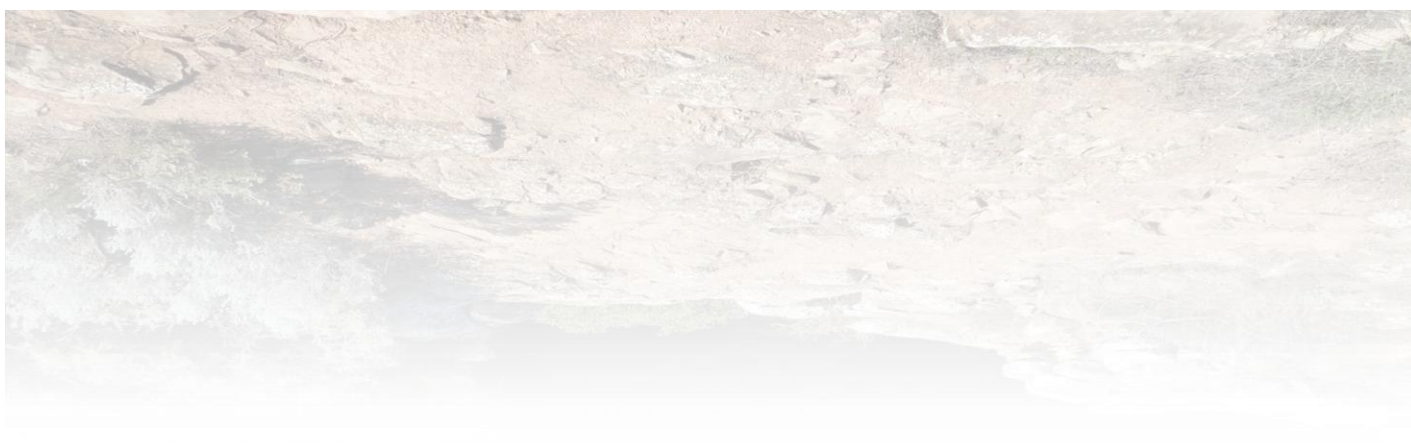




Review of the Threatened Plant Species/Communities in the Alinytjara Wilurara NRM Region – Central Ranges to the Nullarbor Plains, Cliffs





June 2013



Government of South Australia
Department of Environment,
Water and Natural Resources



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Certain assumptions have been made in the preparation of this report. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

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Front cover images:

Koonalda Cave –McCallum B.J., 2012 Nullarbor Plains. Nullarbor Survey

Microlepidium alatum – McCallum M.J., 2007, South of Penong (towards Point Bell)

Pterostylis sp. (*Oligochaetichilus*) 'Everard Ranges' – Robert Bates

Santalum spicatum - Ko-warra Native Grasses

http://www.nativegrasses.com.au/field_days/field_days.html

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1. INTRODUCTION

1.1 Aim

The aim of this project is to develop 30 Species Profile and Threats (SPRATs) for key species with the Alinytjara Wilurara Natural Resources Management (AW NRM) region, with a particular focus on parts of the landscape that are 'Biodiversity and Landscape Hotspots'. These 'Hotspots' are areas within the landscape where a high relative proportion of threatened species occur, due to a combination of biotic and abiotic factors.

This will enable a focal species approach to be adopted within the AW NRM region (Lambeck 1999, Lindenmayer *et al.* 2002). The focal species approach involves the identification of a suite of species targeted to manage their threatening processes and restoration efforts. Together, meeting their requirements to persist, can be considered to define the attributes that should be present in the landscape to meet the needs of the remaining biota (Lambeck 1999). Within the AW NRM region, targeting focal species can assist land managers to efficiently and effectively use existing resources to maximise biodiversity gains.

The review also aims to develop more ecological understanding on species poorly known, data deficient and with no current regional, state or national ratings. Development of an enhanced ecological understanding of species will help facilitate a strategic management focus.

2. METHODS OF FLORA TAXA SELECTION AND PRIORITISATION CRITERIA

SPRATS have been written for all known plant taxa within the AW NRM region currently listed under the EPBC Act (1999).

SPRATs for additional taxa have been further selected for one or more of the following reasons:

- Endemic to the AW NRM region;
- Small, isolated or outlier populations;
- Limited and specialised microhabitat;
- Culturally significant species;
- Taxa where threatening process impact considered high, such as pests, fire regimes, mining;
- Taxa that could be feasibly managed by community (ie. proximity to settlements; cost of management and community commitment allow high likelihood for community engagement). Note similar to "focal species management" used by Ward (2010)¹
- State Endangered and Vulnerable taxa currently listed under the Schedules of the SA National Parks & Wildlife Act (1972)
- Taxa identified through the Regional Species Conservation Assessment Project for the West and Northern Regions at least Rare (low numbers and at some risk due to the low numbers), but poorly known and needing further research.

¹ Ward, M., (2010) APY Lands Regional NRM Implementation Plan. Alinytjara Wilurara NRM. unpublished

Taxa clustered in Biodiversity Landscape Hotspots were also given special consideration. These Hotspots are discussed in Section 3.4. As the AW NRM region covers a large, diverse area, the AW NRM Board may be able to achieve better outcomes if its activities are focused on areas with high biodiversity and/or threat values. Development of SPRATs for species in these areas can help underpin planning, source funding and on-ground works within these Biodiversity Hotspot areas.

Table 1 shows the species considered for this project. A more detailed description of the species selection attributes is provided in Section 3.

Table 1, All species considered for selection process

Species	EPBC rated	Endemic	Small/isolated outlier populations	Limited /specialised Habitat	Biodiversity hotspot	Cultural significance	Threatening processes	Feasible community management	State at least rare / regionally rare	Poorly known, least rare & requiring future research
<i>Austrostipa nullanulla</i>									✓	
<i>Acacia ammobia</i>					✓		✓	✓	✓	
<i>Acacia oswaldii</i>						✓	✓			
<i>Acacia rhodophloia</i>			✓			?			✓	✓
<i>Acacia tenuior</i>			✓		✓		✓	✓	✓	
<i>Baeckea tuberculata</i>		✓			✓					
<i>Basedowia tenerrima</i>		✓			✓				✓	✓
<i>Bergia perennis</i> ssp. <i>exigua</i>									✓	✓
<i>Brachyscome tatei</i>		✓					✓			
<i>Calostemma abdicatum</i>		✓	✓		✓		✓	✓		
<i>Cremnothamnus thomsonii</i>			✓		✓			✓	✓	
<i>Dicrastylis gilesii</i> var. <i>bagotensis</i>		✓			✓					
<i>Eremophila decussata</i>										✓
<i>Eremophila dendritica</i>										✓
<i>Eremophila delisseri</i>		✓	✓				✓			
<i>Eremophila hillii</i>									✓	
<i>Eremophila verrucosa</i> ssp. <i>brevistella</i>		✓								✓
<i>Eremophila verrucosa</i> ssp. <i>verrucosa</i>		✓								
<i>Eremophila willsii</i> ssp. <i>intermediate</i>		✓	✓		✓					
<i>Eucalyptus minniritchi</i>			✓							✓
<i>Eucalyptus wyolensis</i>		✓	✓						✓	
<i>Goodenia brunnea</i>			✓							
<i>Grevillea treueriana</i>	✓	✓	✓							
<i>Gunniopsis calcarea</i>				✓	✓					✓
<i>Hibbertia crispula</i>	✓		✓		✓					
<i>Hibbertia glaberrima</i>					✓				✓	
<i>Lechenaultia aphylla</i>										
<i>Leiocarpa semicalva</i> ssp. <i>vincaea</i>					✓					
<i>Lepidium pseudoruderale</i>									✓	
<i>Lepidosperma avium</i>					✓				✓	
<i>Limosella granitica</i>	✓		✓	✓						
<i>Logania centralis</i>										

Species	EPBC rated	Endemic	Small/isolated outlier populations	Limited /specialised Habitat	Biodiversity hotspot	Cultural significance	Threatening processes	Feasible community management	State at least rare / regionally rare	Poorly known, least rare & requiring future research
<i>Melaleuca fulgens</i> ssp. <i>corugata</i>			✓		✓				✓	
<i>Microlepidium alatum</i>	✓			✓						
<i>Monotaxis luteiflora</i>					✓					✓
<i>Neurachne lanigera</i>									✓	
<i>Olearia arida</i>									✓	
<i>Phlegmatospermum richardsii</i>								✓		
<i>Phlegmatospermum eremaicum</i>								✓		
<i>Pimelea microcephala</i> ssp. <i>glabra</i>		✓			✓					
<i>Prostanthera nudula</i>	✓		✓		✓					
<i>Psydrax suaveolens</i>									✓	
<i>Pterostylis</i> sp. (<i>Oligochaetochilus</i>) 'Everard Ranges'		✓	✓		✓					✓
<i>Pterostylis</i> (<i>Oligochaetochilus</i>) <i>xerophila</i>	✓		✓		✓					
<i>Ptilotus schwartzii</i>									✓	
<i>Ptilotus symonii</i>									✓	✓
<i>Ptilotus schwartzii</i>										
<i>Rulingia magniflora</i>										✓
<i>Santalum spicatum</i>						✓	✓			
<i>Sarcozona bicarinata</i>						?				✓
<i>Senecio euclaensis</i>					✓					
<i>Sida</i> sp. 'billbarkei'										✓
<i>Sida</i> sp. Everard Ranges (D.J. Whibley 1085)(Everard Ranges <i>Sida</i>)		✓	✓		✓					
<i>Stylidium inaequipetalum</i>										✓
<i>Swainsona dictyocarpa</i>									✓	✓
<i>Teucrium grandisculum</i> ssp. <i>grandisculum</i>										✓
<i>Teucrium grandisculum</i> ssp. <i>pilosum</i>					✓					
<i>Teucrium reidii</i>					✓				✓	
<i>Thryptomene longifolia</i>		✓								
<i>Wurmbea centralis</i>		✓		✓	✓					

2.1 New and Existing SPRATs

Part of the aim of this project is to develop 30 SPRATs for the AW NRM region. SPRATs have previously been developed for a number of taxa by Badman in 2009, with further draft SPRATs developed by Te in 2011. Since these SPRATs, some taxa may have had changes to their threats and ratings, as new populations have been found or populations declined. This has resulted in some taxa being re-assessed.

Selection of *Swainsona dictyocarpa* is unusual in this document, as it is yet to be recorded for the AW NRM region. It has been selected on the advice of its threatened nature, and as it has been recorded on the eastern boundary of the AW NRM region (Duval pers. comm. 2013). The AW NRM region is considered to contain very similar habitat to where the species has been found, hence a high likelihood the species also occurs in the region (Duval pers. comm. 2013). Further survey effort would increase the chance of this species being found within the AW NRM region.

Note, not all taxa have been added to Table 2, as they are considered under least threat and have not been considered for SPRATs or future research at this stage.

Table 2: New SPRATs created as part of this project, existing SPRATs and species for future consideration

Scientific name	Common Name	National	SA	Region ^{2,3}	IUCN 2001 Categories & criteria	New/ Existing SPRATs
<i>Acacia ammobia</i>	Mount Connor Wattle	Not listed	Not listed	Not listed		New
<i>Acacia oswaldii</i>	Umbrella Wattle	Not listed	Not listed	Not listed		Extra, assessed listed by (Ward 2010)
<i>Acacia rhodophloia</i>	Minni Ritchi	Not listed	R	Not listed		Future
<i>Acacia tenuior</i>	Central Ranges Wattle	Not listed	R	R	Not assessed	New
<i>Baeckea tuberculata</i>	No common name	Not listed	Not listed	Not listed		New
<i>Basedowia tenerrima</i>	No common name	Not listed	R	R	(d(i,ii). DD	Badman 2009
<i>Bergia perennis</i> ssp. <i>exigua</i>	Perennial Water-fire	Not listed	Not listed	Not listed	Recommended as Rare (d(i,ii)).	Future
<i>Brachyscome tatei</i>	Nullarbor Daisy	Not listed	R		Recommended as Rare for region	New

² Gillam, S, & Urban, R. (2009). Regional Species Conservation Assessment Project, Phase 1 Report. Regional Species Status Assessments, West Region. DEH, South Australia.

³ Gillam, S. & Urban, R. (2013 in prep.). Regional Species Conservation Assessment. AWNRM Region.

Scientific name	Common Name	National	SA	Region ²³	IUCN 2001 Categories & criteria	New/ Existing SPRATS
<i>Calostemma abdicatum</i>	Everard Garland Lily	Not listed	Not listed	R	Recommended as Rare (d(i,ii))	New
<i>Cremnothamnus thomsonii</i>	Cliffside Daisy or Thompson's Daisy	Not listed	R	Not listed		New
<i>Dicrastylis gilesii</i> var. <i>bagotensis</i>	Giles' Sand-sage	Not listed	Not listed	Not listed	Probably Rare (d(i,ii)) DD	New
<i>Eremophila decussata</i>	No common name	Not listed	Not listed	Not listed		New
<i>Eremophila dendritica</i>	No common name	Not listed	Not listed	Not listed		New
<i>Eremophila delisseri</i>	No common name	Not listed, NT	Not listed, NT	Not listed, NT		New
<i>Eremophila hillii</i>	Hills Emubush	Not listed	R	R		New
<i>Eremophila verrucosa</i> ssp. <i>brevistella</i>	Warty Emubush	Not listed	Not listed	Not listed		New
<i>Eremophila verrucosa</i> ssp. <i>verrucosa</i>	No common name	Not listed	Not listed	Not listed		New
<i>Eremophila willsii</i> ssp. <i>intermediate</i>	Musgrave Range Fuschia'	Not listed	Not listed	Not listed		New
<i>Eucalyptus minniritchi</i>	No common name	Not listed	Not listed	Not listed	Recommended as Vulnerable D 2	New
<i>Eucalyptus wyolensis</i>	Wyola Mallee	Not listed	R	Not listed		New
<i>Goodenia brunnea</i>	Central Ranges Goodenia	Not listed		R		New
<i>Grevillea treueriana</i>	Mt. Finke Grevillea	VU	V	V		New
<i>Gunningsia calcarea</i>		Not listed	Not listed	Not listed	NT	Future
<i>Hibbertia crispula</i>	Ooldea Guinea-flower	VU	V	Not listed		Badman 2009
<i>Lechenaultia aphylla</i>	Leafless Lechenaultia	Not listed	V (2009)	Not listed		Badman 2009
<i>Leiocarpa semicalva</i> ssp. <i>vincaea</i>	Red-stem Button-bush	Not listed	Not listed	Not listed	Recommended as Rare (d(i,ii)) DD	Future
<i>Lepidium pseudoruderale</i>	No common name	Not listed	R			Badman 2009
<i>Lepidosperma avium</i>	Central Ranges Rapier Sedge Or Desert Rush	Not listed	R	R		Badman 2009
<i>Limosella granitica</i>	Granite Mudwort	VU	V			New
<i>Melaleuca fulgens</i> ssp. <i>corugata</i>	Wrinkled honey-myrtle	Not listed	R			New
<i>Microlepidium alatum</i>	No common name	VU	V			New
<i>Monotaxis luteiflora</i>	No common name	Not listed	Not listed	Not listed	Recommended as Vulnerable DD	Future
<i>Olearia arida</i>	Desert Daisy-bush	Not listed	V		(D 1,2) DD Pop. trend	Badman 2009
<i>Phlegmatospermum richardsii</i>	Nullarbor Cress	Not listed	V		Recommended as Vulnerable	New
<i>Pimelea microcephala</i> ssp. <i>glabra</i>	No common name	Not listed	Not listed	Not listed	DD	Future
<i>Prostanthera nudula</i>	Mount Illibillee Mintbush	VU	V	V		New
<i>Pterostylis</i> sp.	Mimili Orchid	Not listed	Not listed	Not listed	DD	New

Scientific name	Common Name	National	SA	Region ²³	IUCN 2001 Categories & criteria	New/ Existing SPRATs
(<i>Oligochaetochilus</i>) 'Everard Ranges'						
<i>Pterostylis</i> (<i>Oligochaetochilus</i>) <i>xerophila</i>	Desert Rufoushood	VU	V			New
<i>Ptilotus symonii</i>	No common name	Not listed	Not listed	Not listed	DD	Future
<i>Rulingia magniflora</i>	No common name	Not listed	Not listed	Not listed		Future
<i>Santalum spicatum</i>	Sandlewood or Fragrant Sandlewood	Not listed	V	V		Badman 2009
<i>Sarcozona bicarinata</i>	No common name		Vulnerable		DD	Future
<i>Senecio euclaensis</i>	No common name	Not listed	Not listed	Not listed		New
<i>Sida</i> sp. 'billbarkei'	No common name	Not listed	Not listed	Not listed		Future
<i>Sida</i> sp. Everard Ranges (D.J. Whibley 1085)(Everard Ranges <i>Sida</i>)	No common name	Not listed	Not listed	Not listed	Recommended as NT DD	New
<i>Stylidium inaequipetalum</i>	No common name	Not listed	Not listed	Not listed	Probably Rare (d (ii))	Future
<i>Swainsona dictyocarpa</i>	No common name	Not listed	V		Considered Endangered for the West region	Draft Te, T. 2011 continue
<i>Teucrium grandisculum</i> ssp. <i>grandisculum</i>	No common name	Not listed	V		Poorly known	Future
<i>Teucrium grandisculum</i> ssp. <i>pilosum</i>	No common name	Not listed	E		Recommended as Endangered for the region	New
<i>Teucrium reidii</i>	Showy Germander	Not listed	R			New
<i>Thryptomene longifolia</i>	No common name	Not listed	Not listed	Not listed	NT, DD D 2. Regarded as Endangered	New
<i>Wurmbea centralis</i>	Inland Nancy	Not listed	E		B 2 ab (i-iii)	New

*Taxa highlighted in orange were considered, but were not included in the final 30 SPRATs. These could possibly be assessed in the future. However, as part of this project, supplementary information was gathered on some of these, and this has been included in Appendix 1. #Species highlighted in green were identified in (Paltridge *et al.* 2009) and (Ward *unpubl.* 2010) reports.

3. Notes on the Attributes Used for Species Selection for SPRATs

3.1 EPBC listed & National distribution

As with the selection process outlined by (Ward *unpubl.* 2010), listing under the EPBC Act 1999, formed a high priority.

Listing under the *EPBC Act 1999* has been based on existing information and nomination. A number of other taxa in the region, on further research may also be listed. Proposals for nominating taxa for listing have been made in SPRATs where appropriate.



Figure 1, *Pterostylis (Oligochaetochilus) xerophila*
Gawler Ranges, Brewer, K -
Nationally Vulnerable, Orchid
Society

3.2 Endemic species

Many of the taxa selected for SPRATs are endemic to the AW NRM region, however they are largely data deficient. Although other taxa within the AW NRM are more broadly endemic to South Australia, for the purpose of this study, more emphasis has been placed on regionally endemic taxa.

Table 3, Species endemic to the AW NRM Region

Scientific name	Region, sub-region or locations
<i>Baeckea tuberculata</i>	Tallaringa, Everard Block & Maralinga
<i>Basedowia tenerrima</i>	Mann-Musgrave Block & Everard Block
<i>Brachyscome tatei</i>	Nullarbor Plain & Hampton
<i>Calostemma abdicatum</i>	Everard Block
<i>Dicrastylis gilesii</i> var. <i>bagotensis</i>	Kintore
<i>Eremophila delisseri</i>	Nullarbor Plain
<i>Eremophila verrucosa</i> ssp. <i>brevistella</i>	Nullarbor Plain
<i>Eremophila verrucosa</i> ssp. <i>verrucosa</i>	Ooldea area
<i>Eremophila willsii</i> ssp. <i>intermediate</i>	Nullarbor Plain

Scientific name	Region, sub-region or locations
<i>Eucalyptus wyolensis</i>	Nullarbor Plain & Maralinga
<i>Grevillea treuriana</i>	Mt Finke (Kingoonya)
<i>Oligochaetochilus</i> sp. 'Everard Ranges'	Everard Block
<i>Pimelea microcephala</i> ssp. <i>glabra</i>	Everard Block
<i>Prostanthera nudula</i>	Kintore, Tieyon, Everard & Mann-Musgrave Block
<i>Sida</i> sp. (D.J Whibley 1085) 'Everard Ranges'	Everard Block
<i>Thryptomene longifolia</i>	Tallaringa
<i>Wurmbea centralis</i>	Mann-Musgrave Block

3.3 Small/ isolated populations

The size and degree of isolation of populations was considered an important part of the selection process. A number of the region's taxa have small known scattered and localised populations. These may be vulnerable to localised extinctions.

As noted throughout this document, many of the region's taxa are poorly known, with only limited areas of this large region surveyed. However, a number of taxa have been included to encourage further research into their distribution, population size and any threats.

For example, *Baekkea tuberculata*, a South Australian endemic, has very limited information regarding population size and dynamics, although recorded over a wide area of the eastern Great Victoria Desert. Research is needed to determine its population size and age structure, define its distribution, and investigate its potential threats. Similarly, *Acacia rhodophloia* (Minni Ritchi) and *Thryptomene longifolia*, also recorded for this district, are likewise highly data deficient regarding population and distribution.

3.4 Limited and specialised microhabitat

The AW NRM region is a large area, covering a quarter of a million hectares, capturing unique topographical, climatic and habitat features. This gives rise to an array of vegetation types, from the granitic outcrops of the Central Ranges with its summer rainfall trend and relic vegetation, to the more winter trending coastal mists influencing vegetation along the Nullarbor cliffs. Within this broad array of vegetation types, there are small, specialised niches providing unique microhabitat, such as shaded mossy areas in the Yalata mallee. Frequently plant taxa associated with these specialised microhabitats are vulnerable to disturbance, such as weed invasion.

Some taxa recorded at higher elevation in the granitic formations can be considered relic populations. These higher elevations can also provide refugia habitat. They are highly important in offering the best chance of survival for threatened and other species, acting as a safe haven from climatic changes (Keppel *et al.* 2012).

Many of the taxa considered here, occur on isolated granitic or quartzite outcrops. These outcrops form island habitats (inselbergs), often harbouring species specific to them, with complex evolutionary histories (Byrne and Hopper 2008). For example, Mt. Finke with *Grevillea treueriana* and the Everard Ranges with *Calostemma abdicatum*.

Table 2, Examples of species requiring specialised or niche habitats in table 3 below

Species	Specialised habitat
<i>Brachyscome tatei</i>	restricted to the calcrete cliffs of the Nullarbor region
<i>Calostemma abdicatum</i>	edges of sandy creek banks, and Mt Illbillee higher altitude elevation gullies in shaded pockets of deeper soil
<i>Eucalyptus miniritchi</i>	high elevation in SA
<i>Limosella granitica</i>	growing in silt at the bottom of water-filled granite rockholes/ shallow pools
<i>Microlepidium alatum</i>	growing on calcareous soils in mossy, shady, sheltered situations.
<i>Prostanthera nudula</i>	watercourses and run-on areas at the base of rock slabs of the larger granitic hills



Figure 2, *Microlepidium alatum* growing out of moss, on calcareous soil. McCallum, M. south of Penong, EP 2008.

3.5 Culturally Significant Taxa

Culturally significant taxa include those used as a food, for hunting, medicinal value, or for trade. They are generally relatively common.

Only *Santalum spicatum* has been included in the SPRATs, as this has both a State Vulnerable rating, as well as considered highly culturally significant. Most of the SPRAT species that were developed were not necessarily viewed by the communities as culturally significant, possibly due to their rare nature.

Four other species were considered but not included. These could form part of a future review, and a brief summary of these species is given below:

***Acacia oswaldii* (Umbrella Wattle).** Perennial shrub to small tree growing 2-6m high. It is widespread in South Australia, except for the higher rainfall areas of the South East and Mount Lofty Ranges botanical regions. It is most prevalent in arid to semi-arid regions in *Acacia aneura* complex and *Casuarina pauper* Low Open Woodland, Shrublands and *Eucalyptus socialis* Mallee on calcareous sandy loams to loams (Whibley and Symon 1992). It is also recorded widely in all mainland States and the Northern Territory. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. It was considered as Least Concern in all regions of the West Region Species Conservation Assessment Project Phase 1 (DEH 2009). The species is listed Not Threatened for Western Australia. Listed as Data Deficient for Northern Territory (*Territory Parks and Wildlife Conservation Act 2000* (TPW Act)).

This species was used by the people around Ooldea for its edible gum called 'dauw' used for crafting Boomerangs (Cleland and Johnston 1942).

***Santalum acuminatum* (Quandong).** A slow growing, semi-parasitic perennial shrub, but usually a small tree growing up to 5m high. It can be found in widespread areas of South Australia, except the highest rainfall areas of the South East and Mount Lofty Ranges botanical regions, in a variety of habitats and soils. It is also recorded widely in all mainland States and Territories. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. It was considered as Least Concern in all regions of the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The species is listed Not Threatened for Western Australia, but Vulnerable for Northern Territory.

Highly valued culturally, for instance used by Ooldea region people for its fruits which were roasted when green. It was also an important timber used in getting tinder smouldering for small fires (Cleland & Johnston 1942).

***Lepidium pseudoruderale* (Native Cress).** This is an annual herb, recorded in the AW NRM region in the Nullarbor. It is listed as Rare under Schedule 9 of the State *NPW Act 1972*, and Vulnerable for the

Nullarbor in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

It produces cress-like leaves which may have been eaten. A similar *Lepidium* species was used as food by people around the Musgrave Ranges (Cleland and Johnston 1937).

***Santalum lanceolatum* (Plumbush).** Hemiparasitic shrub, although more typically a small tree growing on occasions up to 7m high, but less than 4m in South Australia. It is a very widespread plant found in all mainland States and Territories, but usually avoiding the highest rainfall areas. Consequently it can be found in a wide variety of habitats. It is mostly recorded from the semi-arid, arid and tropical areas of the Australian mainland, with one record for southern Papua New Guinea. In South Australia, it is more prevalent in the eastern pastoral areas, and less so in the AW NRM region. It is not recorded for the Nullarbor area. It is not listed under the *EPBC Act 1999*, or the *State NPW Act 1972*. It was considered as Near Threatened overall for the West Region Species Conservation Assessment Project Phase 1, but Rare for the Yellabinna and Yalata IBRA sub-regions (DEH 2009). Conservation status for the Northern Territory not assessed. Listed as Not Threatened for WA.

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3. 6 Threats and threatening processes

Threats and threatening processes in the AW NRM are on a broad scale and vary from invasive species such as Buffel Grass, camels, donkeys to climatic changes (inland drying and shift in rainfall pattern) to recreational activities (off road vehicle use).

In the prioritisation process threat classes were assigned to every species considered during the selection process using the IUCN - CMP Unified Classification of Direct Threats, Version: 3.1 (2011) list.

Table 3, IUCN - CMP Unified Classification of Direct Threats, Version: 3.1 (2011).

Threat class	Threat description
2.3 Livestock Farming & Ranching	Cattle grazing impact on native veg/ habitat
3.2 Mining & Quarrying	Exploration and general mining practices
5.2 Gathering Terrestrial Plants	Wild stocks harvesting eg. <i>Santalum spicatum</i>
6.1 Recreational Activities	Off road vehicles
7. Natural System Modifications,	Suppression or increase in fire frequency and/or intensity outside of its natural range of variation
7.1.1 Increase in Fire Frequency/Intensity,	List the specific source of fire e.g., inappropriate fire management, escaped agricultural fires, arson, campfires, fires for hunting, etc.
8.1 Invasive Non-Native/Alien Species/Diseases	Harmful plants, animals (Camels, Donkeys), pathogens and other microbes not originally found within the ecosystem(s) in question and directly or indirectly introduced and spread into it by human activities
8.2 Problematic Native Species/Diseases	encroachment of another native plant/ increased Kangaroo population/ Triodia
8.5.2 Named "species" (disease)	Galls
9.3.2 Soil Erosion, Sedimentation	Loss of soil due to excessive fire regimes and loss of shade for understorey species
11.1 Habitat Shifting & Alteration	Desertification
11.3 Temperature Extremes	Inland drying and increased summer rainfall
12.1 Other Threat	Population decreasing, isolated populations and low seed viability
Unknown	

Many threats to individual species have flow on effects. For example, *Melaleuca fulgens* ssp. *corrugata* does not respond well to repeated fire (7.1.1 Increase in Fire Frequency/Intensity). In turn lower strata species such as *Lepidosperma avium* and *Prostanthera nudula* become exposed to greater radiant heat. This has the flow on effect of hill slopes becoming exposed (9.3.2 Soil Erosion, Sedimentation).

Loss of important shade → stabilisation lost → soil erosion during first rains (Latz 2007). Important cryptogammic crust layers are also lost during this process.

3.6.1 Inappropriate Fire regimes and threat to Fire Sensitive vegetation

INAPPROPRIATE FIRE REGIMES

Background

Inappropriate fire regime's refers to too frequent or infrequent fires and/or fires in the wrong season or wrong intensity.

Fire is a natural component of the environment, especially for most Australian landscapes. It is an ecologically complex issue, depending on time of year, intensity, and what happens after a fire (eg. rainfall, fauna grazing intensity). Fire will favour some plant species over others, and has a strong influence on biodiversity and ecosystems. It is also an important part of the cultural traditions of the traditional Aboriginal people.

In the AW NRM region, the most intensive traditional fire management practice was considered to have been in the northern and western areas of the APY Lands, due to the availability of permanent water and a relatively large nomadic population. It is also possible that traditional burning practices may have been more intensive in the Maralinga Tjarutja, including the Yellabinna Reserve complex to the south and east (Morelli 1992). Based upon comments from Aboriginal traditional owners, use of fire in the Great Victoria Desert within the MT Lands was confined to regularly used tracks between waterholes, and focused on hunting, camping and cultural business uses (Morelli, 1992 citing Cane 1990).

The draft AW NRM Plan identified "altered fire regimes and lack of documented fire history information, cultural burning and species' response to fire" as a "major threat to the country asset" (AW NRM Board 2009). Increased predation of small mammals, birds and reptiles by cats and foxes can result from the loss of ground and shrub cover post fire. However, herbivores such as Kangaroos (*Macropus* sp.) can benefit significantly from post-fire plant regeneration, finding highly palatable food within the recently burnt area (Gill and Catling 2002; Murphy and Bowman 2007). Traditional use of fire by Anangu supported hunting and foraging in significant parts of the strategy area. The NRM plan also identified significant knowledge gaps in relation to fire management, and fire requirements of species, particularly threatened species.

Draft AW NRM Fire Management Plan

The AW NRM Draft Fire Management Strategy (DEWNR & AW NRM 2013) has proposed dividing the AW NRM region into seven Fire Management Landscapes. These landscapes (APY Ranges; Southern APY; Eastern APY & Tallaringa; Great Victoria Desert; Nullarbor Plain; Yellabinna and Yumbarra; Yalata), have been based largely on the AW Regional NRM Plan 'Regional Landscapes' (AW NRM Board 2009). The regional landscapes have been primarily based on the IBRA Regions, soils and landforms and logic for management and reporting of program and project initiatives (DEWNR & AW NRM 2013).

Objective 5 of the DENR & AW NRM Draft Fire Management Strategy is to 'protect and enhance biodiversity by protecting important habitats and providing protection of fauna and flora species of cultural and conservation significance at the landscape scale; and integrate active management with

natural fire events to maintain and improve viability of native species, populations, communities and habitats’.

Fire Management

On DEWNR managed reserves in the AW NRM region, standard DEWNR fire management policy and procedure have been applied, and where appropriate, in accordance with the existing reserve management plans.

On Anangu owned land, the Anangu owners have final say about the management of their country.

Jointly managed country, united management reinforces Aboriginal traditional owners as the custodians and interpreters of their own culture, and advocates for the own social and economic interests (DELM 1993).

Fire Causes

In the AW NRM region, fire can begin through a number of causes, which indicates the importance of fire to the daily life of the Anangu people in the contemporary and traditional contexts (DEWNR & AW NRM 2013):

- **Roadside fires:** lit on the roadside after vehicle breakdown, flat tyres, run out of fuel. Small or large fires lit for light, warmth, and signal, regardless of time of year or condition.
- **‘Rubbish clearing’:** lit to remove *Triodia* spp. (Spinifex) for camping areas, drive out snakes, or remove grass around communities.
- **Play:** lit by children.
- **Patch burning:** lit for hunting, increase availability of plant and animal food; and protection of important sites and areas in the landscape (not burning of sites).
- **‘Institutional fires’:** APYLM term to describe planned fires lit by senior Aboriginal traditional owners (Nguraritja) with the support of APYLM to protect species and look after country.
- **Accidental fires:** includes roadside fires but also dropped cigarettes, escaped cooking fires.
- **‘Arson’:** unknown causes, but includes ‘play’ or ‘settle scores’ etc.
- **Fires connected with ceremonies:** lit during men’s business to send smoke plumes to signal to women and the uninitiated to keep away and the road should be kept clear to allow for the ‘passage of business’ Fire is also generally used in ceremonies for the deceased (Morelli 1992).
- **Signalling:** important role in signalling location in desert country and such fires are not generally extinguished (Morelli 1992).
- **Lightning strikes:** ignited by lightning, generally in the hotter months. Lightning activity can be very significant and is likely to account for a large proportion of major fires on the lands.

Australian arid and semi-arid desert regions have characteristically high levels of ephemeral grasses which can resprout following successive seasons of higher than average rainfall. This results in an increased likelihood of major fire events in seasons after these rain events (eg. 1974/75 fires) (Luke and McArthur 1978).

Threatened Flora and fauna

The draft AW NRM Fire Management Strategy assessed the risk to state and nationally endangered flora species using the *DENR Fire Policy and Procedure for Risk Assessment*. This is summarised in the Table below. Recovery plans are in place for some of these species, providing guidance regarding appropriate fire management, in some instances.

Additionally, establishment and spread of the introduced Buffel Grass, has been considered to have increased fuel loads and associated fire events. Large fire events can also have detrimental effects on soil erosion, sedimentation of rock-holes and alteration of floodplains.

Table 4, Fire risk to threatened flora

Scientific Name	Common Name	Status EPBC Act.	Status NPW Act.	Fire Risk Rating
<i>Acacia ammobia</i>	Mount Connor Wattle		R	H
<i>Acacia tenuior</i>	Central Ranges Wattle		R	H
<i>Calostemma abdicatum</i>	Everard Garland Lily		R	H
<i>Eremophila willisii</i> ssp. indeterminate	Musgrave Ranges Fuschia			H
<i>Goodenia brunnea</i>	Central Ranges Goodenia		R	M
<i>Grevillea treuriana</i>	Mount Finke Grevillea	V	V	H
<i>Lepidosperma avium</i>	Central Australian Rapier Sedge		R	H
<i>Prostanthera nudula</i>	Naked Mintbush	V	V	H
<i>Hibbertia crispula</i>	Ooldea Guinea Flower	V	V	H
<i>Santalum spicatum</i>	Sandalwood		V	E
<i>Teucrium gradisculum</i> spp. <i>pilsoum</i>			E	H
<i>Melaleuca fulgens</i> ssp. <i>corrugata</i>	Wrinkled Honey Myrtle		R	H

Source: Draft DEWNR & AW NRM Fire Management Strategy 2013.

Acacia aneura complex (Mulga) forming important woodlands, is also considered sensitive to fire.

Plant Fire Response & Sensitivity

Very limited detailed information is available on the fire response and ability of plant species to survive fire in the AW NRM region. Some information is available from the report by Paltridge and Latz 2009 and on the Web via the 'Northern Land Manager'; however this is often based on limited sample size and observation.

It can be expected the ability of a plant population and species to survive and recover from fire will vary depending on fire intensity, frequency, and time of year. The ability of regrowth and seedlings to survive following fire will also depend on moisture availability, particularly follow-up rainfall.

It is considered important if control burning near fire sensitive vegetation, for the fire to occur as soon as possible after rains, helping to prevent the important soil crusts from being damaged (Latz 2007). A number of species can be found in rocky habitats of the North West Central Australian Ranges. Here burning can bare the ground making it susceptible to erosion and loss of soil following heavy rain events (Paltridge *et al.* 2009), as well as exposing the area to greater radiation and evaporation.

As the region is prone to human and natural fires (lightning strikes), which can be left to burn themselves out, the issue of fire is of critical importance. For the species of interest in this document, many with limited distribution within habitat niches, their response to fire is an important knowledge gap.

Amongst information needed is how long a species can possibly live, time before it sets seed after germination or recovery from fire, and how it responds to fire (eg. resprout and need to repopulate from seedlings). Below is some of the limited information available.

***Acacia ammobia* (Mt Connor Wattle)**, Considered fire sensitive, as plants killed by even mild fires. However, can readily germinate from seed after the fire. In the Northern Territory, where the species is more prevalent, seeds are produced after 6-10 years of age (Paltridge *et al.* 2009).

***Acacia oswaldii* (Umbrella Wattle)**. Response following fire depends on fire intensity and follow-up moisture, able to resprout after mild fires (Paltridge *et al.* 2009).

***Acacia tenuior* (Central Ranges Wattle)**. Considered capable of resprouting following fire, (Paltridge *et al.* 2009), depending on the fire intensity.

***Cremnothamnus thomsonii* (Cliffside Daisy)**. No known information, but generally not considered threatened by fire, as it grows on bare rocky cliffs (Paltridge *et al.* 2009).

***Goodenia brunnea* (Central Ranges Goodenia)**. Considered an early successional species following fire, where it can be a prominent for a couple of years, thereafter persisting in small numbers (Lang *et al.* 2003, Paltridge *et al.* 2009).

***Lepidosperma avium* (Central Australian Rapier Sedge)**. Considered a resprouting species, and hence probably capable of surviving some level of burning (Paltridge *et al.* 2009).

***Melaleuca fulgens* ssp. *corrugata* (Wrinkled Honey Myrtle)**. Although plants of *M. fulgens* subsp. *corrugata* appear to be capable of resprouting after being burnt, resprouting plants can be slow to

fruit and seedling recruitment can be poor (Paltridge *et al.* 2009). In far south-west NT *Triodia* hummock grasslands dominate the landscape, and despite the rocky habitat of *M. fulgens* subsp *corrugata* conferring a degree of fire protection, there is considerable risk of populations being subject to frequent hot fires resulting in further decline.

***Prostanthera nudula* (Naked Mintbush).** Considered capable of resprouting following fire, (Patridge *et al.* 2009), depending on the fire intensity. A monitored site at Victory Well, Everard Ranges, burnt in 2002, is dominated by young plants, most likely growing from seed following the fire, with only a few larger plants considered to have resprouted after the fire (Paltridge *et al.* 2009).

***Pterostylis xerophila* (Desert Greenhood).** It is considered fire early in the growing season up to seeding of *P. xerophila*, would be considered to be detrimental to its population (Duncan 2010).

***Santalum acuminatum* (Quandong).** Considered slow growing and fire sensitive, as trees are killed when burnt (Paltridge *et al.* 2009).

***Teucrium grandiusculum* ssp. *grandiusculum*.** Grows 4 to 20 years, setting seed after 2 to 3 years. Although a limited sample of one, the species appears able to resprout following fire, depending on fire intensity, and moisture conditions after the fire (eg. rainfall events).

***Teucrium reidii* (Showy Germander).** Usually grows in areas that usually do not burn, and fire has low impact. However, at two monitoring sites at Tilun Tilun in the Tomkinson Ranges, and Angatja in the Mann Ranges, burnt 2001-02, the species regenerated from seed and resprouted from butts (Paltridge *et al.* 2009).

A Fire management Plan has been produced for the Mann, Musgrave and Tomkinson Ranges (Paltridge and Latz, 2009).

3.6.2 Future Mining Proposals and exploration

It is not yet known to what impact future mining will have on the AW NRM region's threatened plants species, but it is critical to find out more about species which fall within proposed mining zones.

An APY Lands Mining Tenement Officer was appointed in July 2005 to liaise between APY, Primary Industries and Resources, SA, and Mineral Exploration Companies. This Officer worked in conjunction with Anthropologists, Legal Officers and Traditional Owners to facilitate consultations regarding mineral exploration applications on the APY Lands. The AW NRM region is considered to have potential economic resources of petroleum, natural gas, nickel, copper, vanadium, titanium, platinum, palladium and other commodities.

Officer Basin

The most significant potential mining area of the AW NRM region is the Officer Basin, an area of about 300 000 km² straddling western South Australia into Western Australia. The basin is seen as having high petroleum potential and has been the focus of exploration since the 1950s (Morton & Drexel 1997). However, its remoteness, limited and restricted access, lack of infrastructure, together with limited geological information, has previously deterred its exploration and development. Part of the Officer Basin in South Australia fell within the Maralinga and Woomera defence restricted areas.

It is considered to have geological affinities with the productive Amadeus Basin in the Northern Territory, highly productive basins in Russia and Oman, both very large oil and gas fields and proven oil reserves. Numerous oil shows have been known in the Officer Basin from mineral and stratigraphic drill holes, although there has been little on-structure drilling (Morton and Drexel 1997).

The Officer Basin is considered by some geologists as one of the last remaining onshore frontier exploration areas, where large petroleum discoveries could still be made.

Continuing exploration, intensity and interest has fluctuated, largely driven by market matters. Exploration has had some impact on remote, wilderness like areas of the region. If the Officer Basin becomes fully developed, this will have a greater impact on the area, creating localised disturbance, increased pollution risk, and open up areas previously with limited or no access. As the area has effectively no surface water, and only saline groundwater, effects on regional groundwater can be expected.

In South Australia, the Officer Basin contains parts of six parks and reserves, and all allow mining exploration access aside from Mamungari Conservation Park and Nullarbor National Park. Most of the area is held as Aboriginal land (as a freehold title by a body corporate), the Anangu Pitjantjatjara (AP) in the north and the Maralinga Tjarutja (MT) in the south (Morton and Drexel 1997). In both of these areas, the Aboriginal people have the right to control entry to their lands and seek compensation for disturbance to their ways of life, and both have expressed willingness to allow further petroleum exploration on their lands.

Entry to the Woomera Prohibited Area, except for main roads, needs to be cleared with the Defence Support Centre, Woomera. Public access to the Maralinga and Emu test sites is generally prohibited.

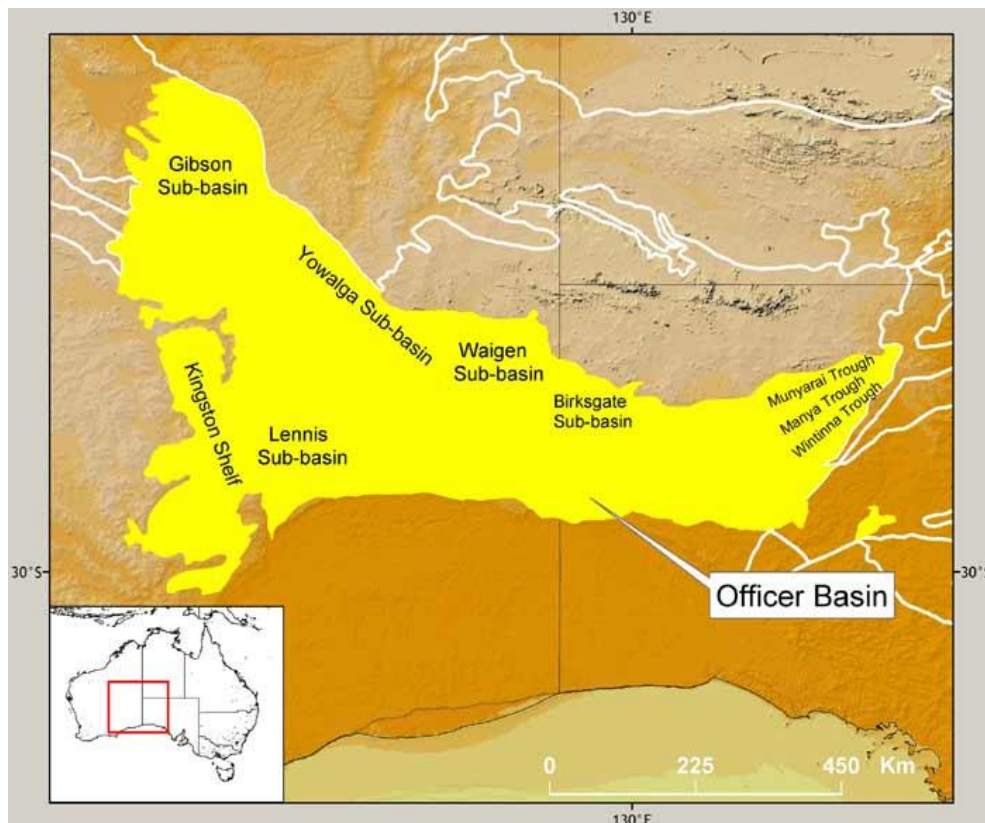


Figure 3, Officer Basin mining proposals, Geoscience Australia.⁴

Musgrave Geological Province

To the north of the Officer Basin lies the Musgrave Province, straddling adjacent areas of Western Australia and Northern Territory. The South Australian part of the Musgrave Province lies almost entirely within Anangu Pitjantjatjara Yankunytjatjara (APY) land (Aboriginal freehold land). It is also one of the last under-explored mineral exploration areas in Australia, with prospects for a number of minerals. The centrepiece is probably the Giles Complex, a 1080 million years before present mafic-ultramafic layered intrusive complex with a major nickel and copper sulphide deposit in the Western Australian portion of the province. Other mineral deposits, including silver are possible.

3.6.3 ClimateChange

Australian Bureau of Meteorology average and trend maps indicate since 1970, the AW NRM region has been receiving more summer rainfall than in previous recorded times. Winter rainfall has also increased in the extreme North West, and the western Nullarbor area. But for Anangu Pitjantjatjara there has also been a trend for a modest decline in average rainfall over the region except for the far North West.

⁴ Geoscience Australia (2013) www.ga.gov.au/oceansea_Officer.jsp

Climatic change predicted can be expected to influence species, population and structural dynamics. The northern parts of the AW NRM region can be expected to experience significant inland warming 'Drying Trend' away from the buffering influences of the oceans (Bardsley and Wiseman 2012).

Consequently, the AW NRM will likely have a decline in mean rainfall, shift to more spasmodic summer rainfall events, and increasing average temperature.

Impact

The AW NRM region has a number of what can be considered higher rainfall relict species, found on isolated inselbergs (eg. Mt Finke), and the Central Australian Ranges. Some of the species from the Central Australian Ranges can be found in other arid ranges (for example the Flinders Ranges), but not in between. These are likely to be highly impacted by climate change.

Example species:

Teucrium reidii, an endemic species to South Australia, is found in the northern Flinders Ranges, and is also known from 7 populations in the Tomkinson, Mann and Musgrave Ranges of the North West APY Lands.

An important related point is the shifting rainfall pattern apparent in the long term climatic observations for the region (see Figure 4, above). These 30 year time series images depict rainfall in the north western corner of South Australia shifting further inland to south east, and a simultaneous northerly inland shift of the rainfall along the Great Australian Bight and northern Eyre Peninsula over the 90 year period from 1911 to 2001. This shifting rainfall pattern has the potential to increase the extent of major fire events through the landscape given its ephemeral nature.

Other species impact include:

- reducing plant life cycles for reproduction
- reducing the frequency of formation of ephemeral pools (Box *et al*)
- Increasing encroachment of woody shrubs into arid and semiarid rangelands (Hughes 2003).

3.6.4 Buffel Grass

Buffel Grass (*Cenchrus ciliaris*) is a deep rooted, perennial grass native to Africa into the Middle East and India (Dept. of Land Resource Management. (web version)). It flowers most of year, usually after rain, with its seed dispersed by wind, water, stock and machinery. Consequently roads, tracks, and other disturbed areas, are usually the first areas where it spreads and colonises.

It was primarily introduced into some semi-arid areas of Australia as pasture, to increase domestic stock pastoral productivity, and to a lesser extent, land rehabilitation and dust suppression. At least 30 cultivars were trialled in Central Australia in the 1960s, with at least eight more introduced on pastoral properties in the 1970s. It is well adapted to drought and can grow in a diverse range of soil types, with sandy fertile soils being preferred by dominant varieties in Central Australia (Dept. of Land Resource Management (web version)).

It is now found over most of the arid and semi-arid areas of Australia. Its palatability is considered moderate, but it became well regarded as pasture, as it grows rapidly under warm, moist conditions. It also persists under heavy grazing and drought. However, now well established, some pastoralists have expressed concerns that the productivity of Buffel Grass dominated pastures can decline in the longer term (CRC for Australian Weed Management 2008).

Buffel Grass has now become a serious environmental weed, spreading well beyond planted areas into native vegetation. It favours drainage lines and alluvial flats, and has also become established on plains, rocky terrain and hill slopes. Hybridisation amongst cultivars may enable further adaptation.

Native Vegetation Threat

- **Native species diversity**

Buffel Grass spread into native plant communities has led to it dominating, in areas, the ground cover, reducing native plant species diversity and density. Following fire it can rapidly re-establish, out competing seedlings of overstorey species’.

- **Fire regime**

During drought, the native grass cover died off and decayed, reducing the fuel load over the long dry periods. The drought tolerance of Buffel Grass has led to it increasing the level of biomass over longer periods. This has increased fuel loads, and is considered to have altered the vegetation structure through changing the fire regime (DEWNR & AW NRM Board 2013). The more frequent hot fires can kill the established trees and shrubs, and also the regrowth trees and shrubs before they have produced seed (CRC for Australian Weed Management 2008).

The greater risk of more frequent and hotter fires has further economic costs through protecting biodiversity assets and infrastructure. Research has confirmed a significant correlation between Buffel Grass and increased fuel loads, and that there is a positive fire invasion feedback for Buffel Grass in the Alice Springs region (Miller *et al.* 2010).

3.6.5 Athel Pine

Athel Pine (*Tamarix aphylla*) is a tree growing up to 15m, native to northern Africa, through the Middle East, and into parts of western and southern Asia. It was first introduced via California to Whyalla in the 1930s, and was subsequently widely planted throughout arid and semi-arid Australia for shade, shelter belts and erosion control, especially around settlements. It became a ‘sleeping weed’, as it was present for some time before it became weedy (NHT 2003).

Athel Pine is now listed as a weed of national significance. It is considered one of the worst weeds in Australia, due to its potential to spread and invasiveness. It invades inland rivers, and is drought tolerant. It can consume water more quickly than native plants, lowering the watertable, reducing the number and quality of waterholes, increasing erosion and soil salinity (NHT 2003, SAAL undated). Once established, it can cause significant environmental and economic problems through using

valuable water resources, hindering mustering and altering the riverine vegetation and structure. Once established Athel Pine is difficult to control (SAAL undated).

Native Vegetation Threat

Athel Pine can form dense stands stretching for some distance (up to hundreds of kilometres) along river banks displacing native vegetation. The trees consume more water than native plants, reducing water available to the native plants (and fauna through loss of springs and waterholes). They can also concentrate salt in their leaves, which when dropped result in higher soil salt level underneath, excluding salt sensitive native plants (NHT 2003, SAAL undated).

Although the AW NRM has limited watercourse habitat for this serious weed, it does contain some outlying populations of the plant in the Central Australian Ranges drainage. As its control is advised as difficult and expensive, quick eradication is considered important. Spread can be rapid during flooding events, as it spreads by both seed, and vegetatively as fragments break off (SAAL undated).

3.6.6 Introduced Herbivores

A number of pest animals exist in the AW NRM area. These include Arabian Camel (*Camelus dromedarius*), Red Fox (*Vulpes vulpes*), Cat (*Felis catus*), the Wild Horse (*Equus caballus*), Donkey (*Equus africanus asinus*) and European Rabbit (*Oryctolagus cuniculus*) (AW NRM Board 2009). Browsing by rabbits and camels, particularly in high densities, can have significant impacts on flora regeneration. Camels (*Camelus dromedarius*) can severely inhibit recruitment of their preferred food species by suppressing flowering and fruit production and by browsing and killing juvenile plants. It is considered that camels have the ability to cause the local extinction of highly preferred species like the Quandong (*Santalum acuminatum*), Plumbush (*S. lanceolatum*) and even *Eremophila spp.* seedlings.

Rabbits (*Oryctolagus cuniculus*) can breed in astonishing numbers where ground layer vegetation is plentiful, generally targeting fleshy seedling recruitment. A study by Auld 1994 researched grazing pressures on *Acacia oswaldii* using four different treatments, some caged and some not. The study showed that most seedlings were eliminated unless protected, although despite protection, mortalities were still high. However, protection did increase the seedling survival rate.

The Nullarbor Plain is particularly harsh, forcing plants to use adaptive techniques for survival and the right climatic conditions for recruitment. Tree and shrub recruitment can be severely limited by rabbits. The genus name *Eremophila* implies 'desert loving' and it has adapted to thrive in arid Australia. However, most *Eremophila* species seedlings are highly palatable and have not adapted against grazing by introduced herbivores such as rabbits. The flow on effect of losing seedlings is that you have no mixed age classes, no succession and in turn no reproduction. Species such as *Eremophila delisseri* could become extinct in the worse case scenario. The *Acacia aneura* complex community in the Bonificio study was considered threatened through extensive fires in good seasons, followed by inhibited regeneration due to rabbit grazing.

It is not known to what extent, but it is known that certain species such as *Eremophila longifolia* rely on Emus for dispersal throughout the landscape (Rogers *et al.* 1993). Emus prefer to eat the fleshy fruits of *Eremophila*, but do not necessarily aid germination, so it could be possible that the decline of Emu's from certain parts of the AW NRM region could be coinciding with grazing pressures and the decline of Emus. Other species which could be affected might be *Eremophila verrucosa* ssp. *brevistellata*, *Eremophila verrucosa* ssp. *verrucosa*, *Eremophila hillii* and even *Santalum* spp.

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3.7 Feasibility for Community Management

The proximity to population centres, cost of management, and community commitment were also considered as part of the process for choosing the 30 SPRATs. This is because make these species are likely to be easier to focus community engagement and commitment to conservation, and will also deliver good investment outcomes. The examples below of very general management costs show the high degree of variability in project costs and required skills and commitment. Obviously the pest plant control project lends itself more easily to community involvement, as the cost, equipment required, and capacity of the workforce (skills, knowledge and understanding) is less than the camel control project.

Camel Control – aerial control⁵ (Current as of 2012)

- Usually need 2 R44 choppers each day, approx. cost \$10,000 per day – includes fuel, food employee costs/ contractor.
- Usually allow for a minimum 10 days a year.
- Biosecurity spends - \$110,000 per year in the Simpson Desert (Seacombe N)
- This control can also be used for Goat management – particularly for the Gawler bioregion, which I believe has had some recent culls.

Plant pest Control – Buffel grass, Pepper Trees etc.⁶ (Current as of 2012)

- Cheaper to cover most of the costs with existing contractor
- Potential source funding to train local people to use herbicides for management – employment opportunity
- Use a lecturer to give professional training and guidance
- Usually \$50,000 per year for each area targeted, best approach is engage or source local contractors.
- Each project will need a minimum of 3-4, 1-2 week blocks per annum allowed in budgeting
- Costs are very variable

⁵ Greg Patrick (2013) Pers comm. Camel Control – aerial control

⁶ Greg Patrick (2013) Pers comm, Plant pest Control – Buffel grass, Pepper Trees etc

3.8 State & regionally Rare Taxa

Taxa with a State or regionally Endangered, Vulnerable or Rare status were also considered for this report. For example, *Lepidospermum avium* is listed as Rare for the State and the region, although the species was also added due to its specific habitat requirements and limited range.

Acacia tenuior, *Basedowia tenerrima*, *Eucalyptus wyolensis* were other State species listed under the NPW Act Schedules considered for inclusion as the 30 SPRATs taxa.



Figure 5, *Eucalyptus wyolensis* Rare for the State. D. Nicolle

3.9 Poorly known, but at least Rare & requiring future research

Gillam and Urban (2009) and Gillam and Urban (in prep. 2013) have assessed the conservation status of all known and recorded plant taxa within the AW NRM region, using the DEWNR Biological Data Base Records and an expert panel. However, many of the taxa were assessed as data deficient regarding habitat, topography, soil type, population size, and distribution. In a number of cases, taxa were assessed as Rare, but due to lack of information, may be threatened. For the purpose of this report, taxa assessed as at least Rare, data deficient and with a restricted population in the Regional Species Conservation Assessment Project, were considered for inclusion as a SPRAT.

Due to the remoteness of the region, restricted access over large areas, and lack of roads and tracks, the region is some of the least biologically researched in the State. The Regional Species Conservation Assessment Project clearly highlighted the critical lack of information regarding most of the taxa within the region, and the need for further research. Particularly for Biodiversity Hotspot areas (see 3.10).



Figure 6, *Dicrastylis gilesii* var. *bagotensis* (Giles' Sand-sage) is largely data deficient.

3.10 Biodiversity Hotspots and Landscapes

Many factors (eg. endemism, limited and specialised microhabitat, small population) lend themselves to formation of “Biodiversity Hotspots”. These areas of the landscape have a higher concentration of threatened or interesting taxa, due to biotic and abiotic factors, such as topography, climate, soils and vegetation types. The AW NRM Board may be able to achieve best outcomes through activities focus on these specific areas with their intrinsic high biodiversity values. Development of SPRATs for taxa in these “Hotspots” can assist in identifying common threats, and allowing co-ordinated threat abatement activities to deliver better outcomes for multiple species. Given limited budgets, this could help underpin planning, funding sources and direct on-ground

works within these Biodiversity Hotspots. For these reasons, species that occurred in these “Hotspots” were prioritised for inclusion into the 30 SPRATs for this project.

Some of these “Hotspots” have been mapped as part of the Regional Species Conservation Assessment Project. This was achieved by calculating the number of Critically Endangered, Endangered and Vulnerable flora taxa within 1km² grid cells over project areas, from all BDBSA records. Using *ESRI GIS ArcInfo* software, the Spatial Analyst Extension ‘Kernel Density’ was then employed to calculate the density of threatened taxa richness, and presented in raster and contour form (Gillam and Urban (2009), Gillam and Urban in prep. 2013). Others hotspots have evolved through the course of this project and discussion with experts. These are described in the following section.

Fig. 5. Outback threatened flora species richness. The number of Critically Endangered, Endangered and Vulnerable flora species were calculated within 1km² grid cells over the project area, from all BDBSA records. Using *ESRI GIS ArcInfo* software, the Spatial Analyst Extension ‘Kernel Density’ was employed to calculate the density of threatened species richness, and presented in raster and contour form. *NB: BDBSA records are largely a reflection of biological and scientific surveys that have occurred over the last 30 years and are biased towards areas where those surveys have occurred.

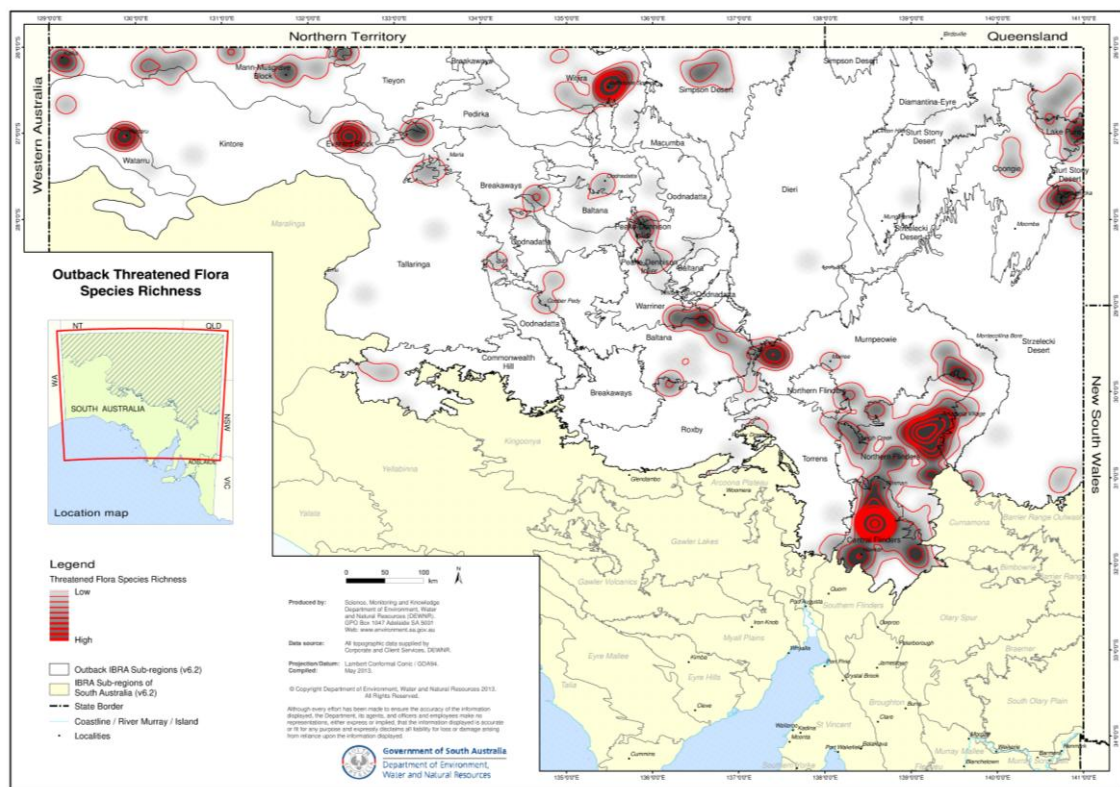


Figure 4, Outback threatened flora species richness. The number of Critically Endangered, Endangered and Vulnerable flora species were calculated within 1km² grid cells over the project area, from all BDBSA records. Using *ESRI GIS ArcInfo* software, the Spatial Analyst Extension ‘Kernel Density’ was employed to calculate the density of threatened species richness, and presented in raster and contour form. *NB: BDBSA records are largely a reflection of biological and scientific surveys that have occurred over the last 30 years and are biased towards areas where those surveys have occurred.

3.10.1 Central Australian Ranges (North Region)

The Regional Species Conservation Assessment Project, other reports and expert opinion indicate the Central Australian Ranges IBRA region as an important area for species refuge, endemism, and specialised habitats. The South Australian part of the IBRA region is split into the Mann-Musgrave Block, Everard Block, and Watarru IBRA sub regions. However, they are a complex of ranges, many with different geologies and separated from each other. Each can be considered a Biodiversity Hotspot, and a number located within the Central Australia Connection are considered below.



Figure 5, Central Australian Connection (DSEWP & C)

EVERARD RANGES AND SENTINEL HILL

The Everard Ranges are part of the Antara-Sand Bore Indigenous Protected Area, as proclaimed in June 2011. They are likely to have already attracted attention as an important fauna area, but this report focuses on their high significance for flora.

Sentinel Hill is located just south of the Northern Territory border and about 100km north of the Everard Ranges. It lies off the north east end of the Musgrave Ranges.

Geology

The Everard Block IBRA region is described as hills and ridges of a variety of rock types, separated by undulating plains. The Everard Ranges themselves are a large, isolated complex of weathered domed granitic hills up to 420m above the surrounding alluvial plain (Benbow 2003). Their domed bare exfoliating rock surfaces are considered to be very efficient in channelling run-off water when it does rain, forming moist sheltered refugia (Lang *et al.* 2003).

Sentinel Hill is an isolated inselberg located at the extreme north eastern end of the Musgrave Ranges, but is geologically different. Instead it has a similar rounded, exfoliating granitic outcrops to the Everard Ranges, based on similar granitic intrusive Illbillee Adamellite rock (Lang *et al.* 2003).

Rainfall

The only significant settlement within the Everard Ranges is Mimili. There are no climate stations maintained in the Everard Ranges themselves, the closest being the Marla Police Station about 70kms to the west on the Stuart Highway. Here the average yearly rainfall is about 220mm/yr.

Biological Significance

The Biological Survey of the Anangu Pitjantjatjara Lands report highlighted both the Everard Ranges and Sentinel Hill areas as similar botanically and geologically and as Important Plant Habitats. Although of lower profile and smaller area than the Musgrave Ranges, the Everard ranges can be

considered of similar significance as a centre of rare, threatened and endemic species (Lang *et al.* 2003)

The area's significance was further indicated through workshops with the regional Northern Species Conservation Assessment Project Phase 1. The draft report's threatened flora species richness map indicates two areas of the Everard Block, and Sentinel Hill as containing some of the most significant areas in the northern region assessment (Gillam and Urban in prep. 2013).

Plant taxa recorded for the Everard Ranges and Sentinel Hill indicate they can be considered isolated outliers of higher rainfall or water retaining areas, due to their higher elevation from the surrounding sand plain. As noted by Lang *et al.* 2003, it appears to be an area where plant species are evolving to separate taxa due to this isolation.

Plant Species

1. Restricted to Everard and Sentinel Hill

***Calostemma abdicatum* (Everard Garland Lily)**, seasonally growing from an onion-like bulb. Only recorded for the Everard Ranges. Endemic to SA and the AW NRM region. There are three known populations with a total population estimated to be 10,000 to 20,000 plants over limited areas (total 4 ha.).

***Prostanthera nudula* (Naked Mintbush/Mount Illbillee Mintbush)**, a perennial shrub up to 2 m high. Leaves are reduced and at times the plant can be spiny and leafless (Lang *et al.* 2003). There are five known populations, with an estimated 200 plants at Sentinel Hill, and more than 3,000 plants in the Everard Ranges (Paltridge *et al.* 2009).

***Pterostylis* sp. (*Oligochaetochilus* sp.) 'Everard Ranges' (Mimili Orchid)**, although not formally recognised in the current online Census of SA Plants, Algae and Fungi (2013), it is a taxa of Greenhood Orchid which seems to be endemic to the Everard Ranges. It remains poorly known and not formally described.



Figure 5, *Pterostylis* sp.
(*Oligochaetochilus*)
'Everard Ranges', Mt Illbillee. R. Bates

***Sida* sp. Everard Ranges (D.J. Whibley 1085) (Everard Range Sida)**, Erect shrub. Initially collected in 1985 and yet to be described. Restricted to the Everard Ranges and inselbergs with similar geology.

2. Rare and threatened taxa, largely restricted to Everard Ranges and Sentinel Hill

Basedowia tenerrima, an ephemeral herbaceous daisy, likely abundant in good seasons. The species was first recorded and described from specimens collected from the Everard Ranges. It is also recorded relatively abundantly and widespread from the western Musgrave Ranges. Previously this species was listed as Vulnerable under the *EPBC Act 1999*. However, the species was delisted on scientific advice resulting from the SA Department for Environment biological surveys, in December 2009. The species is considered endemic to South Australia and the AW NRM region. Its habitat is higher rocky slopes of the ranges.

***Hibbertia glaberrima* (Central Australian Guinea-flower)**, a perennial shrub to 1.5m high. In SA occurs in the Everard Ranges, eastern Musgrave Ranges and Sentinel Hill. It also occurs in the Northern Territory (NT), where most specimens have been recorded, and Western Australia (WA). It is listed as Rare for SA (*NPW Act, 1972*).

***Leiocarpa semicalva* ssp. *vinacea* (Red-stem Button-bush)**, a perennial herbaceous daisy. Recorded from both the Everard Ranges and Sentinel Hill. May also occur in NT and WA, where similar taxa have been recorded. The species is little known, and has a limited distribution. Recommended as Rare in the Northern region Species Conservation Assessment Project Workshops. It is considered data deficient regarding population trend and other information. More survey work is required to confirm its conservation status.

***Lepidosperma avium* (Central Australian Rapier-sedge)**, long-lived sedge growing 1m to 2.4 m high. Recorded from the Everard Ranges, but also Mt Lindsay in the Birksgate Range, Musgrave Ranges, and Sentinel Hill. It is listed as Rare for SA (*NPW Act, 1972*). It was recorded in 2009 just across the border in NT. It is currently known from 5 populations in the Central Ranges bioregion, with a single record from Dalhousie Springs. The biggest population is in the Everard Ranges where it is known from 16 sites (Paltridge *et al.* 2009).

Monotaxis luteiflora, Recorded in SA only for the Everard Ranges. Recommended as Vulnerable due to highly localised population in the Northern region (Gillam and Urban in prep. 2013) This species prefers red soils and is considered fire responsive. Population trend is data deficient.

Pimelea microcephala* ssp. *glabra. This species has been recorded in the Everard Ranges and Mt Lindsay in the Watarru IBRA region to the west. It has been recommended as Rare for both IBRA regions (Gillam and Urban in prep. 2013).

MANN & MUSGRAVE RANGES

The Musgrave Ranges form part of the Central Australian Ranges. They were recognised as an Important Plant Habitat in the Biological survey of the Anangu Pitjantjatjara Lands South Australia Report (Lang *et al.* 2003). The Ranges form part of the Mann -Musgrave Block IBRA region. This is described as the rocky, easterly trending Mann and Musgrave Ranges and their immediate foreland of short alluvial fans, both with deep massive earths. Numerous granitic and gneissic inselbergs protrude through the plain which is locally overlain by sand dunes, particularly along the southern

margin (DEWNR via Gillam and Urban in prep. 2013). The IBRA region also occurs in the adjacent areas of Western Australia and Northern Territory.

Geology

The Musgrave Block contains the regions oldest rocks of Mesoproterozoic age (1,300-1,100 million years old). The Block is an extensive crystalline basement terrain extending into the Northern Territory and Western Australia. It is comprised of amphibolite and granulite metamorphic grade rocks of the Birksgate Complex. Common metamorphic type rocks include gneiss (Benbow, 2003). The Musgrave Ranges themselves include the highest peak in South Australia, Mount Woodroffe (1443m AHD).

Rainfall

Annual average rainfall is 275mm at Pukatja/Ernabella (Paltridge *et al.* 2009) in the Musgrave Ranges, but due to the nature of the region, annual rainfall will vary considerable depending on the area and climatic conditions. It is likely higher on the highest peaks, such as Mt Woodroffe.

Biological Significance

The Ranges geological and structural complexity of soil and rock types, altitude, aspects, and drainage provide a wide diversity of habitats. Some of the drainage systems include important permanent rockholes (Lang *et al.* 2003). They provide important habitat and supports some of the largest known populations of Central Australian Range endemics, such as *Acacia tenuior* and *Melaleuca fulgens* ssp. *corrugata*. These and other significant species are considered below. It also supports outlying populations of species more common in the higher rainfall temperate regions of South Australia, such as *Clematis*, *Arthropodium strictum*, *Dianella revoluta* var. *divaricata*.

Areas of the ranges were also indicated as significant for threatened species richness through the workshops with the regional Northern Species Conservation Assessment Project Phase 1. The draft report's threatened flora species richness map indicates hotspots in the Tomkinson, Mann and Musgrave Ranges. These hotspots were analysed to contain some the higher significant areas in the northern region assessment (Gillam and Urban in prep. 2013).

Watarru IBRA sub region Mt. Lindsay was also analysed as a highly important area for threatened plant taxa richness (Gillam and Urban in prep. 2013), but at this stage has not been considered as it lies outside the Central Australian Connection.

1. Plant Species

***Acacia ammobia* ('Mount Connor Wattle')**, Shrub or small tree growing 1.5 to 7m high, often on dunes, sandy, or gravelly soils with *Triodia* spp. Most of its population is in Northern Territory, particularly around Uluru/Ayers Rock. South Australia's known population is represented by a localised outlier at the eastern end of the Indulkana Range.

***Acacia tenuior* ('Central Ranges Wattle')**, is a dense, rounded shrub to 2.5m high. There are currently 2 known populations in SA and 2 in NT in the Mann and Musgrave Ranges, with an estimated population size of 6000 plants. It is endemic to the Central Australian Ranges. Only small disjunct populations are known for this species known.

***Cremanothamnus thomsonii* (Cliffside Daisy/Thomson's Daisy)**, is a small perennial daisy growing to 50cm high. There is only one known outlier population in South Australia in the Indulkana Range, but it has a widespread distribution in NT, primarily the MacDonnell Ranges and outlying hills (Paltridge *et al.* 2009). It is reasonably common in NT.

***Dicrastylis gilesii* ssp. *bagotensis* (Giles' Sand Sage)**, is a perennial shrub growing 1-1.5m, but occasionally 2m high. It is endemic to the Central Australian Ranges, with most of the population found in the Northern Territory, but also the north west of South Australia in the Kintore IBRA sub-region,

***Eremophila willsii* ssp. *intermediate* ('Musgrave Range Fuschia')**, is a tall spindly shrub growing to 1.7m high. Only one localised population is known and occurs in the Musgrave Ranges, occupying about 1 km². Population size is estimated to be over 10,000 plants.

Eucalyptus minniritchi is a mallee growing 2-3 m high. In South Australia, its occurrence appears to be restricted to the highest rocky peaks of the Musgrave Ranges, such as Mt Woodroffe. However, just across the border in NT it is found on the peak of Mt Mann. There is only one record for Western Australia on the border with NT, but the species is more prevalent in NT, particularly west of Alice Springs.

***Goodenia brunnea* (Central Ranges Goodenia)**, is an erect, sticky shrub to 80cm high. Seven populations have been recorded in SA, mostly in the Musgrave Ranges, with an outlier in the Tomkinson Ranges, and 3 in NT. The population size is unknown. It is endemic to the Central Australian Ranges bioregion.

***Lepidosperma avium* (Central Australian Rapier-sedge)**, is a long-lived sedge growing 1m to 2.4 m high. Recorded from the Everard Ranges, but also Mt Lindsay in the Birksgate Range, Musgrave Ranges, and Sentinel Hill. It is classified as Rare for SA (*NPW Act, 1972*). It was recorded in 2009 just across the border in NT. Currently there are five known populations in the Central Ranges bioregion, with a single record from Dalhousie Springs. The biggest population is in the Everard Ranges where it is known from 16 sites (Paltridge *et al.* 2009).

***Melalueca fulgens* ssp. *corrugata* (Wrinkled Honey Myrtle)**, is a shrub growing to 2.6m high. Its flowering is non-seasonal, but probably induced by rain events. It is currently known from 5 populations in SA, 2 in NT and one in WA, where it occurs in the Petermann, Rawlinson, Mann, Musgrave, Everard, and Birksgate Ranges. All these populations are highly fragmented, as it occurs only on the highest peaks of these ranges. Total population size estimated to be less than 2,500 plants. It is endemic to the Central Australian Ranges. Both the NT and WA populations are very small.

***Teucrium reidii* (Showy Germander)**, is a multi-stemmed sub-shrub, which can occasionally grow to 2m high but usually 1m high. Currently there are 7 known populations in the Tomkinson, Mann and Musgrave Ranges, where the population is estimated to be more than 2000 plants. It is a SA endemic also occurring in the northern Flinders Ranges.

***Wurmbea centralis* (Inland Nancy)**, is a herb growing from 4.5cm up to 20cm high. It grows among rocks, mainly on hills. A species of the Central Australian Ranges, in NW South Australia and adjacent areas of Northern Territory.

2. Ecological Communities

Possible State Threatened Ecological Communities have been identified by Science, Monitoring and Knowledge project in 2012. Advice was sought from all of the State's NRM regions regarding Threatened Ecological communities in their respective regions. Two possible Threatened Ecological Communities in the Musgrave and other Central Ranges were proposed at workshops as part of this process, listed below. The Musgrave Ranges contain significant, if poorly identified areas of these ecological communities.

- Communities associated with freshwater springs in ranges of SA aridlands.
- Fire sensitive communities of 'Centralian Ranges'.

3.10.2 Nullarbor (South & West Region)

The Nullarbor IBRA region is split between South Australia and Western Australia, comprising in South Australia Nullarbor Plain, Hampton, Carlisle (in part), and Yalata IBRA sub regions. It is an extensive area of largely flat plain. Within this area are specialised habitats forming Biodiversity Hotspots.

NULLARBOR KARST SYSTEM

Background

The Nullarbor Plain has Australia's largest karst area (about 220,000 km²) and one of the largest in the world. Although a flat landscape, with surface relief less than 10m, the Plain can be divided into extensive closed karstic depressions separated by low rocky ridges (Gillieson *et al.* 1994). The Nullarbor karst system is considered a unique area of national and international acclaim, including hundreds of caves and rock-holes, that are currently largely unmanaged. The karst system is split between Western Australia and South Australia. The Nullarbor Bioregion has been considered for nomination as a World Heritage site, indicating its significance and uniqueness (Barton *et al.* 2002).

Geological Development

Initial karst development probably occurred during the warm, seasonally wet climatic conditions of the Oligocene, when the withdrawal of the sea exposed the recently deposited Eocene Wilson Bluff Limestone for over 10 million years (Webb and James 2006). Several major channels probably developed at this time, which were flooded by the return of the sea. The sea finally retreated in the late Miocene followed by regional uplift. Cave formation in the Pliocene and Quaternary was minimal due to the semiarid climate, which became increasingly arid. The overall dryness caused crystallization of evaporite minerals in cracks and pore spaces within the limestone walls of the caves. These suffered extensive collapse, producing large passages, dome chambers, and dolines. However, during a wet phase, rivers extended across the karst plain, and caves formed where they sank into the limestone. Shallower caves, also probably formed at this time, possibly associated with perched water tables. However, the Nullarbor Plain did not develop extensive surface and underground karst features as elsewhere in the world, as its flatness and calcrete characteristics resulted in limited cave formation (Webb and James 2006). As the area's climate is again too arid to produce acidic water to dissolve the calcrete, caves are no longer being formed or extended.

One of the most significant and most visited of the Nullarbor caves is Koonalda Cave

Koonalda Cave

Koonalda Cave is considered the most famous and significant of the Nullarbor Karst system caves, and the most major cave on the South Australian side of the system. It contains a series of cathedral-like chambers, mirror-like lakes, narrow passages and steep slopes covered with boulders. Most of the other major caves of the system are in Western Australia.

Beginning in 1956 through 1964, archaeologist Alexander Gallus explored Koonalda Cave, including three excavation trenches. In 1967, the Australian Institute of Aboriginal Studies expedition, led by

Richard Wright, carried out further excavation, dating, and documentation of the rock art (Wright 1971).

This archaeological exploration indicated the cave was occupied over a period extending from about 14,000 to 30,000 years ago (Gallus 1971). The cave was used as a flint mine, with nodules of chalcedonic quartzes quarried and taken elsewhere to be worked into tools. Hearths, charcoal and the residue of the quarrying process were found, mainly in the first chamber, some 100 meters from the entrance and 76 meters below the surface of the plain. Quarry pits measured up to 6 meters deep; some still contained remains of mining tools and wooden torches. Some 300 meters inside cave walls are covered with markings, finger fluting, lattices and grids and a few rare circular forms at the entrance to a squeeze passageway, which leads to platform high in a dome of a large chamber with a lake below (Gallus 1971).

Cultural Significance

The Nullarbor caves have important Aboriginal heritage sites. As noted above, Koonalda Cave had significant Aboriginal used 14,000 to 30,000 years ago, as a flint mine and for art. Rock holes, another karst feature, are also important for conservation and cultural heritage, as they are the only place that surface water can collect within the dry plain.

Local Aboriginal lore reports that the caves in the western part of the Nullarbor Plain were inhabited by evil spirits, who can be heard roaring in the rushing water of the subterranean lakes.

Biological Significance

The Nullarbor karst system includes fragile ecosystems including wetter areas for flora; and fauna such as bats and birds. In 1992, the Commonwealth Government commissioned a report on the suitability of the Nullarbor Region for World Heritage Listing. The report was submitted but not supported by the Western Australian Government and the recommendation did not progress (Barton *et al.* 2002).

Significant sub-fossil megafauna fossil deposits have also been found in the caves. These sub-fossil deposits are very important in the reconstruction of past fauna composition (Barton *et al.* 2002).

Although none of the following plants species are unique to the Nullarbor Karst features, species of note include:

Gunniopsis calcarea, is a perennial shrub, also recorded from Western Australia, where it is listed as Not Threatened. It has been recorded from Koonalda Cave, where the moister conditions make it an interesting outlier.

Leiocarpa pluriseta, is a perennial shrubby herb, endemic to South Australia, but not restricted to the Nullarbor region. It has been recorded from some caves in the Nullarbor Karst system. It is listed as Rare under the SA NPW Act 1972.

Lepidium pseudoruderale, is an annual herb, also recorded from Western Australia, where it is listed as Not Threatened. It is listed as Rare under the SA NPW Act 1972. It has been recorded from a few cave areas and rockholes in the SA Nullarbor, including Koonalda Cave.

***Phlegmatospermum eremaeum* (Spreading Cress)**, is an annual herb found in drier areas of southern Australia. Recorded near Koonalda Cave and elsewhere in the SA Nullarbor Karst system.

It is also recorded from Western Australia's Nullarbor karst system, and has been recorded near Koonalda Cave and elsewhere in the SA Nullarbor Karst system.

***Phlegmatospermum richardsii* (Nullarbor Cress)**, grows in calcareous soils and calcrete. Most of the current known population is recorded in the Far West Yalata mallee and Nullarbor regions (Koonalda Cave). There are also old collections from around Fowlers Bay, and one old later 1800s collection from just across the Western Australian border. As the Western Australian collection is very early and same date and collector as one of the Fowlers Bay area

***Santalum spicatum* (Sandalwood)**, a slow growing, semi-parasitic perennial shrub or small tree recorded over a wide area of Western Australia into the western half of South Australia. It has been recorded from Koonalda Cave.

***Eremophila delisseri* (Nullarbor Emubush)**, is a perennial shrub growing up to 1m high. It is Endemic to the Nullarbor Plain. Its known population is restricted to the South Australian portion of the Nullarbor Plain, except for one late 19th century collection from adjacent the border, in the Western Australian portion of the Nullarbor Plain. Location of these old collections is imprecise, and may also be within South Australia. It appears to grow on skeletal calcareous loams.

Microlepidium alatum, is an annual herb, growing at times up to 20cm high. It grows on calcareous soils in mossy, shady, sheltered situations. Endemic to South Australia on Eyre Peninsula and the Far West. Listed as Vulnerable under the EPBC Act 1999 and Schedule 8 of the SA NPW Act 1972. Recommended as Rare for Eyre Mallee and Yalata IBRA sub-regions in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The population is considered stable.

Threats

Uncontrolled visitation, and lack of understanding of their fragility and significance, has led to degradation of the caves. Altered hydrology is also likely a problem in some areas.

Education of the wider public is needed for the karst system to be protected in the long term.

As the Nullarbor karst system is shared between South Australia and Western Australia, information and resources need to be shared between the two jurisdictions.

YALATA SWAMP AND COASTAL BUNDA/NULLARBOR CLIFFS

Description

The Nullarbor Cliffs range 790km forming the southern boundary of the Nullarbor Plain. The Nullarbor Plain itself is formed from a Miocene seabed, uplifted about 3 million years ago. The cliffs rise 60 to 120 m, commencing at the Head of the Great Australian Bight at its eastern end. After 210kms as coastline, the cliffs move inland as the Hampton Bluffs for another 300kms, before reaching the coast again at Twilight Cove in Western Australia. The initial area of coastal cliff in South Australia is known as the Bunda Cliffs.

To the eastern end of the Bunda Cliffs at the Head of the Bight lies Yalata Swamp and dune system. Yalata Swamp is a large saline depression or salina located behind large coastal dunes. These coastal dunes overlie part of this depression forming a barrier to the sea. In extent the depression covers 12sq kilometres. Soaks located in the swamp adjacent the coastal dunes have historic importance to aboriginal communities. Edward John Eyre also camped in the area during his journey across the Nullarbor in 1841 (Fotheringham 2010).

It is considered Yalata Swamp formed when sea level reached its present position 6500 years ago. The area may initially have been an inlet. If so, as barrier dunes formed, access to the sea was blocked creating a lake. Over time this lake probably in-filled as evaporitic sediments of aragonite, halite and gypsum were produced. These likely eventually filled the lake to approximately sea level (Fotheringham 2010).

Cultural Significance

Yalata Swamp has high cultural significance to the Anangu and Wirangu Peoples, and other Aboriginal communities. It contains the traditional waterhole and meeting place called Illcumba. The Eyre Well, used by John Eyre during his journey across the Nullarbor in 1841 also has European Heritage significance.

Biological Significance

Yalata Swamp.

The Yalata swamp is a unique system which was cut off from the ocean by the formation of a barrier dune approximately 6,500 years ago (Fotheringham 2010). Five main structural communities have been identified occurring on Gypsum flats, Gypsum ridges/ swales, Limestone ridges, Dunes and Interdune flats. The nationally and state Vulnerable *Austrostipa nullanulla* occur around the edges of

Following final assessment, spatial analysis of the West region threatened species indicated the Yalata Swamp and surrounding area was one of the higher threatened species richness localities, particularly for fauna, outside of the developed agricultural areas of Eyre Peninsula and Far West (Gillam and Urban 2009). This analysis was restricted to Critically Endangered, Endangered, and Vulnerable species, and would be more pronounced if all taxa of higher conservation significance were taken into account.

Of note is the highly gypseous nature of the swamp, which provides specialised habitat for those plant species adapted to such areas. Its gypsum flats comprise over half of its area, uniformly covered by *Tecticornia* spp Low Shrubland to Low Very Open Shrubland. The more specialised habitat of gypsum ridges, while small and localised, contain a number of highly specialised species unique to them. The predominant plant community on gypsum ridges was *Kippistia suaedifolia* Low Open Shrubland. *Austrostipa nullanulla* (Club Spear-grass) currently rated vulnerable under the Schedules of the *NPWS Act 1972*, was recorded on the gypseous ridges.

Currently rabbits and camels are causing significant grazing pressure to some of the plant species including *Austrostipa nullanulla*. The camels are also creating tracks across the vegetation particularly near the dunes.

Coastal Cliffs

The Nullarbor coastal cliffs provide specialised habitat for some plant species.

Plant Species

***Brachyscome tatei* (Nullarbor Daisy)**, low growing, semi-succulent perennial herb, restricted to the calcrete cliffs of the Nullarbor region, particularly the Bunda Cliffs. The plant can grow on a thin layer of soil on the calcrete (Coombe-Smith 2011). Most of the population occurs in South Australia, although there is one 1890s collection for just across the border in Western Australia. The population size, life-cycle and ecology of the plant are not considered well understood (Coombe-Smith 2011).



Figure 6, *Brachyscome tatei* Coombe-Smith 2011.

Senecio euclaensis, Perennial shrub growing up to 1.5m high. Recorded from the coastal cliffs of a restricted area both sides of the border between South Australia and Western Australia in the Hampton IBRA sub-region. Although not thoroughly surveyed, South Australia may have the larger population of the species. It is not listed under the *EPBC Act 1999*, or the *State NPW Act 1972*.

OOLDEA

Background

The Ooldea area is an interesting biological area, which includes the Ooldea Soak, site of the old railway siding and fettlers camp, and the beginning of the Ooldea Range. It is a transitional area from the Nullarbor Plain to the south, and the red sand dunes of the Ooldea Range immediately to the north. It lies at the north-western area of the Nullarbor Plain IBRA sub-region, and the south western margin of the Yellabinna IBRA region.

The Ooldea Range are coastal dune ridges marking the edge of an ancient sea from the end of the Eocene. It is essentially a sand range 650km long, rising from the flat Nullarbor Plain. It is the southern fringe of the Great Victoria Desert.

The Ooldea Soak itself had high importance to the Aboriginal People of the general desert region. As one of the very few permanent regional freshwater sources, it became an important drought refuge for the desert Aborigines in prehistoric times. It also became an important meeting place and ceremonial trade centre. Post European settlement, the soak served as a depot for a number of late 19th century explorers, including Giles, Tietkins and Maurice. After 1917, it was further used as an important watering point on the Trans-Australian Railway, especially the construction phase. The construction of the railway brought many of the desert Aborigines into contact with Europeans for the first time. Many of the desert people eventually left their homelands and sought refuge at Ooldea.

With all this human activity, the area has become disturbed and modified, particularly since European settlement. As the blue clay soil layer important for retaining soil freshwater was damaged during railways water extraction, the soak no longer supplies freshwater. Many of the trees, especially *Casuarina pauper* were used for fuel during the early period of railway construction. Rabbits moved into the area, and denuded much native vegetation, particularly during drought. However the area still retains high biological significance.

Rainfall

Annual rainfall records were kept at Ooldea railway siding from 1918 to 1980. Annual rainfall in this period was 170mm/year (Copley and Kemper, 1987). There has been no rainfall data collected since this period. However, average annual rainfall fluctuated widely from year to year in this period, with extended droughts and floods occurring..

Biological significance

Following final assessment, spatial analysis of the West region threatened species indicated the Ooldea vicinity as one of the highest flora rare and threatened species richness localities, outside of the developed agricultural areas of Eyre Peninsula and Far West (Gillam and Urban 2009). This analysis was restricted to Critically Endangered, Endangered, and Vulnerable species, and would be more pronounced if all taxa of conservation significance were taken into account.

The area's biological interest is also indicated by a number of species, including plants, which have common names relating to Ooldea (eg *Eucalyptus youngiana*, *Hibbertia crispula*). This reflects the area's significance, at least as an important collecting area, as well as its higher biodiversity. Some plant species have their population largely centred around Ooldea, and these are listed below.

Plant Species

Eremophila decussata has almost all of its known populations within a few kilometres of the Ooldea Railway Siding. It grows on skeletal calcareous soils, often with exposed rock. It has also been recorded on the smaller red dunes of the area. Population size is estimated at about 100 plants in areas.

***Eremophila hillii* (Hill's Emubush).** This species has been mostly recorded from the Nullarbor Plain of South Australia, with a few sparse collections in similar areas of the Nullarbor IBRA region of Western Australia. The largest populations occur within about 5km around the Ooldea railway siding. It seems to prefer shallow calcareous loams over limestone.

***Eremophila verrucosa* ssp. *brevistella* (Warty Emubush),** is a perennial shrub growing to 1.5m high. Endemic to South Australia, and specifically Ooldea. It is recorded from stony low red sand dunes within a few kilometres of Ooldea Railway Siding (Chinnock 2007). Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*.

***Hibbertia crispula* (Ooldea Guinea-flower),** is a small perennial shrub up to 0.5m high, growing mostly on sand dunes. Most of the population occurs on the dunes north of the Ooldea Railway Siding, with a further population recorded to the east around Lake Everard (outside the AW NRM region). It is recorded in one localised area of Western Australia, at the western end of the Great Victoria Desert IBRA region.

***Teucrium grandiusculum* ssp. *pilosum*,** a perennial shrub growing up to 0.8m high. An endemic taxa to South Australia. In the AW NRM region, only recorded from within a few kilometres of the Ooldea Railway Siding. This includes a significant population adjacent the railway siding of about 300 plants. Collecting notes record the plant growing on shallow red sand over calcrete.

3.10.3 Great Victoria Desert (Central West Region)

The Great Victoria Desert bioregion covers an area of 418 750 km², lying north of the Nullarbor Plain and south of the Central Australian Ranges. The bioregion is described as a dune fields with playa lakes and lunettes. Most of the bioregion is little developed unallocated crown land, and particularly in South Australia, conservation reserve and Aboriginal Land. It is about equally split between South Australia and Western Australia, with the South Australian component comprised of the Maralinga (in part), Yellabinna, Kintore and Tallaringa IBRA sub regions.

Except for the Tallaringa IBRA sub region, most of the area lies outside of the Central Australian Connection. However, important high biodiversity hotspots occur through the Great Victoria Desert, including Mt Finke and Serpentine Lakes. Ooldea itself lies roughly on the boundary between the Nullarbor and the Great Victoria Desert IBRA region, and has features of both regions.

Mt. FINKE

Biological Significance

Following final assessment, spatial analysis of the West region threatened species indicated the Mt Finke area as one of the highest flora rare and threatened species richness localities, outside of the developed agricultural areas of Eyre Peninsula and Far West (Gillam and Urban 2009). This analysis was restricted to Critically Endangered, Endangered, and Vulnerable species, and would be more pronounced if all taxa of higher conservation significance were taken into account.

Geology

Mt Finke is an inselberg (monadnock) rising quite dramatically above the surrounding landscape. It is about 5 km long and has a maximum height of 369m (ADH). It is an elevated flat surface developed on steeply dipping quartzite of the Tarcoola Formation (Copley and Kemper 1987).

Plant Species

***Grevillea treueriana* (Mt Finke Grevillea).** Perennial shrub growing in rock crevices on Mt Finke, Yellabinna Regional Reserve. Endemic to South Australia, its entire natural population confined to Mt Finke. Listed as Vulnerable under the *EPBC Act 1999*, and Schedule 8 of the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

Listing under the EPBC Act 1999, includes potential threats of grazing by feral rabbits (*Oryctolagus cuniculus*) and goats (*Capra hircus*); habitat loss; fragmentation (ANRA, 2007); and inappropriate fire regimes. Of most concern for the species is lack of regeneration.

Pterostylis (*Oligochaetochilus*) *xerophila* (Desert Rustyhood),. A small, terrestrial orchid, found mostly on red loamy soils on or around granite or quartzite rock outcrops (Jessop and Toelken 1986), and less frequently alluvial soils. It is found in semi-arid mallee areas of Eyre Peninsula and Gawler Ranges with a disjunct population in the mallee district of north-western Victoria and adjacent areas of South Australia. It was also recorded in 2004 from Mt Finke. Currently there are only eight known populations. Listed nationally as Vulnerable under the EPBC Act 1999, and Vulnerable under the State NPW Act 1972. Listed as Threatened for Victoria (Flora and Fauna Guarantee Act 1988).A small population of about 3 *Pterostylis xerophila* were found on the steep quartzite slopes of Mt Finke in 2004. This is the closest known population to the type locality of Wynbring on the east-west railway line. The species was described by Mark Clements in 1986, based on plants grown in cultivation collected at Wynbring.

Little is known of its biology and ecology, largely due to the drier and remote areas where much of the population occurs. It is dormant in drier months, emerging after winter rains. However due to the more unreliable and drier areas where it occurs, flowering is sporadic. Few if any plants flower in dry years (Duncan 2010).

Little is also known of the extent or impact of current threats to populations (Duncan 2010). Likely threats include grazing by rabbits, feral goats, kangaroos; weeds such as *Echium plantagineum* (Salvation Jane) and *Carrichtera annua* (Wards Weed); habitat degradation and loss in the mallee areas; disturbance; and climate change (Duncan 2010).

TALLARINGA

Biological Significance

The Tallaringa High Biodiversity area has significant biodiversity values as it is an overlap of temperate to semi-arid species indicative of southern South Australia, and semi-arid to arid species of northern South Australia. This leads to unique species assemblages, as well as high biodiversity.

The Tallaringa IBRA subregion is described as an undulating plain with dunes, low gibber-covered rises and shallow sandy depressions associated with relict drainage. *Acacia aneura* complex Low Open Woodland is associated with the sandy plains. Tallaringa Conservation Park forms a large part of the IBRA subregion, which includes Tallaringa Well, of high cultural significance as an old Aboriginal soak.

Transitional Area

Tallaringa is the limit of range for a number of species such northern edge for *Alternanthera nodiflora* (Common Joyweed), *Babingtonia behrii*, (Silver Broombush), *Calytrix gypsophila* (Gypsum Fringe-myrtle), *Damasonium minus* (Star-fruit), *Dicrastylis costelloi* var *costelloi* (Sand Sage), *Lycium australe*, *Eremophila deserti*, *Myoporum platycarpum* ssp. *platycarpum*, *Velleia arguta*; western edge for *Goodenia australis*, *Centipeda cunninghamii* (Common Sneezeweed), *Erigeron sessilifolius*, *Eucalyptus coolabah* (Coolibah), *Lythrum wilsonii* (Wilson's Loosestrife), *Olearia muelleri* (Mueller's Daisy-bush) *Acacia stenobotrya* (River Cooba), *Marsilea exarata* (Swayback Nardoo); eastern edge *Eucalyptus mannensis* ssp. *mannensis* (Mann Ranges Mallee); *Micromyrtus fimbrisepala*, *Micromyrtus flaviflora* (Yellow Heath-myrtle), *Thryptomene longifolia*, *Swainsona unifoliolata*.

Amongst vegetation communities recorded for the region are *Acacia aneura* Low Woodland, *Acacia papyrocarpa* Low Open Woodland, *Myoporum platycarpum* ssp. *platycarpum* Low Woodland, *Tecticornia indica* ssp. *leiostachya* Low Shrubland, *Eragrostis falcata* + *Zygophyllum eremaeum* Grassland, *Senna artemisioides* ssp. *petiolaris* Tall open Shrubland, *Acacia ramulosa* Tall Open Shrubland, *Senna artemisioides* + *Dodonaea microzyga* Low Open Shrubland (Robinson et al 1988). Both the *Myoporum platycarpum* ssp. *platycarpum* and *Acacia papyrocarpa* Low Woodlands are on their northern distribution limits in South Australia, in the Tallaringa region.

These species and vegetation communities reflect a variety of habitats that can be found in the Tallaringa IBRA subregion, which is a transition area to the Central Australian Ranges to the north, Great Victoria Desert to the west, Breakaway country to the east and mallee areas to the south. However due to the remoteness and restricted access to the region, and limited number of tracks within the area, there have been limited number of surveys and collections made in the IBRA subregion.

Plant Species

***Acacia rhodophloia* (Minni Ritchi)**, is a rounded shrub 1-2m high or at times a small tree of 4m high. It has distinctive curly strips of red bark (Minni Ritchi). There are two records of the species in South Australia a record from Bulgunnia Station just outside the AW NRM region, and west of Tallaringa CP. South Australia's populations, however are south-eastern outliers to extensive populations in Western Australia and Northern Territory.

Baeckea tuberculata, is a poorly known perennial shrub to waist height, growing in a range of different habitat, but primarily red dunes within the eastern Great Victoria Desert (Bates pers comm. 2013). It is endemic to South Australia within the AW NRM region, and likely the North West botanical region. Most of the population is in the Tallaringa IBRA sub region, especially Tallaringa CP.

Thryptomene longifolia, is a perennial shrub growing to 2m high. It is endemic to South Australia and the AW NRM region. It is primarily recorded on the red sand dunes, with the largest population

apparently in Tallaringa Conservation Park. Most of the collections held by the State Herbarium of South Australia are in the dunes around Tallaringa Well, west to Emu.

SERPENTINE LAKES

Biological Significance

The Serpentine Lakes are essentially a palaeodrainage channel on the border between Western Australia and South Australia. Like Yalata Swamp, it forms a moister, specialised habitat in the region. The majority of the lakes lie in South Australia in the Mamungari Conservation Park (formerly Unnamed CP.). Mamungari Conservation Park itself has been listed as one of twelve UNESCO World Biosphere Reserves in Australia, in recognition of its high biodiversity (DEWNR web page).

Following final assessment, spatial analysis of the West region threatened species indicated the Serpentine Lakes one of the higher flora rare and threatened species richness localities (Gillam and Urban 2009). This analysis was restricted to Critically Endangered, Endangered, and Vulnerable species, and would be more pronounced if all taxa of conservation significance were taken into account.

Plant Species

The following are examples of some of the species listed as Rare or Vulnerable under Schedules of the State NPW Act 1972 that have been recorded in the area of the Serpentine Lakes (Foulkes and Thompson 2008).

***Acacia jennerae* (Coonavitra Wattle).** A multistemmed shrub or tree growing 2 to 6m high (Whibley & Symon 1992). A sparsely distributed wattle of arid and semi-arid central Australia, with few collections, mainly from the Great Victoria Desert in South Australia. It is more widely found in Western Australia, but also Northern Territory, and New South Wales. A small population has been recorded at the Serpentine lakes. It is listed as Rare under Schedule 9 of the SA NPW Act 1972.

***Sclerolaena symoniana* (Symon's Bindyi).** Rounded perennial shrub growing up to 30cm high, usually found growing on the sandy margins of salt lakes. Serpentine Lakes has the largest and most frequently recorded known population of the species. It is found elsewhere largely in the Great Victoria Desert of SA, but also sparsely recorded in Western Australia and Northern Territory. It is listed as Vulnerable under Schedule 8 of the SA NPW Act 1972.

Cultural Significance

The Serpentine Lakes have high cultural significance and visitors and any surveys of the area need permission and to respect its significance.

5. Recommendations

The AW NRM region has a low population, is remote, and with a number of areas of restricted access (Maralinga Atomic Test area, Woomera). The region also has a limited number of roads and tracks. Consequently, it has been generally poorly biologically surveyed, especially compared to other South Australian regions. Large gaps exist between roads and tracks which have not been assessed.

The region also has lower average rainfall, characterised by periodic intermittent heavy rainfall events primarily in summer. During the rainfall events the countryside can ‘come alive’, reviving flora and fauna. Many flora species have adapted to take advantage of these rainfall events, germinating rapidly and flowering before disappearing again. However, the rainfall events can make access more difficult due to flooding and the nature of the tracks, to take advantage of these rich times and fully survey the area.

These factors contribute to the critical lack of information about the region’s flora. This report has highlighted over 30 plant taxa of national, State and regional significance and interest. It also highlights high biodiversity areas, and ecological communities likely to be of national significance. Even the species of national significance have limited critical information on threats and ecology to manage the species so they are no longer threatened.

These broad recommendations have been made in light of the above to address common threats for individual SPRAT documents.

Define taxa taxonomically where required; <i>Eremophila willsii</i> ssp. <i>intermediate</i> and <i>Pterostylis</i> sp. (Oligochaetichilus) ‘Everard Ranges’
Survey to discover additional populations, and identify any threats to these populations
Investigate to see whether nominations for listing species and ecological communities under Commonwealth <i>EPBC Act 1999</i> .
Upgrade listings under the Schedules of the SA <i>NPW Act 1972</i>
Establish exclusion zones and a monitoring strategy for major species populations
Develop Research Proposals to determine more critical information for the SPRAT species, such as:- <ul style="list-style-type: none"> • Distribution • Fire response of plants and their fire sensitivity • Relic species and their response to climatic shifts eg, Mann-Musgrave Ranges, Mt. Finke • Species ecology– age to setting seed, longevity, population age classes • Grazing responses and whether they are selectively grazed
Identify critical areas and populations under threats of weeds and herbivores, and implement a Pest Abatement Programs
Discuss fire management regimes with the communities; If necessary, modify burning regimes and discuss with the local community people.

References

Albrecht, D.E., Duguid, A.W., Coulson, H., Harris, M.G. and Latz, P.K. (2007). Vascular Plant Checklist for the Southern Bioregions of the Northern Territory: Nomenclature, Distribution and Conservation Status Second Edition. Department of Natural Resources, Environment and the Arts. Northern Territory Herbarium, Alice Springs, Northern Territory Government

Australian Weeds Committee (1999) Weeds of National Significance. (National Weeds Strategy Executive Committee, Commonwealth of Australia: Canberra).

AW NRM Board (2009). Alinytjara Wilurara Regional Natural Resources Management Plan. (Alinytjara Wilurara Natural Resources Management Board, Government of South Australia Adelaide).

AW NRM Board (2011). Alinytjara Wilurara Regional NRM Plan. (Alinytjara Wilurara Natural Resources Management Board, Government of South Australia Adelaide).

Australia's Virtual Herbarium. Online database.

Auld, T.D., (1994) *Seedling survival under grazing in the arid perennial Acacia oswaldii*. NSW National Parks and Wildlife Service. Biological Conservation Journal. p27-32.

Bardsley, D., & Wiseman, N., (2012). *An integrated assessment of projected climate change impacts and adaptation options for the Alinytjara Wilurara Natural Resources Management region* FINAL REPORT June 2012. Prepared for the AW NRM Management Board.

Barton, B., Cowan, M. & Tiedemann, K. (2002). A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions: Nullarbor 2 (NUL2) – Nullarbor Central Band subregion. The Department of Conservation and Land Management, WA.

Bates, R. (2013) *Personal comments on Baekea tuberculata, Thryptomene longifolia, Pterostylis sp. (Oligochaetochilus sp.) 'Everard Ranges'*

Baxter, C., and Henderson, R. (2000). A literature summary of the princess parrot *Polytelis alexandrae* and a suspected recent breeding event in South Australia. The South Australian Ornithologist 33:93-108.

Benbow, M.C. (2003) Geology and Geomorphology. . In Robinson, A.C., Coley, P.B., Canty, P.D., Baker, L.M., and Nesbitt, B.J. (Eds). A Biological Survey of the Anangu Pitjantjatjara Lands, South Australia, 1991-2001. Dept. for Environment and Heritage, South Australia.

Biosecurity SA (2010) Draft State Buffel Grass Operational Plan. Biosecurity SA, Department of Primary Resources and Regions SA, Government of South Australia, Adelaide.

Biosecurity SA (2012) South Australia Buffel Grass Strategic Plan 2012-2017. Department of Primary Industries and Regions South Australia, Government of South Australia, Adelaide.

Bonificio, R. (unpub. 2012) *Threatened Ecosystems workshops*. Department for Environment and Natural Resources.

Box, J.B., Duguid, A., Read, R.E., Kimber, R.G., Knapton, A., Davis, J. & Bowland, A.E. (2008). Central Australian waterbodies: The importance of permanence in a desert landscape', *Journal of Arid Environments*, vol. 72, no. 8, pp. 1395-1413.

Byrne, M. & Hopper (2008) *Granite outcrops as ancient islands in old landscapes: evidence from the phylogeography and population genetics of Eucalyptus caesia (Myrtaceae) in Western Australia*. Biological Journal of Linnean Society, **93**, 177-188

Census of SA Plants, Fungi and Algae. Online database

Chinnock, R.J. (2007). *Eremophila and Allied Genera*. A monograph of the plant family Myoporaceae. Everbest Printing Co Limited, China.

Cleland, J.B. & Johnston T.H. (1942) *Aboriginal names and uses of plants in the Ooldea region, South Australia*. Transactions of the Royal Society of South Australia. **v 66 (1)** pp 93-103.

Cleland, J.B. & Johnston T.H. (1937) *Notes on Native Names and Uses of Plants in the Musgrave Ranges*. Reprinted in Oceania 1937. **v7 No. 2**, pp 204-215 & 3, 329- 340.

Clements, M. A. 1989. Catalogue of Australian Orchidaceae. In, Australian Orchid Research Volume 1. Australian Orchid Foundation, Melbourne.

Coombe-Smith, K. (2011). Species spotlight - Nullarbor daisy, Living on the edge. Dept Environment and Heritage internal newsletter (30/8/2011).

CRC for Australian Weed Management (2008). Weed Management Guide: Buffel Grass – *Cenchrus ciliaris*.

DELM (1993) Unnamed Conservation Park Management Plan. (Ed. Department of Environment and Land Management)Adelaide).

Dept. of Land Resource Management Web site.

Dept. of Land Resource Management. (web version). Buffel Grass Management Guide for Central Australia. Northern Territory Government.

Dept. of Sustainability, Environment, Water, Population & Communities Web Site. Major Vegetation Groups.

DEWNR & AW NRM Board (2013). Alinytjara Wilurara draft Regional Fire management Strategy. (Alinytjara Wilurara Natural Resources Management Board, Government of South Australia Adelaide).

Duncan, M. 2010. National Recovery Plan for the Desert Greenhood *Pterostylis xerophila*. Department of Sustainability and Environment, Melbourne.

Duval, D. (2013). SA Seed Conservation Centre, DEWNR. *Personal comments on Swainsona dictyocarpa, Lepidium pseudoruderale, Bracyscome tatei, Senecio eucalaensis, Ptilotus symmonii, Microlepidium alatum,*

Elith, J. and Bidwell, S. (2004). Nationally Threatened Woodlands. Descriptions of Ecological Communities: Arid Eucalypt Woodlands. Report to the Commonwealth Department of the Environment and Heritage, Canberra, A.C.T.

EPBC Act 1999. Online database. (2013)

Florabase: Flora of Western Australia. Online database. Dept. of Environment and Conservation. Western Australia.

Fotheringham, D. (2010) *A transect survey of the Topography and Flora of Yalata Swamps within the Indigenous Protected Area May 2010 including potential sea level rise*

Foulkes, J.N. & Thompson, D.S. (2008). A Biological Survey of the Maralinga Tjarutja Lands South Australia. DEH, Adelaide.

Friedel M., Bastin G., Brock C., Butler D., Clarke A, Eyre T. *et al.* [van Leeuwen S]. (2007). Developing a research agenda for the distribution and rate of spread of Buffel Grass (*Cenchrus ciliaris*) and identification of landscapes and biodiversity assets at most risk from invasion. (A report to the Department of the Environment and Water Resources, Canberra.

Gallus, A. 1971. Results of the exploration of Koonalda Cave, 1956-1968. In R. V. S. Wright (ed.), *Archaeology of the Gallus Site, Koonalda Cave*, pp. 87–133. Australian Aboriginal Studies 26, Australian Institute of Aboriginal Studies, Canberra.

Gillam, S., & Urban, R. (2009). Regional Species Conservation Assessment Project, Phase 1 Report. Regional Species Status Assessments, West Region. DEH, South Australia.

Gillam, S. & Urban, R. (in prep. 2013). Regional Species Conservation Assessment. AW NRM Region, Phase 1 Draft Report. Regional Species Status Assessments, Northern Region. DEWNR, South Australia.

Gillieson, D.S., Cochrane, J.A. & Murray, A. (1994). Surface hydrology and soil movement in an arid karst: the Nullarbor Plain, Australia. *Environmental Geology* 23: 125-133.

Hughes, L. (2003) *Climate change and Australia: Trends, projections and impacts*. Department of Biological Sciences, Macquarie University, North Ryde, New South Wales 2109, Australia. *Austral Ecology* (2003) **28**, 423–443.

Jessop, J. P. and Toelken, H. R. (1986). *Flora of South Australia: Part 4. Alismataceae – Orchidaceae*. Government Printer, Adelaide.

Keppel G., Van Niel K.P., Wardell-Johnson G.W., Yates C.J., Byrne M., Mucina L., Schut A.G.T, Hopper S.D. & Franklin S.E. (2012). *Refugia: identifying and understanding safe havens for biodiversity under climate change*. *Global Ecology and Biogeography*, (Global Ecol. Biogeogr.) **21**, 393–404.

Lang, P.J., Nesbitt, B.J., Baker, L.M. and Robinson, A.C. (2003). Vegetation. In Robinson, A.C.,Coley, P.B., Canty, P.D., Baker, L.M., and Nesbitt, B.J. (Eds). A Biological Survey of the Anangu Pitjantjatjara Lands, South Australia, 1991-2001. Dept. for Environment and Heritage, South Australia.

Lang, P.J. (2008). *Calostemma abdicatum* (Amaryllidaceae), a new species of Garland Lily endemic to the Everard ranges, and a comparison of the three species within *Calostemma* R. Br. *Journal of the Adelaide botanical Gardens* 22, 47-56.

Latz, P. (2007). The Flaming Desert: Arid Australia – A fire shaped landscape. NT Print Management, Alice Springs, Northern Territory.

Lindenmayer D.B., Manning A.D., Smith P.L., Possingham H.P., Fischer J., Oliver I., & McCarthy M.A. (2002) The Focal-Species Approach and Landscape Restoration: a critique. *Conservation Biology* 16, 338-345.

Luke R. and McArthur A. (1978). Bushfires in Australia. (Australian Government Publishing Service: Canberra).

Mamungari Conservation Park Board of Management (2011). *Mamungari Conservation Park Management Plan*, Adelaide, SouthAustralia.

Miller G., Friedel M., Adam P., Chewings V. (2010). Ecological impacts of Buffel Grass (*Cenchrus ciliaris* L.) invasion in central Australia - does field evidence support a fire-invasion feedback? *The Rangeland Journal* 32, 353-365.

Morelli, J. (1992). Fire Management in the Great Victoria Desert. (A State Assistance Cooperative Project with the Australian National Parks and Wildlife Service and South Australian National Parks and Wildlife Service.

Morton, J.G.G. and Drexel, J.F.(1997). The petroleum geology of South Australia. Vol 3: Officer Basin. South Australia. Department of Mines and Energy Resources. Report Book, 97/19.

National Heritage Trust. (2003). Weed Management Guide: Athel pine or tamarisk – *Tamarix aphylla*. Commonwealth DEH Fact Sheet.

Nicolle, D. (2013). Native Eucalypts of South Australia. Lane Print & Post, Adelaide.

Paltridge, R., Latz,P.,Pickburn, A., and Eldridge, S. (2009). Management Plan for Rare and Threatened Flora in the Anangu Pitjantjatjara Yankunytjatjara Lands of South Australia. Department for Environment and Heritage, South Australia.

Patrick, G. (2013) *Personal comments about cost of pest species control*. Department of Environment, Water and Natural Resources (DEWNR).

Pobke, K. (2007). Draft recovery plan for 23 threatened flora taxa on Eyre Peninsula, South Australia 2007-2012. Department for Environment and Heritage, South Australia.

Robinson, A.C.,Copley, P.B., Canty, P.D., Baker, L.M., and Nesbitt, B.J. (Eds). (2003). A Biological Survey of the Anangu Pitjantjatjara Lands, South Australia, 1991-2001. Dept. for Environment and Heritage, South Australia.

Rogers R.W., Butler D. & Carnell J. (2003) *Dispersal of germinable Seeds by Emus in Semi-arid Queensland*. Botany Department, The University of Queensland. *EMU* Vol. 94, pp 132-134.

South Australian Arid Lands NRM Board (SAAL). (undated). Pest Plant Species Fact Sheet. Athel Pine *Tamarix aphylla*. DEWNR.

Te, T., (2011) *Swainsona dictyocarpa* SPRAT information.

Te, T. (2013). Personal comments on species selection.

Tingate, P.R. & Duddy I.R. (2002). The thermal history of the eastern Officer Basin (South Australia): evidence from apatite fission track analysis and organic maturity data : *Tectonophysics* 349: 251–275

Toelken. H.R., and Cunningham, D.D. (2008). *Teucrium reidii* (Labiatae): a new species from north-western South Australia. *Journal of the Adelaide botanical Gardens* 22, 97-100.

Ward, M. (2010). APY Lands Regional NRM Implementation Plan. Alinytjara Wilurara NRM. unpublished

Webb, J. A. James, J.M. (2006). Karst evolution of the Nullarbor Plain, Australia. In Harmon, R. S. & Wicks, C. M. *Perspectives on Karst Geomorphology, Hydrology and Geochemistry - a Tribute Volume to Derek C. Ford and William B. White*. Geological Society of America Special Paper 404. pp. 65–78.

Wright, R. V. S. (ed.). (1971). *Archaeology of the Gallus Site, Koonalda Cave*. Canberra: Australian Institute for Aboriginal Studies

APPENDIX 1: SPRATs and Additional species information, including Threatened Ecological Communities

The following plant taxa descriptions include additional information for new SPRAT taxa, as part of this project, and for additional taxa where information was generated and may be useful in the future. Note that this is not a comprehensive list, but includes many of the species from Table 1.

Further plant taxa, which came to prominence through research for this document, are also briefly noted.

SPRATs were not written for potential Threatened Ecological Communities. However, information has been generated for three ecological communities through the course of this project, and also included in this Appendix.

***Acacia ammobia* ('Mount Connor Wattle')**. (New SPRAT). Shrub or small tree growing 1.5 to 7m high, often on dunes, sandy, or gravelly soils with *Triodia* spp. Most of its population is in Northern Territory, particularly around Uluru/Ayers Rock. South Australia's known population is represented by a localised outlier at the eastern end of the Indulkana Range. It was first discovered in 2009, with the population estimated to be 1000 plants over 4 square kms. The Indulkana population was recorded growing in a rocky gully with *Callitris glaucophylla* Low Woodland, *Acacia aneura* complex, *A. minyurra* over *Triodia irritans* (Paltridge *et al* 2009). Not listed under the *EPBC Act 1999*, but currently Rare under the State *NPW Act 1972*. It is listed as Near Threatened for Northern Territory (*Territory Parks and Wildlife Conservation Act 2000* (TPW Act)).

Threats include increased fire frequency. The species in the Northern Territory is considered fire sensitive, with up to 70% mortality following fire (Latz 2004). It can be killed by even the mildest fires. However seedlings come up readily following fire. Reproductive maturity occurs after 6-10 years in NT, however Indulkana has lower rainfall (Paltridge *et al.* 2009). Camel grazing is also considered a threat.

***Acacia oswaldii* (Umbrella Wattle)**. Perennial shrub to small tree growing 2-6m high. It is found in widespread areas of South Australia, except the higher rainfall areas of the South East and Mount Lofty Ranges botanical regions. It is most prevalent in arid to semi-arid regions in *Acacia aneura* complex and *Casuarina pauper* Low Open Woodland, Shrublands and *Eucalyptus socialis* Mallee on calcareous sandy loams to loams (Whibley and Symon 1992). It is also recorded widely in all mainland States and the Northern Territory. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. It was considered as Least Concern in all regions of the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The species is listed Not Threatened for Western Australia. Listed as Data Deficient for Northern Territory (*Territory Parks and Wildlife Conservation Act 2000* (TPW Act)).



Figure, *Acacia oswaldii* Dan Duval, SA Seed Conservation Centre.

***Acacia tenuior* ('Central Ranges Wattle').** (New SPRAT). Dense, rounded shrub to 2.5m high. Currently 2 known populations in SA and 2 in NT in the Mann and Musgrave Ranges, with an estimated population size of 6000 plants. It is endemic to the Central Australian Ranges. There are only small disjunct populations of this species known. It occurs on granite-gneiss ranges, often along drainage lines. In the Musgrave Ranges it occurs on or below rocky saddles at high altitudes (1,200m). In the Mann Ranges in gully heads, and south facing slopes. It is apparently capable of resprouting after fire. It is not listed under the *EPBC Act 1999*, but Rare under Schedule 9 of the State *NPW Act 1972*. Not assessed as yet for Northern Territory.

Threats include increased fire frequency. Galls caused by Phlaeothripinae thrips are particularly prevalent in the Jacky's Pass population of the Musgrave Ranges. These may cause stress on some plants preventing reproduction capability. The small scattered populations may also make the populations vulnerable to catastrophic events.

***Baeckea tuberculata*.** (New SPRAT). Poorly known perennial shrub to waist height, growing primarily on red sand dunes (Bates pers comm. 2013). It is endemic to South Australia and the North West botanical region, and likely the AW NRM region. It is largely recorded in the Great Victoria Desert, mostly in the Tallaringa IBRA sub region, including Tallaringa CP. But also Maralinga IBRA sub region to the west and adjoining areas of the Everard Block IBRA sub region to the north. It is recorded from deep sands in low numbers, never dominant. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Rare for the West and North regions (Gillam and Urban 2009, Gillam and Urban in prep. 2013).

***Basedowia tenerrima*.** Small, spreading annual herbaceous daisy growing 5-15mm high, in rocky areas on the sides of the higher range peaks. It is Endemic to South Australia, and more specifically the Musgrave and Everard Ranges of the AW NRM region. Likely ephemeral, its population seems to

fluctuate due to seasonal climatic conditions, abundant in years of good rainfall. The species was listed Vulnerable under the *EPBC Act 1999*, but following additional information from the Anangu Pitjantjatjara Lands Biological Survey, it was delisted. It is now not listed under the *EPBC Act 1999*, but Rare under Schedule 9 of the State *NPW Act 1972*. Recommended as Rare (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013). However the population size and trend is data deficient.

Threats may include encroachment of Buffel Grass; increased fire frequency and intensity due to increased Buffel Grass. The populations appear habitat specific to the higher rocky slopes of the ranges, so may be susceptible to climatic changes and other catastrophic events.

***Brachyscome tatei* (Nullarbor Daisy).** (New SPRAT). Low growing, semi-succulent perennial herb, restricted to the calcrete cliffs of the Nullarbor region, particularly the Bunda Cliffs. The plant can grow on a thin layer of soil on the calcrete (Coombe-Smith 2011). The population occurs in South Australia, although there are two collections in the late 1800s in the Victorian National Herbarium from 'Eucla', just across the Western Australian border. No recent records are known from the area, and old collection localities are imprecise, the species may be endemic to the State and AW NRM region. Not listed under the *EPBC Act 1999*, but Rare under the Schedules of the State *NPW Act 1972*. Recommended as Rare in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The population is considered stable.

The population size, life-cycle and ecology of the plant are not considered well understood (Coombe-Smith 2011).

Threats include the situation where the species grows, which are subject to erosion. Increased erosion rate may be detrimental, as the erosion of the cliffs may occur before the species can colonise (Coombe-Smith 2011). The species occurs in specialised habitat, making it vulnerable to any deleterious events, including climatic changes, or a new weed invasion.

***Calostemma abdicatum* (Everard Garland Lily).** (New SPRAT). Seasonally growing from an onion-like bulb. Its leaves do not appear until the plant has finished flowering in March to April (Lang et al 2003, Paltridge et al 2009). It grows along the edges of sandy creek banks, and Mt Illbillee higher altitude gullies in shaded pockets of deeper soil. Only recorded for the Everard Ranges. Endemic to SA and the AW NRM region. There are three known populations with a total population estimated to be 10,000 to 20,000 plants over limited areas (total 4 ha.). Habitat is deep alluvial soils of creek beds, rocky gullies and steep, south facing slopes of granite hills and gorges (Lang 2008). *Eucalyptus camaldulensis* ssp. and *E. intertexta* Open Woodlands are often associated along the creek beds; *Acacia olgana* Tall Open Shrubland in the more rocky sites. Not currently listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Rare (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013).

Threats includes its extremely localised habitat and range making it vulnerable to localised catastrophic events. Weeds may also pose a future threat, such as Buffel Grass. Loss of soil following fire denuding the granitic slopes may also provide a threat to one of the populations. Recommended as Rare (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013).

***Cremnothamnus thomsonii* (Cliffside Daisy/Thomson's Daisy).** (New SPRAT). Small perennial daisy growing to 50cm high. There is only one known outlier population in South Australia in the Indulkana Range, but it has a widespread distribution in NT, primarily the MacDonnell Ranges and outlying hills (Paltridge *et al.* 2009). It is reasonably common in NT. The SA population is estimated to be 240 plants (Paltridge *et al.* 2009). It grows in the crevices of cliffs of sandstone gorges, escarpments and at times amongst boulders on scree slopes. Not currently listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. No conservation status recorded for NT.

There are no known threats due to its occurrence on rocky cliff sides, inaccessible to herbivores and fire.

***Dicrastylis gilesii* ssp. *bagotensis* (Giles' Sand Sage).** (New SPRAT). Perennial shrub growing 1-1.5m, but occasionally 2m high. Endemic to the Central Australian Ranges, with most of the population found in the Northern Territory, but also the north west of South Australia in the Kintore IBRA sub-region, into Western Australia. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Rare status due to its localised and fragmented populations (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013). As essentially a newly described taxa, its conservation status has not been evaluated in any jurisdiction. The subspecies is not currently listed separately in Western Australia.

***Eremophila decussata*.** (New SPRAT). Perennial, low, spreading shrub growing up to 0.5m high. Most of the scattered population occurs in South Australia in the Nullarbor Plain and Ooldea area, growing on skeletal calcareous soils, often with exposed rock near the surface (Chinnock 2007). There is one collection from Western Australia. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The population is considered stable). Listed as Priority 1 for Western Australia (poorly known species from <5 collections).



Figure, *Eremophila decussata*, Ooldea Dan Duval, SA Seed Conservation Centre.

***Eremophila delisseri* (Nullarbor Emubush).** (New SPRAT). Perennial shrub growing up to 1m high. It is Endemic to the Nullarbor Plain. Its known population is restricted to the South Australian portion of the Nullarbor Plain, except for one late 19th century collection from adjacent the border, in the Western Australian portion of the Nullarbor Plain. Location of these old collections is imprecise, and may also be within South Australia. It appears to grow on skeletal calcareous loams. Not listed under the *EPBC Act 1999* or the State *NPW Act 1972*. Recommended as Near Threatened (Uncommon) in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). However due to the localised populations it warrants reconsideration for listing under the *NPW Act 1972*. The population is considered stable.

***Eremophila dendritica*.** (New SPRAT). Small, perennial shrub growing up to 0.5m high. It grows in a band from the Murchison, Nullarbor and Great Victoria Desert IBRA regions of Western Australia into similar areas of South Australia. It appears to be restricted to skeletal brown calcareous soils. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The population is considered stable. In Western Australia the species is listed as Priority 2 (poorly known taxa).

***Eremophila hillii* (Hill's Emubush).** (New SPRAT). Low, compact perennial shrub which can grow up to 1m high. The species has been mostly recorded from the Nullarbor Plain of South Australia, with a few sparse collections in similar areas of the Nullarbor IBRA region of Western Australia. One of the largest populations is on the plain areas around the Ooldea railway siding. It seems to prefer shallow calcareous loams over limestone. Not listed under the *EPBC Act 1999*, but currently listed Rare under the Schedules of the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species

Conservation Assessment Project Phase 1 (Gillam and Urban 2009). Listed as Priority 4 in Western Australia (Rare, Near Threatened or species in need of monitoring).

***Eremophila verrucosa* ssp. *brevistella* (Warty Emubush).** (New SPRAT). Perennial shrub growing to 1.5m high. Endemic to South Australia, and only known from the red sand dunes around Ooldea. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009), due to its highly restricted distribution. However, the population is considered stable.

***Eremophila verrucosa* ssp. *verrucosa* (Warty Emubush).** (New SPRAT). Perennial shrub at times growing up to 2m high. Widespread, scattered population. Grows on shaly areas or rocky slopes with gibber or other stones. Endemic to South Australia, but most of the population lies outside the AW NRM region. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009), due to its highly restricted distribution. However, the population is considered stable.

***Eremophila willsii* ssp. *intermediate* ('Musgrave Range Fuschia').** (New SPRAT). Tall spindly shrub growing to 1.7m high. Only one known localised population in the Musgrave Ranges, occupying about 1 sq. km. Population size is estimated to be over 10,000 plants. Habitat is *Triodia* dominated gravelly mid-slopes of granitic hills (800-850m altitude). It straddles the inter zone of two *Triodia* species of *Triodia scariosa* and *T. irritans*. These areas had low species diversity. Little is known of its biology, except it does persist in frequently burnt areas. The population seems to be of one age class, that shows signs of resprouting following fire and drought events. Due to lack of information there are no known threats. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*, but the taxa has not been assessed

***Eucalyptus minniritchi* (Round-leaved Mallee).** (New SPRAT). Low perennial mallee growing 2-3 m high. The mallee is considered endemic to the Central Australian Ranges (Nicolle 2013). It has been found mostly in the Northern Territory in the Petermann and McDonnell Ranges, with only one record for Western Australia on the border with NT. In South Australia, its occurrence appears to be restricted to the highest rocky peaks of the Musgrave Ranges, such as Mt Woodrofe. It is also found just across the NT border on the peak of Mt Mann (Nicolle 2013). Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Vulnerable status due to its highly localised and fragmented populations (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013). No conservation status under the NT legislation (Albrecht *et al.* 2007).

***Eucalyptus wyolensis* (Wyola Mallee).** (New SPRAT). Low perennial tree growing 4-6m high, with distinctive rounded sessile blue-green leaves, always regarded in their juvenile phase (Nicole 1997). Recorded from highly localised localities, primarily one, on a red sandy plain with other mallees near Lake Wyola, Great Victoria Desert. This is an area between the Nullarbor Plain before the Great Victoria Desert dunes begin to the north. It is Endemic to South Australia and the AW NRM Region. Not listed under the *EPBC Act 1999*, but listed Rare under Schedule 9 of the SA *NPW Act 1972*. Recommended as Rare in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

***Goodenia brunnea* (Central Ranges Goodenia).** Erect, sticky shrub to 80cm high. Seven populations recorded in SA, mostly in the Musgrave Ranges, with an outlier in the Tomkinson Ranges, and 3 in NT. Population size unknown. Endemic to the Central Australian Ranges bioregion. Occurs in *Triodia* dominated communities on the rocky slopes of the ranges with granite or metamorphic geologies (White *et al.* 2005). It is most abundant in recently burnt areas. It can be a dominant species in early successional stages following fire (Lang *et al.* 2003). It lasts a couple of years following fire and then largely disappears as *Triodia* cover increases, persisting in *Triodia* free areas in small numbers. Not listed under the *EPBC Act 1999*, but listed Rare under Schedule 9 of the *SA NPW Act 1972*. Listed as Near Threatened for Northern Territory (*Territory Parks and Wildlife Conservation Act 2000 (TPW Act)*).

No known threats.

***Grevillea treueriana* (Mt Finke Grevillea).** (New SPRAT). Perennial shrub growing in rock crevices on Mt Finke, Yellabinna Regional Reserve. Endemic to South Australia, its entire natural population confined to Mt Finke. Listed as Vulnerable under the *EPBC Act 1999*, and Schedule 8 of the *State NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).



Figure, *Grevillea treueriana*, Mt Finke. Dan Duval, SA Seed Conservation Centre.

***Gunniopsis calcarea*,** is a perennial shrub, also recorded from Western Australia, where it is listed as Not Threatened. It has been recorded from Koonalda Cave, where the moister conditions make it an interesting outlier.

***Hibbertia crispula* (Ooldea Guinea-flower)**. Small perennial shrub up to 0.5m high, growing mostly on sand dunes. Most of the population occurs on the dunes north of the Ooldea Railway Siding, with a further population recorded to the east around Lake Everard (outside the AW NRM region). It is recorded in one localised area of Western Australia, at the western end of the Great Victoria Desert IBRA region. Listed as Vulnerable under the *EPBC Act 1999*, and Vulnerable under Schedule 8 of the *SA NPW Act 1972*. Recommended as Vulnerable for all subregions it occurs in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). Listed as Priority 1 for Western Australia (poorly known species from <5 collections).



Figure, *Hibbertia crispula* shrub and habitat, sand dunes east of Ooldea. Dan Duval, SA Seed Conservation Centre.

***Hibbertia glaberrima* (Cental Australian Guinea-flower)**. Perennial shrub to 1.5m high. In SA occurs in the Everard Ranges, eastern Musgrave Ranges and Sentinel Hill. But also occurs in NT, where most specimens have been recorded, and WA. Rare SA *NPWS Act, 1972*.

***Lechenaultia aphylla* (Leafless Leschenaultia)**. Small; probably perennial shrub, growing to 0.3 m high. It primarily grows on red sand, including lower slopes of the sand dunes and drainage areas. Most of the known population occurs in widely distributed localised areas of the South Australian Kingoonya, Yellabinna (Yellabinna Regional Reserve), and Watarru IBRA sub-regions. In Western Australia there is one known localised population at the western end of the Great Victoria Desert IBRA region. However, all the Western Australian collections appear to be more than 80 years old, and the population very small. Not listed under the *EPBC Act 1999*, but Vulnerable under Schedule 8 of the *SA NPW Act 1972*. Recommended as Vulnerable in the West Region Species Conservation

Assessment Project Phase 1 (Gillam and Urban 2009). Recommended as Vulnerable status due to its highly localised population (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops Gillam and Urban in prep. 2013). However, due to limited information, population trend is unknown in all areas. Listed as Priority 1 for Western Australia (poorly known species from <5 collections).



Figure, *Lechenaultia aphylla* Dan Duval, SA Seed Conservation Centre.

Leiocarpa pluriseta is a perennial shrubby herb, endemic to South Australia, but not restricted to the Nullarbor region. It has been recorded from some caves in the Nullarbor Karst system. It is listed as Rare under the SA NPW Act 1972. Possibly considered near threatened.

***Leiocarpa semicalva* ssp. *vinacea* (Red-stem Button-bush)**. Perennial herbaceous daisy. Recorded from both the Everard Ranges and Sentinel Hill. May also occur in NT and WA, where similar taxa has been recorded. The species is little known, and has a limited distribution. Recommended as Rare in the Northern region Species Conservation Assessment Project Workshops. Essentially data deficient regarding population trend and other information. More survey work required (Gillam and Urban in prep. 2013).

Lepidium pseudoruderale, An annual or ephemeral usually erect herb to 30 cm tall, also recorded from Western Australia, where it is listed as Not Threatened. It is listed as Rare under the SA NPW Act 1972. It has been recorded from a few cave areas and rockholes in the SA Nullarbor, including Koonalda Cave. Painted Hills subpopulation was discovered during the Lake Eyre South study (Badman 1999).

***Lepidosperma avium* (Central Australian Rapier-sedge)**. Long-lived sedge growing 1m to 2.4 m high. Recorded from the Everard Ranges, but also Mt Lindsay in the Birks Gate Range, Musgrave Ranges, and Sentinel Hill. Recorded in 2009 just across the border in NT. Currently five known populations in

the Central Ranges bioregion, with a single record from Dalhousie Springs. The biggest population is in the Everard Ranges where it is known from 16 sites (Paltridge *et al.* 2009). It grows on rocky hillsides, usually at the base of large granitic rock slabs or domes, providing maximum run off, as well as restricting passage of wildfire. Similar habitat areas to *Prostanthera nudula*, growing in the fire sensitive *Acacia olgana* Tall Open Shrubland plant community. It can likely resprout following fire, but effect is unknown (Paltridge *et al.* 2009). Not listed under the *EPBC Act 1999*, but Rare under Schedule 9 of the *SA NPW Act 1972*. Recommended as Vulnerable status due to its highly localised population for Watarru and Witjera IBRA sub-regions, and Rare for Mann_ Musgrave Block and Everard Block (regional Northern Species Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013). No conservation status assessed as yet under the NT legislation.

Threats are likely increased fire frequency, as like *P nudula* it appears to avoid areas likely to burn. Increased fire frequency is likely to denude its habitat, making it susceptible to soil loss in the event of heavy rain events (Paltridge *et al.* 2009).

***Limosella granitica* (Granite Mudwort).** (New SPRAT). Perennial aquatic herbaceous plant growing in silt at the bottom of water-filled granite rockholes. It is Endemic to South Australia, with most of the population occurring in the Gawler Ranges and Eyre Peninsula. A small population of unknown size occurs on granite outcrops in the Yellabinna IBRA sub-region of the AW NRM region. Listed as Vulnerable under the *EPBC Act 1999* and Schedule 8 of the *SA NPW Act 1972*. Recommended as Vulnerable for all IBRA sub-regions in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).



Figure, *Limosella granitica*. Gawler Ranges Dan Duval, SA Seed Conservation Centre.

***Melaleuca fulgens ssp. corrugata* (Wrinkled Honey Myrtle).** (New SPRAT). Shrub growing to 2.6m high. Flowering non-seasonal, but probably induced by rain events. It is currently known from 5

populations in SA, 2 in NT and one in WA, where it occurs in the Petermann, Rawlinson, Mann, Musgrave, Everard, and Birks Gate Ranges. All these populations are highly fragmented, as it occurs only on the highest peaks of these ranges. Total population size estimated to be less than 2,500 plants. It is endemic to the Central Australian Ranges. Both the NT and WA populations are very small. Its habitat is described as shallow, skeletal soils associated with watercourses, or run-on areas at the base of large rock slabs. It is noticeably restricted to the highest altitudes, implying it is a possible relict population to previous higher rainfall climatic conditions. Although it grows in *Triodia* dominated areas, it tends to prefer bare rock areas. Not listed under the *EPBC Act 1999*, but Rare under Schedule 9 of the *SA NPW Act 1972*. Listed as *Near Threatened for Northern Territory (Territory Parks and Wildlife Conservation Act 2000 (TPW Act))*. Not listed as a separate taxa for Western Australia.

Threats include increased fire frequency. It appears to be able to resprout following fires, but largely grows in bare areas where fire impact is limited. This may be due to loss of soil cover from denuded rocky hillsides following fire, and subsequent rain events. *Triodia* encroachment may also pose problems in increasing fire intensity and frequency where the species occurs.

Microlepidium alatum. (New SPRAT). Annual herb, growing at times up to 20cm high. It grows on calcareous soils in mossy, shady, sheltered situations. Endemic to South Australia on Eyre Peninsula and the Far West. Listed as Vulnerable under the *EPBC Act 1999* and Schedule 8 of the *SA NPW Act 1972*. Recommended as Rare for Eyre Mallee and Yalata IBRA sub-regions in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The population is considered stable.

Monotaxis luteiflora. Recorded in SA only for the Everard Ranges. Recommended as Vulnerable due to highly localised population in the Northern region Species Conservation Assessment Project workshops. Prefers red soils and is considered fire responsive. Population trend is data deficient.

Phlegmatospermum ermaeum (Spreading Cress), is an annual herb found in drier areas of southern Australia. recorded near Koonalda Cave and elsewhere in the SA Nullarbor Karst system.

It is also recorded from Western Australia's Nullarbor karst system, and elsewhere, where it is listed as Priority 2. In South Australia it is listed as Rare under the *SA NPW Act 1972*. Recommended as Endangered for the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). It has been recorded near Koonalda Cave and elsewhere in the SA Nullarbor Karst system.

Phlegmatospermum richardsii (Nullarbor Cress). (New SPRAT). Annual herb, growing at times up to 20cm high. It grows on calcareous soils and calcrete. Most of the current known population is recorded in the Far West Yalata mallee and Nullarbor regions (Coonalda Cave). There are also old collections from around Fowlers Bay, and one old later 1800s collection from just across the Western Australian border. As the Western Australian collection is very early, and same date and collector as one of the Fowlers Bay area collections, its location can be regarded as imprecise, and may have been made in South Australia. It may be a South Australian endemic. Not listed under the *EPBC Act 1999*, but Vulnerable under Schedule 8 of the *SA NPW Act 1972*. Recommended as Endangered for Eyre Mallee and Vulnerable for Yalata IBRA sub-regions in the West Region Species Conservation

Assessment Project Phase 1 (Gillam and Urban 2009). The Nullarbor collection was made after this assessment. Listed as Priority 1 for Western Australia (poorly known species from <5 collections).

Pimelea ammocharis. Upright perennial shrub growing 0.2 to 1.5m high. It can be found on sand dunes, rocky rises, and along watercourses. Occurs more in northern Western Australia east into Northern Territory. There are two South Australian populations. One in the Lake Eyre botanical region, with a further population contiguous with the Western Australian population in the Musgrave Ranges. There is some taxonomic confusion regarding the species, as it is not currently recognised as a separate taxa by the State Herbarium of South Australia. The State Herbarium of South Australia recognises the species as part of *Pimelea penicillaris* (Sandhill Riceflower). It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. As it is not currently recognised by the State Herbarium of South Australia, it was not considered in the Northern Region Species Conservation Assessment Project Phase 1 workshops (Gillam and Urban in prep. 2013). The species is listed Not Threatened for Western Australia and Least Concern for Northern Territory.

Pimelea microcephala* ssp. *glabra. Recorded in the Everard Ranges and Mt Lindsay in the Watarru IBRA region to the west. Recommended as Rare for both IBRA regions in the Northern region Species Conservation Assessment Project workshops. Considered there may be identification problems with the similar *P. microcephala* ssp. *microcephala*. Population trend is data deficient (Gillam and Urban in prep. 2013).

NRM region. Grows in granite areas on granitic soils. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Considered Rare in the Northern Region Species Conservation Assessment Project Phase 1 workshops (Gillam and Urban in prep. 2013). However population size and trend is data deficient.

***Prostanthera nudula* (Naked Mintbush/Mount Illbillee Mintbush)**. (New SPRAT). A perennial shrub up to 2 m high. Leaves are reduced and at times the plant can be spiny and leafless (Lang et al 2003). Endemic to South Australia and the AW NRM region. Recorded from both the Everard Ranges and Sentinel Hill, where it occurs along watercourses and run-on areas at the base of rock slabs of the larger granitic hills. There are five known populations, with an estimated 200 plants at Sentinel Hill, and more than 3,000 plants in the Everard Ranges (Paltridge et al 2009). Its habitat include fire sensitive communities including *Acacia olgana* (Mt Olga Wattle) Tall Open Shrubland of domed, exfoliating granitic hills (Lang et al 2003). It is capable of resprouting and growing from seed after fire, but seems to occur in areas absent of *Triodia*, and can carry fire rarely (Paltridge et al 2009). Listed as Vulnerable under the *EPBC Act 1999* and SA *NPWS Act 1972*. Recommended as Vulnerable due highly restricted populations, in the Northern Region Species Conservation Assessment Project Phase 1 workshops (Gillam and Urban in prep. 2013).

Fire is likely its most significant threat, due impact on the fragile soil where it occurs. The exposed soil on the localised slopes where it occurs has high potential of being washed away during heavy rainfall events.

***Pterostylis* sp (*Oligochaetochilus* sp.) 'Everard Ranges' (Mimili Orchid)**. (New SPRAT). Although not formally recognised in the current online Census of SA Plants, Algae and Fungi (2013), it is a taxa of Greenhood Orchid which seems to be endemic to the Everard Ranges. It remains poorly known and not formally described. Recommended as Vulnerable due to its highly restricted range (regional

Northern Species. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. However the taxa is not described and hence not assessed. Conservation Assessment Project Phase 1, Regional Species Status Assessment workshops (Gillam and Urban in prep. 2013). However its population size and trend is data deficient.

***Pterostylis xerophila* (Desert Greenhood).** (New SPRAT). A small, terrestrial orchid, found mostly on red loamy soils on or around granite or quartzite rock outcrops (Jessop & Toelken 1986), and less frequently alluvial soils. It is found in semi-arid mallee areas of Eyre Peninsula and Gawler Ranges, with a disjunct population in the mallee districts of north-western Victoria and adjacent areas of South Australia. It was also recorded in 2004 from Mt Finke, in the AW NRM region. Currently there are only eight known populations. Listed nationally as Vulnerable under the *EPBC Act 1999*, and Vulnerable under the State *NPW Act 1972*. Listed as Threatened for Victoria (*Flora and Fauna Guarantee Act 1988*).

Little is known of the species biology and ecology, largely due to the drier and remote areas where much of the population occurs. It is dormant in drier months, emerging after winter rains. However due to the more unreliable rainfall and drier areas where it occurs, flowering is sporadic. Few if any plants flower in dry years (Duncan 2010).

Little is also known of the extent or impact of current threats to the populations . Likely threats include grazing by rabbits, feral goats, kangaroos; weeds such as *Echium plantagineum* (Salvation Jane) and *Carrichtera annua* (Wards Weed); habitat degradation and loss in the mallee areas; disturbance; and climate change (Duncan 2010).

***Santalum acuminatum* (Quandong).** Slow growing, semi-parasitic perennial shrub, but usually a small tree growing up to 5m high. It can be found in widespread areas of South Australia, except the highest rainfall areas of the South East and Mount Lofty Ranges botanical regions, in a variety of habitats and soils. It is also recorded widely in all mainland States and Territories. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. It was considered as Least Concern in all regions of the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009). The species is listed Not Threatened for Western Australia, but Vulnerable for Northern Territory.



Figure, *Santalum acuminatum* fruit, Arkaringa Hills. Dan Duval, SA Seed Conservation Centre.

***Santalum spicatum* (Sandalwood).** Slow growing, semi-parasitic perennial shrub or small tree growing up to 8m high. It is recorded over a wide area of Western Australia into the western half of South Australia in a number of botanical regions (NW, NU, GT, FR, EA, EP). It is not listed under the *EPBC Act 1999*, but listed Vulnerable under Schedule 8 of the State *NPW Act 1972*. The species is listed Not Threatened for Western Australia where it is more widespread.

Threats include illegal harvest and trade of the timber, roots, due to its highly fragrant wood. Trade is international. Camel grazing also a threat.



Figure, *Santalum spicatum*, Googs Track, Yellabinna Regional Reserve. Dan Duval, SA Seed Conservation Centre.

Senecio euclaensis. Perennial shrub growing up to 1.5m high. Recorded from the coastal cliffs of a restricted area both sides of the border between South Australia and Western Australia in the Hampton IBRA sub-region. Although not thoroughly surveyed, South Australia may have the larger population of the species. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Listed as Not Threatened for Western Australia. As it was not listed in the SA Plant, Fungi and Algae Census at time of assessment, it was not considered in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

***Senna planiticola* (Yellow Pea)**. Recorded in the Everard Ranges and adjacent areas of Teyon IBRA region. Recommended as Rare for both IBRA regions in the Northern region Species Conservation Assessment Project workshops. Population in the Everard Ranges is considered stable.

***Sida* sp. Everard Ranges (D.J. Whibley 1085) (Everard Range Sida)**. Erect shrub. Initially collected in 1985 and yet to be described. Restricted to the Everard Ranges and inselbergs with similar geology. Not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as Near Threatened (Gillam and Urban in prep. 2013). Population trend is considered data deficient.

Swainsona dictyocarpa. (New SPRAT). Small herbaceous plant growing up to 6cm high. Endemic to South Australia, currently only recorded from the Gairdner-Torrens botanical region outside of the AW NRM region. However the AW NRM region contains similar habitat and the species could be reasonably expected to occur in the region. It is not listed under the *EPBC Act 1999*, but Vulnerable under Schedule 8 of the State *NPW Act 1972*. It was considered Endangered for the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

***Teucrium grandiusculum* ssp. *grandiusculum*.** Perennial shrub growing up to 0.8m high, recorded on red sands, rocky slopes and watercourses. It is a species primarily of the Central Australian Ranges recorded in the Northern Territory, Western Australia, and only in the Mann Ranges of South Australia. It is not listed under the *EPBC Act 1999*, but Vulnerable under Schedule 8 of the State *NPW Act 1972*. In Western Australia the species is listed as Priority 2 (poorly known taxa). Listed as Near Threatened for Northern Territory. The taxa is similarly poorly known in South Australia.

***Teucrium grandiusculum* ssp. *pilosum*.** (New SPRAT). Perennial shrub growing up to 0.8m high. Considered to grow on calcrete areas. An endemic taxa to South Australia. In the AW NRM region it is recorded from the Yellabinna IBRA sub-region in the vicinity of Ooldea Railway Siding. It is also recorded from the Gawler Lakes IBRA sub-region outside of the AW NRM region. It is not listed under the *EPBC Act 1999*, but Endangered under Schedule 7 of the State *NPW Act 1972*. Recommended as Endangered for all sub-regions in the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).



Figure, *Teucrium grandiusculum* ssp. *pilosum*, Ooldea. Dan Duval, SA Seed Conservation Centre.

***Teucrium reidii* (Showy Germander).** (New SPRAT). Multi-stemmed shrub, growing at times up to 2m high but usually 1m high. It is endemic to South Australia. In the AW NRM region, it is known from 7 populations in the Tomkinson, Mann and Musgrave Ranges, where there are estimated to be more than 2000 plants. Outside of the AW NRM it is also recorded from the northern Flinders Ranges. It grows in shallow soils at the base of boulder piles usually in igneous rock formations such as granite or ultramafic rock, eg. south facing slopes of the Tomkinson Range; refuge areas at high altitudes of the Musgrave Ranges. It prefers shady, well watered areas where triodia is absent or in low numbers. *Callitris glaucophylla*, *Ficus brachypoda*, *Santalum lanceolatum* often associated. It is capable of resprouting following fire, implying it can tolerate a low level of fire. It is not listed under the *EPBC Act 1999*, or the State *NPWS Act 1972*.

Threats include competition with weeds (eg. Buffel Grass), and encroachment by more dominant groundcover species increasing fire frequency and intensity (eg. Buffel Grass and *Triodia* spp.).

Thryptomene longifolia. (New SPRAT). Perennial shrub growing to 2m high. Endemic to South Australia and more specifically the AW NRM region. It is primarily recorded on the red sand dunes, with the largest population apparently in Tallaringa Conservation Park. It is not listed under the *EPBC Act 1999*, or the State *NPW Act 1972*. Recommended as probably Near Threatened (Gillam and Urban in prep. 2013), although little is known about the species. Population trend is considered likely stable.

***Wurmbea centralis* (Inland Nancy)**. (New SPRAT). Herb growing 4.5cm. up to 20cm high. It grows among rocks, mainly on hills. A species of the Central Australian Ranges, in NW South Australia and adjacent areas of Northern Territory. It is not listed under the *EPBC Act 1999*, or the current Schedules of the State *NPW Act 1972*. Listed as Near Threatened for Northern Territory. Recommended as Endangered for northern region (Gillam and Urban in prep. 2013), due to its limited habitat. The assessment considered the population was likely declining.

Additional taxa –

Below are further taxa, which background research indicated had limited or rare populations within the AW NRM region. However these species were not considered to fulfil the strict criteria outlined through this document (eg. more widespread distribution interstate and/or elsewhere in the State).

Acacia hemiteles - Spreading, perennial shrub growing 0.5 to 2m high on a variety of soils (Florabase 2013). Not considered for more detailed consideration, as it has a widespread distribution in Western Australia. In Western Australia, the species is listed as Not Threatened. The one record for the South Australian Nullarbor botanical region is an extreme disjunct easterly outlier. On the basis of this 1977 record, the species is listed as Rare under the *SA NPW Act 1972*. Further survey work would be useful to determine if the shrub still exists in South Australia, and the extent of the population.

***Cuphonotus andraenus* (Downy Mother of Misery)** - Annual herb growing up to 25cm high, found on red loamy soils (Florabase 2013). Not considered for more detailed consideration, as it has a widespread distribution in Western Australia through southern Northern Territory into Queensland and northern New South Wales. The South Australian population is on the southern margin of its distribution. Here it is recorded from the Everard Block and adjacent Breakaways IBRA sub regions. It was considered locally common, but generally Rare in SA northern region (Gillam and Urban in prep. 2013).

Halgania glabra - Erect or straggling perennial shrub growing 0.3-1.2 m high, found on red sandy soils of stony slopes and sand dunes (Florabase 2013). Although largely a Central Australian Ranges species, it was not considered for more detailed consideration, as more of the population occurs in Western Australia, with further areas in south west Northern Territory. The South Australian population is the southern margin of its range, where it only occurs in the Mann-Musgrave Block IBRA sub region. Considered Rare for SAs northern region (Gillam and Urban in prep. 2013).

***Lechenaultia striata* (Striate Lechenaultia)** - Perennial shrub growing 15 to 60cm high, found on the red sand dunes (Florabase 2013). Not considered, as most of the population occurs in Western

Australia (Not Threatened) and the Northern Territory. In South Australia, the species is recorded from the Kintore IBRA sub region, where it was considered Rare for SAs northern region (Gillam and Urban in prep. 2013).

Logania centralis - Compact perennial shrub, growing 15 up to 45cm high, found on the red sand dunes and sandy plains (Florabase 2013). Not considered for further consideration, as the species mostly occurs in Western Australia (Not Threatened) into south western Northern Territory. In South Australia, an edge of range outlying population occurs in the Watarru IBRA sub region. Considered Rare for SAs northern region (Gillam and Urban in prep. 2013).

Phlegmatospermum eremaeum (Spreading Cress) - An annual herb found in drier areas of southern Australia on loam soils. In the AW NRM region, it has been recorded near Koonalda Cave and elsewhere in the SA and WA Nullarbor Karst system. Not considered for more detailed consideration, as occurs more widely in South Australia (LE, NU, EP, NL, MU, YP botanical regions), and interstate in Western Australia, north western Victoria and adjacent areas of New South Wales. However, it is listed as Rare under the SA *NPW Act 1972*, and recommended as Endangered for the West Region Species Conservation Assessment Project Phase 1 (Gillam and Urban 2009).

Psyrax ammophila - Multi-stemmed tree or shrub growing 1-3 m high, found mostly on alluvial soils of creek beds and the sand plain (Florabase 2013). Not considered for more detailed consideration, as most of the population occurs in widespread areas of Northern Territory, with edge of range populations extending into Queensland, Western Australia and South Australia. In South Australia, it occurs in limited habitat. Considered Rare, but with a stable population in SAs northern region (Gillam and Urban in prep. 2013).

***Psyrax suaveolens* (Narrow-leaf Native Currant)** - Shrub growing 0.5-3 m high, found on sandy clay to stony loam soils of rocky slopes and creek banks (Florabase 2013). Not considered for more detailed consideration, as most of the population occurs in widespread areas of Western Australia and the Northern Territory. In South Australia it has been recorded from a number of localities in the AW NRM region. Recommended as rare in SAs northern region (Gillam and Urban in prep. 2013).

Ptilotus aervoides - Prostrate annual herb growing up to 10cm high, usually found on stony red sandy loam soils of the open plains (Florabase 2013). Not considered for further consideration, as the most of the population occurs in Western Australia (Not Threatened (Florabase 2013)) into south western Northern Territory. The South Australian population is at the edge of its range in the Mann-Musgrave Block IBRA sub-region. Considered Rare in SAs northern region (Gillam and Urban in prep. 2013).

***Ptilotus schwartzii* (Horse Mulla Mulla)** - Perennial herb or shrub growing 20cm up to 1m high, found on sandy and often stony soils on the plains (Florabase 2013). Not considered for more detailed consideration, as most of the population occurs in Western Australia (Not Threatened (Florabase 2013)) through the Northern Territory into Queensland. The South Australian population is the southern edge of its range found in the Mann-Musgrave Block & Everard Block IBRA sub regions. Here it was considered Rare (Gillam and Urban in prep. 2013).

Ptilotus symonii - A herbaceous plant growing up to 50cm high, but usually lower, found on sandy soils, limestone plains, floodplains, and low rocky rises (Florabase 2013). It occurs in sub-coastal

areas adjacent the Great Australian Bight. Not considered for more detailed consideration, as most of the population occurs in Western Australia (Not Threatened (Florabase 2013)). However, there are few recent collections in South Australia despite specific searching for the species (Te pers. comm. 2013). The species appears to be very rare and maybe declining in South Australia. Currently listed as rare under the SA *NPW Act 1972*.

***Samolus eremaeus* (Desert Samolus)** - Perennial herb, although limited information is available for the species. Not considered for more detailed consideration, as most of the population occurs in southern Northern Territory in a number of localities, and possibly just into Western Australia. The South Australian population is the southern extent of its range, restricted to limited sites of the border areas of Mann- Musgrave Block IBRA sub region. Recommended as probably Rare for SAs northern region (Gillam and Urban in prep. 2013). However, it has a restricted range and probably specific habitat requirements, and warrants further research.

Scaevola glabrata - Erect perennial subshrub growing up to 50 cm high, usually found in rocky soil, often over limestone. Also occasionally found on sand. Not considered for further consideration, as most of its population occurs in the southern half of the Northern Territory and into western Queensland. In South Australia, it has been found just south of the border in the Mann-Musgrave Block IBRA sub region. Considered Rare, but could be Vulnerable for SAs northern region (Gillam and Urban in prep. 2013).

Scaevola obovata - Spreading shrub growing up to 50 cm high on rocky hillsides. Not considered, as more of the population occurs further north in the Northern Territory, with a small outlier population in South Australia on the Tomkinson Ranges. However, the species is poorly known and listed as Vulnerable under the SA *NPW Act 1972*. The Northern Territory population is data deficient (Albrecht *et al.* 2007).

Sclerolaena fusiformis - Prostrate to erect perennial herb growing 10-20cm high. It grows on calcareous clay loam, clay, red sand, as well as sandstone or granite outcrops, and flats (Florabase 2013). Not considered for more detailed consideration, as most of the population occurs in Western Australia, where it is listed as Not Threatened (Florabase 2013). The South Australian population has been recorded near the border, and represents the eastern most extent of its population. Listed as Vulnerable in the SA *NPW Act 1972*. Only two records for SA.

Sida 'bill barkeri' - Poorly known and undescribed perennial taxa. Not considered, due to taxonomic issues, and lack of information.

***Tribulus micrococcus* (Yellow Vine/Spineless Caltrop)** - Prostrate, mostly annual herb, which can respond quickly after good summer rainfalls, but dies off after the soil dries out. Not considered for more detailed consideration, as most of the population occurs in Queensland and New South Wales, where it is considered a weed. Scattered populations occur in Northern Territory and northern South Australia. In the AW NRM region it has been found in the Kintore IBRA sub region. It was considered probably Rare in SAs northern region (Gillam and Urban in prep. 2013).

Threatened Ecological Communities

Below are descriptions for three ecological communities recognised as being under threat within the AW NRM region:

- *Acacia aneura* complex (Mulga) Low Woodlands
- Semi-Arid *Lomandra* Grasslands
- *Eucalyptus gongylocarpa* (Marble Gum) Woodland of Maralinga Tjarutja Lands.

1. ACACIA ANEURA COMPLEX (MULGA) LOW WOODLANDS

Background

Acacia aneura (Mulga) is here referred to as a complex, as it comprises a number of species and varieties. Habitat preference and distribution is still being determined for the taxonomic review of the complex.

Acacia aneura complex Mulga Low Woodlands are the most widespread of Australia's arid and semi-arid *Acacia* Woodlands. They form extensive areas of north-western New South Wales, eastern Queensland, southern Northern Territory, South Australia and Western Australia. Nationally, the majority of the community occurs on leasehold or privately owned land subject to pastoral grazing (Dept SEWP&C).

Ecological Community Description

In South Australia, the ecological community forms extensive areas on the red sand plains and interdunal swales, and is a major community of the Great Victoria Desert IBRA region, particularly the Tallaringa and Kintore IBRA subregions (Lang *et al.* 2003, Foulkes and Thompson 2008). It prefers sandy loam soils of these areas. Its understorey is dominated by tussock grasses of *Aristida contorta* (Curly Wire-grass), *A. holathera* var. *holathera* (Tall Kerosene Grass), *Eragrostis eriopoda* (Woollybutt), *E. laniflora* (Hairy-flower Woollybutt), *Monachather paradoxa* (Bandicoot Grass), *Thyridolepis mitchelliana* (Window Mulga-grass), and open to mid dense shrub cover of *Eremophila* spp., *Maireana* spp. (Lang *et al.* 2003, Foulkes and Thompson 2008).

The community grades into tussock grasslands with emergent Mulga, which probably reflects fire history (Lang *et al.* 2003)

Conservation Status

The community has been rated as Vulnerable in An Inventory of the Biological Resources of the Rangelands of South Australia (Neagle 2003). The community was further listed as Vulnerable in the Provisional List of Threatened Ecosystems of South Australia, where it was considered in decline (DEH, 2009 update). In this assessment it was considered threatened through extensive fires in good seasons, followed by inhibited regeneration due to rabbit grazing. Formal conservation was also considered poor (DEH, 2009 update).

In the northern regional arid lands workshops to propose State Threatened Ecological Communities in 2012, *Acacia aneura* complex (Mulga) Low Woodland on red earth plains of the AW Lands was proposed as possibly Vulnerable. As noted, it is not an endemic community to the AW NRM region, or South Australia. However, the AW NRM region contains large areas of the community.

It is considered highly sensitive to fire. *Acacia aneura* complex are generally killed in hot fires, but can survive and regenerate after rain in milder fires (Foulkes 2008). Regeneration success is dependent on seed germination, with subsequent seedling survival influenced by climatic factors such as rainfall and radiant heat, and herbivore grazing.

With changes in traditional land practices, particularly decrease or cessation of small patch burning by the Traditional owners, there has been an increased tendency for more intense and larger fires. These fires can be extensive covering thousands of square kilometres after periods of high rainfall and subsequent increase in groundcover grass growth. Buffel Grass encroachment is exacerbating this problem (DEWNR and AW NRM Board 2013).

Key Threats

- inappropriate or altered fire management regimes; ;
- feral animal grazing preventing regeneration of seedlings and young plants, particularly after fire;
- ongoing degradation associated with weeds, especially Buffel Grass increasing fire frequency and intensity; and
- elsewhere outside the AW NRM region, modification through clearance for pastoral activities, change in local drainage systems, increased local grazing pressure by providing stock watering, and overall increase in grazing.

Cultural Significance

The community has high cultural significance as a source of food, timber for tools and crafts, medicinal, and fuel for heating and cooking (Foulkes 2008).

2. SEMI-ARID *LOMANDRA* GRASSLANDS

Background

Temperate *Lomandra effusa* and *L. micrantha* ssp. *dura* Iron-grass Grassland of South Australia has been listed as a Critically Endangered ecological community under the Commonwealth *EPBC Act, 1999*. The ecological community is endemic to South Australia, where it mostly occurs in the Northern Agricultural Districts, northern Yorke Peninsula, eastern Mt Lofty Ranges, and south of Tailem Bend in the Murray Mallee.

Although not grasses, the *Lomandra* species are characteristic of and dominate areas of primarily *Austrostipa* and *Austrodanthonia* Tussock Grassland. However, the *Lomandra*'s form perennial grass-like tussocks. They are considered a unique type of natural temperate grassland (Carter *et al.* 2003). The ecological community occurs on loam to clay loam soils in areas of winter-dominant rainfall,

generally on gentle to steep slopes of hills and rocky ridgelines. Mean annual rainfall ranges from 280-600 mm/year across the distribution range (Turner 2012).

Semi-arid *Lomandra* spp. (Iron Grass) Grassland

Areas of similar and mainly *Lomandra effusa* Grassland, but also *L. collina*, and *L. leucocephala* ssp. *robusta* Grasslands occur on the Far West Coast of South Australia, primarily between Penong to just east of Yalata, and between the coast and just north of the Eyre Highway.

The area is predominantly mallee, with the *Lomandra* Grasslands usually occurring in natural openings within the mallee. It occurs on shallow calcareous loam soils over calcrete. On rises where the soil is skeletal with outcropping calcrete, *Gahnia lanigera* (Black-grass) Sedgeland predominates.

Where *Lomandra* Grasslands and *Gahnia lanigera* Sedgeland occur, were noted as openings in the mallee on the original surveyor plans of the region. In the Far West agricultural areas, the ecological community appears to have been preferentially cleared for cropping land, as it had deeper soil, and was easy to clear due to the lack of mallee tree cover. Some remnants can be found on road reserves in the agricultural areas. But where they still occur on private land, they are degraded and grazed by domestic stock. Most of the *Lomandra collina* Grassland could be found in the agricultural areas, mostly now on roadsides.

Further to the west in the Yalata mallee, remnant areas can be found in the natural openings. At least one of these large natural openings contains *Lomandra leucocephala* ssp. *robusta* Grassland. However, even these areas have been degraded through introduced plant species, and introduced herbivores, especially rabbits.

Ecological Community Description

This ecological community is disjunct from the listed Temperate *Lomandra* Grassland in the eastern regions of the State, occurring in slightly lower average annual rainfall areas. The average annual rainfall for the semi-arid *Lomandra* Grassland varies between about 250mm at Yalata to about 300mm at Penong and Coorabie. Emergent shrubs such as *Acacia oswaldii*, and small trees of *Acacia papyrocarpa* and occasionally *Myoporum platycarpum* ssp. *platycarpum* frequently occur. However, the small trees appear small, young trees, and may be invading into the ecological community. The ecological community has a similar structure, but a different species composition to the Temperate *Lomandra* Grassland.

Conservation Status

The Semi-arid *Lomandra* Grasslands has been recommended as a likely Vulnerable in the northern regional arid lands workshops to propose State Threatened Ecological Communities in 2012. It is endemic to South Australia and the Far West Region.

Key Threats

- changes in land use and management, such as altered grazing regimes, cultivation or fertiliser application;
- changes in land ownership and associated lack of knowledge on appropriate management;

- ongoing degradation associated with weeds such as *Carrichtera annua* (Wards Weed) and Thread Iris;
- inappropriate or altered fire management regimes; and
- ecological, economic and social impacts of climate change.

Knowledge Gaps

Information about the location, size, condition and integrity of remaining areas is a key knowledge gap that needs to be addressed to better understand this ecological community. Other critical gaps include knowledge of its fauna, habitat requirements and species that are functionally important or depend on the community for their survival; community structure and dynamics; ‘best practice’ management strategies for conservation outcomes in different land uses; effective restoration techniques; the role and management of fire; and potential impacts of climate change.

3. EUCALYPTUS GONGLYOCARPA (MARBLE GUM) WOODLAND OF MARALINGA TJARUTJA LANDS

Background

Eucalyptus gonglyocarpa Woodland is an impressive ecological community within Australia’s inland deserts, where tall woodland trees with white glistening bark are an unexpected sight. Typically trees are 8-13m high, sometimes taller.

Most of the ecological community occurs in the Great Victoria Desert IBRA region in Western Australia, extending eastward into South Australia. The community is more prevalent in Western Australia, where it occurs further in the Murchison, Great Sandy Desert, and to a lesser extent adjoining IBRA regions. The community also occurs in south-western Northern Territory largely on the expanses of sand dunes, adjacent to Lake Amadeus (Elith and Bidwell 2004).

In South Australia, the community has its greatest concentration in the northern part of Mamungari Conservation Park and similar areas to the north of the park, extending further eastward, but not as far as the Tallaringa IBRA region.

Ecological Community Description

Eucalyptus gonglyocarpa Woodland primarily occurs on deeper sandy soils of the sand plain, red sand dune slopes and bases. Typically *Triodia* hummocks dominate the ground cover. In South Australia, mallee eucalypts of *Eucalyptus youngiana* and *Eucalyptus glomerosa*, and tall shrubs of *Acacia ligulata*, *Acacia ramulosa*, *Grevillea juncifolia* are often associated, with *Triodia basedowii* as groundcover (Foulkes and Thompson 2008). Composition of the community varies elsewhere interstate (Elith and Bidwell 2004).

Conservation Status

In the northern regional arid lands workshops to propose State Threatened Ecological Communities in 2012, the Woodland was nominated as possibly Vulnerable. Concern for the South Australian part

of the community was raised due to a fire devastating a large area, and limited regeneration. However, as noted, it is not endemic to South Australia or the AW NRM region.

This community is of particular interest, as it possibly provides breeding habitat for the nationally Vulnerable Princess Parrot (*Polytelis alexandrae*) (Baxter & Henderson 2000). Due to the tree size, its hollow producing potential and understorey, the community is considered to support a diverse fauna (Elith and Bidwell 2004).

Key Threats

- mining including exploration, opening up access to previously inaccessible areas;
- feral animals (especially camels and rabbits) reducing regeneration and degrading the understorey;
- inappropriate or altered fire management regimes; and
- ecological, economic and social impacts of climate change.

The Commonwealth of Australia 2004 report on nationally threatened arid eucalypt Woodlands included *Eucalyptus gongylocarpa* Woodland. However, as there was no perceived definite threats to the community, the investigation and full description of the ecological community was incomplete. It was concluded at the time that the Woodland was not threatened, although there were some threatening processes impacting on some of areas. The Woodland did occur in national areas where altered fire regimes and feral animals are considered threatening processes (Elith and Bidwell 2004).

APPENDIX 2: SPRATs and additional species distribution maps

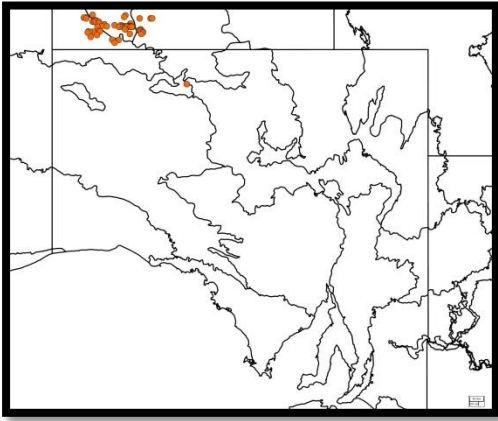


Figure 7, *Acacia ammobia*

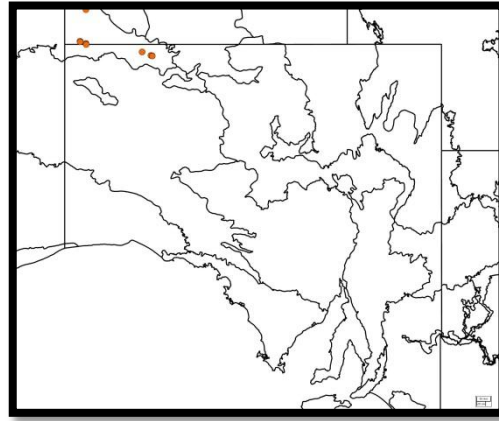


Figure 8, *Acacia tenuior*

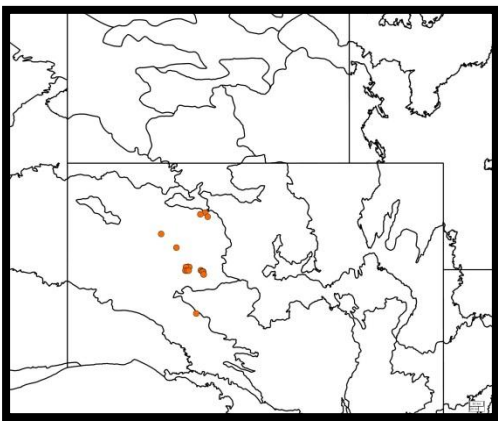


Figure 9, *Baeckea tuberculata*

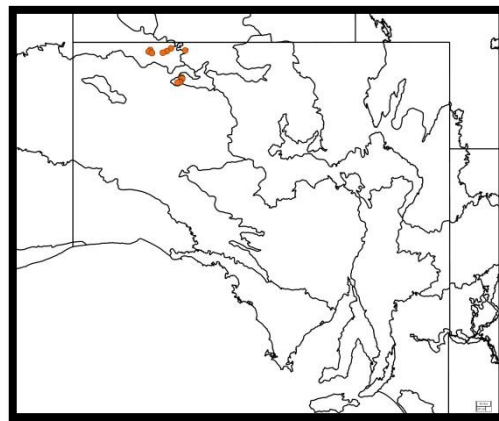


Figure 10, *Basedowia tenerrima*

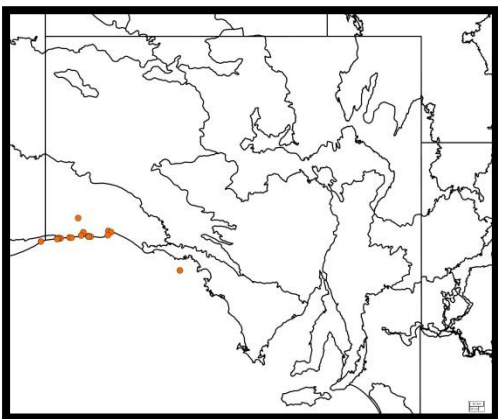


Figure 11, *Brachyscome tatei*

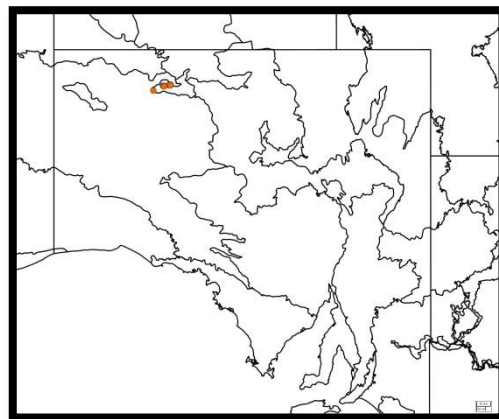


Figure 12, *Calostemma abdicatum*

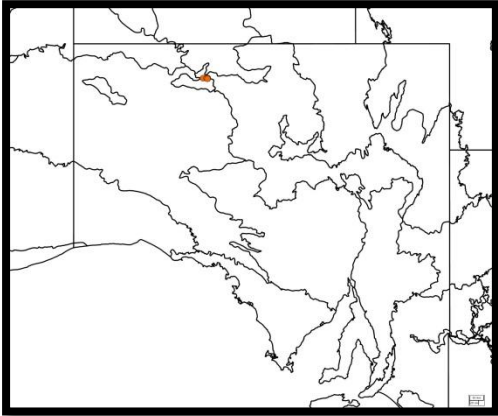


Figure 13, *Cremnothamnus thomsonii*

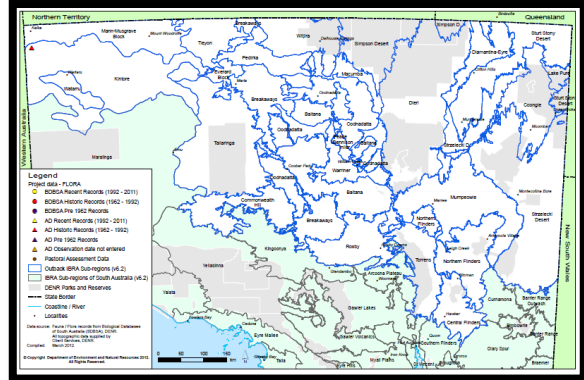


Figure 14, *Dicrasyllis gilesii* var. *bagotensis*

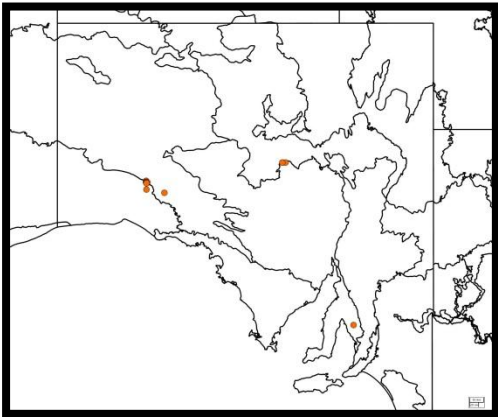


Figure 15, *Eremophila decussata*

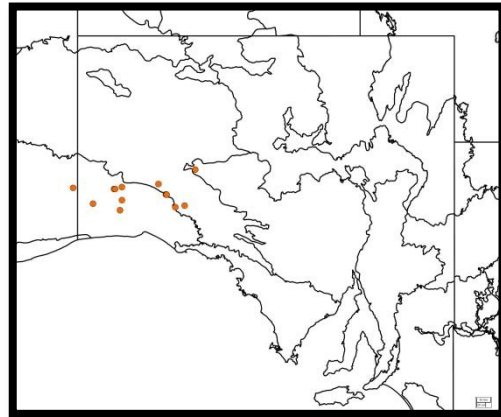


Figure 16, *Eremophila delisseri*

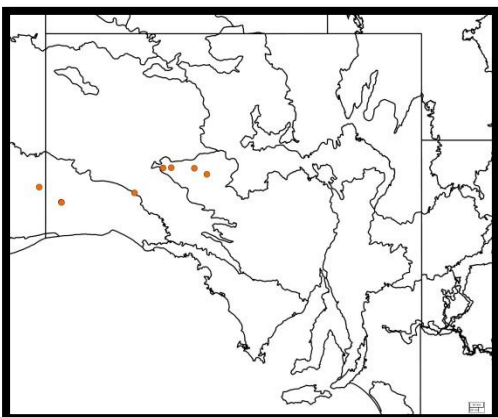


Figure 17, *Eremophila dendritica*

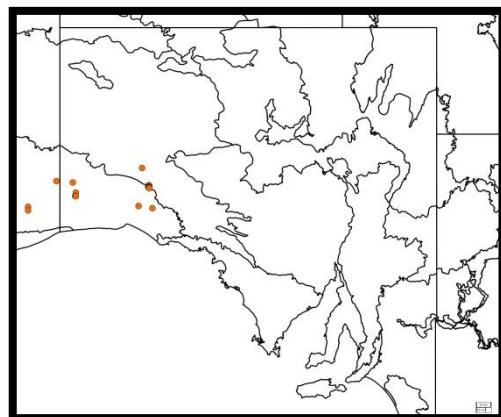


Figure 18, *Eremophila hillii*

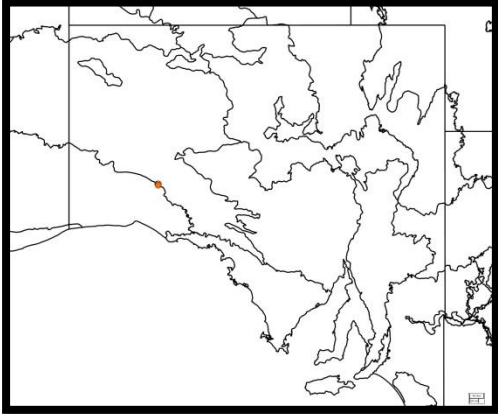


Figure 19, *Eremophila verrucosa* ssp. *brevistella*

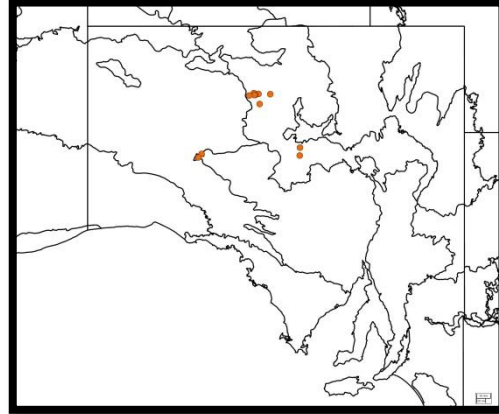


Figure 20, *Eremophila verrucosa* ssp. *verrucosa*

PENDING DISTRIBUTION MAP FOR
Eremophila willsii ssp. *intermediate*
 Need Sharon's

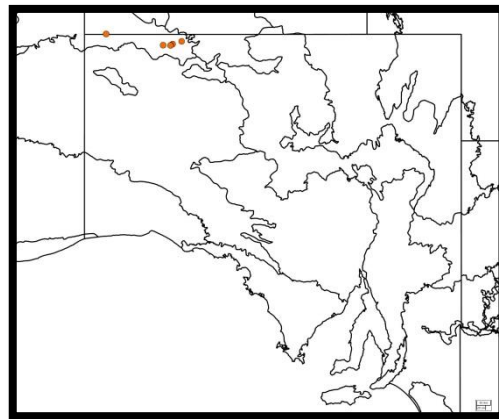


Figure 21, *Eucalyptus miniritchi*

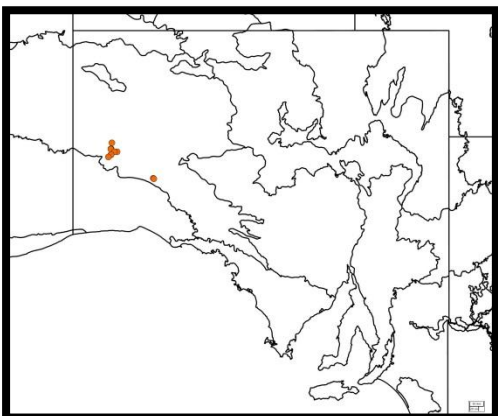


Figure 22, *Eucalyptus wyolensis*

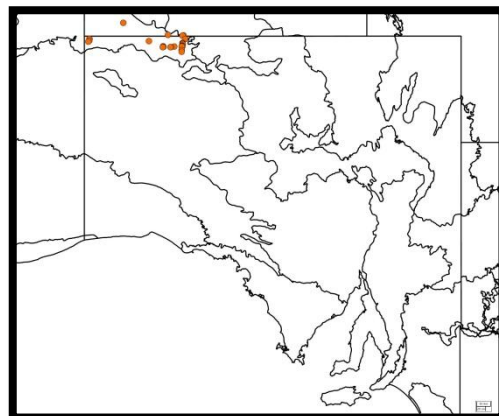


Figure 23, *Goodenia brunnea*

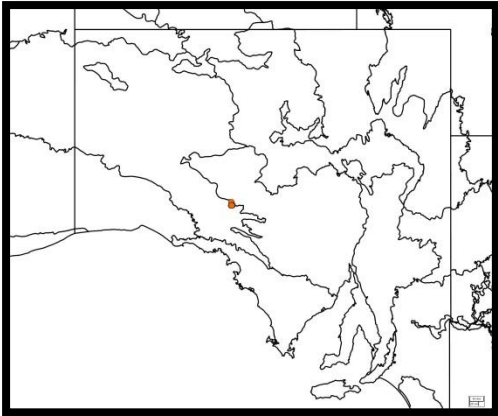


Figure 24, *Grevillea treuriana*

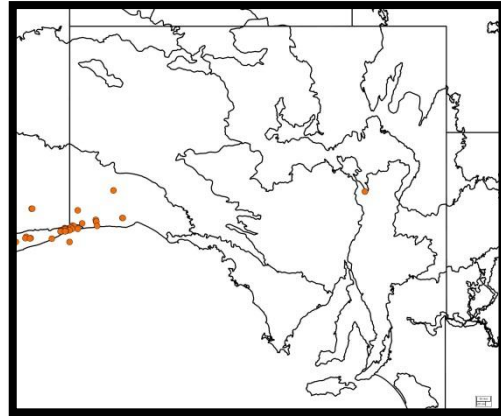


Figure 25, *Gunniopsis calcarea*

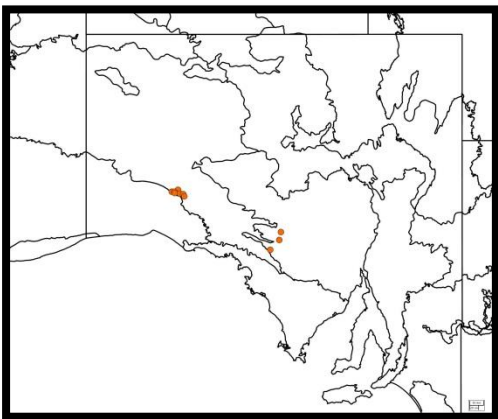


Figure 26 *Hibbertia crispula*

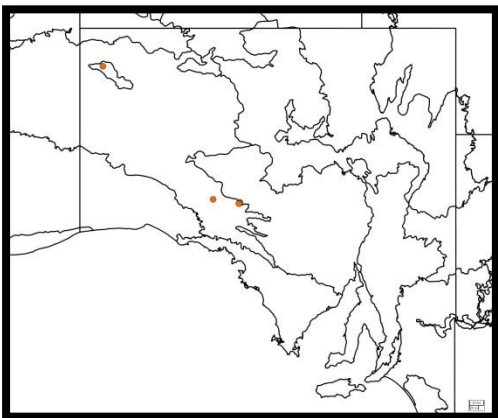


Figure 27, *Lechenaultia aphylla*

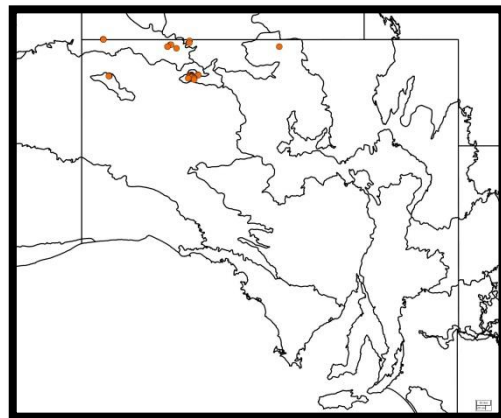


Figure 28, *Lepidosperma avium*

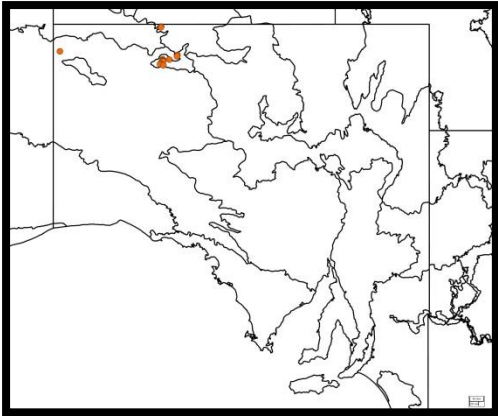


Figure 29, *Leiocarpa semicalva* ssp. *vincaea*

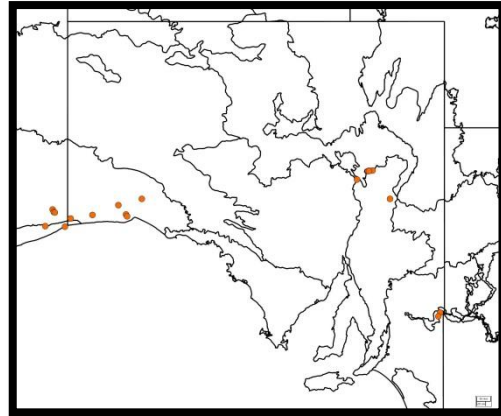


Figure 30, *Lepidium pseudoruderale*

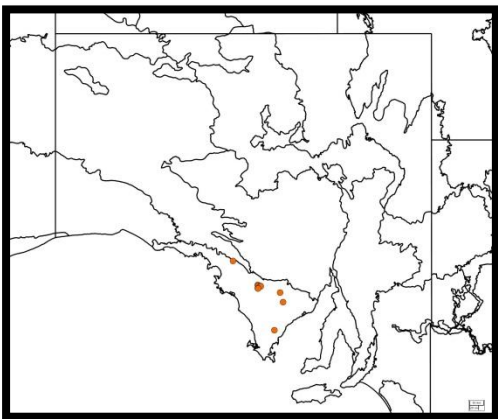


Figure 31, *Limosella granitica*

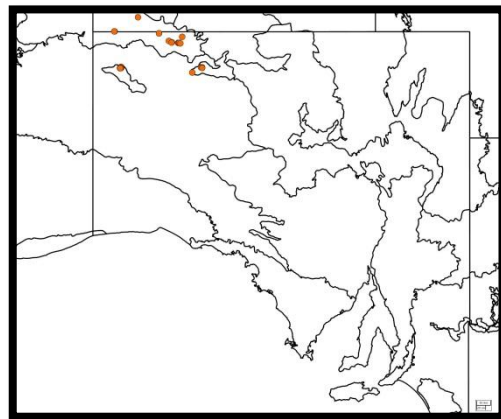


Figure 32, *Melaleuca fulgens* ssp. *corrugata*

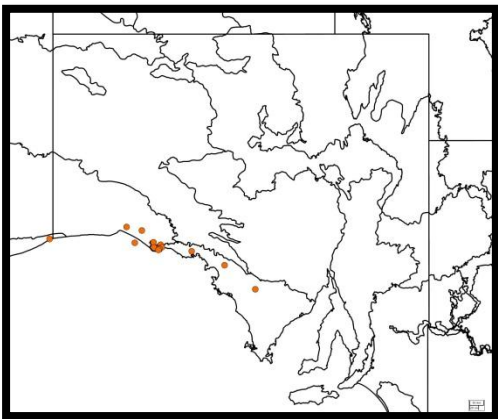


Figure 33, *Microlepideum alatum*

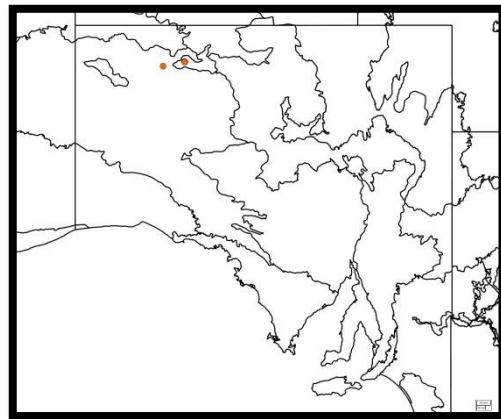


Figure 34, *Monotaxis luteiflora*

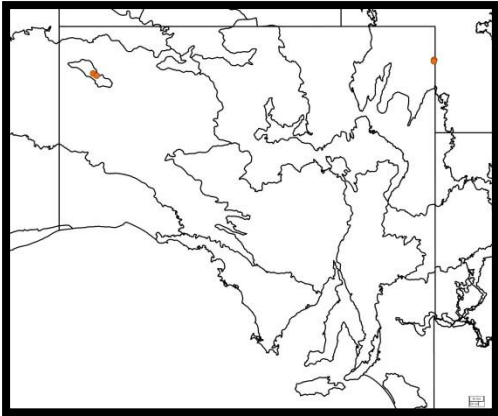


Figure 35, *Neurachne lanigera*

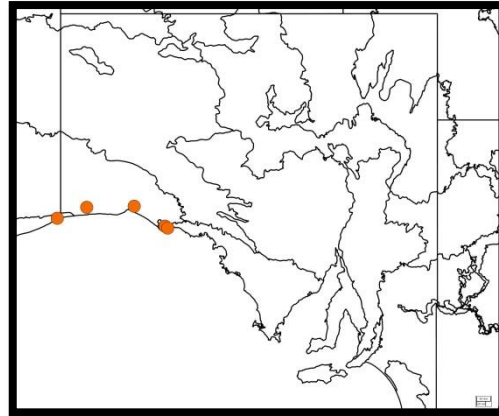


Figure 36, *Phlegmatospermum richardsii*

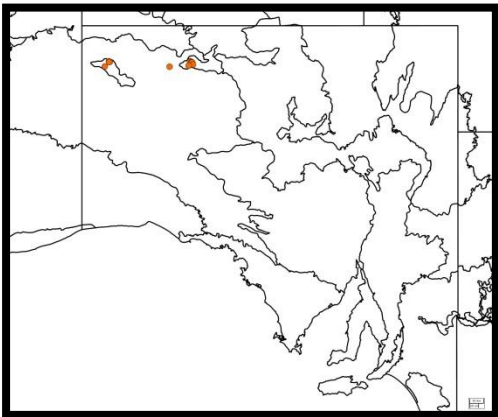


Figure 37, *Pimelea microcephala ssp. glabra*

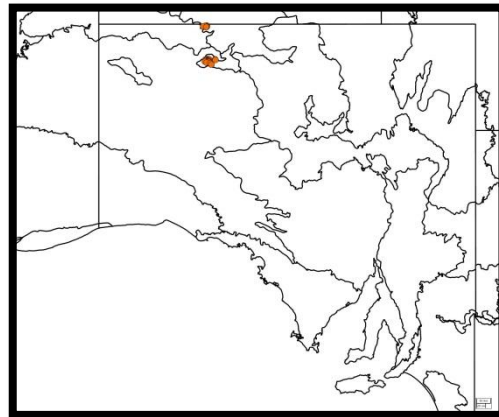


Figure 38, *Prostanthera nudula*

PENDING DISTRIBUTION MAP FOR
Pterostylis sp (*Oligochaetochilus* sp.)
 'Everard Ranges'

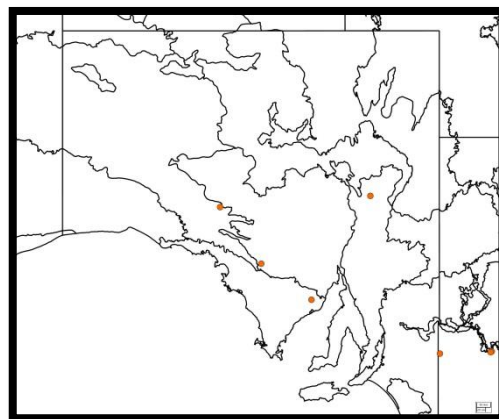


Figure 39, *Pterostylis xerophila*

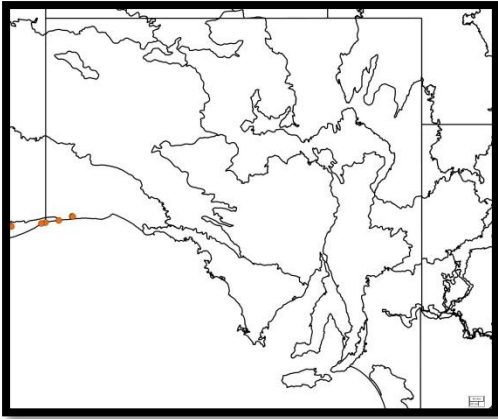


Figure 40, *Ptilotus symonii*

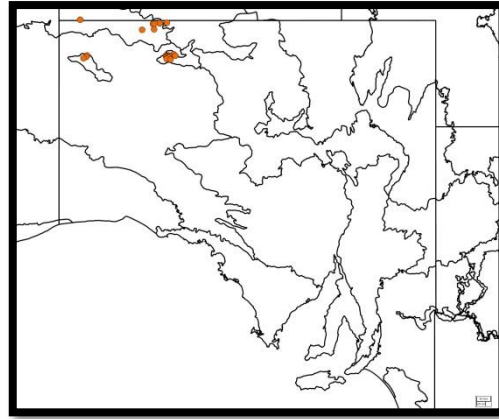


Figure 41, *Rulingia magniflora*

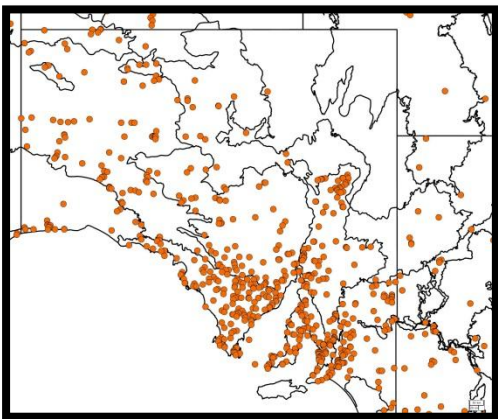


Figure 42, *Santalum acuminatum*

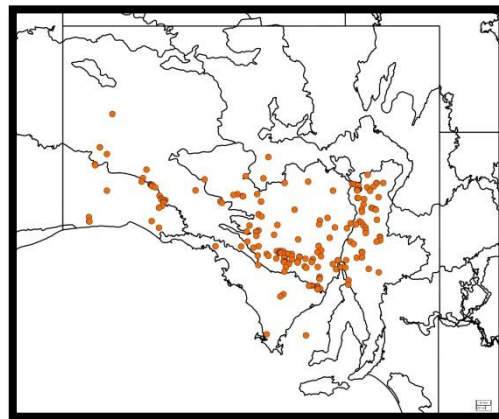


Figure 43, *Santalum spicatum*

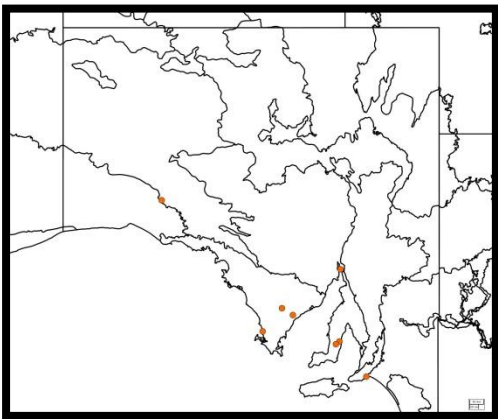


Figure 44, *Sarcozona bicarinata*

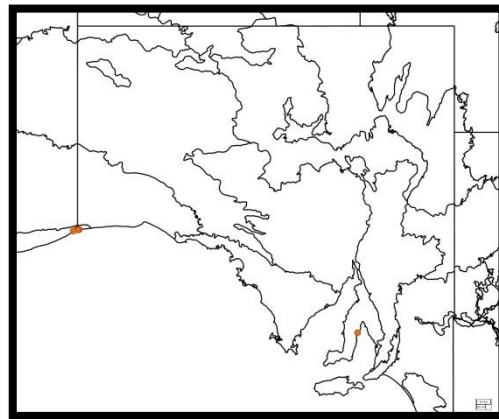


Figure 45, *Senceio euclaensis*

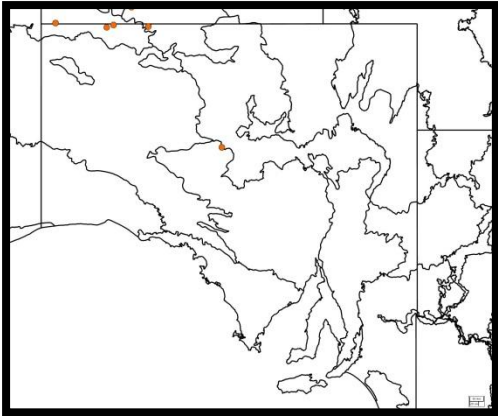


Figure 46, *Stylidium inaequipetalum*

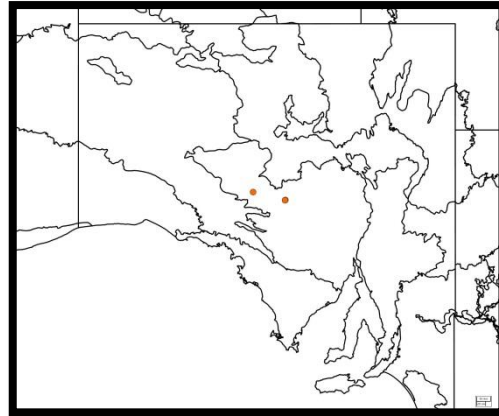


Figure 47, *Swainsona dictyocarpa*

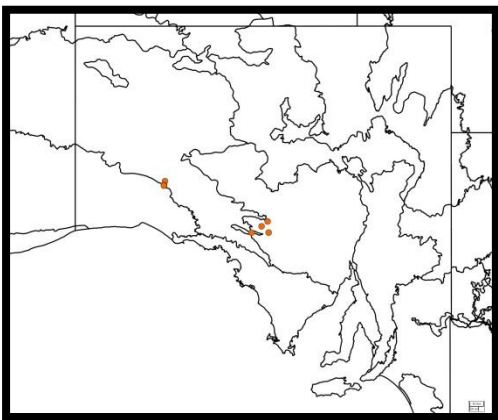


Figure 48, *Teucrium grandisculum ssp. pilosum*

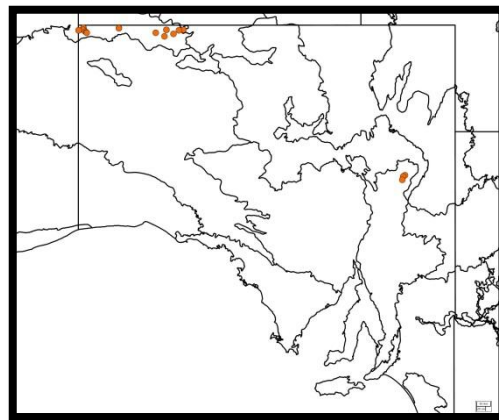


Figure 49, *Teucrium reedii*

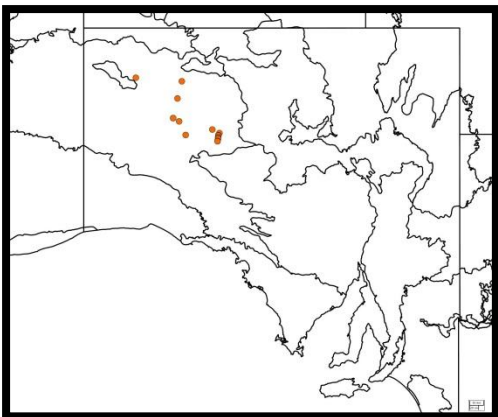


Figure 50, *Thryptomene longifolia*

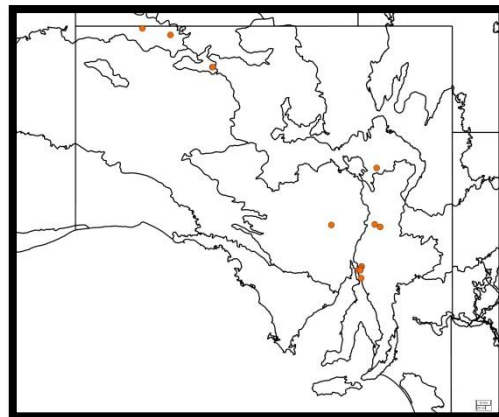


Figure 51, *Wurmbea centralis*

APPENDIX 3: Status category table

Table 7, Status categories⁷

CR	Critically Endangered	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.
EN	Endangered	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered, and it is therefore considered to be facing a very high risk of extinction in the wild.
V	Vulnerable	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable, and it is therefore considered to be facing a high risk of extinction in the wild.
R	Rare	A taxon is Rare if it occurs in small numbers, and the best available evidence indicates that it meets any of the criteria A to D for Rare, and it is at some risk due to low numbers. Taxa in this category are usually localised within restricted geographical areas or are thinly scattered over a more extensive range. This may include taxa which are perceived to be at risk for which there is insufficient information available to assign them any other category, and taxa that are considered to be dependent on ongoing conservation programs to prevent them moving into the Critically Endangered, Endangered or Vulnerable categories.
NT	Near Threatened	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered, Vulnerable or Rare now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
DD	Data Deficient	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that a threatened classification may be appropriate. It is important to make positive use of whatever data are available. In many cases great care should be taken in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively restricted, and/or if a considerable period of time has elapsed since the last record of the taxon, threatened status may be well justified.

⁷ Gillam, S. and Urban, R. (2009) *Regional Species Conservation Assessment Project, Phase 1 Report: Regional Species Status Assessments, West Region*. Department for Environment and Heritage, South Australia.

