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

FIS 80034

www.environment.sa.gov.au

ISBN 978-1-921466-10-6

June, 2009

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

Willson, A. and Bignall, J. (2009) *Regional Recovery Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia*. Department for Environment and Heritage, South Australia.

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

Acknowledgements

The preparation of the Recovery Plan would not have been possible without the input of many people. The authors are especially indebted to the following for their significant contribution:

- Members of the Project's Steering Committee: Adrian Stokes (DEH - Chair), Andrew Chalklen (AGDEWHA), David Turner (DEH), Dominic Nicholls (TSN), Hafiz Stewart (DEH), Jody Gates (DEH), Marcus Walters (LGA), Penny Paton (AMLR Board), Peter Copley (DEH), Vicki-Jo Russell (TSN) and Wendy Stubbs (DEH).
- Other DEH staff who have provided valuable expertise and assistance: Alan Lambert, Amelia Hurren, Andrew Graham, Andrew West, Angela Duffy, Ann Prescott, Bill Barker, Chris Holden, Dan Duval, Dave Armstrong, David Thompson, Doug Bickerton, Helen Vonow, Maria Johns, Martin Oleary, Jason van Weenen, Jean Turner, Joe Quarmby, Kate Smith, Kirstin Long, Kirsty Bevan, Lisa Farroway, Mike Wouters, Peter Lang, Robyn Barker, Sandy Carruthers, Sandy Kinnear, Sonia Croft, Sue Graham and Tim Croft.
- Others who have provided valuable expertise and information: Alys Stevens (SEWFPSRP), Bea Hurrell (DEH), Bob Bates (NOSSA), Caroline Dorr (AMLRNRMB), Cathy Houston (NOSSA), Ceridwen Synnot (DWLBC), David Paton (University of Adelaide), Denzel Murfet, Donna-Lee Edwards (DWLBC), Geoffrey Bradford (EPA), Graham Carpenter (DWLBC), Jason Downs (PIRSA), Jeremiah Smith, Jessica Mitchell (DWLBC), Kieran Brewer, Lynn Baker (NSW DECC), Marcus Pickett (SEWFPSRP), Mark Hutchinson (SAM), Michael Hammer, Robert Henzell (DWLBC), Ron Taylor (FNHCP), Rosemary Taplin and Tim Jury (TPAG).
- Members of the AMLR NRM Four Nations Governance Group.
- Members of the Commonwealth Threatened Species Scientific Committee.
- Those who have provided photos for use in this document.

The majority of funding support was provided by the Australian Government through the Natural Heritage Trust, administered by the AMLRNRMB. Additional funding and in-kind support was provided by DEH.

The authors acknowledge the past and present Aboriginal custodians of the land within the AMLR and South Australia, valuing their knowledge and understanding of the region's natural heritage.

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.[19]

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

- No Species Loss, A Nature Conservation Strategy for South Australia 2007-2017[10]
- Natural Resources Management Plan for the AMLR Region[1]
- Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges[13], 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.[13] 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.[13]

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)[14]. 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 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
Acacia gunnii	Ploughshare Wattle		R	V	Shrub
Acacia menzelii	Menzel's Wattle	V	V	V	Shrub
Acacia pinguifolia	Fat-leaf Wattle	E	E	E	Shrub
Acacia rhetinocarpa	Resin Wattle	V	V	E	Shrub
Adiantum capillus-veneris	Dainty Maiden-hair		V	V	Fern
Allocasuarina robusta	Mount Compass Oak-bush	E	E	E	Shrub
Amphibromus pithogastrus	Plump Swamp Wallaby-grass			T	Grass
Asterolasia muricata	Rough Star-bush		R	V	Shrub
Austrostipa echinata	Spiny Spear-grass		R	T	Grass
Austrostipa oligostachya	Fine-head Spear-grass		E	E	Grass
Boronia parviflora	Swamp Boronia		R	V	Shrub
Brachyscome diversifolia	Tall Daisy		E	E	Herb
Caladenia argocalla	White Beauty Spider-orchid	E	E	E	Orchid
Caladenia behrii	Pink-lip Spider-orchid	E	E	E	Orchid
Caladenia bicalliata ssp. *bicalliata*	Western Daddy-long-legs		R	E	Orchid
Caladenia colorata	Coloured Spider-orchid	E	E	E	Orchid
Caladenia gladiolata	Bayonet Spider-orchid	E	E	E	Orchid
Caladenia ovata	Kangaroo Island Spider-orchid	V	E	E	Orchid
Caladenia rigida	Stiff White Spider-orchid	E	E	E	Orchid
Caladenia valida	Robust Spider-orchid		E	E	Orchid
Caladenia vulgaris	Plain Caladenia		R	E	Orchid
Caleana major	Large Duck-orchid		V	V	Orchid
Callistemon teretifolius	Needle Bottlebrush			V	Shrub
Calochilus campestris	Plains Beard-orchid		R	E	Orchid
Calochilus cupreus	Copper Beard-orchid		E	E	Orchid
Calochilus paludosus	Red Beard-orchid		V	E	Orchid
Centrolepis glabra	Smooth Centrolepis		R	T	Herb
Correa calycina var. *calycina*	Hindmarsh Correa	V	V	V	Shrub
Correa eburnea	Deep Creek Correa		V	V	Shrub
Corybas dentatus	Finniss Helmet-orchid	V	E	E	Orchid
Corybas expansus	Dune Helmet-orchid		V	E	Orchid
Corybas unguiculatus	Small Helmet-orchid		R	E	Orchid
Crassula sieberiana	Sieber's Crassula		E	E	Herb
Cryptostylis subulata	Moose Orchid		V	E	Orchid
Cullen parvum	Small Scurf-pea		V	E	Herb
Dampiera lanceolata var. *intermedia*	Aldinga Dampiera		E	E	Shrub
Daviesia pectinata	Zig-zag Bitter-pea		R	E	Shrub
Dianella longifolia var. *grandis*	Pale Flax-lily		R	V	Lily
Dipodium pardalinum	Leopard Hyacinth-orchid		V	V	Orchid
Diuris behrii	Behr's Cowslip Orchid		V	V	Orchid
Diuris brevifolia	Short-leaf Donkey-orchid		E	E	Orchid
Eleocharis atricha	Tuber Spike-rush		V	E	Rush
Eremophila gibbifolia	Coccid Emubush		R	V	Shrub
Eucalyptus cneorifolia	Kangaroo Island Narrow-leaf Mallee			V	Mallee
Eucalyptus paludicola	Mount Compass Swamp Gum	E	E	E	Mallee
Eucalyptus phenax ssp. *compressa*	Kangaroo Island Mallee		R	V	Mallee
Euphrasia collina ssp. *osbornii*	Osborn's Eyebright	E	E	V	Herb
Gahnia radula	Thatch Saw-sedge		R	E	Sedge
Gastrodia sesamoides	Potato Orchid		R	E	Orchid
Glycine latrobeana	Clover Glycine	V	V	V	Herb
Glycine tabacina	Variable Glycine		V	E	Herb
Gratiola pumilo	Dwarf Brooklime		R	E	Herb
Haloragis brownii	Swamp Raspwort		R	T	Herb
Haloragis myriocarpa			R	E	Herb
Helichrysum rutidolepis	Pale Everlasting		E	E	Herb

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

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

Common name	Scientific name	AUS	SA	AMLR*	Class
Murray hardyhead	*Craterocephalus fluviatilis*	V		E	Fish
Pouched lamprey	*Geotria australis*			V	Fish
River blackfish	*Gadopsis marmoratus*			E	Fish
Short-headed lamprey	*Mordacia mordax*			V	Fish
Southern pygmy perch	*Nannoperca australis*			E	Fish
Yarra pygmy perch	*Nannoperca obscura*	V		E	Fish
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	E	V	V	Mammal
Western Pygmy-possum	*Cercartetus concinnus*			V	Mammal
Carpet Python	*Morelia spilota*		R	E	Reptile
Cunningham`s Skink	*Egernia cunninghami*		E	V	Reptile
Eastern Water Skink	*Eulamprus quoyii*			V	Reptile
Five-lined Earless Dragon	*Tympanocryptis lineata lineata*			E	Reptile
Flinders Ranges Worm-lizard	*Aprasia pseudopulchella*	V		U	Reptile
Heath Goanna	*Varanus rosenbergi*		V	E	Reptile
Olive Snake-lizard	*Delma inornata*			V	Reptile
Pygmy Copperhead	*Austrelaps labialis*			V	Reptile
Southern Grass Skink	*Pseudemoia entrecasteauxii*			V	Reptile
Tiger Snake	*Notechis scutatus*			V	Reptile
Yellow-bellied Water Skink	*Eulamprus heatwolei*		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 (*Lomandra effusa – L. multiflora* ssp. *dura*) Natural Temperate Grassland of SA	CE
Peppermint Box (*Eucalyptus odorata*) 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*
Banksia marginata Grassy Low Woodland	E
Eucalyptus dalrympleana ssp. *dalrympleana* Open Forest	E
Eucalyptus microcarpa Grassy Low Woodland	E
Eucalyptus odorata +/- E. leucoxylon Grassy Low Woodland	E
Freshwater wetlands e.g. *Triglochin procerum* Herbland	E
Leptospermum lanigerum Closed Shrubland	E
Lomandra effusa Tussock Grassland	E
Melaleuca squamea +/- Leptospermum continentale Closed Scrubland	V
Themeda triandra +/- Danthonia spp. Tussock Grassland	E
Callitris preissii +/- E. leucoxylon Grassy Low Woodland	V
Eucalyptus fasciculosa +/- E. leucoxylon Heathy Woodland	V
Eucalyptus ovata +/- E. viminalis ssp. *cygnetensis +/- E. camaldulensis* Low Woodland	V
Gahnia filum Sedgeland	V
Eucalyptus viminalis ssp. *cygnetensis* and/or *E. viminalis* ssp. *viminalis* Woodland	V
Allocasuarina verticillata Grassy Low Woodland	V
Eucalyptus leucoxylon ssp. *pruinosa +/- E. odorata* Grassy Low Woodland	V
Eucalyptus porosa Woodland	#
Melaleuca halmaturorum Shrubland/ Low Open Forest	#

*Source: Provisional List of Threatened Ecosystems of South Australia (DEH 2005).[8]
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[34]; *Recovery Plan for Twelve Threatened Orchids in the Lofty Block Region of SA 2007-2012*[31]; *SA Murray Darling Basin Threatened Flora Recovery Plan*[28] *and Draft Recovery Plan for Twenty-three Threatened Flora Taxa on Eyre Peninsula, SA 2007-2012*[30]. 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.[14,15]

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[13] (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**
Fauna	2	3	3	**8**	5 (4)	10 (9)	13 (13)	**28 (26)**
Flora	3	11	13	**27**	42 (26)	38 (30)	41 (40)	**121 (96)**
Total	**4**	**14**	**16**	**35***	**47 (30)**	**48 (39)**	**54 (53)**	**149 (122)**

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*
AMLR endemic	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
State endemics & non-endemics	**Disjunct** 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)
	Limited A species whose AMLR distribution is more or less contiguous across one to three adjacent regions.	17 (14)	23 (1)
	Peripheral 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)
	Widespread 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)[24], based on database records post 1983).[12]

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*[3,16]
- *State Natural Resources Management Plan 2006*[17]
- *No Species Loss: A Nature Conservation Strategy for South Australia 2007-2017*[10]
- *A Biodiversity Conservation Strategy for Adelaide and the Mount Lofty Ranges (Draft)*[13], *and*
- *Creating a Sustainable Future: A Natural Resources Management Plan for the Adelaide and Mount Lofty Ranges Region*[1].

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
Current	1 (1)	1 (1)	7 (4)	6 (1)	6 (1)	33 (33)	25 (4)
In prep	2 (2)						
Draft	6 (6)	1 (1)			2 (1)		
Not current	1 (1)	3 (3)	4 (3)		3 (1)		
Total	**10 (10)**	**5 (5)**	**11 (7)**	**6 (1)**	**11 (3)**	**33 (33)**	**25 (4)**

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.[13]

The AMLR experiences a Mediterranean climate, characterised by hot, dry summers and cool, wet winters.[13] 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.[38] 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.[38]

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.[13,22]

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.[22]

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.[13] 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.[13,22]

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

3.2 Biodiversity Overview

The following information is sourced from the Draft Biodiversity Strategy for Adelaide and the Mount Lofty Ranges[13], 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.[37]

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.[1] 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.[1]

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.[37]

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[26] 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 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.[20,36]

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).[23] 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.[5]

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.[5]

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.[5] 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*).[5] The loss of woody debris can also lead to increased competition for the remaining hollows, particularly where they are used by introduced species.[5]

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.[2,9]

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.[4,33] 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.[1,33]

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).[31]

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.[1] 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.[6]

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, desalinisation 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.[5] 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.[5] Domestic dogs (*Canis* spp.) are also identified as a potential disturbance or predator of some threatened fauna species. Introduced fish (e.g. *Gambusia holbrookii*) 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*

moreleti) 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).[39] 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.[5,29]

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).[39] The level of infestation and its impact vary significantly at local and regional scales. There are difficulties in identifying areas affected without soil testing.[5] 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*).[5,29]

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.[5]

Management guidelines to abate the threat of *Phytophthora* have been developed at both State and national levels.[18,29] 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).[5,29]

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.[5]

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.[1] 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 monilifera* ssp. *monilifera*), olives (*Olea europaea*) and many grasses such as perennial veldt grass (*Ehrharta calycina*).[5] 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.[5]

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.[5]

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 the1983 Ash Wednesday fires. Fire regimes in the region have been altered dramatically from pre-European times.[5]

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.[5] 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 re-instate 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.[5]

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.[1] Species' life history traits have a strong influence on the ability to persist or recolonise after fire.[5]

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.[28,40]

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.[5]

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 lead 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.[5]

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.[25]

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.[25]

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.[35]

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.[5]

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.[13]

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[5] 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

SRL population proportion	Regional Vulnerability Group 1	2	3	4	5	6
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

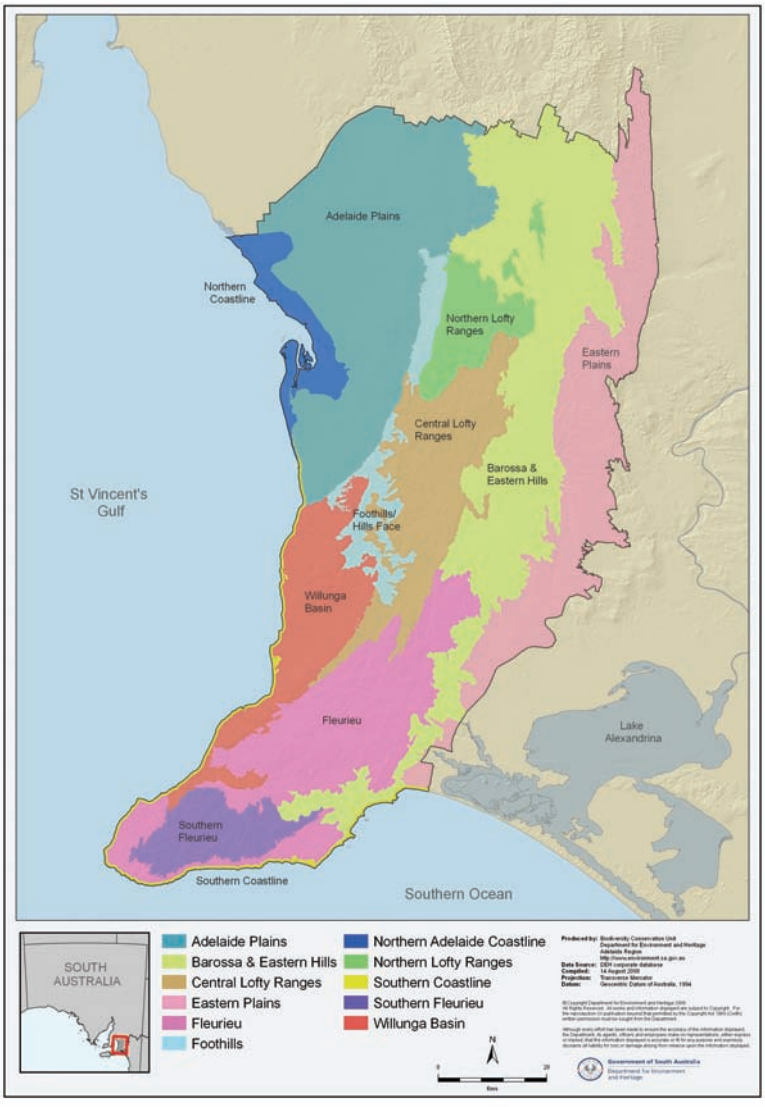
Note: VH= Very High; H=High; M=Medium

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-Variegated >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*
Grassland	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.
Grassy Woodland	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.
Heathy Woodland	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
Heathy Open Forest	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
Shrubland	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.
Mallee	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.
Riparian	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.
Wetland	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.
Coastal	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)[7,32] 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.[7,26] 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: Kaurna, 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 Kaurna, 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.[27] 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							
	1	**2**	**3**	**4**	**5**	**6**	**Total (#)**	**Total (%)**
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							
	1	**2**	**3**	**4**	**5**	**6**	**Total (#)**	**Total (%)**
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 g*rassy 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 leucoxylon* 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. leucoxylon* 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)[8]	**AMLR RRP priority**
	Very High	**High**	**Medium**		
Grassy Woodland	1	3,4,5	2,9,13,14,15	*Banksia marginata* Grassy Low Woodland	**Very High**
				Eucalyptus microcarpa Grassy Low Woodland	**Very High**
				Eucalyptus odorata +/- E. leucoxylon Grassy Low Woodland	**Very High**
				Callitris preissii +/- Eucalyptus leucoxylon Grassy Low Woodland	**High**
				Allocasuarina verticillata Grassy Low Woodland	**Medium**
				Eucalyptus leucoxylon ssp. *pruinosa +/- E. odorata* Grassy Low Woodland	**Medium**
				Eucalyptus porosa Woodland	**Concern**
Wetland	6	1,2,3	4,5,8,12,13,18	Freshwater wetlands e.g. *Triglochin procerum* Herbland	**Very High**
				Leptospermum lanigerum Closed Shrubland	**Very High**
				Melaleuca squamea +/- Leptospermum continentale Closed Shrubland	**Very High**
				Gahnia filum Sedgeland	**High**
Riparian	1,6	2,3,19	7,8,10,12,13,14,19	*Eucalyptus dalrympleana* ssp. *dalrympleana* Open Forest	**Very High**
				Eucalyptus ovata +/- E. viminalis ssp. *cygnetensis +/- E. camaldulensis* var. *camaldulensis* Low Woodland	**High**
				Eucalyptus viminalis ssp. *cygnetensis* and/or *E. viminalis* ssp. *viminalis* Woodland	**Medium +**
Grassland	1	3,4	2,5,8,9,15	*Lomandra effusa* Tussock Grassland	**Very High**
				Themeda triandra +/- Danthonia spp. Tussock Grassland	**Very High**
Heathy Woodland		1,5	2,3,4,6,9,12,14,16	*Eucalyptus fasciculosa +/- E. leucoxylon* Heathy Woodland	**High**
Coastal	1,2	4,7,10,11	3,5,6,9,14,15,17		
Shrubland		2	3,4,17	*Melaleuca halmaturorum* Shrubland/ Low Open Forest	**Concern**
Mallee		1,7	3,4,5,10,11,		
Heathy O. Forest		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 & management links

Current direct threat category	FLORA	FAUNA*	FISH	Actions^
Agriculture & Aquaculture				
Grazing & Disturbance by Stock	Medium-High	Very High	High	A1.3; A3.15
Biological Resource Use				
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
Climate Change, Drought & Severe Weather				
Climate Change, Drought & Severe Weather	Very High	Very High	Very High	A3.19
Energy Production & Mining				
Mining & Quarrying	Low	Low	Medium-High	A4.2
Human Intrusions & Disturbance				
Recreational Activities & Site Disturbance	Medium-High	Medium	Medium-High	A1.5
Invasive & Other Problematic Species & Genes				
Competition with Honey Bees	-	Low	-	
Disease & Insect Damage#	Low	Medium	Medium-High	A4.2; see note #
Grazing & Disturbance by Deer or Goats	Low	Low	-	
Grazing & Disturbance by Kangaroos	Medium-High	Low	-	A1.8; A3.15
Grazing & Disturbance by Rabbits	Medium	Medium-High	-	A1.9; A3.15
Predation & Disturbance by Uncontrolled Dogs	-	Medium	-	A1.12
Predation by Cats	-	Very High	-	A1.12; A3.22
Predation by Foxes	-	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)	Low	Low	-	
Weed Invasion+	Very High	High	-	A1.13; A1.14; A3.15
Natural Systems Modifications				
Fire Management Activities	Low	Medium-High	-	A1.15
Inappropriate Fire Regimes	Medium-High	Very High	Low	A3.17; A3.15
Incompatible Site Management	Medium-High	Medium	-	A1.16
Removal of Snags	-	-	Medium-High	A1.4; A1.20
Water Management & Use	High	High	Very High	A1.17-A1.19; A3.15
Pollution				
Pollution & Poisoning	Medium	Medium-High	Medium-High	A1.16
Residential & Commercial Development				
Residential & Commercial Development	Medium-High	High	Medium-High	A1.21
Transportation & Service Corridors				
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.

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

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

^ 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.

Table 15. Threatened flora species analysis summary (pages 34-37)

^ Sorted alphabetically by Regional Vulnerability Group
# Level of Knowledge/management: Poor = ✖; Some = ✓; Fair = ✓✓ (see Section 5.4)
* The first and second preferred BVG: GW = Grassy Woodland; HF = Heathy Open Forest; HW = Heathy Woodland; CO = Coastal; WE = Wetland; MA = Mallee; RI = Riparian; SH = Shrubland; GR = Grassland. Species with an asterisk after the abbreviated BVG have been classified as entirely confined to that BVG within the region.

				Sub-regional Landscape Priority ◆ **Very High;** ◈ **High;** ◇ **Medium**												**Threat Summary – Regional** VH **Very High;** H **High;** M **Medium;** L **Low**																				
Species^	**Regional Vulnerability Group**	**Level of Knowledge & Management #**	**Broad Vegetation Group preference ***	**Adelaide Plains**	**Barossa & Eastern Hills**	**Eastern Plains**	**Fleurieu**	**Foothills/ Hills Face**	**Central Lofty Ranges**	**Northern Coastline**	**Northern Lofty Ranges**	**Southern Coastline**	**Southern Fleurieu**	**Willunga Basin**	**Grazing & Disturbance by Stock**	**Illegal Hunting or Collection**	**Climate Change, Drought & Severe Weather**	**Mining & Quarrying**	**Recreational Activities & Site Disturbance**	**Disease & Insect Damage**	**Grazing & Disturbance by Kangaroos**	**Grazing & Disturbance by Rabbits**	**Grazing & Disturbance by Deer or Goats**	**Problematic Native Species (Other)**	**Weed Invasion**	**Fire Management Activities**	**Inappropriate Fire Regimes**	**Incompatible Site Management**	**Water Management & Use**	**Pollution & Poisoning**	**Residential & Commercial Development**	**Road, Rail & Utilities Maintenance Activities**
Corybas dentatus	1a	✓✓	HF*		◆				◆							M	M		M		M	M			M			M			L		M
Hibbertia tenuis	1a	✖	WE*				◆								L		M											M	M				
Prasophyllum murfetii	1a	✓	WE*				◆						◆		H	L	M				L	L			M		M	VH	VH				
Pterostylis bryophila	1a	✓✓	GW*				◆									M	H				M	L			VH		M		L				
Thelymitra cyanapicata	1a	✓✓	WE*					◆							M	M	M				M	L			M			H	M	M			
Allocasuarina robusta	1b	✓	HW/WE				◆								M		M		M		M	H			M		L		M	M			H
Caladenia colorata	1b	✓✓	HW*			◆									VH	L	M		L		L				M			L					M
Caladenia gladiolata	1b	✓✓	HW/GW					◆								M	H				M	M			L	M	M						
Caladenia ovata	1b	✓	HW/SH										◆				H				L	L			L		H						
Calochilus cupreus	1b	✓✓	CO*									◆				M	M		H		L	L			H	L	M						
Corybas expansus	1b	✓	CO*									◆					M				L	L			M								
Lycopodiella serpentina	1b	✖	WE*				◆								M		VH		M						H			M	H				M
Pratia puberula	1b	✖	WE*					◆	◆								M							M	H				L				
Prostanthera eurybioides	1b	✓✓	MA/SH			◆									M	L		L	M		M	M			M	M	H			L		M
Psilotum nudum	1b	✓	RI*					◆	◆							L	L												VH				
Pterostylis uliginosa	1b	✓	WE*				◆								M		H								H			M	H		M		
Thelymitra circumsepta	1b	✓	WE*						◆							L	M							M	M		M		M				
Todea barbara	1b	✓	HF/WE					◆	◆						L	L	L								H	H	L		M		M		
Caladenia argocalla	1c	✓✓	GW*		◆	◆					◆						M				M	L			M						L	L
Caladenia behrii	1c	✓✓	HW*					◈	◈		◆			◈	L	M	M		M		M	L	L		L	L							L
Caladenia rigida	1c	✓✓	HW*					◈	◈		◆					L	M		M		M	L	L		L	L	H						L
Correa calycina var. *calycina*	1c	✓✓	RI/WE				◆								M		M		L	M	M	L			M		M	L	M	L			L
Dampiera lanceolata var. *intermedia*	1c	✓✓	CO/HW									◆							M						M		M	L				VH	L
Eleocharis atricha	1c	✖	WE*											◆			M												M				
Eucalyptus paludicola	1c	✖	HW/WE				◆								M		M				L				M			L	M				M
Helichrysum rutidolepis	1c	✓	RI*				◈	◈	◆					◈			H								M				H				
Juncus prismatocarpus	1c	✖	WE*				◆										M	L	M						M								
Lycopodium deuterodensum	1c	✓	HF/SH						◆								M							M	H				L				
Maireana decalvans	1c	✖	CO*	◆									◈	◈			H		M						H				M		H		
Mazus pumilio	1c	✖	WE*					◆							M		L				L				H			M	H	L			

Species^	Regional Vulnerability Group	Level of Knowledge & Management #	Broad Vegetation Group preference *	Sub-regional Landscape Priority ◆ Very High; ◈ High; ◇ Medium: Adelaide Plains	Barossa & Eastern Hills	Eastern Plains	Fleurieu	Foothills/ Hills Face	Central Lofty Ranges	Northern Coastline	Northern Lofty Ranges	Southern Coastline	Southern Fleurieu	Willunga Basin	Threat Summary – Regional VH Very High; H High; M Medium; L Low: Grazing & Disturbance by Stock	Illegal Hunting or Collection	Climate Change, Drought & Severe Weather	Mining & Quarrying	Recreational Activities & Site Disturbance	Disease & Insect Damage	Grazing & Disturbance by Kangaroos	Grazing & Disturbance by Rabbits	Grazing & Disturbance by Deer or Goats	Problematic Native Species (Other)	Weed Invasion	Fire Management Activities	Inappropriate Fire Regimes	Incompatible Site Management	Water Management & Use	Pollution & Poisoning	Residential & Commercial Development	Road, Rail & Utilities Maintenance Activities
Olearia glandulosa	**1**c	✖	WE*				◆								M		M								H					M			
Prasophyllum pruinosum	**1**c	✓	GW*		◆											L	M		H			H					VH					H	
Pterostylis arenicola	**1**c	✓✓	GW/SH							◆						M	H		M			L				H	M		H			H	M
Pterostylis falcata	**1**c	✓	WE*				◆								H	L	H		M							VH			L	VH	L		
Pterostylis sp. Hale (R.Bates 21725)	**1**c	✓	HW*								◆								L														
Ranunculus papulentus	**1**c	✖	WE*				◆	◆					◆				H													H			
Thelymitra cyanea	**1**c	✓	WE*				◆		◈						H	L	H		M			M	M			M	H	M	M	H	L		L
Tricostularia pauciflora	**1**c	✖	SH/WE			◆	◆								H		M									M	M			L			
Wurmbea uniflora	**1**c	✓	RI/GW					◆									H						L			H							
Acacia pinguifolia	**2**	✓✓	MA/SH			◆										L			L							H	VH	L		L		L	H
Austrostipa oligostachya	**2**	✖	GW/GR				◆		◈		◈				M		H		M										M				
Brachyscome diversifolia	**2**	✓	HW/GW					◆	◈																	M			M				
Calochilus paludosus	**2**	✖	HW/WE				◆								M		M		M							VH							
Crassula sieberiana	**2**	✖	RI/GW	◈			◆			◈			◈		H											M			M				
Veronica derwentiana ssp. *anisodonta*	**2**	✖	HW/RI				◆				◈						L		L			L	L			H			L	M	M		M
Veronica derwentiana ssp. *homa.*	**2**	✓	HW/WE				◆	◈	◈		◈						M		L			M	M			H			M	M	M		
Diuris brevifolia	**2**	✓✓	HW/WE		◈		◆	◈					◈		L	L	H		M			H	M			H			L	VH	L		
Gahnia radula	**2**	✖	RI/HW						◆								H					M				M							
Gratiola pumilo	**2**	✖	WE*		◆				◆								H													H			
Microtis rara	**2**	✓	WE*				◆								H		H									VH				H	VH		
Paracaleana disjuncta	**2**	✖	HW*				◆									L	M					M	M							H	VH	VH		
Podolepis muelleri	**2**	✖	CO*							◆																		VH					H	
Pterostylis cucullata ssp. *sylvicola*	**2**	✓✓	GW*					◆	◈					◈		M	H		L			L	H			VH	M	M	L		L		L	L
Schizaea fistulosa	**2**	✖	WE*				◆		◈				◈				H													H			L
Senecio megaglossus	**2**	✖	SH/GR			◆									M				L	L		L				M		M					
Thelymitra mucida	**2**	✓	WE*				◆								H	L	H						L			M	H	H	M	H	L		
Utricularia lateriflora	**2**	✖	WE*				◆	◈					◈		M		H		L							M		M		M			
Viola betonicifolia ssp. *betonicifolia*	**2**	✓	HW/GW					◆									M									H				VH	H		
Acacia rhetinocarpa	**3**	✓✓	MA/SH		◈										M						L					H				M		L	L
Adiantum capillus-veneris	**3**	✖	WE*	◈					◈					◈			H	M								M				VH		M	M
Austrostipa echinata	**3**	✖	CO*									◆								H													
Caladenia bicalliata ssp. *bicalliata*	**3**	✓	CO*								◆						H					M	H			L	M						
Caladenia vulgaris	**3**	✖	HW*		◈				◈						L		H		M			M	H			H	M				L		
Corybas unguiculatus	**3**	✓	HF*		◈		◆							◈		L	H		H							H				H	M		L
Cryptostylis subulata	**3**	✖	WE*				◆	◈					◈		M		H					L	L			H				H	L	L	L
Daviesia pectinata	**3**	✖	MA/CO				◆					◈							M							M							M

Species^	Regional Vulnerability Group	Level of Knowledge & Management #	Broad Vegetation Group preference *	Adelaide Plains	Barossa & Eastern Hills	Eastern Plains	Fleurieu	Foothills/ Hills Face	Central Lofty Ranges	Northern Coastline	Northern Lofty Ranges	Southern Coastline	Southern Fleurieu	Willunga Basin	Grazing & Disturbance by Stock	Illegal Hunting or Collection	Climate Change, Drought & Severe Weather	Mining & Quarrying	Recreational Activities & Site Disturbance	Disease & Insect Damage	Grazing & Disturbance by Kangaroos	Grazing & Disturbance by Rabbits	Grazing & Disturbance by Deer or Goats	Problematic Native Species (Other)	Weed Invasion	Fire Management Activities	Inappropriate Fire Regimes	Incompatible Site Management	Water Management & Use	Pollution & Poisoning	Residential & Commercial Development	Road, Rail & Utilities Maintenance Activities
Euphrasia collina ssp. *osbornii*	3	✓	HW/CO		◇		◈	◇	◈			◈	◇	◇	M		H		L						M	M	M		M		L	M
Glycine tabacina	3	✖	RI/GW					◆						M					M												M	
Haloragis myriocarpa	3	✓	HW/SH						◆						M		H								M							
Lycopodiella lateralis	3	✖	WE*				◆														H						H		H			
Microtis atrata	3	✓	WE*		◈		◈				◈				M		H				M				M		H		H			
Oreomyrrhis eriopoda	3	✓	GW/RI					◈	◈						L				M			M			M						L	
Orobanche cernua var. *australiana*	3	✖	CO*							◆									H						H							
Paracaleana minor	3	✓	HW*				◆									M		L	M			M			M		L	M				H
Prasophyllum fecundum	3	✓	MA*		◆										L		H	L			H	H			H					L		
Prasophyllum occultans	3	✓	GW/HW		◈			◈						◈			H	M			H	H			H					L	M	
Ranunculus inundatus	3	✓	WE*				◈		◈				◈				H								H			H	H			
Schizaea bifida	3	✖	WE/HW				◆								L		VH								H			M			L	
Schoenus discifer	3	✖	WE*				◈	◈					◈		M		H		M						H		M	M				M
Spiranthes australis	3	✖	WE*				◈						◇		H		H				M	M			H			L	H	L		
Spyridium coactilifolium	3	✓	CO/HW		◈		◈					◈			L		H	H	M		M	L			M				M	L	M	
Acacia menzelii	4	✓✓	MA/GW			◈									M										M		H					H
Amphibromus pithogastrus	4	✖	RI/GW						◈		◈						H												H			
Caladenia valida	4	✓✓	HW/HF				◈					◈			L	M	H		L		M				H			L	H		L	L
Caleana major	4	✓	HW*				◈	◇	◈						M	L	H		M						H		M	M			L	L
Calochilus campestris	4	✓	WE/MA				◈										M		M										M			
Centrolepis glabra	4	✖	WE*		◈		◈				◈						H												H		M	
Correa eburnea	4	✓	RI/HW				◈					◇	◈	◇	M					M					M		M		L				
Cullen parvum	4	✓	GW/GR	◈				◇	◈					◇	L		H		M			M			H						H	L
Eucalyptus phenax ssp. *compressa*	4	✖	MA*				◈						◈		M													L	L	M		M
Haloragis brownii	4	✓	WE/RI		◇		◈	◇					◈				H								H				H			M
Juncus radula	4	✖	GW/RI	◈	◇												H												H		H	
Lagenophora gracilis	4	✓	WE/GW				◈	◈	◇						M						M				H						L	
Leionema hillebrandii	4	✓	HW/RI					◇	◈		◇						VH		L		L	L			H				H		M	
Logania minor	4	✖	CO*				◈			◈									M			L			M						VH	
Luzula flaccida	4	✖	GW/RI				◇	◇	◈		◇						H		L												L	
Montia fontana ssp. *chondrosperma*	4	✓	WE/HW		◈			◇	◈		◈			◇	M		M				L	L			M				M	M		M	
Neopaxia australasica	4	✖	WE*		◈						◈						H												H		M	
Potamogeton ochreatus	4	✖	WE*		◇		◇		◈				◈				H												H		L	
Prasophyllum pallidum	4	✓	GW/HW	◇	◈			◇			◈			◈	M	L	H		M		L	M			H		M	L			L	
Pultenaea dentata	4	✖	WE*				◈								M		H		M						H			M	M			M
Schoenus latelaminatus	4	✖	WE/RI		◈		◇	◇	◇					◇			M								H							H

Sub-regional Landscape Priority
◆ Very High; ◈ High; ◇ Medium

Threat Summary – Regional
VH Very High; H High; M Medium; L Low

Species^	Regional Vulnerability Group	Level of Knowledge & Management #	Broad Vegetation Group preference *	Adelaide Plains	Barossa & Eastern Hills	Eastern Plains	Fleurieu	Foothills/ Hills Face	Central Lofty Ranges	Northern Coastline	Northern Lofty Ranges	Southern Coastline	Southern Fleurieu	Willunga Basin	Grazing & Disturbance by Stock	Illegal Hunting or Collection	Climate Change, Drought & Severe Weather	Mining & Quarrying	Recreational Activities & Site Disturbance	Disease & Insect Damage	Grazing & Disturbance by Kangaroos	Grazing & Disturbance by Rabbits	Grazing & Disturbance by Deer or Goats	Problematic Native Species (Other)	Weed Invasion	Fire Management Activities	Inappropriate Fire Regimes	Incompatible Site Management	Water Management & Use	Pollution & Poisoning	Residential & Commercial Development	Road, Rail & Utilities Maintenance Activities
Tecticornia flabelliformis	4	✓	CO*							◈					M		VH		M						H			M			H	M
Thelymitra inflata	4	✓	HW/RI				◈				◈					L	H		L		M	M			M		H			L		M
Asterolasia muricata	5	✓	HW/SH				◈					◈															M		L			
Boronia parviflora	5	✖	WE*				◈		◇				◇		M		L		M						M			M	H			
Dipodium pardalinum	5	✓	HF/HW						◇				◈		L		H		L		H				L					M		
Gastrodia sesamoides	5	✖	HF/RI		◇		◇		◇				◇		L		H		L						H			M			M	
Hydrocotyle crassiuscula	5	✖	GW*				◈																		M				M			
Juncus amabilis	5	✓	HW/WE		◇		◇		◇						M		H		M						M			M	M		L	
Olearia pannosa ssp. *pannosa*	5	✓	MA/SH	◇	◇		◇		◇				◇		M				L						H	M				M	L	H
Prasophyllum fitzgeraldii	5	✖	GW/MA		◇		◇				◈						H		L		L	L			M			M			L	
Pteris tremula	5	✓	WE/RI				◈								M		H								H				H	M		
Thelymitra holmesii	5	✓	WE*				◈		◇						M				L		H	M			M			M	M	L		
Thelymitra peniculata	5	✓	HW/WE								◈						M								M			M				
Trymalium wayi	5	✖	HW/SH			◇					◇														M							
Xyris operculata	5	✖	WE*				◈							◇			H		M						M				H			
Acacia gunnii	6	✓	HW/HF					◇	◇								M			M					L		H			L	M	
Callistemon teretifolius	6	✖	HW/GW		◇			◇			◇				M										M							
Dianella longifolia var. *grandis*	6	✓✓	GW/GR	◇	◇	◇	◈	◇	◇		◇				M	L	M		M		L	M			H			M			L	
Diuris behrii	6	✓✓	GW/GR		◇	◇		◇						◇	M	L	M		L		M	M			M						M	
Eremophila gibbifolia	6	✖	MA*		◇	◇									H							L			M						M	
Eucalyptus cneorifolia	6	✖	HW/MA		◇		◇						◇		M										M							M
Glycine latrobeana	6	✓✓	GW/GR		◇		◇	◇	◇		◇		◇	◇	M				L						H	H			L	L		
Melaleuca squamea	6	✖	WE*				◈	◇				◇	◇				H												H			
Phyllanthus striaticaulis	6	✖	CO/HW		◇		◇		◇		◇		◇												M					L		
Prasophyllum australe	6	✓	WE*				◈					◇	◇		M		H		L		M	M			H		M		M		L	M
Prostanthera chlorantha	6	✖	SH/MA		◇		◇		◇		◇		◇		M						L	M			M						L	M
Pterostylis curta	6	✓	GW/RI	◇			◇	◇	◇				◇	◇	L	L	H				H	H			H		H				L	
Pultenaea viscidula	6	✖	HF/HW										◈																			

Sub-regional Landscape Priority
◆ Very High; ◈ High; ◇ Medium

Threat Summary – Regional
VH Very High; H High; M Medium; L Low

Table 16. Threatened fauna species analysis summary (pages 38-39)

^ Sorted alphabetically by Regional Vulnerability Group
# Level of Knowledge/management: Poor = ×; Some = ✓; Fair = ✓✓ (see Section 5.4)
* The first and second preferred BVG: GW = Grassy Woodland; HF = Heathy Open Forest; HW = Heathy Woodland; CO = Coastal; WE = Wetland; MA = Mallee; RI = Riparian; SH = Shrubland; GR = Grassland. Species with an asterisk after the abbreviated BVG have been classified as entirely confined to that BVG within the region.
[1] MLR subspecies
[2] Chestnut-rumped Heath-wren (MLR subspecies)
[3] St. Vincent Gulf subspecies

Sub-regional Landscape Priority
◆ Very High; ◈ High; ◇ Medium

Threat Summary – Regional
VH **Very High;** H **High;** M **Medium;** L **Low**

Species^	Class	Regional Vulnerability Group	Level of Knowledge & Management #	Broad Vegetation Group preference *	Adelaide Plains	Barossa & Eastern Hills	Eastern Plains	Fleurieu	Foothills/ Hills Face	Central Lofty Ranges	Northern Coastline	Northern Lofty Ranges	Southern Coastline	Southern Fleurieu	Willunga Basin	Grazing & Disturbance by Stock	Firewood Removal & Rock Removal	Illegal Hunting or Collection	Climate Change, Drought & Severe Weather	Mining & Quarrying	Recreational Activities & Site Disturbance	Competition with Honey bees	Disease & Insect Damage	Grazing & Disturbance by Kangaroos	Grazing & Disturbance by Rabbits	Grazing & Disturbance by Deer or Goats	Predation & Disturbance by Uncontrolled Dogs	Predation by European Fox	Predation by Feral & Uncontrolled Cats	Predation & Competition by Introduced Birds	Problematic Native Species (Other)	Weed Invasion	Fire Management Activities	Inappropriate Fire Regimes	Incompatible Site Management	Water Management & Use	Pollution & Poisoning	Residential & Commercial Development	Road, Rail & Utilities Maintenance Activities	Road-kill
Southern Emu-wren [1]	AVES	1a	✓✓	WE/HW			◈	◆					◈	◆		H			H								L	M	H			M	M	H	L	VH			L	
Spotted Quail-thrush	AVES	1a	×	GW/HW											◆	L	L		M		L			L	L	L	L	H	H			L	L	M						
Chestnut-rumped HW [2]	AVES	1b	✓	HW/SH	◈			◆	◈	◆		◈	◈	◈		L			L	L	L				L				L	M			L	L	H						
Heath Goanna	REPTILIA	1c	×	HW*		◈		◆		◈		◈						L		L							M	H	H		M			L			M			L
Slender-billed Thornbill [3]	AVES	1c	✓	CO*	◈						◆								L		L				L			L	L					L		M		M		
Southern Brown Bandicoot	MAMMALIA	1c	✓✓	HW*		◈		◈	◆	◆				◈	◈	M			L				M				L	M	M			L	M	M	L			L		
Beautiful Firetail	AVES	2	✓	CO/HW				◆		◈			◈	◈	◈	M		L	M						L				L	M	L		L	L	H						
Black-chinned Honeyeater	AVES	2	✓✓	GW/HW	◈	◈	◈	◈	◈	◈		◈	◈		◈				M				M								L		L	M		M		L		
Carpet Python	REPTILIA	2	×	RI*		◆											L	L								M	H	H		L		M				M			L
Cunningham's Skink	REPTILIA	2	✓	GW/CO					◈	◈		◈	◈		◈		L	L	H		L							L	L				M				L			
Lewin's Rail	AVES	2	✓	WE*		◈		◈	◈	◈	◈			◈	◈	H			H								L	M	M			M	L	L		VH	L			L
Orange-bellied Parrot	AVES	2	✓✓	CO*							◆				◆	L		L	H		L						L	L	L	L							L			L
Yellow-bellied Water Skink	REPTILIA	2	×	RI*		◈	◈	◆						◈					H		L							M	L					L	M	M			
Australasian Bittern	AVES	3	✓	WE*	◈	◇			◇		◈		◈		◈	H			H		L						L	L	L				L	L		VH	L	L		
Bassian Thrush	AVES	3	×	HW/GW		◇		◈	◇	◈		◈		◈	◇	L	L		M		L		L	L	M	L		L	L	M		L	L	H						
Brown Quail	AVES	3	×	GR/GW	◇	◈	◈	◈	◇				◈		◇	L	L		M					L	M	L	L	L	L			L		M	L			L		
Brown Toadlet	AMPHIBIA	3	×	HW/WE				◇	◈	◈		◈		◇					H	L			L									L			M	L	H	L		
Buff-banded Rail	AVES	3	✓	WE*	◈	◈		◇	◇	◈	◈		◇	◇	◈	H			M		L						L	M	M			M	L	L		VH	L	L		L
Crested Shrike-tit	AVES	3	×	GW/HW	◇	◈	◇	◈	◇	◈	◇	◇	◇	◇	◈	L	L						M										L	M		M		L		
Diamond Firetail	AVES	3	✓	GW/WE	◇	◈	◈	◇	◇			◈		◇		M	L	L	L	L	L			L	M			L	L	L		H			L	L			L		
Eastern Water Skink	REPTILIA	3	×	RI*	◇				◈	◈		◈		◈	◈		L											M				L		M		M	M			
Five-lined Earless Dragon	REPTILIA	3	×	GR/GW			◈								◈													L	L			L		M			M			
Flinders Ranges Worm-lizard	REPTILIA	3	✓	GR/GW	◈							◈				L	L															L		M	L		M			
Hooded Robin (South-East)	AVES	3	✓	GW/HW	◇	◈	◈	◇	◇	◇		◇	◇		◇	L	L							L	L				L		L	L		L	L			L		
Olive Snake-lizard	REPTILIA	3	×	GR/GW		◈	◈									L	L			L					L			H	H			M	L	L			L			
Painted Button-quail	AVES	3	×	HW/GW	◇	◈	◇	◈	◇	◇		◈	◇		◇	L					L			L	M	L	L	L	L			L	L	L	L			L		
Pygmy Copperhead	REPTILIA	3	×	HF*	◇			◈		◈					◇				H	L								M	M		L			L	M			M	L		
Restless Flycatcher	AVES	3	✓	GW/HW	◇	◈	◈	◇	◇	◇	◇	◇	◇	◇	◇	M	L		L						L				L			L		M				L	L	
Southern Grass Skink	REPTILIA	3	×	WE/CO				◈			◈						L		M		L							M	M				L	L		M	L			L

					Sub-regional Landscape Priority ◆ Very High; ◈ High; ◇ Medium											Threat Summary – Regional VH Very High; H High; M Medium; L Low																								
Species^	Class	Regional Vulnerability Group	Level of Knowledge & Management #	Broad Vegetation Group preference *	Adelaide Plains	Barossa & Eastern Hills	Eastern Plains	Fleurieu	Foothills/ Hills Face	Central Lofty Ranges	Northern Coastline	Northern Lofty Ranges	Southern Coastline	Southern Fleurieu	Willunga Basin	Grazing & Disturbance by Stock	Firewood Removal & Rock Removal	Illegal Hunting or Collection	Climate Change, Drought & Severe Weather	Mining & Quarrying	Recreational Activities & Site Disturbance	Competition with Honey bees	Disease & Insect Damage	Grazing & Disturbance by Kangaroos	Grazing & Disturbance by Rabbits	Grazing & Disturbance by Deer or Goats	Predation & Disturbance by Uncontrolled Dogs	Predation by European Fox	Predation by Feral & Uncontrolled Cats	Predation & Competition by Introduced Birds	Problematic Native Species (Other)	Weed Invasion	Fire Management Activities	Inappropriate Fire Regimes	Incompatible Site Management	Water Management & Use	Pollution & Poisoning	Residential & Commercial Development	Road, Rail & Utilities Maintenance Activities	Road-kill
Tiger Snake	REPTILIA	3	✖	RI/HW						◈		◈					L	L	H								L	M	L				L	L	L	M	M			
Yellow-tailed Black-Cockatoo	AVES	3	✓	GW/HW	◇	◇	◇	◈	◈	◈		◇	◇	◇	◈		L	L	M	L		L	L					L	M	L	M		L	M				L		L
Baillon's Crake	AVES	4	✓	WE*	◈	◇		◇		◇	◇	◇	◇		◈	H			H								L	M	M			M	L	L		VH	L	L		L
Brown Treecreeper	AVES	4	✓✓	GW/MA	◇	◈	◇	◇	◇	◇		◇		◇	◇	L	M				L	L			L		L	L	L	L		L		M						
Chestnut-rumped Thornbill	AVES	4	✖	GW/HW		◈	◈		◇						◇	M	L							L	M			L	L				L	L						
Jacky Winter	AVES	4	✖	GW/HW	◇	◈	◈	◇	◇	◇		◇	◇		◇		L				L		L						L			L		L				H		
Peregrine Falcon	AVES	4	✓✓	RI/CO	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇			L	L	L	M								L								L	L		
Red-capped Robin	AVES	4	✓	GW/MA	◇	◇	◈		◇	◇	◇	◇	◇		◇	L	L							L	L				L			L	L	L				L		
Scarlet Robin	AVES	4	✓✓	GW/HW	◇	◇	◇	◈	◇	◈		◇	◇	◇	◇	L	L		M						L	L		L	L			L	L	M				L		
Southern Whiteface	AVES	4	✖	GW/HW		◈	◈	◇							◇	M									M			L	L				L	L						
Spotless Crake	AVES	4	✓	WE*	◈	◇	◇			◇	◈		◇	◇	◈	M			H								L	M	M			M	L	L		VH	L	L		
Tawny-crowned Honeyeater	AVES	4	✓	SH/CO	◇	◇	◇	◈	◇	◇		◈	◇		◇	L			M			L			L				L				L	H				L		
Western Pygmy-possum	MAMMALIA	4	✓✓	MA/HW		◇		◈		◇				◇					H		L	L	M					L	L				L	H						
White-winged Chough	AVES	4	✓✓	GW/MA	◇	◇	◇	◇	◇	◇		◈															L	L	L			L						L		L
Zebra Finch	AVES	4	✖	GW/SH	◇	◈	◇			◇	◇	◇			◈	L			L										L	L		L						L	L	
Brush Bronzewing	AVES	5	✖	HW/CO	◇	◇	◇	◇	◇	◇		◇	◇	◇	◇	L			M					L	M	L	L	M	M			L	L	H				L		L
Little Wattlebird	AVES	5	✖	HW/SH	◇	◇	◇	◇	◇	◇	◇	◇	◇		◇	L			M			L		L									L	M				L		
Pallid Cuckoo	AVES	5	✓	SH/MA	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L			L																					
Red-rumped Parrot	AVES	5	✖	GW/RI	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L	L					L	M	L	L	L	L	L	L	L	L	L						L		L
Tawny Frogmouth	AVES	5	✖	HW/GW	◇	◇		◇	◇	◇		◇	◇		◈				M										L						M	L	L			
Varied Sittella	AVES	5	✓	HW/GW	◇	◇	◇	◇	◇	◇		◇	◇	◇	◇	L	L						M										L	M				L		
Whistling Kite	AVES	5	✖	GW/RI	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇			L			M																L	L		L
White-browed Babbler	AVES	5	✓✓	GW/HW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L	L											L	L			L	L	M				L		
White-fronted Chat	AVES	5	✖	SH/WE	◇	◇	◇	◇			◈	◇	◇	◇	◇	L			L		L				L							L		L	M			L		
White-naped Honeyeater	AVES	5	✓	HW/GW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L			M				M								L	L	L	M		M		L		
Brown-headed Honeyeater	AVES	6	✓	HW/GW	◇	◇	◇	◇	◇	◇		◇	◇	◇	◇	L			L			L	L								L	L	L	M		M		L		
Fairy Martin	AVES	6	✖	RI*	◇	◇	◇	◇	◇	◇	◇	◇	◇		◇				L		M									L							L	L		
Fan-tailed Cuckoo	AVES	6	✓	HF*	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L			M																			H		
Horsfield's Bronze-cuckoo	AVES	6	✓	HW/GW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L																						L		
Rufous Whistler	AVES	6	✓	GW/HW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L							L								L		L	L				L		
Sacred Kingfisher	AVES	6	✖	GW/HW	◇	◇	◇	◇	◇	◇	◇	◇	◇		◇		L		L			L	L							L							L	L		
Shining Bronze-Cuckoo	AVES	6	✓	HW/GW	◇	◇		◇	◇	◇	◇	◇	◇	◇	◇	L			M																			L		
Tree Martin	AVES	6	✖	GW/HW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇		L					L								L								L	L	
Yellow Thornbill	AVES	6	✓	GW/HW	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L				L					L								L	H				L		
Yellow-rumped Thornbill	AVES	6	✓	GW/GR	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	L	L								L				L			L			M			L		

Table 17. Threatened freshwater fish analysis summary

		Basin Presence (confirmed, post-1984 records) ● Present						Threat Summary – Regional VH **Very High;** H **High;** M **Medium;** L **Low**													
Species	**Family**	**Fleurieu Peninsula**	**Gawler River**	**Lower Murray River**	**Myponga River**	**Onkaparinga River**	**Torrens River**	**Grazing & Disturbance by Stock**	**Fishing & Harvesting Aquatic Resources**	**Illegal Hunting or Collection**	**Climate Change, Drought & Severe Weather**	**Mining & Quarrying**	**Recreational Activities & Site Disturbance**	**Disease & or Insect Damage**	**Predation & Competition by Introduced Fish**	**Inappropriate Fire Regimes**	**Removal of Snags**	**Water Management & Use**	**Pollution & Poisoning (chemical & solid waste)**	**Residential & Commercial Development**
Climbing galaxias	*GALAXIIDAE*	●[1]	●[1]		●[1]	●[1]	●[1]	H	L	L	VH	L	M	L	H	M	L	VH	M	L
Congolli	*BOVICHTHYIDAE*	●[1]	●[1]	●[2]	●[1]	●[1]	●[1]	M	L	M	VH	L	M	L	M		L	VH	M	L
Mountain galaxias	*GALAXIIDAE*	●[1]	●[1]	●[2]	●[1]	●[1]	●[1]	H	L	L	VH	L	M	L	H	M	L	VH	M	L
Murray hardyhead	*ATHERINIDAE*			●[2]				M	L	L	VH	L	M	L	H	M	L	VH	M	L
Pouched lamprey	*GEOTRIIDAE*			●[2]			●[1]	M	L	L	VH	L	M	L	M		L	VH	M	L
River blackfish	*GADOPSIDAE*			●[2]				M	L	M	VH	M	M	L	H	M	H	VH	M	H
Shortheaded lamprey	*MORDACIIDAE*						●[1]	M	L	L	VH	L	M	L	M		L	VH	M	L
Southern pygmy perch	*NANNOPERCIDAE*	●[1]		●[2]				H	L	M	VH	L	M	L	VH	M	L	VH	H	H
Yarra pygmy perch	*NANNOPERCIDAE*			●[2]				M	L	M	VH	L	M	L	H		L	VH	M	L

[1] South Australian Gulf Drainage Division
[2] Murray-Darling Drainage Division

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).[25]

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

	# species*				
	Poor ✖	**Some ✓**	**Fair ✓✓**	**Total (#)**	**Total (%)**
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%**
Total (#)	28	26	10	**64**	
Total (%)	**44%**	**41%**	**15%**		

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

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*

HEATHY 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 bicalliata* ssp. *bicalliata, Corybas expansus, Spyridium coactilifolium*

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

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

HEATHY 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*

HEATHY OPEN FOREST: *Corybas dentatus*

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

MALLEE: *Acacia pinguifolia, Acacia rhetinocarpa, 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*

HEATHY WOODLAND: *Caladenia valida*

MALLEE: *Acacia menzelii*

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.[11] 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. leucoxylon* 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

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

Broad vegetation group - current direct threat	
Weed Invasion ⬇ (see Appendices Part A for priority weed species)	Very High
Grazing & Disturbance by Kangaroos ⬇ ⚑	High
Grazing & Disturbance by Stock ⬇ ⚑	High
Inappropriate Fire Regimes ⬇ ⚑	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 <u>urgent and sustained action</u> 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**
O1.1	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**
O2.1	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
	Threat abatement (current direct threats)			
A1.1	**Threat Abatement Planning** 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
A1.2	**Threat Abatement Planning** 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
A1.3	**Stock grazing & disturbance** 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
A1.4	**Fishing & Harvesting Aquatic Resources** Increase legislative protection of threatened freshwater fish species through listing on threatened species schedules.	DEH; PIRSA; NGO	PC11	O1.1
A1.5	**Recreational Activities** 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
A1.6	**Disease & Insect Damage - *Phytophthora*** Land management agencies implement best practice according to the *Phytophthora* Management Guidelines (2006).	DEH; AMLRNRMB; AMLRRRT; DWLBC; LM	PC12	O1.1
A1.7	**Disease & Insect Damage - *Phytophthora*** Prevent *Phytophthora* infestation at uninfested locations of priority species that are considered susceptible.	DEH; AMLRNRMB; RP; AMLRRRT	PC13	O1.1
A1.8	**Kangaroos** 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
A1.9	**Rabbits** 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; AMLRNRMB; SAMDBNRMB; LM; LG	PC10; PC4.1	O1.1
A1.10	**Foxes** Develop regional protocols for fox baiting including identification of priority locations and monitoring procedures.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; DWLBC; RP	PC14; PC4.2; PC10	O1.1
A1.11	**Foxes** If feasible for species recovery outcomes, implement landscape scale fox baiting programs.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; DWLBC; LM; RP	PC10; PC4.2	O1.1
A1.12	**Cats and Dogs** Promote responsible cat and dog ownership through education, council by-laws and policies.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; LG; NGO; RP	PC15; PC4	O1.1
A1.13	**Weeds** Minimise impacts of weeds at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; RP; NGO; DWLBC; SAW; FSA; LG	PC10; PC3; PC4.1	O1.1
A1.14	**Weeds** Implement improved weed hygiene control measures (e.g. tool and vehicle wash-downs, particularly for earth moving machinery in conservation areas).	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; DWLBC; SAW; FSA; LG	PC16; PC3	O1.1
A1.15	**Fire Management** 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
A1.16	**Site Management (also Pollution & Poisoning, Firewood & Rock Removal)** 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; AMLRNRMB; SAMDBNRMB; AMLRRRT; RP; NGO;	PC6; PC17; PC10; PC22	O1.1
A1.17	**Water - Management** Minimise impacts of inappropriate water use at priority locations of threatened species and ecological communities as determined by prioritisation and associated tools.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; RP; DWLBC; SAW; EPA; LG; CC	PC10; PC3.1	O1.1
A1.18	**Water - Forestry** Increase consideration of threatened species and ecological community requirements during	FSA; AMLRNRMB; 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		
A1.19	**Water – Planning** 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
A1.20	**Water - Freshwater fish recovery planning** 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
A1.21	**Residential & Commercial Development** 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
A1.22	**Roadside Maintenance** 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
	Habitat re-establishment			
A2.1	Further analyse distribution and habitat requirements of priority species to inform habitat re-establishment initiatives. *Note: To be undertaken after key impediments to recovery actions commenced. See other important related actions A3.2; A3.19; A4.2.*	AMLRRRT; DEH	PC8	O2.1
	Recovery activity, coordination and integration of management			
A3.1	**State and federal NRM programs** 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
A3.2	**Regional landscape restoration plans** 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
A3.3	**Regional Recovery Team** 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

	ACTION THEME/ACTION	RESPONSIBILITIES	PC LINK	OBJ. LINK
A3.4	**Review plan analyses** Regularly review the species inclusion, prioritisation and threat analysis processes undertaken in this plan.	AMLRRRT; DEH; AMLRNRMB	PC8	O3.1
	Knowledge-base systems			
A3.5	**Conservation rating systems** Improve regional conservation rating systems to facilitate long-term monitoring of threatened species and ecological community conservation status.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT	PC20	O3.2
A3.6	**Monitoring and reporting system** Develop an integrated regional monitoring and reporting system to enable long-term tracking of priority species status.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT	PC21	O3.2
A3.7	**Database capacity and accessibility** 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
A3.8	**Knowledge-base system** 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
A3.9	**Analyse and review monitoring** Analyse monitoring data and use results to review outcomes and management actions.	DEH; AMLRRRT	PC38	O3.2
	Knowledge Gaps			
A3.10	**Extant distributions (sub-population status)** 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
A3.11	**Extant distributions (uncaptured data)** Visit flora sites identified from anecdotal knowledge and collect minimum dataset information.	DEH; RP; NGO; CG	PC25	O3.3
A3.12	**Extant distributions (uncaptured data)** Review existing species observation data held by universities, NGOs and community groups and capture into corporate databases.	DEH; AMLRRRT	PC27; PC17	O3.3
A3.13	**Extant distributions (potential)** 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
A3.14	**Population trends** Investigate more effective data treatment and analysis methods to improve knowledge of priority species' population trend.	DEH; AMLRRRT; UNI	PC29	O3.3
A3.15	**Threat abatement interactions** 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
A3.16	**Foxes** 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
A3.17	**Fire** Improve knowledge of fire responses of priority species which are fire sensitive or fire dependent.	DEH; RP	PC31; PC3.2; PC4	O3.5
A3.18	***Phytophthora*** Conduct risk analysis for *Phytophthora* susceptibility for threatened species in conjunction with predictive modelling of *Phytophthora* distribution.	DEH; UNI; AMLRNRMB; SAMDBNRMB	PC32; PC28; PC39	O3.6; O3.5
A3.19	**Climate Change** 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
A3.20	**Ecological Communities** Improve mapping and review recovery requirements of AMLR priority threatened ecological communities.	DEH; AMLRNRMB; SAMDBNRMB; AMLRRRT; RP	PC24; PC9	O3.7
A3.21	**Collaborative Research** Conduct collaborative university research projects targeting threatened species and ecological community priorities.	UNI; DEH; AMLRRRT; NGO	PC36	O3.8
A3.22	**Predation impacts review** 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
	Stakeholder Engagement			
A4.1	**Stakeholder engagement strategy** Develop and implement a regional recovery stakeholder engagement strategy (to guide plan implementation).	AMLRRRT	PC33	O4.1; O4.2; O3.1
A4.2	**Disseminate plan information** 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.			
A4.3	**Aboriginal engagement protocols** 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
A4.4	**Four Nations Governance Group engagement** 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
A4.5	**Community volunteer groups capacity** Increase capacity of landholders and community groups to implement programs targeting regional threatened species and ecological community priorities.	AMLRRRT	PC41	O4.1
	Ex-situ Conservation			
A5.1	**Review ex-situ conservation requirements** Conduct a review of priority species to determine ex-situ conservation requirements.	AMLRRRT; DEH	PC42	O5.1
A5.2	**Support ex-situ conservation programs** 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	**Flora** 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):	A3.2; A1.1; A3.15; A3.19; A1.13; A1.14
		PC3.1 Wetland (Fleurieu, Southern Fleurieu, Central Lofty, Barossa and Eastern Hills) by 2011.	A1.3; A1.17-A1.19
		PC3.2 Heathy Woodland (Foothills/Hills Face, Northern Lofty, Fleurieu, Central Lofty) by 2012.	A3.17; A1.8
		Note: Refer to Table 15 for individual species sub-regional priorities.	
PC4	CORE1	**Fauna** species threat abatement, habitat re-establishment and knowledge gap actions indicated are directed towards the following vegetation groups (in order of priority):	A3.2; A1.1; A1.3; A3.15; A3.17; A3.19; A1.8; A1.12
		PC4.1 Grassy Woodland by 2011.	A1.9; A1.13; A1.21
		PC4.2 Heathy Woodland by 2012.	A1.10; A1.11
		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.	
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 *Phytophthora* Management Guidelines (2006) by 2010.	A1.6
PC13	CORE2	A framework for management of uninfested areas for *Phytophthora* 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 trialled 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 trialled 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	*Phytophthora* 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
	Threat abatement (current direct threats)	
A1.1-1.2	**Threat Abatement Planning** Included in Implementation and Stakeholder Engagement costs.	
A1.3	**Stock grazing & disturbance** 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).	**400,000**
A1.4	**Fishing & Harvesting Aquatic Resources** Included in Implementation and Stakeholder Engagement costs.	
A1.5	**Recreational Activities** 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).	**60,000**

A1.6	**Disease & Insect Damage – *Phytophthora***	
	Included in Implementation and Stakeholder Engagement costs.	
A1.7	**Disease & Insect Damage – *Phytophthora***	
	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.	**20,000**
A1.8	**Kangaroos**	
	Included in Implementation and Stakeholder Engagement costs.	
A1.9	**Rabbits**	
	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).	**178,000**
	Assuming 25% of total sites targeted each year, based on $2,500/site/year, increasing by 20% each year for follow up works.	
A1.10	**Foxes**	
	Included in Implementation and Stakeholder Engagement costs.	
A1.11	**Foxes**	
	Will require funding estimates after strategic assessment and planning, and will be dependant on achievement of key knowledge gap actions.	
A1.12	**Cats**	
	Community consultation, forums, brochure updates and printing. Other costs included in Implementation and Stakeholder Engagement costs.	**15,000**
A1.13	**Weeds (minimise impacts)**	
	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.	**530,000**
	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.	**560,000**
A1.14	**Weeds (hygiene control)**	
	Included in Implementation and Stakeholder Engagement costs.	
A1.15	**Fire Management**	
	Included in Implementation and Stakeholder Engagement costs.	
A1.16	**Site Management (also Pollution & Poisoning, Firewood & Rock Removal)**	
	Included in Implementation and Stakeholder Engagement costs.	
A1.17	**Water - Management**	
	Information provision. Included in Implementation and Stakeholder Engagement costs.	
A1.18	**Water – Forestry**	
	Included in Implementation and Stakeholder Engagement costs.	

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

A3.7	**Database capacity and accessibility**	
	Collaborative funding contribution.	**20,000**
A3.8	**Knowledge-base system**	
	Contract project work & collaborative funding contribution.	**85,000**
A3.9	**Analyse and review monitoring**	
	Included in Implementation costs, plus additional contractor costs (approximately 300 hours at $100/hour).	**30,000**

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

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

* 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
AMLRRRT	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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