: *Daviesia pectinata*

RIPARIAN: *Crassula sieberiana*, *Gahnia radula*, *Glycine tabacina*

SHRUBLAND: *Senecio megaglossus*, *Tricostularia pauciflora*

WETLAND: *Adiantum capillus-veneris*, *Cryptostylis subulata*, *Eleocharis atricha*, *Gratiola pumilo*, *Hibbertia tenuis*, *Juncus prismatocarpus*, *Lycopodiella lateralis*, *Lycopodiella serpentina*, *Mazus pumilio*, *Olearia glandulosa*, *Pratia puberula*, *Ranunculus papulentus*, *Schizaea bifida*, *Schizaea fistulosa*, *Schoenus discifer*, *Spiranthes australis*, *Utricularia lateriflora*

**Higher priority flora species (VG 1-3) with 'some' level of management and knowledge:**

COASTAL: *Caladenia bicallata* ssp. *bicallata*, *Corybas expansus*, *Spyridium coactillifolium*

GRASSY WOODLAND: *Oreomyrrhis eriopoda*, *Prasophyllum occultans*, *Prasophyllum pruinosum*

HEALTHY OPEN FOREST: *Corybas unguiculatus*, *Lycopodium deuterodensum*, *Todea barbara*

HEALTHY WOODLAND: *Allocasuarina robusta*, *Brachyscome diversifolia*, *Caladenia ovata*, *Veronica derwentiana* ssp. *homalodonta*, *Euphrasia collina* ssp. *osbornii*, *Haloragis myriocarpa*, *Paracaleana minor*, *Pterostylis* sp. *Hale* (R.Bates 21725), *Viola betonicifolia* ssp. *betonicifolia*

MALLEE: *Prasophyllum fecundum*

RIPARIAN: *Helichrysum rutidolepis*, *Psilotum nudum*, *Wurmbea uniflora*

WETLAND: *Microtis atrata*, *Microtis rara*, *Prasophyllum murfetii*, *Pterostylis falcata*, *Pterostylis uliginosa*, *Ranunculus inundatus*, *Thelymitra circumsepta*, *Thelymitra cyanea*, *Thelymitra mucida*,

**Higher priority flora species (VG 1-3) with a 'fair' level of management and knowledge:**

COASTAL: *Calochilus cupreus*, *Dampiera lanceolata* var. *intermedia*

GRASSY WOODLAND: *Caladenia argocalla*, *Pterostylis arenicola*, *Pterostylis bryophila*, *Pterostylis cucullata* ssp. *sylvicola*

HEALTHY OPEN FOREST: *Corybas dentatus*

HEALTHY WOODLAND: *Caladenia behrii*, *Caladenia colorata*, *Caladenia gladiolata*, *Caladenia rigida*, *Diuris brevifolia*

MALLEE: *Acacia pinguifolia*, *Acacia rhotinocarpa*, *Prostanthera eurybioides*

RIPARIAN: *Correa calycina* var. *calycina*

WETLAND: *Thelymitra cyanapicata*

**Lower priority flora species (VG 4-6) with fair level of management and knowledge:**

GRASSY WOODLAND: *Dianella longifolia* var. *grandis*, *Diuris behrii*, *Glycine latrobeana*

HEALTHY WOODLAND: *Caladenia valida*

MALLEE: *Acacia menzelli*

## 5.5 Habitat Re-establishment Planning Linkages & Analyses Summaries

In this plan, 're-establishment' is defined as management with long-term aims of geographically increasing habitat area, connectivity and function for target species. The range of activities may include active revegetation to assist regeneration through protection of remnant patches, e.g. by fencing. Re-establishment also aims in the long-term to reduce threats (and thus threat abatement needs) which are currently magnified due to the nature of fragmented remnant habitat surrounded by modified landscapes.

'Threat abatement' in this plan refers to types of activities managing a range of 'current direct threats'. Such activities may involve direct on-ground immediate management (e.g. weed or predator control) or more preventative actions (e.g. track closure or environmental interpretation to reduce recreational impacts). It is recognised that such threat abatement activities are usually integral to the longer-term management of areas undergoing habitat re-establishment.

This plan acknowledges that it is very difficult to categorise and assess threats to prioritise management. Threats do not operate discretely, and importantly, in reality management actions for conservation outcomes are also not discrete – they are considered with other actions and usually attempt to achieve multiple outcomes, blurring distinctions between 'habitat re-establishment', 'threat abatement' and even management of 'impediments to recovery'. In this plan, threat abatement actions sit alongside actions to address habitat re-establishment and impediments to recovery, and are linked with each other where appropriate. On-ground management, for the purposes of this plan, must be targeted according to known species locations. Sub-regional priorities have been proposed to assist in determining species priorities, and therefore focus areas, within the region. Adjuncts to this plan will be developed to map areas according to specific management requirements and aims. It is recognised that planning for habitat re-establishment for species must form part of a broader planning process for landscape restoration.

The threat analysis approach taken in this plan is described in Section 3.3, including the rationale for separating 'current direct threats' from 'ecological stresses'. A review of linkages between the current direct threats assessed and associated ecological stresses, highlights that, while broad-scale vegetation clearance is not considered a current direct threat, a significant number of current threats link directly to 'Habitat Loss and Modification' and 'Incremental Clearance' ecosystem conversion stresses. Similarly, many threats link to 'Indirect Ecosystem Effects' stresses relating to habitat fragmentation, barriers to dispersal, edge effects and isolation (Appendices Part A). This implies that although the region has already undergone massive ecological change (approximately 12 per cent of pre-European vegetation remains due to historical clearance) habitat loss and modification remains as an ongoing impact manifested through a range of current direct threats. This emphasises the requirement to slow ongoing habitat degradation processes and to urgently increase vegetation restoration planning and management efforts. As indicated above, it is outside the scope of this species-based plan to propose landscape ecological community restoration targets, however this plan's content and analysis should form an integral component of future landscape restoration planning.

This plan has been developed to complement and inform other regional planning processes, including the Cape Borda to Barossa NatureLinks Plan, the AMLR NRM Plan and in particular the Draft AMLR Biodiversity Strategy. The Strategy proposes landscape restoration strategies and targets (around the principles of 'maintain', 'improve' or 'reconstruct') based on an analysis of landscape variables (e.g. pre-European vegetation, vegetation modification patterns, remnant vegetation, reservation, land use), using the best available information and data.

Ideally, implementation of the Biodiversity Strategy and this plan would be concurrent. The method for incorporating 'coarse' and 'fine' filter planning processes for strategic restoration planning has already been conceptualised.<sup>11</sup> The process involves an iterative method combining a series of analyses and overlays based around landscape and species-based variables. This planning process will be facilitated by this plan's use of the sub-regional landscape and broad vegetation groups developed in the Draft Biodiversity Strategy. In addition, the significant impediments to threatened species recovery identified in this plan, are largely shared by any regional planning process. Therefore concurrent implementation would be mutually beneficial with many further significant opportunities for integration. It is imperative that the Strategy be finalised, adopted and implemented to drive strategic ecological restoration within AMLR.

In addition to the species prioritisation and threat analyses results, several overall conclusions can be proposed to assist in developing management and habitat re-establishment priorities for threatened species and vegetation community associations in the AMLR region. These are presented below.

At the regional scale, to benefit the majority of AMLR threatened **flora** species, management should focus on species habitats associated with the following vegetation groups (in order of priority):

1. Wetland
2. Heathy Woodland

Note, the focus of sub-regional scale management may vary according to individual species priorities (Table 15).

For each priority vegetation group, flora threat abatement priorities and other analyses summaries are presented below.

### 1. Wetland threatened flora priority association

Flora species - current direct threat	Priority*
Climate Change, Drought & Severe Weather  	Very High
Water Management & Use  	Very High
Weed Invasion  (see Appendices Part A for priority weed species)	High
Broad vegetation group - current direct threat	
Water Management & Use  	Very High
Climate Change, Drought & Severe Weather  	High
Grazing & Disturbance by Stock  	High
Weed Invasion  (see Appendices Part A for priority weed species)	High

#### Summary of analysis results:

Sub-regional restoration strategies should be primarily planned according to the AMLR Biodiversity Strategy as described above, using priority 'Wetland' threatened species and ecological community extant distributions to assist in determining spatial priorities for restoration. Further summary results relevant to 'Wetland' and the threatened flora species associated with this vegetation group include:

- The Fleurieu and Southern Fleurieu sub-regional landscapes are the most important areas (the former SRL containing numerous Wetland species not occurring in any other SRL). These areas are currently receiving focussed Wetland ecosystem recovery management (however management targeting individual flora species requirements is limited).
- Other important SRLs for 'Wetland' species include Central Lofty Ranges and Barossa and Eastern Hills. These areas are not currently a 'Wetland' focus for recovery management.
- There are threatened Wetland ecological communities which range outside of the Fleurieu Peninsula area, including *Triglochin procerum* Herbland and *Gahnia filum* Sedgeland which do not receive focussed recovery management, their distribution and condition is uncertain.
- A significant number of the most vulnerable species (Group 1) are 'Wetland' species.
- The level of ecological knowledge including sub-population status for the majority of threatened Wetland flora species is very poor. Many of these are regionally highly vulnerable (Groups 1-3), occurring in the Fleurieu sub-regional landscape.

\* Only Very High and High threats shown.

 A threat category which is highly interactive with other threats, and therefore difficult to assess independently.

 A threat category with a high degree of assessment uncertainty due to lack of knowledge.

## 2. Heathy Woodland threatened flora priority association

Flora species - current direct threat	Priority*
Climate Change, Drought & Severe Weather  	Very High
Weed Invasion  (see Appendices Part A for priority weed species)	Very High
Inappropriate Fire Regimes  	High
Broad vegetation group - current direct threat	
Grazing & Disturbance by Kangaroos  	High
Weed Invasion  (see Appendices Part A for priority weed species)	High

### Summary of analysis results:

Sub-regional restoration strategies should be primarily planned according to the AMLR Biodiversity Strategy as described above, using priority 'Heathy Woodland' threatened species and ecological community extant distributions to assist in determining spatial priorities for restoration. Further summary results relevant to 'Heathy Woodland' and the threatened flora species associated with this vegetation group include:

- The Foothills/Hills Face and Northern Lofty SRLs are the most important areas for Heathy Woodland threatened flora species. The Fleurieu and Central Lofty Ranges are the next most important SRLs.
- Within the Heathy Woodland broad vegetation group, *Eucalyptus fasciculosa* +/- *E. leucoxyton* heathy woodland is a threatened ecological community within AMLR. The distribution and condition of this community is uncertain.
- The level of ecological knowledge for the majority of threatened Heathy Woodland flora species is very low.

\* Only Very High and High threats shown.

 A threat category which is highly interactive with other threats, and therefore difficult to assess independently.

 A threat category with a high degree of assessment uncertainty due to lack of knowledge.

At the regional scale, to benefit the majority of AMLR threatened **fauna** species, management should focus on species habitats associated with the following vegetation groups (in order of priority):

1. Grassy Woodland
2. Heathy Woodland

Note, the focus of sub-regional scale management may vary according to individual species priorities (Table 16).

For each priority vegetation group, fauna (excluding freshwater fish) threat abatement priorities and other analyses summaries are presented below.

### 1. Grassy Woodland threatened fauna priority association

<b>Fauna species - current direct threat</b>	<b>Priority*</b>
Grazing & Disturbance by Stock <b>⚡</b> <b>Ⓜ</b>	Very High
Inappropriate Fire Regimes <b>⚡</b> <b>Ⓜ</b>	Very High
Predation by Cats <b>⚡</b> <b>Ⓜ</b>	Very High
Climate Change, Drought & Severe Weather <b>⚡</b> <b>Ⓜ</b>	High
Firewood & Rock Removal	High
Grazing & Disturbance by Rabbits <b>⚡</b>	High
Residential & Commercial Development	High
Weed Invasion <b>⚡</b> (see Appendices Part A for priority weed species)	High

<b>Broad vegetation group - current direct threat</b>	
Weed Invasion <b>⚡</b> (see Appendices Part A for priority weed species)	Very High
Grazing & Disturbance by Kangaroos <b>⚡</b> <b>Ⓜ</b>	High
Grazing & Disturbance by Stock <b>⚡</b> <b>Ⓜ</b>	High
Inappropriate Fire Regimes <b>⚡</b> <b>Ⓜ</b>	High

#### Summary of analysis results:

Sub-regional restoration strategies should be primarily planned according to the AMLR Biodiversity Strategy as described above, using priority 'Grassy Woodland' threatened species and ecological community extant distributions to assist in determining spatial priorities for restoration. Further summary results relevant to 'Grassy Woodland' and the threatened fauna species associated with this vegetation group include:

- The Grassy Woodland fauna species are relatively evenly distributed across sub-regional landscapes. Further investigation is required to propose more refined across-species sub-regional priorities for threatened fauna species. However, several smaller SRLs have relatively high occurrence of fauna species including Northern Lofty Ranges, Foothills/Hills Face, Willunga Basin and Southern Coast.
- The level of ecological knowledge for the majority of threatened Grassy Woodland fauna species is very poor. Many of these are regionally highly vulnerable (Groups 1-3).

\* Only Very High and High threats shown.

**⚡** A threat category which is highly interactive with other threats, and therefore difficult to assess independently.

**Ⓜ** A threat category with a high degree of assessment uncertainty due to lack of knowledge.

## 2. Heathy Woodland threatened fauna priority association

Fauna species - current direct threat	Priority*
Climate Change, Drought & Severe Weather  	Very High
Inappropriate Fire Regimes  	Very High
Grazing & Disturbance by Stock  	High
Predation by Cats  	High
Predation by Foxes  	High
Broad vegetation group - current direct threat	
Grazing & Disturbance by Kangaroos  	High
Weed Invasion  (see Appendices Part A for priority weed species)	High

### Summary of analysis results:

Sub-regional restoration strategies should be primarily planned according to the AMLR Biodiversity Strategy as described above, using priority 'Heathy Woodland' threatened species and ecological community extant distributions to assist in determining spatial priorities for restoration. Further summary results relevant to 'Heathy Woodland' and the threatened fauna species associated with this vegetation group include:

- The Heathy Woodland fauna species are relatively evenly distributed across sub-regional landscapes. Further investigation is required to propose more refined across-species sub-regional priorities for threatened fauna species. However, several smaller SRLs have relatively high occurrence of fauna species including Northern Lofty Ranges, Foothills/Hills Face, Willunga Basin and Fleurieu.
- The level of ecological knowledge for the majority of threatened Heathy Woodland fauna species is very poor. Many of these are regionally highly vulnerable (Groups 1-3).

\* Only Very High and High threats shown.

 A threat category which is highly interactive with other threats, and therefore difficult to assess independently.

 A threat category with a high degree of assessment uncertainty due to lack of knowledge.

## 6. Impediments to Recovery

### 6.1 Capacity and Management

There are many significant organisational-related impediments to threatened species recovery. Essentially, they revolve around themes of capacity and funding, knowledge management systems and community engagement. Impediment issues do not operate independently, that is, many are closely inter-related. Many important impediments are associated with much wider organisational issues and fully addressing these will be beyond the scope of this plan's implementation. Relevant management objectives for impediments to recovery are presented in Section 7.

#### Resources and Capacity

- There is a general lack of resource capacity for:
  - Government management agencies, NGOs and community groups to address the recovery needs of all priority species and ecological communities,
  - Recovery programs to fully engage and utilise community groups to contribute to recovery needs of all priority species and ecological communities, and
  - Comprehensive monitoring and evaluation of threatened species recovery management performance.
- Issues involving funding arrangements include:
  - Lack of adequate funding to address the recovery needs of all priority species and ecological communities,
  - Inadequate funding structures for securing long-term sustainability for recovery programs (also affecting project staff satisfaction and staff continuity), and
  - Lack of consistency and coordination of project funding sources, leading to difficulties in integrating management priorities across programs.

#### Knowledge-base systems

- Inadequate systems to assess long-term trends in regional conservation status (hence monitoring baselines are unknown and population decline is not detected in a timely way).
- Inadequate 'knowledge management' by conservation agencies. Knowledge is poorly captured and stored in management agency documentation, databases, monitoring and reporting systems. Consequently there is a great deal of uncertainty in relation to the status of most extant threatened species and communities. This poor institutional knowledge also leads to poor project planning, information dissemination, sharing of knowledge and continuity in program management. Note, the term 'knowledge' refers to both descriptive and database forms of knowledge.
- Inadequate mapping and condition assessment of threatened ecological communities.
- Current database systems and content are lacking for effective threatened species recovery planning. Issues include:
  - Poor integration of corporate and non-corporate databases
  - Poor systems structures
  - Persistent (known) erroneous and unreliable records
  - Lack of validation systems (or implementation thereof)
  - Incomplete minimum dataset information (e.g. unknown spatial precision for hundreds of threatened flora records)
  - Difficulty in applying consistent filtering to extract reliable data
  - Lack of capacity to document changes to extant status for individual records or sub-populations, and
  - Unsubmitted observation records to corporate databases for many significant species.

### Community engagement & coordination

- Insufficient community engagement, inter-agency engagement and coordination in recovery programs to address all recovery priorities.
- Insufficient engagement with Aboriginal stakeholders in recovery programs.
- The awareness levels concerning AMLR threatened species and recovery programs in AMLR are generally low amongst the urban and rural resident population.

### Other

- Lack of knowledge of regional conservation priorities to implement more integrated and coordinated recovery programs.
- Insufficient applied research to inform management and planning (e.g. disturbance regimes and threat abatement interactions).
- State and local government policy and planning conflicts (e.g. economic development and population policies versus conservation policies), driving numerous direct threats to threatened species and ecological community populations.

## 6.2 Knowledge Gaps

A major knowledge gap for the majority of species and ecological communities included in this plan is the lack of knowledge concerning distributions (including both area of occupancy and extent of occurrence). This is, in part caused by database related issues as discussed above but is also due to the vast amount of known threatened species observations not submitted to, or shared with, corporate databases. This includes anecdotal observations by individuals (particularly for many threatened flora species) and observation records stored by universities, NGOs and community groups. Through consultation with regional experts, over 30 per cent of flora species included in this plan have known occurrences that have not been captured in any database record system. Most of these species are very rare and reviewing and incorporating anecdotal records and external database information into existing systems would significantly increase species distributional knowledge and thus contribute to a more robust assessment of species national, State and regional status. More complete databases will also contribute to improving species distribution modelling efforts (vital for investigating climate change impacts), general regional planning, and further species prioritisation.

There is also uncertainty in many species distributions due to records requiring re-visiting and surveying to confirm population status, particularly for more cryptic fauna species or annual and ephemeral flora species. This would include improving the spatial precision of location coordinates for records of many priority species in biological database systems.

Improving species sub-population status and distributional knowledge (including database record quality) will significantly contribute to quantifying species and ecological community decline. This knowledge is vital for improving future conservation status assessments and prioritisation processes.

Recovery planning and management is impeded by the significant ecological knowledge gaps for the range of species and ecological communities included in this plan. This includes the issues of population dynamics and species persistence, particularly for remnant, small isolated sub-populations resulting from dramatic historical habitat decline and which are currently experiencing a range of direct threats.

It is not intended in this plan to detail the full range of ecological knowledge gaps that exists for threatened species and ecological communities. However, to inform immediacy of research needs, general knowledge has been assessed for each species (Section 5.4). The primary research needs that should be addressed during the life of this plan are included in the management actions in Section 7. In addition, details on each species, including knowledge gaps about species ecology captured through personal communication that was not otherwise documented, are presented in the species profiles (Appendices Part B).

## 7. Recovery Management Framework

The long-term aim of the plan is to reduce the probability of threatened species and ecological communities of the AMLR region becoming extinct in the wild, and to maximise species' viability.

Devising measurable recovery objectives with performance criteria to meet this aim is the means by which both short and long-term recovery management success can be determined. However, considering the broad scope of this plan, development of comprehensive and quantitative recovery targets to achieve recovery strategies within the AMLR is constrained by a range of factors. These include:

1. *Extensive loss of habitat. The ecological systems in AMLR have been fundamentally modified by changes occurring in the last 200 years.*
2. *There is an extinction debt. There are large numbers of threatened species and numerous threatened ecological communities, many of which are likely on an extinction trajectory.*
3. *There are significant knowledge gaps of species and community ecological status and threatening processes.*
4. *There is an urgent requirement to improve corporate knowledge-base systems to facilitate monitoring of threatened species recovery and revisions of conservation status.*
5. *Coordination and integration of prioritised recovery management is challenging as current on-ground management activities are undertaken by a very diverse range of government and non-government stakeholders (planning and policy responsibilities are similarly varied).*
6. *Currently there are limited resources and capacity to achieve even modest conservation targets.*
7. *The intended duration of this plan is only five years.*

Consequently this recovery plan recognises that the management proposed comprises only an initial phase of regional recovery, and that one plan alone cannot address all the complex ecological and management issues involved in recovering threatened species and ecological communities within the AMLR region.

Further, due to the diversity of current conservation management and its decentralised nature throughout the region, it is proposed that additional sub-regional threat abatement planning is required to implement targeted actions (that reflect broader regional priorities). To this end, the main purpose of this plan is, through mainly a species-based analysis, to inform threat abatement implementation by proposing both regional and sub-regional priorities according to transparent analyses of the best available information and data. This plan only presents a summary of this work. More detailed analysis results will be presented elsewhere by DEH for implementation use.

The objectives and management actions proposed under the five strategic management themes attempt to set a realistic management framework over the next five years. In essence, this *initial* phase of regional recovery aims to:

- Increase recovery resources, capacity and coordination
- Improve planning strategies to reflect regional priorities and address information gaps
- Increase the current level of priority threat abatement activities
- Contribute to developing the information base and systems necessary to enhance recovery of threatened species and ecological communities
- Continue developing and refining status assessment and prioritisation systems, and
- Complement and inform other relevant regional biodiversity planning processes.

**Threatened species and ecological community recovery for the AMLR region requires urgent and sustained action under five broad strategic management themes:**

1. Abatement of current direct threats
2. Habitat re-establishment
3. Impediments to recovery
4. Stakeholder engagement
5. Ex-situ conservation

## 7.1 Objectives

STRATEGIC MANAGEMENT THEME 1 – CURRENT DIRECT THREATS	
OBJECTIVE THEME/OBJECTIVE	ACTION LINK
<b>O1.1</b> To reduce current levels of threats to priority threatened species, their habitats and ecological communities.	A1.1-A1.22

Note: for each assessed current direct threat, regional threat priorities for flora and fauna targets, broad vegetation groups and associated threatened ecological communities are presented in Section 5.3. In some cases specific actions are not presented for threats assessed as low priority across taxa and broad vegetation groups. Priority actions have been developed but are not exhaustive, in consideration of the plan's scope and constraints as discussed above. However, actions will direct and inform more specific site-based activities as part of further implementation planning.

STRATEGIC MANAGEMENT THEME 2 – HABITAT RE-ESTABLISHMENT	
OBJECTIVE THEME/OBJECTIVE	ACTION LINK
<b>O2.1</b> To increase habitat area, connectivity and functionality for priority threatened species and ecological communities.	A2.1; A3.2; A3.19; A4.2

**STRATEGIC MANAGEMENT THEME 3 – IMPEDIMENTS TO RECOVERY****OBJECTIVE THEME/OBJECTIVE****ACTION LINK****Recovery activity, coordination and integration of management**

- O3.1** To strengthen recovery activity, coordination and integration for priority threatened species and ecological communities. A3.1-A3.4; A4.1; A4.2

**Knowledge-base systems**

- O3.2** To strengthen agency monitoring and knowledge-base systems to facilitate threatened species and ecological community recovery. A3.5-A3.9

**Knowledge gaps**

- O3.3** To improve knowledge of extant threatened species' regional distribution, status and trend. A3.10-A3.14
- O3.4** To improve knowledge of the effects of threat abatement interactions on threatened species. A3.15
- O3.5** To improve knowledge of poorly known key threats to threatened species. A3.16-A3.19; A3.22
- O3.6** To improve knowledge of the spatial distributions of poorly known key threats. A3.18; A3.19
- O3.7** To improve knowledge of extant threatened ecological community regional distribution, condition and status. A3.13; A3.20
- O3.8** To increase the number of applied research projects addressing key knowledge gaps. A3.21

**STRATEGIC MANAGEMENT THEME 4 – STAKEHOLDER ENGAGEMENT****OBJECTIVE THEME/OBJECTIVE****ACTION LINK****Stakeholder engagement**

- O4.1** To inform, encourage and support landholder and community participation in regional recovery in line with regional priorities. A4.1; A4.2; A4.5; A1.2
- O4.2** To increase the awareness level concerning AMLR threatened species and recovery programs in the urban and rural resident population. A4.1
- O4.3** To increase the level of engagement with Aboriginal stakeholders in existing and new recovery programs. A4.3; A4.4

**STRATEGIC MANAGEMENT THEME 5 – EX-SITU CONSERVATION****OBJECTIVE THEME/OBJECTIVE****ACTION LINK**

- O5.1** To increase ex-situ conservation efforts for priority species to safeguard against the risk of regional species extinction. A5.1-A5.2

## 7.2 Actions

Note: Responsibilities are in approximate order of lead agency or organisation (they represent proposed responsibilities only and are not confined to legislative obligations). PC = Performance Criteria (see Section 7.3). OBJ. = Objective (see Section 7.1).

ACTION THEME/ACTION	RESPONSIBILITIES	PC LINK	OBJ. LINK
<b>Threat abatement (current direct threats)</b>			
<b>A1.1 Threat Abatement Planning</b> Use prioritisation results to influence threat abatement programs to maximise outcomes for threatened species and ecological community programs.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; NVC; NGO; CG; RP	PC1; PC2; PC3; PC4; PC5; PC9; PC30	O1.1
<b>A1.2 Threat Abatement Planning</b> Ensure threat abatement for recovery outcomes is goal-based, adaptive and coordinated across properties and tenures, with monitoring and analyses of results.	DEH; AMLRNRMB; SAMDBNRMB; NGO; RP	PC2; PC38	O1.1
<b>A1.3 Stock grazing &amp; disturbance</b> Prevent and/or manage grazing at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; NGO; LM; RP	PC10; PC3.1; PC4	O1.1
<b>A1.4 Fishing &amp; Harvesting Aquatic Resources</b> Increase legislative protection of threatened freshwater fish species through listing on threatened species schedules.	DEH; PIRSA; NGO	PC11	O1.1
<b>A1.5 Recreational Activities</b> Prevent and/or manage impacts of recreational activities at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; LG; CG; NGO	PC10	O1.1
<b>A1.6 Disease &amp; Insect Damage - <i>Phytophthora</i></b> Land management agencies implement best practice according to the <i>Phytophthora</i> Management Guidelines (2006).	DEH; AMLRNRMB; AMLRRRT; DWLBC; LM	PC12	O1.1
<b>A1.7 Disease &amp; Insect Damage - <i>Phytophthora</i></b> Prevent <i>Phytophthora</i> infestation at uninfested locations of priority species that are considered susceptible.	DEH; AMLRNRMB; RP; AMLRRRT	PC13	O1.1
<b>A1.8 Kangaroos</b> Investigate management options at locations where kangaroos are known to be having an adverse impact on priority threatened species and ecological communities, and develop appropriate programs.	DEH; AMLRNRMB; SAMDBNRMB; RP; LM	PC10; PC3.2; PC4	O1.1

ACTION THEME/ACTION		RESPONSIBILITIES	PC LINK	OBJ. LINK
<b>A1.9 Rabbits</b>	Minimise impacts of grazing by rabbits (and hares) at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DWLBC; DEH; AMLNRNRM; SAMDBNRMB; LM; LG	PC10; PC4.1	O1.1
<b>A1.10 Foxes</b>	Develop regional protocols for fox baiting including identification of priority locations and monitoring procedures.	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; DWLBC; RP	PC14; PC4.2; PC10	O1.1
<b>A1.11 Foxes</b>	If feasible for species recovery outcomes, implement landscape scale fox baiting programs.	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; DWLBC; LM; RP	PC10; PC4.2	O1.1
<b>A1.12 Cats and Dogs</b>	Promote responsible cat and dog ownership through education, council by-laws and policies.	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; LG; NGO; RP	PC15; PC4	O1.1
<b>A1.13 Weeds</b>	Minimise impacts of weeds at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; RP; NGO; DWLBC; SAW; FSA; LG	PC10; PC3; PC4.1	O1.1
<b>A1.14 Weeds</b>	Implement improved weed hygiene control measures (e.g. tool and vehicle wash-downs, particularly for earth moving machinery in conservation areas).	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; DWLBC; SAW; FSA; LG	PC16; PC3	O1.1
<b>A1.15 Fire Management</b>	Improve information quality and dissemination for prescribed burning and fire suppression activities to protect and manage threatened species and ecological community locations.	DEH	PC17; PC10; PC22	O1.1
<b>A1.16 Site Management (also Pollution &amp; Poisoning, Firewood &amp; Rock Removal)</b>	Provide improved and targeted information on threatened species and ecological communities to assist organisations to minimise the likelihood of adverse impacts on threatened species and ecological communities (e.g. targeting DWLBC, NVC, SAW, FSA, LG, NRM & DEH).	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; RP; NGO;	PC6; PC17; PC10; PC22	O1.1
<b>A1.17 Water - Management</b>	Minimise impacts of inappropriate water use at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLNRNRM; SAMDBNRMB; AMLRRRT; RP; DWLBC; SAW; EPA; LG; CC	PC10; PC3.1	O1.1
<b>A1.18 Water - Forestry</b>	Increase consideration of threatened species and ecological community requirements during	FSA; AMLNRNRM; SAMDBNRMB; DWLBC; DEH; AMLRRRT; SAW;	PC18; PC3.1	O1.1

ACTION THEME/ACTION	RESPONSIBILITIES	PC LINK	OBJ. LINK
the planning process of forestry activities.	LG; NGO		
<b>A1.19 Water – Planning</b> Ensure active contribution to Water Allocation Planning by key stakeholders involved in recovery management of threatened species and ecological communities.	FSA; AMLRNRMB; SAMDBNRMB; DWLBC; DEH; AMLRRRT; SAW; EPA; LG; NGO	PC18; PC3.1; PC10	O1.1
<b>A1.20 Water - Freshwater fish recovery planning</b> Support the implementation of the Draft Action Plan for South Australia's Freshwater Fish for priority AMLR species.	DEH, DWLBC, PIRSA; AGDEWHA, LG, SAMDBNRMB; AMLRNRMB; NFASA; SAW; EPA; NGO	PC10	O1.1
<b>A1.21 Residential &amp; Commercial Development</b> Provide targeted information on threatened species and ecological communities to relevant government planning and assessment departments and local councils to inform development planning controls and assessment.	LG; PSA; DEH; AMLRRRT; NGO; RP	PC6; PC10; PC17; PC4.1	O1.1
<b>A1.22 Roadside Maintenance</b> Provide targeted information on threatened species and ecological communities to relevant bodies to minimise impacts of road and track maintenance activities.	LG; DEH; AMLRRRT; DTEI; NGO; RP	PC19; PC10	O1.1
<b>Habitat re-establishment</b>			
<b>A2.1</b> Further analyse distribution and habitat requirements of priority species to inform habitat re-establishment initiatives.  <i>Note: To be undertaken after key impediments to recovery actions commenced. See other important related actions A3.2; A3.19; A4.2.</i>	AMLRRRT; DEH	PC8	O2.1
<b>Recovery activity, coordination and integration of management</b>			
<b>A3.1 State and federal NRM programs</b> Ensure that priority threatened species and ecological community requirements are integrated into State and Commonwealth NRM programs.	AMLRNRMB; SAMDBNRMB; DEH; NGO; NVC	PC1	O3.1
<b>A3.2 Regional landscape restoration plans</b> Ensure that threatened species and ecological communities priorities are integrated into regional landscape restoration plans.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT	PC2; PC3; PC4; PC5	O3.1; O2.1; O4.1
<b>A3.3 Regional Recovery Team</b> Create an 'AMLR Regional Recovery Team' (AMLRRRT) to implement this plan and facilitate integrated recovery actions with government and non-government groups.	AGDEWHA; AMLRNRMBB; SAMDBNRMB; DEH	PC7	O3.1

	<b>ACTION THEME/ACTION</b>	<b>RESPONSIBILITIES</b>	<b>PC LINK</b>	<b>OBJ. LINK</b>
<b>A3.4</b>	<b>Review plan analyses</b> Regularly review the species inclusion, prioritisation and threat analysis processes undertaken in this plan.	AMLRRRT; DEH; AMLNRMB	PC8	O3.1
<b>Knowledge-base systems</b>				
<b>A3.5</b>	<b>Conservation rating systems</b> Improve regional conservation rating systems to facilitate long-term monitoring of threatened species and ecological community conservation status.	DEH; AMLNRMB; SAMDBNRMB; AMLRRRT	PC20	O3.2
<b>A3.6</b>	<b>Monitoring and reporting system</b> Develop an integrated regional monitoring and reporting system to enable long-term tracking of priority species status.	DEH; AMLNRMB; SAMDBNRMB; AMLRRRT	PC21	O3.2
<b>A3.7</b>	<b>Database capacity and accessibility</b> Improve the capacity and accessibility of the corporate databases to support key stakeholders involved in threatened species recovery management and planning.	DEH; AMLRRRT	PC22	O3.2
<b>A3.8</b>	<b>Knowledge-base system</b> Develop an interactive knowledge-base system to enable sharing of information on activities and outcomes of regional-specific recovery projects.	DEH; AMLRRRT	PC23	O3.2
<b>A3.9</b>	<b>Analyse and review monitoring</b> Analyse monitoring data and use results to review outcomes and management actions.	DEH; AMLRRRT	PC38	O3.2
<b>Knowledge Gaps</b>				
<b>A3.10</b>	<b>Extant distributions (sub-population status)</b> Revisit database record sites to confirm extant status and to collect minimum dataset information for priority species.	DEH; RP; NGO; CG	PC25; PC26	O3.3
<b>A3.11</b>	<b>Extant distributions (uncaptured data)</b> Visit flora sites identified from anecdotal knowledge and collect minimum dataset information.	DEH; RP; NGO; CG	PC25	O3.3
<b>A3.12</b>	<b>Extant distributions (uncaptured data)</b> Review existing species observation data held by universities, NGOs and community groups and capture into corporate databases.	DEH; AMLRRRT	PC27; PC17	O3.3
<b>A3.13</b>	<b>Extant distributions (potential)</b> Conduct searches for populations of priority threatened species and ecological communities, informed by predictive modelling and other information.	DEH; AMLRRRT; NGO; RP	PC26; PC28	O3.3; O3.7

ACTION THEME/ACTION	RESPONSIBILITIES	PC LINK	OBJ. LINK
<b>A3.14 Population trends</b> Investigate more effective data treatment and analysis methods to improve knowledge of priority species' population trend.	DEH; AMLRRRT; UNI	PC29	O3.3
<b>A3.15 Threat abatement interactions</b> Promote applied research targeting priority species and communities to investigate threat abatement responses and interactions, particularly related to disturbance regimes.	DEH; AMLRNRMB; SAMDBNRMB; RP	PC30; PC9; PC3; PC4	O3.4
<b>A3.16 Foxes</b> Monitor response of key threatened species and other threats (e.g. rabbits) to fox baiting at priority sites.	DEH; AMLRNRMB; SAMDBNRMB	PC37; PC30	O3.5
<b>A3.17 Fire</b> Improve knowledge of fire responses of priority species which are fire sensitive or fire dependent.	DEH; RP	PC31; PC3.2; PC4	O3.5
<b>A3.18 <i>Phytophthora</i></b> Conduct risk analysis for <i>Phytophthora</i> susceptibility for threatened species in conjunction with predictive modelling of <i>Phytophthora</i> distribution.	DEH; UNI; AMLRNRMB; SAMDBNRMB	PC32; PC28; PC39	O3.6; O3.5
<b>A3.19 Climate Change</b> Conduct risk analysis for priority species and communities in conjunction with predictive modelling of projected climate change impacts.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; NGO	PC32; PC28; PC3; PC4	O3.5; O3.6; O2.1
<b>A3.20 Ecological Communities</b> Improve mapping and review recovery requirements of AMLR priority threatened ecological communities.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; RP	PC24; PC9	O3.7
<b>A3.21 Collaborative Research</b> Conduct collaborative university research projects targeting threatened species and ecological community priorities.	UNI; DEH; AMLRRRT; NGO	PC36	O3.8
<b>A3.22 Predation impacts review</b> Conduct a review and comprehensive threat analysis to better determine the significance of predation impacts on priority threatened fauna species.	DEH; AMLRRRT; NGO; RP	PC40	O3.5
<b>Stakeholder Engagement</b>			
<b>A4.1 Stakeholder engagement strategy</b> Develop and implement a regional recovery stakeholder engagement strategy (to guide plan implementation).	AMLRRRT	PC33	O4.1; O4.2; O3.1
<b>A4.2 Disseminate plan information</b> Develop and disseminate a project information tool to inform and assist government and non-	DEH; AMLRNRMB; AMLRRRT	PC6	O4.1; O2.1; O3.1

ACTION THEME/ACTION	RESPONSIBILITIES	PC LINK	OBJ. LINK
government restoration planners/advisors and threatened species and ecological community recovery programs.			
<b>A4.3 Aboriginal engagement protocols</b> All groups involved with threatened species and ecological community recovery activities utilise the Four Nations NRM Governance Group Consultation & Engagement Protocols (2008) publication to guide appropriate consultation.	RP; DEH; CG; NGO	PC34	O4.3
<b>A4.4 Four Nations Governance Group engagement</b> Existing and new recovery programs within the AMLR NRM Region engage the Four Nations NRM Governance Group to determine project-specific consultation requirements.	RP	PC35	O4.3
<b>A4.5 Community volunteer groups capacity</b> Increase capacity of landholders and community groups to implement programs targeting regional threatened species and ecological community priorities.	AMLRRRT	PC41	O4.1
<b>Ex-situ Conservation</b>			
<b>A5.1 Review ex-situ conservation requirements</b> Conduct a review of priority species to determine ex-situ conservation requirements.	AMLRRRT; DEH	PC42	O5.1
<b>A5.2 Support ex-situ conservation programs</b> Support existing ex-situ conservation programs to target regional priorities.	AMLRRRT	PC43	O5.1

## 7.3 Performance Criteria

### Priority code:

CORE1 = Primary performance criteria to achieve priority management needs, representing minimum funding required (see Section 8.1) to undertake listed actions or part-actions according to prioritisation.

CORE2 = Primary performance criteria to achieve other priority management needs representing next level of funding required (see Section 8.1) to undertake listed actions or part-actions according to prioritisation.

PRIORITY CODE	PERFORMANCE CRITERIA DESCRIPTION	ACTION LINK
PC1	CORE1 Priorities as determined by this plan and associated tool are incorporated into NRM Investment Strategies, and other relevant funding programs (e.g. NVC & DEH grant programs) by 2010.	A3.1; A1.1
PC2	CORE1 Priorities as determined by this plan are incorporated into the Draft AMLR Biodiversity Strategy and the Cape Borda to Barossa NatureLinks Plan by 2010, and other relevant planning programs.	A3.2; A1.1; A1.2
PC3	CORE1 <b>Flora</b> species threat abatement, habitat re-establishment and knowledge gap actions indicated are directed towards the following vegetation groups and sub-regional landscapes (in order of priority):  PC3.1 <u>Wetland</u> (Fleurieu, Southern Fleurieu, Central Lofty, Barossa and Eastern Hills) by 2011.  PC3.2 <u>Heathy Woodland</u> (Foothills/Hills Face, Northern Lofty, Fleurieu, Central Lofty) by 2012.  Note: Refer to Table 15 for individual species sub-regional priorities.	A3.2; A1.1; A3.15; A3.19; A1.13; A1.14  A1.3; A1.17-A1.19  A3.17; A1.8
PC4	CORE1 <b>Fauna</b> species threat abatement, habitat re-establishment and knowledge gap actions indicated are directed towards the following vegetation groups (in order of priority):  PC4.1 <u>Grassy Woodland</u> by 2011.  PC4.2 <u>Heathy Woodland</u> by 2012.  Note: further planning and research required to propose across-species sub-regional priorities for fauna. Refer to Table 16 for individual species sub-regional priorities.	A3.2; A1.1; A1.3; A3.15; A3.17; A3.19; A1.8; A1.12  A1.9; A1.13; A1.21  A1.10; A1.11
PC5	CORE1 Management for 'Very High' and 'High' sub-regional priority species other than those included in PC3 and PC4 is planned and implemented by 2012 (note, threat abatement priorities have been included in Section 8.1 costing analyses).	A3.2; A1.1
PC6	CORE1 Plan information including species profiles disseminated to stakeholders and information tool available on project website by 2010.	A4.2
PC7	CORE1 AMLR Regional Recovery Team commenced by end 2009.	A3.3
PC8	CORE1 The plan's prioritisation analysis processes are reviewed with further analyses conducted to contribute to habitat re-establishment and other recovery outcomes, annually.	A2.1; A3.4
PC9	CORE1 Existing recovery programs are targeting new priorities proposed in this plan, where practicable, by end 2009.	A1.1; A3.20; A3.15

	PRIORITY CODE	PERFORMANCE CRITERIA DESCRIPTION	ACTION LINK
PC10	CORE1	Priority locations and activities identified using the prioritisation tool, and implementation commenced by 2010.	A1.3; A1.5; A1.8-A1.11; A1.13; A1.15-A1.17; A1.19-A1.22
PC11	CORE1	Conservation status of freshwater fish is assessed and legislative protection revised as required by 2010.	A1.4
PC12	CORE2	Land managers and contractors are aware of and implementing the <i>Phytophthora</i> Management Guidelines (2006) by 2010.	A1.6
PC13	CORE2	A framework for management of uninfested areas for <i>Phytophthora</i> developed incorporating priority locations of susceptible threatened species by 2012.	A1.7
PC14	CORE1	Fox baiting review completed by 2010.	A1.10
PC15	CORE2	Conduct at least one update of responsible cat ownership information in conjunction with facilitating an information forum to strengthen council by-laws.	A1.12
PC16	CORE2	Weed hygiene protocol developed and implemented by land management agencies and contractors by 2011.	A1.14
PC17	CORE1	Data from threatened species projects is incorporated into corporate biological databases by 2014.	A1.15; A1.16; A1.21; A3.12
PC18	CORE1	Ecological water requirements of priority threatened species and ecological communities are investigated and the results communicated to relevant bodies by 2012.	A1.18; A1.19
PC19	CORE2	Information of known locations incorporated into Council's Roadside Significant Sites Database and roadside markers installed where required by 2011.	A1.22
PC20	CORE2	Benchmarks and regional conservation rating systems developed by 2014.	A3.5
PC21	CORE2	Regional monitoring and reporting system established by 2013.	A3.6
PC22	CORE1	Recommendations regarding improvements and requirements provided to BDBSA system review by 2011.	A3.7; A1.15; A1.16
PC23	CORE1	Knowledge base system trialed by 2013.	A3.8
PC24	CORE1	Mapping and review commenced for AMLR 'Very High' and 'High' priority ecological communities by 2011.	A3.20
PC25	CORE1	Records for more than 50% of poorly known priority flora species reviewed by 2012, remainder of priority species by 2014.	A3.10; A3.11
PC26	CORE1	Surveys commenced for more than 50% of poorly known priority species reviewed by 2012, remainder of priority species by 2014.	A3.10; A3.13
PC27	CORE2	All relevant universities, NGOs and other groups involved in data sharing arrangements for priority species by 2011.	A3.12
PC28	CORE2	Priority threatened species data incorporated into current project work modelling distributions of species and poorly known threats by 2011.	A3.13; A3.18; A3.19
PC29	CORE1	Data treatment and analysis methodology trialed for priority species by 2011.	A3.14

PRIORITY CODE	PERFORMANCE CRITERIA DESCRIPTION	ACTION LINK
PC30	CORE2 Monitoring programs for priority threat abatement activities consider interactions between threats and unintended impacts on other species.	A3.15; A3.16; A1.1
PC31	CORE2 Recovery programs review knowledge gaps for fire sensitive and fire dependent priority species, and implement targeted vital attribute data collection, by 2011.	A3.17
PC32	CORE1 Risk analysis conducted for priority species and ecological communities by 2012.	A3.18; A3.19
PC33	CORE2 Community Engagement Strategy prepared and adopted by end 2009.	A4.1
PC34	CORE2 All groups involved with recovery activities have reviewed and acted upon relevant actions according to the Consultation & Engagement Protocols (2008) publication by 2010.	A4.3
PC35	CORE1 All formal recovery programs have engaged with the Four Nations NRM Governance Group, by 2011.	A4.4
PC36	CORE2 Funding (through collaborative arrangements) in place for at least two honours or post-graduate research projects per year by 2010.	A3.21
PC37	CORE2 Fox baiting programs for threatened species identified and monitoring for recovery outcomes established by 2011.	A3.16
PC38	CORE2 Monitoring established and analysis and review performed annually for all projects implementing priorities as determined by this plan.	A3.9; A1.2
PC39	CORE2 <i>Phytophthora</i> susceptibility trials conducted on 10% of priority flora species from high risk families by 2014.	A3.18
PC40	CORE1 Predation impacts review including threat analysis conducted by 2011.	A3.22
PC41	CORE1 Contribute additional funds to at least two existing community volunteer grant programs per year, tied to specified regional priorities.	A4.5
PC42	CORE1 Ex-situ conservation requirements review completed by 2012.	A5.1
PC43	CORE2 Existing ex-situ conservation programs are targeting regional priorities by 2013.	A5.2

## 7.4 Management Practices

It is important that any management practices associated with recovery actions that may have a significant impact on species or on habitat critical to the survival of species in this plan are carefully considered. Generally, it is recommended that any activities that increase or contribute to the threats identified in this plan be avoided where practicable.

Section 3.3 details the nature of regional-specific threats assessed in this plan, and includes descriptions on undesirable management practices associated with each threat. Summaries of the threat analysis have been presented, including species-specific results and regional across-species results, to indicate important threats for which undesirable management practices need to be considered.

The plan has also highlighted the importance of considering the effects of management practices on both target species and off-target species. Similarly, assumed benefits of management practices aimed at the broader ecological community level on threatened species need to be carefully considered and monitored.

It is envisaged that the implementation of several knowledge-base system related actions proposed in this plan will improve information capture and accessibility concerning recovery activities and methods. This will serve to encourage and promote appropriate and effective management practices.

## 8. Plan Administration

### 8.1 Timelines and Costs

This plan is intended for use by natural resource managers, planners and funding partners to guide regional investment of threatened species projects. For the most part, implementation of the plan will rely on additional funding sources from both within and outside of the region. Possible funding sources include the AMLRNRMB, SAMDBNRMB, Caring for Our Country and Threatened Species Network.

For some species a number of the actions included in this plan are already being undertaken in various forms by numerous agencies and individuals. Also, several species included within this regional recovery plan, are the subject of a national single or multi-species recovery plan. Cost estimates for some actions which are also to be undertaken as part of these national recovery plans are therefore potentially an overestimate. However, in general it is more likely that costs have been underestimated due to the difficulty in comprehensively costing site-specific management requirements for the numerous species and communities included in this plan.

It will primarily be the responsibility of the proposed Regional Recovery Team to facilitate recovery coordination and integration, which will involve liaison with existing recovery teams to ensure there is no overlap or doubling up of efforts with regard to specific actions.

The total funding required to support implementation over five years is estimated to be \$10,164,680. The priorities for funding are indicated in the performance criteria above. The estimated costs of undertaking the actions are presented below.

ACTION THEME/ACTION/COST DESCRIPTION		TOTAL
<b>Threat abatement (current direct threats)</b>		
<b>A1.1-1.2</b>	<b>Threat Abatement Planning</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.3</b>	<b>Stock grazing &amp; disturbance</b> Any priority species (VG 1-3) with High or Very High Stock Grazing & Disturbance threat rating for High or Very High sub-regional priorities. 13 priority flora & fauna species, assume action at 80 priority sites (potential of 170 sites). Note, requiring on-ground assessment. Sites occurring in conservation areas not included.  Based on small-scale fencing of sub-populations (average 2km fencing @ \$2500/km/site).	<b>400,000</b>
<b>A1.4</b>	<b>Fishing &amp; Harvesting Aquatic Resources</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.5</b>	<b>Recreational Activities</b> Planning costs Included in Implementation costs. Other likely cost items include signage, fencing, track works and education activities (12 potential sites for 5 priority flora species, estimated \$5,000/site).	<b>60,000</b>

<b>A1.6</b>	<b>Disease &amp; Insect Damage – <i>Phytophthora</i></b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.7</b>	<b>Disease &amp; Insect Damage – <i>Phytophthora</i></b> Planning costs Included in Implementation costs. Other likely cost items include signage, track closure, site closures and education activities, pending achievement of Action A3.18.	<b>20,000</b>
<b>A1.8</b>	<b>Kangaroos</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.9</b>	<b>Rabbits</b> Priority species (VG 1-3) with High or Very High Rabbit Grazing & Disturbance threat rating for High or Very High sub-regional priorities. 7 priority flora species over 53 priority sites identified (note, requiring on-ground assessment). Assuming 25% of total sites targeted each year, based on \$2,500/site/year, increasing by 20% each year for follow up works.	<b>178,000</b>
<b>A1.10</b>	<b>Foxes</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.11</b>	<b>Foxes</b> Will require funding estimates after strategic assessment and planning, and will be dependant on achievement of key knowledge gap actions.	
<b>A1.12</b>	<b>Cats</b> Community consultation, forums, brochure updates and printing. Other costs included in Implementation and Stakeholder Engagement costs.	<b>15,000</b>
<b>A1.13</b>	<b>Weeds (minimise impacts)</b> Priority species (VG 1-2) with Medium, High or Very High Weed threat ratings for High or Very High Sub-regional priorities (39 species over 158 sites). Assumes weed control primarily by community groups. Assuming 25% of total sites targeted each year, based on \$2,500/site/year, increasing by 20% each year for follow up works.  Other priority species (VG 3-6) with High or Very High Weed threat ratings, for High or Very High Sub-regional priorities (25 species over 167 sites). Note, 23 sites overlapping with above VG 1-2 priority sites have been accounted for. Assumes weed control primarily by community groups. Assuming 25% of total sites targeted each year, based on \$2,500/site/year, increasing by 20% each year for follow up works.	<b>530,000</b>  <b>560,000</b>
<b>A1.14</b>	<b>Weeds (hygiene control)</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.15</b>	<b>Fire Management</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.16</b>	<b>Site Management (also Pollution &amp; Poisoning, Firewood &amp; Rock Removal)</b> Included in Implementation and Stakeholder Engagement costs.	
<b>A1.17</b>	<b>Water - Management</b> Information provision. Included in Implementation and Stakeholder Engagement costs.	
<b>A1.18</b>	<b>Water – Forestry</b> Included in Implementation and Stakeholder Engagement costs.	

<b>A1.19</b>	<b>Water – Planning</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>A1.20</b>	<b>Water - Freshwater fish recovery planning</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>A1.21</b>	<b>Residential &amp; Commercial Development</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>A1.22</b>	<b>Roadside Maintenance</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>Habitat re-establishment planning</b>		
<b>A2.1</b>	Analysis and planning included in Implementation costs, and pending achievement of several 'Impediments to Recovery' related actions.	
<b>Implementation - Recovery activity, coordination of management</b>		
<b>A3.1</b>	<b>State and federal NRM programs</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>A3.2</b>	<b>Regional landscape restoration plans (input)</b>	
	Included in Implementation and Stakeholder Engagement costs.	
<b>A3.3</b>	<b>Regional Recovery Team</b>	
	<b>Coordination, Planning &amp; Analysis Officers</b>	
	Salaries + on-costs (PO3 & PO2 positions)	895,000
	Operating costs (travel, computing, administration)	32,000
	Operating costs	9,000
	<b>Threatened Fauna &amp; Flora Recovery Officers</b>	
	Salaries + on-costs (5 x PO2 positions)	2,050,000
	Operating costs (25K/position/year)	625,000
	<b>Threatened Ecological Community Recovery Officers</b>	
	Salaries + on-costs (3 x PO2 positions)	1,230,000
	Operating costs (25K/position/year)	375,000
	<b>Recovery Extension/Community Engagement Officer</b>	
	Salary + on-costs (1 x PO2 positions)	410,000
	Operating costs (25K/position/year)	125,000
<b>A3.4</b>	<b>Review plan analyses</b>	
	Included in Implementation costs, plus additional contractor costs (approximately 300 hours at \$100/hour).	30,000
<b>Knowledge-base systems</b>		
<b>A3.5</b>	<b>Conservation rating systems</b>	
	Collaborative funding contribution.	20,000
<b>A3.6</b>	<b>Monitoring and reporting system</b>	
	Collaborative funding contribution.	30,000

<b>A3.7</b>	<b>Database capacity and accessibility</b> Collaborative funding contribution.	<b>20,000</b>
<b>A3.8</b>	<b>Knowledge-base system</b> Contract project work & collaborative funding contribution.	<b>85,000</b>
<b>A3.9</b>	<b>Analyse and review monitoring</b> Included in Implementation costs, plus additional contractor costs (approximately 300 hours at \$100/hour).	<b>30,000</b>
<b>Knowledge Gaps</b>		
<b>A3.10</b>	<b>Extant distributions (sub-population status)</b> Included in Implementation and Stakeholder Engagement costs, plus additional contractor costs (approximately 64 poorly known priority species, 329 potential sites/5 hours/site, \$100/hour).	<b>165,000</b>
<b>A3.11</b>	<b>Extant distributions (uncaptured data)</b> Included in Implementation costs, plus additional contractor costs (approximately 35 priority species; 75 sites/6 hours/site, \$100/hour).	<b>45,000</b>
<b>A3.12</b>	<b>Extant distributions (uncaptured data)</b> Included in Implementation costs, plus additional contractor costs (approximately 300 hours at \$100/hour).	<b>30,000</b>
<b>A3.13</b>	<b>Extant distributions (potential)</b> Collaborative funding contribution with existing DEH project work (.25 PO2 position 2 years).	<b>41,000</b>
<b>A3.14</b>	<b>Extant distributions (data treatment &amp; analysis)</b> Included in Implementation costs, plus additional contract project work costs (approximately 200 hours at \$100/hour).	<b>20,000</b>
<b>A3.15</b>	<b>Threat abatement interactions</b> Included in Implementation costs plus additional contractor costs (approximately 300 hours at \$100/hour).	<b>30,000</b>
<b>A3.16</b>	<b>Foxes</b> Included in Implementation and Stakeholder Engagement costs. Also dependant on achievement of Actions A1.10 and 1.11.	
<b>A3.17</b>	<b>Fire</b> Collaborative funding contribution to existing DEH fire ecology project work (.25 PO2 position 2 years).	<b>41,000</b>
<b>A3.18</b>	<b><i>Phytophthora</i></b> Funding contribution to inter-agency collaborative project, to increase research activity in AMLR.	<b>75,000</b>
<b>A3.19</b>	<b>Climate Change</b> Collaborative funding contribution with existing DEH project work (.5 PO2 position 2 years).	<b>85,000</b>
<b>A3.20</b>	<b>Ecological Communities</b> Collaborative funding contribution with existing programs and DEH project work (.5 PO2 position 3 years).	<b>120,000</b>
<b>A3.21</b>	<b>Collaborative Research</b> Collaborative funding contribution. 2 PhD (15K/ea/year) + 3 Honours (10K	<b>150,000</b>

	ea/year)	
<b>A3.22</b>	<b>Predation impacts</b>	
	Contract project work (approximately 300 hours at \$100/hour).	<b>30,000</b>
<b>Stakeholder Engagement</b> (see Action 3.3 for other related operational costs)		
<b>A4.1</b>	<b>Stakeholder engagement strategy</b>	
	Contract project work (130 hours at \$100/hour).	<b>13,000</b>
<b>A4.2</b>	<b>Disseminate plan information</b>	
	Collaborative funding contribution to further develop and maintain tool and other information dissemination (.5 PO2 position 2 years).	<b>85,000</b>
<b>A4.3</b>	<b>Aboriginal engagement protocols</b>	
	Included in Implementation costs.	
<b>A4.4</b>	<b>Four Nations Governance Group</b>	
	Workshop costs (10 workshops at \$3,500 each).	<b>35,000</b>
<b>A4.5</b>	<b>Community volunteer groups</b>	
	Funding contributions to relevant existing volunteer group funding programs, tied to recovery regional priorities (\$100,000/year).	<b>500,000</b>
<b>Ex-situ conservation</b>		
<b>A5.1</b>	<b>Review ex-situ conservation requirements</b>	
	Included in Implementation costs.	
<b>A5.2</b>	<b>Support ex-situ conservation programs</b>	
	Included in Implementation costs, plus collaborative funding contribution to existing programs (\$20,000/year).	<b>100,000</b>
	Sub-total	<b>\$9,294,000</b>
	CPI*	<b>\$870,680</b>
	<b>TOTAL</b>	<b>\$10,164,680</b>

\* CPI total calculated by applying compounding 3% CPI to base rate of \$1,858,800 average annual funding for each financial year (2009-2014).

## 8.2 Plan Review and Evaluation

This plan will be reviewed within five years of adoption. The recovery team, most likely in conjunction with key stakeholders such as DEH and the NRM Boards, will be responsible for evaluating the implementation and success of this plan. Progress towards achieving the recovery objectives in this plan will be reported against the performance criteria and as required by management and funding arrangements. However it is recognised that many desired ecological outcomes will need to be measured over a much longer time-frame than the intended duration of this plan.

## 9. Social and Economic Consequences

The total cost of implementing the recovery actions is estimated to be \$10,164,680 over the 5 year period covered by this plan. It is anticipated that there will be no significant adverse social or economic costs associated with the implementation of this plan and that the overall benefits to society will outweigh any disadvantages.

Successful implementation of this recovery plan is dependent on the involvement of a wide range of stakeholders (see Appendices Part A). The combined involvement of a diverse range of stakeholders will foster and promote a co-operative approach to threatened species recovery in the AMLR.

It is hoped that the consultation with regional Aboriginal representatives that occurred during development of this plan will continue throughout the plan's implementation. Indeed, it will be one of the pre-requisites for successful implementation.

### 9.1 Responsibilities and Affected Interests

Whilst the NRM Boards, SA DEH and existing recovery programs including those currently being operated by NGOs will take the lead role in administering this plan, implementation will require a co-ordinated approach involving partnership arrangements with various affected and interested parties, including the Australian Government, other NGOs, local government, community groups and the private sector.

Effective communication will be required with and between project partners to maximise the effective contribution of each group and ensure there is a common understanding of the priorities, goals and respective deliverables. To facilitate this, it is proposed that a regional recovery team is established to oversee implementation of this recovery plan and facilitate integration and coordination of recovery work (Action A3.3). The team should be comprised of representatives from key stakeholder organisations and groups. The recovery team should also lead the preparation of a stakeholder engagement strategy (Action 4.1). Until a regional recovery team has been established, it is recommended that the steering committee which directed the development of this plan continues to function.

There are a range of existing stakeholders that will be affected by the implementation of this plan. An indicative list is presented in the Appendices Part A.

## Abbreviations

AGDEWHA	Australian Government Department of the Environment, Water, Heritage and the Arts
AMLR	Adelaide and Mount Lofty Ranges
AMLRNRMB	Adelaide and Mount Lofty Ranges Natural Resources Management Board
AMLRRT	AMLR Regional Recovery Team (proposed)
ARC	Australian Research Council
BDBSA	Biological Databases of South Australia
BVG	Broad Vegetation Group
CBD	Convention on Biological Diversity
CC	Conservation Council of South Australia
CG	Community Groups (AMLR region)
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CL Act	Crown Lands Act 1929
DAC	Development Assessment Commission
DECC	Department of Environment & Climate Change (NSW Government)
DEH	Department for Environment and Heritage (SA Government)
DTEI	Department for Transport, Energy and Infrastructure
DWLBC	Department of Water, Land and Biodiversity Conservation (SA Government)
EPA	Environment Protection Authority (SA Government)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FNGG	Four Nations Governance Group
FSA	Forestry SA
GIS	Geographic Information System
IUCN	International Union for Conservation of Nature and Natural Resources
LG	Local Government
LGA	Local Government Association
LM	Land managers
MLR	Mount Lofty Ranges
NGO	Non-government Organisations
NHT	Natural Heritage Trust
NOSSA	Native Orchid Society of South Australia
NP	National Park
NPW Act	National Parks and Wildlife Act 1972
NRM	Natural Resources Management
NRM Act	Natural Resources Management Act 2004
NT Act	Native Title Act 1993
NV Act	Native Vegetation Act 1991
NVC	Native Vegetation Council (also includes the Native Vegetation Assessment Panel)
PIRSA	Primary Industries and Resources South Australia
PSA	Planning SA
RRP	Regional Recovery Pilot (Project)

RP	Recovery Programs (managed by both government and non-government programs)
RVG	Regional Vulnerability Groups
SA	South Australia
SAMDBNRMB	South Australian Murray Darling Basin Natural Resources Management Board
SAM	South Australian Museum
SASP	South Australia's Strategic Plan
SAW	SA Water
SEWFPSRP	Southern Emu-wren/Fleurieu Peninsula Swamps Recovery Program
sp.	Species
spp.	Species (plural)
SRL	Sub-regional Landscape
ssp.	Subspecies
TPAG	Threatened Plant Action Group
TSN	Threatened Species Network
UNI	Universities
VG	Vulnerability Groups
WCF	Wildlife Conservation Fund (Research Grants Program)

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# REGIONAL RECOVERY PLAN

for Threatened Species and Ecological Communities  
of Adelaide and the Mount Lofty Ranges, South Australia



2009 - 2014



Appendices PART A

Department  
for Environment  
and Heritage



Australian Government



Government  
of South Australia

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## 1. Consultation and Stakeholders

### 1.1 Electronic Distribution Networks

The project was promoted in the following existing newsletters and electronic distribution lists:

- Echidna Express - e-publication of the Adelaide and Mount Lofty Ranges NRM Board
- Conservation Council of SA Briefs
- Conservation Council of SA E-bulletin
- Xanthopus - newsletter of the Nature Conservation Society SA
- MLR Grassy Woodland Network Newsletter
- DEH News - internal e-newsletter for DEH staff
- AMLR NRM email distribution list (co-ordinated by DWLBC)
- SA MDB NRM email distribution list (co-ordinated by SAMDBNRM)

### 1.2 Summary of Key Stakeholders

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#### National

Australian Department of the Environment, Water, Heritage and Arts  
Threatened Species Scientific Committee

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#### State

Department for Environment and Heritage  
Department of Water, Land and Biodiversity Conservation  
Department of Transport Energy and Infrastructure  
Primary Industries and Resources South Australia  
Country Fire Service  
Conservation Council of SA  
SA Water  
Threatened Species Network

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#### Non-government Environmental and allied Organisations

Field Naturalists' Society  
Greening Australia SA Inc  
Native Orchid Society of South Australia  
Nature Conservation Society of SA  
Nature Foundation SA Inc  
SA Native Fish Association  
South Australian Farmers Federation  
Threatened Plant Action Group  
Threatened Species Network  
Trees for Life  
Weed Management Society SA

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#### Regional

Adelaide and Mount Lofty Ranges Natural Resource Management Board  
AMLR NRM Sub groups (see below)  
Various Environmental Community Groups, e.g. Landcare Groups, Catchment Groups, Local Action Planning Groups, Friends of Parks

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#### Adjoining regions

South Australian Murray Darling Basin Natural Resource Management (NRM) Board  
Northern and Yorke NRM Board  
South East NRM Board  
DEH Murraylands and South-East Regions

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#### Regionally relevant Conservation/Recovery Programs and staff

Mount Lofty Ranges Southern Emu-wren and Fleurieu Peninsula Swamps Recovery Program  
Bandicoot Project Officer (SADEH)  
Southern Emu-wren/Fleurieu Peninsula Swamps Recovery Program  
Murraylands Threatened Species Project  
SAMDB Threatened Flora Project Officer, Environment & Biodiversity Services  
OBP Survey Co-ordinator  
Lofty Block Orchid Recovery Project

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Lofty Block Threatened Orchid Recovery Project  
 Hindmarsh Tiers Biodiversity Group  
 Program Leader & MDBC Native Fish Strategy Coordinator PIRSA  
 South Para Biodiversity Project  
 Urban Forest Biodiversity Program/ Million Trees Program  
 Ecologist, River Murray Corridor Fauna  
 Ecologist, Threatened Mallee Birds  
 SA Water, Land Management Manager  
 ForestrySA, Coordinator Community Programs

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**Local Government** (see below for full list)

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**Indigenous Groups**

Four Nations Governance Group (Kurna, Ngarrindjeri, Ngadjuri, Peramangk and Nganguraku)

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**Research Institutions**

University of Adelaide, School of Earth and Environmental Sciences  
 Flinders University, School of Biological Sciences  
 University of South Australia, School of Natural and Built Environments

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### 1.3 Land Management Agency Administrative Areas

The following list shows the major land management agencies within the AMLR region.

Land Management Agency	Area
<b>AMLR NRM Board</b>	
Southern Group	Whole
Fleurieu Group	Whole
Central Group	Whole
Northern Group	Whole
<b>MDB NRM Board</b>	
Ranges to River Group	Partial
<b>DEH</b>	
Adelaide Region (Southern Lofty District)	Whole
Adelaide Region (Fleurieu District)	Whole
Adelaide Region (Northern Lofty District)	Majority
Murraylands Region (Mallee District)	Partial
Murraylands Region (Riverland District)	Partial
South-East Region (Coorong District)	Partial
Urban Forests Biodiversity Program	Whole
<b>Forestry SA</b>	
Mount Lofty Ranges Region	Majority
<b>SA Water</b>	
<b>Local Government Area</b>	
Adelaide City Council	Whole
Adelaide Hills Council	Whole
Alexandrina Council	Partial
Campbelltown City Council	Whole
City of Burnside	Whole
City of Charles Sturt	Whole
City of Holdfast Bay	Whole
City of Marion	Whole
City of Mitcham	Whole
City of Onkaparinga	Whole
City of Playford	Whole

Land Management Agency	Area
City of Port Adelaide Enfield	Whole
City of Salisbury	Whole
City of Tea Tree Gully	Whole
City of Unley	Whole
City of Victor Harbor	Whole
City of West Torrens	Whole
Light Regional Council	Partial
Mid Murray Council	Partial
The Barossa Council	Majority
The City of Norwood Payneham & St Peters	Whole
The City of Prospect	Whole
The Corporation Of The Town of Walkerville	Whole
The District Council of Mallala	Partial
The District Council of Mount Barker	Whole
The District Council of Yankalilla	Whole
The Rural City of Murray Bridge	Partial
Town of Gawler	Whole

## 2. Chronological Snapshot of the AMLR Region

<b>1836 – 1860</b>	<ul style="list-style-type: none"> <li>The site to become the city 'Adelaide' decided on December 31, 1836 by Colonel Light.<sup>10</sup></li> <li>By 1840, a number of villages established outside the parklands fringe. Pioneer pastoralists spread beyond the bounds of surveyed land, running flocks of sheep across the open grassy woodlands of the Adelaide Plains.<sup>10</sup></li> <li>Dingo, kangaroo, emu and wallaby hunts occurred across the plains.<sup>17</sup></li> <li>In the early 1840's, parcels of land known as 'hundreds' established to promote farming.<sup>17</sup></li> <li>The open woodlands of the Adelaide Plains (extending from McLaren Vale north to the Gawler River) and adjoining hills heavily cleared and replaced with crops and pastures. The stringy bark forests of the eastern MLR were felled for timber to build houses and fences.<sup>7,10,17</sup></li> <li>By the late 1840's, Adelaide was well-established and major settlements extended south along the coastal plain and east across the MLR. Vines were planted in the Barossa Valley and southern vales districts.<sup>10,17</sup></li> <li>By 1860, an estimated 145,000ha around Adelaide was under cultivation.<sup>3</sup> The population of Adelaide was over 40,000.<sup>18</sup></li> </ul>
<b>1861 - 1900</b>	<ul style="list-style-type: none"> <li>Timber licences were issued between Rapid Bay and Encounter Bay on the southern Fleurieu in 1861.<sup>18</sup></li> <li>Coastal foreshores and the banks of rivers and lakes reserved for public use from the 1860s.<sup>17</sup></li> <li>In 1869 two fox cubs were given to the Adelaide Hunt. By 1888, foxes were well established along the Coorong.<sup>17</sup></li> <li>By 1880, remaining stands of black forest (<i>Eucalyptus microcarpa</i>) which occurred on the south-eastern foot slopes were mostly cleared.<sup>3,12</sup> The Adelaide plains noticeably lacked any form of native vegetation cover.<sup>17</sup></li> <li>By the early 1860's rabbits were common in parts of Adelaide Hills, and quickly spread across the region.<sup>17</sup></li> <li>By the late 1800's, commercial fishers supplying the Adelaide Market had noticed a decline in native fish stocks in the Murray River.<sup>17</sup></li> <li>Belair was made a National Park in 1891 (the 2<sup>nd</sup> National Park adopted in Australia).<sup>10</sup></li> </ul>

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<b>1901 - 1946</b>	<ul style="list-style-type: none"> <li>• By 1914, suburban housing extended three-kilometres around the parkland belt, with other separate growth areas clustered around Port Adelaide, Glenelg, Henley Beach, Grange, Mitcham, Woodville and Magill. The surrounding plains had become an intensive horticultural production zone including vegetables, fruit and vines.<sup>10</sup></li> <li>• A significant housing boom followed the end of World War I. By 1920, the population of Adelaide had reached 200,000. Only a few significant areas of vegetation remained in the MLR. Urban expansion continued well into the 1930's, mainly to the south and east of the city. A suburban strip through Woodville linked the Adelaide city with Port Adelaide.<sup>10</sup></li> <li>• The late 1930's saw concentrated clearing of the Fleurieu Peninsula. Knowledge of trace element deficiencies in the 1940's promoted agricultural development of lands previously considered unfavourable.<sup>18</sup></li> <li>• The population rose steadily to around 400,000 by the end of World War II in 1946.<sup>3</sup></li> <li>• Much of the remaining forest in the MLR, including Belair National Park, burnt during the 1939 fires.<sup>10</sup></li> </ul>
<b>1947 - present</b>	<ul style="list-style-type: none"> <li>• Improvements in ploughs and fertilisers saw clearing expand to areas of naturally nutrient poor soils.<sup>10</sup> The remaining undeveloped Adelaide Plains and alluvial fans along the foothills were surrendered to a low density housing explosion after World War II. Nearly all the market gardens, orchards and vineyards on the plains were displaced by 1957.<sup>10</sup> The coastline was developed from Brighton to Outer Harbour.<sup>3</sup></li> <li>• The 1955 'Black Sunday' fires spread across the Mount Lofty Ranges over a total area of 40,000ha. Another significant fire event occurred in 1957.<sup>3</sup></li> <li>• The outer-towns of Elizabeth and Noarlunga were created in the 1950's and 60's to cope with the housing demands and anticipated future growth of South Australia's capital.<sup>10</sup> Between 1960 and 1980, development focus shifted to the Hills Face Zone.<sup>14</sup></li> <li>• Of about 240,000ha of native vegetation in 1945 in the southern MLR, less than 90,000ha remained by 1980. Only 3 significant stands of native vegetation remained in 1980.<sup>10</sup></li> <li>• A significant fire event occurred in the Adelaide Hills in 1980, followed by the 'Ash Wednesday' fires of February 1983 (the worst on record in SA) which burnt 2,714ha of parks and reserves in the MLR.<sup>17</sup> Bushfires also occurred in 1986, 1995, 1996, 1998.<sup>3</sup></li> <li>• Regulations were adopted under the Planning Act in the 1970's, and strengthened in 1983 to control vegetation clearance.<sup>17</sup> The Native Vegetation Management Act was introduced in 1985, superseded by the <i>Native Vegetation Act 1991</i>, seeing the end to broad-scale vegetation clearance.<sup>10</sup></li> <li>• By 1990, the population had reached one million.<sup>10</sup></li> <li>• An urban boundary for Adelaide was introduced in 2002 to manage urban growth around the outer limits of metropolitan Adelaide. The boundary was expanded in 2007 to help meet urban development needs.<sup>8,9</sup></li> </ul>

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### 3. Legislation and Planning

#### 3.1 Relevant Legislation

There are numerous Acts of Parliament relevant to this plan. The principal Acts are described in the main body of this plan (*Environment Protection and Biodiversity Conservation Act 1999*, *National Parks and Wildlife Act 1972* and the *Native Vegetation Act 1991*). Other relevant legislation is described below.

##### *Natural Resources Management Act 2004*

The State's *Natural Resources Management Act 2004* (NRM Act) provides the legislative framework for the sustainable and integrated management of the State's natural resources. The NRM Act replaces and updates the *Animal and Plant Control Act 1986*, *Soil Conservation and Land Care Act 1989* and *Water Resources Act 1997*, and has resulted in the amendment of a further 15 state NRM related Acts.

Key regulatory functions of the NRM Act include the ability to control water use through prescription, allocations and restrictions; and the requirement to control pest plants and animals, and activities that might result in land degradation. A 'duty of care' is a fundamental component of this Act, i.e. ensuring one's environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations.

Established under the NRM Act is a peak advisory body, the NRM Council, and eight regionally based, community-driven NRM Boards. The guiding document for NRM is the State Natural Resources Management Plan 2006.<sup>6</sup> Each regional NRM Board is required to prepare a regional NRM Plan with associated Investment Strategies. A draft regional NRM plan has been developed for the Adelaide and Mount Lofty Ranges Region.<sup>1</sup> Where a water resource is prescribed the NRM Act requires that a water allocation plan is prepared by the relevant NRM Board.

##### *Development Act 1993*

In accordance with Section 37 of the State's Development Act and Regulation 24 of the Development Regulations (Part 5), planning authorities are required to refer certain types of development applications to other agencies for specialist advice.

Advice is sought from the Native Vegetation Council (NVC) regarding applications for land subdivision, where the development may impact on native vegetation. However, the decisions made by local councils and the Development Assessment Commission (DAC) may go against the advice of the NVC. Any approved development within an area of intact native vegetation is subject to the regulations of the NV Act.

The Coast Protection Board (CPB) establishes whether land and any development on it is likely to affect or be affected by coastal processes including storm surge flooding and short or long-term changes in the coastline's position. The CPB can recommend development applications along the coast be rejected if, for example, the development impinges on the conservation of coastal, estuarine and marine habitats.

##### *Environment Protection Act 1993*

The State's *Environment Protection Act 1993* (EP Act) is administered by the Environment Protection Authority to provide for the protection of the environment; control actions that will or might result in pollution; and prepare the State of Environment Report.

##### *Coast Protection Act 1972*

The State's *Coast Protection Act 1972* (CP Act) is administered by the Department for Environment and Heritage to protect the coast from erosion, deterioration, pollution or misuse on both private and public land and to engage in environmental restoration. The Coast Protection Board is the primary authority and prescribed body in South Australia managing coastal protection issues and providing advice on coastal development.

The CP Act is currently under review. It is anticipated that the new Act will establish a Coastal Board, provide the statutory basis for marine plans, and interacts with and informs the *Development Act 1993*, the *NRM Act 2004* and other coast and marine resource use legislation.

### Crown Lands Act 1929

The State's *Crown Lands Act 1929* (CL Act) regulates the use of crown land under the care of local government (e.g. cemetery reserves, water reserves, stone reserves and parklands). Numerous sub-populations of the species in this plan occur on CL Act reserves. Crown land under the care of local government can be proclaimed as Conservation Reserves under the CL Act, and managed for biodiversity conservation purposes.

### Forestry Act 1950

The State's *Forestry Act 1950* (FA Act) regulates the use of land gazetted for the purpose of forestry. Forestry SA manages large areas of native vegetation in the Mount Lofty Ranges, which contain populations of species in this plan. Native Forest Reserves can be proclaimed under the FA Act for purposes relating to the conservation and management of land supporting flora and fauna.

### Fisheries Management Act 2007

Management and regulation of fishing in South Australia comes under the State's *Fisheries Management Act 2007* (FM Act). This Act replaces the *Fisheries Act 1982*. The FM Act regulates the fishing of protected species and protected areas. Some of the freshwater fish included in this plan are fully protected from fishing activities. Penalties apply if offences are committed. The FM Act also provides for a more ecosystem-based approach to managing fisheries, with conservation objectives, risk-based assessments of potential impacts on the ecosystem and tools to protect fish habitats. A Fisheries Council is established under the Act to provide advice to the Minister in relation to fisheries management for commercial, recreational and traditional indigenous use.

### River Murray Act 2003

This act provides for the protection and enhancement of the Murray River and its tributaries within South Australia. The objectives of the act relate to river health, environmental flow, water quality and human use.

### Native Title Act 1993

Generally the Commonwealth's *Native Title Act 1993* (NT Act) requires certain assessment procedures to be followed prior to undertaking activities. The relevant provisions of the NT Act will be considered before undertaking any future acts that might affect Native Title. Procedures under the NT Act are additional to those required to comply with the State's *Aboriginal Heritage Act 1988*.

The requirements of the NT Act only apply to land where Native Title rights and interests may exist. When implementing any recovery actions in this plan where there has been no Native Title determination, or where there has been no clear extinguishment of Native Title, there will be consideration of the possibility that Native Title may continue to exist. This plan will be adopted and released subject to any Native Title rights and interests that may continue in relation to the land and/or waters. Content in this plan is not intended to affect Native Title.

## **3.2 EPBC Act Recovery Plan Requirements**

The EPBC Act and its accompanying regulations stipulate specific information that must be included in a recovery plan adopted by the Minister. While the Act requires specific information for each species or community, the Act does provide the option of developing multi-species recovery plans where feasible. These may cover a range of species/communities that occur in the same area or a number of species that have closely related requirements based on their habitats, threats or recovery actions. Although these guidelines do not specifically address regional recovery plans, this plan and others being prepared under regional pilot projects will test whether regional recovery plans can meet the requirements for adoption under the EPBC Act.

The EPBC Act requires 'habitat critical to survival of species' to be identified. Regional recovery plans cater for large numbers of species and diverse taxa; consequently there are significant challenges in identifying 'habitat critical to survival of species' specific enough to be useful for formulating meaningful management actions. In this respect, this plan's approach is multi-scaled. Species' threats, distribution patterns and habitat at the broad ecological community level were analysed and summarised in a variety of ways to define management requirements. Species-specific details have been presented in a 'profile' for each species based on the best available data and knowledge (see Appendices Part B).

Plans may cover a combination of species/communities listed under the EPBC Act and relevant State legislation, in such cases the Commonwealth Minister for the Environment, Heritage and the Arts will only adopt the plan in relation to those species listed under the EPBC Act.

As per the EPBC Act's recovery planning guidelines, this plan is not intended to be a detailed implementation plan. This plan specifies management actions directly related to achieving the objectives, however the specific details of these actions (e.g. scientific or technical information, specific information on nature of research to be undertaken or experimental design) may be organisational and/or site-dependent. To aid implementation however, more detailed analysis will be provided for in separate operational documents and products.

In preparing a recovery plan liaison between the authors of the plan and a broad range of interested parties is required. Before a plan is made or adopted by the Commonwealth Minister under the EPBC Act there must be an opportunity for input by the general public. A recovery plan must identify interests that will be affected by the plan's implementation. In developing a recovery plan it is necessary to ensure that there is consultation with relevant indigenous people that have an interest in the species' /communities and where they occur.

While preparing this plan, DEH conducted the community consultation in line with Commonwealth requirements. The draft plan was circulated within State Government prior to being made available for a three month public comment period by AGDEWHA. Details of the consultation process, and comments received during the consultation period are provided to the Commonwealth Minister for consideration at the time of submitting the plan for adoption.

### 3.3 International Obligations

There are a number of international agreements and conventions that are relevant to this plan.

#### Convention on International Trade in Endangered Species

A number of species covered by this plan are listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES has established a world-wide system of controls on international trade in threatened wildlife. The legislative basis for meeting Australia's responsibilities under CITES is now provided by Part 13A of the EPBC Act. The actions identified in this plan are consistent with Australia's obligations under CITES.

#### Convention on Biological Diversity

Australia is a signatory to the Convention on Biological Diversity (CBD). The primary aims of the CBD are the conservation and sustainable use of biological diversity. The CBD emphasises the need for *in situ* conservation measures, and promotes the recovery of threatened species. The main implementation tools for the Convention are national strategies, plans or programs. This recovery plan is consistent with Australia's obligations under the CBD.

#### Agreements and Convention on Migratory Species

Some of the bird species included in this plan are migratory. The following bilateral agreements provide a formal framework for the conservation of migratory birds of the East Asian - Australasian Flyway. All migratory bird species listed in these bilateral agreements are protected in Australia as matters of national environmental significance under the EPBC Act.

- Japan Australia Migratory Bird Agreement (JAMBA),
- China Australia Migratory Bird Agreement (CAMBA),
- Republic of Korea Australia Migratory Bird Agreement (ROKAMBA).

Australia has also encouraged multilateral cooperation for migratory bird conservation through the Partnership for the East Asian-Australasian Flyway.

The Convention on the Conservation of Migratory Species of Wild Animals (CMS/Bonn Convention) is an intergovernmental treaty aimed to conserve terrestrial, marine and avian migratory species throughout their range.

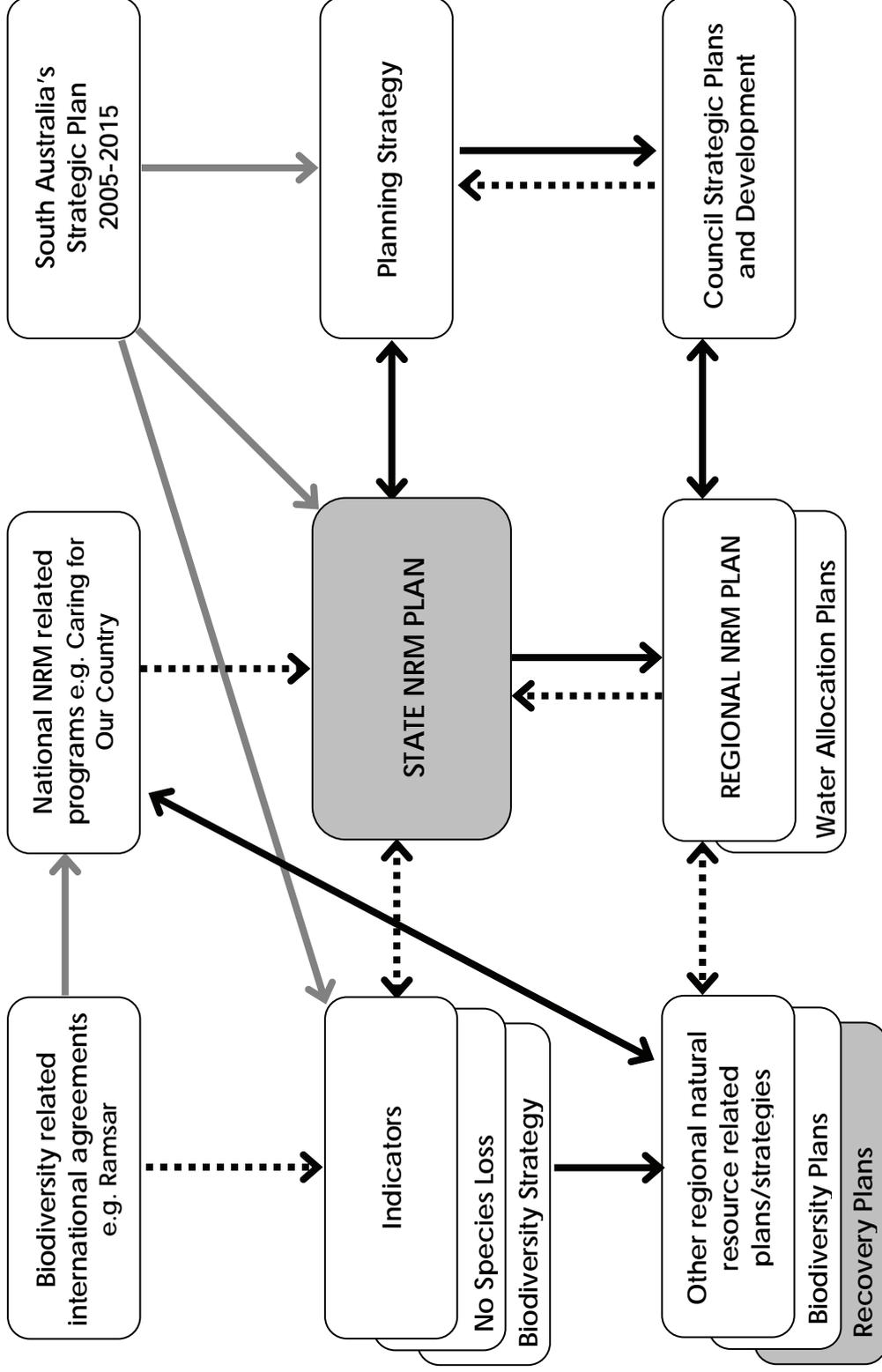
#### Ramsar Convention on Wetlands

The Ramsar Convention encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity. Once designated these sites are added to the Convention's List of Wetlands of International Importance and become known

as Ramsar sites. In designating a wetland as a Ramsar site, countries agree to manage the wetlands in a way that ensures their internationally important ecological values and character are maintained or improved over time. The Coorong and Lakes Alexandrina and Albert which border the AMLR region are Ramsar listed. The implementation of Australia's international environmental responsibilities is not adversely affected by this plan.

### 3.4 Key State Planning Relationships

(Source: adapted from the State NRM Plan<sup>6</sup>)



### 3.5 Recovery Plan Status (Flora)

Note: for flora species included in the plan only.

Scientific name	Common name	EPBC SPRAT*	NATIONAL PLAN	STATE PLAN (SA)	INTER-STATE PLAN	REGIONAL PLAN (SA)
<i>Acacia menzelli</i>	Menzel's Wattle	✓				✓ (current non-AMLR)
<i>Acacia pingulifolia</i>	Fat-leaf Wattle	✓	✓ (in prep)			✓ (current non-AMLR)
<i>Acacia rheticocarpa</i>	Resin Wattle	✓				✓ (current non-AMLR)
<i>Caladenia argocalla</i>	White Beauty Spider-orchid	✓		✓ (not current)		✓ (current AMLR)
<i>Caladenia behrii</i>	Pink-lip Spider-orchid	✓		✓ (not current)		✓ (current AMLR)
<i>Caladenia colorata</i>	Coloured Spider-orchid	✓				✓ (current non-AMLR)
<i>Caladenia gladiolata</i>	Bayonet Spider-orchid	✓				✓ (current AMLR)
<i>Caladenia ovata</i>	Kangaroo Island Spider-orchid	✓				✓ (not current non-AMLR)
<i>Caladenia rigida</i>	Stiff White Spider-orchid	✓			✓ (current)	✓ (current AMLR)
<i>Calochilus campestris</i>	Plains Beard-orchid					
<i>Correa calycina</i> var. <i>calycina</i>	Hindmarsh Correa	✓				✓ (not current non-AMLR, different ssp.)
<i>Cullen parvum</i>	Small Scurf-pea	✓	✓ (not current)			
<i>Euphrasia collina</i> ssp. <i>osbornii</i>	Osborn's Eyebright	✓	✓ (draft)		✓ (not current)	✓ (not current non-AMLR)
<i>Glycine latrobeana</i>	Clover Glycine	✓		✓ (draft)	✓ (current)	
<i>Microtis atrata</i>	Yellow Onion-orchid				Yes (current)	
<i>Olearia pannosa</i> ssp. <i>pannosa</i>	Silver Daisy-bush	✓				✓ (draft non-AMLR)
<i>Paracaleana disjuncta</i>	Black-beak Duck-orchid		✓ (draft)			
<i>Prasophyllum fitzgeraldii</i>	Fitzgerald's Leek-orchid				✓ (not current)	
<i>Prasophyllum murfettii</i>		✓			✓ (not current)	
<i>Prostanthera eurybioides</i>	Monarto Mintbush	✓	✓ (in prep)	✓ (not current)		✓ (current non-AMLR)
<i>Pterostylis arenicola</i>	Sandhill Greenhood	✓				✓ (current non-AMLR)
<i>Pterostylis bryophila</i>	Hindmarsh Greenhood	✓				✓ (current AMLR)
<i>Pterostylis cucullata</i> ssp. <i>sylvicola</i>	Leafy Greenhood	✓			Yes (current)	✓ (current AMLR)
<i>Tecticornia flabelliformis</i>	Bead Samphire	✓	✓ (draft)			✓ (draft non-AMLR)
<i>Thelymitra mucida</i>					✓ (current)	
<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid	✓				

**Only species with an existing recovery plan or EPBC SPRAT profile have been included in the list**

\* EPBC SPRAT profile refers to species listed under the Environment Protection and Biodiversity Conservation Act 1999, which have information available on the Species Profile and Threats (SPRAT) Database: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

### 3.6 Recovery Plan Status (Fauna)

Note: for fauna species included in the plan only.

Scientific name	Common name	EPBC SPRAT*	NATIONAL PLAN	STATE PLAN (SA)	INTER-STATE PLAN	ACTION PLAN <sup>^</sup>
<i>Acanthiza iredalei rosinae</i>	Slender-billed Thornbill (SVG spp.)	✓				✓
<i>Aphelocephala leucopsis leucopsis</i>	Southern Whiteface (eastern)					✓
<i>Aprasia pseudopulchella</i>	Flinders Ranges Worm-lizard	✓				✓
<i>Austrelaps labialis</i>	Pygmy Copperhead					✓
<i>Botaurus poeciloptilus</i>	Australasian Bittern					✓
<i>Cercartetus concinnus</i>	Western Pygmy-possum				✓ (not current)	
<i>Cincosoma punctatum anachoreta</i>	Spotted Quail-thrush	✓				✓
<i>Cratogeomys fluvialis</i>	Murray hardyhead	✓	✓ (draft)			✓ (SA, draft)
<i>Gadopsis marmoratus</i>	River blackfish					✓ (SA, draft)
<i>Galaxias brevipinnis</i>	Climbing galaxias				✓ (current NZ)	✓ (SA, draft)
<i>Galaxias olidus</i>	Mountain galaxias					✓ (SA, draft)
<i>Geotria australis</i>	Pouched lamprey					✓ (SA, draft)
<i>Hylacola pyrrhopygia parkeri</i>	Chestnut-rumped Heathwren (MLR spp.)	✓				✓
<i>Isodon obesulus obesulus</i>	Southern Brown Bandicoot	✓		✓ (current)	✓ (current)	✓
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (south-eastern)					✓
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern)					✓
<i>Mordacia mordax</i>	Short-headed lamprey					✓ (SA, draft)
<i>Nannoperca australis</i>	Southern pygmy perch					✓ (SA, draft)
<i>Nannoperca obscura</i>	Yarra pygmy perch	✓	✓ (draft)			✓ (SA, draft)
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	✓	✓ (current)			✓
<i>Pseudaphritis urvillii</i>	Congolli					✓ (SA, draft)
<i>Lewinia pectoralis pectoralis</i>	Lewin's Rail (eastern)					✓
<i>Stagonopleura guttata</i>	Diamond Firetail					✓
<i>Stipiturus malachurus intermedius</i>	Southern Emu-wren (MLR spp.)	✓	✓ (draft)			✓
<i>Tympanocryptis lineata lineata</i>	Five-lined Earless Dragon					✓ (different sub-species only)
<i>Zoothera lunulata halmaturina</i>	Bassian Thrush (South Australian)					✓

Only species with an existing recovery plan, EPBC SPRAT profile or action statement have been included in the list. There are no regional recovery plans written for fauna species included in this plan.

\* EPBC SPRAT profile refers to species listed under the Environment Protection and Biodiversity Conservation Act 1999, which have information available on the Species Profile and Threats (SPRAT) Database: <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>

<sup>^</sup> Action Plan includes species with a specific recovery outline, taxon summary or action statement in a recognised National or South Australian Action Plan. The action plan is National unless otherwise stated. Note that some species have interstate action statements/plans but these have not been included in this assessment. The Native Fish Strategy for the Murray Darling Basin 2003-2013 includes recovery actions for a number of the freshwater fish included in this plan, but has not been included in this assessment.

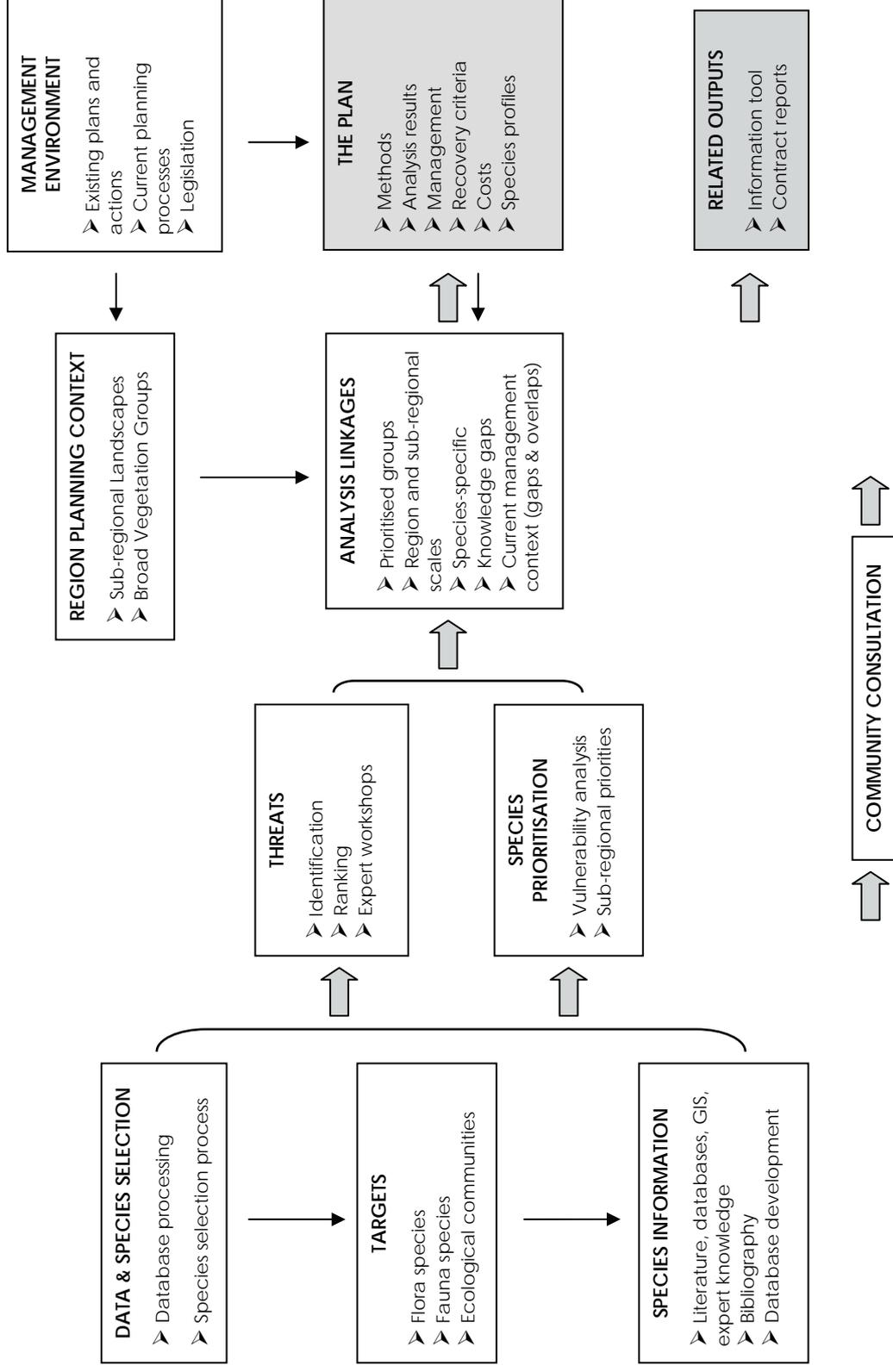
### 3.7 Recovery Plan Status (Ecological Communities)

Note: Greybox Woodland has been nominated for listing but has not yet been adopted.

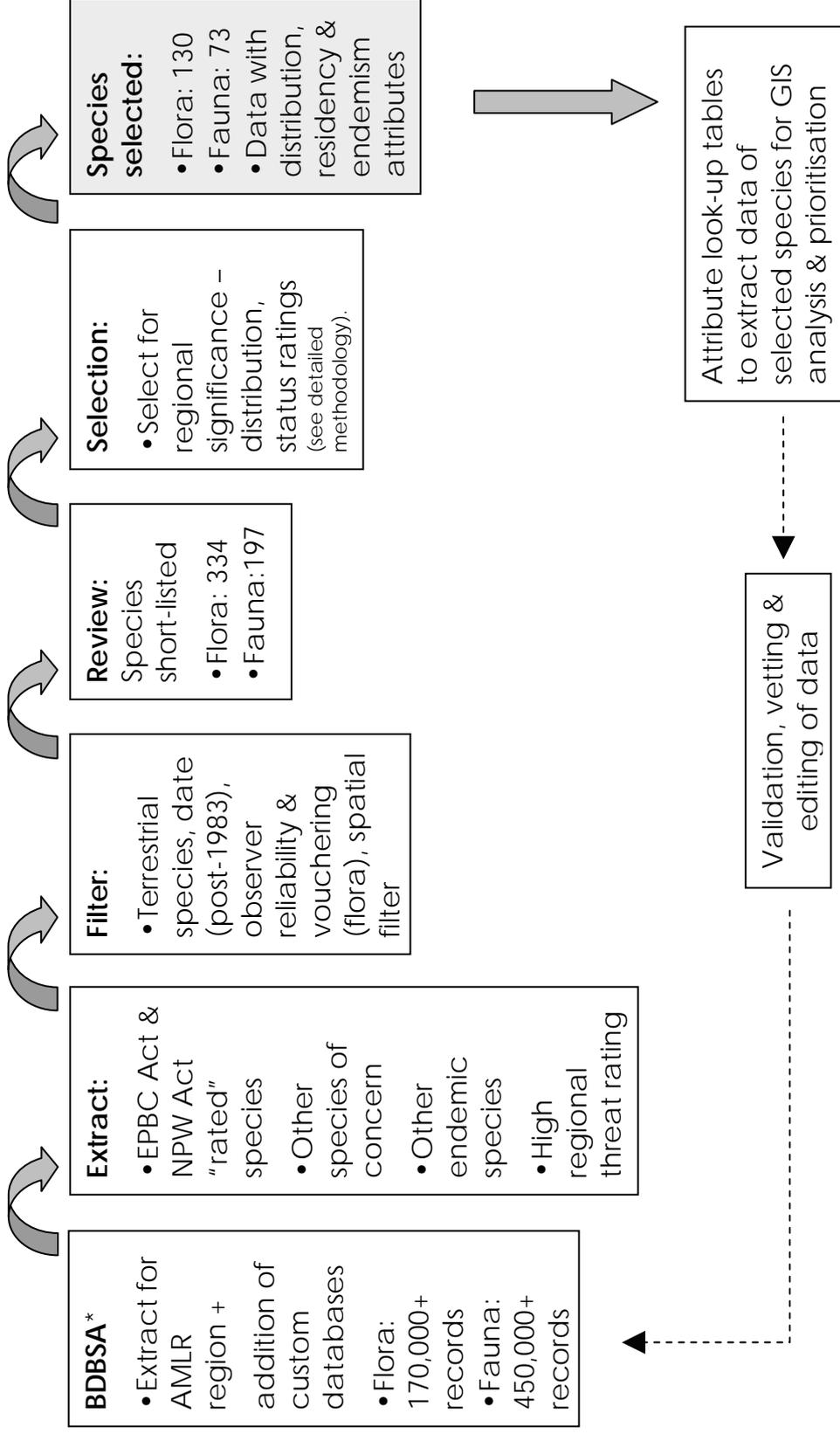
Scientific name	EPBC SPRAT	NATIONAL PLAN	STATE PLAN SA	INTER-STATE	OTHER
Iron Grass ( <i>Lomandra effusa</i> – <i>L. multiflora</i> ssp. <i>dura</i> ) Natural Temperate Grassland of SA	✓	✓ (in prep)			
Peppermint Box ( <i>Eucalyptus odorata</i> ) Grassy Woodland of SA	✓	✓ (in prep)			
Swamps of Fleurieu Peninsula	✓				✓ (Draft 'Recovery Statement')

## 4. Project Planning and Methodology

### 4.1 Project Planning Model

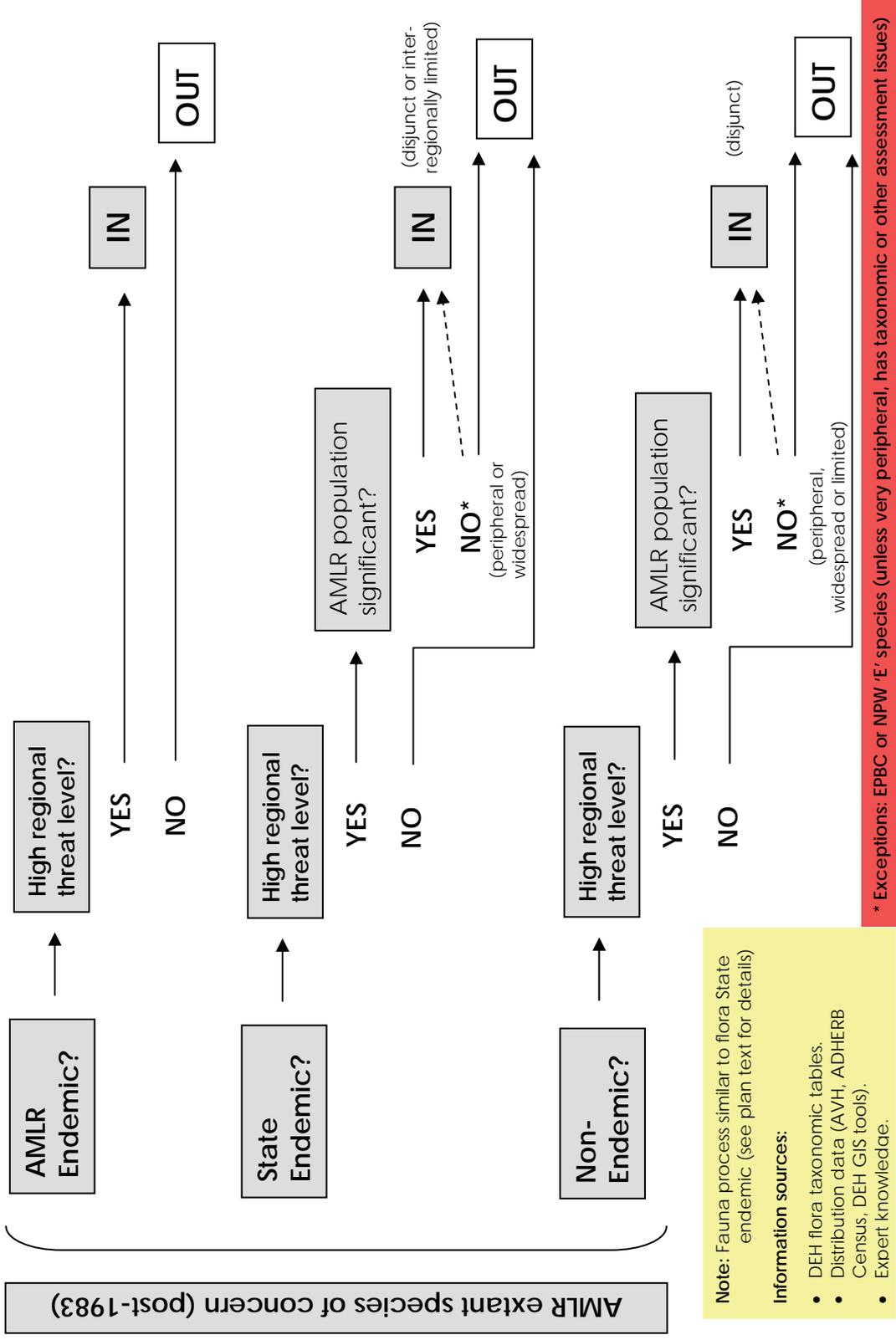


## 4.2 Species Data Processing Model



\* BDBSA: Biological Databases of South Australia

### 4.3 Flora Species Inclusion Process



#### 4.4 Regional Vulnerability Groups (Methodology)

All species (except freshwater fish) were prioritised into six flora and fauna 'Regional Vulnerability Groups' (RVGs) (decreasing in priority from 1 to 6), according to scored criteria under the following categories:

- Regional conservation status (AMLR region);
- Relative area of occupancy (AMLR region);
- Endemism & distribution (South Australia);
- Habitat specialisation (flora);
- State (NPW Act) & National (EPBC Act) conservation status;
- Residency - AMLR (fauna).

Sub-species were treated as species. Each category was equally weighted and point-scored according to the criteria as below. The process was iterative, involving sensitivity analyses to determine criteria and scoring influence. Results were also assessed by expert opinion.

##### Regional Conservation Status (AMLR)

An unofficial rating relevant to the AMLR region used in this plan, derived from existing conservation ratings systems and expert opinion.

##### Flora

Score	Criteria
3	Endangered
2	Threatened
1	Vulnerable

##### Fauna

Score	Criteria
3	Endangered
2	Vulnerable
1	Rare or Uncommon

##### Relative area of occupancy (AMLR)

Measured by calculating species presence within a 5km grid cell (irrespective of the number of occurrences within a grid cell) using post-1983 filtered presence data, and counting the occupied grid cells. The range of counts was classified into three classes using the 'Jenk's Natural Breaks algorithm, as below.

##### Flora

Score	Description & criteria
3	Extremely Limited: 1-4 grid cells
2	Very Limited: 5-11 grid cells
1	Moderately Limited: 12-22 grid cells

**Fauna**

Score	Description & criteria
3	Extremely Limited: 1-35 grid cells
2	Very Limited: 36-101 grid cells
1	Moderately Limited: 102-205 grid cells

**Endemism & Distribution (South Australia)****Flora**

Score	Description & criteria
3	AMLR endemic
2	State endemic or AMLR confined non-endemic*
1	Other (non-endemic and/or peripheral)

\*Non-endemic species where the majority or all of the mainland State population is confined within AMLR region.

**Fauna**

Score	Description & criteria
3	AMLR endemic or State endemic
2	Disjunct or inter-regionally limited*
1	Other (widespread or peripheral)

\* The AMLR distribution is more or less contiguous across one to three adjacent regions with SA.

**Habitat Specialisation (Flora)**

Score	Description & criteria
3	Very High: <i>A very narrow habitat requirement within one broad vegetation group (e.g. Thelymitra circumsepta, requiring peaty bogs in high rainfall areas, within 'Wetland' broad vegetation group. Other habitat examples may include wetland margins or exposed coastal headlands.</i>
2	High: <i>A narrow habitat requirement that may occur within one or two broad vegetation groups (e.g. Acacia gunnii restricted to rocky areas within higher rainfall heathy communities).</i>
1	Moderate-Low: <i>Habitat requirements not relatively specific, and that may occur within more than one broad vegetation group (e.g. Spyridium coactilifolium).</i>

**State-wide & National Conservation Concern**

**Flora & Fauna**

Score	Description & criteria
3	Nationally listed (Critically Endangered, Endangered, Vulnerable)
2	State listed (Endangered or Vulnerable)
1	State listed (Rare)
0	Not listed

*Note: if a species is both Nationally and State listed, it cannot be scored twice (i.e. it will only be scored for National listing).*

**Residency - AMLR (fauna)**

Score	Description & criteria
3	Resident
2	Migrant (breeding)
1	Other (e.g. nomadic)

#### 4.5 Ecological Community Inclusion and Prioritisation

DEH ID	Ecological Community	Landscape description	Broad Ecological Community	State DEH rating	EPBC rating <sup>^</sup>	AMLR significance <sup>*</sup>	Expert priority adjustment	AMLR priority <sup>\$</sup>
SA0018	<i>Banksia marginata</i> Grassy Low Woodland	Sandy loam plains in higher rainfall areas	Grassy Woodland	E		High	-	VERY HIGH
SA0001	<i>Eucalyptus dalympleana</i> ssp. <i>dalympleana</i> Open Forest	Heavy soils of upland valleys	Riparian	E		Very High	-	VERY HIGH
SA0012	<i>E. microcarpa</i> Grassy Low Woodland	Southern foothills and hill slopes	Grassy Woodland	E	Nom.	Very High	-	VERY HIGH
SA0011	<i>E. odorata</i> +/- <i>E. leucoxylo</i> n Grassy Low Woodland	Loamy soils of low hills	Grassy Woodland	E	CE	Medium	-	VERY HIGH
SA0033	Freshwater wetlands e.g. <i>Triglochin procerum</i> Hermland		Wetland	E	CE (SFP)	Medium	-	VERY HIGH
SA0025	<i>Leptospermum lanigerum</i> Closed Shrubland	Non-saline wetlands	Wetland (or Shrubland)	E	CE (SFP)	High	-	VERY HIGH
SA0027	<i>Lomandra effusa</i> Tussock Grassland	Shallow loams in low hills	Grassland	E	CE	Medium	-	VERY HIGH
SA0026	<i>Melaleuca squamea</i> +/- <i>Leptospermum continentale</i>	Closed Shrubland on peaty soils	Wetland	V	CE (SFP)	High	-	VERY HIGH
SA0029	<i>Themeda triandra</i> +/- <i>Danthonia</i> spp. Tussock Grassland	Heavy, fertile soils of plains and hill slopes	Grassland	E	Note 1	Very High	-	VERY HIGH
SA0014	<i>Callitris preissii</i> +/- <i>E. leucoxylo</i> n Grassy Low Woodland	Quartzite gravels on western foot-slopes	Grassy Woodland	V		Very High	-	HIGH
SA0008	<i>E. fasciculosa</i> +/- <i>E. leucoxylo</i> n Heathy Woodland	Sandy loams of flats and slopes	Heathy Woodland	V		High	Increased	HIGH
SA0010	<i>E. ovata</i> +/- <i>E. viminalis</i> ssp. <i>cygnetensis</i> +/- <i>E. camaldulensis</i> var. <i>camaldulensis</i> Low Woodland	Valleys and drainage lines	Riparian (or Wetland)	V		High	Increased	HIGH
SA0030	<i>Gahnia filum</i> Sedgeland	Drainage lines and	Wetland	V	Note 2	High	Increased	HIGH

DEH ID	Ecological Community	Landscape description	Broad Ecological Community	State DEH rating	EPBC rating <sup>^</sup>	AMLR significance <sup>*</sup>	Expert priority adjustment	AMLR priority <sup>§</sup>
		depressions						
SA0004	Eucalyptus viminalis ssp. cygnensis and/or E. viminalis ssp. viminalis Woodland	Alluvial soils in moist areas	Riparian	V		High	-	MEDIUM+
SA0015	Allocasuarina verticillata Grassy Low Woodland	Clay loams of low hills	Grassy Woodland	V		Medium	-	MEDIUM
SA0013	E. leucoxyloides ssp. pruinosa +/- E. odorata Grassy Low Woodland	Loams of hill slopes	Grassy Woodland	V		Medium	-	MEDIUM
-	Eucalyptus porosa Woodland		Grassy Woodland					Conservation concern but more detailed assessment required
-	Melaleuca halmaturorum Shrubland/ Low Open Forest		Shrubland					Conservation concern but more detailed assessment required

Adapted from the Provisional List of Threatened Ecosystems of South Australia (DEH 2005)<sup>4</sup>. Note, communities selected by presence within FLB1 or KAN2 IBRA sub-regions of the Agricultural Regions (16 TEC's selected from 33 State-listed communities occurring in agricultural regions).

<sup>^</sup> As indicated in DEH 2005. Nom. = nomination current; SFP = Swamps of the Fleurieu Peninsula (EPBC CE)

<sup>\*</sup> AMLR Significance: relative to State-wide distribution, determined by mapped distribution (presence by IBRA sub-region as per DEH 2005)

Very High: AMLR endemic or near endemic (or AMLR portion of range is very disjunct from remaining State-wide distribution)

High: Limited distribution around AMLR, or, AMLR portion of range is disjunct from remaining State-wide distribution

Medium: Range occurs in numerous adjoining regions around AMLR.

<sup>§</sup> AMLR Priority determined by:

if EPBC listed, then Very High, otherwise, State rating & AMLR Significance = AMLR Priority ...

E & Very High = Very High      V & Very High = High

E & High = Very High      V & High = Medium+

E & Medium = High+      V & Medium = Medium

Note: if community priority increased via expert adjustment, then '+' status not retained.

Note 1: Noted in DEH (2005) as EPBC nominated, however for this analysis not assumed to be part of any currently listed EPBC community.

Note 2: Noted in DEH (2005) as EPBC listed, however for this analysis not assumed to be part of any currently listed EPBC community.

## 5. Excluded Flora Species

The following flora species were reviewed but excluded from the detailed planning process.

Scientific name	Common name	Family	EPBC	NPW
<i>Acacia araneosa</i>		LEGUMINOSAE	V	E
<i>Acacia argyrophylla</i>	Silver Mulga-bush	LEGUMINOSAE		
<i>Acacia dodonaeifolia</i>	Hop-bush Wattle	LEGUMINOSAE		R
<i>Acacia leiophylla</i>		LEGUMINOSAE		
<i>Acacia montana</i>	Mallee Wattle	LEGUMINOSAE		R
<i>Acacia nematophylla</i>	Coast Wallowa	LEGUMINOSAE		
<i>Acacia rhigiophylla</i>	Dagger-leaf Wattle	LEGUMINOSAE		R
<i>Acacia trineura</i>	Three-nerve Wattle	LEGUMINOSAE		E
<i>Acacia whibleyana</i>	Whibley's Wattle	LEGUMINOSAE	E	E
<i>Acrotriche fasciculiflora</i>	Mount Lofty Ground-berry	EPACRIDACEAE		
<i>Allocasuarina striata</i>		CASUARINACEAE		
<i>Amphibromus archeri</i>	Pointed Swamp Wallaby-grass	GRAMINEAE		R
<i>Amphibromus macrorhinus</i>	Long-nosed Swamp Wallaby-grass	GRAMINEAE		R
<i>Anogramma leptophylla</i>	Annual Fern	ADIANTACEAE		R
<i>Anthocercis angustifolia</i>	Narrow-leaf Ray-flower	SOLANACEAE		R
<i>Aristida australis</i>		GRAMINEAE		R
<i>Atriplex australasica</i>		CHENOPODIACEAE		R
<i>Austrodanthonia laevis</i>	Smooth Wallaby-grass	GRAMINEAE		R
<i>Austrodanthonia tenuior</i>	Short-awn Wallaby-grass	GRAMINEAE		R
<i>Austrostipa breviglumis</i>	Cane Spear-grass	GRAMINEAE		R
<i>Austrostipa densiflora</i>	Fox-tail Spear-grass	GRAMINEAE		R
<i>Austrostipa gibbosa</i>	Swollen Spear-grass	GRAMINEAE		R
<i>Austrostipa multispiculis</i>		GRAMINEAE		R
<i>Austrostipa pilata</i>	Prickly Spear-grass	GRAMINEAE		V
<i>Austrostipa tenuifolia</i>		GRAMINEAE		R
<i>Baumea acuta</i>	Pale Twig-rush	CYPERACEAE		R
<i>Baumea gunnii</i>	Slender Twig-rush	CYPERACEAE		R
<i>Baumea laxa</i>	Lax Twig-rush	CYPERACEAE		R
<i>Billardiera uniflora</i>		PITOSPORACEAE		
<i>Blechnum nudum</i>	Fishbone Water-fern	BLECHNACEAE		R
<i>Blechnum wattsii</i>	Hard Water-fern	BLECHNACEAE		R
<i>Boronia edwardsii</i>	Edwards' Boronia	RUTACEAE		
<i>Bothriochloa macra</i>	Red-leg Grass	GRAMINEAE		R
<i>Botrychium australe</i>	Austral Moonwort	BOTRYCHIACEAE		E
<i>Brachyscome basaltica</i> var. <i>gracilis</i>	Swamp Daisy	COMPOSITAE		R
<i>Brachyscome breviscapis</i>	Short-stem Daisy	COMPOSITAE		R
<i>Brachyscome parvula</i>	Coast Daisy	COMPOSITAE		R
<i>Caladenia brumalis</i>	Winter Spider-orchid	ORCHIDACEAE	V	V
<i>Caladenia cardiochila</i>		ORCHIDACEAE		
<i>Caladenia flaccida</i>	Drooping Spider-orchid	ORCHIDACEAE		V
<i>Caladenia gracilis</i>		ORCHIDACEAE		E
<i>Caladenia parva</i>	Small Comb Spider-orchid	ORCHIDACEAE		E
<i>Caladenia pusilla</i>		ORCHIDACEAE		
<i>Caladenia stellata</i>	Star Spider-orchid	ORCHIDACEAE		R
<i>Caladenia stricta</i>		ORCHIDACEAE		
<i>Caladenia tensa</i>		ORCHIDACEAE	E	
<i>Caladenia verrucosa</i>		ORCHIDACEAE		
<i>Calytrix glaberrima</i>		MYRTACEAE		
<i>Calytrix involuocrata</i>	Cup Fringe-myrtle	MYRTACEAE		
<i>Cardamine gunnii</i>	Spade-leaf Bitter-cress	CRUCIFERAE		V
<i>Cardamine papillata</i>		CRUCIFERAE		
<i>Cardamine paucijuga</i> (NC)	Annual Bitter-cress	CRUCIFERAE		R
<i>Carex gunniana</i>	Mountain Sedge	CYPERACEAE		R
<i>Carex iynx</i>		CYPERACEAE		
<i>Cassinia tegulata</i>		COMPOSITAE		E

Scientific name	Common name	Family	EPBC	NPW
<i>Centrolepis cephaloformis</i> ssp. <i>cephaloformis</i>	Cushion Centrolepis	CENTROLEPIDACEAE		R
<i>Cladium procerum</i>	Leafy Twig-rush	CYPERACEAE		R
<i>Correa aemula</i>	Hairy Correa	RUTACEAE		R
<i>Correa alba</i> var. <i>pannosa</i>	White Correa	RUTACEAE		R
<i>Correa decumbens</i>		RUTACEAE		
<i>Correa glabra</i> var. <i>turnbullii</i>		RUTACEAE		
<i>Correa pulchella</i>		RUTACEAE		
<i>Crassula exserta</i>	Large-fruit Crassula	CRASSULACEAE		R
<i>Crassula peduncularis</i>	Purple Crassula	CRASSULACEAE		R
<i>Cryptandra hispidula</i>		RHAMNACEAE		
<i>Cryptandra</i> sp. <i>long hypanthium</i> (C.R. Alcock 10626)	Long-flower Cryptandra	RHAMNACEAE		R
<i>Cyperus lhotskyanus</i>		CYPERACEAE		R
<i>Cyperus sanguinolentus</i>	Dark Flat-sedge	CYPERACEAE		R
<i>Daviesia asperula</i>		LEGUMINOSAE		
<i>Daviesia benthamii</i> ssp. <i>humilis</i>	Mallee Bitter-pea	LEGUMINOSAE		R
<i>Daviesia ulicifolia</i>		LEGUMINOSAE		
<i>Dennstaedtia davallioides</i>	Lacy Ground-fern	DENNSTAEDTIACEAE		E
<i>Veronica derwentiana</i> ssp. <i>derwentiana</i>	Derwent Speedwell	SCROPHULARIACEAE		E
<i>Deyeuxia densa</i>	Heath Bent-grass	GRAMINEAE		R
<i>Deyeuxia minor</i>	Small Bent-grass	GRAMINEAE		V
<i>Dianella callicarpa</i>	Swamp Flax-lily	LILIACEAE		E
<i>Dicksonia antarctica</i>		DICKSONIACEAE		
<i>Dipodium punctatum</i>		ORCHIDACEAE		E
<i>Diuris chryseopsis</i>		ORCHIDACEAE		E
<i>Diuris palustris</i>	Little Donkey-orchid	ORCHIDACEAE		
<i>Dodonaea baueri</i>		SAPINDACEAE		
<i>Dodonaea humilis</i>		SAPINDACEAE		
<i>Dodonaea subglandulifera</i>		SAPINDACEAE		E
<i>Dodonaea tepperi</i>		SAPINDACEAE		
<i>Doodia caudata</i>		BLECHNACEAE		
<i>Drosera binata</i>	Forked Sundew	DROSERACEAE		R
<i>Drosera praefolia</i>	Early Sundew	DROSERACEAE		R
<i>Drosera whittakeri</i> ssp. <i>whittakeri</i>		DROSERACEAE		
<i>Echinopogon ovatus</i>	Rough-beard Grass	GRAMINEAE		R
<i>Elatine gratioloides</i>	Waterwort	ELATINACEAE		R
<i>Eragrostis infecunda</i>	Barren Cane-grass	GRAMINEAE		R
<i>Eragrostis lacunaria</i>	Purple Love-grass	GRAMINEAE		R
<i>Eremophila behriana</i>		MYOPORACEAE		
<i>Eriochilus</i> sp. <i>swamp</i> (D.E. Murfet 1950b)		ORCHIDACEAE		E
<i>Eryngium rostratum</i>	Blue Devil	UMBELLIFERAE		V
<i>Eryngium vesiculosum</i>	Prostrate Blue Devil	UMBELLIFERAE		R
<i>Eucalyptus behriana</i>	Broad-leaf Box	MYRTACEAE		R
<i>Eucalyptus cosmophylla</i>		MYRTACEAE		
<i>Eucalyptus dalrympleana</i> ssp. <i>dalrympleana</i>	Candlebark Gum	MYRTACEAE		R
<i>Eucalyptus fasciculosa</i>	Pink Gum	MYRTACEAE		R
<i>Eucalyptus viminalis</i> ssp. <i>viminalis</i>	Manna Gum	MYRTACEAE		R
<i>Festuca benthamiana</i>		GRAMINEAE		
<i>Genoplesium ciliatum</i>		ORCHIDACEAE		E
<i>Gleichenia microphylla</i>	Coral Fern	GLEICHENIACEAE		R
<i>Gonocarpus micranthus</i> ssp. <i>micranthus</i>	Creeping Raspwort	HALORAGACEAE		R
<i>Haloragis eichleri</i>	Eichler's Raspwort	HALORAGACEAE		R
<i>Histiopteris incisa</i>	Bat's-wing Fern	DENNSTAEDTIACEAE		E
<i>Hydrocotyle comocarpa</i>	Fringe-fruit Pennywort	UMBELLIFERAE		R
<i>Hypericum calycinum</i>	Large-flower St John's Wort	GUTTIFERAE		
<i>Hypericum japonicum</i>	Matted St John's Wort	GUTTIFERAE		R
<i>Hypolepis rugosula</i>	Ruddy Ground-fern	DENNSTAEDTIACEAE		R

Scientific name	Common name	Family	EPBC	NPW
<i>Isoetes drummondii</i> ssp. <i>drummondii</i>	Plain Quillwort	ISOETACEAE		R
<i>Joycea clelandii</i>	Cleland's Wallaby-grass	GRAMINEAE		
<i>Juncus australis</i>	Austral Rush	JUNCACEAE		R
<i>Juncus continuus</i>	Pithy Rush	JUNCACEAE		
<i>Juncus homalocaulis</i>	Wiry Rush	JUNCACEAE		V
<i>Lachnagrostis punicea</i> var. <i>filifolia</i>	Narrow-leaf Blown-grass	GRAMINEAE		R
<i>Lepyrodia valliculae</i>	Kangaroo Island Scale-rush	RESTIONACEAE		R
<i>Leucopogon concurvus</i>		EPACRIDACEAE		
<i>Leucopogon hirsutus</i>	Hairy Beard-heath	EPACRIDACEAE		R
<i>Logania crassifolia</i>	Coast Logania	LOGANIACEAE		
<i>Logania recurva</i>		LOGANIACEAE		
<i>Logania saxatilis</i>	Rock Logania	LOGANIACEAE		R
<i>Lomandra densiflora</i>		LOMANDRACEAE		
<i>Lomandra fibrata</i>		LOMANDRACEAE		
<i>Lomandra multiflora</i>		LOMANDRACEAE		
<i>Luzula ovata</i>	Clustered Wood-rush	JUNCACEAE		R
<i>Lythrum salicaria</i>	Purple Loosestrife	LYTHRACEAE		R
<i>Maireana rohlachii</i>	Rohrlach's Bluebush	CHENOPODIACEAE		R
<i>Mentha diemenica</i>	Slender Mint	LABIATAE		R
<i>Mentha satureioides</i>	Native Pennyroyal	LABIATAE		R
<i>Micrantheum demissum</i>		EUPHORBIACEAE		
<i>Microlepidium pilosulum</i>	Hairy Shepherd's-purse	CRUCIFERAE		R
<i>Microtis frutetorum</i>		ORCHIDACEAE		
<i>Myoporum parvifolium</i>	Creeping Boobialla	MYOPORACEAE		R
<i>Myriophyllum amphibium</i>	Broad Milfoil	HALORAGACEAE		R
<i>Myriophyllum crispatum</i>	Upright Milfoil	HALORAGACEAE		V
<i>Myriophyllum integrifolium</i>	Tiny Milfoil	HALORAGACEAE		R
<i>Myriophyllum papillosum</i>	Robust Milfoil	HALORAGACEAE		R
<i>Nymphoides crenata</i>	Wavy Marshwort	MENYANTHACEAE		R
<i>Olearia grandiflora</i>	Mount Lofty Daisy-bush	COMPOSITAE		
<i>Olearia passerinoides</i> ssp. <i>glutescens</i>	Sticky Daisy-bush	COMPOSITAE		R
<i>Olearia picridifolia</i>	Rasp Daisy-bush	COMPOSITAE		R
<i>Ottelia ovalifolia</i> ssp. <i>ovalifolia</i>	Swamp Lily	HYDROCHARITACEAE		R
<i>Pentapogon quadrifidus</i> var. <i>quadrifidus</i>	Five-awn Spear-grass	GRAMINEAE		R
<i>Philothea angustifolia</i> ssp. <i>angustifolia</i>	Narrow-leaf Wax-flower	RUTACEAE		R
<i>Phyllangium distylis</i>	Tiny Mitrewort	LOGANIACEAE		R
<i>Phylloglossum drummondii</i>	Pigmy Clubmoss	LYCOPODIACEAE		R
<i>Picris squarrosa</i>	Squat Picris	COMPOSITAE		R
<i>Pilularia novae-hollandiae</i>	Austral Pillwort	MARSILEACEAE		R
<i>Poa drummondiana</i>	Knotted Poa	GRAMINEAE		R
<i>Poa umbricola</i>	Shade Tussock-grass	GRAMINEAE		R
<i>Prasophyllum constrictum</i>	Tawny Leek-orchid	ORCHIDACEAE		R
<i>Prasophyllum occidentale</i>	Plains Leek-orchid	ORCHIDACEAE		
<i>Prasophyllum validum</i>		ORCHIDACEAE		V
<i>Prostanthera behriana</i>		LABIATAE		
<i>Pseudanthus micranthus</i>	Fringed Pseudanthus	EUPHORBIACEAE		R
<i>Pterostylis cycnocephala</i>	Swan-head Greenhood	ORCHIDACEAE		
<i>Pterostylis foliata</i>	Slender Greenhood	ORCHIDACEAE		R
<i>Prasophyllum</i> sp. 'Enigma' (R. Bates 2350)	Contorted Leek-orchid	ORCHIDACEAE		E
<i>Pterostylis</i> sp. Halbury (R. Bates 8425)		ORCHIDACEAE		
<i>Ptilotus erubescens</i>	Hairy-tails	AMARANTHACEAE		R
<i>Pultenaea involucreta</i>	Mount Lofty Bush-pea	LEGUMINOSAE		
<i>Pultenaea scabra</i>	Rough Bush-pea	LEGUMINOSAE		R
<i>Pultenaea trinervis</i>		LEGUMINOSAE		
<i>Ranunculus hamatosestosus</i>	Hill Buttercup	RANUNCULACEAE		
<i>Rhodanthe anthemoides</i>		COMPOSITAE		E

Scientific name	Common name	Family	EPBC	NPW
<i>Rorippa dictyosperma</i>	Forest Bitter-cress	CRUCIFERAE		R
<i>Rumex dumosus</i>	Wiry Dock	POLYGONACEAE		R
<i>Sarcozona bicarinata</i>	Ridged Noon-flower	AIZOACEAE		V
<i>Scaevola calendulacea</i>	Dune Fanflower	GOODENIACEAE		V
<i>Scaevola linearis</i>		GOODENIACEAE		
<i>Schoenus laevigatus</i>		CYPERACEAE		R
<i>Schoenus lepidosperma</i> ssp. <i>lepidosperma</i>	Slender Bog-rush	CYPERACEAE		R
<i>Schoenus tesquorum</i>	Grassy Bog-rush	CYPERACEAE		R
<i>Sclerolaena muricata</i> var. <i>villosa</i>	Five-spine Bindyi	CHENOPODIACEAE		R
<i>Scutellaria humilis</i>	Dwarf Skullcap	LABIATAE		R
<i>Sphaerolobium minus</i>	Leafless Globe-pea	LEGUMINOSAE		R
<i>Sprengelia incarnata</i>	Pink Swamp-heath	EPACRIDACEAE		R
<i>Spyridium phlebophyllum</i>		RHAMNACEAE		
<i>Spyridium phyllicoides</i>		RHAMNACEAE		
<i>Spyridium spathulatum</i>	Spoon-leaf Spyridium	RHAMNACEAE		R
<i>Spyridium thymifolium</i>		RHAMNACEAE		
<i>Stellaria palustris</i> var. <i>tenella</i>	Swamp Starwort	CARYOPHYLLACEAE		R
<i>Stylidium beaugleholei</i>	Beauglehole's Trigger-plant	STYLIDIACEAE		R
<i>Templetonia stenophylla</i>	Leafy Templetonia	LEGUMINOSAE		V
<i>Thelymitra albiflora</i>		ORCHIDACEAE		
<i>Thelymitra batesii</i>		ORCHIDACEAE		R
<i>Thelymitra benthamiana</i>	Leopard Sun-orchid	ORCHIDACEAE		
<i>Thelymitra carnea</i>	Small Pink Sun-orchid	ORCHIDACEAE		R
<i>Thelymitra epipactoides</i>	Metallic Sun-orchid	ORCHIDACEAE	E	E
<i>Thelymitra flexuosa</i>	Twisted Sun-orchid	ORCHIDACEAE		R
<i>Thelymitra grandiflora</i>	Great Sun-orchid	ORCHIDACEAE		R
<i>Thelymitra matthewsii</i>		ORCHIDACEAE	V	E
<i>Thysanotus tenellus</i>	Grassy Fringe-lily	LILIACEAE		R
<i>Triglochin alcockiae</i>	Alcock's Water-ribbons	JUNCAGINACEAE		R
<i>Veronica gracilis</i>	Slender Speedwell	SCROPHULARIACEAE		V
<i>Viminaria juncea</i>	Native Broom	LEGUMINOSAE		R
<i>Wahlenbergia gracilis</i>	Sprawling Bluebell	CAMPANULACEAE		
<i>Wurmbea latifolia</i> ssp. <i>vanessae</i>	Broad-leaf Nancy	LILIACEAE		R
<i>Xanthorrhoea quadrangulata</i>		XANTHORRHOEACEAE		
<i>Xanthorrhoea semiplana</i> ssp. <i>tateana</i>	Tate's Grass-tree	XANTHORRHOEACEAE		R
<i>Xanthosia tasmanica</i>	Southern Xanthosia	UMBELLIFERAE		R
<i>Zieria veronicea</i> ssp. <i>veronicea</i>	Pink Zieria	RUTACEAE		R

## 6. Excluded Fauna Species

The following fauna species were reviewed but excluded from the detailed planning process.

Common name	Scientific name	Class	EPBC	NPW
Australasian Shoveler	<i>Anas rhynchotis</i>	AVES		R
Australian Bustard	<i>Ardeotis australis</i>	AVES		V
Australian Reed-Warbler	<i>Acrocephalus australis</i>	AVES		
Australian Spotted Crake	<i>Porzana fluminea</i>	AVES		
Banded Stilt	<i>Cladorhynchus leucocephalus</i>	AVES		V
Barking Owl	<i>Ninox connivens</i>	AVES		R
Blue-billed Duck	<i>Oxyura australis</i>	AVES		R
Blue-winged Parrot	<i>Neophema chrysostoma</i>	AVES		V
Brolga	<i>Grus rubicunda</i>	AVES		V
Bush Stone-curlew	<i>Burhinus grallarius</i>	AVES		R
Cape Barren Goose	<i>Cereopsis novaehollandiae</i>	AVES		R
Cattle Egret	<i>Ardea ibis</i>	AVES		R
Common Bronzewing	<i>Phaps chalcoptera</i>	AVES		
Darter	<i>Anhinga novaehollandiae</i>	AVES		R
Dusky Woodswallow	<i>Artamus cyanopterus</i>	AVES		
Eastern Curlew	<i>Numerius madagascariensis</i>	AVES		V
Elegant Parrot	<i>Neophema elegans</i>	AVES		R
Flame Robin	<i>Petroica phoenicea</i>	AVES		V
Freckled Duck	<i>Stictonetta naevosa</i>	AVES		V
Gilbert's Whistler	<i>Pachycephala inornata</i>	AVES		R
Glossy Ibis	<i>Plegadis falcinellus</i>	AVES		R
Golden-headed Cisticola	<i>Cisticola exilis</i>	AVES		
Great Crested Grebe	<i>Podiceps cristatus</i>	AVES		R
Grey Falcon	<i>Falco hypoleucos</i>	AVES		R
Grey Goshawk	<i>Accipiter novaehollandiae</i>	AVES		E
Intermediate Egret	<i>Ardea intermedia</i>	AVES		R
King Quail	<i>Excalfactoria chinensis</i>	AVES		E
Latham's Snipe	<i>Gallinago hardwickii</i>	AVES		R
Lesser Sand Plover	<i>Charadrius mongolus</i>	AVES		R
Letter-winged Kite	<i>Elanus scriptus</i>	AVES		R
Little Bittern	<i>Ixobrychus dubius</i>	AVES		E
Little Egret	<i>Egretta garzetta</i>	AVES		R
Little Lorikeet	<i>Glossopsitta pusilla</i>	AVES		E
Long-toed Stint	<i>Calidris subminuta</i>	AVES		R
Magpie Goose	<i>Anseranas semipalmata</i>	AVES		E
Major Mitchell's Cockatoo	<i>Cacatua leadbeateri</i>	AVES		R
Malleefowl	<i>Leipoa ocellata</i>	AVES	V	V
Masked Owl	<i>Tyto novaehollandiae</i>	AVES		E
Musk Duck	<i>Biziura lobata</i>	AVES		R
Olive-backed Oriole	<i>Oriolus sagittatus</i>	AVES		R
Pacific Golden Plover	<i>Pluvialis fulva</i>	AVES		R
Pectoral Sandpiper	<i>Calidris melanotos</i>	AVES		R
Plains-wanderer	<i>Pedionomus torquatus</i>	AVES		E
Rainbow Bee-eater	<i>Merops ornatus</i>	AVES		
Red-browed Finch	<i>Neochmia temporalis</i>	AVES		
Red-chested Button-quail	<i>Turnix pyrrothorax</i>	AVES		R
Red-lored Whistler	<i>Pachycephala rufogularis</i>	AVES	V	R
Regent Honeyeater	<i>Anthochaera phrygia</i>	AVES	E	E
Rock Parrot	<i>Neophema petrophila</i>	AVES		R
Ruff	<i>Philomachus pugnax</i>	AVES		R
Rufous Fieldwren	<i>Calamanthus campestris</i>	AVES		
Scarlet-chested Parrot	<i>Neophema splendida</i>	AVES		R
Shy Heathwren (Shy Hylacola)	<i>Hylacola cauta</i>	AVES		R
Square-tailed Kite	<i>Lophoictinia isura</i>	AVES		E
Striped Honeyeater	<i>Plectorhyncha lanceolata</i>	AVES		R
Swift Parrot	<i>Lathamus discolor</i>	AVES	E	E
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	AVES		R

Common name	Scientific name	Class	EPBC	NPW
White-browed Treecreeper	<i>Climacteris affinis</i>	AVES		R
White-throated Gerygone	<i>Gerygone albogularis</i>	AVES		R
White-throated Treecreeper	<i>Cormobates leucophaea</i>	AVES		
Wood Sandpiper	<i>Tringa glareola</i>	AVES		R
Black-footed Rock Wallaby	<i>Petrogale lateralis pearsoni</i>	MAMMALIA	V	R
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	MAMMALIA		E
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	MAMMALIA		R
Little Forest Bat	<i>Vespadelus vulturnus</i>	MAMMALIA		
Southern Bent-wing Bat	<i>Miniopterus schreibersii bassanii</i>	MAMMALIA		CE
Swamp Rat	<i>Rattus lutreolus</i>	MAMMALIA		R
Water-rat	<i>Hydromys chrysogaster</i>	MAMMALIA		
Western Broad-nosed Bat	<i>Scotorepens balstoni</i>	MAMMALIA		
Yellow-bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>	MAMMALIA		R
Yellow-footed Antechinus	<i>Antechinus flavipes</i>	MAMMALIA		V
Adelaide Snake-lizard	<i>Delma mollerii</i>	REPTILIA		
Delicate Skink	<i>Lampropholis delicata</i>	REPTILIA		
Macquarie Tortoise	<i>Emydura macquarii</i>	REPTILIA		V
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	REPTILIA		
Southern Rock Dtella	<i>Gehyra</i> sp. 2n=44	REPTILIA		
Tawny Dragon	<i>Ctenophorus decresii</i>	REPTILIA		
Barramundi	<i>Lates calcarifer</i>	FISH		
Bony herring	<i>Nematalosa erebi</i>	FISH		
Brook trout	<i>Salvelinus fontinalis</i>	FISH		
Brown trout	<i>Salmo trutta</i>	FISH		
Carp gudgeons	<i>Hypseleotris</i> spp.	FISH		
Chanda perch	<i>Ambassis agassizii</i>	FISH		
Common carp	<i>Cyprinus carpio</i>	FISH		
Common galaxias	<i>Galaxias maculatus</i>	FISH		
Dwarf flathead gudgeon	<i>Philypnodon macrostomus</i>	FISH		
Flathead gudgeon	<i>Philypnodon grandiceps</i>	FISH		
Freshwater catfish	<i>Tandanus tandanus</i>	FISH		
Gambusia	<i>Gambusia holbrooki</i>	FISH		
Goldfish	<i>Carassius auratus</i>	FISH		
Lagoon goby	<i>Tasmanogobius lasti</i>	FISH		
Murray cod	<i>Maccullochella peelii</i>	FISH	V	
Murray rainbowfish	<i>Melanotaenia fluviatilis</i>	FISH		
Murray-Darling golden perch	<i>Macquaria ambigua</i>	FISH		
Rainbow trout	<i>Oncorhynchus mykiss</i>	FISH		
Redfin	<i>Perca fluviatilis</i>	FISH		
Shortfinned eel	<i>Anguilla australis</i>	FISH		
Silver perch	<i>Bidyanus bidyanus</i>	FISH		
Smallmouthed hardyhead	<i>Atherinosoma microstoma</i>	FISH		
Smelt	<i>Retropinna semoni</i>	FISH		
Southern purple-spotted gudgeon	<i>Mogurnda adspersa</i>	FISH		
Tench	<i>Tinca tinca</i>	FISH		
Unspecked hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	FISH		
Western bluespot goby	<i>Pseudogobius olorum</i>	FISH		

## 7. Summary of Level of Knowledge, Broad Vegetation Groups and Habitat Specialisation (Flora)

Species (Scientific name)	Knowledge	BVG 1	BVG 2	BVG 3	Habitat Specialisation
<i>Acacia gunnii</i>	some	HEATHY WOODLAND	HEATHY OPEN FOREST		High
<i>Acacia menzelli</i>	fair	MALLEE	GRASSY WOODLAND		Moderate-Low
<i>Acacia pinguiifolia</i>	fair	MALLEE	SHRUBLAND		Moderate-Low
<i>Acacia thetinocarpa</i>	fair	MALLEE	SHRUBLAND	GRASSY WOODLAND	Moderate-Low
<i>Adiantum capillus-veneris</i>	poor	WETLAND	RIPARIAN		Very High
<i>Allocasuarina robusta</i>	some	HEATHY WOODLAND	WETLAND		High
<i>Amphibromus pithogastrus</i>	poor	RIPARIAN	GRASSY WOODLAND		High
<i>Asterolasia muricata</i>	some	HEATHY WOODLAND	SHRUBLAND		Moderate-Low
<i>Austrostipa echinata</i>	poor	COASTAL			High
<i>Austrostipa oligostachya</i>	poor	GRASSY WOODLAND	GRASSLAND		Moderate-Low
<i>Boronia parviflora</i>	poor	WETLAND			Very High
<i>Brachyscome diversifolia</i>	some	HEATHY WOODLAND	GRASSY WOODLAND	RIPARIAN	High
<i>Caladenia argocalla</i>	fair	GRASSY WOODLAND			High
<i>Caladenia behrii</i>	fair	HEATHY WOODLAND			High
<i>Caladenia bicallinata</i> ssp. <i>bicallinata</i>	some	COASTAL			High
<i>Caladenia colorata</i>	fair	HEATHY WOODLAND			High
<i>Caladenia gladiolata</i>	fair	HEATHY WOODLAND	GRASSY WOODLAND		High
<i>Caladenia ovata</i>	some	HEATHY WOODLAND	SHRUBLAND		High
<i>Caladenia rigida</i>	fair	HEATHY WOODLAND			Moderate-Low
<i>Caladenia valida</i>	fair	HEATHY WOODLAND	HEATHY OPEN FOREST	MALLEE	Moderate-Low
<i>Caladenia vulgaris</i>	poor	HEATHY WOODLAND			High
<i>Caleana major</i>	some	HEATHY WOODLAND			High
<i>Callistemon teretifolius</i>	poor	HEATHY WOODLAND	GRASSY WOODLAND		Moderate-Low
<i>Calochilus campestris</i>	some	WETLAND	MALLEE	HEATHY WOODLAND	Moderate-Low
<i>Calochilus cupreus</i>	fair	COASTAL			High
<i>Calochilus paludosus</i>	poor	HEATHY WOODLAND	WETLAND		High
<i>Centrolepis glabra</i>	poor	WETLAND			High
<i>Correa calycina</i> var. <i>calycina</i>	fair	RIPARIAN	WETLAND	HEATHY WOODLAND	High
<i>Correa eburnea</i>	some	RIPARIAN	HEATHY WOODLAND		Moderate-Low
<i>Corybas dentatus</i>	fair	HEATHY OPEN FOREST			High
<i>Corybas expansus</i>	some	COASTAL			Very High
<i>Corybas unguiculatus</i>	some	HEATHY OPEN FOREST			High
<i>Crassula sieberiana</i>	poor	RIPARIAN	GRASSY WOODLAND	WETLAND	Moderate-Low
<i>Cryptostylis subulata</i>	poor	WETLAND			Very High
<i>Cullen parvum</i>	some	GRASSY WOODLAND	GRASSLAND		Moderate-Low
<i>Dampiera lanceolata</i> var. <i>intermedia</i>	fair	COASTAL	HEATHY WOODLAND		Moderate-Low
<i>Daviesia pectinata</i>	poor	MALLEE	COASTAL		High
<i>Dianella longifolia</i> var. <i>grandis</i>	fair	GRASSY WOODLAND	GRASSLAND		High
<i>Dipodium pardalinum</i>	some	HEATHY OPEN FOREST	HEATHY WOODLAND	GRASSY WOODLAND	Moderate-Low

Species (Scientific name)	Knowledge	BVG 1	BVG 2	BVG 3	Habitat Specialisation
<i>Diuris behrii</i>	fair	GRASSY WOODLAND	GRASSLAND		Moderate-Low
<i>Diuris brevifolia</i>	fair	HEATHY WOODLAND	WETLAND	RIPARIAN	High
<i>Eleocharis atricha</i>	poor	WETLAND			Very High
<i>Eremophila gibbifolia</i>	poor	MALLEE			Moderate-Low
<i>Eucalyptus cneorifolia</i>	poor	HEATHY WOODLAND	MALLEE		Moderate-Low
<i>Eucalyptus paludicola</i>	poor	HEATHY WOODLAND	WETLAND	RIPARIAN	High
<i>Eucalyptus phenax</i> ssp. <i>compressa</i>	poor	MALLEE			High
<i>Euphrasia collina</i> ssp. <i>osbornii</i>	some	HEATHY WOODLAND	COASTAL	WETLAND	Moderate-Low
<i>Gahnia radula</i>	poor	RIPARIAN	HEATHY WOODLAND		Very High
<i>Gastrodia sesamoides</i>	poor	HEATHY OPEN FOREST	RIPARIAN	SHRUBLAND	Moderate-Low
<i>Glycine latrobeana</i>	fair	GRASSY WOODLAND	GRASSLAND		Moderate-Low
<i>Glycine tabacina</i>	poor	RIPARIAN	GRASSY WOODLAND		Moderate-Low
<i>Gratiola pumilo</i>	poor	WETLAND			Very High
<i>Haloragis brownii</i>	some	WETLAND	RIPARIAN		Very High
<i>Haloragis myrtocarpa</i>	some	HEATHY WOODLAND	SHRUBLAND		High
<i>Helichrysum rutidolepis</i>	some	RIPARIAN			Very High
<i>Hibbertia tenuis</i>	poor	WETLAND			Very High
<i>Hydrocotyle crassiuscula</i>	poor	GRASSY WOODLAND			Moderate-Low
<i>Juncus amabilis</i>	some	HEATHY WOODLAND	WETLAND	RIPARIAN	High
<i>Juncus prismaticarpus</i>	poor	WETLAND			Very High
<i>Juncus radula</i>	poor	GRASSY WOODLAND	RIPARIAN		High
<i>Lagenophora gracilis</i>	some	WETLAND	GRASSY WOODLAND	RIPARIAN	Very High
<i>Leionema hillebrandii</i>	some	HEATHY WOODLAND	RIPARIAN		High
<i>Logania minor</i>	poor	COASTAL			High
<i>Luzula fiacida</i>	poor	GRASSY WOODLAND	RIPARIAN		High
<i>Lycopodiella lateralis</i>	poor	WETLAND			Very High
<i>Lycopodiella serpentina</i>	poor	WETLAND			Very High
<i>Lycopodium deuterodensum</i>	some	HEATHY OPEN FOREST	SHRUBLAND		High
<i>Maireana decalvans</i>	poor	COASTAL			Very High
<i>Mazus pumilo</i>	poor	WETLAND			Very High
<i>Melaleuca squamea</i>	poor	WETLAND			Very High
<i>Microtis atrata</i>	some	WETLAND			Very High
<i>Microtis rara</i>	some	WETLAND			Very High
<i>Montia fontana</i> ssp. <i>chondrosperma</i>	some	WETLAND	HEATHY WOODLAND		High
<i>Neopaxia australasica</i>	poor	WETLAND			Very High
<i>Olearia glandulosa</i>	poor	WETLAND			Very High
<i>Olearia pannosa</i> ssp. <i>pannosa</i>	some	MALLEE	SHRUBLAND	GRASSY WOODLAND	Moderate-Low
<i>Oreomyrrhis efipoda</i>	some	GRASSY WOODLAND	RIPARIAN		High
<i>Orobanche cernua</i> var. <i>australiana</i>	poor	COASTAL			High
<i>Paracaleana disjuncta</i>	poor	HEATHY WOODLAND			High
<i>Paracaleana minor</i>	some	HEATHY WOODLAND			Moderate-Low
<i>Phyllanthus striaticaulis</i>	poor	COASTAL	HEATHY WOODLAND		Moderate-Low

Species (Scientific name)	Knowledge	BVG 1	BVG 2	BVG 3	Habitat Specialisation
<i>Podolepis muelleri</i>	poor	COASTAL			High
<i>Potamogeton ochreateus</i>	poor	WETLAND			Very High
<i>Prasophyllum australe</i>	some	WETLAND			High
<i>Prasophyllum fecundum</i>	some	MALLEE			Moderate-Low
<i>Prasophyllum fitzgeraldii</i>	poor	GRASSY WOODLAND	MALLEE		Moderate-Low
<i>Prasophyllum murtetii</i>	some	WETLAND			Very High
<i>Prasophyllum occultans</i>	some	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	Moderate-Low
<i>Prasophyllum pallidum</i>	some	GRASSY WOODLAND	HEATHY WOODLAND		Moderate-Low
<i>Prasophyllum prunosum</i>	some	GRASSY WOODLAND			Moderate-Low
<i>Pratia puberula</i>	poor	WETLAND			Very High
<i>Prostanthera chlorantha</i>	poor	SHRUBLAND	MALLEE	COASTAL	Moderate-Low
<i>Prostanthera eurybioides</i>	fair	MALLEE	SHRUBLAND	GRASSY WOODLAND	High
<i>Psilotum nudum</i>	some	RIPARIAN			Very High
<i>Pteris tremula</i>	some	WETLAND	RIPARIAN		High
<i>Pterostylis arenicola</i>	fair	GRASSY WOODLAND	SHRUBLAND	MALLEE	Moderate-Low
<i>Pterostylis bryophila</i>	fair	GRASSY WOODLAND			High
<i>Pterostylis cucullata</i> ssp. <i>sylvicola</i>	fair	GRASSY WOODLAND			Moderate-Low
<i>Pterostylis curta</i>	some	GRASSY WOODLAND	RIPARIAN		High
<i>Pterostylis falcata</i>	some	WETLAND			Very High
<i>Pterostylis</i> sp. <i>Hale</i> (R.Bates 21725)	some	HEATHY WOODLAND			Moderate-Low
<i>Pterostylis uliginosa</i>	some	WETLAND			Very High
<i>Pultenaea dentata</i>	poor	WETLAND			Very High
<i>Pultenaea viscidula</i>	poor	HEATHY OPEN FOREST	HEATHY WOODLAND		Moderate-Low
<i>Ranunculus inundatus</i>	some	WETLAND			Very High
<i>Ranunculus papulentus</i>	poor	WETLAND			Very High
<i>Schizaea bifida</i>	poor	WETLAND	HEATHY WOODLAND		High
<i>Schizaea fistulosa</i>	poor	WETLAND			Very High
<i>Schoenus discifer</i>	poor	WETLAND			High
<i>Schoenus latelaminatus</i>	poor	WETLAND	RIPARIAN		High
<i>Senecio megaglossus</i>	poor	SHRUBLAND	GRASSLAND	GRASSY WOODLAND	Moderate-Low
<i>Spiranthes australis</i>	poor	WETLAND			Very High
<i>Spyridium coactifolium</i>	some	COASTAL	HEATHY WOODLAND	SHRUBLAND	Moderate-Low
<i>Tecticornia flabelliformis</i>	some	COASTAL			High
<i>Thelymitra circumsepta</i>	some	WETLAND			Very High
<i>Thelymitra cyanapicata</i>	fair	WETLAND			Very High
<i>Thelymitra cyanea</i>	some	WETLAND			Very High
<i>Thelymitra holmesii</i>	some	WETLAND			High
<i>Thelymitra inflata</i>	some	HEATHY WOODLAND	RIPARIAN		High
<i>Thelymitra mucida</i>	some	WETLAND			Very High
<i>Thelymitra peniculata</i>	some	HEATHY WOODLAND	WETLAND		Moderate-Low
<i>Todea barbara</i>	some	HEATHY OPEN FOREST	WETLAND		Very High
<i>Tricostularia pauciflora</i>	poor	SHRUBLAND	WETLAND		Very High

Species (Scientific name)	Knowledge	BVG 1	BVG 2	BVG 3	Habitat Specialisation
<i>Trymalium wayi</i>	poor	HEATHY WOODLAND WETLAND	SHRUBLAND	MALLEE	High Very High
<i>Utricularia lateriflora</i>	poor	HEATHY WOODLAND	RIPARIAN		High
<i>Veronica derwentiana</i> ssp. <i>anisodonta</i>	some	HEATHY WOODLAND	WETLAND	HEATHY OPEN FOREST	High
<i>Veronica derwentiana</i> ssp. <i>homalodonta</i>	some	HEATHY WOODLAND	GRASSY WOODLAND		Moderate-Low
<i>Viola betonicifolia</i> ssp. <i>betonicifolia</i>	some	RIPARIAN	GRASSY WOODLAND		High
<i>Wurmbea uniflora</i>	poor	WETLAND			Very High
<i>Xyris operculata</i>	poor	WETLAND			Very High

## 8. Summary of Level of Knowledge, Broad Vegetation Groups and Habitat Specialisation (Fauna)

Species (Common name)	Knowledge	Habitat 1	Habitat 2	Habitat 3	Habitat specialisation
Australasian Bittern	some	WETLAND			
Baillon's Crane	some	WETLAND			
Bassian Thrush	poor	HEATHY WOODLAND	GRASSY WOODLAND		
Beautiful Firetail	some	COASTAL	HEATHY WOODLAND	WETLAND	
Black-chinned Honeyeater	fair	GRASSY WOODLAND	HEATHY WOODLAND	RIPARIAN	
Brown Quail	poor	GRASSLAND	GRASSY WOODLAND	WETLAND	
Brown Toadlet	poor	HEATHY WOODLAND	WETLAND		High
Brown Treecreeper	fair	GRASSY WOODLAND	MALLEE	RIPARIAN	
Brown-headed Honeyeater	some	HEATHY WOODLAND	GRASSY WOODLAND	MALLEE	
Brush Bronzewing	poor	HEATHY WOODLAND	COASTAL	SHRUBLAND	
Buff-banded Rail	some	WETLAND	RIPARIAN		
Carpet Python	poor	RIPARIAN			High
Chestnut-rumped Heathwren (MLR)	some	HEATHY WOODLAND	SHRUBLAND	COASTAL	
Chestnut-rumped Thornbill	poor	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Crested Shrike-itt	poor	GRASSY WOODLAND	HEATHY WOODLAND	RIPARIAN	
Cunningham's Skink	some	GRASSY WOODLAND	COASTAL	HEATHY WOODLAND	High
Diamond Firetail	some	GRASSY WOODLAND			
Eastern Water Skink	poor	RIPARIAN			High
Fairy Martin	poor	RIPARIAN			
Fan-tailed Cuckoo	some	HEATHY OPEN FOREST			
Five-lined Earless Dragon	poor	GRASSLAND	GRASSY WOODLAND		High
Flinders Worm Lizard	some	GRASSLAND	GRASSY WOODLAND		Moderate-Low
Heath Goanna	poor	HEATHY WOODLAND			High
Hooded Robin (South-eastern)	some	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Horsfield's Bronze-cuckoo	some	HEATHY WOODLAND	GRASSY WOODLAND	SHRUBLAND	Moderate-Low
Jacky Winter	poor	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Lewin's Rail	some	WETLAND			
Little Wattletbird	poor	HEATHY WOODLAND	SHRUBLAND	WETLAND	
Olive Snake-lizard	poor	GRASSLAND	GRASSY WOODLAND		Moderate-Low
Orange-bellied Parrot	fair	COASTAL			
Painted Button-quail	poor	HEATHY WOODLAND	GRASSY WOODLAND	HEATHY OPEN FOREST	
Pallid Cuckoo	some	SHRUBLAND	MALLEE	RIPARIAN	
Peregrine Falcon	fair	RIPARIAN	COASTAL		
Pygmy Copperhead	poor	HEATHY WOODLAND			High
Red-capped Robin	some	GRASSY WOODLAND	MALLEE	SHRUBLAND	
Red-rumped Parrot	poor	GRASSY WOODLAND	RIPARIAN		
Restless Flycatcher	some	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Rufous Whistler	some	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Sacred Kingfisher	poor	GRASSY WOODLAND	HEATHY WOODLAND	RIPARIAN	

Species (Common name)	Knowledge	Habitat 1	Habitat 2	Habitat 3	Habitat specialisation
Scarlet Robin	fair	GRASSY WOODLAND	HEATHY WOODLAND	HEATHY OPEN FOREST	
Shining Bronze-Cuckoo	some	HEATHY WOODLAND	GRASSY WOODLAND	HEATHY OPEN FOREST	
Slender-billed Thornbill (SVG)	some	COASTAL			
Southern Brown Bandicoot	fair	HEATHY WOODLAND			High
Southern Emu-wren	fair	WETLAND	HEATHY WOODLAND		
Southern Grass Skink	poor	WETLAND	COASTAL		High
Southern Whiteface	poor	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Spotless Crane	some	WETLAND			
Spotted Quail-thrush	poor	GRASSY WOODLAND	HEATHY WOODLAND		
Tawny Frogmouth	poor	HEATHY WOODLAND	GRASSY WOODLAND	MALLEE	
Tawny-crowned Honeyeater	some	SHRUBLAND	COASTAL	MALLEE	
Tiger Snake	poor	RIPARIAN	HEATHY WOODLAND	WETLAND	Moderate-Low
Tree Martin	poor	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
Variied Sittella	some	HEATHY WOODLAND	GRASSY WOODLAND	MALLEE	
Western Pygmy-possum	fair	MALLEE	HEATHY WOODLAND		High
Whistling Kite	poor	GRASSY WOODLAND	RIPARIAN		
White-browed Babbler	fair	GRASSY WOODLAND	HEATHY WOODLAND	MALLEE	
White-fronted Chat	poor	SHRUBLAND	WETLAND	COASTAL	
White-naped Honeyeater	some	HEATHY WOODLAND	GRASSY WOODLAND		
White-winged Chough	fair	GRASSY WOODLAND	MALLEE		
Yellow Thornbill	some	GRASSY WOODLAND	HEATHY WOODLAND	COASTAL	
Yellow-bellied Water Skink	poor	RIPARIAN			High
Yellow-rumped Thornbill	some	GRASSY WOODLAND	GRASSLAND	GRASSY WOODLAND	
Yellow-tailed Black-Cockatoo	some	GRASSY WOODLAND	HEATHY WOODLAND	HEATHY OPEN FOREST	
Zebra Finch	poor	GRASSY WOODLAND	SHRUBLAND	WETLAND	

## 9. Recovery Management & Research

### 9.1 Flora Species

Note, this list should be considered a provisional inventory only of recovery management and research occurring in the AMLR region.

Species	Knowledge	Organisations	Activities
<i>Acacia gunnii</i>	some	TPAG/FOSCCP/FOMGCP/ APOS/DTEI/ FOER	Seed collection, propagation, restocking for some populations, threat abatement & habitat management for several sub-populations
<i>Acacia menzelli</i>	fair	MDBTRP/MTSP/TPAG	Surveys, seed collection, population database, fact sheets, mapping, recovery plan, roadside sites included in RMS
<i>Acacia pinguffolia</i>	fair	TPAG/MDBTRP/MTSP/ SCC/DEH/ Private	Bridal creeper control and seedling establishment at Finnis. Active management and monitoring at Brimavi Road (MDB). Site action plan prepared. Seed collection EP & SL. Nurragi Conservation area. Old Milang to Sandergrrove Rail Reserve. There have been several groups planted along this corridor to help conserve the local population. Surveys, monitoring, seed collection, buffer zone revegetation project, propagation & planting out, burn trial research, genetic research, weed control at 3 priority sites, population database, fact sheets, mapping, recovery plan, roadside sites included in RMS, bridal creeper rust introduced to suitable sites
<i>Acacia rhotinocarpa</i>	fair	MDBTRP/TPAG/MTSP/ DEH/SCC	Active management and monitoring at Brinkley plains and Gilbert's Siding (AMLR). Site action plan prepared for Gilbert's siding. Bridal creeper control and seedling establishment at Finnis. Monitoring/ weeding at Pine Point, Yorke Peninsula. Seed collection from Monarto. Surveys, seed collection, buffer zone revegetation project, propagation & planting out, population database, fact sheets, mapping, recovery plan, roadside sites included in RMS, fence remnant habitat site
<i>Adiantum capillus-veneris</i>	poor		
<i>Allocasuarina robusta</i>	some		
<i>Amphibromus pithogastrus</i>	poor		
<i>Asterolasia muricata</i>	some	FONHCP	
<i>Austrostipa echinata</i>	poor		
<i>Austrostipa oligostachya</i>	poor		
<i>Boronia parviflora</i>	poor	FPSRP	
<i>Brachyscome diversifolia</i>	some	TPAG/SAW/FOSC/DEH	Active management and monitoring undertaken on <i>Brachyscome diversifolia</i> ssp. dissecta at Dorset Vale. Site action plan prepared.
<i>Caladenia argocalla</i>	fair	LBORP/TPAG/NOSSA/ FOSG/TFL/BEST	Active site management at Mt Beavor, Tanunda Creek (AMLR), Emu Flat, Spring Gully, Waninga, Seventhill and Leighton Road (N&Y). Monitoring undertaken
<i>Caladenia behrii</i>	fair	LBORP/TPAG/NOSSA/FOB/ FOSC/DEH/FOB/ SLBORT	Recovery Plan current. Active management at Belair, Wongalere & Ironbank. Surveys & monitoring undertaken
<i>Caladenia bicallata</i> ssp. <i>bicallata</i>	some	NOSSA	Surveys
<i>Caladenia colorata</i>	fair	MDBTRP/MTSP/DEH	Surveys, weed control at 1 priority site, community awareness field day planned, genetic analysis research, population database, fact sheets, mapping, recovery plan, roadside

<b>Species</b>	<b>Knowledge</b>	<b>Organisations</b>	<b>Activities</b>
<i>Caladenia gladiolata</i>	fair	LBORP/TPAG/FOSC/ NOSSA/SLBORT	sites included in RMS, bridal creeper rust introduced to suitable sites Recovery Plan current. Active site management at Scott Creek. Monitoring undertaken
<i>Caladenia ovata</i>	some	NOSSA	Surveys
<i>Caladenia rigida</i>	fair	LBORP/TPAG/DEH/SAW/ FOSC/FSA/NOSSA/FOB/ NTSA	Recovery Plan current. Active site management at Millbrook, Scott Creek, Roachdale, Belair. Survey & monitoring undertaken
<i>Caladenia valida</i>	fair	TPAG/NOSSA/FONH/ LBORP	Active site management at Newland Hill. Surveys undertaken
<i>Caladenia vulgaris</i>	poor		
<i>Caleana major</i>	some	NOSSA/TPAG	Habitat protection & population monitoring at Knott Hill
<i>Callistemon teretifolius</i>	poor		
<i>Calochilus campestris</i>	some	NOSSA	Surveys
<i>Calochilus cupreus</i>	fair	TPAG/NOSSA/FOAS/DEH	Active management and monitoring at Aldinga Scrub
<i>Calochilus paludosus</i>	poor		
<i>Centrolepis glabra</i>	poor		
<i>Correa calycina</i> var. <i>calycina</i>	fair	TPAG/HTBG/SAW/SCC/ DCVH/DEH	Active management and monitoring at Hindmarsh Falls, Hindmarsh River, Myponga CP. Site action plan prepared. Seed collection Myponga CP
<i>Correa eburnea</i>	some		Surveys.
<i>Corybas dentatus</i>	fair	TPAG/LBO/NOSSA/DCA	RSMS markers for Frome Road. Survey and threat abatement. Sandy Ck population relocation
<i>Corybas expansus</i>	some	NOSSA	
<i>Corybas unguiculatus</i>	some	NOSSA	
<i>Crassula sieberiana</i>	poor		
<i>Cryptostylis subulata</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Cullen parvum</i>	some	TPAG/SAW/DEH/SCC	Active management (weeding) and monitoring at Hope Valley. Site action plan prepared. Seed collection Terowie
<i>Dampiera lanceolata</i> var. <i>intermedia</i>	fair	TPAG/FOASCP/DEH	Active management at Aldinga Scrub.
<i>Daviesia pectinata</i>	poor		
<i>Dianella longifolia</i> var. <i>grandis</i>	fair	KB/UFBP/CO/ WRMC	Weed control to protect plants currently being undertaken at Billy Goat Hill Lenswood, Montacute CP, Peter Himo property Upper Sturt; Richards property Montacute, Black Hill CP, Tangari Regional Reserve, Northern Skate Park Happy Valley. Active management at Waitparinga Reserve.
<i>Dipodium pardalinum</i>	some	NOSSA	Surveys
<i>Diuris behrii</i>	fair	NOSSA/LBORP/TPAG/FOB	Active site management at Millbrook, Belair, Tanunda Creek
<i>Diuris brevifolia</i>	fair	TPAG/LBORP/FOSC/ NOSSA/FSA	Active site management at Knott Hill, Wilson Hill.
<i>Eleocharis atricha</i>	poor		
<i>Eremophila gibbifolia</i>	poor		

<b>Species</b>	<b>Knowledge</b>	<b>Organisations</b>	<b>Activities</b>
<i>Eucalyptus cneorifolia</i>	poor		
<i>Eucalyptus paludicola</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Eucalyptus phenax</i> ssp. <i>compressa</i>	poor		
<i>Euphrasia collina</i> ssp. <i>osbornii</i>	some	SEWFPSRP/FONHCP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Gahnia radula</i>	poor		
<i>Gastrodia sesamoides</i>	poor		
<i>Glycine latrobeana</i>	fair	TPAG/SCC	Site restoration and monitoring at Millbrook Reservoir. Minor seed collection from Montacute CP.
<i>Glycine tabacina</i>	poor	WRMC	Active management at Waitparinga Reserve
<i>Gratiola pumilo</i>	poor		
<i>Haloragis brownii</i>	some	FOSCCP	Weed control along Bushrat Creek
<i>Haloragis myriocarpa</i>	some	TPAG	Surveys
<i>Helichysum ruitolepis</i>	some	TPAG	Weeding, site action planning and monitoring at Thomas Gully, Mount Bold
<i>Hibbertia tenuis</i>	poor		Surveys
<i>Hydrocotyle crassiuscula</i>	poor		
<i>Juncus amabilis</i>	some	TPAG/FOCSCP	Surveys, seed collections. Weed removal Bushrat Creek
<i>Juncus prismatocarpus</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Juncus radula</i>	poor		
<i>Lagenophora gracilis</i>	some	KB	Higgs Property Pages Flat Rd, Myponga weed control
<i>Leionema hillebrandii</i>	some	TPAG	Surveys, threat abatement, habitat management
<i>Logania minor</i>	poor		
<i>Luzula flaccida</i>	poor		
<i>Lycopodiella lateralis</i>	poor		
<i>Lycopodiella serpentina</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Lycopodium deuterodensum</i>	some	TPAG	Population monitoring, habitat restoration, woody weed control, Site Action Plan completed
<i>Maireana decalvans</i>	poor		
<i>Mazus pumilo</i>	poor		
<i>Melaleuca squamea</i>	poor		
<i>Microtis atrata</i>	some	SEWFPSRP/NOSSA	Potentially benefited by SEWFPSRP swamp habitat restoration/protection. NOSSA surveys
<i>Microtis rara</i>	some	SEWFPSRP/NOSSA	Potentially benefited by SEWFPSRP swamp habitat restoration/protection. NOSSA surveys
<i>Montia fontana</i> ssp. <i>chondrosperma</i>	some	FOSCCP/TPAG	Habitat restoration, monitoring
<i>Neopaxia australasica</i>	poor		
<i>Olearia glandulosa</i>	poor	SEWFPSRP	
<i>Olearia pannosa</i> ssp. <i>pannosa</i>	some	TPAG/MTSP/MDBITFRP/ SCC	Seed collections from Tarcowie, Goolwa, Blackhill & Keith. Surveys, seed collection, genetic research, weed control at priority sites; population database, fact sheets, mapping, recovery plan, roadside sites included in RMS, bridal creeper rust introduced to

<b>Species</b>	<b>Knowledge</b>	<b>Organisations</b>	<b>Activities</b>
<i>Oreomyrhis eriopoda</i>	some	TPAG/SAW/SCC	suitable sites, fence remnant habitat site Weeding, site action planning and monitoring at Thomas Gully, Mount Bold. Seed collection from private property near Lenswood. Planned collections from Mt Bold.
<i>Orobanche cernua</i> var. <i>australiana</i>	poor		
<i>Paracaleana disjuncta</i>	poor		
<i>Paracaleana minor</i>	some	NOSSA/LBORP/IPAG	Surveys
<i>Phyllanthus striaticaulis</i>	poor		
<i>Podolepis muelleri</i>	poor		
<i>Potamogeton ochreatus</i>	poor		
<i>Prasophyllum australe</i>	some	NOSSA/SEWFPSPR	Surveys by NOSSA. Potentially benefited by MLRSEW swamp habitat restoration/protection
<i>Prasophyllum fecundum</i>	some	NOSSA	Surveys
<i>Prasophyllum fitzgeraldii</i>	poor		
<i>Prasophyllum murefeti</i>	some	NOSSA/SEWFPSPR	Potentially benefited by SEWFPSPR swamp habitat restoration/protection
<i>Prasophyllum occultans</i>	some	NOSSA	Surveys
<i>Prasophyllum pallidum</i>	some	NOSSA	Surveys
<i>Prasophyllum pruinatum</i>	some	NOSSA	Surveys
<i>Pratia puberula</i>	poor		
<i>Prostanthera chlorantha</i>	poor		
<i>Prostanthera eurybioides</i>	fair	SAMDBIFRP/MTSP	Surveys, monitoring, seed collection, genetic research, weed control at priority sites, population database, fact sheets, mapping, recovery plan, bridal creeper rust introduced to suitable sites
<i>Psilotum nudum</i>	some	TPAG	Monitoring
<i>Pteris tremula</i>	some	TPAG/HIBG	Habitat restoration, monitoring
<i>Pterostylis arenicola</i>	fair	TPAG/DEH/NOSSA/MTSP/ SAMDBIFRP	Active site management at Grange Golf Course. Surveys & monitoring undertaken. Surveys, population database, fact sheets, mapping, recovery plan, bridal creeper rust introduced to suitable sites
<i>Pterostylis bryophila</i>	fair	TPAG/LBORP/NOSSA/ FOMBCP	Recovery Plan current. Active site management at Mount Billy C.P. Hindmarsh Reservoir & Hindmarsh Falls. Surveys and monitoring undertaken.
<i>Pterostylis cucullata</i> ssp. <i>syvicola</i>	fair	TPAG/LBORP/NOSSA/ FOBNP/SLBRT	Recovery Plan current. Active site management at Belair NP and Bushland Park. Surveys and monitoring
<i>Pterostylis curta</i>	some	TPAG/LBORP/NOSSA/ FOBNP	Some surveys. Benefited by habitat restoration work for <i>P.cucullata</i>
<i>Pterostylis falcata</i>	some	SEWFPSPR/FOSSC/P/IPAG/ NOSSA	Potentially benefited by MLRSEW swamp habitat restoration/protection. Habitat restoration & monitoring
<i>Pterostylis</i> sp. <i>Hale</i> (R.Bates 21725)	some	NOSSA	Surveys. Previously included in LBORP but taken off due to taxonomic issues.
<i>Pterostylis uliginosa</i>	some	NOSSA/SEWFPSPR	Surveys & monitoring by NOSSA. Previously by LBORP. Potentially benefited by MLRSEW swamp habitat restoration/protection

Species	Knowledge	Organisations	Activities
<i>Pultenaea dentata</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Pultenaea viscidula</i>	poor		
<i>Ranunculus inundatus</i>	some	KB/UFBP	Delaney and Smith properties Norton Summit weed control
<i>Ranunculus papulentus</i>	poor		
<i>Schizaea bifida</i>	poor	SEWFPSRP/ FOER	Potentially benefited by SEWFPSRP swamp habitat restoration/protection. Managed at Engelbrook Reserve.
<i>Schizaea fistulosa</i>	poor		
<i>Schoenus discifer</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Schoenus latelaminatus</i>	poor		
<i>Senecio megaglossus</i>	poor		
<i>Spiranthes australis</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Spyridium coactilifolium</i>	some	TPAG/FONHCP/SCC	Weed control (Boneseed), seed collection and site action planning at Victor Harbor. Seed collection Parsons Beach
<i>Tecticornia flabelliformis</i>	some		
<i>Thelymitra circumsepta</i>	some	NOSSA/TPAG	Surveys
<i>Thelymitra cyanapicata</i>	fair	LBORP/NOSSA/TPAG/ SLBORT/FSA	Surveys & habitat protection at Knott Hill.
<i>Thelymitra cyanea</i>	some	NOSSA	Surveys
<i>Thelymitra holmesii</i>	some	NOSSA	Surveys
<i>Thelymitra inflata</i>	some	NOSSA	Surveys
<i>Thelymitra mucida</i>	some	NOSSA	Surveys
<i>Thelymitra peniculata</i>	some	NOSSA	Surveys
<i>Todea barbara</i>	some	TPAG	Surveys, monitoring, habitat management
<i>Tricostularia pauciflora</i>	poor		
<i>Trymalium wayi</i>	poor		
<i>Utricularia lateriflora</i>	poor	SEWFPSRP	Potentially benefited by SEWFPSRP swamp habitat restoration/protection
<i>Veronica derwentiana</i> ssp. <i>amisodontia</i>	poor		
<i>Veronica derwentiana</i> ssp. <i>homalodonta</i>	some	TPAG/FOSCCP/SCC/DEH/ Private	A site action plan has been written for Bushrat Creek. Seed collection from Mt Lofty Ranges populations. Creekbed restoration by Friends of Scott Creek CP. Active management and monitoring at Scott Creek, Ironbank, Devils Gully, Warren C.P.
<i>Viola betonicifolia</i> ssp. <i>betonicifolia</i>	some	TPAG/SAW	Weeding, site action planning and monitoring at Thomas Gully, Mount Bold
<i>Wurmbea uniflora</i>	some	TPAG/SAW	Weeding, seed collection, site action planning and monitoring at Thomas Gully, Mount Bold
<i>Xyris operculata</i>	poor		

Abbreviations:

CO	City of Onkaparinga
DEH	Department for Environment & Heritage
FOASCP	Friends of Aldinga Scrub CP
FOBNP	Friends of Belair NP
FOER	Friends of Engelbrook Reserve
FOMBCP	Friends of Mount Billy CP
FOMGCP	Friends of Mount George CP
FONHCP	Friends of Newland Head CP
FOSCCP	Friends of Scott Creek CP
FSA	Forestry SA
HTBG	Hindmarsh Tiers Biodiversity Group
KB	Keiran Brewer
LBORP	Lofty Block Orchid Recovery Program
MDBTFRT	Murray Darling Basin Threatened Flora Recovery Team
MTSP	Murraylands Threatened Species Project
NOSSA	Native Orchid Society of South Australia
SAW	SA Water
SEWFPSRP	Southern Emu-wren/Fleurieu Peninsula Swamps Recovery Program
TPAG	Threatened Plant Action Group
UFBP	Urban Forests Biodiversity Program
WRMC	Waiparanga Reserve Management Committee

## 9.2 Fauna Species

Note, this list should be considered a provisional inventory only of recovery management and research occurring in the AMLR region.

Species (Common name)	Knowledge	Notes
Australasian Bittern	some	Potential benefit from SEWFPSRP wetland restoration and protection
Baillon's Crane	some	Potential benefit from SEWFPSRP wetland restoration and protection
Bassian Thrush	poor	
Beautiful Firetail	some	Potential benefit from SEWFPSRP heath restoration and protection
Black-chinned Honeyeater	fair	Local research by Paton PA (2002), Chapman (1995), Paton et al. (1999) and Paton (2002)
Brown Quail	poor	Potential benefit from SEWFPSRP wetland restoration and protection
Brown Toadlet	poor	Potential benefit from SEWFPSRP wetland/health restoration and protection
Brown Treecreeper	fair	
Brown-headed Honeyeater	some	Potential benefit from SEWFPSRP restoration and protection, local research by Willoughby (2005)
Brush Bronzewing	poor	Potential benefit from SEWFPSRP heath restoration and protection
Buff-banded Rail	some	Potential benefit from SEWFPSRP wetland restoration and protection
Carpet Python	poor	
Chestnut-rumped Heathwren (MLR ssp)	some	Potential benefit from SEWFPSRP heath restoration and protection, DEH fire management surveys
Chestnut-rumped Thornbill	poor	
Crested Shrike-tit	poor	
Cunningham's Skink	some	Some survey work by Herpetology Group
Diamond Firetail	some	Some research by Read JL (1994), Houdet (2003), Ankor (2005 pending)
Eastern Water Skink	poor	
Fairy Martin	poor	
Fan-tailed Cuckoo	some	Potential benefit from SEWFPSRP heath restoration and protection
Five-lined Earless Dragon	poor	
Flinders Worm Lizard	some	
Heath Goanna	poor	Potential benefit from SEWFPSRP heath restoration and protection
Hooded Robin (South-eastern)	some	Some research by Paton & Rogers (2003), Gillespie (2005)
Horsfield's Bronze-cuckoo	some	Potential benefit from SEWFPSRP heath restoration and protection
Jacky Winter	poor	
Lewin's Rail	some	Potential benefit from SEWFPSRP wetland restoration and protection
Little Wattlebird	poor	
Olive Snake-lizard	poor	
Orange-bellied Parrot	fair	
Painted Button-quail	poor	
Pallid Cuckoo	some	
Peregrine Falcon	fair	
Pygmy Copperhead	poor	
Red-capped Robin	some	Some research by Paton & Rogers (2003), Gillespie (2005)
Red-rumped Parrot	poor	
Restless Flycatcher	some	Some research by Paton & Rogers (2003), Gillespie (2005)
Rufous Whistler	some	

<b>Species (Common name)</b>	<b>Knowledge</b>	<b>Notes</b>
Sacred Kingfisher	poor	
Scarlet Robin	fair	Some research by Heddle (1999), Paton et al. (2004)
Shining Bronze-Cuckoo	some	
Slender-billed Thornbill (St. Vinc. Gulf ssp.)	some	
Southern Brown Bandicoot	fair	DEH Adelaide Region recovery project
Southern Emu-wren	fair	
Southern Grass Skink	poor	Potential benefit from SEWFPSRP wetland restoration and protection
Southern Whiteface	poor	
Spotless Crane	some	Potential benefit from SEWFPSRP wetland restoration and protection
Spotted Quail-thrush	poor	
Tawny Frogmouth	poor	
Tawny-crowned Honeyeater	some	Potential benefit from SEWFPSRP heath restoration and protection
Tiger Snake	poor	Potential benefit from SEWFPSRP heath restoration and protection
Tree Martin	poor	
Varied Sittella	some	Potential benefit from SEWFPSRP heath restoration and protection
Western Pygmy-possum	fair	Potential benefit from SEWFPSRP heath restoration and protection, University of Adelaide research
Whistling Kite	poor	
White-browed Babbler	fair	Local research by Tan MSM (1996)
White-fronted Chat	poor	Potential benefit from SEWFPSRP wetland restoration and protection
White-naped Honeyeater	some	Local research by Willoughby (2005)
White-winged Chough	fair	
Yellow Thornbill	some	Some research by Allan (2004)
Yellow-bellied Water Skink	poor	Potential benefit from SEWFPSRP wetland restoration and protection
Yellow-rumped Thornbill	some	Local research by Davill C (2001)
Yellow-tailed Black-Cockatoo	some	Potential benefit from SEWFPSRP heath restoration and protection
Zebra Finch	poor	

## 10. Broad Vegetation Groups

### 10.1 Descriptions

BVG	Description
Coastal	Subject to the influences of coastal environments. This includes sheltered and exposed cliffs on non-calcareous substrates, sheltered and exposed dunes on non-calcareous or calcareous substrates, and sheltered tidal zones. Coastal vegetation faces different environmental conditions than terrestrial vegetation, and in particular, it must be able to tolerate exposure, high salt content and unstable substrates such as sandy soils and eroded cliff-tops. parameters such as geology and level of exposure are important determinants of the type and composition of coastal vegetation that will persist at a particular coastal location.
Grassland	Few or no trees, and an understorey dominated by native grasses and herbs. Grasslands may have patches of shrubs in the mid-storey, particularly on shallow and rocky soils. All grasslands in the AMLR are tussock grasslands, having discrete clumps or tussocks of grasses, herbs or sedges. Inter-tussock spaces consist of bare ground with a diverse range of herbs and annual plants emerging in spring. Grasslands with an emergent tree or shrub layer have been classified in this document as grasslands with emergents. However, in reality, vegetation is a continuum with subtle intergrades between grasslands, grasslands with emergents and grassy woodlands.
Grassy Woodland	Woodlands with an understorey dominated by grasses, herbaceous species (e.g. daisies, lilies) and sedges, a scattered shrub layer and a discontinuous tree layer. Grassy woodlands have an overstorey typically dominated by eucalypts, including smooth-barked gums and/or box. Tree density is variable, but a typical grassy woodland may have a tree density of approximately 30 trees per hectare, which results in some open areas without canopy. In high rainfall areas, tree density may be higher resulting in woodlands that resemble forests. The mid-storey of grassy woodlands may contain scattered woody shrubs. Shrub density is highly variable between communities and individual patches of vegetation, probably reflecting soil quality and fire history. Grassy woodlands contain a very high diversity of native plant species. This diversity is particularly apparent during spring, when many species of wildflower emerge from spaces between grass tussocks.
Heathy Open Forest	Forest with a canopy dominated by eucalypts, and a dense understorey comprising many species of low shrubs, generally with small, hard leaves (sclerophyllous). The understorey is dominated by the Families Dilleniaceae (e.g. <i>Hibbertia</i> spp.), Epacridaceae (e.g. <i>Acrotriche fasciculiflora</i> , <i>Astroloma humifusum</i> ), Leguminosae (e.g. <i>Pultenaea involucrata</i> , <i>Platylobium obtusangulum</i> , <i>Acacia myrtifolia</i> ) and Proteaceae (e.g. <i>Hakea rostrata</i> ). The understorey also contains abundant lilies and orchids, and sparse but diverse native grasses. A sparse midstorey of Blackwood <i>Acacia melanoxylon</i> , Native Cherry <i>Exocarpus cupressiformis</i> and banksias <i>Banksia</i> spp. may be present. The understorey and midstorey density is heterogeneous, with structure dependant upon fire history and other disturbance.
Heathy Woodland	Similar to heathy open forest, heathy woodland has a dense understorey and midstorey of a variety of low small-leaved (sclerophyllous) shrubs. These layers have high structural diversity, but contain fewer species than that of grassy woodlands. Most of the midstorey and understorey species listed under heathy open forest would also be found in heathy woodland. The overstorey is more widely spaced than in heathy open forest. Most heathy woodland is dominated by eucalypts (often stringybarks), although some is dominated by native pines.
Mallee	Vegetation with low, characteristically multi-stemmed trees. Mallee may have a grassy or shrubby understorey, or a mixture of both – the type of understorey is dependant upon soil and rainfall patterns. Chenopod low shrubs are dominant in arid areas, sandy soils support a more grassy understorey with <i>Triodia</i> spp. hummocks, and in high rainfall areas, mallee may have a midstorey comprising sclerophyllous shrubs. Mallee has a dense ground layer of twigs and leaf litter and good soil crust.
Riparian	Vegetation found along watercourses and on flood plains. Riparian zones represent transition areas between land and water. The natural vegetation of these areas usually reflects the better soils and moist conditions found in the lower parts of the landscape. In the AMLR, riparian zones can be separated into two distinct types. The first is the creeks and gullies of the steeper slopes and ridges of

BVG	Description
	<p>the Mount Lofty Ranges, where riparian zones are dominated by tall open forests of Candlebarks, Manna Gums, Swamp Gums, Blackwoods and Stringybarks. The second type of riparian zone is the Red Gum dominated drainage lines of the foothills and eastern flanks. Riparian zones support typically dense vegetation, with dense understorey, shrublayer and overstorey. Red Gum drainage lines support more open vegetation, with some open grassy patches in the understorey.</p>
<b>Shrubland</b>	<p>Vegetation with an open to very dense layer of shrubs up to 2 m in height, with few or no trees. Shrubland types in the AMLR include coastal chenopod shrublands, low-rainfall open plains shrublands, and high-rainfall sclerophyllous shrublands.</p>
<b>Wetland</b>	<p>A number of wetland types are found in the AMLR. Discussion of these wetlands and their conservation requirements is included under freshwater aquatic biodiversity. However, native vegetation associations specific to freshwater wetlands are considered in this section. In the AMLR, wetland vegetation is associated with: freshwater swamps of the MLR and lower Fleurieu Peninsula; seasonal wetlands of the Adelaide Plains; estuarine creeks of the south coast (considered under coastal); and Red Gum wetlands along creeks featuring waterholes with fringing reeds (considered under riparian). Freshwater swamp vegetation in the AMLR is shrub-dominated and typically very dense. This vegetation has high structural and floristic diversity, and contains many endemic and naturally rare plants. Seasonal wetlands on the Adelaide plains were flat areas with open water and fringing vegetation such as macrophytes, lignum and samphire.</p>

## 10.2 Vegetation Associations

Broad Vegetation Group	Vegetation Association
Coastal	Basement rock
	Low cliffs/hills
	Estuarine
	Landward of saltmarsh
	Mangroves
	Saltmarsh
Grassland	<i>Lomandra effusa</i> / <i>L. multiflora</i> tussock grassland
	<i>Stipa</i> spp., <i>Danthonia</i> spp. Grassland
	<i>Themeda triandra</i> grassland
Grassy Woodland	<i>A. verticillata</i> grassland w/ emergents
	<i>A. verticillata</i> grassland w/ emergents (heath)
	<i>Banksia marginata</i> grassland w/ emergents
	<i>Callitris preissii</i> grassland w/ emergents
	<i>E. fasciculosa</i> + <i>E. leucoxylon</i> grassland w/ emergents
	<i>E. behriana</i> +/- <i>E. odorata</i> grassy woodland
	<i>E. fasciculosa</i> grassy woodland
	<i>E. largiflorens</i> grassy woodland
	<i>E. leucoxylon</i> grassy woodland
	<i>E. leucoxylon</i> ssp <i>pruinosa</i> grassy woodland
	<i>E. microcarpa</i> grassy woodland
	<i>E. odorata</i> grassy woodland
	<i>E. porosa</i> grassy woodland
	<i>E. viminalis</i> ssp. <i>cygnetensis</i> grassy woodland
<i>E. obliqua</i> and/or <i>E. baxteri</i> heathy open forest	
Heathy Woodland	<i>Callitris preissii</i> heathy woodland
	<i>E. fasciculosa</i> heathy woodland
	<i>E. baxteri</i> heathy woodland
	<i>E. baxteri</i> , <i>E. cosmophylla</i> , <i>E. fasciculosa</i> heathy woodland
	<i>E. cosmophylla</i> , <i>E. fasciculosa</i> heathy woodland
	<i>E. goniocalyx</i> heathy woodland
	<i>E. leucoxylon</i> shrubby woodland
	<i>E. obliqua</i> + <i>E. cosmophylla</i> heathy woodland
	<i>E. obliqua</i> + <i>E. fasciculosa</i> heathy woodland
	<i>E. obliqua</i> + <i>E. goniocalyx</i> heathy woodland
	<i>E. calycogona</i> var. <i>calycogona</i> +/- <i>E. dumosa</i> over shrubs/grasses
Mallee	<i>E. incrassata</i> mixed mallee
	<i>E. phenax</i> , <i>E. dumosa</i> , <i>E. socialis</i> mallee
	Mallee zone shrubland
Riparian	<i>E. camaldulensis</i> riparian or grassy woodland
	<i>E. viminalis</i> and/or <i>E. dalrympleana</i> riparian woodland
Shrubland	<i>Allocasuarina muelleriana</i> heath
	<i>Banksia marginata</i> shrubland
	<i>Callitris rhomboidea</i> shrubland
	<i>Maireana aphylla</i> shrubland
	<i>Melaleuca uncinata</i> shrubland
	<i>Senna artemisioides</i> ssp. <i>petiolaris</i> , +/- <i>Eremophila longifolia</i> shrubland
Wetland	<i>E. ovata</i> woodland over wet heath
	<i>Gahnia filum</i> +/- <i>Bolboschoenus caldwellii</i> sedgeland
	<i>Leptospermum lanigerum</i> shrubland
	<i>Phragmites australis</i> +/- <i>Typha</i> sp. sedgeland

## 11. Threat Analysis

Species and ecological communities in the AMLR are at risk as a result of a combination of historical, current and potential threats. Species have initially become threatened because of historical actions, in particular the vast clearance of native vegetation, causing populations to become reduced in size and restricted to small and isolated pockets of remaining habitat.

### 11.1 Threat Terminology and Categorisation

#### What is a stress?

Stresses are impaired aspects of conservation targets that result directly or indirectly from threats. In essence, stresses are degraded key ecological attributes, e.g. habitat loss, habitat fragmentation, altered hydrological regimes, low population size.

For example, 'habitat loss' (stress) is the result of "residential and commercial development" (direct threat).

Identifying the stresses and their relationship with the threats is an important step in understanding their impact on threatened species, and appropriate direction for management, as highlighted by the following example:

*The construction of a road across a watercourse is identified as a threat to native fish. Without considering what the stress is resulting from the threat, one would draw the conclusion that the construction of the road must be refused. But the stress is not the road, it is the loss of water flow. Given this, consideration could be given to ways to keep tidal waters flowing whilst allowing development of the road to proceed (e.g. culverts may be the answer).*

It can be difficult identifying stresses and threats in a consistent style. In cases where the decision isn't clear, it is more important that they be considered in the analysis process rather than spending too much time deciding into which category they fit.

There are many cases where the human caused threats have been abated, but the persistent stresses are still affecting the targets, e.g. *habitat loss and fragmentation caused by historical land clearance*. This further highlights the importance of identifying the stresses in the first instance, thereby ensuring the impacts of such historical actions are not overlooked in the formulation of management actions.

#### What is a direct threat?

Direct threats (also known as 'sources of stress') are the proximate activities or processes that have caused, are causing or may cause the stresses, by physically causing the destruction or degrading the integrity of the conservation target. For example, a roadside plant population might be affected by the direct threats of road maintenance and stock grazing.

Direct threats can be classed as historical (occurred in the past, although their effects may still persist), current, or future (not actively occurring, but have some probability of occurring in the future).

For the most part, direct threats are limited to human activities. There is often a fine line between a naturally occurring event such as a fire started by lightning and a human-caused threat such as a deliberate fire or even increased intensity of fires due to management practices. In general, a direct threat in the context of this plan is human induced. In systems that depend on human actions to maintain biodiversity such as the use of prescribed burns, the removal or alteration of these management activities may also constitute a threat.<sup>11,15</sup>

#### What is an indirect threat?

Indirect threats are the underlying causes (usually social, economic, political, institutional or cultural) that enable or otherwise contribute to the occurrence and or persistence of direct threats. For example, a lack of planning regulations (indirect threat) may allow inappropriate development (direct threat) to occur, resulting in the destruction of habitat (stress).

Sometimes underlying indirect threats can be inferred from the direct threats. Regard for such underlying causes can present opportunities for management (e.g. revision in government regulations). The distinction between a direct threat and an indirect threat is not always clear; it is sometimes situational.<sup>15</sup>

#### Threat categories

Recovery plans use varied terminology to describe threats and their relationship to one another. This plan has adopted threat terminology consistent with the Nature Conservancies Conservation Action Planning hierarchical threat categories and IUCN-CMP Unified Classification of Direct Threats.<sup>2,11</sup> These systems provided comprehensive threat categories at the high level of classification but were incomplete at lower levels, requiring definition of some additional threat categories specific to the AMLR. The threat analysis was mostly performed within the Nature Conservancies Conservation Action Planning Tool (Version 5, July 2007), however final summarising was undertaken outside of this tool.

A detailed summary of the broad threat categories, and the more specific threat categories relevant to the AMLR threatened species is provided in the main plan. The threat analysis was performed at the broad threat category level for some threats, and at the more specific level for others, depending on the significance of the threat sub-categories, the quality of available information, and the level of detail necessary in establishing suitable management actions. The analysis focused on the direct threats currently impacting, or likely to have impact on the species within the next five year period (i.e. the life of the plan). Many species are clearly suffering prolonged stress associated with past threats. For example, vegetation clearance was not considered a current direct threat and so was not assessed. However, threats that currently cause incremental vegetation clearance were assessed (e.g. residential development).

## Threat Categories

Broad Threat Categories (IUCN)	Threat categories used for analysis
(1) Agriculture <i>Threats from grazing and agricultural expansion, intensification, and change in agricultural land use</i>	<ul style="list-style-type: none"> <li>• Grazing &amp; Disturbance by Stock</li> <li>• Intensive Agriculture</li> </ul>
(2) Biological Resource Use <i>Threats from consumptive use of "wild" biological resources including both deliberate and unintentional harvesting effects; also persecution or control of specific species</i>	<ul style="list-style-type: none"> <li>• Firewood Harvest &amp; Rock Removal</li> <li>• Fishing &amp; Harvesting of Aquatic Resources</li> <li>• Illegal Hunting or Collection</li> </ul>
(3) Climate Change & Severe Weather <i>Threats from long-term climatic changes which may be linked to global warming and other severe climatic/weather events that are outside of the natural range of variation, or potentially can wipe out a vulnerable species or habitat</i>	<ul style="list-style-type: none"> <li>• Climate Change, Drought &amp; Severe Weather</li> </ul>
(4) Energy Production & Mining <i>Threats from production of non-biological resources</i>	<ul style="list-style-type: none"> <li>• Mining &amp; Quarrying</li> </ul>
(5) Human Intrusions & Disturbance <i>Threats from human activities that alter, destroy and disturb habitats and species associated with non-consumptive uses of biological resources</i>	<ul style="list-style-type: none"> <li>• Recreational Activities &amp; Site Disturbance</li> </ul>
(6) Invasive & Other Problematic Species & Genes <i>Threats from non-native and native plants, animals, pathogens/microbes, or genetic materials that have or are predicted to have harmful effects on biodiversity following their introduction, spread and/or increase in abundance</i>	<ul style="list-style-type: none"> <li>• Competition with Honey Bees</li> <li>• Disease &amp; Insect Damage</li> <li>• Grazing &amp; Disturbance by Deer or Goats</li> <li>• Grazing &amp; Disturbance by Kangaroos</li> <li>• <i>Phytophthora</i>*</li> <li>• Predation &amp; Competition by Introduced Birds</li> <li>• Predation &amp; Competition by Introduced Fish</li> <li>• Predation &amp; Disturbance by Uncontrolled Dogs</li> <li>• Predation by European Fox</li> <li>• Predation by Feral &amp; Uncontrolled Cats</li> <li>• Problematic Native Species (other)</li> <li>• Weed Invasion</li> </ul>
(7) Natural System Modifications <i>Threats from actions that convert or degrade habitat in service of "managing" natural or semi-natural systems, often to improve human welfare</i>	<ul style="list-style-type: none"> <li>• Fire Management Activities</li> <li>• Inappropriate Fire Regimes</li> <li>• Inappropriate Site Management</li> <li>• Removal of Snags</li> <li>• Water Management &amp; Use</li> </ul>
(8) Pollution <i>Threats from introduction of exotic and/or excess materials (e.g. chemicals, solid rubbish) or energy from point and non-point sources</i>	<ul style="list-style-type: none"> <li>• Pollution &amp; Poisoning (Chemical, Solid Waste &amp; Other)</li> </ul>
(9) Residential & Commercial Development <i>Threats from human settlements or other non-agricultural land uses with a substantial footprint</i>	<ul style="list-style-type: none"> <li>• Residential &amp; Commercial Development</li> </ul>
(10) Transportation & Service Corridors <i>Threats from long narrow transport corridors and the vehicles that use them including associated wildlife mortality</i>	<ul style="list-style-type: none"> <li>• Road-kill</li> <li>• Road, Rail &amp; Utilities Maintenance Activities</li> </ul>

## Direct Threat Hierarchy

Direct Threat Category Level 1 (IUCN)	Direct Threat Category Level 2 (IUCN)	Direct Threat Category Level 3 (plan specific categories)	Links to Stresses	
Agriculture	Annual & Perennial Non-Timber Crops	Intensive Agriculture	E, B	
	Marine & Freshwater Aquaculture			
	Livestock Farming	Grazing & Disturbance by Stock	A, B, E, G, I	
Biological Resource Use	Hunting & Collecting terrestrial Animals	Illegal Hunting or Collection	A, I, K, L	
	Gathering Terrestrial Plants			
	Logging & Wood Harvesting	Firewood Harvest	A, I	
	Fishing & Harvesting Aquatic Resources	Fishing & Harvesting of Aquatic Resources	A, I, K, L	
		Rock Removal	A, K	
Climate Change & Severe Weather	Drought	Climate Change, Drought & Severe Weather	A, B, C, D, F, G, H, K, L	
	Habitat Shifting and Alteration			
	Temperature Extremes			
	Storms and Flooding			
Energy Production & Mining	Mining & Quarrying	Mining & Quarrying	A, B, E, G, I, K	
Human Intrusions & Disturbance	Recreational Activities	Recreational Activities & Site Disturbance	A, B, G, I, K	
	Work and other Activities			
Invasive & Other Problematic Species & Genes	Invasive Non-Native/ Alien Species	<i>Phytophthora</i>	A, B, G, I, L	
		Disease/Dieback & Insect Damage	A, B, E, G, I, K, L	
		Predation by European Fox	I	
		Predation by Feral & Uncontrolled Cats	I	
		Grazing & Disturbance by Rabbits	A, K, L	
		Grazing & Disturbance by Deer or Goats	A, K, L	
		Predation/ Competition by Introduced Birds	I, K	
		Predation/ Competition by Introduced Fish	A, I, K	
		Competition with Honey Bees	I, K, L	
		Predation & Disturbance by Uncontrolled Dogs	I, K	
		Weed Invasion	A, B, G, I, K, L	
		Problematic Native Species	Grazing & Disturbance by Kangaroos	A, B, I, K, L
			Problematic Native Species (Other)	I, K, L
Natural System Modifications	Fire & Fire Suppression	Inappropriate Fire Regimes	A, C, E, F, G, H, I, K	
		Fire Management Activities	A, B, C, E, F, G, H, I, K, L	
	Dams & Water Management/Use	Water Management & Use	A, D, E, F, H, I, K	
	Other Ecosystem Modifications	Incompatible Site Management	A, B, G, I, K	
		Removal of Snags	A, E, K, L	
Pollution	Household Sewage & Urban Waste Water	Pollution & Poisoning (chemical, solid waste & other)	A, F, I, K	
	Industrial & Military Effluents			
	Agricultural & Solid Waste			
	Garbage and Solid Waste			
	Air-Borne Pollutants			
Residential & Commercial Development	Housing & Urban Areas	Residential & Commercial Development	A, B, D, E, F, G, H, I, J, K, L	
	Commercial & Industrial Areas			
	Tourism & Recreation Areas			

Direct Threat Category Level 1 (IUCN)	Direct Threat Category Level 2 (IUCN)	Direct Threat Category Level 3 (plan specific categories)	Links to Stresses
Transportation & Service Corridors	Roads & Railroads	Road/ Rail & Utilities Maintenance	A, B, E, F, G, H, I, J, K, L
	Utility & Service Lines	Activities	
		Road Kill	J

### Stress Hierarchy and links to AMLR current direct threats

Stress Category Level 1	Stress Category 2	Stress Category 3	Link to Threats
Ecosystem/Community Stresses	Ecosystem Conversion	Habitat Loss and Modification	A
		Incremental Clearance	B
	Ecosystem Degradation	Altered Fire Regimes	C
		Altered Hydrological Regimes (drainage, diversion, extraction, regulation, altered flow regimes)	D
	Indirect Ecosystem Effects	Fragmentation of Existing Habitat (isolation of populations)	E
		Barriers to Dispersal	F
		Edge Effects	G
		Distance Effects (isolation)	H
Species Stresses	Species Mortality	Species Mortality General (e.g. killing or capturing species)	I
		Road Mortality	J
	Species Disturbance	Species Disturbance (e.g. disruption of critical life stages)	K
	Indirect Species Effects	Indirect Species Effects (e.g. inbreeding, loss of pollinator or host, increased competition)	L

## 11.2 Threat Rating Criteria

The threat analysis was performed within the Nature Conservancies Conservation Action Planning (CAP) Tool, a Microsoft Excel based workbook used by environmental practitioners around the world to guide conservation action.<sup>16</sup> The CAP Tool has many components; only a simplified version of the threat analysis function was utilised in this plan, the main benefits being transparency and the ability to easily revisit and update the ratings.

The first step was to rate the **Severity** and **Scope** of each threat, based on defined criteria. These ratings were combined to obtain an overall **Threat Magnitude** rating. Given that documented information on the severity and scope was lacking for most threats, workshops were held with threatened flora and fauna experts to inform the threat analysis process.

The CAP Tool has inbuilt formulae to calculate an overall status for each threat across all species. However, an alternative method was used to summarise and rank threats to determine an overall regional rating for each threat. This was performed within flora, fauna, freshwater fish groups and broad vegetation groups, by:

1. Allocating scores to the threat magnitude ratings
2. Summing the scores for each threat
3. Ranking the threat according to the score
4. Classifying the threat rankings into descriptive classes according to the maximum threat score (75-100% = very high; 50-75% = high; 30-50% = medium-high; 20-30% = medium; 1-20% = low)

The threat of Inappropriate Fire Regimes was particularly difficult to rate consistently because of the significant gaps in the knowledge of species' fire requirements. This should be taken into consideration when assessing the ratings (i.e. the lack of a rating for this threat may be due to a lack of information). The threat of *Phytophthora* and Dieback has been assessed at the Broad Vegetation

Group level, but could not be assessed on a species-based level because there is currently no information on susceptibility of the species included in this plan. Instead, inference was drawn about *Phytophthora* risk based on species' occurrence within two kilometres of known or suspected *Phytophthora* infestations (see the individual species profiles, Appendices Part B).

1. The **Severity** and **Scope** of each threat is determined, based on defined criteria.

**Severity:** *The level of damage to the conservation target that can reasonably be expected within 5 years under current circumstances (i.e. given the continuation of the existing situation).*

- Very High: The threat is likely to destroy or eliminate the conservation target over some portion of the target's occurrence in the region.
- High: The threat is likely to seriously degrade the conservation target over some portion of the target's occurrence in the region.
- Medium: The threat is likely to moderately degrade the conservation target over some portion of the target's occurrence in the region.
- Low: The threat is likely to only slightly impair the conservation target over some portion of the target's occurrence in the region.

**Scope:** *Most commonly defined spatially as the geographic scope of impact on the conservation target in the region can reasonably be expected within 5 years under current circumstances (i.e. given the continuation of the existing situation).*

- Very High: The threat is likely to be very widespread or pervasive in its scope, and affect the conservation target throughout the target's occurrences in the region.
- High: The threat is likely to be widespread in its scope and affect the conservation target at many of its locations in the region.
- Medium: The threat is likely to be localized in its scope and affect the conservation target at some of the target's locations in the region.
- Low: The threat is likely to be very localized in its scope and affect the conservation target at a limited portion of the target's location in the region.

2. The **Severity** and **Scope** ratings are combined to give an overall **Threat Magnitude** rating:

		Severity			
		Very High	High	Medium	Low
Scope	Very High	Very High	High	Medium	Low
	High	High	High	Medium	Low
	Medium	Medium	Medium	Medium	Low
	Low	Low	Low	Low	Low

**Severity & Scope = Threat Magnitude**

Note:

\* For the purpose of this plan, the conservation targets were the threatened species, considered at the regional population level.

\*\* The ratings represent the threat magnitude likely within a time period of five years; in line with the life of the recovery plan. Longer timeframes may need to be considered for some threats.

### 11.3 Threat Analysis Limitations

Performing a criteria-based threat analysis is a difficult process when the nature and impact of threats are not well understood.<sup>13</sup> Whilst a genuine attempt was made to base the analysis on the best available information, it is acknowledged that there are significant gaps in our knowledge of certain species and certain threats. Information to inform the threat analysis was initially sourced from existing literature; however as threats are often referred to generically, such as 'vegetation clearance', 'fragmentation' or 'lack of recruitment' it was difficult to translate much of the available information into specific management actions for species. Expert opinion was heavily relied on to refine the threat analysis. The resultant threat ratings should be considered as a 'best guess'. As further research is undertaken and more information obtained, the threat ratings should be reviewed and updated.

The authors acknowledge the following limitations of the threat analysis:

- The separation of threats into distinct categories is essentially artificial, given that many threats are intrinsically inter-related and can be exacerbated by other threats. The analysis is based on the primary impacts of a given threat.
- Threats are active at a range of scales across the project area. The threat analysis for this plan was performed at a regional scale, therefore does not necessarily reflect the situation for sub-regions or individual sub-populations.
- The threat of vegetation clearance was not assessed *per se*, as it is predominantly an historical threat which combined with other direct threats has contributed to a range of ecological stresses. The act of illegal clearance and incremental legal clearance that still occurs on a small scale has been considered under the threat category of Inappropriate Site Management. Also, due to lack of knowledge and difficulty in dealing with related threat classes, it was difficult to comprehensively assess 'disturbance regimes', particularly relating to grazing and hydrology.
- A general regional-scale threat category was used to rate weed invasion (rather than rating the threat of individual weed species). Due to the information available and the nature of weed invasion threats, it is difficult to rate individual weed species at the regional scale and devise meaningful management actions. However, existing weed species threat analysis information for the region was adapted and generically ranked within Broad Vegetation Groups. Implementation of the plan will involve more detailed weed threat assessment at the sub-regional and site level.
- A lack of a rating for a threat does not necessarily mean that the threat has no impact on the species in question. Rather, ratings were applied to threats when the impact on a species was considered significant enough to warrant recognition and some form of action (guided by the rating criteria). For example, whilst all species are potentially at low threat from illegal collection, assigning a low rating for all species would reduce the meaningfulness of the rating for species considered at real risk.
- In some cases, the lack of a rating for a threat may represent a lack of information, highlighting that care should be taken in interpreting the analysis results (e.g. 'Inappropriate Fire Regimes'). Research should take precedence, particularly for threats that rate as high priority, but are not well understood. Management actions have been recommended to address information gaps.
- It was difficult to predict the frequency and scale of impact of potential threats (e.g. Inappropriate Fire Regimes) hence making them difficult to rate in a consistent fashion.
- Potential future threats (e.g. pest incursions) not included in the analysis may warrant priority action in the event that they occur.
- Based on the threat analysis criteria, a high overall threat rating is allocated when the scope and severity of the threat are high. However in the case of invasive pest species, priority action may be warranted when the scope is low and the pest can potentially be eradicated (i.e. new invaders or species yet to become well established).

## 12. Threatening Weeds (by Broad Vegetation Group)

The following information was sourced and adapted from the State of the Environment Report 2008<sup>5</sup> and other unpublished sources.

### Weeds posing a moderate to high threat in Heathy Open Forest

Common Name	Species Name
African weed-orchid	<i>Disa bracteata</i>
Asparagus Fern	<i>Asparagus scandens</i>
Blackberry*	<i>Rubus</i> spp.
Blue Periwinkle <sup>1</sup>	<i>Vinca major</i>
Bluebell Creeper <sup>^</sup>	<i>Billardiera scandens</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Bridal Veil <sup>1</sup>	<i>Asparagus declinatus</i>
Montpellier Broom <sup>1</sup>	<i>Genista monspessulana</i>
English Broom <sup>1</sup>	<i>Cytisus scoparius</i>
Bulbil Watsonia <sup>1</sup>	<i>Watsonia meriana</i> var. <i>bulbillifera</i>
Cotoneaster	<i>Cotoneaster</i> spp.
English Ivy	<i>Hedera helix</i>
Euryops	<i>Euryops abrotanifolius</i>
Orse*	<i>Ulex europaeus</i>
Holly	<i>Ilex aquifolium</i>
Japanese Honeysuckle	<i>Lonicera japonica</i>
Muraltia (Furze) <sup>1</sup>	<i>Muraltia heisteria</i>
Spanish heath <sup>1</sup>	<i>Erica lusitanica</i>
Sweet Pittosporum <sup>1^</sup>	<i>Pittosporum undulatum</i>
Sydney golden wattle <sup>^</sup>	<i>Acacia longifolia</i> ssp. <i>longifolia</i>
Three-corner Garlic	<i>Allium triquetrum</i>
Tree heath <sup>1</sup>	<i>Erica arborea</i>

<sup>^</sup> Non-indigenous native species; \* WONS (weed of national significance); <sup>1</sup> Weed is considered a high regional priority

### Weeds posing a moderate to high threat in Heathy Woodlands

Common Name	Species Name
African weed-orchid	<i>Disa bracteata</i>
Blackberry*	<i>Rubus</i> spp.
Bluebell Creeper <sup>^</sup>	<i>Billardiera scandens</i>
Boneseed*	<i>Chrysanthemoides monillifera</i> ssp. <i>monillifera</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Bridal Veil <sup>1</sup>	<i>Asparagus declinatus</i>
Montpellier Broom <sup>1</sup>	<i>Genista monspessulana</i>
Buckthorn <sup>1</sup>	<i>Rhamnus alaternus</i>
Cotoneaster	<i>Cotoneaster</i> spp.
Freesia <sup>1</sup>	<i>Freesia alba</i> x <i>F. leichtlinii</i>
Orse*	<i>Ulex europaeus</i>
Myrtle-leaved Milkwort	<i>Polygala myrtifolia</i>
Pussy-tail Grass <sup>1</sup>	<i>Pentaschistis pallida</i>
Spanish heath <sup>1</sup>	<i>Erica lusitanica</i>
Sydney golden wattle <sup>^</sup>	<i>Acacia longifolia</i> ssp. <i>longifolia</i>
Tree heath <sup>1</sup>	<i>Erica arborea</i>

<sup>^</sup> Non-indigenous native species; \* WONS; <sup>1</sup> Weed is considered a high regional priority

## Weeds posing a moderate to high threat in Grassy Woodlands and Grasslands

Common Name	Species Name
-	<i>Oxalis brasiliensis</i>
Cane Needlegrass+	<i>Nassella hyalina</i>
Espartillo+	<i>Achnatherum caudatum</i>
Lobed Needlegrass+	<i>Nassella charruana</i>
Mexican Feather Grass+	<i>Nassella tenuissima</i>
Serrated Tussock+	<i>Nassella trichotoma</i>
African Boxthorn	<i>Lycium ferocissimum</i>
African Feather Grass <sup>1</sup>	<i>Pennisetum macrourum</i>
African Lovegrass <sup>1</sup>	<i>Eragrostis curvula</i>
African weed-orchid	<i>Disa bracteata</i>
Athel Pine*	<i>Tamarix aphylla</i>
Bluebell Creeper <sup>^</sup>	<i>Billardiera scandens</i>
Boneseed*	<i>Chrysanthemoides monilifera</i> ssp. <i>monilifera</i>
Briar Rose <sup>1</sup>	<i>Rosa</i> spp.
Bridal Creeper*	<i>Asparagus asparagoides</i>
Bridal Veil <sup>1</sup>	<i>Asparagus declinatus</i>
Broad-leaved Cotton Bush	<i>Gomphocarpus cancellatus</i>
Montpellier Broom <sup>1</sup>	<i>Genista monspessulana</i>
Buckthorn <sup>1</sup>	<i>Rhamnus alaternus</i>
Bulbil Watsonia <sup>1</sup>	<i>Watsonia meriana</i> var. <i>bulbilifera</i>
Chilean Needlegrass*	<i>Nassella neesiana</i>
Cocksfoot	<i>Dactylis glomerata</i>
Coolatai Grass <sup>1</sup>	<i>Hyparrhenia hirta</i>
Cotoneaster	<i>Cotoneaster</i> spp.
Edible Asparagus	<i>Asparagus officinalis</i>
Fountain grass <sup>1</sup>	<i>Pennisetum setaceum</i>
Freesia <sup>1</sup>	<i>Freesia alba</i> x <i>F. leichtlinii</i>
Gorse*	<i>Ulex europaeus</i>
Hawthorn <sup>1</sup>	<i>Crataegus monogyna</i>
Longstyle Feathergrass <sup>1</sup>	<i>Pennisetum villosum</i>
Narrow-Leaf Cotton Bush	<i>Gomphocarpus fruticosus</i>
Olive <sup>1</sup>	<i>Olea europaea</i>
One-Leaf Cape Tulip	<i>Moraea flaccida</i>
Soursob	<i>Oxalis pes-caprae</i>
Perennial Veldt Grass	<i>Ehrharta calycina</i>
Phalaris	<i>Phalaris aquatica</i>
Pussy-tail Grass <sup>1</sup>	<i>Pentaschistis pallida</i>
Ribwort	<i>Plantago lanceolata</i>
Rice Millet	<i>Piptatherum miliaceum</i>
Scabious <sup>1</sup>	<i>Scabiosa atropurpurea</i>
Sorrel	<i>Acetosella vulgaris</i>
Sparaxis	<i>Sparaxis bulbifera</i>
Spiny Rush	<i>Juncus acutus</i>
St John's Wort	<i>Hypericum perforatum</i>
Tall Wheatgrass	<i>Thinopyrum ponticum</i>
Tangier Pea	<i>Lathyrus tingitanus</i>
Texan Needlegrass	<i>Nassella leucotricha</i>
Topped Lavender	<i>Lavandula stoechas</i>
Tree Lucerne <sup>1</sup>	<i>Chamaecytisus palmensis</i>
Two-Leaf Cape Tulip	<i>Moraea miniata</i>
Wild Gladiolus	<i>Gladiolus</i> spp.
Yorkshire Fog	<i>Holcus lanatus</i>

+ Emerging weeds not yet in AMLR region; ^ Non-indigenous native species; \* WONS; <sup>1</sup> Weed is considered a high regional priority

**Weeds posing a moderate to high threat in Wetlands**

<b>Common Name</b>	<b>Scientific Name</b>
Arum Lily	<i>Zantedeschia aethiopica</i>
Blackberry*	<i>Rubus</i> spp.
Blue Morning Glory	<i>Ipomoea indica</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Montpellier Broom <sup>1</sup>	<i>Genista monspessulana</i>
Clover	<i>Trifolium</i> spp.
Cocksfoot	<i>Dactylis glomerata</i>
Fountain grass <sup>1</sup>	<i>Pennisetum setaceum</i>
Orse*	<i>Ulex europaeus</i>
Hawthorn <sup>1</sup>	<i>Crataegus monogyna</i>
Jointed Rush	<i>Juncus articulatus</i>
Paspalum	<i>Paspalum dilatatum</i>
Phalaris	<i>Phalaris aquatica</i>
Radiata Pine	<i>Pinus radiata</i>
Spiny Rush	<i>Juncus acutus</i>
Watercress	<i>Rorippa nasturtium-aquaticum</i>
Yorkshire Fog	<i>Holcus lanatus</i>

\* WONS; <sup>1</sup> Weed is considered a high regional priority

**Weeds posing a moderate to high threat in Riparian vegetation**

<b>Common Name</b>	<b>Species Name</b>
African Boxthorn	<i>Lycium ferocissimum</i>
African Feather Grass <sup>1</sup>	<i>Pennisetum macrourum</i>
African weed-orchid	<i>Disa bracteata</i>
Arum Lily	<i>Zantedeschia aethiopica</i>
Athel Pine*	<i>Tamarix aphylla</i>
Blackberry*	<i>Rubus</i> spp.
Blue Morning Glory	<i>Ipomoea indica</i>
Blue Periwinkle <sup>1</sup>	<i>Vinca major</i>
Boneseed*	<i>Chrysanthemoides monillifera</i> ssp. <i>monillifera</i>
Briar spp. <sup>1</sup>	<i>Rosa</i> spp.
Bridal Creeper*	<i>Asparagus asparagoides</i>
Montpellier Broom <sup>1</sup>	<i>Genista monspessulana</i>
Buckthorn <sup>1</sup>	<i>Rhamnus alaternus</i>
Bulbil Watsonia <sup>1</sup>	<i>Watsonia meriana</i> var. <i>bulbillifera</i>
Cocksfoot	<i>Dactylis glomerata</i>
Creeping Yellowcress	<i>Rorippa sylvestris</i>
Crow Garlic	<i>Allium vineale</i>
Desert Ash <sup>1</sup>	<i>Fraxinus angustifolia</i>
Edible Asparagus	<i>Asparagus officinalis</i>
English Ivy	<i>Hedera helix</i>
Fountain grass <sup>1</sup>	<i>Pennisetum setaceum</i>
Giant Reed	<i>Arundo donax</i>
Orse*	<i>Ulex europaeus</i>
Hawthorn <sup>1</sup>	<i>Crataegus monogyna</i>
Jointed Rush	<i>Juncus articulatus</i>
Nasturtium	<i>Tropaeolum majus</i>
Olive <sup>1</sup>	<i>Olea europaea</i>
Soursob	<i>Oxalis pes-caprae</i>
Paspalum	<i>Paspalum dilatatum</i>
Phalaris	<i>Phalaris aquatica</i>
Ribwort	<i>Plantago lanceolata</i>
Sparaxis	<i>Sparaxis bulbifera</i>
Spiny Rush	<i>Juncus acutus</i>
Sweet Pittosporum <sup>1^</sup>	<i>Pittosporum undulatum</i>
Tangier Pea	<i>Lathyrus tingitanus</i>
Three-corner Garlic	<i>Allium triquetrum</i>

Common Name	Species Name
Tree Lucerne <sup>1</sup>	<i>Chamaecytisus palmensis</i>
Willows*	<i>Salix</i> spp.
Yorkshire Fog	<i>Holcus lanatus</i>

^Non-indigenous native species; \* WONS; <sup>1</sup> Weed is considered a high regional priority

### Weeds posing a moderate to high threat in Mallee

Common Name	Species Name
Boneseed*	<i>Chrysanthemoides monillifera</i> ssp. <i>monillifera</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Bridal Veil <sup>1</sup>	<i>Asparagus declinatus</i>
Buckthorn <sup>1</sup>	<i>Rhamnus alaternus</i>
Crow Garlic	<i>Allium vineale</i>
Fountain grass <sup>1</sup>	<i>Pennisetum setaceum</i>
Longstyle Feathergrass <sup>1</sup>	<i>Pennisetum villosum</i>
Olive <sup>1</sup>	<i>Olea europaea</i>
Perennial Veldt Grass	<i>Ehrharta calycina</i>
Prickly Pear	<i>Opuntia</i> spp.
Scabious <sup>1</sup>	<i>Scabiosa atropurpurea</i>

\*WONS; <sup>1</sup> Weed is considered a high regional priority

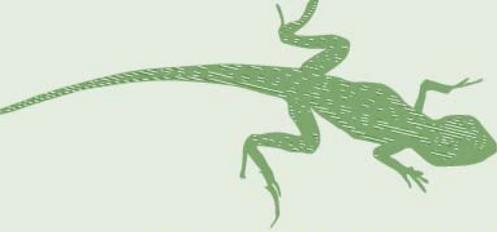
### Weeds posing a moderate to high threat in the Coastal vegetation

Common Name	Species Name
-	<i>Oxalis brasiliensis</i>
African Boxthorn	<i>Lycium ferocissimum</i>
African Orchid	<i>Disa bracteata</i>
Berry Seablite	<i>Suaeda baccifera</i>
Boneseed*	<i>Chrysanthemoides monillifera</i> ssp. <i>monillifera</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Bridal Veil <sup>1</sup>	<i>Asparagus declinatus</i>
Buckthorn <sup>1</sup>	<i>Rhamnus alaternus</i>
Coast Tea-tree^	<i>Leptospermum laevigatum</i>
Common Ice Plant	<i>Mesembryanthemum crystallinum</i>
Dune Onion Weed	<i>Trachyandra divaricata</i>
False Caper	<i>Euphorbia terracina</i>
Gazania <sup>1</sup>	<i>Gazania</i> spp.
Golden pallenis	<i>Pallenis spinosa</i>
Golden Wreath Wattle^	<i>Acacia saligna</i>
Gorse*	<i>Ulex europaeus</i>
Hottentot Fig	<i>Carpobrotus edulis</i>
Lavatory Creeper	<i>Dipogon lignosus</i>
Marguerite Daisy	<i>Argyranthemum frutescens</i>
Mirror-bush	<i>Coprosma repens</i>
Myrtle-leaf Milkwort	<i>Polygala myrtifolia</i>
Olive <sup>1</sup>	<i>Olea europaea</i> ssp. <i>europaea</i>
Perennial Veldt Grass	<i>Ehrharta calycina</i>
Pyp Grass	<i>Ehrharta villosa</i> var. <i>maxima</i>
Scabiosa	<i>Scabiosa atropurpurea</i>
Sea Spurge	<i>Euphorbia paralias</i>
Soursob	<i>Oxalis pes-caprae</i>
Spiny Rush	<i>Juncus acutus</i>
Sydney Golden Wattle^	<i>Acacia longifolia</i> ssp. <i>longifolia</i>
Tufted Honey-flower	<i>Melianthus comosus</i>
Western Coastal Wattle	<i>Acacia cyclops</i>
White Arctotis	<i>Arctotis stoechadifolia</i>

^Non-indigenous native species; \* WONS; <sup>1</sup> Weed is considered a high regional priority

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# REGIONAL RECOVERY PLAN

for Threatened Species and Ecological Communities  
of Adelaide and the Mount Lofty Ranges, South Australia



2009 - 2014



Appendices PART B  
(Species profiles)

Department  
for Environment  
and Heritage



Australian Government



Government  
of South Australia



### **Introduction - Regional Species Profiles**

The main body of this regional recovery plan has a strategic focus, and prioritises threatened species recovery from a regional perspective. This part of the plan takes a species-based approach, and is useful for those seeking further information on species or taxa groups of particular interest.

A one to two-page regional profile has been prepared for every species included in this plan; 130 plant species and 73 animal species (amphibian, bird, freshwater fish, mammal and reptile). Whilst the profiles include general information about each species, most of the content is specific to the Adelaide and the Mount Lofty Ranges (AMLR) region.

**Note, not all species with a State or National conservation listing that occur within the AMLR have been included in the plan and therefore will not have a profile (refer to the main plan for details of species inclusion).**

Profiles are available online and can be found by following links located on the Adelaide Region Biodiversity Conservation Program website [http://www.environment.sa.gov.au/biodiversity/adelaide\\_bcp/index.html](http://www.environment.sa.gov.au/biodiversity/adelaide_bcp/index.html).

Profiles for the plant species are ordered alphabetically by scientific name. Profiles for the animal species are ordered alphabetically by common name, within taxa types. The table on the following page describes the information fields in each profile.

The profiles have been assembled from existing information, plan analyses and personal communication. The authors recognise there are significant knowledge gaps and often conflicting information available for many species.

### **Acknowledgements**

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Prepared as part of the Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia 2009 – 2014



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**Summary of the information fields in the species profiles**

Field	Description
<b>AUS</b>	<p>Refers to the species National conservation listing under the <i>Environment Protection and Biodiversity Conservation Act 1999</i>.</p> <p>CE = Critically Endangered. Species is facing an extremely high risk of extinction in the wild in the immediate future.</p> <p>E = Endangered. Species is not critically endangered, but is facing a very high risk of extinction in the wild in the near future.</p> <p>V = Vulnerable. Species is not critically endangered or endangered, but is facing a high risk of extinction in the wild in the medium-term future.</p> <p><i>Note: there are also conservation listing categories for Extinct, Extinct in the Wild, and Conservation Dependent under the EPBC Act 1999, but none of the species included in this plan fall under these categories.</i></p>
<b>SA</b>	<p>Refers to the species State conservation listing under the <i>National Parks and Wildlife Act 1972</i> (Schedules 7, 8, 9, gazetted February 2008).</p> <p>E = Endangered. Taxa that are likely to become extinct in SA unless the circumstances and factors threatening their abundance, survival or evolutionary development cease to operate.</p> <p>V = Vulnerable. Taxa that are likely to move into the Endangered category in SA in the near future unless the circumstances and factors threatening their abundance, survival or evolutionary development cease to operate.</p> <p>R = Rare. Taxa that occur in small populations in South Australia, that are not at present endangered or vulnerable but are at some risk due to their low numbers. These taxa are usually localised within restricted geographical areas or are thinly scattered over a more extensive range. This may include taxa which are perceived to be at risk for which there is insufficient information available to assign them to any other category, and taxa that are considered to be dependent on ongoing conservation programs to prevent them moving into the endangered or vulnerable categories. Populations of rare taxa in SA may be contiguous with populations interstate that are considered to be secure. The rare category does not include taxa that are considered to be vagrants in South Australia.</p> <p>Note that freshwater fish are not currently listed under the NPW Act Schedules, despite recommendations as part of the 2003 review of threatened species status under the NPW Act.<sup>3</sup></p>
<b>AMLR</b>	<p>Refers to the species unofficial interim regional conservation rating within the AMLR derived during the process of developing this plan.</p> <p>Regional ratings for flora are based on Lang &amp; Kraehenbuehl (1998)<sup>7</sup>, revised with expert input in 2007 to reflect the AMLR planning region.</p> <p>E = Endangered. Scarce and in danger of becoming extinct in the wild.</p> <p>T = Threatened. Likely to be either Endangered or Vulnerable but insufficient information exists for a more precise assessment.</p> <p>V = Vulnerable. Rare and at risk from potential threats or long-term threats which could cause the species to become Endangered in the future.</p> <p>R = Rare. Has a low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.</p> <p>Regional ratings for fauna are based on Carpenter &amp; Reid (1987)<sup>2</sup>, updated to 1999, and further revised with expert input in 2007:</p> <p>E = Endangered. In danger of becoming extinct in the wild in the immediate future given current trends in populations and reasons for decline.</p> <p>V = Vulnerable. Likely to become Endangered in the immediate future given current trends in populations and reasons for decline.</p> <p>R = Rare. At risk due to low numbers of individuals even though no or little decline in distribution has been detected.</p>

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**ADELAIDE AND MOUNT LOFTY RANGES**  
**SOUTH AUSTRALIA**  
 Threatened Species Profile

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Field	Description
	<p>U = Uncommon. Animals or vegetation types which are inadequately conserved or declining but are not yet sufficiently threatened to be listed as rare.</p> <p>The freshwater fish have not been given a regional conservation rating.</p>
<b>Endemism</b>	<p><b>AMLR:</b> A species or subspecies considered to only occur in the AMLR region and not found elsewhere in South Australia or nationally. May include species that previously ranged more widely before habitat and population losses.</p> <p><b>State:</b> A species or subspecies ranging outside of the AMLR region but considered to occur only within South Australia.</p> <p>A dash represents a non-endemic; a species that is not endemic to the AMLR region or SA (i.e. also occurs in other Australian states and/or territories).</p>
<b>Life History</b> ( <i>flora</i> )	<p><b>Annual:</b> Plants that perform their entire life cycle from seed to flower to seed within a single growing season. All roots, stems and leaves of the plant die annually. Only the dormant seed bridges the gap between one generation and the next.</p> <p><b>Perennial:</b> Plants that persist for many growing seasons.</p>
<b>Residency</b> ( <i>fauna</i> )	<p><b>Resident:</b> A species which carries out all life stages within the AMLR region.</p> <p><b>Migratory breeder:</b> A species which moves from one country, region, or place to another, seasonally occupying and known to breed in areas of the AMLR.</p> <p><b>Migratory non-breeder:</b> A species which moves from one country, region, or place to another, seasonally occupying the AMLR but not known to breed in the region. All Migratory non-breeding species have been excluded from this planning process, except for extant EPBC Act listed species.</p> <p><b>Nomadic:</b> A species of variable, erratic movement, often related to the effects of irregular rainfall.</p> <p><b>Diadromous</b> (fish only): A species which moves between freshwater and estuarine/marine habitats for one or more life cycle stages.</p> <p><b>Obligate freshwater</b> (fish only): A species that completes life cycle within inland aquatic habitats (freshwater).</p>
<b>Family</b> ( <i>flora</i> )	The taxonomic category of related organisms, ranking below an order and above a genus. A family usually consists of several genera.
<b>Conservation Significance</b>	<p>This field provides the context for species' AMLR regional significance, including comments on:</p> <ul style="list-style-type: none"> <li>• Endemism (see description above);</li> <li>• AMLR significance in relation to broader extent of occurrence within SA (terms adapted from Groves 2003)<sup>6</sup> based on post-1983 records<sup>4</sup>;</li> <li>• Species previously classified as 'declining' (birds only)<sup>1</sup>;</li> <li>• Descriptive classification of area of occupancy within the AMLR, relative to all flora or fauna species included in the plan (see the accompanying plan and appendices for methods);</li> <li>• Taxonomic uniqueness: a measure of the taxonomic lineage or uniqueness relative to all terrestrial species present within the AMLR. A regional-specific approach was used after Freitag &amp; Jaarsveld (1997)<sup>5</sup>, which accounts for order, family and genus representation for each taxon (to species level only). Due to ongoing taxonomic revisions for some species, the results should be considered indicative only;</li> <li>• State, interstate, national and international conservation ratings;</li> <li>• Unresolved taxonomic issues.</li> </ul>
<b>Description</b>	A brief outline of some of the physical traits and distinguishing features of the species. Scientific terminology has purposely been avoided. The information provided is not intended to be of sufficient detail for taxonomic identification.
<b>Distribution and Population</b>	Information regarding the size and area of occupancy of populations/sub-populations (where known); known sites of occurrence within the AMLR; and species' broader distribution outside of the AMLR. Note, for flora species, State and regional distribution descriptions should be considered interim due to current inconsistencies between herbarium records and other information sources (e.g. the South Australian plant census). Occurrences in regions where such

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**ADELAIDE AND MOUNT LOFTY RANGES**  
**SOUTH AUSTRALIA**  
 Threatened Species Profile

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Field	Description
	<p>discrepancies exists are marked with "(?)".</p> <p>Inference has been drawn about the current and past distribution of each species within the AMLR based on post-1983 and pre-1983 filtered records from the custom project database<sup>4</sup> (for further details refer to the main plan). The map accompanying each species profile shows the post 1983 filtered records only. Note that the information provided does not necessarily reflect the actual species' distribution within the region. There may be other populations (either unknown, unsurveyed or not included in DEH databases – such as records held in other herbaria) that are not included. Sites of recorded occurrence post-1983 have not necessarily been re-surveyed so species may no longer exist at these sites.</p> <p>Locality descriptions are purposely non-specific, to prevent misuse of information.</p>
<b>Habitat</b>	<p>Outlines the main habitats occupied by the species, across their range and specific to the AMLR region.</p> <p>Inference has been drawn about the preference for broad vegetation groups (BVGs) within the AMLR, based on cited references and expert opinion. There are nine BVG classifications for the AMLR region (Open Forest, Heathy Woodland, Grassy Woodland, Shrubland, Mallee, Grassland, Riparian, Coastal, Wetland), as adopted and explained in more detail in the main plan. BVG preference is ordered from most preferred (i.e. greatest proportion of the species occurring in this BVG) to least preferred (least proportion of species occurring in this BVG). Each species has been assigned to at least one, and up to three BVGs.</p> <p>A coarse determination has been made of habitat specialisation (for the flora species only), describing how narrowly defined a species habitat requirements are, based on existing knowledge and evaluated relative to within the suite of target species. The criteria relate to habitat characteristics only, not to other factors such as extant habitat area, reservation or species rarity. For some species information from other regions or States was used to determine habitat specialisation where relevant local information was scarce. Habitat specialisation was categorised as follows:</p> <p><b>Very High:</b> A very narrow habitat requirement within one BVG (eg. <i>Thelymitra circumsepta</i>, requiring peaty bogs in high rainfall areas, within the 'Wetland' BVG). Other examples may include wetland margins or exposed coastal headlands.</p> <p><b>High:</b> A narrow habitat requirement that may occur within one or two BVGs (eg. <i>Acacia gunnii</i> restricted to rocky areas within higher rainfall heathy communities).</p> <p><b>Moderate-Low:</b> Habitat requirements not relatively specific, and that may occur within more than one BVG category (eg. <i>Spyridium coactillifolium</i>).</p>
<b>Biology and Ecology</b>	<p>Outlines key biological and ecological features of the species, such as: flowering time; known interactions with other species (e.g. pollinators, hosts); response to fire; incubation period; clutch size.</p>
<b>Aboriginal Significance</b>	<p>Describes species' current distribution relevant to the five indigenous nations of the AMLR region. Documented and anecdotal accounts of the importance/use of species' or genera, with respect to the AMLR and/or other areas may also be included.</p>
<b>Threats</b>	<p>An assessment of threats (where known or perceived) that are impacting on the species within the AMLR (note that the text descriptions are not inclusive).</p> <p>The threat rating summary table in the main plan identifies and rates threats significant to the species in the AMLR, as determined with the assistance of experts. The threat rating methodology, including limitations of the process, is described in the main plan.</p> <p>For most species, susceptibility to the soil-borne disease <i>Phytophthora cinammomi</i> ('<i>Phytophthora</i>') is not known. Therefore, <i>Phytophthora</i> risk has been described based on species' distribution within 2 km of confirmed or suspected <i>Phytophthora</i> infestations (as at May 2008, see also Velzeboer et al. 2005)<sup>8</sup> This does not imply that species' are susceptible to <i>Phytophthora</i>; rather it highlights a potential risk (either to a species or its habitat) given its occurrence in an at-risk zone and proximity to a known infestation.</p>
<b>Reference citations (e.g. <sup>1,2,3</sup>)</b>	<p>Numbers in superscript refer to the reference from which the information has been sourced, which corresponds to the reference list at the end of this document. Primary references (referred to within cited references) have also been retained in most cases.</p>

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**List of threatened flora profiles**

Scientific name	Common name	EPBC	NPW	Life form
<i>Acacia gunnii</i>	Ploughshare Wattle		R	Shrub
<i>Acacia menzeli</i>	Menzel's Wattle	V	V	Shrub
<i>Acacia pinguifolia</i>	Fat-leaf Wattle	E	E	Shrub
<i>Acacia retinocarpa</i>	Resin Wattle	V	V	Shrub
<i>Adiantum capillus-veneris</i>	Dainty Maiden-hair		V	Fern
<i>Allocasuarina robusta</i>	Mount Compass Oak-bush	E	E	Shrub
<i>Amphibromus pithogastrus</i>	Plump Swamp Wallaby-grass			Grass
<i>Asterolasia muricata</i>	Rough Star-bush		R	Shrub
<i>Austrostipa echinata</i>	Spiny Spear-grass		R	Grass
<i>Austrostipa oligostachya</i>	Fine-head Spear-grass		E	Grass
<i>Boronia parviflora</i>	Swamp Boronia		R	Shrub
<i>Brachyscome diversifolia</i>	Tall Daisy		E	Herb
<i>Caladenia argocalla</i>	White Beauty Spider-orchid	E	E	Orchid
<i>Caladenia behrii</i>	Pink-lip Spider-orchid	E	E	Orchid
<i>Caladenia bicallata</i> ssp. <i>bicallata</i>	Western Daddy-long-legs		R	Orchid
<i>Caladenia colorata</i>	Coloured Spider-orchid	E	E	Orchid
<i>Caladenia gladiolata</i>	Bayonet Spider-orchid	E	E	Orchid
<i>Caladenia ovata</i>	Kangaroo Island Spider-orchid	V	E	Orchid
<i>Caladenia rigida</i>	Stiff White Spider-orchid	E	E	Orchid
<i>Caladenia valida</i>	Robust Spider-orchid		E	Orchid
<i>Caladenia vulgaris</i>	Plain Caladenia		R	Orchid
<i>Caleana major</i>	Large Duck-orchid		V	Orchid
<i>Callistemon teretifolius</i>	Needle Bottlebrush			Shrub
<i>Calochilus campestris</i>	Plains Beard-orchid		R	Orchid
<i>Calochilus cupreus</i>	Copper Beard-orchid		E	Orchid
<i>Calochilus paludosus</i>	Red Beard-orchid		V	Orchid
<i>Centrolepis glabra</i>	Smooth Centrolepis		R	Herb
<i>Correa calycina</i> var. <i>calycina</i>	Hindmarsh Correa	V	V	Shrub
<i>Correa eburnea</i>	Deep Creek Correa		V	Shrub
<i>Corybas dentatus</i>	Finniss Helmet-orchid	V	E	Orchid
<i>Corybas expansus</i>	Dune Helmet-orchid		V	Orchid
<i>Corybas unguiculatus</i>	Small Helmet-orchid		R	Orchid
<i>Crassula sieberiana</i>	Sieber's Crassula		E	Herb
<i>Cryptostylis subulata</i>	Moose Orchid		V	Orchid
<i>Cullen parvum</i>	Small Scurf-pea		V	Herb
<i>Dampiera lanceolata</i> var. <i>intermedia</i>	Aldinga Dampiera		E	Shrub
<i>Daviesia pectinata</i>	Zig-zag Bitter-pea		R	Shrub
<i>Dianella longifolia</i> var. <i>grandis</i>	Pale Flax-lily		R	Lily
<i>Dipodium pardalinum</i>	Leopard Hyacinth-orchid		V	Orchid
<i>Diuris behrii</i>	Behr's Cowslip Orchid		V	Orchid
<i>Diuris brevifolia</i>	Short-leaf Donkey-orchid		E	Orchid
<i>Eleocharis atricha</i>	Tuber Spike-rush		V	Rush
<i>Eremophila gibbifolia</i>	Coccid Emubush		R	Shrub
<i>Eucalyptus cneorifolia</i>	Kangaroo Island Narrow-leaf Mallee			Mallee
<i>Eucalyptus paludicola</i>	Mount Compass Swamp Gum	E	E	Mallee
<i>Eucalyptus phenax</i> ssp. <i>compressa</i>	Kangaroo Island Mallee		R	Mallee
<i>Euphrasia collina</i> ssp. <i>osbornii</i>	Osborn's Eyebright	E	E	Herb
<i>Gahnia radula</i>	Thatch Saw-sedge		R	Sedge
<i>Gastrodia sesamoides</i>	Potato Orchid		R	Orchid
<i>Glycine latrobeana</i>	Clover Glycine	V	V	Herb
<i>Glycine tabacina</i>	Variable Glycine		V	Herb
<i>Gratiola pumilo</i>	Dwarf Brooklime		R	Herb
<i>Haloragis brownii</i>	Swamp Raspwort		R	Herb

**Further information:**

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# ADELAIDE AND MOUNT LOFTY RANGES SOUTH AUSTRALIA

Threatened Species Profile

Department  
for Environment  
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Scientific name	Common name	EPBC	NPW	Life form
<i>Haloragis myriocarpa</i>			R	Herb
<i>Helichrysum rutidolepis</i>	Pale Everlasting		E	Herb
<i>Hibbertia tenuis</i>			E	Shrub
<i>Hydrocotyle crassiuscula</i>	Spreading Pennywort		R	Herb
<i>Juncus amabilis</i>			V	Rush
<i>Juncus prismatocarpus</i>	Branching Rush		E	Rush
<i>Juncus radula</i>	Hoary Rush		V	Rush
<i>Lagenophora gracilis</i>	Slender Bottle-daisy		V	Herb
<i>Leionema hillebrandii</i>	Mount Lofty Phebalium		R	Shrub
<i>Logania minor</i>	Spoon-leaf Logania			Shrub
<i>Luzula flaccida</i>	Pale Wood-rush		V	Herb
<i>Lycopodiella lateralis</i>	Slender Clubmoss		R	Clubmoss
<i>Lycopodiella serpentina</i>	Bog Clubmoss		E	Clubmoss
<i>Lycopodium deuterodensum</i>	Bushy Clubmoss		E	Clubmoss
<i>Maireana decalvans</i>	Black Cotton-bush		E	Shrub
<i>Mazus pumilio</i>	Swamp Mazus		V	Herb
<i>Melaleuca squamea</i>	Swamp Honey-myrtle		R	Shrub
<i>Microtis atrata</i>	Yellow Onion-orchid		R	Orchid
<i>Microtis rara</i>	Sweet Onion-orchid		R	Orchid
<i>Montia fontana</i> ssp. <i>chondrosperma</i>	Waterblinks		V	Herb
<i>Neopaxia australasica</i>	White Purslane		R	Herb
<i>Olearia glandulosa</i>	Swamp Daisy-bush		V	Shrub
<i>Olearia pannosa</i> ssp. <i>pannosa</i>	Silver Daisy-bush	V	V	Shrub
<i>Oreomyrrhis eriopoda</i>	Australian Carraway		E	Herb
<i>Orobanche cernua</i> var. <i>australiana</i>	Australian Broomrape		R	Herb
<i>Paracaleana disjuncta</i>	Black-beak Duck-orchid		E	Orchid
<i>Paracaleana minor</i>	Small Duck-orchid		V	Orchid
<i>Phyllanthus striaticaulis</i>	Southern Spurge			Herb
<i>Podolepis muelleri</i>	Button Podolepis		V	Herb
<i>Potamogeton ochreateus</i>	Blunt Pondweed		R	Herb
<i>Prasophyllum australe</i>	Austral Leek-orchid		R	Orchid
<i>Prasophyllum fecundum</i>	Self-pollinating Leek-orchid		R	Orchid
<i>Prasophyllum fitzgeraldii</i>	Fitzgerald's Leek-orchid			Orchid
<i>Prasophyllum murfetii</i>		CE	E	Orchid
<i>Prasophyllum occultans</i>	Hidden Leek-orchid		R	Orchid
<i>Prasophyllum pallidum</i>	Pale Leek-orchid	V	R	Orchid
<i>Prasophyllum pruinatum</i>	Plum Leek-orchid		V	Orchid
<i>Pratia puberula</i>	White-flower Matted Pratia		V	Herb
<i>Prostanthera chlorantha</i>	Green Mintbush		R	Shrub
<i>Prostanthera eurybioides</i>	Monarto Mintbush	E	E	Shrub
<i>Psilotum nudum</i>	Skeleton Fork-fern		E	Fern
<i>Pteris tremula</i>	Tender Brake		R	Fern
<i>Pterostylis arenicola</i>	Sandhill Greenhood	V	V	Orchid
<i>Pterostylis bryophila</i>	Hindmarsh Greenhood	CE	E	Orchid
<i>Pterostylis cucullata</i> ssp. <i>sylvicola</i>	Leafy Greenhood	V	E	Orchid
<i>Pterostylis curta</i>	Blunt Greenhood		R	Orchid
<i>Pterostylis falcata</i>			E	Orchid
<i>Pterostylis</i> sp. Hale (R. Bates 21725)	Hale Greenhood	E		Orchid
<i>Pterostylis uliginosa</i>			E	Orchid
<i>Pultenaea dentata</i>	Clustered Bush-pea		R	Shrub
<i>Pultenaea viscidula</i>	Dark Bush-pea			Shrub
<i>Ranunculus inundatus</i>	River Buttercup		R	Herb
<i>Ranunculus papulentus</i>	Large River Buttercup		V	Herb
<i>Schizaea bifida</i>	Forked Comb-fern		V	Fern
<i>Schizaea fistulosa</i>	Narrow Comb-fern		V	Fern

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**ADELAIDE AND MOUNT LOFTY RANGES**  
**SOUTH AUSTRALIA**  
 Threatened Species Profile

Department  
for Environment  
and Heritage

Scientific name	Common name	EPBC	NPW	Life form
<i>Schoenus discifer</i>	Tiny Bog-rush		R	Rush
<i>Schoenus latelaminatus</i>	Medusa Bog-rush		V	Rush
<i>Senecio megaglossus</i>	Large-flower Groundsel	V	E	Shrub
<i>Spiranthes australis</i>	Austral Lady's Tresses		R	Orchid
<i>Spyridium coactillifolium</i>	Butterfly Spyridium	V	V	Shrub
<i>Tecticornia flabelliformis</i>	Bead Samphire	V	V	Shrub
<i>Thelymitra circumsepta</i>	Naked Sun-orchid		E	Orchid
<i>Thelymitra cyanapicata</i>	Blue Top Sun-orchid	CE	E	Orchid
<i>Thelymitra cyanea</i>	Veined Sun-orchid		E	Orchid
<i>Thelymitra holmesii</i>	Blue Star Sun-orchid		V	Orchid
<i>Thelymitra inflata</i>	Plum Sun-orchid		V	Orchid
<i>Thelymitra mucida</i>			R	Orchid
<i>Thelymitra peniculata</i>	Peniculate Sun-orchid		V	Orchid
<i>Todea barbara</i>	King Fern		E	Fern
<i>Tricostularia pauciflora</i>	Needle Bog-rush		E	Rush
<i>Trymalium wayi</i>	Grey Trymalium			Shrub
<i>Utricularia lateriflora</i>	Small Bladderwort		V	Herb
<i>Veronica derwentiana</i> ssp. <i>anisodonta</i>	Kangaroo Island Speedwell		R	Shrub
<i>Veronica derwentiana</i> ssp. <i>homalodonta</i>	Mt Lofty Speedwell		E	Shrub
<i>Viola betonicifolia</i> ssp. <i>betonicifolia</i>	Showy Violet		E	Herb
<i>Wurmbea uniflora</i>	One-flower Nancy		E	Lily
<i>Xyris operculata</i>	Tall Yellow-eye		R	Herb

**List of threatened fauna profiles**

Common name	Scientific name	EPBC	NPW	Class
Brown Toadlet	<i>Pseudophryne bibronii</i>		R	Amphibian
Australasian Bittern	<i>Botaurus poiciloptilus</i>		V	Bird
Baillon's Crake	<i>Porzana pusilla</i>			Bird
Bassian Thrush	<i>Zoothera lunulata halmaturina</i>		R	Bird
Beautiful Firetail	<i>Stagonopleura bella</i>		R	Bird
Black-chinned Honeyeater	<i>Melithreptus gularis gularis</i>		V	Bird
Brown Quail	<i>Coturnix ypsilophora</i>		V	Bird
Brown Treecreeper	<i>Climacteris picumnus</i>			Bird
Brown-headed Honeyeater	<i>Melithreptus brevirostris pallidiceps</i>			Bird
Brush Bronzewing	<i>Phaps elegans</i>			Bird
Buff-banded Rail	<i>Gallirallus philippensis</i>			Bird
Chestnut-rumped Heathwren (MLR ssp.)	<i>Hylacola pyrrhopygia parkeri</i>	E	E	Bird
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>			Bird
Crested Shrike-tit	<i>Falcunculus frontatus frontatus</i>		R	Bird
Diamond Firetail	<i>Stagonopleura guttata</i>		V	Bird
Fairy Martin	<i>Petrochelidon ariel</i>			Bird
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>			Bird
Hooded Robin	<i>Melanodryas cucullata cucullata</i>		R	Bird
Horsfield's Bronze-cuckoo	<i>Chalcites basalis</i>			Bird
Jacky Winter	<i>Microeca fascinans fascinans</i>		R	Bird
Lewin's Rail	<i>Lewinia pectoralis pectoralis</i>		V	Bird
Little Wattlebird	<i>Anthochaera chrysoptera</i>			Bird
Orange-bellied Parrot	<i>Neophema chrysogaster</i>	CE	E	Bird
Painted Button-quail	<i>Turnix varia</i>		R	Bird
Pallid Cuckoo	<i>Cacomantis pallidus</i>			Bird
Peregrine Falcon	<i>Falco peregrinus</i>		R	Bird
Red-capped Robin	<i>Petroica goodenovii</i>			Bird
Red-rumped Parrot	<i>Psephotus haematonotus</i>			Bird

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# ADELAIDE AND MOUNT LOFTY RANGES SOUTH AUSTRALIA

Threatened Species Profile

Department  
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Common name	Scientific name	EPBC	NPW	Class
Restless Flycatcher	<i>Myiagra inquieta</i>		R	Bird
Rufous Whistler	<i>Pachycephala rufiventris rufiventris</i>			Bird
Sacred Kingfisher	<i>Todiramphus sanctus</i>			Bird
Scarlet Robin	<i>Petroica boodang boodang</i>		R	Bird
Shining Bronze-Cuckoo	<i>Chalcites lucidus</i>			Bird
Slender-billed Thornbill (SVG ssp.)	<i>Acanthiza iredalei rosinae</i>		V	Bird
Southern Emu-wren (MLR ssp.)	<i>Stipiturus malachurus intermedius</i>	E	E	Bird
Southern Whiteface	<i>Aphelocephala leucopsis leucopsis</i>			Bird
Spotless Crake	<i>Porzana tabuensis</i>		R	Bird
Spotted Quail-thrush	<i>Cincoloma punctatum anachoreta</i>	CE	E	Bird
Tawny Frogmouth	<i>Podargus strigoides</i>			Bird
Tawny-crowned Honeyeater	<i>Glyciphila melanops</i>			Bird
Tree Martin	<i>Petrochelidon nigricans</i>			Bird
Varied Sittella	<i>Daphoenositta chrysoptera chrysoptera</i>			Bird
Whistling Kite	<i>Haliastur sphenurus</i>			Bird
White-browed Babbler	<i>Pomatostomus superciliosus</i>			Bird
White-fronted Chat	<i>Epthianura albifrons</i>			Bird
White-naped Honeyeater	<i>Meliphreptus lunatus lunatus</i>			Bird
White-winged Chough	<i>Corcorax melanorhamphos</i>		R	Bird
Yellow Thornbill	<i>Acanthiza nana</i>			Bird
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>			Bird
Yellow-tailed Black-Cockatoo	<i>Calyptorhynchus funereus</i>		V	Bird
Zebra Finch	<i>Taeniopygia guttata</i>			Bird
Climbing galaxias	<i>Galaxias brevipinnis</i>			Fish
Congolli	<i>Pseudaphritis urvillii</i>			Fish
Mountain galaxias	<i>Galaxias olidus</i>			Fish
Murray hardyhead	<i>Craterocephalus fluviatilis</i>	V		Fish
Pouched lamprey	<i>Geotria australis</i>			Fish
River blackfish	<i>Gadopsis marmoratus</i>			Fish
Short-headed lamprey	<i>Mordacia mordax</i>			Fish
Southern pygmy perch	<i>Nannoperca australis</i>			Fish
Yarra pygmy perch	<i>Nannoperca obscura</i>	V		Fish
Southern Brown Bandicoot	<i>Isoodon obesulus obesulus</i>	E	V	Mammal
Western Pygmy-possum	<i>Cercartetus concinnus</i>			Mammal
Carpet Python	<i>Morelia spilota variegata</i>		R	Reptile
Cunningham's Skink	<i>Egernia cunninghami</i>		E	Reptile
Eastern Water Skink	<i>Eulamprus quoyii</i>			Reptile
Five-lined Earless Dragon	<i>Tympanocryptis lineata lineata</i>			Reptile
Flinders Ranges Worm-lizard	<i>Aprasia pseudopulchella</i>	V		Reptile
Heath Goanna	<i>Varanus rosenbergi</i>		V	Reptile
Olive Snake-lizard	<i>Delma inornata</i>			Reptile
Pygmy Copperhead	<i>Austrelaps labialis</i>			Reptile
Southern Grass Skink	<i>Pseudemoia entrecasteauxii</i>			Reptile
Tiger Snake	<i>Notechis scutatus</i>			Reptile
Yellow-bellied Water Skink	<i>Eulamprus heatwolei</i>		V	Reptile

## Further information:

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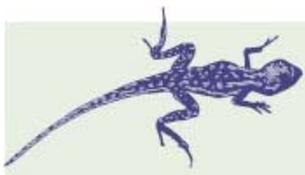
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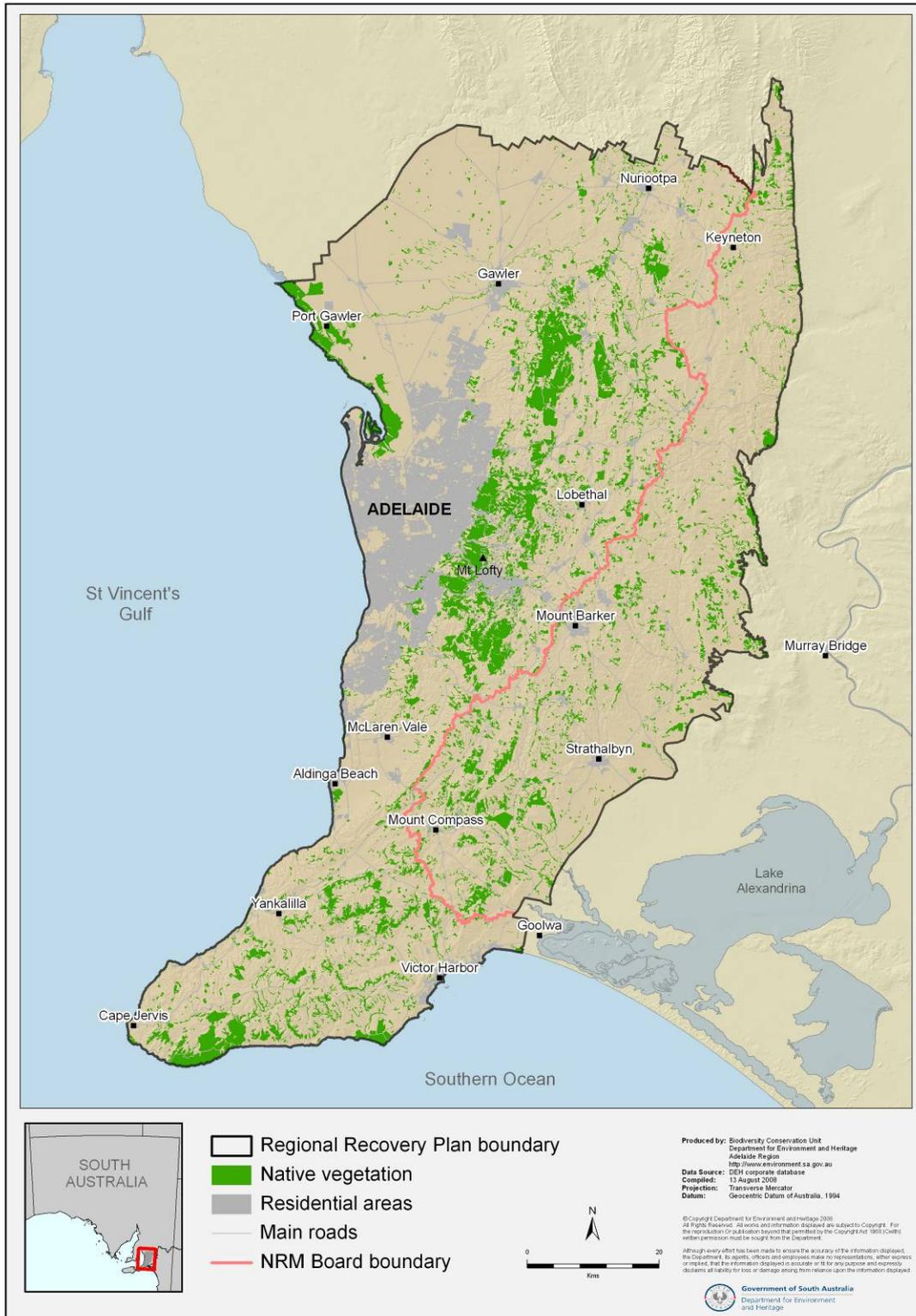


# ADELAIDE AND MOUNT LOFTY RANGES SOUTH AUSTRALIA

Threatened Species Profile

Department  
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## Map of the Adelaide and Mount Lofty Ranges Region



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### Acronyms used in Species Profiles

ACT	Australian Capital Territory
AMLR	Adelaide and Mount Lofty Ranges
ANBG	Australian National Botanic Gardens
BVG	Broad Vegetation Group/s
cm	Centimetres
CP	Conservation Park
EA	Eastern (referring to SA herbarium region)
EP	Eyre Peninsula (referring to SA herbarium region)
FR	Flinders Ranges (referring to SA herbarium region)
GT	Gairdner-Torrens (referring to SA herbarium region)
KI	Kangaroo Island
LE	Lake Eyre (referring to SA herbarium region)
m	Metres
MDB	Murray-Darling Basin
MLR	Mount Lofty Ranges
mm	Millimetres
Mt	Mount
MU	Murray (referring to SA herbarium region)
NC	Not current (referring a species' scientific name no longer being current).
NL	Northern Lofty (referring to SA herbarium region)
Nominate	The species or subspecies that has the same name as the genus or species respectively (usually the first form described)
NP	National Park
NSW	New South Wales
NZ	NZ
NT	Northern Territory
NU	Nullarbor (referring to SA herbarium region)
NW	North-Western (referring to SA herbarium region)
QLD	Queensland
RP	Recreation Park
SA	South Australia/ South Australian
SE	South-eastern (referring to SA herbarium region)
SL	Southern Lofty (referring to SA herbarium region)
SMLR	Southern Mount Lofty Ranges
sp.	Any species belonging to a genus
spp.	Species (multiple) belonging to a genus
ssp.	Subspecies
SV	Snout-vent length
TAS	Tasmania/ Tasmanian
VIC	Victoria/ Victorian
WA	Western Australia/ Western Australian
YP	Yorke Peninsula (referring to SA herbarium region)

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