

# TRACKING CHANGES IN THE GAWLER BIOREGION

*Report Compiled for the Australian Collaborative  
Rangeland Information System (ACRIS)*

July 2005

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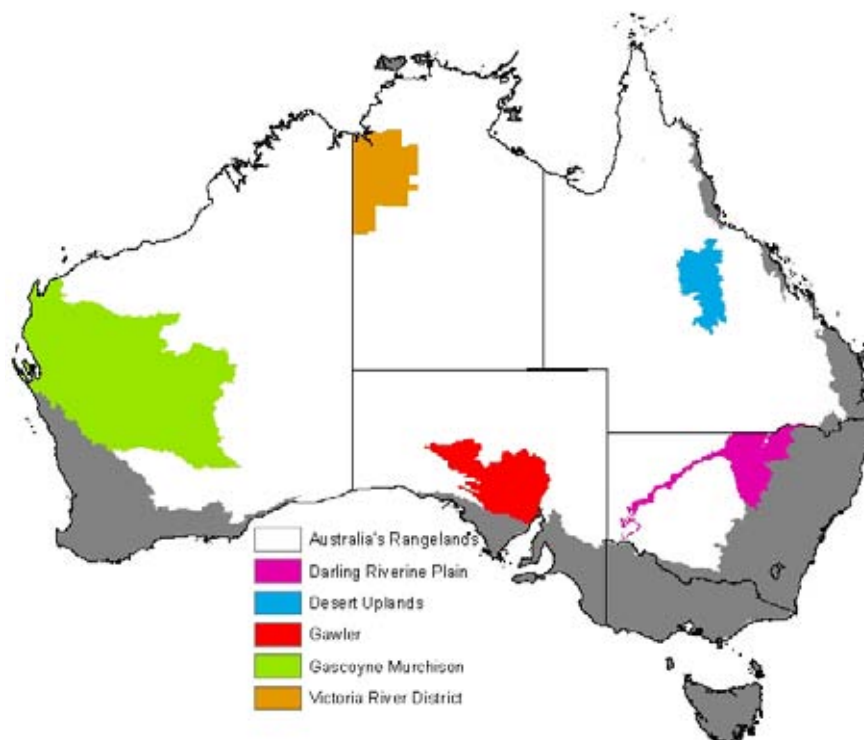


## Summary

This document reports change in the Gawler Bioregion for the Australian Collaborative Rangeland Information System (ACRIS). ACRIS is a coordinating mechanism that brings together rangeland information from Australian Government, state and Northern Territory (NT) agencies and other sources. It has a Management Committee comprising representatives of Australian, state and NT governments and a management unit co-located with the Desert Knowledge CRC (Cooperative Research Centre) in Alice Springs. When fully functional, ACRIS should allow monitoring and other information reporting change in the rangelands to be widely disseminated amongst rangeland managers, advisers, administrators and those formulating policy.

Reporting on change in the rangelands is an important, although difficult, task. It is important that the pastoral industry, other rangeland users and the various Australian and state governments monitor and understand change in the rangelands so that those involved can act quickly and effectively to maintain or improve ecological, economic and social values. If we are to promote internationally our improving management of the natural resource base, it is also vital to report on these values in a consistent and credible way.

The critical first stage for ACRIS has been testing the quality of available information and our capacity to combine it into a national picture. This has been done across five pilot regions (see map) with the Gawler Bioregion being the nominated region for South Australia (SA). The reporting period covers approximately 1992 to 2002.



To guide reporting and provide consistency across regions, the ACRIS Management Committee specified five focus questions:

1. What is the change in critical stock forage productivity?
2. What is the change in native plant species?
3. What is the change in landscape function?
4. What is the capacity for people to change in the region?
5. What is the change in cover?

This report provides a brief description of:

- The environment of the Gawler Bioregion;
- The SA Department of Water, Land and Biodiversity Conservation's pastoral monitoring program, the main data source used to answer the four biophysically-related questions;
- A simple matrix filter used to partition probable seasonal effects on site change from the more subtle effects of grazing management;
- Results compiled from information available to answer each question; and
- Concluding remarks from having participated in this reporting exercise.

## Change in Stock Forage Productivity

Information to answer this question is largely based on change in density of perennial species that decrease with grazing. Data were available from 179 pastoral monitoring sites assessed twice during the 1992–2002 period. There were both increases and decreases in the density of perennial decreaser species; bladder saltbush (*Atriplex vesicaria*) generally increased in density across the region while the density of pearl bluebush (*Maireana sedifolia*) and low bluebush (*M. astrotricha*) remained stable through the monitoring period. The highly palatable bandicoot grass (*Monochather paradoxa*) significantly decreased in density over the bioregion. The density of mulga (*Acacia aneura*) increased at monitoring sites, by an average of 1.6 plants per site.

Almost two thirds of monitoring sites either maintained or improved their density of perennial decreaser species following a period of below average rainfall. This is encouraging as a decrease in perennial density could have been expected with drier years. Similarly, almost two thirds of sites assessed after average seasons had an improved density of perennial decreaser species. Of some concern, 11 per cent of sites had a reduced density of decreaser perennials following these average seasons when no real change would have been anticipated.

## Change in Native Plant Species

The Gawler Bioregion has been extensively surveyed to establish the current status of native (and introduced) flora and fauna. This work has identified that at least nine plant taxa, one bird and one reptile species are endemic to the bioregion. Seven plant and 14 fauna species are nationally threatened. Four ecological communities are threatened at the state level.

Unfortunately, there is limited capacity for the biological survey data to report change until a systematic resurvey is conducted. As for critical stock forage productivity, the main data to report change in native plant species come from the reassessment of 179 pastoral monitoring sites – this time examining change in density of all perennial species.

The density of all chenopod and other perennial species increased at the majority of pastoral monitoring sites in the Gawler Bioregion. Separated into components: (1) the density of long-lived chenopods remained stable throughout and (2) there was a reduction in the density of perennial grasses in the northern area of the bioregion following below-average seasonal conditions. The density of perennial species increased at more than half of the sites through the reporting period, an encouraging result as perennials contribute to more persistent vegetation. This would seem to benefit protection of the soil surface against erosion and improve landscape function (next question) and habitat for various fauna (provided the increase in density is not excessive, leading to non-natural thickening of perennial vegetation).

Episodic wildfire, generally following wetter years, is considered a threat to some native plant species in the Gawler Bioregion. Extensive areas of mulga were killed by wildfire in the mid 1970s, with subsequent regeneration hindered by rabbits.

## Change in Landscape Function

For monitoring and reporting purposes, landscape function is interpreted as the capacity of landscapes to capture and retain rainwater and nutrients as vital resources for plant growth. There are formal methods for assessing landscape function but these methods are not currently part of the pastoral monitoring program in SA. Instead, the Richards-Green Functionality Index was used to indicate landscape function.

Based on index data averaged across 179 monitoring sites, landscape function improved in the period 1990 to 2002 (index improved from 2.11 to 1.97 – where 1 = ‘highly functional’ and 3 = ‘poorly functioning’).

At the site level, the results provide an encouraging indication of improving trend in landscape function. Three-quarters of sites assessed in the below-average season of 2002 maintained or improved their Richards-Green Functionality Index value. Similarly, 92 per cent of sites assessed the year before (following average seasons) had either stable or improved function.

## Capacity for Change

This question was designed to extend our reporting capacity into the area of socio-economics. (Rangeland monitoring and reporting of change has traditionally focussed on the biophysical domain of soil and vegetation information). Information sources included Australian Bureau of Statistics (ABS) census and agricultural survey data and surveys conducted by the Australian Bureau of Agriculture and Resource Economics (ABARE). Information was also compiled for the Gawler Bioregion on change in domestic stock numbers, land use and land values.

Based on national census data collected in 1991, 1996 and 2001, the Gawler Bioregion:

- Has a steadily increasing median age of ‘farmers’ (pastoralists);
- Is losing young people. This is partly inevitable for gaining secondary and tertiary levels of education but the failure of many young people to return and gain meaningful employment in the region may reduce capacity to change, innovate and adopt technologies and practices that lead to improved resource management;
- Has an increasing age dependency ratio. This means there is a lower proportion of working-age people to support the younger and older components of the population – and is partly linked to young people moving away from the region. Regional economies are probably ‘healthier’ or more vibrant with moderate levels of age dependency – and are probably better able to cope with, or adapt to, change; and
- Has a slowly increasing population – a healthy sign.

ABS and ABARE survey data show that pastoralism and mining are important sources of income and employment in the region. We presume that regions with a broader economic base and more diverse forms of employment are probably better able to adapt to and cope with change.

From data compiled by SA Government departments:

- Total stock numbers for the Gawler Bioregion have fluctuated between ~250,000 and ~750,000 sheep equivalents between 1992 and 2002. Stock numbers responded to seasonal conditions and commodity prices with the lowest number present in the very dry year of 2002;
- There has been an 11 per cent change in pastoral land use (across 97 leases) between 1994 and 2003; and
- There were insufficient property sales to accurately indicate change in property values through the reporting period. Unimproved value of leases increased on average by 58per cent – but this does not mean that improved value has increased by the same amount.

## Change in Cover

Information on cover change in the Gawler Bioregion was compiled from step-point measurements at pastoral monitoring sites and Landsat-derived change in forest cover.

There was a small (statistically non-significant) increase in the mean cover of perennial species averaged across 179 monitoring sites. Within vegetation types, perennial cover decreased in the mulga–open woodland group of sites. Elsewhere, there was a significant increase in bare ground and a decrease in annuals and litter at five (of 11) vegetation groups. These changes were related mainly to seasonal variation. At individual sites, cover remained the same or improved at 96 per cent of sites assessed following below average seasonal conditions (in 2002). Ninety two percent of sites had similar or improved cover after an average season (2001).

Based on the Australian Greenhouse Office's (AGO) definition of forest, forests covered 11.3 per cent of the Gawler Bioregion in 1972 decreasing to 11 per cent in 2000. This corresponds with a decline in forest area of 364 km<sup>2</sup>. (The AGO defines forest as 'potential to reach a minimum 20 per cent canopy cover, two metres in height and minimum area of 0.2 hectares').

## Concluding Remarks

This opportunity to report change for the Gawler Bioregion is considered to have produced a number of benefits for the Pastoral Program and Department of Water, Land and Biodiversity Conservation. These include:

- Issues of data management (collation, analysis and reporting) have partly contributed to significant upgrading of the Pastoral Management Information System. This should allow more efficient analysis and reporting on pastoral monitoring data in the future;
- Embedding of a 'quality of past seasons' by 'direction of site change' matrix within the Pastoral Program's reporting procedures. This should enable more confident partitioning of seasonal effects on vegetation change recorded at sites from that likely due to grazing management; and
- Increased ability and confidence to report on monitoring data, particularly over larger areas and to make inter-regional comparisons.

ACRIS will now embark on a national report of change across as much of the rangelands as possible, with this report due mid 2007. This report will comprise a number of products grouped under several themes (described briefly at the end of the 'Concluding Remarks' section). It is highly desirable that SA be part of this reporting process as it is the rangeland states and NT who hold some of the most valuable data from which to report change. However, our ability to report change using the Pastoral Management Information System is currently diminished beyond the Gawler Bioregion because of the limited number of site reassessments. This will improve with the second round of lease inspections now getting underway. There is also some scope for expanded grazing gradient analysis to improve reporting of change in the northern cattle-grazed areas. As for other jurisdictions, SA currently has limited capacity to report change in biodiversity. The comprehensive analysis of the distribution of water points and watered area that is close to being completed places us in a good position to report against this theme. The water point data should also allow inferences to be made at the regional scale about biodiversity status.

## Introduction

The Australian Collaborative Rangeland Information System (ACRIS) is a coordinating mechanism that brings together rangeland information from Australian Government, state, and NT and Commonwealth agencies and other sources. ACRIS grew out of the Rangeland Monitoring theme of the first phase of the National Land and Water Resources Audit and its detailed report *Rangelands – Tracking Change* (NLWRA 2001 and the Audit web site <[http://audit.ea.gov.au/ANRA/atlas\\_home.cfm](http://audit.ea.gov.au/ANRA/atlas_home.cfm)>).

ACRIS has a Management Committee comprising representatives of Australian and State/NT Governments and a small Management Unit.

The ACRIS Management Committee has an agreed workplan that comprises several activities:

- Development of a reporting framework;
- Testing ACRIS's ability to report change in a nominated pilot region in each state and the NT – in South Australia (SA), the Gawler Bioregion;
- National reporting of rangeland change using existing data; and
- Facilitating further development and implementation of products that will allow more comprehensive reporting of change (e.g. biodiversity and socio-economics).

## Reporting on Pilot Regions

A critical first stage for ACRIS is developing our reporting ability using existing data. The ACRIS Management Committee has endorsed a preliminary assessment to develop and test reporting procedures across jurisdictions to obtain a national picture of change in specified criteria, and showcase potential outputs. This activity is designed to test the reporting process more so than available data and derived products.

To focus reporting activity, the Management Committee has specified five questions against which to report change. Questions one to three and five have a biophysical focus, mainly related to the effects of climate and grazing on vegetation and soils. This is the area where most of state and NT agency rangeland monitoring activity has concentrated in the last two decades.

### Focus questions

1. What is the change in critical stock forage productivity?

This question has a specific focus on long term pastoral productivity and to the extent possible, is answered by the data of species known to indicate grazing pressure – i.e. “decreasers” or species that decrease with grazing pressure.

2. What is the change in native plant species?

Rangeland monitoring has traditionally focussed on documenting and understanding change in the biophysical environment from the perspective of pastoral productivity. ACRIS recognises the need to broaden this reporting base. Although techniques and systems are being developed and progressively implemented for monitoring aspects of biodiversity, data to report change are as yet limited. This question tests the ability of established pastoral monitoring programs and other relevant data sources to report on a narrow component of biodiversity.

3. What is the change in landscape function?

Landscape function describes the capacity of landscapes to capture and retain, not leak, rainwater and nutrients, the resources for plant growth (Ludwig *et al.* 1997). Functional landscapes have a good cover and arrangement of persistent vegetation patches (typically perennial vegetation) such

that much of the rainfall is retained and is able to infiltrate the soil. Because there is little runoff, there is limited movement of sediment and subsequent loss of entrained nutrients, organic matter (litter) and seeds. Similarly, the good cover and arrangement of vegetation patches minimises wind erosion and loss of nutrients in dust. As patch cover decreases and patches become more distant, runoff increases resulting in lower infiltration and increased nutrient loss in transported sediments (i.e. erosion). Landscapes with lower cover are also exposed to greater risk of wind erosion and nutrient loss in dust. These eroding landscapes become progressively more leaky and dysfunctional, i.e. have reduced landscape function.

#### 4. What is the capacity for change in the region?

Question 4 recognises that people are an integral part of the rangelands, and particularly pastoralists because their land management actions can have a profound effect on biophysical change. This question is designed to extend ACRIS's reporting capacity into the socio-economic domain. Our reporting ability for Question four has been facilitated by the National Land and Water Resources Audit (with funding from Department of Agriculture, Fisheries and Forestry) contracting the Australian Bureau of Statistics (ABS) to analyse and report on national census and other socio-economic data.

#### 5. What is the change in cover?

In theory, this is a straightforward question that can be answered with a number of data sources including remote sensing (air photography and satellite data).

## **Purpose of this Report**

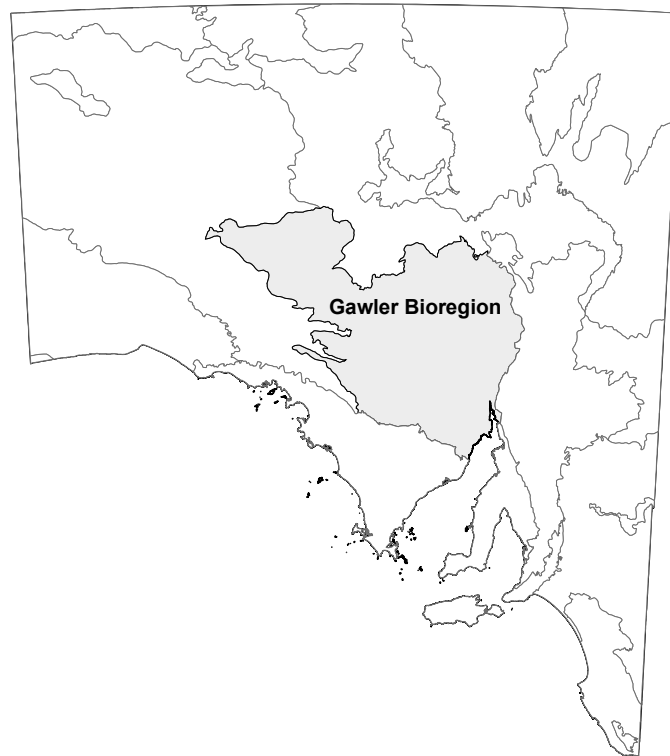
The purpose of this report is to provide a comprehensive and integrated inventory on the status of the Gawler Bioregion, as a SA pilot study as part of the ACRIS workplan. The intention is to provide this information to a range of potential users, at regional, state and national scales. The information in this study comprises mainly biophysical indicators, but covers, where possible, socio-economic and institutional aspects as well.

The report provides:

- An introduction to the Gawler Bioregion;
- A brief account of the Pastoral Monitoring Program, the main data source used in this report;
- A description of a procedure proposed by Ian Watson and Paul Novelly of the Western Australian (WA) Department of Agriculture for separating seasonal effects on site change from those that may be due to grazing;
- Answers to each of the five questions framed by the ACRIS Management Committee;
- Photo pairs illustrating change over time at several monitoring sites; and
- Concluding remarks and several appendices providing additional information to that presented in the main body of the report.

## The Gawler Bioregion

The Gawler Bioregion comprises over one quarter of SA's Pastoral Rangelands and spans an area of 123,070 km<sup>2</sup>. It is bounded to the north by the Stony Plains Bioregion, to the south by the higher rainfall agricultural areas of Eyre Peninsula, to the west by the Great Victoria Desert Bioregion, and to the east by the Flinders and Olary Sub-regions (Figure 1).



**Figure 1: The Gawler Bioregion within South Australia.**

The Gawler Bioregion has a semi-arid to arid climate (Laut *et al.* 1977) with long, hot, dry summers and cool mild winters. Average annual rainfall varies across the bioregion. Southern parts are characterised by a higher and distinctly winter-dominant pattern (up to 300 mm). By contrast, in the north and east of the bioregion totals of less than 150 mm are received, falling irregularly throughout the year (Kingoonya Soil Conservation Board, 1996; Gawler Ranges Soil Conservation Board, 1996).

There is a wide diversity of sub-regional landscapes within this bioregion. In the central and southern parts abutting the agricultural areas, distinctive granitic rocky hills forming the Gawler Ranges contrast with a number of large salt lakes which surround it (Lakes Acraman, Everard, Gairdner, Harris, Torrens, Island Lagoon and Macfarlane). The sand plains and dunes with *Acacia aneura* woodlands to the north-west, an extension from the Great Victoria Desert Bioregion, contrast with the undulating stone-covered Arcoona tablelands along the western edge of Lake Torrens. This tableland supports mainly *Atriplex vesicaria* and *Sclerostegia* species. Calcareous plains with a *Maireana sedifolia*, *M. astrotricha* and *Atriplex vesicaria* chenopod shrubland occur across the central and northern parts of the region, while similar country in the south-eastern portion supports open *Acacia papyrocarpa* woodlands with chenopod shrublands of *Maireana sedifolia* and *Atriplex vesicaria* (Kingoonya Soil Conservation Board, 1996; Gawler Ranges Soil Conservation Board, 1996).

The dominant land use in the bioregion is the grazing of sheep on native pastures for the production of wool and meat. In addition, several pastoral stations to the north stock cattle. The other main land uses are conservation and mining. Conservation reserves make up 12.9 per cent of the bioregion (Neagle, 2003), including the Lake Torrens, Gawler Ranges and Lake Gairdner National Parks, Lake Gilles Conservation Park, Lake Gilles Conservation Reserve and the sections of Yellabinnia Regional Reserve which occur in the bioregion.. Mining is carried out at Olympic Dam (Roxby Downs), Andamooka, Iron Knob, Iron Baron and Mt. Gunson. Tourism interest is focussed on the Gawler Ranges National Park, as well as at Olympic Dam and the Andamooka and Coober Pedy Opal Fields (Kingoonya Soil Conservation Board, 1996; Gawler Ranges Soil Conservation Board, 1996). Active Defence Force and aerospace facilities are located at Woomera.

From the information collected in the Gawler Bioregion, and in common with other arid and semi-arid rangeland regions, there has been a substantial loss of biodiversity since European colonisation. The expansion of water points for grazing by domestic stock throughout the bioregion has led to extensive land degradation, and an overall decline in biodiversity. Notably there has been a significant loss of original mammal fauna, and in areas a breakdown in the landscape's ability to function in a natural state (Robinson *et al* 1988; Ehmann and Tynan 1997; Tynan 2000). This is made evident by Neagle's (2003) study which identified seven plant and fourteen fauna species within the Bioregion that are nationally threatened.



For all leases within the Gawler Bioregion, and other sheep pastoral areas of SA, permanent vegetation monitoring points or sites have now been established in each paddock as part of the lease assessment process under the Pastoral Land Management and Conservation Act 1989. This program dictated that in the main, sites be located within grazing range of stock, and consequently most sites are located about 1.5 km from working stock watering points. These areas were selected to be uniform and representative of a major pasture type in the paddock. Each 'quantitative assessment site' is a permanently pegged photopoint with records of vegetation composition and density, assessment of rangeland condition and the extent of soil erosion. These quantitative sites consist of a fixed belt transect, called a Jessup transect, in which shrub density is measured. In addition, throughout the Gawler Bioregion, the step-point technique was used to estimate projected foliar cover. For more information on these techniques refer to PIRSA (2000).

White and Gould (2002) used data gathered from the base-line pastoral assessments in 1990–93 and compared it with re-measurements in 2001–2002 (Figure 2). The objective was to measure change in perennial density and frequency of indicator species in the Gawler and Kingoonya Soil Conservation Districts, which includes the major portion of the Gawler Bioregion. The study was undertaken as part of the South Australian component of the National Land and Water Resources Audit. It utilised the Pastoral Program's site-based data from the existing permanent vegetation sites described above to monitor change in ecological processes as a result of grazing practices.



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Management Information System (PMIS), with spatial information held on Arc/info. Fifteen possible vegetation groups were identified upon which to base further analysis (Table 1). Of these, three groups (Groups 4, 5 and 7) were excluded due to insufficient sites for statistical analysis. Adequate representation of the remaining twelve groups was obtained by selecting a 10 per cent stratified sample of sites to revisit. The selection process attempted to maintain the ratio of sites assessed to be in good, fair and poor condition across each group. In total 179 sites were re-visited over 2001 and 2002, which included a minimum sample of ten sites for smaller groups and a maximum of twenty sites for larger groups.

**Table 1: Vegetation groups identified from pattern analysis of pastoral monitoring data.**

Group #	Total No of Sites	No of Sites reassessed 2001-02	Group Description (Key species with % of sites at which they occur)
1	183	15	Mulga over perennial and annual grasses <i>Acacia aneura</i> (97%), <i>Aristida contorta</i> (90%), <i>Eragrostis eriopoda</i> (87%), <i>Maireana georgei</i> (70%), <i>Ptilotus obovatus</i> (60%), <i>Monachather paradoxa</i> (54%)
2	400	27	Mulga over pearl bluebush with speargrass, silvertails & kerosene grass <i>Stipa sp.</i> (83%), <i>Maireana sedifolia</i> (83%), <i>Acacia aneura</i> (76%), <i>Ptilotus obovatus</i> (76%), <i>Aristida contorta</i> (70%), <i>Sclerolaena obliquicuspis</i> (67%)
3	180	15	Pearl bluebush with bladder saltbush, low bluebush & scattered western myall <i>Maireana sedifolia</i> (90%), <i>Ptilotus obovatus</i> (72%), <i>Atriplex vesicaria</i> (68%), <i>Sclerolaena obliquicuspis</i> (67%), <i>Maireana astrotricha</i> (63%), <i>Stipa sp.</i> (56%), <i>Acacia papyrocarpa</i> (49%)
4	13	0	Mt Eba country <i>Acacia tetragonophylla</i> (62%), <i>Maireana aphylla</i> (54%), <i>Aristida contorta</i> (46%), <i>Atriplex vesicaria</i> (46%), <i>Eragrostis setifolia</i> (31%), <i>Pittosporum phylliraeoides</i> (31%), <i>Acacia aneura</i> (23%)
5	8	0	<i>Enchylaena tomentosa</i> (63%), <i>Astrebla pectinata</i> (25%), <i>Pittosporum phylliraeoides</i> (38%), <i>Critesion murinum</i> (38%), <i>Atriplex nummularia ssp. omissa</i> (25%), <i>Chenopodium nitrariaceum</i> (25%), <i>Nitraria billardierei</i> (25%), <i>Eucalyptus camaldulensis</i> (25%)
6	40	10	Mulga & northern native pine with tall shrubs and annual grasses <i>Acacia aneura</i> (83%), <i>Aristida contorta</i> (70%), <i>Aristida holathera</i> (63%), <i>Enneapogon avenaceus</i> (53%), <i>Alectryon oleifolius</i> (45%), <i>Dodonaea viscosa ssp. angustissima</i> (43%), <i>Callitris glaucophylla</i> (15%)
7	18	0	Tall shrubland on sandy soils <i>Acacia ligulata</i> (72%), <i>Dodonaea viscosa ssp. angustissima</i> (72%), <i>Alectryon oleifolius</i> (44%), <i>Stipa sp.</i> (33%), <i>Aristida contorta</i> (28%), <i>Enneapogon sp.</i> (28%), <i>Eucalyptus socialis</i> (28%), <i>Triodia irritans</i> , <i>Aristida holathera</i> (22%), <i>Crotalaria eremaea</i> (22%), <i>Danthonia caespitosa</i> (22%), <i>Enchylaena tomentosa</i> (22%), <i>Eucalyptus oleosa</i> (22%), <i>Phyllanthus fuernrohrii</i> (22%).

Group #	Total No of Sites	No of Sites reassessed 2001-02	Group Description (Key species with % of sites at which they occur)
8	227	19	Bladder saltbush & low bluebush open shrubland <i>Atriplex vesicaria</i> (90%), <i>Maireana astrotricha</i> (78%), <i>Maireana pyramidata</i> (54%), <i>Stipa</i> sp. (44%), <i>Dissocarpus paradoxus</i> (44%), <i>Sclerolaena divaricata</i> (41%), <i>Ptilotus obovatus</i> (37%), <i>Aristida contorta</i> (33%), <i>Sclerolaena brachyptera</i> (33%), <i>Sclerolaena obliquicuspis</i> (31%)
9	164	15	Open blackbush & saltbush shrubland with pearl bluebush <i>Maireana pyramidata</i> (92%), <i>Atriplex vesicaria</i> (85%), <i>Maireana sedifolia</i> (71%), <i>Stipa</i> sp. (70%), <i>Maireana georgei</i> (69%), <i>Sclerolaena obliquicuspis</i> (65%), <i>Carrichtera annua</i> (56%)
10	31	11	Bladder saltbush & slender glasswort low open shrubland <i>Atriplex vesicaria</i> (100%), <i>Sclerostegia tenuis</i> (94%), <i>Sclerolaena ventricosa</i> (90%), <i>Medicago</i> sp. (87%), <i>Minuria cunninghamii</i> (87%), <i>Sclerolaena brachyptera</i> (81%), <i>Critesion murinum</i> (77%), <i>Maireana pyramidata</i> (71%), <i>Carrichtera annua</i> (71%), <i>Maireana astrotricha</i> (65%), <i>Maireana appressa</i> (61%), <i>Stipa</i> sp. (58%), <i>Sclerolaena divaricata</i> (58%), <i>Plantago drummondii</i> (55%)
11	77	10	Speargrass, wards weed & bitter saltbush plains and valleys <i>Stipa</i> sp. (83%), <i>Carrichtera annua</i> (74%), <i>Medicago</i> sp. (57%), <i>Alectryon oleifolius</i> (57%), <i>Atriplex stipitata</i> (55%)
12	33	11	Mallee with mixed shrub understorey <i>Eremophila scoparia</i> (79%), <i>Cratystylis conocephala</i> (73%), <i>Zygophyllum eremaeum</i> (64%), <i>Maireana pentatropis</i> (64%), <i>Geijera linearifolia</i> (61%), <i>Olearia muelleri</i> (61%), <i>Eucalyptus oleosa</i> (61%), <i>Eremophila glabra</i> (55%), <i>Enchylaena tomentosa</i> (48%), <i>Stipa</i> sp. (45%), <i>Sclerolaena diacantha</i> (45%), <i>Stipa elegantissima</i> (42%), <i>Rhagodia ulicina</i> (42%), <i>Eucalyptus porosa</i> (39%), <i>Senna art petiolaris</i> (39%), <i>Sclerolaena obliquicuspis</i> (36%), <i>Rhagodia spinescens</i> (36%), <i>Senna art coriacea</i> (36%), <i>Exocarpos aphyllus</i> (36%), <i>Rhagodia crassifolia</i> (36%), <i>Atriplex stipitata</i> (33%), <i>Zygophyllum aurantiacum</i> (33%), <i>Atriplex vesicaria</i> (33%), <i>Maireana erioclada</i> (33%), <i>Acacia nyssophylla</i> (33%), <i>Westringia rigida</i> (33%)
13	245	20	Western myall over pearl bluebush & bladder saltbush <i>Stipa</i> sp. (86%), <i>Maireana sedifolia</i> (82%), <i>Atriplex vesicaria</i> (79%), <i>Acacia papyrocarpa</i> (79%), <i>Enchylaena tomentosa</i> (67%), <i>Sclerolaena obliquicuspis</i> (63%), <i>Rhagodia spinescens</i> (60%), <i>Maireana georgei</i> (59%), <i>Eriochiton sclerolaenoides</i> (57%), <i>Lycium australe</i> (53%)
14	142	10	Western myall over blackbush, pearl bluebush, bladder saltbush & tall shrubs <i>Acacia papyrocarpa</i> (87%), <i>Maireana pyramidata</i> (83%), <i>Enchylaena tomentosa</i> (71%), <i>Maireana sedifolia</i> (67%), <i>Sclerolaena obliquicuspis</i> (62%), <i>Atriplex vesicaria</i> (61%), <i>Rhagodia spinescens</i> (57%), <i>Senna art petiolaris</i> (55%), <i>Lycium australe</i> (52%), <i>Senna art coriacea</i> (52%), <i>Alectryon oleifolius</i> (51%), <i>Myoporum platycarpum</i> (50%)

Group #	Total No of Sites	No of Sites reassessed 2001-02	Group Description (Key species with % of sites at which they occur)
15	172	16	Bladder saltbush & samphire low open shrubland <i>Atriplex vesicaria</i> (95%), <i>Sclerolaena divaricata</i> (74%), <i>Eragrostis setifolia</i> (72%), <i>Sclerostegia medullosa</i> (66%), <i>Sclerolaena ventricosa</i> (60%), <i>Frankenia</i> sp. (58%) <i>Dissocarpus paradoxus</i> (55%), <i>Sclerolaena brachyptera</i> (53%), <i>Astrebla pectinata</i> (45%), <i>Sporobolus actinocladius</i> (43%), <i>Minuria cunninghamii</i> (39%), <i>Sclerolaena intricata</i> (37%), <i>Maireana aphylla</i> (32%), <i>Abutilon halophilum</i> (31%), <i>Maireana eriantha</i> (26%)
Total	1933	179	

Statistical analysis of the site information was undertaken by BiometricsSA, South Australian Research and Development Institute (SARDI). Jessup transect data from the 1990–93 survey and 2001–02 surveys was compared to identify significant change in individual species within each vegetation group to partly answer the four biophysical-related questions specified above.

## Drivers of Biophysical Change

Rainfall, both amount and its distribution through the growing season, has a profound effect on pasture growth and ground cover in the short term (seasonal quality) and change in vegetation over longer periods (several years) – e.g. recruitment of chenopod shrubs, tree-grass balance and occurrence of wildfire. Separating rainfall effects from management effects remains a fundamental difficulty in interpreting change in monitoring data. In some environments, particularly northern Australia, the frequency and intensity of fire can also have a strong influence on vegetation change. While we don't yet have a robust method for partitioning seasonal (and fire) effects from those of management, the following interpretative framework (adapted from that provided by Ian Watson, WA Department of Agriculture) allows some degree of separation.

## Seasonal Conditions versus Grazing

Determining causality for change in rangelands is always difficult. Major drivers of change include seasonal conditions, grazing pressure (both stocking rate per amount of feed and factors such as distance to water), fire and demographic inertia (i.e. the relative stability of many chenopod communities where there is a good density of shrubs). For each of these drivers, there are many differences making it difficult to provide simple summaries of the driver. For example, seasonal conditions cannot be simply summarised by examining total rainfall since the timing, frequency and intensity of rainfall help determine its effect, as does the rainfall during preceding and successive periods of interest. Finally, the interactions between the major drivers serve to produce changes in rangelands. Many of these are poorly understood at the research level and are therefore difficult to determine at the monitoring level.

For the vegetation indicators found on monitoring sites in the Gawler Bioregion, the principal mechanisms of change include seasonal conditions and grazing pressure. The main indicators of change on shrubland sites are density and change in canopy size of long lived shrubs.

Table 2 provides a conceptual model of how ACRIS is attempting to separate the impacts of seasonal conditions and grazing and possibly, the interactions between seasonal conditions and change. Should there be a decline in the reported measure (e.g. chenopod density) during favourable seasonal conditions (above average rainfall), then that would suggest that some other factor, probably grazing, had an influence on the change. Conversely, should there be an improvement under unfavourable seasonal conditions (below average rainfall) then that would suggest that the grazing impact has been minimal. These cells in Table 2 are emphasised with red and green colours (a 'red light' for deleterious change and a 'green light' for favourable change). Other changes are more neutral and indicated by "softer" or no colouring.

In general, if there has been an improvement then it is possible to say that the grazing impact did not over-ride the seasonal impact.

**Table 2: Conceptual matrix to help judge attribution between seasonal conditions and grazing.**

Seasonal conditions	Decline	No Change	Improvement
Above average	XX	X	~
Average	X	~	√
Below average	~	√	√√

Characteristics of the vegetation measured at pastoral monitoring sites also provide additional evidence to help build a case for causality.

- We record the density and cover of relatively long lived species. These species are less affected by seasonally driven change and negative changes are less likely to be due to unfavourable seasons alone.
- If species known to be negatively affected by grazing (i.e. decreasers) exhibit different dynamics to those species known to be unaffected (intermediate) or positively affected (increasers), then that would suggest that grazing is having an impact. This assumes that seasonal conditions alone have the same impact on decreaser, increaser and intermediate species.

## Ranking Seasonal Conditions

There are a number of approaches for ranking the quality of seasonal conditions contributing to vegetation attributes measured at monitoring sites. These include:

1. Historic rainfall of recording stations distributed through each reporting region – used here and described below.
2. Aussie-GRASS simulated annual pasture growth (or cover) for the period 1890 to 2003 – processed in a similar way to historic rainfall as described below. Data were supplied by John Carter (Queensland Department Natural Resources and Mines) for the Gawler Bioregion. I evaluated these data but decided to use rainfall because:
  - Rainfall recording stations provided greater spatial flexibility in assigning the data from groups of monitoring sites to particular seasonal rankings. The Aussie-GRASS data are used to indicate probable levels of biomass (Question one reported later) and cover (Question five) but are considered too coarse for reporting seasonal change in the Gawler Bioregion because monitoring sites were assessed in small groups over time with these site groups having relatively limited geographic extent; and
  - The Aussie-GRASS data at this stage are not always adequately calibrated to ground conditions and there is some doubt in how well the simulated output matches reality across the Gawler Bioregion.
3. Images and statistics of seasonal quality derived from NOAA AVHRR (Advanced Very High Resolution Radiometer) data and available from the Environmental Resources Information Network (ERIN) (see <<http://www.deh.gov.au/erin/ndvi/index.html>>). These images are illustrated for the region in Appendix 1. The ERIN procedure for assigning seasonal quality (described at <<http://www.deh.gov.au/erin/ndvi/procedure.html#seasonal>>) was not used here because of:
  - Limited historic context – i.e. images available since 1992; and
  - The relative nature of seasonal quality index values – the NDVI-based (Normalised Difference Vegetation Index) value of each 1.1 km<sup>2</sup> pixel is compared against itself rather than being scaled in absolute terms (such as rainfall or Aussie-GRASS simulated pasture growth).

## Seasonal quality in the Gawler Bioregion

1. Rainfall recording stations with suitable data were selected from *Rainman v4.3* and the monthly rainfall data extracted to a spreadsheet. The locations of eight stations (by way of example) are shown in Figure 3. Rainfall statistics from these eight stations are summarised in Table 3.
2. Annual rainfall was then arranged in ascending order and ranked from lowest to highest amount.

3. This ordering was used to assign “terciles” to annual rainfall for each recording station. The lowest 1/3<sup>rd</sup> of recordings was considered to constitute “below average” seasonal conditions, the middle 1/3<sup>rd</sup> was considered “average” and the highest 1/3<sup>rd</sup> “above average”.



**Figure 3: Location of example rainfall recording stations used in the Gawler Bioregion to assign seasonal quality.**

**Table 3: Summary statistics of rainfall data from selected recording stations in the Gawler Bioregion.**

Station	Recording Period	No. of Years	Annual Rainfall (mm)	
			Mean	Median
Arcoona	1888–2003	116	161.0	143
Kingoonya	1916–2003	88	173.3	166
Mulgathing	1934–2003	70	176.5	179
Oakden Hills	1880–2003	124	176.9	163
Roxby Downs	1931–2003	73	164.2	138
Tarcoola	1903–2003	101	174.3	156
Whyalla	1907–2003	97	275.9	258
Yardea	1877–2003	127	272.7	267

4. Recent seasonal conditions (1990–2003) were then summarised across all locations (Table 4).
5. Finally, a ‘seasonal quality’ score was assigned according to the predominant rainfall tercile in the five years prior to reassessment. This five-year period was used because reported change for the biophysically-related questions (questions one to five) is based on longer-lived perennial shrubs (mainly chenopods).
6. The proximity of sites to recording stations was then used to select the most appropriate seasonal ranking for the data being reported from each site.

**Table 4: Ranking of seasonal quality in recent years based on annual rainfall of selected recording stations in the Gawler Bioregion.**

Year	Recording Station							
	Arcoona	King oonya	Mulga thing	Oakden Hills	Roxby Downs	Tarcoola	Whyalla	Yardea
1990	44	37	28	66	24	51	35	96
1991	3	31	24	61	3	41	38	101
1992	100	88	70	124	70	99	93	127
1993	34	48	48	69	37	37	87	106
1994	42	16	4	37	9	22	19	1
1995	52	59	32	77	39	61	90	54
1996	67	40	26	88	29	26	58	44
1997	98	64	52	101	58	83	88	111
1998	84	81	62	106	57	86	74	103
1999	17	32	29	54	14	50	60	76
2000	48	52	38	83	31	78	46	80
2001	101	79	50	102	65	88	82	82
2002	8	1	8	9	6	2	6	18
2003	85	76	56	38	59	91	53	60

**Notes:**

- The number in each row (i.e. year) is the rank of that year’s total rainfall for that recording station (column) amongst all years.
- The colour scheme is such that red cells represent rainfall amounts in the lowest tercile (considered below average seasonal quality), green the middle tercile (average season) and blue the highest tercile (above average).
- The procedure described here is stylised in that data from additional rainfall recording stations were added to provide greater sensitivity in assigning seasonal conditions.



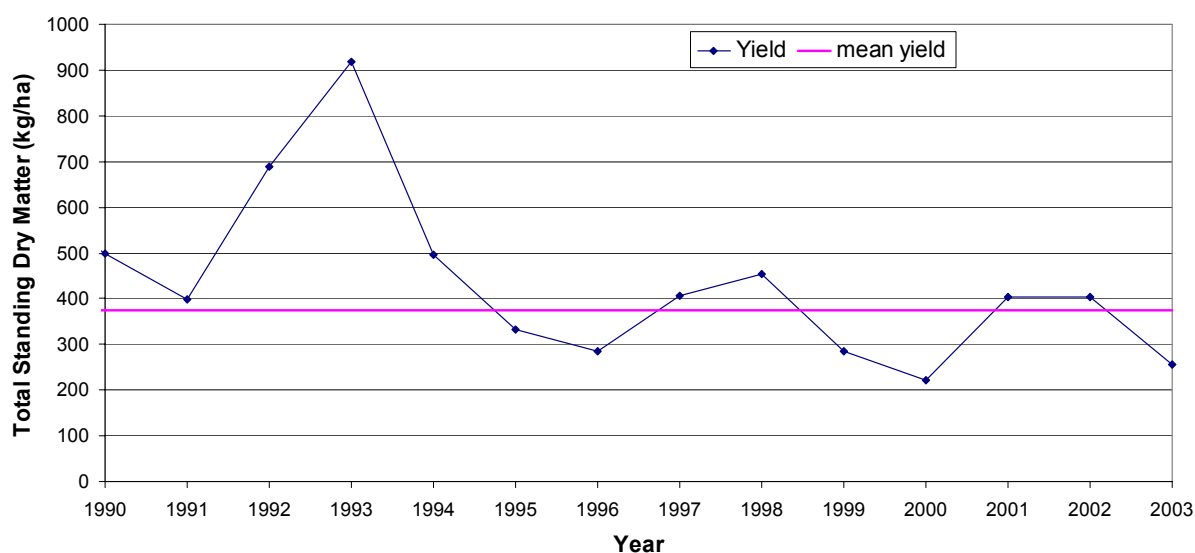
## Change in Critical Stock Forage Productivity

Information sources used to answer this question are summarised below.

Question	Information/data set
1. Change in critical Stock Forage Productivity? (i.e. change in those species known to indicate grazing pressure)	Aussie-GRASS pasture biomass  Change in density of decreaser shrubs at pastoral monitoring sites

### Aussie-GRASS Pasture Biomass

Simulated pasture biomass (as total standing dry matter of the pasture layer) for the Gawler Bioregion is shown in Figure 4 as an indication of stock forage that may have been present through the reporting period. Graphed data extended a little beyond the nominated reporting period of 1992 to 2002. The pink line shows the long term (1890–2003) simulated average biomass for the bioregion. Note that this graph indicates the **expected** (i.e. simulated) pasture availability based largely on rainfall, it **does not** show actual change in annual pasture biomass for the Gawler Bioregion. Additionally, the graphed data show the average biomass for the whole Gawler Bioregion. This average value conceals considerable spatial variation across the region related to rainfall variability, soil differences and other parameters used by Aussie-GRASS. Despite these limitations, the simulated biomass levels illustrate the considerable year-to-year variation in pasture availability related to rainfall.



**Figure 4: Aussie-GRASS simulated yearly levels of pasture dry matter and the long term (1890-2003) mean.**

This Aussie-GRASS product indicates that:

- Pasture dry matter was above the long-term average from 1992 to 1994 and particularly so in 1993. Thereafter, pasture biomass fluctuated around or below the mean (where the long term mean is 375 kg/ha). In 2000 and 2003, modelled yields were close to historical lows;

- In terms of historical context, the 1993 modelled yield of 917 kg/ha was on a par with 1910, 1921 and 1980, a little below that of 1975 (1118 kg/ha) and considerably below the peak yield of 1974 (1527 kg/ha); and
- There have been extended periods when modelled pasture growth was poor (~200 kg/ha) – and on a par with 2000 and 2003. These include 1896-1907, 1933-46 and 1983-88.

## Change in Vegetation Communities and Indicator Species

Change in critical stock forage productivity reported here is based on the density of perennial vegetation species at monitoring sites that are known indicators of grazing within the South Australian Rangelands. The book, 'A Field Guide to the Plants of Outback South Australia' (Kutsche and Lay, 2003) was used as the basis for assigning species to indicator groups of grazing (decrease, increase or not affected by grazing). Additional information on species was gathered through landholders and staff from the Pastoral Program, Department of Water, Land and Biodiversity Conservation.

Table 5 outlines the perennial plant species identified which could be used for statistical analysis in each group during the surveys, with species that showed significant change highlighted in bold.

**Table 5: Jessup data outlining indicator species that demonstrated significant change (highlighted in bold) during the study period (White and Gould, 2002).**

Group	Perennial plant species	No. of sites	Wilcoxon Ranked Sum test result (V = value of test statistic)
1	<b><i>Acacia aneura</i></b>	12	V = 28, p-value = 0.01755
	<i>Enchyleana tomentosa</i>	12	V = 26, p-value = 0.6768
	<i>Eragrostis sp.</i>	13	V = 71.5, p-value = 0.06913
	<i>Maireana georgei</i>	11	V = 32, p-value = 0.9288
	<i>M. pentatropis</i>	9	V = 21.5, p-value = 0.9056
	<i>M. sedifolia</i>	9	V = 2.5, p-value = 0.3173
	<b><i>Monochather paradoxa</i></b>	7	V = 0, p-value = 0.01796
	<i>Ptilotus obovatus</i>	11	V = 35, p-value = 0.8572
	<i>Senna artemisioides</i>	7	V = 10, p-value = 0.4982
2	<i>Acacia aneura</i>	12	V = 6, p-value = 0.1088
	<i>Atriplex vesicaria</i>	7	V = 13, p-value = 0.5961
	<i>Chenopodium desetorum</i>	7	V = 15, p-value = 0.8655
	<i>Enchyleana tomentosa</i>	10	V = 32.5, p-value = 0.6091
	<i>Lycium australe</i>	8	V = 10, p-value = 0.4795
	<i>Maireana georgei</i>	15	V = 60, p-value = 0.6369
	<i>M. pentatropis</i>	9	V = 17, p-value = 0.5109
	<i>M. sedifolia</i>	23	V = 138.5, p-value = 0.07893
	<b><i>M. triptera</i></b>	10	V = 55, p-value = 0.00296
	<b><i>Ptilotus obovatus</i></b>	21	V = 196.5, p-value = 0.0006342
	<i>Rhagodia spinescens</i>	8	V = 4, p-value = 0.3363
	<b><i>Senna artemisoides</i></b>	18	V = 76, p-value = 0.003636
3	<i>Atriplex vesicaria</i>	7	V = 19, p-value = 0.398

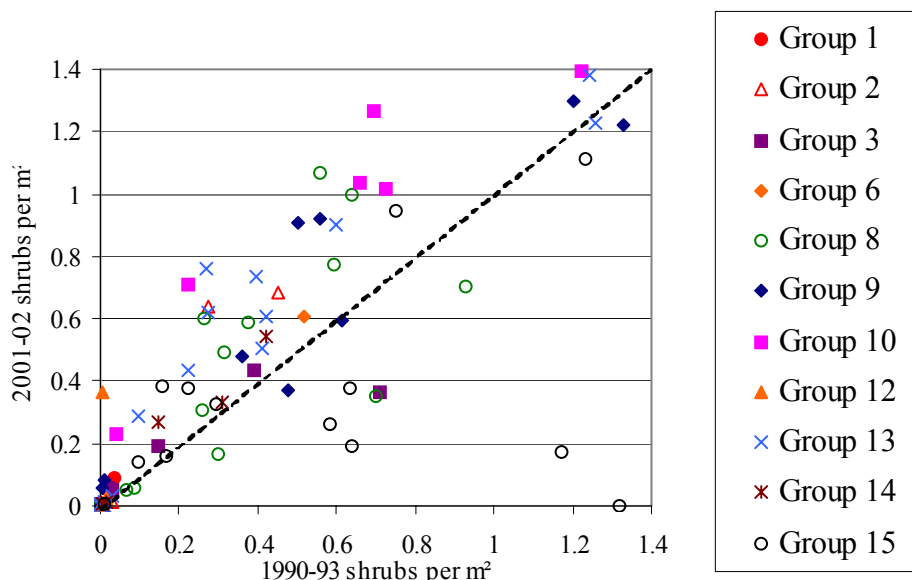
Group	Perennial plant species	No. of sites	Wilcoxon Ranked Sum test result (V = value of test statistic)
	<i>Maireana astrotricha</i>	9	V = 23, p-value = 0.1206
	<b><i>M. sedifolia</i></b>	13	V = 70, p-value = 0.01456
	<b><i>Ptilotus obovatus</i></b>	12	V = 60, p-value = 0.01637
6	Nil	nil	nil
8	<i>Atriplex vesicaria</i>	17	V = 83.5, p-value = 0.1819
	<i>Maireana astrotricha</i>	17	V = 80.5, p-value = 0.2434
	<i>M.pyramidata</i>	7	V = 13.5, p-value = 0.5282
9	<b><i>Atriplex vesicaria</i></b>	13	V = 76, p-value = 0.03271
	<i>Maireana georgei</i>	12	V = 38.5, p-value = 1
	<i>Maireana pyramidata</i>	11	V = 40, p-value = 0.5624
	<i>Minuria cunninghamii</i>	7	V = 19, p-value = 0.4299
	<i>Ptilotus obovatus</i>	7	V = 22.5, p-value = 0.1755
10	<b><i>Atriplex vesicaria</i></b>	11	V = 66, p-value = 0.0009766
	<i>Sclerostegia tenuis</i>	8	V = 17, p-value = 0.9441
11	<i>Atriplex stipitate</i>	7	V = 24, p-value = 0.1094
12	<i>Atriplex stipitata</i>	7	V = 10.5, p-value = 0.6049
	<i>Zygophyllum aurantiacum</i>	9	V = 18, p-value = 0.6523
13	<i>Atriplex stipitata</i>	7	V = 23, p-value = 0.1501
	<b><i>Atriplex vesicaria</i></b>	18	V = 156, p-value = 0.002289
	<i>Enchylaena tomentosa</i>	16	V = 95.5, p-value = 0.1586
	<b><i>Maireana georgei</i></b>	15	V = 103, p-value = 0.01566
	<i>Maireana pyramidata</i>	7	V = 19, p-value = 0.4436
	<i>Maireana sedifolia</i>	15	V = 57.5, p-value = 0.909
	<i>Rhagodia spinescens</i>	8	V = 17.5, p-value = 1
	<b><i>Rhagodia ulicina</i></b>	9	V = 39, p-value = 0.05583
14	<i>Enchylaena tomentosa</i>	7	V = 19, p-value = 0.4452
	<i>Maireana sedifolia</i>	9	V = 38.5, p-value = 0.06513
15	<i>Atriplex vesicaria</i>	15	V = 37, p-value = 0.1914
	<i>Frankenia serpyllifolia</i>	7	V = 13, p-value = 0.8648
	<b><i>Sclerostegia spp</i></b>	11	V = 1.5, p-value = 0.02071

As shown in Table 5, seven of the twelve vegetation groups recorded significant changes in the median number of counts of ten species between the 1990–93 and 2001–2002 sampling periods. The highest number of significant changes in a single group was recorded for Groups 2 and 13 (three species), followed by Groups 1 and 3 (two species). The remaining groups contained changes in only one species or recorded no changes at all.

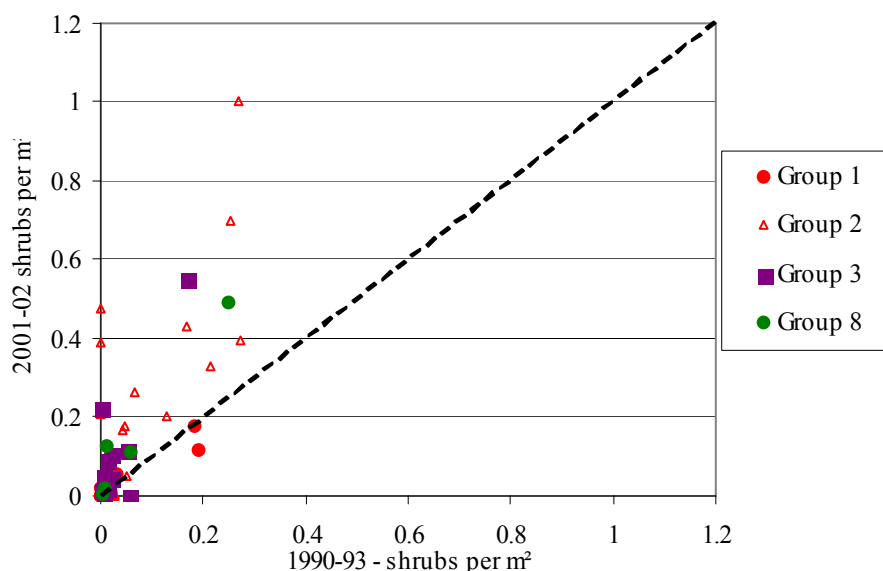
Of the ten species showing significant changes in median counts, significant increases were recorded in eight species of predominantly perennial chenopod shrubs (*Acacia aneura*, *Atriplex*

*vesicaria*, *Maireana triptera*, *M. sedifolia*, *M. georgei*, *Rhagodia ulicina*, *Senna artemisioides* and *Ptilotus obovatus*) and significant decreases in two species (*Monochather paradoxa* and *Sclerostegia* sp.). This occurred in at least one vegetation group.

Of the individual species that showed significant change, all showed change in only one group, except for *Atriplex vesicaria* (increases across three groups) and *Ptilotus obovatus* (increases across two groups). Figures 5 and 6 show density changes for these species at sampling sites across groups.



**Figure 5: Changes in the density of *Atriplex vesicaria* at sampling sites by group in the Gawler and Kingoonya Soil Conservation Districts, 1990–93 to 2001–02.**



**Figure 6: Changes in density of *Ptilotus obovatus* in the Gawler and Kingoonya Soil Conservation Districts, 1990–93 to 2001–02.**

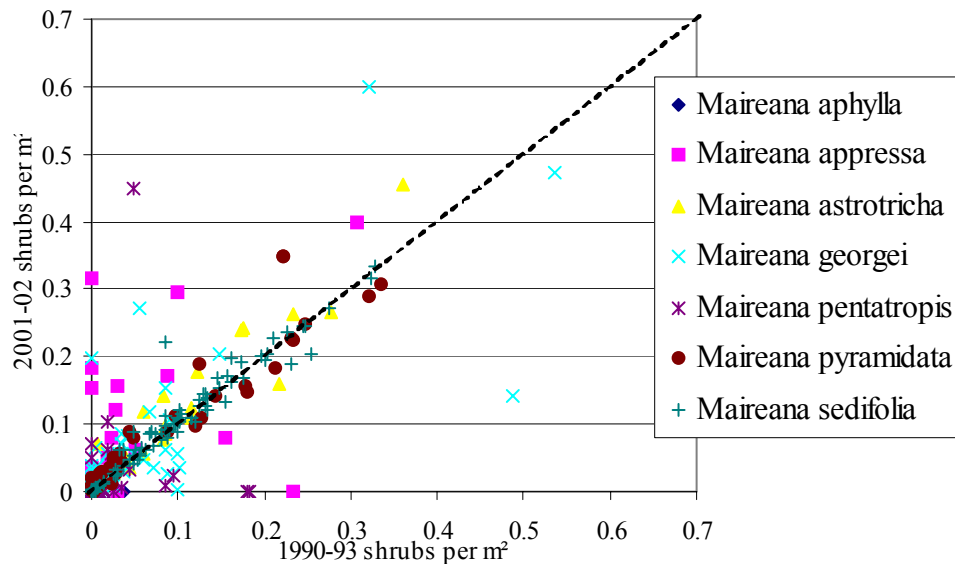
While significant increases in the density of *Atriplex vesicaria* were observed in Groups 9, 10 and 13, which occur in the southern part of the study area, this species has increased in density more generally across most vegetation groups in the two districts in the last 10 years. Recruitment was also recorded from within all vegetation groups for both  $t_1$  (first assessment) and  $t_2$  (reassessment). While these figures represent an increase in adults as opposed to juveniles, greater recruitment was recorded for the entire species across the bioregion (Table 6:  $t_1$  juveniles = 7.5 per cent of recorded population,  $t_2$  = 13.4 per cent). However, although *Atriplex vesicaria* recruitment was

recorded within most vegetation groups, it appears that greater recruitment occurred in the more northern vegetation groups at  $t_2$  than the more southern vegetation groups.

**Table 6: Comparison of the density of *Atriplex vesicaria* adults and juveniles recorded at sampling sites across the Gawler And Kingoonya Soil Conservation Districts between 1990–93 and 2001–02.**

<i>Atriplex vesicaria</i> Recruitment Across Vegetation Groups								
		1990–93			2001–02			
Group No	# sites/group	Mean No. Adults	Mean No. Juv	Ratio (J/A)%	Mean No. Adults	Mean No. Juv	Ratio (J/A)%	% Change
1	2	7	0	-	20	56.5	282.5	↑ 282.5
2	7	43.9	2.9	6.6	76.6	37.6	49.1	↑ 42.5
3	7	74.7	3.0	4.0	62.9	5.1	8.1	↑ 4.1
6	3	68.7	0.7	1.0	82.3	11.3	13.7	↑ 12.7
8	17	201.1	10.6	5.3	267.1	50.2	18.8	↑ 13.5
9	13	251	21.9	8.7	332.2	68.1	20.5	↑ 11.8
10	11	300.1	35.2	11.7	576.0	27.7	4.8	↓ 6.9
12	4	154.5	1.0	0.6	177.8	0.8	0.4	↓ 0.2
13	17	140.9	23.4	16.6	213.8	30.9	0.5	↓ 16.1
14	5	71.6	1.8	2.5	93.4	1.8	1.9	↓ 0.6
15	15	323.4	8.7	2.7	229.5	18.7	8.1	↑ 5.4

While the density of *Maireana sedifolia* and *Maireana astrotricha* (both of which are long lived perennials) remained stable across the districts at the sites sampled over the past decade, the density of *Maireana georgei* and *Maireana appressa* (which are shorter lived perennials) was more variable, with density increases recorded at some sites and decreases at others (Figure 7). All *Maireana* species appear to behave similarly independent of group membership. Additionally, Table 7 outlines an overall decrease in the ratio of adult to juvenile *Maireana sedifolia* species between 1990-93 and 2001-02.

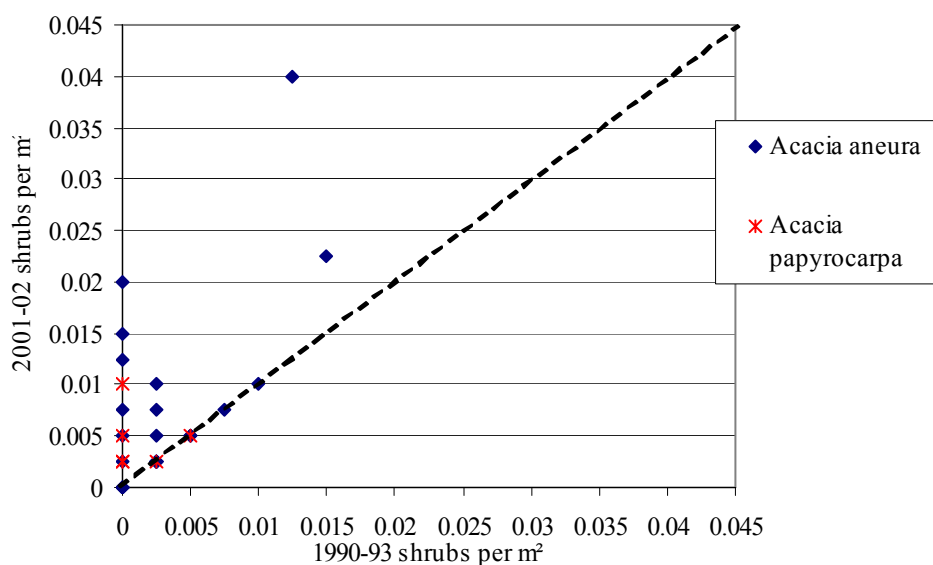


**Figure 7: Changes in density of all *Maireana* species recorded at sampling sites within the Gawler and Kingoonya Soil Conservation Districts, 1990-93 to 2001-02.**

**Table 7: Comparison of the density of *Maireana sedifolia* adults and juveniles recorded at sampling sites across the Gawler and Kingoonya Soil Conservation Districts between 1990-93 and 2001-02.**

<i>Maireana sedifolia</i> Recruitment Across Vegetation Groups								
		1990–93			2001–02			
Group No	# sites/ group	Mean No. Adults	Mean No. Juv	Ratio (J/A)%	Mean No. Adults	Mean No. Juv	Ratio (J/A)%	% Change
1	9	4.2	0.1	2.3	4.0	0.1	2.5	↑ 0.2
2	23	27.2	3.1	11.4	29.0	0.5	1.7	↓ 9.7
3	13	28.6	7.5	26.2	35.9	0.2	0.6	↓ 25.6
8	2	2.5	0	0	2.5	0	0	-
9	8	52.5	0.4	0.8	49.6	0.6	1.2	↑ 0.4
10	2	0.5	0	0	1	0	0	-
12	5	37.7	4.0	10.6	39.9	0.5	1.3	↓ 9.3
13	17	64.5	1.7	2.6	63.8	0.1	0.2	↓ 2.4
14	9	45.4	0.1	0.2	48.4	0	0	↓ 0.2

The density of both *Acacia aneura* and *Acacia papyrocarpa* increased slightly at those sites monitored (Figure 8). This represents an average increase of 1.6 plants per site for *A. aneura* (Table 8). However, the average number of recruits recorded at the sampling sites was less at  $t_2$  than  $t_1$ . Group membership did not appear to influence changes in the density of *A. aneura* during the study period.

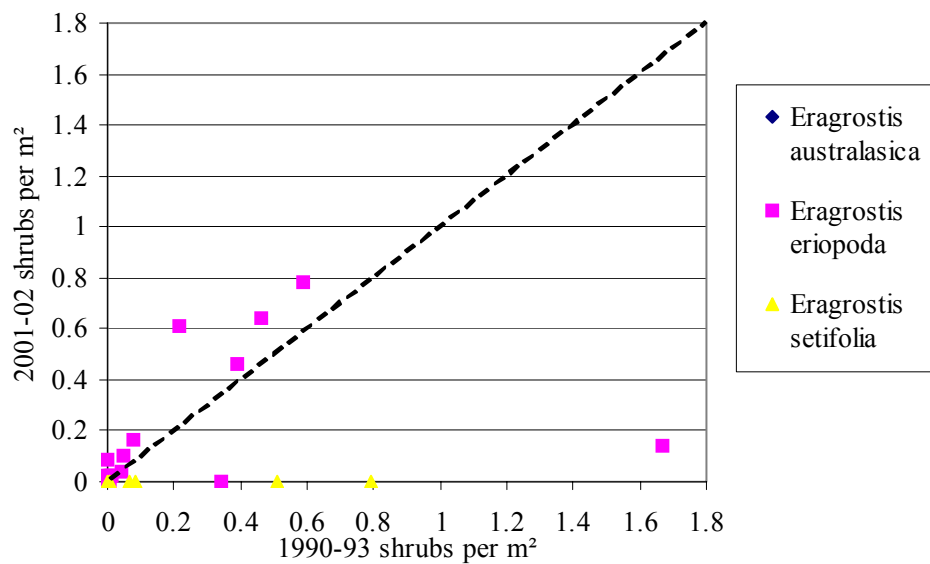


**Figure 8: Changes in the density of *Acacia aneura* and *Acacia papyrocarpa* at sampling sites within the Gawler and Kingoonya Soil Conservation Districts, 1990-93 to 2001-02.**

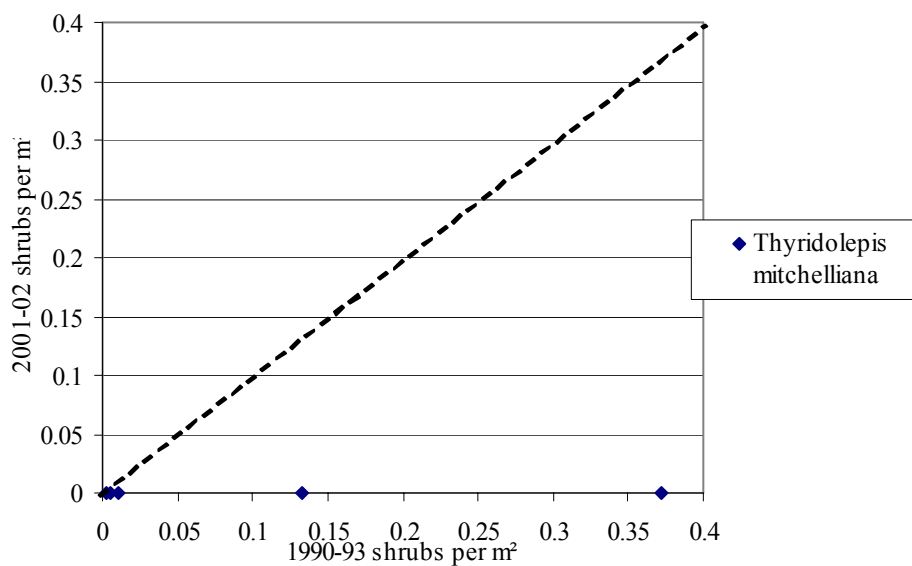
**Table 8: Comparison of the density of *Acacia aneura* adults and juveniles recorded at sampling sites across the Gawler and Kingoonya Soil Conservation Districts between 1990-93 and 2001-02.**

<i>Acacia aneura</i> Recruitment Across Vegetation Groups								
		1990-93			2001-03			
Group No	# sites/group	Mean No. Adults	Mean No. Juv	Ratio (J/A) %	Mean No. Adults	Mean No. Juv	Ratio (J/A) %	% Change
1	12	1.3	0.6	46.2	3.3	0.3	9	↓ 37.2
2	12	0.9	0.3	33.3	1.8	0	0	↓ 33
6	1	5	0	0	16	0	0	-
14	2	3.5	0	0	3.0	1	33.3	↑ 33.3

While the density of the dominant perennial grass *Eragrostis eriopoda* appears to have increased at sites sampled across the two districts in the past decade, *Eragrostis setifolia* was present at a limited number of sites at  $t_1$  but totally absent at the sampling sites at  $t_2$  (Figure 9). *Eragrostis australasica* was only recorded at very low frequencies in the study area and does not appear to have changed in density over the preceding decade. In addition, the highly palatable grass *Thyridolepis mitchelliana* was present in low frequencies in the two Soil Board districts at  $t_1$  but was absent at  $t_2$  (Figure 10).



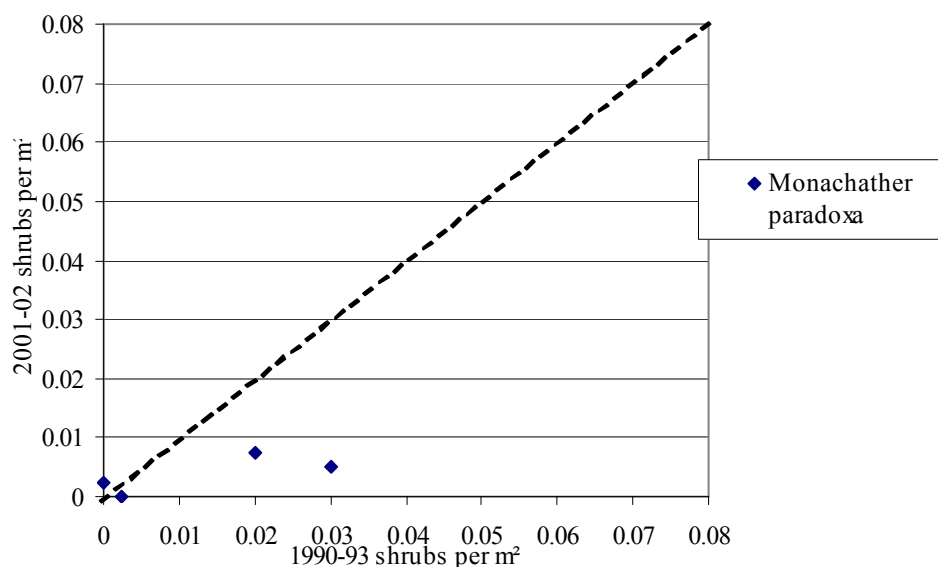
**Figure 9: Changes in density of *Eragrostis* species in the Gawler and Kingoonya Soil Conservation Districts, 1990–93 to 2001–02.**



**Figure 10: Changes in density of *Thyridolepis mitchelliana* in the Gawler and Kingoonya Soil Conservation Districts, 1990–93 to 2001–02.**

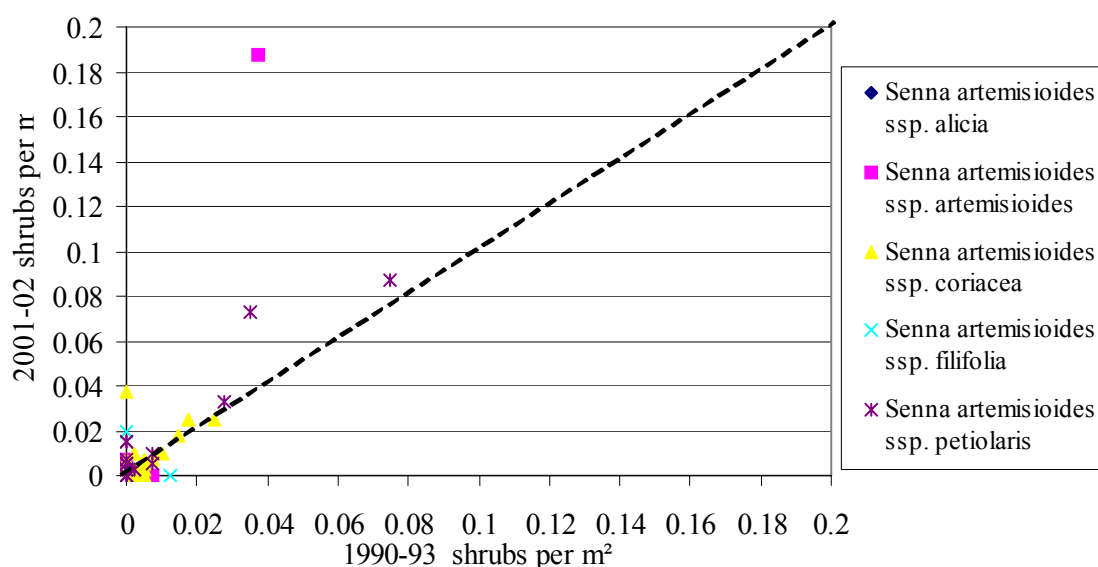
The highly palatable grass *Monochather paradoxa* significantly decreased in density over the decade of the study. This pattern is depicted graphically in Figure 11.



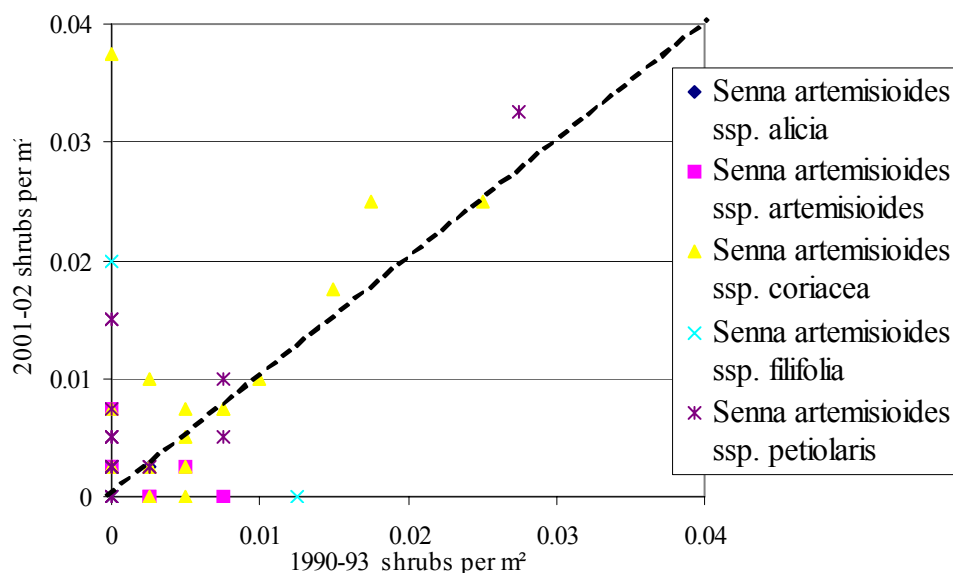


**Figure 11: Changes in density of *Monochather paradoxa* in the Gawler and Kingoonya Soil Conservation Districts, 1990-93 to 2001-02.**

While *Senna* species were frequently recorded at sampling sites across the districts, this species and all its sub-species remain at low numbers and do not appear to have increased in density over the past decade (Figures 12 and 13). The *Senna* species are generally not palatable or known to decrease with grazing. However, the density data are included here for completeness.



**Figure 12: Changes in density of all sub-species of *Senna artemisioides* in the Gawler and Kingoonya Soil Conservation Districts, 1990-93 to 2001-03.**



**Figure 13: Changes in density of all sub-species of *Senna artemisioides* in the Gawler and Kingoonya Soil Conservation Districts, 1990–93 to 2001–02.**

Note that Figure 13 is an enlargement of Figure 12. The dashed line represents the ‘no change’ line.

### Rainfall as a contributor to detected change

Using the framework outlined in the section on “drivers of biophysical change” and illustrated in Table 2, Table 9 partitions seasonal effects on vegetation change.

**Table 9: Percentage of monitoring sites where the density of perennial decreaser species declined, remained stable or improved between the two assessment periods.**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average	104	11	25	64
Below average	75	36	13	51

<sup>1</sup> A tolerance of +/- 10 per cent in perennial density used to categorise “no change”.

The results of this partitioning of seasonal effects on change in density of perennial decreaser species is encouraging because it shows that almost two thirds of monitoring sites either maintained or improved their density following a period of below average rainfall. Similarly, almost two thirds of sites assessed after average seasons had an improved density of perennial decreaser species. Of some concern, 11 per cent of sites had a reduced density of decreaser perennials following these average seasons (i.e. no real change anticipated).

## Summary of Change in Critical Stock Forage Productivity

Based on resampling of 179 pastoral monitoring sites in the Gawler Bioregion, there were both increases and decreases in the density of perennial decreaser species. Bladder saltbush (*Atriplex vesicaria*) generally increased in density across the region. The density of pearl bluebush (*Maireana sedifolia*) and low bluebush (*M. astrotricha*), both long-lived perennials, remained stable through the monitoring period. The highly palatable bandicoot grass (*Monochather paradoxa*) significantly decreased in density over the bioregion. The density of mulga (*Acacia aneura*) increased at monitoring sites, by an average of 1.6 plants per site.

Almost two thirds of monitoring sites either maintained or improved their density of perennial decreaser species following a period of below average rainfall. This is encouraging as a decrease in perennial density could have been expected with drier years. Similarly, almost two thirds of sites assessed after average seasons had an improved density of perennial decreaser species. Of some concern 11 per cent of sites had a reduced density of decreaser perennials following these average seasons (i.e. no real change anticipated).

Aussie-GRASS simulation of pasture biomass (total standing dry matter) based on annual rainfall (and other environmental factors) provided additional seasonal context for interpreting changes recorded at monitoring sites. Simulated average biomass across the bioregion was well above the long-term (1890-2003) average in 1992 and 1993, close to the average through the remainder of the 1990s and close to historical lows in 2000 and 2003.

## Change in Native Plant Species

Question	Information/data set
2. Change in Native Plant Species?	Change in density of perennial species Status of biodiversity Fire patterns

## Change in Density of Perennial Species

This question was framed to extend our reporting ability upon a small component of biodiversity. The question was deliberately restricted to change in plant species, recognising that monitoring data to report change in a broader suite of biodiversity are, as yet, restricted in the rangelands.

All perennial species were used to report on change, this includes species that increase under grazing or are not affected by grazing as well as decreaser species. Using the seasonal conditions by change matrix as for Question one, Table 10 partitions seasonal effects on change in all perennial species density at the 179 pastoral monitoring sites in the Gawler Bioregion.

### Rainfall as a contributor to detected change

**Table 10: Percentage of monitoring sites where the density of perennial species declined, remained stable or improved between the two assessment periods.**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average	104	12	22	66
Below average	75	32	16	52

<sup>1</sup> A tolerance of +/- 10 per cent in perennial density used to categorise "no change".

The results of this partitioning of seasonal effects on change in density of perennial species shows the same encouraging result as for Question 1 (change in critical stock forage productivity). Two thirds of monitoring sites either maintained or improved their density of perennial species following a period of below average rainfall. Similarly, two thirds of sites assessed after average seasons had an improved density of perennial species. Similar to decreaser perennial species (Question 1), 12 per cent of sites had a reduced density of perennials following average seasons (i.e. no real change anticipated).

## Status of Biodiversity in the Gawler Bioregion

By compiling an extensive biological inventory, Neagle (2003) has identified at least nine plant taxa, and one bird and one reptile species that are endemic to the bioregion. As well, seven plant

and fourteen fauna species are nationally threatened, and four state-threatened ecological communities exist. These data were sourced from existing information describing the biological resources of the rangelands of South Australia. A full list of the databases utilised is contained in Table 11. The inventory comprises part of the ongoing statewide Regional Biodiversity Planning Program, supervised by the Department of the Environment and Heritage.

The seven aims of the biological inventory were (Neagle, 2003):

- Compile existing biological data from a wide variety of sources;
- Update existing sources/databases where necessary;
- Consolidate flora and vertebrate fauna data, and mapped vegetation communities;
- Identify threatened flora, fauna and plant associations / ecological communities;
- Identify areas where biological data are deficient;
- Identify major threats to biodiversity; and
- Determine key conservation issues.

**Table 11: Databases sourced for biological data for the rangelands of South Australia (Source: Neagle, 2003).**

Database	Data Stored				
	Plants	Mammals	Reptiles	Frogs	Birds
Survey (DEH)	✓	✓	✓	✓	✓
Opportunistic sightings (DEH)	✓	✓	✓	✓	✓
Reserves (DEH)	✓	✓	✓	✓	✓
Plant Population (DEH)	✓				
SA Museum		✓	✓	✓	✓
RAOU 1981					✓
Birds Australia 2001					✓
Pastoral Management Information System (DWLBC)	✓				
EPA Frog Census (DEH)				✓	
Plant Biodiversity Centre	✓				
Western Mining Corporation Opportune		✓	✓	✓	✓

#### **Flora and fauna recorded in the Gawler Bioregion**

Appendix 2 lists all flora and fauna species recorded within the Gawler Bioregion during Neagle's (2003) study. This is the most complete list available to date.

## Threatened flora recorded in the Gawler Bioregion

Appendix 3 lists all threatened flora recorded in the Gawler Bioregion by Neagle (2003). There are seven nationally threatened species, eight that are vulnerable in South Australia, and 31 that are rare to South Australia. Of the nationally-threatened species, two (*Brachycome muelleri* and *Frankenia plicata*) are rated as endangered, while the remaining five are rated as vulnerable.

## Threatened fauna recorded in the Gawler Bioregion

Appendix 4 lists a total of 57 threatened fauna species recorded in the Gawler Bioregion (Neagle, 2003). Fourteen species are nationally threatened, comprising six from the class *aves*, seven *mammalia* and one *reptilian*. It should be noted that *Perameles bougainville* (Western Barred Bandicoot) is also included as a nationally threatened species despite data sources showing it as extinct in the bioregion. The remaining 42 species have been classified as either endangered, vulnerable or rare to South Australia, under the *National Parks and Wildlife Act 1972*.

## Threatened ecological communities

In the absence of a state-level list of threatened ecological communities for SA, an interim list of threatened ecosystems has been compiled by DEH (2001), Table 12.

**Table 12: Threatened Ecological Communities Recorded in the Gawler Bioregion (Source: Neagle, 2003).**

Ecological Community	Status	
	Aust	SA
<i>Acacia aneura</i> (Mulga) Low Woodland on sand plains		V
<i>Acacia calcicola</i> (Northern Myall) Low Woodland on calcareous soils of breakaway tablelands		V
<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) Tall Shrubland on alluvial soils of plains		V
<i>Eucalyptus coolabah</i> ssp. <i>arida</i> (Coolibah) Woodland on levees and channel banks of regularly inundated floodplains		O

Status: Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

SA = Provisional Threatened Ecosystems of South Australia (DEH 2001).

CD = critically endangered; E = endangered; V = vulnerable; O = of concern.

## Contribution of reference areas and exclosures within the Gawler Bioregion

Rangeland reference areas serve as benchmark levels of land condition within specific land types. They are located in areas unaffected by grazing, and are used for comparison of grazed areas of the same land type. The absence of grazing on reference areas allows the effect of grazing and the influence of seasonal conditions to be analysed objectively elsewhere. Within SA's rangeland, 184 reference sites and exclosures have been established. Of these, 50 reference sites and 12 exclosures are located within the Gawler Bioregion (Fleming *et al.*, undated). Appendix 5 describes the location and land system for each reference site and exclosure.

## Fire Patterns in the Gawler Bioregion

In combination with grazing by native, feral and stock animals, fire has had an effect over considerable areas of the Gawler Bioregion in the last 30 to 50 years. The most significant fires affecting the region during this period occurred in 1974-5 (Figure 14), after several years of unprecedented rainfall (pers comm., B. Lay, Pastoral Program, DWLBC).



**Figure 14: Low-intensity wildfire on Bon Bon Station, December 1975 (Source: Lay, 1976).**

Fires in the Gawler Ranges, which comprise much of the southern part of the bioregion, occur on a regular basis, and consequently are an endemic and important part of the ecology of these areas. These ranges consist of rounded hills of granite or granitoid rock composition, supporting *Triodia* (spinifex) communities and a variety of fire-tolerant sclerophyllous shrubs, as well as *Acacia tarculensis*, and various mallees in the higher rainfall parts. Natural fire frequency over much of the Gawler Ranges varies between once every ten to fifty years. Fires in the ranges are often started by lightning strikes in the warmer months. Additionally, during the early 20<sup>th</sup> century the hills were often deliberately set alight to encourage regrowth, being discontinuous with less fire-prone chenopod shrublands between them. These fires appear to have markedly affected the distribution of fire-sensitive perennials such as *Acacia tarculensis*, *Acacia papyrocarpa* and shrubs such as *Atriplex vesicaria* (pers comm., B. Lay, Pastoral Program, DWLBC).

The areas of Stuart Range and Arcoona Plateau have no fire history, as their gibber-covered silty or clay-loam soils with patchy chenopod shrublands do not support the spread of fire, even after above-average rainfall years.

In the vegetation communities that are associated with open woodlands of *Acacia aneura*/*Acacia papyrocarpa*, dominated by an understorey of ephemeral/perennial grasses, fires occur very infrequently. When they do however, the ecological and economic effects can be significant. In 1974–1975, such fires burnt a large area of the bioregion, contributing to the existence of dead

trees within present-day vegetation communities. Although these fires were for the most part naturally- occurring, the combination of fire and grazing, especially by rabbits, resulted in major changes in some communities, with poor regeneration of the overstorey trees (refer to Photos 9 and 10 in the 'Long-term change with photos' section).

## **Summary of Change in Native Plant Species**

The Gawler bioregion has been extensively surveyed to establish the current status of native (and introduced) flora and fauna. This work has identified that at least nine plant taxa, one bird and one reptile species are endemic to the bioregion. Seven plant and 14 fauna species are nationally threatened. Four ecological communities are threatened at the state level.

Unfortunately, there is limited capacity for the biological survey data to report change until a systematic resurvey is conducted. As with the previous question (critical stock forage productivity), the main data to report change in native plant species come from the reassessment of 179 pastoral monitoring sites.

The density of all chenopod and other perennial species increased at the majority of pastoral monitoring sites in the Gawler bioregion. Separated into components: (1) the density of long-lived chenopods remained stable and (2) there was a reduction in the density of perennial grasses in the northern area of the bioregion following below-average seasonal conditions. The density of perennial species increased at more than half of the sites through the reporting period, an encouraging result, as perennials contribute to more persistent vegetation. This would seem to benefit protection of the soil surface against erosion and improve landscape function (next section) and habitat for various fauna (provided the increase in density is not excessive, leading to non-natural thickening of perennial vegetation).

Episodic wildfire, generally following wetter years, is considered a threat to some native plant species in the Gawler Bioregion. Extensive areas of mulga were killed by wildfire in the mid 1970s, with subsequent regeneration hindered by rabbits.



## Change in Landscape Function

Question	Information/data set
3. Change in Landscape Function? (i.e. change in the capacity of landscapes to retain, not leak, rain water and nutrients – vital resources for plant growth)	Richards/Green Functionality index derived from pastoral monitoring data

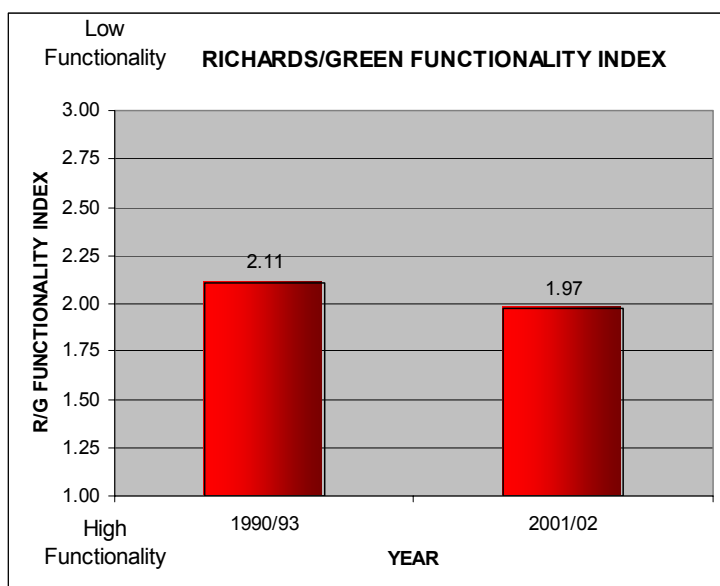
## Applying the Richards/Green Functionality Index

Landscape function is most rigorously determined using formal Landscape Function Analysis (LFA) methods developed by David Tongway and colleagues (Tongway, 1994; Tongway and Hindley, 1995). However LFA data are not currently collected at pastoral monitoring sites in South Australia. In the absence of suitable LFA data, the Richards/Green Functionality Index was developed for deriving common measures of landscape functionality across the various state data sets. The index is calculated using data collected at pastoral monitoring sites. A full description of the index is given in Appendix 6.

## Condition Rating Approach

To determine if any trends in functionality scores existed for the sites sampled across the Gawler Bioregion, Richards/Green Functionality scores derived from the 1990–1993 data were compared against those produced from the 2001–02 data collection (White and Gould, 2002).

South Australian pastoral monitoring sites are currently classified under five conditions ranging from excellent to very poor. However, the Richards/Green Functionality Index refers to only three classes: 'Highly Functional', 'Functional' and 'Poorly Functional'. In order to apply the Richards/Green Functionality Index to South Australian pastoral monitoring sites, White and Gould (2002) combined 'Excellent' with 'Good' sites and 'Poor' with 'Very Poor' sites. Each of the three functionality classes was allocated a weighting (Highly functional = 1; Functional = 2; Poorly functional = 3) then divided by 100 to give the index value.



**Figure 15: Summary of Richards/Green functionality index trend for the Gawler Bioregion.**

The summary from 179 sites that were reassessed using the Richards/Green Functionality index across the Gawler Bioregion indicates an improving trend from 2.11 during 1990/93 to 1.97 in 2001–2002. This trend was consistent across the bioregion (Figure 15).

## Site Based Perennial Density Approach

A site-based approach was investigated by examining change in perennial density of the decreaser plant species measured in Jessup transects and condition classes rated by rangeland officers. Tables 13 and 14 illustrate the direction of change in the Richards/Green functionality index at sites between the 1990–1993 and 2001–2002 assessments.

**Table 13: Richards/Green Functionality Index (number of sites)**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average (2001)	104	8	92	4
Below average (2002)	75	18	36	21

<sup>1</sup> A tolerance of +/-10 per cent was used to categorise “no change”.

**Table 14: Richards/Green Functionality Index (percentage of sites)**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average (2001)	104	8%	41%	51%
Below average (2002)	75	24%	48%	28%

<sup>1</sup> A tolerance of +/-10 per cent was used to categorise “no change”.

Table 14 indicates that 51 per cent of the 104 sites revisited in 2001 during average seasonal conditions improved in landscape function while 41 per cent did not change. Only eight per cent of sites revisited during 2001 showed a decline in the Richards/Green index. The remaining 75 sites were revisited in 2002 during below average seasonal condition. Of these, 75 sites (48 per cent) showed no change in the Richards/Green index while 24 per cent of sites declined in trend. Surprisingly there was an improvement at 28 per cent of the 75 sites revisited during this below average year.

## Summary of Change in Landscape Function

For monitoring and reporting purposes, landscape function is interpreted as the capacity of landscapes to capture and retain rainwater and nutrients as vital resources for plant growth. There are formal methods for assessing landscape function but these methods are not currently part of the pastoral monitoring program in SA. Instead, the Richards/Green Functionality Index was used to indicate landscape function.

Based on index data averaged across 179 monitoring sites, landscape function improved in the period 1990 to 2002 (index improved from 2.11 to 1.97 – where 1 = 'highly functional' and 3 = 'poorly functioning').

At the site level, the results provide an encouraging indication of improving trend in landscape function. Three-quarters of sites assessed in the below-average season of 2002 maintained or improved their Richards/Green Functionality Index value. Similarly, 92 per cent of sites assessed the year before (following average seasons) had either stable or improved function.

## Capacity for Change in the Region

Question	Information/data set
4. Capacity for Change? (i.e. capacity for the region's community to innovate, adapt to and cope with change)	<p>Australian Bureau of Statistics regional profile of demographics for the Gawler Bioregion</p> <p>Domestic stocking estimates across the bioregion</p> <p>Change in pastoral land use</p> <p>Change in land values</p>

## Demographics

Previous work by Haberkorn *et al.* (2001) has identified a set of socio-economic indicators (Table 15) that suggest the ability of rural communities to adapt to change. Data for these "headline indicators" for the Gawler Bioregion (plus other socio-economic data) are presented in Table 16. These results (plus others) were compiled for ACRIS by the ABS under contract to the National Land and Water Resources Audit. The complete report is available at [http://www.nlwra.gov.au/social\\_economic.htm](http://www.nlwra.gov.au/social_economic.htm).

**Table 15: Headline indicators reported by the Australian Bureau of Statistics.**

(Extracted from ABS4\_Rangelands\_profiles\_prelims.pdf available at [http://www.nlwra.gov.au/social\\_economic.htm](http://www.nlwra.gov.au/social_economic.htm))

Indicator	Rationale for inclusion
Median age of farmers	Age statistics can help explain the likely desire of property owners / managers to remain on the property, their exposure to environmental concepts, their attitude towards stewardship and their adoption of different resource management practices.
Total family farm income	Level of income can explain potential opportunities to experiment with new sustainable management practices.
Farms with property management plans	Property management plans reflect motivation to manage more sustainably, skills in management, and access to and use of different information for management decisions.
Age dependency ratio	Provides a useful economic snapshot of the population structure/composition.
Net migration of young people	Net migration assists in understanding population changes, particularly in those beginning their careers, and those most able to be mobile and/or completing their education.

**Table 16: Socio-economic profile of the Gawler bioregion.**

Indicator Type	Gawler Bioregion
Median age of farmers	1991 – 46 years 1996 – 47 years 2001 – 50 years
Total family farm income	Not available
Farms with property management plans	Not available
Age dependency ratio	1991 – 0.49, 1996 – 0.49, 2001 – 0.48
Net migration of young Australians	1996 – -11.3%, 2001 – -15.1%
Population	20,371 in 2001 1.6% increase on 1996 4.1% increase on 1991
Age	2001, 23% pop <sup>n</sup> <15 yrs compare 26% in 1991  2001, 9% pop <sup>n</sup> >64 yrs compare 7% in 1991
% Population identifying as Indigenous	2001, 11% (compared with 2% for SA & Aust.)
Employment	2001, 3% in Agriculture & allied industries 12% in Mining 2% of population are Farmers/managers  2001, 8% unemployed
Income	2001, 37% earning a low income (<\$300/week) 23% with high income (>\$700/week)
Education	2001, 22% of population completed Year 12 11% left school by Year 8
Age of farmers (additional to median age above)	2001, 76% of farmers 40 years or older (68% in 1996)  2001, 26% of farmers 60 years or older (17% in 1996)
Income (farmers)	2001, 20% with high income (>\$700/week) (compared with 23% for regional population)  2001, 28% with low income (<\$300/week) (compared with 37% for regional population)
Education (farmers)	2001, 30% completed Year 12 13% left school by Year 8
Level of qualification	2001, 26% had certificate or higher qualification (compared with region at 28%)

## Possible implications for change

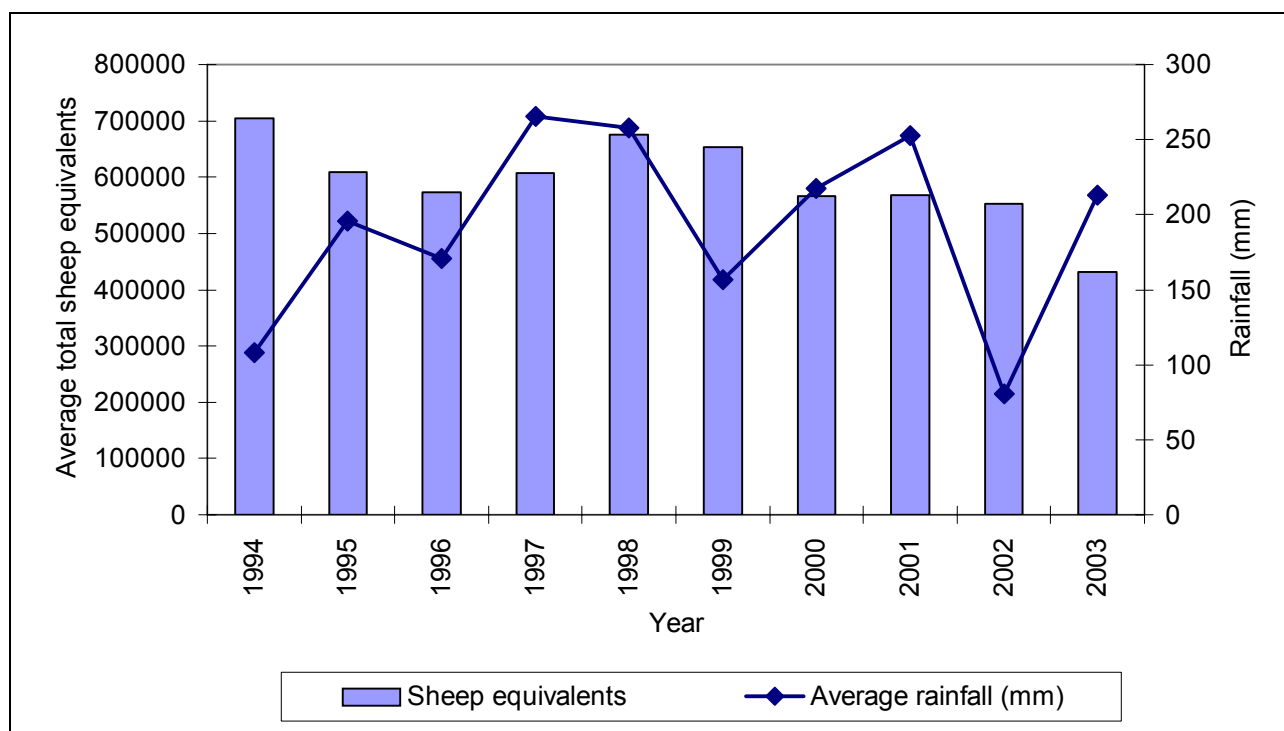
From discussion amongst ACRIS members participating in reporting on pilot regions, the results summarised in Table 16 suggest:

- Indication: Median age of 'farmers' (pastoralists) is increasing.  
May mean: Reduced capacity to change, though older producers may have lower debt burdens;
- Indication: Net emigration of young people.  
May mean: Reduced capacity to change, innovate and adopt technologies and practices that lead to improved resource management;
- Indication: Age dependency ratio is increasing (i.e. the ratio of younger and older people to working-age population).  
May mean: Regional economies probably healthier with moderate dependency, and hence more resilient to change;
- Indication: Pastoralism important income source, Mining also important.  
Meaning: Broader economic base may facilitate change; and
- Indication: Small increase in regional population.  
May mean: Where population decline is associated with limited agricultural commodities, economic growth and capacity to change are probably at greater risk. For other pilot reporting regions, those with a restricted suite of agricultural commodities tend to have a declining population.

## Domestic Stocking Estimates Across Bioregion

It is a requirement for Pastoral Lessees to submit an annual stock return under the *Pastoral Land Management Act 1989*, detailing total stock numbers carried for the year. Figure 16 shows domestic stock numbers in sheep equivalents for the Gawler and Kingoonya Soil Conservation Districts against average annual rainfall. It should be noted that a number of factors would affect stocking rates for any particular year, including fluctuating seasonal conditions, markets and commodity prices.

Figure 16 indicates no clear trends for total stock numbers for the Gawler and Kingoonya Soil Conservation Districts (pastoral administrative regions matching the bioregion) as the numbers have fluctuated between ~250,000 and ~750,000 sheep equivalents. Numbers fluctuate with seasonal conditions and commodity prices with the lowest number present in the very dry year of 2002.



**Figure 16: Total stock numbers and average yearly rainfall across the Gawler and Kingoonya Soil Conservation Districts, 1994-2003 (Source: PMIS Database, 2003).**

## Change in Pastoral Land Use

Currently no database exists which can provide information on change in the pastoral land uses of South Australia. To address this question a series of interviews were held during 2004 with Pastoral Program staff from the Department of Water, Land and Biodiversity Conservation and staff from the Land Services Division, Department of Administrative and Information Services.

Of the 97 pastoral leases that fall within the Gawler Bioregion, an 11 per cent change in pastoral land use has occurred between 1992 and 2003. Three leases have become dedicated to conservation during this time period. This includes Paney Lease and Scrubby Peak Lease, both gazetted into the Gawler Ranges National Park in January 2002. Four pastoral leases have changed their stocking breeds as part of an ongoing management strategy, while three leases have included tourism as another avenue of income over the past ten years. One pastoral lease held by the Defence Department was sub-leased for grazing, however since termination of the sub-lease grazing has not occurred (pers. comm., C. Turner, B. Lay, P. Gould, R. Norris, 2004).

## Change in Land Value

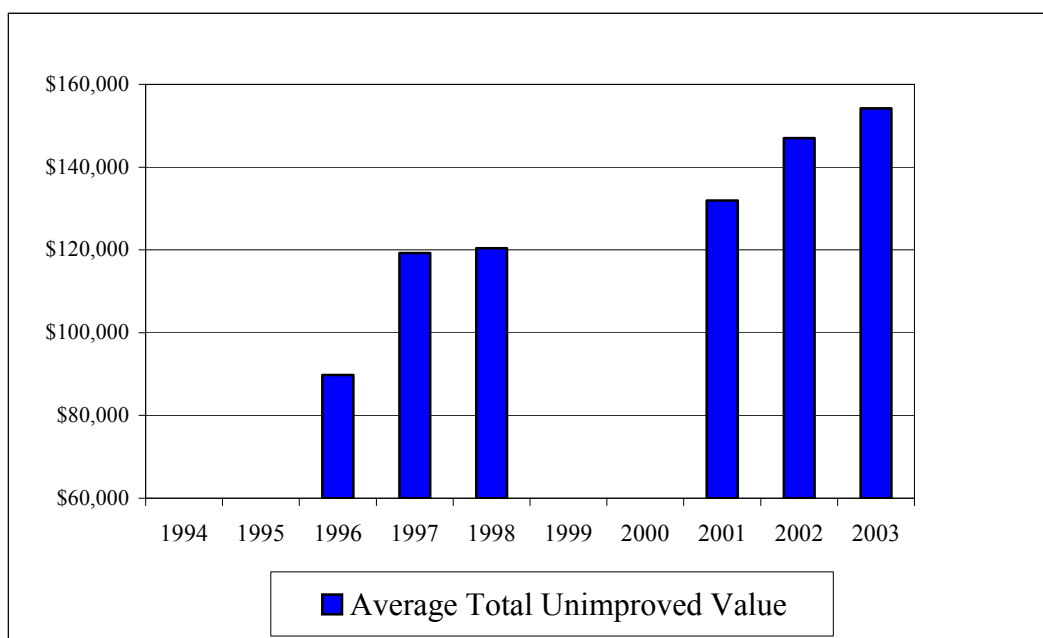
Change in 'improved value' can only be measured if a property has been purchased and then sold during the period in question. As only four leases fulfilled this criteria during the past ten years (1994-2003), this would not provide an accurate representation of change in lease values across the bioregion. Change in 'unimproved value' was therefore chosen to address this question, as each lease is usually assigned an unimproved value annually, regardless of pastoral lease turnover.

Calculation of unimproved value is carried out by the Land Services Division, Department of Administrative and Information Services, for the purpose of determining rent for the lease. A

number of factors are considered in allocating an unimproved value for a lease. To determine a figure, the valuer must:

- Analyse any pastoral lease transactions that have occurred since the last review;
- Discuss transfers with property professionals in adjoining interstate pastoral regions;
- Consult with interstate Offices of the Valuer-General; and
- Collate information in relation to pastoral pursuits and other allied pursuits, including returns on pastoral leases from associated property professionals.

Data on unimproved lease value for the Gawler and Kingoonya Soil Conservation Districts are available for only six of the past ten years. Annual data collection was not completed in 1994, 1995, 1999 or 2000. Average unimproved pastoral lease value for the remaining years in this period is shown in Figure 17. It is noted that a 58 per cent increase occurred in the unimproved value of these properties during this period. These data should be interpreted with caution however as a significant difference exists between the unimproved and improved values of a property. It cannot be assumed that the average increase in improved value would be proportional to that shown for unimproved value.



**Figure 17: Unimproved value of pastoral leases from the Gawler and Kingoonya Soil Conservation Districts, 1996–2003 (Source: Norris, Unpublished, 2004).**

## Summary of Capacity for Change

This question was designed to extend our reporting capacity beyond the biophysical domain of soil and vegetation information collected through traditional monitoring activity into the area of socio-economics. The Australian Bureau of Statistics reported on their census and other survey data. Information was also compiled on change in domestic stock numbers, land use and land values.

The ABS census data are reported by Statistical Local Area (SLA) and concordance procedures were used to minimise the effects of boundary mismatches between the Gawler Bioregion and component SLAs. It was difficult for the ABS to obtain complete geographical alignment between the bioregion boundary and component SLAs and some statistics (e.g. estimated value of



agricultural operations) are distorted by inclusion of neighbouring SLAs that have more intensive agricultural production (mainly cereal cropping). Nevertheless, the ABS data allow the Gawler region to be compared against other regions included in this pilot reporting activity (see Bastin 2005).

The Gawler Bioregion:

- Has a steadily increasing median age of “farmers” (pastoralists);
- Is losing young people. This is partly inevitable for gaining secondary and tertiary levels of education but the failure of many young people to return and gain meaningful employment in the region may reduce capacity to change, innovate and adopt technologies and practices that lead to improved resource management;
- Has an increasing age dependency ratio. This means there is a lower proportion of working-age people to support the younger and older components of the population – and is partly linked to young people moving away from the region. Regional economies are probably ‘healthier’ or more vibrant with moderate levels of age dependency – and are probably better able to cope with, or adapt to, change;
- Has a slowly increasing population – a healthy sign; and
- Pastoralism and mining are important sources of income and employment. Regions with a broader economic base and more diverse forms of employment are probably better able to adapt to and cope with change.

From data compiled by SA Government departments:

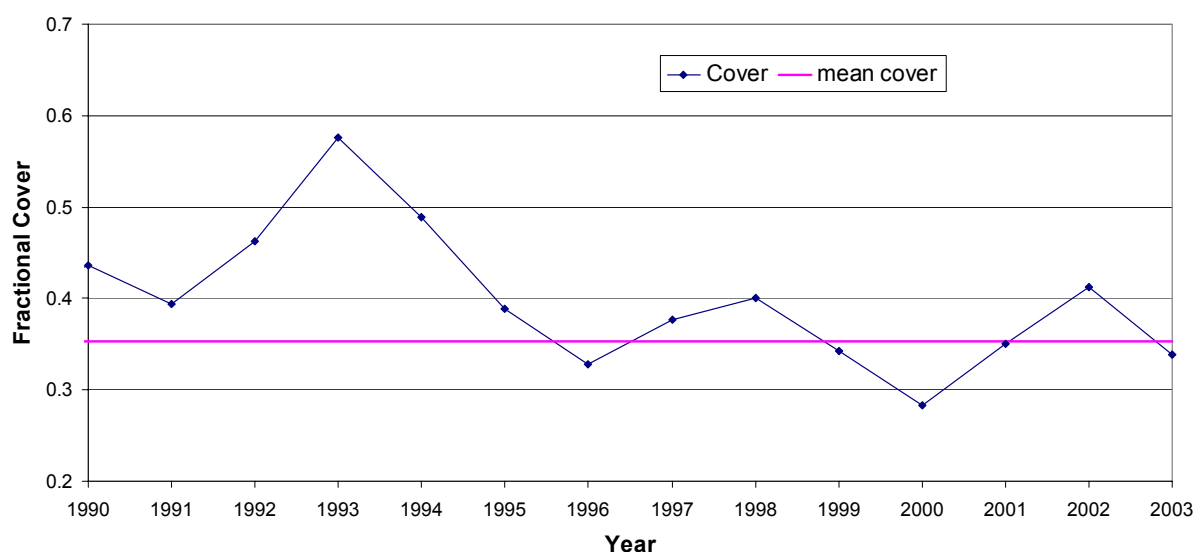
- Total stock numbers for the Gawler bioregion have fluctuated between ~250,000 and ~750,000 sheep equivalents. Stock numbers respond to seasonal conditions and commodity prices with the lowest number present in the very dry year of 2002;
- There has been an 11 per cent change in pastoral land use (across 97 leases) between 1994 and 2003; and
- There were insufficient property sales to accurately indicate change in property values (improved value) through the reporting period. Unimproved value of leases increased on average by 58 per cent (note that this does not mean that improved value has increased by the same amount).

## Change in Cover

Question	Information/data set
5. Change in cover? (i.e. as an indicator of protection against erosion, habitat value and landscape / ecosystem function)	Aussie-GRASS simulated cover  Change in cover of perennial species at pastoral monitoring sites  AGO change in forest cover

### Aussie-GRASS Simulated Cover

Simulated annual levels of ground cover for the Gawler Bioregion are shown in Figure 18. The pink line shows the long term (1890–2003) simulated cover for the bioregion. As for simulated total standing dry matter (Question 1, Figure 4), the graph does not show actual change in cover for the region. Rather, it indicates the expected (i.e. simulated) cover in each year. Additionally, because each year is presented as an average value for the bioregion, it inevitably conceals considerable spatial variation related to rainfall variability, soil differences and other parameter values used by Aussie-GRASS. However, the graph does demonstrate the considerable year-to-year variation in cover that is related mainly to rainfall.



**Figure 18: Simulated Aussie-GRASS yearly fractional cover and the long term (1890–2003) mean for the Gawler Bioregion.**

The Aussie-GRASS product indicates that:

- Simulated cover was above the long term mean between 1990 and 1995 (considerably above between 1992–94), then fluctuated about the mean from 1996 onwards;
- Placing this recent sequence in the context of the long term modelled history, cover increased sharply from a near-record low level in 1988 (fractional cover = 0.223) to a 1989

value slightly below that of 1990. The recent highest cover of 0.575 in 1993 was on a par with that modelled for 1911, 1921–1922, 1976 and 1980, and a little below the peak values of 0.648 in 1974 and 0.638 in 1975;

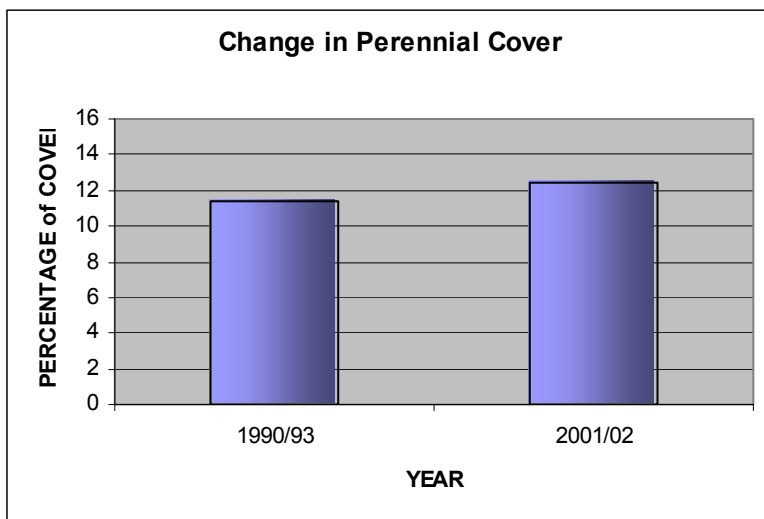
- There were extended periods of modelled cover below the long term mean between 1896–1908, 1933–46 and 1983–88; and
- Cover was well above average between 1909–1912, 1921–1923, 1973–1981 and 1992–1994.

## Cover Change at Pastoral Monitoring Sites

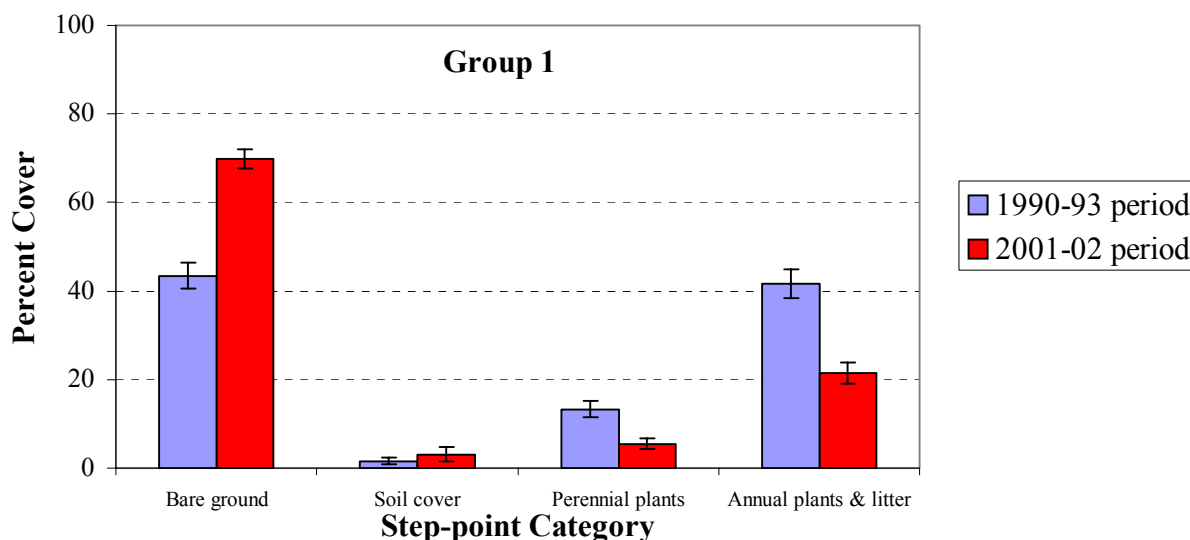
Data are presented from White and Gould's (2002) study using the step-point method.

### Measurement of foliage cover using step-point method

Foliage cover at pastoral monitoring sites within Gawler and Kingoonya Soil Conservation Districts was measured by White and Gould in their 2002 study, using a method known as 'step-point'. Data were collected by stepping through the site and taking a measurement of cover at each step. A full description of the step-point technique can be found in PIRSA (2000). For analysis purposes White and Gould allocated the measurement at each step into one of four categories: *bare only*, *cover* (including stone and lichen), *perennial shrubs and grasses*, and *annual plants and litter*. These amalgamated categories were necessary due to the high number of zeroes within the data. For the purpose of this question the perennial cover has been summarised in the graph below (Figure 19). The graph indicates there was a small (non significant) increase in perennial cover during the monitoring period. The following graph (Figure 20) shows how the 'Acacia aneura Open Woodland over Perennial and Annual Grasses' vegetation type (Group 1) had a significant decrease in perennial cover over the reporting period. There were small changes in perennial cover for other vegetation groups (both increase and decrease) but these were non-significant. Results for these groups are shown in Appendix 7.



**Figure 19: Comparison of perennial cover from 1990–1993 to 2001–2002.**



**Figure 20: Comparison of step-point cover estimates for Group 1: *Acacia aneura* Open Woodland over Perennial and Annual Grasses sites in the Gawler and Kingoonya Soil Conservation Districts.**

In the context of seasonal influences on the change in perennial cover, each site was included into the seasonal matrix below in Tables 17 (number of sites) and 18 (percentage of sites). For a site to decline in trend or improve in trend a change of greater than 10 per cent of perennial cover had to occur at the site.

**Table 17: Number of sites where perennial ground cover declined, remained stable or improved with change in seasonal conditions.**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average (2001)	104	8	92	4
Below average (2002)	75	3	65	7

<sup>1</sup> A tolerance of +/-10 per cent total cover indicates "no change".

**Table 18: Number of sites where perennial ground cover declined, remained stable or improved with change in seasonal conditions.**

Seasonal conditions	No Sites	Decline	No Change <sup>1</sup>	Improvement
Above average	n/a			
Average (2001)	104	8%	88%	4%
Below average (2002)	75	4%	87%	9%

<sup>1</sup> A tolerance of +/-10 per cent total cover indicates "no change".

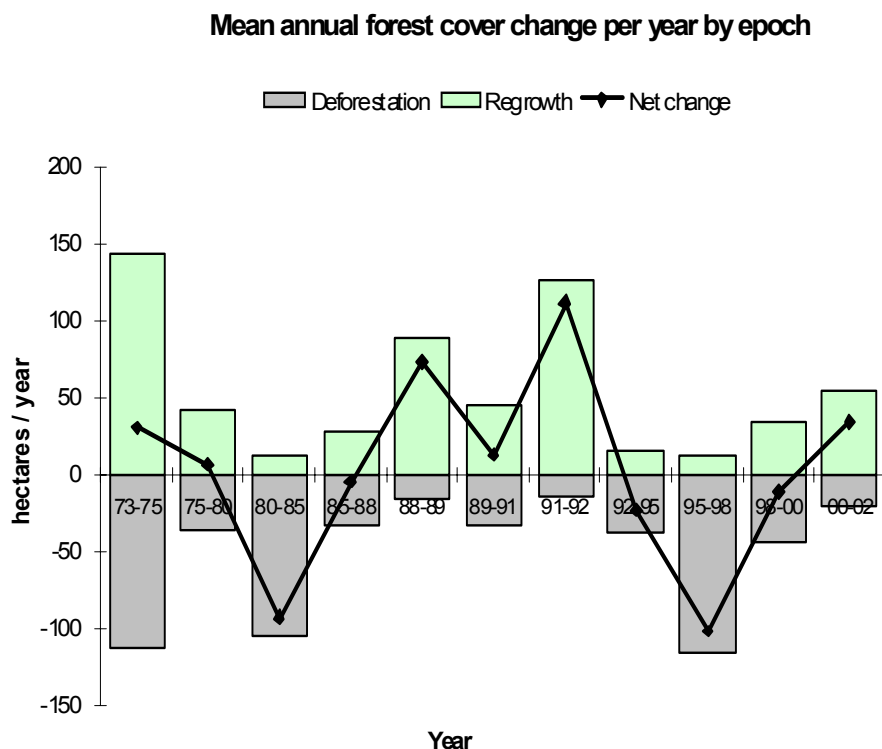
Table 18 indicates that the majority of sites during the 2001 (88 per cent) and 2002 (87 per cent) remonitoring periods showed no change in perennial cover. Interestingly 2002 was a drier year than 2001 and nine per cent of sites showed improvement in perennial cover. However in 2001 which was a wetter year, eight per cent of sites declined in perennial cover.

## AGO Forest Cover

The Australian Greenhouse Office (AGO) has mapped change in forest cover across Australia using 25 and 50 m resolution Landsat imagery spanning the period 1973 to 2002. 'Forest' is defined as vegetation with 'a potential to reach a minimum 20 per cent canopy cover, 2 metres in height and minimum area of 0.2 hectares' (see Department of the Environment and Heritage 2004 for more detail). Using the AGO methods, a little more than 10 per cent of the Gawler bioregion is forest (Figure 22).

Change in forest cover has been calculated over 11 epochs (corresponding with Landsat image dates) measured through 10 transition periods between 1973 and 2002. These transitions vary between 1.21 and 4.96 years (see Department of the Environment and Heritage 2004 for detail on analysis procedures). The AGO methods use a range of filters to limit mapped change to that caused by human activity (clearing and reforestation) and to the extent possible, excludes artefacts such as forest fires and tenures where forests are protected.

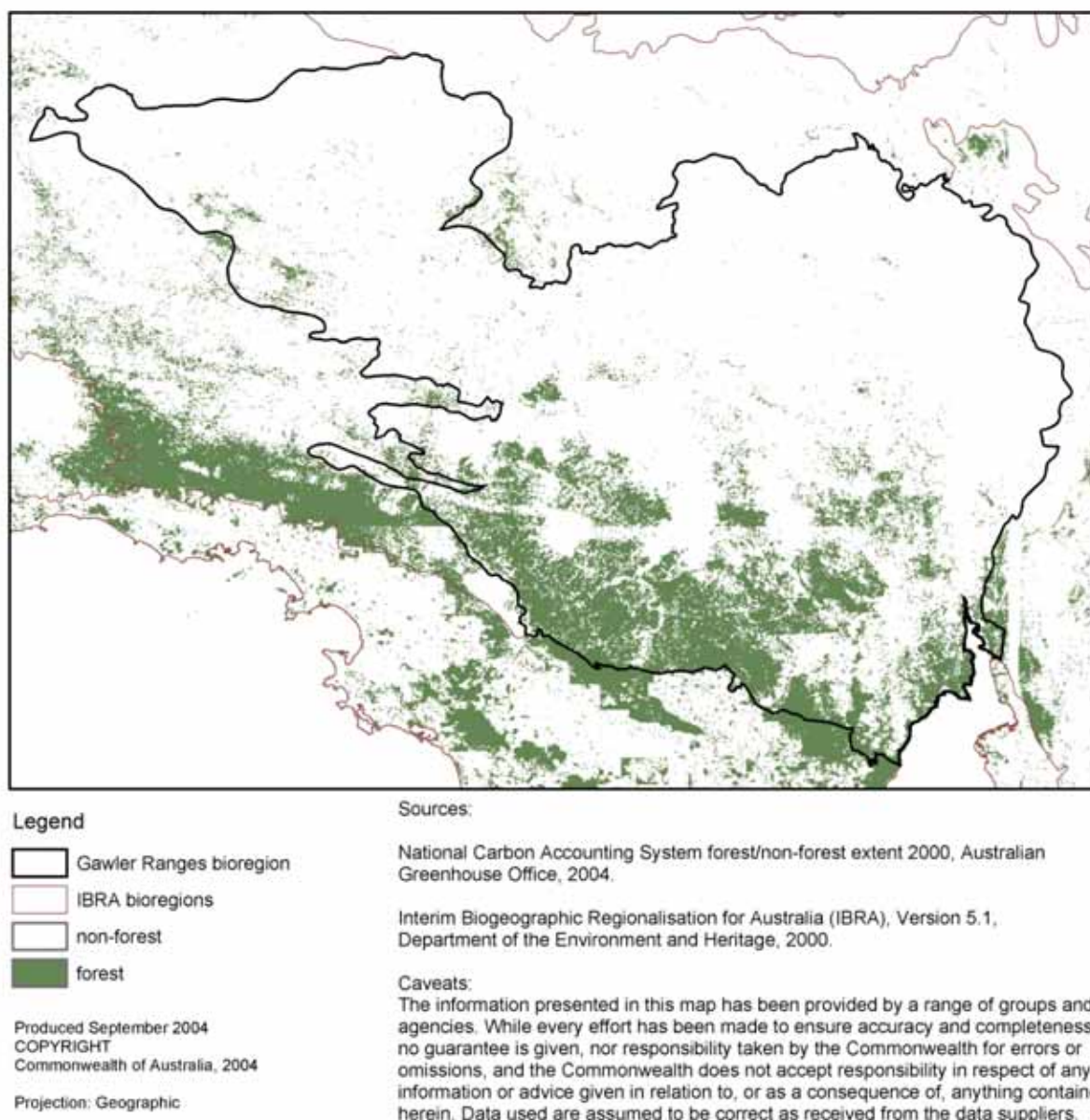
ERIN (part of the Australian Government Department of Environment and Heritage) analysed the AGO data for the Gawler Bioregion (Figure 21).



**Figure 21: Average yearly net change in forest cover within each epoch for the Gawler Bioregion.**

To correctly interpret trends over time ERIN have normalised the data to a per-annum estimate, by dividing the net epoch change by the duration of the epoch. Results are then expressed as average annual change for the epoch. Deforestation is defined as the loss of forest between measurements so that within each epoch a given area of land is not cleared or re-forested more than once. Note also that deforestation and regrowth can occur multiple times on any one piece of land during the period 1973 to 2002. According to ERIN, the sum of clearing/regrowth over all epochs does not give a true estimate of net change over all epochs.

According to ERIN analysis of the AGO data, forests covered 11.3 per cent of the Gawler Bioregion in 1972 (forest area = 13,920 km<sup>2</sup>). Forest cover decreased to 11 per cent of the region in 2000 (i.e. 13,556 km<sup>2</sup>, forest cover shown in Figure 22). Over this time there were relatively small areas of deforestation or regrowth in the region (shown in Figure 21, previous page).



**Figure 22: Forest extent in the Gawler Bioregion and surrounds in 2000.**

## Summary of Change in Cover

Information on cover change in the Gawler Bioregion was compiled from step-point measurements at pastoral monitoring sites, Aussie-GRASS simulation and Landsat-derived change in forest cover.

There was a small (statistically non-significant) increase in the mean cover of perennial species averaged across 179 monitoring sites. Within vegetation types, perennial cover decreased in the mulga–open woodland group of sites. Elsewhere, there was a significant increase in bare ground and a decrease in annuals and litter at 5 (of 11) vegetation groups. These changes were related mainly to seasonal variation. At individual sites, cover remained the same or improved at 96 per cent of sites assessed following below average seasonal conditions (in 2002). Ninety two per cent of sites had similar or improved cover after an average season (2001).

Cover levels simulated by Aussie-GRASS were above the long term (1890-2003) mean between 1990 and 1995, and considerably above the mean between 1992 and 1994. Cover then fluctuated about the mean from 1996 onwards.

Based on the Australian Greenhouse Office's definition of forest, forests covered 11.3 per cent of the Gawler Bioregion in 1972 decreasing to 11 per cent in 2000. This corresponds with a decline in forest area of 364 km<sup>2</sup>.



## Long Term Change with Photos

The present state-wide system of permanent photopoints was initiated in the Gawler Bioregion by Brendan Lay as a graduate student in 1970. These sites were generally established to investigate the ecological processes of growth, regeneration and senescence for both individuals and groups of selected vegetation. The selected photo comparisons in this report also show historical photographs taken by Pastoral Inspectors dating from 1955, and recent Pastoral Lease Assessment re-visit photographs.

The photographic sequence shown by Photos 1 and 2 spans a nine-year period (White and Gould, 2002). It illustrates an open chenopod shrubland dominated by *Maireana sedifolia* and *Atriplex vesicaria* with a sparse overstorey of *Acacia papyrocarpa*, a characteristic vegetation community for the southern area of the Gawler Bioregion. After analysis, *Atriplex vesicaria* showed a statistically significant increase in shrub density across three of the twelve vegetation groups monitored.



**Photo 1: Photopoint 3505. Corunna Pastoral Lease Assessment, 1992.**



**Photo 2: Photopoint 3505. Gawler Bioregion Vegetation Monitoring, 2001.**



The photographic sequence in Photos 3 and 4 was taken on Bon Bon station over a 33 year period. Three major changes are evident. The pronounced sheep-grazing browse-line seen in 1970 on the tall shrub *Acacia tarcuensis* had disappeared by 2003. Presumably for the same reason, the previously bare foreground has been colonised by the palatable perennial bushes *Atriplex vesicaria* and *Maireana astrotricha*. Less obviously, a fire in 1975 has destroyed most of the copse of *Acacia aneura* visible in the right side of the second photograph's background.



**Photo 3: Photopoint 14, Bon Bon Station, 1973.**



**Photo 4: Photopoint 14, Bon Bon Station, 2003.**

Photos 5 and 6 illustrate the recruitment of less palatable shrubs, particularly *Eremophila rotundifolia*, over a 17 year period following continued moderate grazing pressure. This change has been observed across northern areas of the bioregion (pers comm., B. Lay, Pastoral Program, Department of Water, Land and Biodiversity Conservation, SA).



**Photo 5: Photopoint 2534, Bon Bon Station, 1986.**



**Photo 6: Photopoint 2534, Bon Bon Station, 2003.**

Photo 7 is an early photograph taken in 1955 along a disused water-run on Yardea Station in the southern area of the bioregion. This photopoint was dominated by *Maireana sedifolia* which had reduced in density due to the high grazing pressure. Bare sandy ground is visible in the foreground, and in the background a stand of *Alectryon oleifolium* is visible with a clear browse-line.



**Photo 7: Photopoint 3955, Yardea Station, 1955.**

By contrast, the photograph taken during the Pastoral Lease Assessment in 1992 shows significant colonisation by *Atriplex stipitata* and *Atriplex vesicaria*, with some increase in *Maireana sedifolia* (Photo 8). A dramatic increase in abundance of *Acacia tarculensis* is evident on the rhyolite hill in the background, possibly as a result of reduced fire frequency (pers comm., B. Lay, Pastoral Program, DWLBC).



**Photo 8: Photopoint 3955, Yardea Station, 1992**



The photo-comparison in Photos 9 and 10 demonstrates the recovery of *Acacia aneura* woodlands after the severe fires which occurred during the period 1974–1975. The first photograph, taken about 10 years after the fires, shows the *Acacia aneura* woodland with little regeneration of any perennials, apart from some regrowth of *Eragrostis eriopoda*. The second photo, taken in 2003, shows extensive recruitment of *Senna artemisioides* ssp. *petiolaris*, with some regeneration of *Acacia aneura* evident.



**Photo 9: Photopoint 2314, Bon Bon Station, 1986.**



**Photo 10: Photopoint 2314, Bon Bon Station, 2003.**

## **Concluding Remarks**

This concluding section provides comment on the perceived benefit to the SA government, and more particularly, the Pastoral Program of the Department of Water, Land and Biodiversity Conservation, from having participated in this pilot reporting activity of ACRIS. From there, I offer comment on SAs ability to contribute to expanded reporting of change in the rangelands.

## **Perceived Benefits from Reporting on the Gawler Bioregion**

Benefits of both a technical and institutional nature are considered to have accrued. The Pastoral Program has also benefited through the opportunity to publicise results of its monitoring activity in the Gawler bioregion.

### **Technical issues**

The Pastoral Program has laboured for some time with inefficiencies in its Pastoral Monitoring Information System (PMIS) database. System deficiencies have slowed the retrieval, collation and analysis of monitoring data for both routine and more specialised reporting. Data management issues associated with this reporting exercise for the Gawler Bioregion have partly contributed to current work to significantly improve the database. The outcomes of this work should be a consolidated database holding high-quality information with the Pastoral Program having improved capacity to efficiently retrieve and analyse data for future reporting. The linkage between textual (database) and spatial (or geographic, i.e. GIS) information has also been considerably improved.

Prior seasonal conditions (mainly the amount and timing of rainfall) profoundly affect vegetation change. Lack of suitable methods for effectively partitioning seasonal effects from those due to grazing have in the past reduced our ability to confidently report on the sustainability of grazing management using monitoring data. The matrix of seasonal quality by direction of change at sites demonstrated in this report now offers a partial solution to that problem. The results presented for the various biophysically-related questions show how trends counter to the direction of expected seasonal change can be simply identified. Although this method does not prove that grazing is the cause of unexpected change, it is intuitively sensible that grazing will be implicated.

The results of this matrix-analysis approach (using Gawler Bioregion data) have now been discussed at a number of meetings with a generally enthusiastic response being received for its continued (and refined) use. Presentations have been made:

- 'In house' to staff of the Pastoral Program;
- At two meetings between the Pastoral Board and pastoralists in the Kingoonya and Gawler Soil Board Districts;
- To Department of Environment and Heritage staff concerning development of a monitoring program for Chowilla Regional Reserve; and
- To the Rangelands INRM Group for incorporating into future monitoring programs across the South Australian rangelands.

It is likely that the matrix approach for reporting change will become a standard product within the Pastoral Program.

### **Institutional issues**

Procedures developed, and experience gained, from reporting change in the Gawler Bioregion should assist the Pastoral Program with its continued reporting of change in the rangelands to pastoral lessees, the Pastoral Board and to other groups, including ACRIS. Reporting ability for the Gawler Bioregion was assisted because the questions framed by the ACRIS Management

Committee provided clarity and focus in assembling and analysing relevant data to address specific issues. This reporting exercise has demonstrated that although suitable data are often scarce, available data are sometimes quite versatile. For example, I was able to use pastoral monitoring data to report change in both stock forage based on perennial **decreaser** species and change in native plant species based on **all** perennial species. Experience gained here may allow the Pastoral Program to report a little more broadly from its database in the future. There are also now expanded possibilities for comparing available data to determine change across regions (e.g. Soil Boards) within SA and for comparing bioregions or other broadly similar land-type groupings across jurisdictional boundaries.

The reporting exercise has also demonstrated that we have some ingenuity in identifying and adapting data to issues where suitable data are not immediately available. Examples here are the different data assembled to answer questions about biodiversity (Question 2, change in native plant species) and socio-economics (Question 4, capacity for change).

The national synthesis built from the reports compiled for the five pilot regions (see Bastin 2005) allows the utility of the various jurisdictional monitoring programs to be compared. Comments by Bastin (2005) suggest that the Western Australian Rangeland Monitoring System (WARMS, Watson et al. 2005) probably provides the most systematic, robust and quantitative monitoring data for answering the biophysical questions set by the ACRIS Management Committee. The South Australian Pastoral Monitoring System has some similarities with WARMS (as it was to a degree based on that system). That allowed some of the Gawler results to be directly compared with those reported by Watson et al. (2005) for the Gascoyne Murchison region (see Bastin's 2005 national synthesis for these regional comparisons). The robustness of our monitoring program would be increased by including formal assessment of landscape function, on at least a selection of photopoint sites.

In comparing the performance of monitoring programs, it must be remembered that each jurisdictional monitoring system serves particular purposes and direct comparison of methods may not always be valid or helpful. (For example, the SA and NT systems underpin pastoral lease administration, the New South Wales system advises pastoralists about their grazing management, WARMS reports to the WA Pastoral Land Board and Government about trend of pastoral leases and Queensland currently does not have an operational public-domain ground-based monitoring system for its rangelands.) However it is important that we periodically review the effectiveness of our pastoral monitoring system to ensure that it continues to provide suitably rigorous data and information for reporting on how pastoral leases are managed.

## **Public relations**

South Australia's involvement in ACRIS has facilitated reporting of change in the condition of the rangelands of the Gawler Bioregion. The nature and extent of these changes have been communicated to local pastoralists and the Pastoral Board through presentations at meetings as described above. Changes reported for this bioregion have also been compared against that occurring in the other pilot regions in a national synthesis (Bastin 2005). The summarised version of national-level change is highlighted in the brochure "ACRIS Reporting Change in the Rangelands" produced by the ACRIS Management Committee.

In summary, I consider that our participation in this pilot reporting activity has provided:

- Expanded scope for the Pastoral Program to report with its monitoring data. Both the Pastoral Program and the Pastoral Board now should have increased ability to report beyond leases to the bioregional level, and to better make inter-regional comparisons. This provides expanded scope and confidence in reporting to government and the wider community on how the various rangeland regions are being managed;
- Evidence to pastoralists that changes detected through monitoring that relate to their grazing practices and lease management can be reported at regional and larger scales. Where these results are generally favourable, this reporting should support their claims to

the wider public for continued grazing use as good stewards of the rangelands. Such reporting may also assist future access to some markets where environmental credentials must be satisfied; and

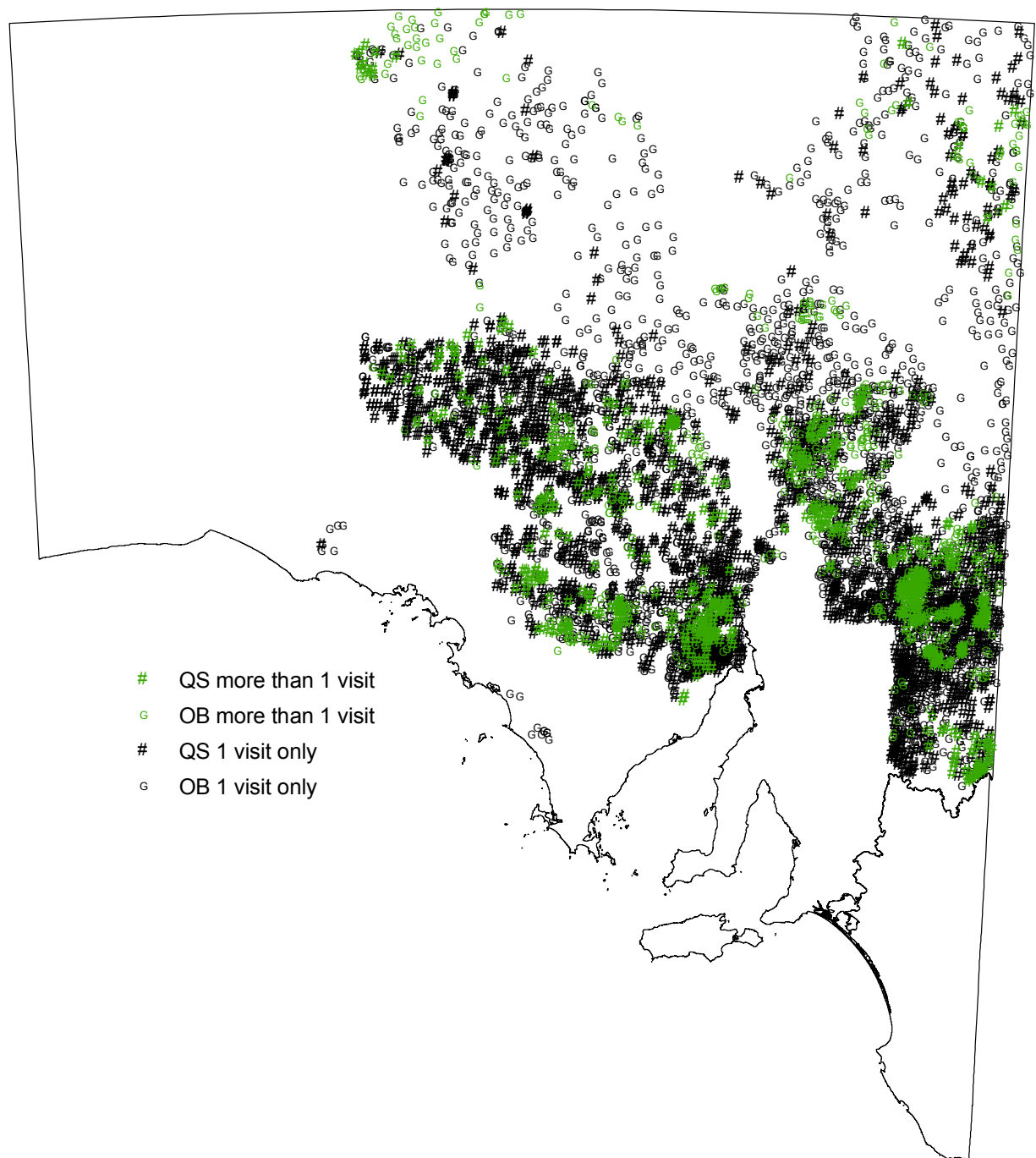
- Increased awareness by other agencies and stakeholders in the rangelands of the possibilities and potential for monitoring and reporting. These include monitoring programs in aboriginal managed lands, arid-land Parks and Regional Reserves managed by the Department of Environment and Heritage.

## Potential for Expanded Reporting

The preceding generally enthusiastic statements are tempered by our present limited ability to report change over larger areas. The Gawler Bioregion was selected as the pilot reporting region because it currently has some of the best pastoral monitoring data in SA (Figure 23). As reported earlier, comprehensive monitoring commenced in the Kingoonya and Gawler Ranges Soil Board districts in the early 1990s and funding available in year 5 of the first National Land and Water Resources Audit provided resources for the repeat assessment of the 179 sites reported here (i.e. these sites resurveyed in 2001 and 2002).

The second complete round of lease assessments is about to commence with the Kingoonya and Gawler Ranges Soil Boards scheduled as the first regions to be reassessed. This will provide the third assessment for those sites surveyed in 1992 and 2002, and the second assessment for the remainder. Thereafter, it is expected that reassessments will proceed systematically across other Soil Boards (Figure 24) although the timetable for completing all assessments is not yet established (Table 19). Presently, the majority of sites have been assessed once meaning that it is not possible to report change based on these sites until a second assessment is made. Although Figure 23 suggests that much of South Australia's pastoral country outside of the Gawler Bioregion has only one assessment at this time, there are small areas with multiple assessments. These include National Parks (e.g. Flinders Ranges and Gammon Ranges), regional reserves (e.g. Innamincka, Chowilla) and the Roxby Downs area through monitoring by Western Mining Corporation. There is also some prospect of grazing gradient analysis being repeated and expanded in parts of the northern rangelands through other projects that the Pastoral Program is engaged in. Because this method uses historical Landsat data, the response of vegetation cover to good rainfall over a number of wet periods can be determined in the one analysis making it feasible to report change retrospectively.

Figure 23 shows that there are two broad types of assessment site – either collection of quantitative data or observation. Quantitative data includes recording perennial density in Jessup transects and step pointing of cover in the southern sheep-grazed rangelands, and grazing gradient analysis in the northern cattle-grazed areas. Observations include collection of a species list and estimating crown separation ratios, scoring erosion if present and assigning a condition score. Obviously quantitative (measured) data are more robust for reporting change than qualitative (estimated) data.

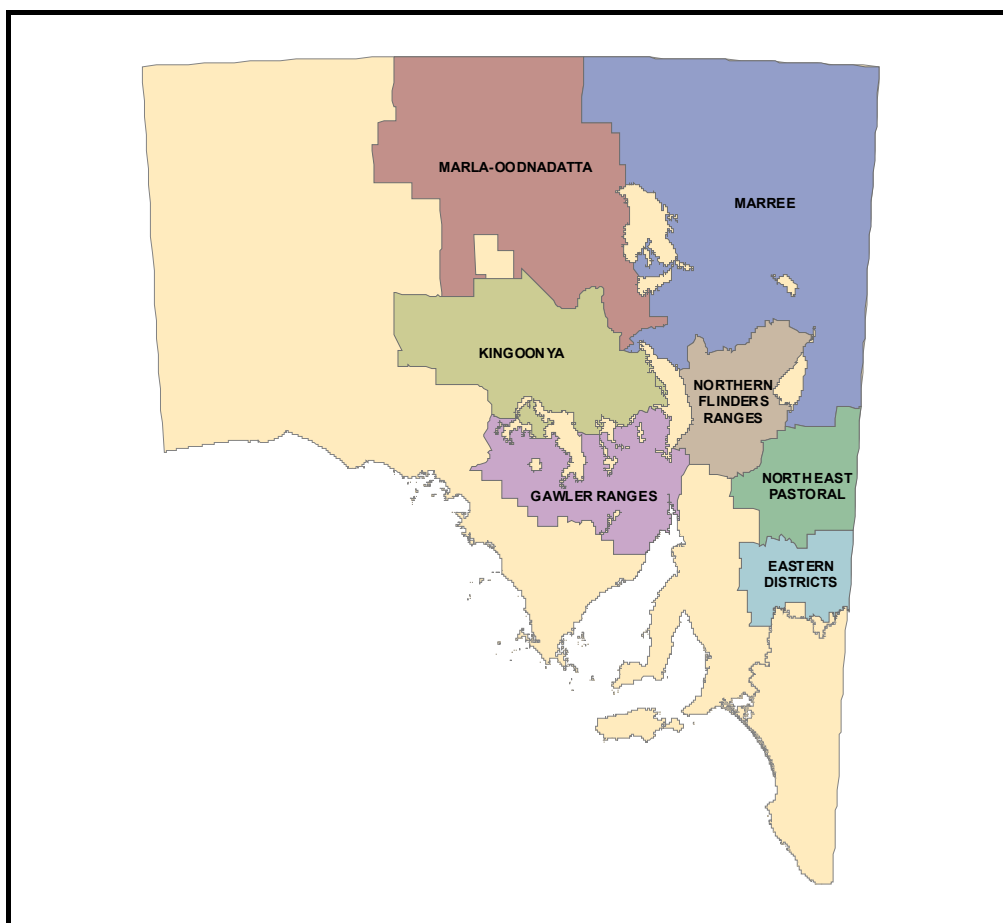


**Figure 23: Types of pastoral monitoring sites showing those that have one visit only and those with more than one visit.**

QS – quantitative data collected.

OB – observations made.





**Figure 24: Soil Board Districts in the pastoral area of South Australia.**

**Table 19: Planned program of pastoral lease re-assessments by Soil Board District.**

Year of re-assessment	Soil Board District
2005	Kingoonya
2006	Kingoonya/Gawler Ranges
2007	Gawler Ranges
2008	Northern Flinders Ranges
2009–2015	Soil Board Districts still to be allocated

### Further reporting by ACRIS

The ACRIS Management Committee has agreed that it will now work towards reporting, by mid 2007, change in the entire rangelands under several broad themes. Successful and comprehensive reporting can only occur with the active involvement of ACRIS partners in the rangeland states and NT because it is they who hold much of the data.

The reporting themes, and likely products, include:

- Indicators of landscape or ecosystem change.

Reporting products to be based on monitoring data describing change in landscape function by formal landscape function analysis or appropriate alternative indices, vegetation cover, plant density and frequency, etc. In some jurisdictions, repeat regional resource condition assessments will complement site-based monitoring data.

Data collected at pastoral monitoring sites are best placed to provide information for this theme in South Australia. We do not collect formal landscape function data but have shown how the Richards/Green Functionality Index can indicate change in landscape function;

- Indicators of sustainable management.

Data from pastoral monitoring programs and other sources will be collated and analysed to report change in longer-term forage quality and availability. Contributions to a national photographic sequence will also illustrate change. Although more difficult to obtain comprehensive and accurate data, ACRIS would like to report change in components of total grazing pressure. ACRIS also plans to report changes in the extent, frequency and timing of larger fires.

Pastoral monitoring data will provide the primary data source for reporting in South Australia, subject to the limitations described above. South Australia will also contribute to the national photographic sequence. We should be able to contribute information on total grazing pressure based on livestock returns, kangaroo survey counts and knowledge of feral animal numbers for some regions (e.g. goats and camels);

- Indicators of biodiversity change.

The current lack of systematic monitoring data prevents comprehensive reporting of change in biodiversity. ACRIS will use landcover change, particularly from satellite data, and ground sources as available (e.g. species diversity, richness, vegetation condition) to report aspects of change. It will also pick up on the results of repeat biological surveys where they exist.

Again, there is some potential for the pastoral monitoring program to contribute information here for South Australia, particularly where step pointing is conducted and from grazing gradient analysis. We can also contribute through the Program's considerable investment into the comprehensive analysis of waterpoint distribution and watered area;

- Indicators of sustainable water management.

Water resource issues are currently high on the national agenda and the ACRIS Management Committee considers that water management in the rangelands should be part of that larger agenda. The Management Committee considers that ACRIS has a more specialised role in reporting change in distribution of waterpoints over time.

As for change in biodiversity, the waterpoint distribution work will contribute valuable information for South Australia; and

- Indicators of social and economic change.

As for biodiversity, ACRIS currently has limited capacity to report change in the social and economic well-being of the rangelands. Early reporting products will include attributes of sustainable management derived from changes in land values, land use, tenure, etc.

This report on the Gawler Bioregion demonstrates how South Australia can provide some information for this theme by way of change in land use, tenure and lease value, and change in stock numbers.

Finally, indicators of climate variability will provide important context in interpreting data based around the preceding indicators. Based on experience gained from this pilot reporting activity, ACRIS expects that useful data and/or products will include regional rainfall histories, Aussie-GRASS simulations of pasture biomass and vegetation cover, and satellite-derived images of seasonal quality.

## **Acknowledgements**

I thank Amanda Brook for her considerable assistance with GIS and database issues in compiling this report. I also thank Nick Neagle for information provided about biodiversity. Robin Norris provided the land value data for the section on “capacity for change”. Hafiz Stewart gave valuable advice on analysis of the Jessup and step-point data following collection of the 2001-02 data.

Finally, I thank John Chappel and Brendan Lay for their advice, guidance and support in compiling this report for ACRIS. Gary Bastin provided valuable assistance in completing the report.

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## **Appendix 1: Environmental Resources Information Network ERIN Images of Seasonal Quality**

The Environmental Resources Information Network (ERIN) products, based on the normalised difference vegetation index (NDVI) derived from satellite imagery, were proposed as contextual information to help interpret change measured on the ground. Yearly images are available for all of the rangelands. Data processed by ERIN were acquired by the Advanced Very High Resolution Radiometer (AVHRR) on-board the NOAA series of satellites. The ERIN seasonal quality images are described in *Rangelands – Tracking Changes* (Product 7, pp 64–7 and further information can be found at

<[http://audit.ea.gov.au/ANRA/rangelands/rangelands\\_frame.cfm?region\\_type=AUS&region\\_code=AUS&info=impact](http://audit.ea.gov.au/ANRA/rangelands/rangelands_frame.cfm?region_type=AUS&region_code=AUS&info=impact)>).

### **Source Data**

Yearly images of seasonal quality for the period 1992 to 2003 were provided by ERIN. An example image can be seen at <<http://www.deh.gov.au/erin/ndvi/images/seasqual/pdfrl02c.html>>.

A description of the seasonal quality image product is available at <<http://www.deh.gov.au/erin/ndvi/images/seasqual/pdfrl02c.html>> and is reproduced below:

### **Seasonal quality analysis**

“The hypothesis behind these analyses is that there is an increase in photosynthetic activity, or ‘greenness’, over the growing season”. The magnitude of this increase is an indicator of quality of the season.

The NDVI flush for each pixel is compared temporally to give relative ratings of the quality of the season. These ratings are then displayed as images to give pictures of the variation in season quality across the landscape.

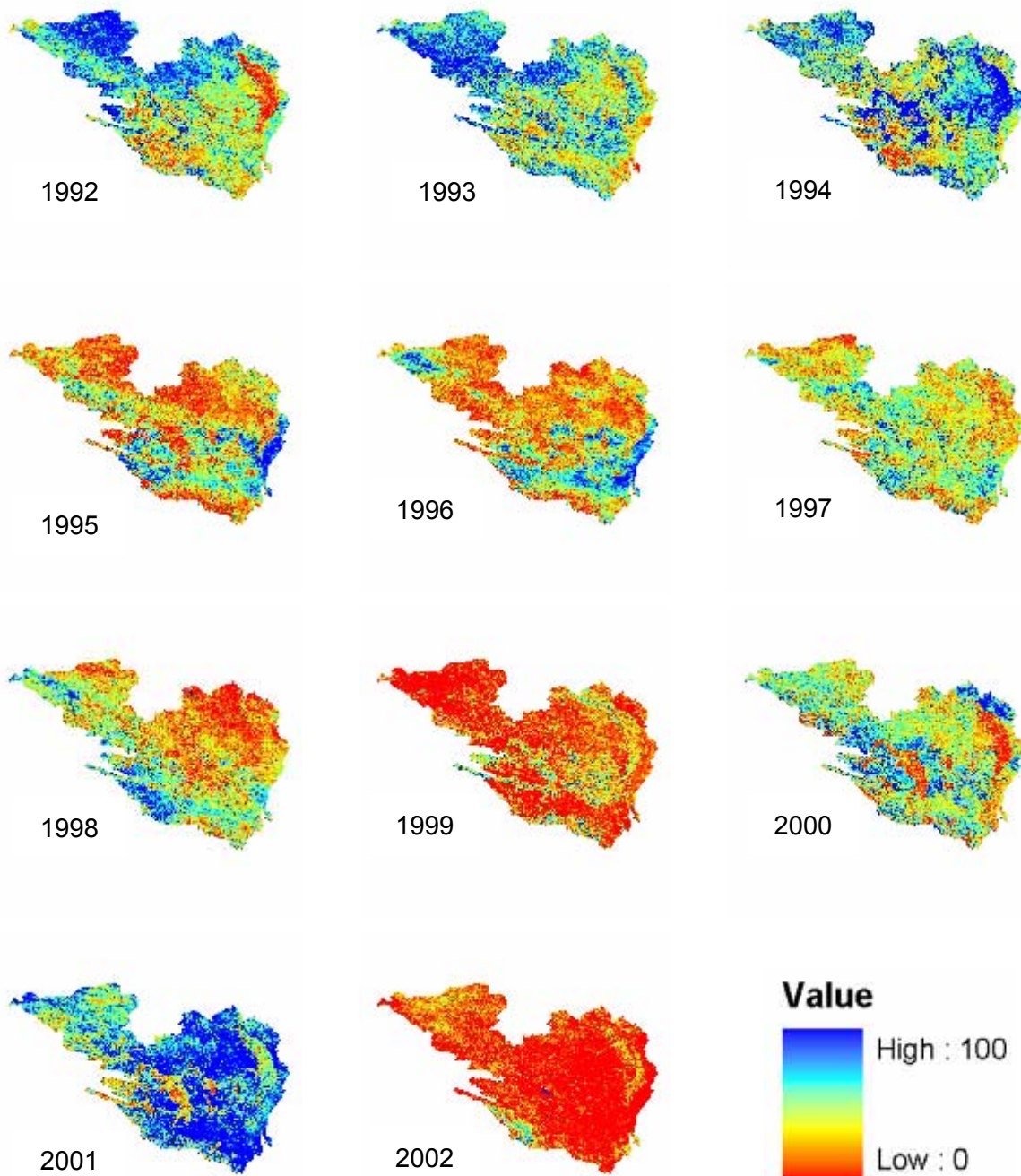
The flush this year (so far) can be expressed as a percentage of the flush range (where 0% is equal to the minimum flush and 100% is equal to the maximum flush). This relative, or scaled, percentage is then able to highlight areas that are yet to reach their previous minimum growth, as well as where they have exceeded the previous range. The analysis of past years is the same, but the new extents have been accounted for, so nothing is beyond the range limits.

Long-term products (Trend): The images are then analysed to produce across-season information.”

(Extracted from <<http://www.deh.gov.au/erin/ndvi/images/seasqual/pdfrl02c.html>>)

### **Yearly Images of Seasonal Quality**

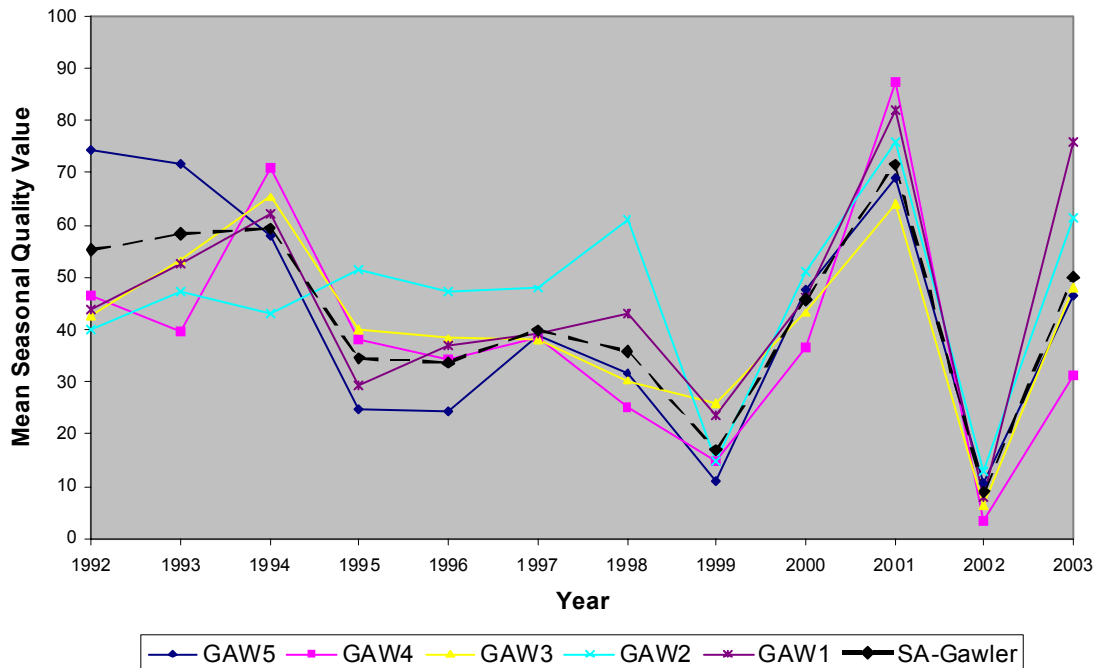
Seasonal quality images for the Gawler Bioregion obtained from ERIN can be seen in Figure 25. These images show considerable variation in seasonal quality (as defined by ERIN) across the region within particular years (e.g. 1992, 1994, and 2000) and between years (e.g. compare 2001 with 2002). In this sense, these images typify the climatic variability of the rangelands:



**Figure 25: Yearly seasonal quality images of the Gawler Bioregion based on NDVI and derived from NOAA AVHRR imagery**

Average seasonal quality (scaled between 0 = low and 100 = high) is shown in Figure 26. These values are shown for each sub IBRA (Interim Biogeographic Regionalisation for Australia) and the whole bioregion. A brief description of each sub IBRA, and its area, is provided in Table 20.





**Figure 26: Mean annual seasonal quality value by sub (IBRA), and the mean for the entire Gawler Bioregion.**

**Table 20: Area of sub IBRAs in the Gawler Bioregion reporting area.**

(Note: these areas are approximate because of the geographic projection used. Each pixel is 0.01 decimal degrees which is ~1.12 km.)

sub IBRA	Name	Area (km <sup>2</sup> )
GAW1	Myall Plains	11813
GAW2	Gawler Volcanics	21543
GAW3	Gawler Lakes	40937
GAW4	Arcoona Plateau	14155
GAW5	Kingoonya	58407
Total		146855

The main features from Figures 25 and 26 are:

- Based on NDVI-derived images of seasonal quality, seasonal conditions appear to have been “fairly ordinary” (poor to moderate) across much of the Gawler Bioregion from 1995 to 1999;
- Seasonal quality then improved during 2000 and 2001 – reaching maximum values in 2001;
- Seasonal quality deteriorated markedly in 2002 to reach the lowest values recorded (slightly worse for most sub IBRAs than in 1999);
- Seasonal conditions (as indicated by NDVI seasonal quality) then improved in 2003 – but in a variable manner. The GAW1 (Myall Plains) sub IBRA experienced strong improvement. The extent of seasonal recovery was slightly less for GAW2 (Gawler Volcanics) and markedly less for GAW4 (Arcoona Plateau); and

- There was some variation about the overall mean response (average for entire Gawler Bioregion) in the early and mid 1990s.

The GAW2 (Gawler Volcanics) sub IBRA had fairly uniform annual seasonal quality values between 1992 and 1997. From 1995 to 1997, this value was slightly higher (better) than for other sub IBRAs, and considerably higher in 1998.

GAW5 (Kingoonya) sub IBRA had considerably higher values (better seasonal conditions) in 1992 and 1995.

Apart from these particular sub-regional levels of variation, most sub IBRAs (apart from GAW2) had similar yearly seasonal quality values between 1994 and 2002.

## Appendix 2: Flora and Fauna Species Recorded in the Gawler Bioregion

### Plants

Source: Neagle (2003)

Taxonomy follows the Department of the Environment and Heritage Flora Taxonomic database as at December, 2002.

Species: This species list has been collated from the sources listed below. Unfortunately it has not been possible to include species records from the DEH Plant Biodiversity Centre as these are not readily available. In the absence of this data the following list, whilst the most comprehensive available, is an incomplete record of the vascular plant species to be found in this Bioregion.

\* = exotic species.

Source: SU = Survey database (DEH); OP = Opportunistic Sightings database (DEH); PP = Plant Population database (DEH); RE = Reserves database (DEH); PM = Pastoral Management Information System database (DWLBC).

Ratings: Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9).

E = endangered; V = vulnerable; R = rare.

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Abutilon cryptopetalum</i>	Hill Lantern-bush		1			1	1		
<i>Abutilon fraseri</i> ssp.		unconfirmed	1	1			1		
<i>Abutilon halophilum</i>	Plains Lantern-bush		1				1		
<i>Abutilon leucopetalum</i>	Desert Lantern-bush		1	1		1	1		
<i>Abutilon macrum</i>	Slender Lantern-bush	unconfirmed				1	1		
<i>Abutilon malvaefolium</i>	Scrambling Lantern-bush	unconfirmed	1						
<i>Abutilon otocarpum</i>	Desert Lantern-bush		1			1	1		
<i>Abutilon oxycarpum</i> var.	Straggly Lantern-bush	could be 1 of 2 var.				1	1		
<i>Abutilon oxycarpum</i> var. <i>oxycarpum</i>	Straggly Lantern-bush		1						
<i>Acacia acanthoclada</i>	Harrow Wattle					1			
<i>Acacia ancistrophylla</i> var. <i>lissophylla</i>	Hook-leaf Wattle		1			1	1		
<i>Acacia aneura</i> complex	Mulga		1			1	1		
<i>Acacia aneura</i> var. <i>aneura</i>	Mulga		1	1		1			
<i>Acacia ayersiana</i> var.	Broad-leaf Mulga	could be 1 of 2 var.					1		
<i>Acacia beckleri</i>	Beckler's Rock Wattle		1	1		1	1		
<i>Acacia burkittii</i>	Pin-bush Wattle		1			1	1		
<i>Acacia calamifolia</i>	Wallowa		1			1	1		
<i>Acacia cibaria</i>	Turpentine Mulga		1	1					
<i>Acacia colletioides</i>	Veined Wait-a-while		1	1			1		
<i>Acacia continua</i>	Thorn Wattle		1	1		1	1		
<i>Acacia hakeoides</i>	Hakea Wattle		1			1	1		
<i>Acacia halliana</i> s.str.	Hall's Wattle		1				1		
<i>Acacia havilandii</i>	Needle Wattle						1		
<i>Acacia iteaphylla</i>	Flinders Ranges Wattle		1	1			1		R
<i>Acacia kempeana</i>	Witchetty Bush		1			1	1		
<i>Acacia ligulata</i>	Umbrella Bush		1	1		1	1		
<i>Acacia merrallii</i>	Merrall's Wattle		1			1	1		
<i>Acacia microcarpa</i>	Manna Wattle		1			1	1		
<i>Acacia montana</i>	Mallee Wattle					1			R
<i>Acacia murrayana</i>	Colony Wattle		1						
<i>Acacia notabilis</i>	Notable Wattle		1	1		1	1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Acacia nyssophylla</i>	Spine Bush		1			1	1		
<i>Acacia oswaldii</i>	Umbrella Wattle		1	1		1	1		
<i>Acacia papyrocarpa</i>	Western Myall		1	1		1	1		
<i>Acacia paradoxa</i>	Kangaroo Thorn						1		
<i>Acacia ramulosa</i>	Horse Mulga		1	1		1	1		
<i>Acacia rigens</i>	Nealie		1	1		1	1		
<i>Acacia rupicola</i>	Rock Wattle		1						
<i>Acacia sclerophylla</i>	Hard-leaf Wattle		1			1	1		
<i>Acacia spinescens</i>	Spiny Wattle		1			1			
<i>Acacia stowardii</i>	Bastard Mulga		1						
<i>Acacia tarculensis</i>	Steel Bush		1	1		1	1		
<i>Acacia tetragonophylla</i>	Dead Finish		1			1	1		
<i>Acacia toondulya</i>									
<i>Acacia victoriae</i> ssp. <i>victoriae</i>	Elegant Wattle		1			1	1		
<i>Acacia wilhelmiana</i>	Dwarf Nealie		1			1			
* <i>Acetosa vesicaria</i>	Rosy Dock		1				1		
<i>Acianthus pusillus</i>	Mosquito Orchid		1						
* <i>Acroptilon repens</i> ssp. <i>repens</i>	Creeping Knapweed	unconfirmed					1		
<i>Actinobole uliginosum</i>	Flannel Cudweed		1	1		1	1		
<i>Adriana klotzschii</i>	Coast Bitter-bush		1						
<i>Agrostis aemula</i>	Blown-grass		1						
<i>Agrostis avenacea</i> var. <i>avenacea</i>	Common Blown-grass		1	1					
* <i>Aira cupaniana</i>	Small Hair-grass						1		
<i>Ajuga australis</i> form A	Australian Bugle	unconfirmed					1		
<i>Alectryon oleifolius</i> ssp. <i>canescens</i>	Bullock Bush		1			1	1		
<i>Allocasuarina helmsii</i>	Helm's Oak-bush		1	1		1			
<i>Allocasuarina muelleriana</i> ssp. <i>muelleriana</i>	Common Oak-bush		1			1	1		
<i>Allocasuarina verticillata</i>	Drooping Sheoak		1			1	1		
<i>Alternanthera denticulata</i>	Lesser Joyweed		1				1		
<i>Alyogyne hakeifolia</i>	Hakea-leaf Hibiscus		1	1		1	1		
<i>Alyogyne huegelii</i>	Native Hibiscus		1			1			
* <i>Alyssum linifolium</i>	Flax-leaf Alyssum		1			1			
<i>Alyxia buxifolia</i>	Sea Box		1			1	1		
<i>Amaranthus grandiflorus</i>	Large-flower Amaranth		1				1		
<i>Amaranthus macrocarpus</i>	Large-fruit Amaranth	unconfirmed	1						
<i>Amaranthus mitchellii</i>	Boggabri Weed		1						
<i>Amphipogon caricinus</i> var. <i>caricinus</i>	Long Grey-beard Grass		1			1	1		
<i>Amyema linophyllum</i> ssp. <i>orientale</i>	Casuarina Mistletoe	unconfirmed	1						
<i>Amyema maidenii</i> ssp. <i>maidenii</i>	Pale-leaf Mistletoe		1			1	1		
<i>Amyema melaleucae</i>	Tea-tree Mistletoe		1						
<i>Amyema miquelii</i>	Box Mistletoe		1	1		1	1		
<i>Amyema miraculosum</i> ssp. <i>boormanii</i>	Fleshy Mistletoe		1			1	1		
<i>Amyema preissii</i>	Wire-leaf Mistletoe		1			1	1		
<i>Amyema quandang</i> var. <i>quandang</i>	Grey Mistletoe		1	1		1	1		
<i>Anacampseros australiana</i>	Australian Anacampseros		1						
* <i>Anagallis arvensis</i>	Pimpernel		1	1					
<i>Anemocarpa podolepidium</i>	Rock Everlasting						1		
<i>Angianthus brachypappus</i>	Spreading Angianthus						1		
<i>Angianthus glabratus</i>	Smooth Angianthus		1			1			
<i>Angianthus tomentosus</i>	Hairy Angianthus		1			1	1		
<i>Anthocercis anisantha</i> ssp. <i>anisantha</i>	Port Lincoln Ray-flower		1						R
<i>Anthocercis anisantha</i> ssp. <i>collina</i>	Gawler Ranges Ray-flower		1				1		
<i>Aotus subspinescens</i>	Mallee Aotus		1	1			1		
<i>Apium annuum</i>	Annual Celery		1	1					
* <i>Aptenia cordifolia</i>	Heart-leaf Iceplant						1		
<i>Arabidella filifolia</i>	Thread-leaf Cress					1			

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Arabidella nasturtium</i>	Yellow Cress		1				1		
<i>Arabidella trisecta</i>	Shrubby Cress		1	1		1	1		
* <i>Arctotheca calendula</i>	Cape Weed		1	1			1		
<i>Aristida anthoxanthoides</i>	Yellow Three-awn		1				1		
<i>Aristida contorta</i>	Curly Wire-grass		1	1		1	1		
<i>Aristida holathera</i> var. <i>holathera</i>	Tall Kerosene Grass		1				1		
<i>Aristida latifolia</i>	Feather-top Wire-grass	unconfirmed					1		
<i>Aristida nitidula</i>	Brush Three-awn		1				1		
<i>Arthropodium fimbriatum</i>	Nodding Vanilla-lily		1						
<i>Arthropodium minus</i>	Small Vanilla-lily		1						
<i>Asperula gemella</i>	Twin-leaf Bedstraw		1						
* <i>Asphodelus fistulosus</i>	Onion Weed		1			1	1		
<i>Asteridea athrixioides</i> forma	Wirewort	could be 1 of 2 forma	1						
<i>Asteridea athrixioides</i> forma <i>athrixioides</i>	Wirewort		1			1			
<i>Astrebla pectinata</i>	Barley Mitchell-grass		1				1		
<i>Astroloma humifusum</i>	Cranberry Heath		1	1		1	1		
<i>Atriplex acutibractea</i> ssp. <i>acutibractea</i>	Pointed Saltbush		1				1		
<i>Atriplex acutibractea</i> ssp. <i>karoniensis</i>	Pointed Saltbush					1			
<i>Atriplex acutiloba</i>						1			
<i>Atriplex angulata</i>	Fan Saltbush		1				1		
<i>Atriplex eardleyae</i>	Eardley's Saltbush		1				1		
<i>Atriplex fissivalvis</i>	Gibber Saltbush		1				1		
<i>Atriplex holocarpa</i>	Pop Saltbush		1				1		
<i>Atriplex kochiana</i>	Koch's Saltbush				1				V
<i>Atriplex leptocarpa</i>	Slender-fruit Saltbush						1		
<i>Atriplex limbata</i>	Spreading Saltbush		1	1			1		
<i>Atriplex lindleyi</i> ssp.	Baldoo	could be 1 of 4 ssp.	1				1		
<i>Atriplex lindleyi</i> ssp. <i>conduplicata</i>	Baldoo		1				1		
<i>Atriplex lindleyi</i> ssp. <i>inflata</i>	Corky Saltbush		1						
<i>Atriplex lindleyi</i> ssp. <i>quadripartita</i>	Baldoo					1			
<i>Atriplex nummularia</i> ssp. <i>nummularia</i>	Old-man Saltbush		1						
<i>Atriplex nummularia</i> ssp. <i>omissa</i>	Old-man Saltbush	unconfirmed	1				1		
<i>Atriplex paludosa</i> ssp. <i>cordata</i>	Marsh Saltbush		1						
<i>Atriplex paludosa</i> ssp. <i>paludosa</i>	Marsh Saltbush		1						
<i>Atriplex pseudocampanulata</i>	Spreading Saltbush	unconfirmed					1		
<i>Atriplex quinii</i>	Kidney-fruit Saltbush					1	1		
<i>Atriplex spongiosa</i>	Pop Saltbush		1	1		1	1		
<i>Atriplex stipitata</i>	Bitter Saltbush		1			1	1		
<i>Atriplex suberecta</i>	Lagoon Saltbush	unconfirmed					1		
<i>Atriplex velutinella</i>	Sandhill Saltbush		1			1	1		
<i>Atriplex vesicaria</i> ssp.	Bladder Saltbush		1			1	1		
<i>Atriplex vesicaria</i> ssp. <i>variabilis</i>	Bladder Saltbush						1		
* <i>Avellinia michelii</i>	Avellinia		1			1			
* <i>Avena barbata</i>	Bearded Oat		1				1		
* <i>Avena fatua</i>	Wild Oat		1						
<i>Avicennia marina</i> var. <i>resinifera</i>	Grey Mangrove		1						
<i>Baeckea behrii</i>	Silver Broombush		1			1	1		
<i>Baeckea crassifolia</i>	Desert Baeckea		1			1	1		
<i>Baeckea ericaea</i>	Mat Baeckea	unconfirmed	1						
<i>Bertya mitchellii</i>	Mitchell's Bertya					1			
<i>Beyeria lechenaultii</i>	Pale Turpentine Bush		1			1	1		
<i>Beyeria opaca</i>	Dark Turpentine Bush		1			1	1		
<i>Billardiera cymosa</i>	Sweet Apple-berry		1			1			
<i>Blennodia canescens</i>	Native Stock		1				1		
<i>Blennodia pterosperma</i>	Wild Stock						1		
<i>Blennospora drummondii</i>	Dwarf Button-flower		1						

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Boerhavia coccinea</i>	Tar-vine		1				1		
<i>Boerhavia dominii</i>	Tar-vine		1				1		
<i>Boerhavia schomburgkiana</i>	Schomburgk's Tar-vine		1						
<i>Boronia coerulescens</i> ssp. <i>coerulescens</i>	Blue Boronia		1			1			
<i>Boronia inornata</i> ssp. <i>leptophylla</i>	Dryland Boronia					1			
<i>Bossiaea walkeri</i>	Cactus Pea		1	1			1		
<i>Brachycome ciliaris</i> var. <i>ciliaris</i>	Variable Daisy		1	1		1	1		
<i>Brachycome ciliaris</i> var. <i>lanuginosa</i>	Woolly Variable Daisy		1				1		
<i>Brachycome dentata</i>	Lobe-seed Daisy	unconfirmed					1		
<i>Brachycome dichromosomatica</i> var. <i>dichromosomatica</i>	Large Hard-head Daisy		1				1		
<i>Brachycome eriogona</i>			1				1		R
<i>Brachycome exilis</i>	Slender Daisy		1				1		
<i>Brachycome iberidifolia</i>	Swan River Daisy		1				1		
<i>Brachycome lineariloba</i>	Hard-head Daisy		1			1	1		
<i>Brachycome muelleri</i>	Corunna Daisy				1			E	E
<i>Brachycome perpusilla</i>	Tiny Daisy		1			1			
<i>Brachycome trachycarpa</i>	Smooth Daisy		1						
<i>Bracteantha bracteata</i>	Golden Everlasting		1				1		
* <i>Brassica tournefortii</i>	Wild Turnip		1			1	1		
<i>Bromus arenarius</i>	Sand Brome		1				1		
* <i>Bromus diandrus</i>	Great Brome		1						
* <i>Bromus madritensis</i>	Compact Brome		1						
* <i>Bromus rubens</i>	Red Brome		1			1	1		
<i>Brunonia australis</i>	Blue Pincushion		1	1					
* <i>Buglossoides arvensis</i>	Sheepweed		1						
<i>Bulbine alata</i>	Winged Bulbine-lily	unconfirmed	1				1		
<i>Bulbine bulbosa</i>	Bulbine-lily						1		
<i>Bulbine semibarbata</i>	Small Leek-lily		1	1		1	1		
* <i>Bupleurum semicompositum</i>	Hare's Ear		1						
<i>Burchardia umbellata</i>	Milkmaids						1		
<i>Bursaria spinosa</i>	Sweet Bursaria		1			1	1		
* <i>Cakile maritima</i> ssp. <i>maritima</i>	Two-horned Sea Rocket		1						
<i>Caladenia cardiochila</i>	Heart-lip Spider-orchid		1						
<i>Caladenia clavula</i>	Brown-club Spider orchid					1			
<i>Caladenia dilatata</i> complex	Green-comb Spider-orchid		1						
<i>Caladenia filamentosa</i> var. <i>tentaculata</i>	Wispy Spider-orchid		1						
<i>Caladenia tentaculata</i>	King Spider-orchid		1						
<i>Caladenia toxochila</i>	Bow-lip Spider-orchid		1	1					
<i>Calandrinia balonensis</i>	Broad-leaf Parakeelya	unconfirmed					1		
<i>Calandrinia calypttrata</i>	Pink Purslane		1	1		1			
<i>Calandrinia disperma</i>	Two-seed Purslane		1				1		
<i>Calandrinia eremaea</i>	Dryland Purslane		1	1		1	1		
<i>Calandrinia granulifera</i>	Pigmy Purslane		1						
<i>Calandrinia polyandra</i> var. <i>polyandra</i>	Parakeelya		1				1		
<i>Calandrinia ptychosperma</i>	Creeping Parakeelya						1		
<i>Calandrinia remota</i>	Round-leaf Parakeelya		1				1		
<i>Calandrinia reticulata</i>		unconfirmed	1						
<i>Calandrinia volubilis</i>	Twining Purslane		1			1			
* <i>Calendula arvensis</i>	Field Marigold		1						
<i>Callitris glaucophylla</i>	White Cypress-pine		1			1	1		
<i>Callitris preissii</i>	Southern Cypress-pine		1			1	1		
<i>Callitris verrucosa</i>	Scrub Cypress-pine		1			1	1		
<i>Calocephalus citreus</i>	Lemon Beauty-heads	unconfirmed				1	1		
<i>Calotis cymbacantha</i>	Showy Burr-daisy		1			1	1		
<i>Calotis erinacea</i>	Tangled Burr-daisy		1	1		1	1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Calotis hispidula</i>	Hairy Burr-daisy		1			1	1		
<i>Calotis lappulacea</i>	Yellow Burr-daisy						1		R
<i>Calotis multicaulis</i>	Woolly-headed Burr-daisy		1				1		
<i>Calotis plumulifera</i>	Woolly-headed Burr-daisy		1						
<i>Calytrix gypsophila</i>	Gypsum Fringe-myrtle			1					
<i>Calytrix involucrata</i>	Cup Fringe-myrtle		1	1		1	1		
<i>Calytrix tetragona</i>	Common Fringe-myrtle					1	1		
<i>Carpobrotus modestus</i>	Inland Pigface		1	1					
<i>Carpobrotus rossii</i>	Native Pigface						1		
* <i>Carrichtera annua</i>	Ward's Weed		1	1		1	1		
* <i>Carthamus lanatus</i>	Saffron Thistle		1	1		1	1		
<i>Cassinia laevis</i>	Curry Bush		1			1	1		
<i>Cassinia uncata</i>	Sticky Cassinia					1			
<i>Cassytha melantha</i>	Coarse Dodder-laurel		1	1		1			
<i>Cassytha peninsularis</i> var. <i>peninsularis</i>	Peninsula Dodder-laurel		1	1		1			
<i>Casuarina pauper</i>	Black Oak		1			1	1		
* <i>Centaurea melitensis</i>	Malta Thistle		1	1		1	1		
* <i>Centaurium tenuiflorum</i>	Branched Centaury		1						
<i>Centipeda cunninghamii</i>	Common Sneezeweed					1	1		
<i>Centipeda thespidioides</i>	Desert Sneezeweed		1				1		
<i>Cephalopterum drummondii</i>	Pompom Head		1						
<i>Ceratogyne obionoides</i>	Wingwort		1						R
<i>Chamaescilla corymbosa</i> var. <i>corymbosa</i>	Blue Squill						1		
<i>Cheilanthes austrotenuifolia</i>	Annual Rock-fern		1			1			
<i>Cheilanthes distans</i>	Bristly Cloak-fern		1			1			
<i>Cheilanthes lasiophylla</i>	Woolly Cloak-fern		1	1		1			
<i>Cheilanthes sieberi</i> ssp. <i>pseudovellea</i>			1						
<i>Cheilanthes sieberi</i> ssp. <i>sieberi</i>	Narrow Rock-fern		1	1		1			
<i>Chenopodium cristatum</i>	Crested Goosefoot		1				1		
<i>Chenopodium curvispicatum</i>	Cottony Goosefoot		1			1	1		
<i>Chenopodium desertorum</i> ssp. <i>anidiophyllum</i>	Mallee Goosefoot		1				1		
<i>Chenopodium desertorum</i> ssp. <i>desertorum</i>	Frosted Goosefoot		1				1		
<i>Chenopodium desertorum</i> ssp. <i>microphyllum</i>	Small-leaf Goosefoot					1	1		
<i>Chenopodium desertorum</i> ssp. <i>rectum</i>	Erect Goosefoot						1		
<i>Chenopodium gaudichaudianum</i>	Scrambling Goosefoot		1	1		1	1		
<i>Chenopodium melanocarpum</i> forma <i>leucocarpum</i>	Pale-fruit Goosefoot	unconfirmed					1		
<i>Chenopodium melanocarpum</i> forma <i>melanocarpum</i>	Black-fruit Goosefoot		1			1			
* <i>Chenopodium murale</i>	Nettle-leaf Goosefoot		1						
<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot		1				1		
<i>Chenopodium pumilio</i>	Clammy Goosefoot		1				1		
<i>Chloris pectinata</i>	Comb Windmill Grass						1		
<i>Chloris truncata</i>	Windmill Grass	unconfirmed	1				1		
<i>Chrysocephalum apiculatum</i>	Common Everlasting		1			1	1		
<i>Chrysocephalum eremaeum</i>	Sand Button-bush		1						
<i>Chrysocephalum pterochaetum</i>	Shrub Everlasting						1		
<i>Chrysocephalum semicalvum</i> ssp. <i>semicalvum</i>	Scented Button-bush		1						
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting		1			1	1		
<i>Chthonocephalus pseudevax</i>	Ground-heads		1	1		1	1		
* <i>Citrullus colocynthis</i>	Colocynth		1				1		
* <i>Citrullus lanatus</i>	Bitter Melon		1			1	1		
<i>Clematis microphylla</i>	Old man's Beard		1						

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Codonocarpus cotinifolius</i>	Desert Poplar						1		
<i>Comesperma scoparium</i>	Broom Milkwort		1			1	1		
<i>Comesperma viscidulum</i>	Varnished Milkwort			1					
<i>Comesperma volubile</i>	Love Creeper		1			1			
* <i>Convolvulus arvensis</i>	Field Bindweed						1		
<i>Convolvulus erubescens</i>	Australian Bindweed		1	1			1		
<i>Convolvulus remotus</i>	Grassy Bindweed		1	1		1	1		
<i>Correa reflexa</i> var. <i>coriacea</i>	Thick-leaf Correa		1						
<i>Correa reflexa</i> var. <i>reflexa</i>	Common Correa		1						
<i>Corynotheca licrota</i>	Sand Lily		1						R
<i>Craspedia glauca</i>	Billy-buttons						1		
<i>Crassula colorata</i> var. <i>acuminata</i>	Dense Crassula		1	1		1			
<i>Crassula colorata</i> var. <i>colorata</i>	Dense Crassula		1						
<i>Crassula exserta</i>	Large-fruit Crassula					1			R
<i>Crassula sieberiana</i> ssp. <i>tetramera</i>	Australian Stonecrop		1	1		1			
<i>Cratystylis conocephala</i>	Bluebush Daisy		1	1		1	1		
<i>Crinum flaccidum</i>	Murray Lily		1				1		
* <i>Critesion murinum</i> ssp. <i>glaucum</i>	Blue Barley-grass		1			1	1		
* <i>Critesion murinum</i> ssp. <i>leporinum</i>	Wall Barley-grass		1				1		
<i>Crotalaria eremaea</i> ssp.	Loose-flowered Rattle-pod	could be 1 of 2 ssp.	1				1		
<i>Crotalaria eremaea</i> ssp. <i>eremaea</i>	Downy Loose-flowered Rattle-pod		1			1	1		
<i>Crotalaria smithiana</i>	Low Rattle-pod	unconfirmed					1		
<i>Cryptandra amara</i> var. <i>amara</i>	Spiny Cryptandra		1			1			
<i>Cryptandra amara</i> var. <i>floribunda</i>	Pretty Cryptandra		1			1	1		
<i>Cryptandra leucophracta</i>	White Cryptandra		1	1		1			
<i>Cryptandra propinqua</i>	Silky Cryptandra			1		1			
<i>Cryptandra tomentosa</i>	Heath Cryptandra					1			
<i>Cryptandra tomentosa</i> complex			1						
<i>Cucumis melo</i>	Ulcardo Melon	unconfirmed	1				1		
* <i>Cucumis myriocarpus</i>	Paddy Melon		1				1		
<i>Cullen australasicum</i>	Tall Scurf-pea		1				1		
<i>Cullen cinereum</i>	Annual Scurf-pea						1		
<i>Cullen discolor</i>			1						
<i>Cullen graveolens</i>	Native Lucerne	unconfirmed	1				1		
<i>Cullen pallidum</i>	White Scurf-pea		1						
<i>Cullen patens</i>	Spreading Scurf-pea					1	1		
<i>Cyanicula deformis</i>	Bluebeard Orchid		1	1					
<i>Cymbopogon ambiguus</i>	Lemon-grass		1				1		
<i>Cymbopogon obtectus</i>	Silky-head Lemon-grass		1	1					
<i>Cyperus bulbosus</i>	Bulbous Flat-sedge						1		
<i>Cyperus gilesii</i>	Giles' Flat-sedge						1		
<i>Cyperus gymnocallos</i>	Spiny Flat-sedge		1						
<i>Cyperus lhotskyanus</i>		unconfirmed	1						V
<i>Cyperus rigidellus</i>	Dwarf Flat-sedge					1	1		
<i>Cyphanthera myosotidea</i>	Small-leaf Ray-flower					1			
<i>Dactyloctenium radulans</i>	Button-grass		1				1		
<i>Dampiera dysantha</i>	Shrubby Dampiera		1				1		
<i>Dampiera lanceolata</i> var. <i>lanceolata</i>	Grooved Dampiera		1			1			
<i>Dampiera rosmarinifolia</i>	Rosemary Dampiera		1			1	1		
<i>Danthonia caespitosa</i>	Common Wallaby-grass		1	1		1	1		
<i>Danthonia setacea</i> var. <i>setacea</i>	Small-flower Wallaby-grass		1						
<i>Darwinia micropetala</i>	Small Darwinia		1						
<i>Darwinia salina</i>	Salt Darwinia					1			
* <i>Datura ferox</i>	Long-spine Thorn-apple	unconfirmed					1		
<i>Daucus glochidiatus</i>	Native Carrot		1			1	1		
<i>Daviesia benthamii</i> ssp.	Spiny Bitter-pea	could be 1 of 2 ssp.				1	1		



Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Daviesia benthamii</i> ssp. <i>acanthoclona</i>	Dryland Bitter-pea		1			1			
<i>Daviesia brevifolia</i>	Leafless Bitter-pea					1			
<i>Daviesia ulicifolia</i> ssp. <i>aridicola</i>	Gorse Bitter-pea		1			1	1		
* <i>Desmazeria rigida</i>	Rigid Fescue						1		
<i>Dianella brevicaulis</i>	Short-stem Flax-lily		1						
<i>Dianella revoluta</i> var. <i>divaricata</i>	Broad-leaf Flax-lily		1						
<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax-lily		1			1			
<i>Dichanthium sericeum</i> ssp.	Silky Blue-grass	could be 1 of 2 ssp.	1				1		
<i>Dichromochlamys dentatifolius</i>		unconfirmed					1		
<i>Dicrastylis beveridgei</i> var. <i>lanata</i>	Woolly Sand-sage		1						
<i>Dicrastylis verticillata</i>	Whorled Sand-sage					1			
<i>Digitaria ammophila</i>	Spider Grass	unconfirmed	1				1		
<i>Digitaria brownii</i>	Cotton Panic-grass		1			1	1		
<i>Digitaria ciliaris</i>	Summer Grass						1		
<i>Digitaria coenicola</i>	Spider Grass						1		
<i>Diplachne fusca</i>	Brown Beetle-grass						1		
* <i>Diploaxis tenuifolia</i>	Lincoln Weed						1		
<i>Disphyma crassifolium</i> ssp. <i>clavellatum</i>	Round-leaf Pigface		1			1	1		
<i>Dissocarpus biflorus</i> var. <i>biflorus</i>	Two-horn Saltbush		1			1	1		
<i>Dissocarpus biflorus</i> var. <i>villosus</i>	Woolly Two-horn Saltbush		1				1		
<i>Dissocarpus paradoxus</i>	Ball Bindyi		1			1	1		
* <i>Dittrichia graveolens</i>	Stinkweed		1	1			1		
<i>Dodonaea baueri</i>	Crinkled Hop-bush		1	1		1	1		
<i>Dodonaea bursariifolia</i>	Small Hop-bush		1			1			
<i>Dodonaea hexandra</i>	Horned Hop-bush		1			1	1		
<i>Dodonaea intricata</i>	Gawler Ranges Hop-bush		1	1		1	1		
<i>Dodonaea lobulata</i>	Lobed-leaf Hop-bush		1	1		1	1		
<i>Dodonaea microzyga</i> var. <i>microzyga</i>	Brilliant Hop-bush					1	1		
<i>Dodonaea stenozyga</i>	Desert Hop-bush		1			1	1		
<i>Dodonaea tepperi</i>	Streaked Hop-bush				1				
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	Narrow-leaf Hop-bush		1	1		1	1		
<i>Dodonaea viscosa</i> ssp. <i>spatulata</i>	Sticky Hop-bush						1		
<i>Drosera glanduligera</i>	Scarlet Sundew		1						
<i>Drosera macrantha</i> ssp. <i>planchonii</i>	Climbing Sundew		1	1					
<i>Duboisia hopwoodii</i>	Pituri		1			1	1		
<i>Dysphania rhadinostachya</i> ssp. <i>rhadinostachya</i>	Green Crumbweed	unconfirmed					1		
* <i>Echium plantagineum</i>	Salvation Jane		1	1			1		
* <i>Echium vulgare</i>	Viper's Bugloss	unconfirmed	1						
<i>Einadia nutans</i> ssp.	Climbing Saltbush	could be 1 of 3 ssp.	1				1		
<i>Einadia nutans</i> ssp. <i>nutans</i>	Climbing Saltbush		1				1		
<i>Einadia nutans</i> ssp. <i>oxycarpa</i>	Pointed-fruit Climbing Saltbush		1						
<i>Elachanthus pusillus</i>	Elachanth		1						
<i>Eleocharis pallens</i>	Pale Spike-rush		1				1		
<i>Eleocharis pusilla</i>	Small Spike-rush						1		
<i>Elymus scabrus</i> var. <i>scabrus</i>	Native Wheat-grass		1						
<i>Embadium uncinatum</i>	Gawler Ranges Slipper-plant		1						
* <i>Emex australis</i>	Three-corner Jack		1			1	1		
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush		1			1	1		
<i>Enneapogon avenaceus</i>	Common Bottle-washers		1			1	1		
<i>Enneapogon caeruleus</i> var. <i>caeruleus</i>	Blue Bottle-washers		1			1	1		
<i>Enneapogon cylindricus</i>	Jointed Bottle-washers		1				1		
<i>Enneapogon nigricans</i>	Black-head Grass						1		
<i>Enneapogon polyphyllus</i>	Leafy Bottle-washers		1			1	1		
<i>Enteropogon acicularis</i>	Umbrella Grass					1	1		
<i>Enteropogon ramosus</i>	Umbrella Grass		1			1			

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Eragrostis australasica</i>	Cane-grass		1	1		1	1		
<i>Eragrostis basedowii</i>	Neat Love-grass						1		
<i>Eragrostis dielsii</i> var. <i>dielsii</i>	Mulka		1			1	1		
<i>Eragrostis eriopoda</i>	Woollybutt		1			1	1		
<i>Eragrostis laniflora</i>	Hairy-flower Woollybutt						1		
<i>Eragrostis lanipes</i>	Woollybutt						1		
<i>Eragrostis leptocarpa</i>	Drooping Love-grass						1		
<i>Eragrostis setifolia</i>	Bristly Love-grass		1				1		
<i>Eragrostis xerophila</i>	Knotty-butt Neverfail						1		
<i>Eremocitrus glauca</i>	Desert Lime						1		V
<i>Eremophila alternifolia</i>	Narrow-leaf Emubush		1	1		1	1		
<i>Eremophila behriana</i>	Rough Emubush		1			1			
<i>Eremophila crassifolia</i>	Thick-leaf Emubush		1			1			
<i>Eremophila deserti</i>	Turkey-bush		1			1	1		
<i>Eremophila duttonii</i>	Harlequin Emubush		1			1	1		
<i>Eremophila freelingii</i>	Rock Emubush					1	1		
<i>Eremophila gilesii</i>	Hairy-fruit Emubush						1		
<i>Eremophila glabra</i> ssp. <i>glabra</i>	Tar Bush		1			1	1		
<i>Eremophila latrobei</i> ssp.	Crimson Emubush	could be 1 of 2 ssp.					1		
<i>Eremophila latrobei</i> ssp. <i>glabra</i>	Crimson Emubush		1			1			
<i>Eremophila longifolia</i>	Weeping Emubush		1	1		1	1		
<i>Eremophila macdonnellii</i>	Macdonnell's Emubush		1				1		
<i>Eremophila maculata</i> var. <i>maculata</i>	Spotted Emubush		1			1	1		
<i>Eremophila oppositifolia</i> var. <i>oppositifolia</i>	Opposite-leaved Emubush		1	1		1	1		
<i>Eremophila paisleyi</i>	Paisley's Emubush		1	1		1	1		
<i>Eremophila rotundifolia</i>	Round-leaf Emubush					1	1		
<i>Eremophila scoparia</i>	Broom Emubush		1	1		1	1		
<i>Eremophila serrulata</i>	Green Emubush		1	1		1	1		
<i>Eremophila sturtii</i>	Turpentine Bush						1		
<i>Eremophila subfloccosa</i> ssp. "imbricata" ms	Woolly Emubush					1			
<i>Eremophila willsii</i>	Wills' Emubush			1			1		
<i>Eriachne helmsii</i>	Woollybutt Wanderrie		1				1		
<i>Eriachne mucronata</i>	Mountain Wanderrie		1						
<i>Eriochiton sclerolaenoides</i>	Woolly-fruit Bluebush		1			1	1		
<i>Eriochlamys behrii</i>	Woolly Mantle		1			1	1		
<i>Eriochloa australiensis</i>	Australian Cupgrass		1						
<i>Eriostemon linearis</i>	Narrow-leaf Wax-flower		1	1		1	1		
<i>Erodiohyllum elderi</i>	Koonamore Daisy						1		
<i>Erodium angustilobum</i>			1						
* <i>Erodium aureum</i>			1				1		
* <i>Erodium botrys</i>	Long Heron's-bill	unconfirmed	1			1	1		
* <i>Erodium cicutarium</i>	Cut-leaf Heron's-bill		1			1	1		
<i>Erodium crinitum</i>	Blue Heron's-bill		1			1	1		
<i>Erodium cygnorum</i> ssp. <i>cygnorum</i>	Blue Heron's-bill		1				1		
<i>Erodium cygnorum</i> ssp. <i>glandulosum</i>	Clammy Heron's-bill		1				1		
* <i>Erodium moschatum</i>	Musky Herons-bill					1			
<i>Eucalyptus brachycalyx</i>	Gilja		1	1		1	1		
<i>Eucalyptus camaldulensis</i> var. <i>camaldulensis</i>	River Red Gum		1				1		
<i>Eucalyptus concinna</i>	Victoria Desert Mallee		1	1			1		
<i>Eucalyptus coolabah</i> ssp. <i>arida</i>	Coolibah						1		
<i>Eucalyptus dumosa</i>	White Mallee		1			1	1		
<i>Eucalyptus flocktoniae</i> x <i>socialis</i>	Merrit intergrade	intergrade	1						
<i>Eucalyptus gracilis</i>	Yorrell		1			1	1		
<i>Eucalyptus incrassata</i>	Ridge-fruited Mallee		1			1	1		
<i>Eucalyptus intertexta</i>	Gum-barked Coolibah						1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Eucalyptus lansdowneana</i> ssp. <i>lansdowneana</i>	Crimson Mallee		1				1		R
<i>Eucalyptus leptophylla</i>	Narrow-leaf Red Mallee		1	1		1	1		
<i>Eucalyptus odorata</i>	Peppermint Box		1						
<i>Eucalyptus oleosa</i>	Red Mallee		1			1	1		
<i>Eucalyptus pimpiniana</i>	Pimpin Mallee			1					
<i>Eucalyptus porosa</i>	Mallee Box		1	1		1	1		
<i>Eucalyptus socialis</i>	Beaked Red Mallee		1	1		1	1		
<i>Eucalyptus striatocalyx</i>	Kopi Mallee		1						
<i>Eucalyptus trivalvis</i>	Three-valve Mallee		1						
<i>Eucalyptus yalataensis</i>	Yalata Mallee			1					
<i>Eucalyptus youngiana</i>	Ooldea Mallee		1						
<i>Euchiton involucratus</i>	Star Cudweed		1						
<i>Euchiton sphaericus</i>	Annual Cudweed		1			1			
<i>Eulalia aurea</i>	Silky Brown-top						1		
<i>Euphorbia australis</i>	Hairy Caustic Weed						1		
<i>Euphorbia drummondii</i>	Caustic Weed		1	1		1	1		
<i>Euphorbia parvicaruncula</i>	Rough-seeded Spurge		1						
<i>Euphorbia stevenii</i>	Bottletree Spurge		1				1		
<i>Euphorbia tannensis</i> ssp. <i>eremophila</i>	Desert Spurge		1	1		1	1		
<i>Euphorbia wheeleri</i>	Wheeler's Spurge						1		
<i>Eutaxia microphylla</i> var. <i>microphylla</i>	Common Eutaxia		1	1		1	1		
<i>Exocarpos aphyllus</i>	Leafless Cherry		1			1	1		
<i>Exocarpos cupressiformis</i>	Native Cherry					1			
<i>Exocarpos sparteus</i>	Slender Cherry					1			
<i>Exocarpos syrticola</i>	Coast Cherry		1						
<i>Frankenia crispa</i>	Hoary Sea-heath	unconfirmed	1			1	1		
<i>Frankenia foliosa</i>	Leafy Sea-heath		1						
<i>Frankenia pauciflora</i> var. <i>fruticulosa</i>	Southern Sea-heath		1			1			
<i>Frankenia pauciflora</i> var. <i>gunnii</i>	Southern Sea-heath		1			1			
<i>Frankenia plicata</i>			1				1	E	R
<i>Frankenia serpyllifolia</i>	Thyme Sea-heath		1			1	1		
<i>Frankenia sessilis</i>	Small-leaf Sea-heath					1			
<i>Gahnia lanigera</i>	Black Grass Saw-sedge		1						
<i>Galium australe</i>	Tangled Bedstraw	unconfirmed	1						
<i>Galium binifolium</i>	Reflexed Bedstraw	unconfirmed	1						
<i>Galium gaudichaudii</i>	Rough Bedstraw		1			1			
<i>Galium migrans</i>	Loose Bedstraw		1						
* <i>Galium murale</i>	Small Bedstraw		1						
* <i>Galium spurium</i> ssp. <i>ibicinum</i>	Bedstraw		1						
* <i>Gazania linearis</i>	Gazania	unconfirmed				1			
<i>Geijera linearifolia</i>	Sheep Bush		1	1		1	1		
<i>Geococcus pusillus</i>	Earth Cress		1						
<i>Geranium retrorsum</i>	Grassland Geranium		1						
<i>Geranium solanderi</i> var. <i>solanderi</i>	Austral Geranium		1						
<i>Glischrocaryon aureum</i> var. <i>angustifolium</i>	Golden Pennants			1		1	1		
<i>Glischrocaryon flavescens</i>	Yellow Pennants		1						
<i>Glycine canescens</i>	Silky Glycine	unconfirmed	1						
<i>Glycine clandestina</i> var. <i>sericea</i>	Twining Glycine		1	1		1	1		
<i>Gnaphalium diamantinense</i>	Diamantina Cudweed	unconfirmed	1						
<i>Gnephosis arachnoidea</i>	Spidery Button-flower		1			1	1		
<i>Gnephosis drummondii</i>	Slender Golden-tip		1			1			
<i>Gnephosis eriocarpa</i>	Native Camomile						1		
<i>Gnephosis tenuissima</i>	Dwarf Golden-tip		1			1	1		
<i>Gonocarpus elatus</i>	Hill Raspswort		1	1					
<i>Gonocarpus meianus</i>	Broad-leaf Raspswort					1			

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			SU	OP	PP	RE	PM	Aus	SA
<i>Goodenia benthamiana</i>	Bentham's Goodenia					1			R
<i>Goodenia berardiana</i>	Split-end Goodenia		1				1		
<i>Goodenia calcarata</i>	Streaked Goodenia					1			
<i>Goodenia cycloptera</i>	Serrated Goodenia		1	1			1		
<i>Goodenia fascicularis</i>	Silky Goodenia		1				1		
<i>Goodenia geniculata</i>	Bent Goodenia		1						
<i>Goodenia gibbosa</i>			1				1		
<i>Goodenia glabra</i>	Smooth Goodenia		1	1					
<i>Goodenia havilandii</i>	Hill Goodenia		1	1		1	1		
<i>Goodenia heterochila</i>	Serrated Goodenia			1					R
<i>Goodenia lobata</i>			1						R
<i>Goodenia lunata</i>	Stiff Goodenia		1						
<i>Goodenia ovata</i>	Hop Goodenia					1			
<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia		1	1		1	1		
<i>Goodenia pusilliflora</i>	Small-flower Goodenia		1			1	1		
<i>Goodenia robusta</i>	Woolly Goodenia			1		1			
<i>Goodenia varia</i>	Sticky Goodenia		1			1			
<i>Goodenia willisiana</i>	Silver Goodenia		1			1			
<i>Goodia medicaginea</i>	Western Golden-tip		1				1		
<i>Grammosolen dixonii</i>	Dixon's Ray-flower		1			1			
<i>Grammosolen truncatus</i>	Shrubby Ray-flower		1			1	1		
<i>Gratwickia monochaeta</i>			1				1		R
<i>Grevillea anethifolia</i>			1	1		1	1		R
<i>Grevillea aspera</i>	Rough Grevillea		1	1		1	1		
<i>Grevillea huegelii</i>	Comb Grevillea		1			1	1		
<i>Grevillea juncifolia</i>	Honeysuckle Grevillea		1	1		1	1		
<i>Grevillea nematophylla</i>	Water Bush		1	1		1	1		
<i>Grevillea parallelinervis</i>	Gawler Ranges Grevillea		1	1			1		
<i>Grevillea pterosperma</i>	Dune Grevillea		1	1		1			
<i>Grevillea stenobotrya</i>	Rattle-pod Grevillea	unconfirmed					1		
<i>Grevillea treueriana</i>	Scarlet Grevillea		1	1				V	V
<i>Gunniopsis calva</i>			1			1			
<i>Gunniopsis papillata</i>	Twin-leaf Pigface	unconfirmed	1						
<i>Gunniopsis quadrifida</i>	Sturt's Pigface		1			1	1		
<i>Gunniopsis septifraga</i>	Green Pigface						1		
<i>Gunniopsis zygophylloides</i>	Twin-leaf Pigface						1		
* <i>Gypsophila tubulosa</i>	Annual Chalkwort		1				1		
<i>Gyrostemon ramulosus</i>	Bushy Wheel-fruit		1	1					
<i>Haeckeria cassiniaeformis</i>	Dogwood Haeckeria						1		R
<i>Hakea cycloptera</i>	Elm-seed Hakea		1				1		
<i>Hakea francisiana</i>	Bottlebrush Hakea		1	1		1	1		
<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	Silver Needlewood		1	1		1	1		
<i>Hakea muelleriana</i>	Heath Needlebush		1				1		
<i>Halgania andromedifolia</i>	Scented Blue-flower					1			
<i>Halgania cyanea</i>	Rough Blue-flower		1	1		1	1		
<i>Haloragis acutangula</i> forma	Smooth Raspwort	could be 1 of many taxa				1			
<i>Halosarcia halocnemoides</i> ssp. <i>halocnemoides</i>	Grey Samphire		1			1	1		
<i>Halosarcia indica</i> ssp.	Brown-head Samphire	could be 1 of 2 ssp.	1						
<i>Halosarcia indica</i> ssp. <i>leiostachya</i>	Brown-head Samphire		1			1	1		
<i>Halosarcia lylei</i>	Wiry Samphire					1			
<i>Halosarcia pergranulata</i> ssp. <i>pergranulata</i>	Black-seed Samphire		1			1			
<i>Halosarcia pruinosa</i>	Bluish Samphire		1						
<i>Harmsiodoxa puberula</i>	Scented Cress	unconfirmed	1						
* <i>Hedypnois rhagadioloides</i>	Cretan Weed		1	1			1		

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			SU	OP	PP	RE	PM	Aus	SA
<i>Helichrysum leucopsidium</i>	Satin Everlasting		1			1			
<i>Heliotropium asperum</i>	Rough Heliotrope		1						
* <i>Heliotropium europaeum</i>	Common Heliotrope		1				1		
<i>Hemichroa diandra</i>	Mallee Hemichroa		1			1			
* <i>Herniaria cinerea</i>	Rupturewort		1				1		
<i>Hibbertia crispula</i>	Ooldea Guinea-flower				1			V	V
<i>Hibbertia riparia</i>	Guinea-flower		1			1			
<i>Hibbertia virgata</i>	Twiggy Guinea-flower		1			1			
<i>Hibiscus krichauffianus</i>	Velvet-leaf Hibiscus		1			1	1		
<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>	Sturt's Hibiscus		1						
* <i>Holcus lanatus</i>	Yorkshire Fog	unconfirmed	1						
<i>Homoranthus wilhelmii</i>	Wilhelm's Homoranthus						1		
* <i>Hordeum vulgare</i> ssp. <i>vulgare</i>	Barley					1			
<i>Hyalosperma demissum</i>	Dwarf Sunray		1			1	1		
<i>Hyalosperma glutinosum</i> ssp. <i>glutinosum</i>	Golden Sunray		1			1			
<i>Hyalosperma semisterile</i>	Orange Sunray		1				1		
<i>Hybanthus floribundus</i> ssp. <i>floribundus</i>	Shrub Violet					1			
<i>Hybanthus monopetalus</i>	Slender Violet		1						
<i>Hydrocotyle pilifera</i> var. <i>glabrata</i>	Buttercup Pennywort		1			1			
<i>Hydrocotyle trachycarpa</i>	Wild Parsley		1						
* <i>Hymenolobus procumbens</i>	Oval Purse		1						
* <i>Hypochaeris glabra</i>	Smooth Cat's Ear		1			1	1		
* <i>Hypochaeris radicata</i>	Rough Cat's Ear		1				1		
<i>Hypoxis glabella</i> var. <i>glabella</i>	Tiny Star		1						
<i>Indigofera australis</i> var. <i>australis</i>	Austral Indigo		1	1			1		
<i>Indigofera georgei</i>	George's Indigo	unconfirmed		1					
<i>Indigofera helmsii</i>	Helm's Indigo		1						
<i>Iseilema membranaceum</i>	Small Flinders-grass		1				1		
<i>Iseilema vaginiflorum</i>	Red Flinders-grass						1		
<i>Isoetopsis graminifolia</i>	Grass Cushion		1			1			
<i>Isolepis hookeriana</i>	Grassy Club-rush		1						
<i>Isotoma petraea</i>	Rock Isotome		1	1		1			
<i>Isotoma scapigera</i>	Salt Isotome		1						R
<i>Ixiolamys cuneifolia</i>	Silverton Daisy		1						
<i>Ixiolamys nana</i>	Small Fuzzweed						1		
<i>Ixiolaena chloroleuca</i>	Pale Plover-daisy		1						
<i>Ixiolaena leptolepis</i>	Narrow Plover-daisy		1				1		
<i>Ixiolaena tomentosa</i>	Woolly Plover-daisy		1				1		
<i>Kennedia prostrata</i>	Scarlet Runner		1						
<i>Kippistia suaedifolia</i>	Fleshy Kippistia					1			
<i>Korthalsella japonica</i> forma <i>japonica</i>	Jointed Mistletoe					1	1		
<i>Lagenifera huegelii</i>	Coarse Bottle-daisy	unconfirmed					1		
* <i>Lamarckia aurea</i>	Toothbrush Grass		1	1			1		
* <i>Lamium amplexicaule</i> var. <i>amplexicaule</i>	Deadnettle	unconfirmed					1		
<i>Lasiopetalum baueri</i>	Slender Velvet-bush					1			
<i>Lasiopetalum behrii</i>	Pink Velvet-bush		1			1	1		
<i>Lavatera plebeia</i>	Australian Hollyhock						1		
<i>Lawrencella davenportii</i>	Davenport Daisy		1						
<i>Lawrenzia berthae</i>	Showy Lawrenzia					1			R
<i>Lawrenzia glomerata</i>	Clustered Lawrenzia		1			1	1		
<i>Lawrenzia squamata</i>	Thorny Lawrenzia		1			1	1		
<i>Lechenaultia aphylla</i>	Leafless Lechenaultia		1						
<i>Lechenaultia divaricata</i>	Tangled Lechenaultia	unconfirmed	1						
<i>Lemooria burkittii</i>	Wires-and-wool		1				1		
<i>Lepidium leptopetalum</i>	Shrubby Peppergrass		1						
<i>Lepidium oxytrichum</i>	Green Peppergrass		1			1	1		

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			SU	OP	PP	RE	PM	Aus	SA
<i>Lepidium papillosum</i>	Warty Peppergrass		1			1			
<i>Lepidium phlebopetalum</i>	Veined Peppergrass		1				1		
<i>Lepidium rotundum</i>	Veined Peppergrass						1		
<i>Lepidosperma carphoides</i>	Black Rapier-sedge	unconfirmed		1					
<i>Lepidosperma concavum</i>	Spreading Sword-sedge		1	1			1		
<i>Lepidosperma viscidum</i>	Sticky Sword-sedge		1			1			
<i>Lepilaena australis</i>	Austral Water-mat		1						
<i>Leptorhynchus</i> sp.	Buttons	could be 1 of 6 spp.					1		
<i>Leptospermum coriaceum</i>	Dune Tea-tree		1	1		1	1		
<i>Leucochrysum molle</i>	Hoary Sunray		1				1		
<i>Leucochrysum stipitatum</i>	Salt-spoon Daisy		1						
<i>Leucopogon cordifolius</i>	Heart-leaf Beard-heath		1			1	1		
<i>Levenhookia dubia</i>	Hairy Stylewort					1			
* <i>Limonium lobatum</i>	Winged Sea-lavender		1				1		
<i>Limosella curdieana</i> var. "curdieana"	Large Mudwort					1			
<i>Linum marginale</i>	Native Flax		1						
<i>Logania nuda</i>	Leafless Logania		1	1		1			
<i>Lomandra collina</i>	Sand Mat-rush		1			1	1		
<i>Lomandra effusa</i>	Scented Mat-rush		1			1	1		
<i>Lomandra juncea</i>	Desert Mat-rush					1			
<i>Lomandra leucocephala</i> ssp. <i>robusta</i>	Woolly Mat-rush		1			1	1		
<i>Lotus australis</i>	Austral Trefoil						1		
<i>Lotus cruentus</i>	Red-flower Lotus		1			1	1		
<i>Lycium australe</i>	Australian Boxthorn		1	1		1	1		
* <i>Lycium ferocissimum</i>	African Boxthorn		1			1	1		
<i>Lysiana exocarpi</i> ssp. <i>exocarpi</i>	Harlequin Mistletoe		1			1	1		
<i>Lysiana murrayi</i>	Mulga Mistletoe		1				1		
<i>Lythrum paradoxum</i>						1	1		
<i>Maireana aphylla</i>	Cotton-bush		1			1	1		
<i>Maireana appressa</i>	Pale-fruit Bluebush		1			1	1		
<i>Maireana astrotricha</i>	Low Bluebush		1			1	1		
<i>Maireana brevifolia</i>	Short-leaf Bluebush		1	1		1	1		
<i>Maireana campanulata</i>	Bell-fruit Bluebush			1			1		
<i>Maireana cannonii</i>	Cannon's Bluebush		1			1	1		
<i>Maireana coronata</i>	Crown Fissure-plant						1		
<i>Maireana enchylaenoides</i>	Wingless Fissure-plant		1						
<i>Maireana eriantha</i>	Woolly Bluebush		1			1	1		
<i>Maireana erioclada</i>	Rosy Bluebush		1			1	1		
<i>Maireana georgei</i>	Satiny Bluebush		1			1	1		
<i>Maireana integra</i>	Entire-wing Bluebush		1				1		
<i>Maireana lanosa</i>	Woolly Bluebush	unconfirmed					1		
<i>Maireana lobiflora</i>	Lobed Bluebush		1				1		
<i>Maireana microcarpa</i>	Swamp Bluebush		1						
<i>Maireana oppositifolia</i>	Salt Bluebush		1			1			
<i>Maireana ovata</i>		unconfirmed					1		
<i>Maireana pentagona</i>	Slender Fissure-plant						1		R
<i>Maireana pentatropis</i>	Erect mallee Bluebush		1			1	1		
<i>Maireana pyramidata</i>	Black Bluebush		1			1	1		
<i>Maireana radiata</i>	Radiate Bluebush		1			1	1		
<i>Maireana rohrlachii</i>	Rohrlach's Bluebush						1		R
<i>Maireana schistocarpa</i>	Split-fruit Bluebush					1	1		
<i>Maireana sedifolia</i>	Bluebush		1			1	1		
<i>Maireana spongiocarpa</i>	Spongy-fruit Bluebush		1				1		
<i>Maireana suaedifolia</i>	Lax Bluebush					1			R
<i>Maireana tomentosa</i> ssp. <i>urceolata</i>							1		
<i>Maireana trichoptera</i>	Hairy-fruit Bluebush		1			1	1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Maireana triptera</i>	Three-wing Bluebush		1			1	1		
<i>Maireana turbinata</i>	Top-fruit Bluebush		1			1	1		
<i>Maireana villosa</i>	Silky Bluebush	unconfirmed	1				1		
<i>Malacocera biflora</i>	Two-flower Soft-horns						1		
<i>Malacocera gracilis</i>	Slender Soft-horns		1						V
<i>Malacocera tricornis</i>	Goat-head Soft-horns		1				1		
* <i>Malva parviflora</i>	Small-flower Marshmallow		1	1			1		
<i>Malvastrum americanum</i>	Malvastrum		1				1		
* <i>Marrubium vulgare</i>	Horehound		1	1		1	1		
<i>Marsdenia australis</i>	Native Pear		1						
<i>Marsilea drummondii</i>	Common Nardoo			1			1		
<i>Marsilea hirsuta</i>	Short-fruit Nardoo		1						
* <i>Matthiola</i> sp.	Stock	unconfirmed					1		
* <i>Medicago minima</i> var. <i>minima</i>	Little Medic		1				1		
* <i>Medicago polymorpha</i> var. <i>polymorpha</i>	Burr-Medic		1	1			1		
* <i>Medicago truncatula</i>	Barrel Medic		1						
<i>Melaleuca armillaris</i> ssp. <i>akineta</i>	Needle-leaf Honey-myrtle		1	1			1		R
<i>Melaleuca eleutherostachya</i>	Hummock Honey-myrtle		1				1		
<i>Melaleuca halmaturorum</i> ssp. <i>halmaturorum</i>	Swamp Paper-bark						1		
<i>Melaleuca lanceolata</i> ssp. <i>lanceolata</i>	Dryland Tea-tree		1			1	1		
<i>Melaleuca oxyphylla</i>	Pointed-leaf Honey-myrtle		1	1					R
<i>Melaleuca pauperiflora</i> ssp. <i>mutica</i>	Boree		1			1			
<i>Melaleuca</i> sp. <sup>1</sup>	Tea-tree			1			1		
<i>Melaleuca uncinata</i>	Broombush		1	1		1	1		
* <i>Mesembryanthemum aitonis</i>	Angled Iceplant		1						
* <i>Mesembryanthemum crystallinum</i>	Common Iceplant		1				1		
* <i>Mesembryanthemum nodiflorum</i>	Slender Iceplant		1			1	1		
<i>Microcybe multiflora</i> var. <i>baccharoides</i>	Scale-leaf Microcybe		1						
<i>Microcybe multiflora</i> var. <i>multiflora</i>	Small-leaf Microcybe		1			1			
* <i>Micropterum papulosum</i>			1						
<i>Microseris lanceolata</i>	Yam Daisy		1			1			
<i>Microtis</i> sp.	Onion-orchid		1						
<i>Millotia greevesii</i> ssp.		could be 1 of 3 taxa					1		
<i>Millotia greevesii</i> ssp. <i>kempei</i> var. <i>helmsii</i>		unconfirmed					1		
<i>Millotia muelleri</i>	Common Bow-flower		1						
<i>Millotia myosotidifolia</i>	Broad-leaf Millotia		1			1			
<i>Millotia perpusilla</i>	Tiny Bow-flower		1						
<i>Millotia tenuifolia</i> var. <i>tenuifolia</i>	Soft Millotia		1						
<i>Minuria cunninghamii</i>	Bush Minuria		1			1	1		
<i>Minuria denticulata</i>	Woolly Minuria		1				1		
<i>Minuria integerrima</i>	Smooth Minuria		1						
<i>Minuria leptophylla</i>	Minnie Daisy		1			1	1		
<i>Monachather paradoxa</i>	Bandicoot Grass		1				1		
<i>Muehlenbeckia adpressa</i>	Climbing Lignum		1	1		1			
<i>Muehlenbeckia florulenta</i>	Lignum		1	1		1	1		
<i>Murchisonia volubilis</i>			1						
<i>Myoporum brevipes</i>	Warty Boobialla		1			1	1		
<i>Myoporum insulare</i>	Common Boobialla		1						
<i>Myoporum montanum</i>	Native Myrtle		1				1		
<i>Myoporum platycarpum</i> ssp.	False Sandalwood	could be 1 of 2 ssp.	1			1	1		
<i>Myoporum platycarpum</i> ssp. <i>platycarpum</i>	False Sandalwood		1			1			
<i>Myosotis australis</i>	Austral Forget-me-not		1						
<i>Myosurus minimus</i> var. <i>australis</i>	Mousetail	unconfirmed	1						
<i>Myriocephalus rhizocephalus</i> var. <i>rhizocephalus</i>	Woolly-heads						1		
* <i>Neatostema apulum</i>	Hairy Sheepweed		1						

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Neobassia proceriflora</i>	Desert Glasswort		1						
<i>Neurachne alopecuroidea</i>	Fox-tail Mulga-grass		1						
<i>Neurachne munroi</i>	Window Mulga-grass						1		
* <i>Nicotiana glauca</i>	Tree Tobacco		1				1		
<i>Nicotiana goodspeedii</i>	Small-flower Tobacco		1						
<i>Nicotiana maritima</i>	Coast Tobacco		1						
<i>Nicotiana rosulata</i> ssp. <i>rosulata</i>			1	1					
<i>Nicotiana velutina</i>	Velvet Tobacco		1			1	1		
<i>Nitraria billardiarei</i>	Nitre-bush		1			1	1		
<i>Olearia axillaris</i>	Coast Daisy-bush		1						
<i>Olearia calcarea</i>	Crinkle-leaf Daisy-bush		1	1		1	1		
<i>Olearia ciliata</i> var. <i>ciliata</i>	Fringed Daisy-bush					1			
<i>Olearia decurrens</i>	Winged Daisy-bush		1	1		1	1		
<i>Olearia floribunda</i> var. <i>floribunda</i>	Heath Daisy-bush			1		1			
<i>Olearia lepidophylla</i>	Clubmoss Daisy-bush		1			1			
<i>Olearia muelleri</i>	Mueller's Daisy-bush		1			1	1		
<i>Olearia passerinoides</i> ssp. <i>passerinoides</i>	Feather Daisy-bush					1			
<i>Olearia pimeleoides</i> ssp. <i>pimeleoides</i>	Pimelea Daisy-bush		1			1	1		
<i>Olearia rudis</i>	Azure Daisy-bush					1			
<i>Olearia stuartii</i>	Stuart's Daisy-bush		1						
<i>Olearia subspicata</i>	Spiked Daisy-bush		1						
<i>Omphalolappula concava</i>	Burr Stickseed		1				1		
* <i>Onopordum acaulon</i>	Horse Thistle						1		
<i>Opercularia turpis</i>	Twiggy Stinkweed		1			1			
<i>Ophioglossum lusitanicum</i>	Austral Adder's-tongue		1				1		
* <i>Opuntia ficus-indica</i>	Indian Fig	unconfirmed				1			
* <i>Opuntia imbricata</i>	Devil's Rope Pear					1			
* <i>Orbea variegata</i>	Carrion-flower					1			
<i>Osteocarpum acropterum</i> var.	Bonefruit	could be 1 of 2 var.	1				1		
<i>Osteocarpum acropterum</i> var. <i>acropterum</i>	Tuberculate Bonefruit		1			1	1		
<i>Osteocarpum dipterocarpum</i>	Two-wing Bonefruit		1			1	1		
<i>Osteocarpum salsuginosum</i>	Inland Bonefruit		1						
* <i>Osteospermum calendulaceum</i>		unconfirmed					1		
* <i>Osteospermum clandestinum</i>	Tripteris		1				1		
<i>Othonna gregorii</i>	Fleshy Groundsel		1			1	1		
<i>Oxalis perennans</i>	Native Sorrel		1	1		1			
* <i>Oxalis pes-caprae</i>	Soursob						1		
<i>Oxalis radicata</i>	Downy Native Sorrel		1						
<i>Ozothamnus decurrens</i>	Ridged Bush-everlasting		1			1	1		
<i>Ozothamnus retusus</i>	Notched Bush-everlasting		1			1			
<i>Pachyornis triandra</i>	Desert Glasswort		1				1		
<i>Panicum decompositum</i> var. <i>decompositum</i>	Native Millet		1				1		
<i>Panicum effusum</i> var. <i>effusum</i>	Hairy Panic					1	1		
* <i>Papaver hybridum</i>	Rough Poppy		1						
<i>Paractaenum novae-hollandiae</i> ssp. <i>reversum</i>	Barbed-wire Grass		1				1		
<i>Paractaenum refractum</i>	Bristle-brush grass		1				1		
* <i>Parapholis incurva</i>	Curly Ryegrass		1						
<i>Parietaria cardiostegia</i>	Mallee Smooth-nettle		1						
<i>Parietaria debilis</i>	Smooth-nettle		1			1			
<i>Paspalidium basicladum</i>			1				1		
<i>Paspalidium clementii</i>	Clement's Paspalidium					1	1		
<i>Paspalidium constrictum</i>	Knotty-butt Paspalidium		1			1	1		
<i>Paspalidium reflexum</i>						1	1		
* <i>Pentaschistis airoides</i>	False Hair-grass		1				1		



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			SU	OP	PP	RE	PM	Aus	SA
* <i>Phalaris</i> sp.	Canary Grass	could be 1 of 2 spp.					1		
<i>Phebalium bullatum</i>	Silvery Phebalium		1			1			
<i>Phlegmatospermum cochlearinum</i>	Downy Cress						1		
<i>Phyllangium divergens</i>	Wiry Mitrewort		1						
<i>Phyllanthus fuernrohrrii</i>	Sand Spurge		1			1	1		
<i>Phyllanthus lacunarius</i>	Lagoon Spurge		1			1	1		
<i>Phyllanthus saxosus</i>	Rock Spurge		1						
<i>Phyllanthus</i> sp. aff. <i>lacunarius</i>	Sandhill Spurge	unconfirmed					1		
<i>Pimelea curviflora</i> var. <i>sericea</i>	Curved Riceflower		1						
<i>Pimelea glauca</i>	Smooth Riceflower						1		
<i>Pimelea imbricata</i> var. <i>petraea</i>	Woolly Riceflower		1						
<i>Pimelea linifolia</i> ssp. <i>linifolia</i>	Slender Riceflower						1		
<i>Pimelea micrantha</i>	Silky Riceflower		1			1			
<i>Pimelea microcephala</i> ssp. <i>microcephala</i>	Shrubby Riceflower		1	1		1	1		
<i>Pimelea petrophila</i>	Rock Riceflower		1	1			1		
<i>Pimelea simplex</i> ssp. <i>continua</i>	Desert Riceflower					1			
<i>Pimelea simplex</i> ssp. <i>simplex</i>	Desert Riceflower		1	1					
<i>Pimelea stricta</i>	Erect Riceflower						1		
<i>Pimelea trichostachya</i>	Spiked Riceflower		1				1		
<i>Pittosporum phylliraeoides</i> var. <i>microcarpa</i>	Native Apricot		1			1	1		
<i>Plantago</i> aff. <i>Debilis</i>	Shade Plantain	unconfirmed	1						
<i>Plantago cunninghamii</i>	Clay Plantain	unconfirmed					1		
<i>Plantago drummondii</i>	Dark Plantain		1	1		1	1		
<i>Plantago</i> sp. B	Little Plantain		1						
<i>Pleurosorus rutifolius</i>	Blanket Fern		1	1		1	1		
<i>Pleurosorus subglandulosus</i>	Clubbed Blanket Fern		1						
* <i>Poa annua</i>	Winter Grass		1						
<i>Podolepis canescens</i>	Grey Copper-wire Daisy		1			1	1		
<i>Podolepis capillaris</i>	Wiry Podolepis		1	1		1	1		
<i>Podolepis davisiana</i>	Button Podolepis		1				1		
<i>Podolepis jaceoides</i>	Showy Copper-wire Daisy		1				1		R
<i>Podolepis longipedata</i>	Tall Copper-wire Daisy		1	1					
<i>Podolepis muelleri</i>	Button Podolepis	unconfirmed					1		V
<i>Podolepis rugata</i> var. <i>rugata</i>	Pleated Copper-wire Daisy		1						
<i>Podolepis tepperi</i>	Delicate Copper-wire Daisy		1						
<i>Podotheca angustifolia</i>	Sticky Long-heads		1			1			
<i>Pogonolepis muelleriana</i>	Stiff Cup-flower		1			1	1		
<i>Polycalymma stuartii</i>	Poached-egg Daisy		1			1	1		
* <i>Polycarpon tetraphyllum</i>	Four-leaf Allseed		1	1					
<i>Pomaderris paniculosa</i> ssp.	Coast Pomaderris	could be 1 of 2 spp.	1						
<i>Pomax umbellata</i>	Pomax		1	1		1	1		
<i>Poranthera microphylla</i>	Small Poranthera		1			1			
<i>Portulaca intraterranea</i>	Buttercup Purslane	unconfirmed					1		
<i>Portulaca oleracea</i>	Common Purslane		1			1	1		
<i>Prasophyllum odoratum</i>	Scented Leek-orchid		1						
<i>Prostanthera althoferi</i> ssp. <i>longifolia</i>			1						
<i>Prostanthera aspalathoides</i>	Scarlet Mintbush		1			1	1		
<i>Prostanthera florifera</i>	Gawler Ranges Mintbush		1	1		1	1		
<i>Prostanthera serpyllifolia</i> ssp. <i>microphylla</i>	Small-leaf Mintbush		1			1			
<i>Prostanthera serpyllifolia</i> ssp. <i>serpyllifolia</i> (purplish-green flowers)	Thyme Mintbush					1			
<i>Prostanthera striatiflora</i>	Striated Mintbush		1	1		1	1		
<i>Pseudognaphalium luteoalbum</i>	Jersey Cudweed					1			
<i>Pterocaulon sphacelatum</i>	Apple-bush		1				1		
<i>Pterostylis biseta</i>	Two-bristle Greenhood		1			1			
<i>Pterostylis boormanii</i>	Boorman's Greenhood					1			

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Pterostylis excelsa</i>	Dryland Greenhood		1			1			
<i>Pterostylis mutica</i>	Midget Greenhood		1			1			
<i>Pterostylis nana</i>	Dwarf Greenhood		1	1			1		
<i>Pterostylis ovata</i>	Gawler Ranges Greenhood		1	1					
<i>Ptilotus decipiens</i>			1						
<i>Ptilotus exaltatus</i> var. <i>exaltatus</i>	Pink Mulla Mulla		1	1		1	1		
<i>Ptilotus gaudichaudii</i> var. <i>gaudichaudii</i>	Paper Fox-tail		1				1		
<i>Ptilotus macrocephalus</i>	Feather-heads	unconfirmed					1		
<i>Ptilotus nobilis</i> var. <i>nobilis</i>	Yellow-tails		1				1		
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	Silver Mulla Mulla		1			1	1		
<i>Ptilotus parvifolius</i> var. <i>laetus</i>	Small-leaf Mulla Mulla		1						
<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>	Long-tails		1	1			1		
<i>Ptilotus seminudus</i>	Rabbit-tails		1	1		1	1		
<i>Ptilotus sessilifolius</i> var. <i>sessilifolius</i>	Crimson-tails		1				1		
<i>Ptilotus spathulatus</i> forma	Pussy-tails	could be 1 of 2 forma	1	1			1		
<i>Ptilotus spathulatus</i> forma <i>spathulatus</i>	Pussy-tails		1	1		1			
<i>Pycnosorus pleiocephalus</i>	Soft Billy-buttons		1	1			1		
<i>Ranunculus sessiliflorus</i> var. <i>sessiliflorus</i>	Annual Buttercup		1						
* <i>Rapistrum rugosum</i> ssp. <i>rugosum</i>	Turnip Weed	unconfirmed					1		
* <i>Reichardia tingitana</i>	False Sowthistle					1	1		
<i>Rhagodia candolleana</i> ssp. <i>candolleana</i>	Sea-berry Saltbush		1			1			
<i>Rhagodia crassifolia</i>	Fleshy Saltbush		1			1	1		
<i>Rhagodia eremaea</i>	Desert Saltbush		1						
<i>Rhagodia parabolica</i>	Mealy Saltbush		1	1		1	1		
<i>Rhagodia preissii</i> ssp. <i>preissii</i>	Mallee Saltbush		1			1	1		
<i>Rhagodia spinescens</i>	Spiny Saltbush		1			1	1		
<i>Rhagodia ulicina</i>	Intricate Saltbush		1			1	1		
<i>Rhodanthe chlorocephala</i> ssp. <i>rosea</i>	Western Sunray		1						
<i>Rhodanthe corymbiflora</i>	Paper Everlasting		1				1		
<i>Rhodanthe floribunda</i>	White Everlasting		1				1		
<i>Rhodanthe haigii</i>	Haig's Everlasting		1						
<i>Rhodanthe laevis</i>	Smooth Daisy		1			1			
<i>Rhodanthe microglossa</i>	Clustered Everlasting		1				1		
<i>Rhodanthe moschata</i>	Musk Daisy		1			1	1		
<i>Rhodanthe oppositifolia</i> ssp. <i>oppositifolia</i>	Twin-leaf Everlasting		1						V
<i>Rhodanthe polygalifolia</i>	Milkwort Everlasting		1			1	1		
<i>Rhodanthe pygmaea</i>	Pigmy Daisy		1			1	1		
<i>Rhodanthe stricta</i>	Slender Everlasting		1				1		
<i>Rhodanthe stuartiana</i>	Clay Everlasting		1			1	1		
<i>Rhodanthe uniflora</i>	Woolly Daisy		1				1		
<i>Rhyncharrhena linearis</i>	Climbing Purple-star		1	1			1		
* <i>Romulea</i> sp.	Onion-grass	could be 1 of 2 spp.					1		
<i>Rostellularia adscendens</i> ssp. <i>adscendens</i> var.	Pink Tongue	unconfirmed	1						
<i>Rostellularia adscendens</i> ssp. <i>adscendens</i> var. <i>pogonanthra</i>	Pink Tongues	unconfirmed					1		
* <i>Rostraria cristata</i>	Annual Cat's-tail		1				1		
* <i>Rostraria pumila</i>	Tiny Bristle-grass		1				1		
<i>Rulingia crauophylla</i>						1			V
<i>Rumex dumosus</i> var. <i>dumosus</i>	Wiry Dock		1						
<i>Rutidosis multiflora</i>	Small Wrinklewort		1						
* <i>Sagina</i> sp.	Pearlwort	could be 1 of 2 spp.		1					
<i>Salsola kali</i>	Buckbush		1			1	1		
* <i>Salvia verbenaca</i> form A	Wild Sage		1						

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
* <i>Salvia verbenaca</i> form B	Wild Sage					1			
<i>Santalum acuminatum</i>	Quandong		1			1	1		
<i>Santalum lanceolatum</i>	Plumbush		1			1	1		
<i>Santalum murrayanum</i>	Bitter Quandong		1			1	1		
<i>Santalum spicatum</i>	Sandalwood		1			1	1		V
<i>Sarcocornia quinqueflora</i>	Beaded Samphire		1			1			
<i>Sarcostemma viminale</i> ssp. <i>australe</i>	Caustic Bush		1			1	1		
<i>Sarcozona praecox</i>	Sarcozona		1				1		
<i>Sauropus trachyspermus</i>	Rough-seed Spurge						1		
<i>Scaevola aemula</i>	Fairy Fanflower		1	1		1	1		
<i>Scaevola albida</i>	Pale Fanflower						1		
<i>Scaevola collaris</i>				1		1	1		
<i>Scaevola collina</i>	Hill Fanflower	unconfirmed	1						
<i>Scaevola humilis</i>	Inland Fanflower	unconfirmed	1				1		
<i>Scaevola spinescens</i>	Spiny Fanflower		1			1	1		
* <i>Schinus areira</i>	Pepper-tree		1						
* <i>Schismus barbatus</i>	Arabian Grass		1			1	1		
<i>Schoenia cassiniana</i>	Pink Everlasting		1						
<i>Schoenia ramosissima</i>	Dainty Everlasting		1				1		
<i>Schoenus nanus</i>	Little Bog-rush		1						
<i>Schoenus subaphyllus</i>	Desert Bog-rush					1	1		
<i>Scleranthus minusculus</i>	Cushion Knawel		1						
<i>Scleranthus pungens</i>	Prickly Knawel		1	1		1	1		
<i>Sclerolaena bicornis</i>	Goat-head Bindyi						1		
<i>Sclerolaena bicuspis</i>	Two-spine Bindyi						1		
<i>Sclerolaena blackiana</i>	Black's Bindyi	unconfirmed					1		R
<i>Sclerolaena brachyptera</i>	Short-wing Bindyi		1			1	1		
<i>Sclerolaena brevifolia</i>	Small-leaf Bindyi		1				1		
<i>Sclerolaena constricta</i>		unconfirmed	1				1		
<i>Sclerolaena convexula</i>	Tall Bindyi						1		
<i>Sclerolaena costata</i>	Ribbed Bindyi		1				1		
<i>Sclerolaena cuneata</i>	Tangled Bindyi		1				1		
<i>Sclerolaena decurrens</i>	Green Bindyi		1			1	1		
<i>Sclerolaena diacantha</i>	Grey Bindyi		1			1	1		
<i>Sclerolaena divaricata</i>	Tangled Bindyi		1			1	1		
<i>Sclerolaena eriakantha</i>	Silky Bindyi		1				1		
<i>Sclerolaena holtiana</i>	Holt's Bindyi						1		R
<i>Sclerolaena intricata</i>	Tangled Bindyi		1				1		
<i>Sclerolaena johnsonii</i>	Johnson's Bindyi	unconfirmed					1		
<i>Sclerolaena lanicuspis</i>	Spinach Bindyi		1			1	1		
<i>Sclerolaena limbata</i>	Pearl Bindyi		1				1		
<i>Sclerolaena longicuspis</i>	Long-spine Bindyi	unconfirmed	1				1		
<i>Sclerolaena obliquicuspis</i>	Oblique-spined Bindyi		1			1	1		
<i>Sclerolaena parallelicuspis</i>	Western Bindyi		1			1	1		
<i>Sclerolaena parviflora</i>	Small-flower Bindyi		1			1	1		
<i>Sclerolaena patentispis</i>	Spear-fruit Bindyi		1			1	1		
<i>Sclerolaena tatei</i>	Tate's Bindyi						1		
<i>Sclerolaena tricuspis</i>	Three-spine Bindyi	unconfirmed	1				1		
<i>Sclerolaena uniflora</i>	Small-spine Bindyi		1				1		
<i>Sclerolaena ventricosa</i>	Salt Bindyi		1			1	1		
<i>Sclerostegia arbuscula</i>	Shrubby Samphire		1			1	1		
<i>Sclerostegia disarticulata</i>			1	1		1	1		
<i>Sclerostegia medullosa</i>		unconfirmed	1				1		
<i>Sclerostegia tenuis</i>	Slender Samphire		1			1	1		
<i>Senecio gawlerensis</i>	Gawler Ranges Groundsel		1	1			1		
<i>Senecio glossanthus</i>	Annual Groundsel		1	1		1	1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Senecio laceratus</i>	Cut-leaf Groundsel		1						
<i>Senecio lautus</i>	Variable Groundsel		1			1	1		
<i>Senecio magnificus</i>	Showy Groundsel		1				1		
<i>Senecio quadridentatus</i>	Cotton Groundsel		1			1			
<i>Senecio tenuiflorus</i>	Woodland Groundsel		1						
<i>Senna "phyllodinea"</i>		unconfirmed	1						
<i>Senna artemisioides</i> nothosp. <i>artemisioides</i>	Silver Senna		1			1	1		
<i>Senna artemisioides</i> nothosp. <i>coriacea</i>	Broad-leaf Desert senna		1			1	1		
<i>Senna artemisioides</i> nothosp. <i>sturtii</i>	Grey Senna		1			1	1		
<i>Senna artemisioides</i> ssp. <i>alicia</i>	Desert Senna						1		
<i>Senna artemisioides</i> ssp. <i>filifolia</i>	Fine-leaf Desert Senna		1	1		1	1		
<i>Senna artemisioides</i> ssp. <i>helmsii</i>	Blunt-leaf Senna		1				1		
<i>Senna artemisioides</i> ssp. <i>oligophylla</i>	Limestone Senna						1		
<i>Senna artemisioides</i> ssp. <i>petiolaris</i>	Flat-stalk Senna		1			1	1		
<i>Senna artemisioides</i> ssp. <i>zygophylla</i>	Twin-leaf Desert Senna						1		
<i>Senna cardiosperma</i> ssp. <i>gawlerensis</i>	Gawler Ranges Senna		1			1	1		
<i>Senna cardiosperma</i> ssp. <i>microphylla</i>	Curved-leaf Senna					1	1		
<i>Senna pleurocarpa</i> var. <i>pleurocarpa</i>	Stripe-pod Senna		1	1					
<i>Sida ammophila</i>	Sand Sida		1			1	1		
<i>Sida calyxhymenia</i>	Tall Sida	unconfirmed	1				1		
<i>Sida corrugata</i> var.	Corrugated Sida	could be 1 of 3 var.	1			1	1		
<i>Sida corrugata</i> var. A (N.N.Donner 7573)			1						
<i>Sida corrugata</i> var. <i>angustifolia</i>	Grassland Sida		1						
<i>Sida corrugata</i> var. <i>corrugata</i>	Corrugated Sida	unconfirmed	1						
<i>Sida cunninghamii</i>	Ridge Sida	unconfirmed					1		
<i>Sida fibulifera</i>	Pin Sida		1			1	1		
<i>Sida filiformis</i>	Fine Sida		1	1			1		
<i>Sida intricata</i>	Twiggy Sida		1			1	1		
<i>Sida petrophila</i>	Rock Sida		1			1	1		
<i>Sida trichopoda</i>	High Sida		1			1	1		
<i>Sigesbeckia australiensis</i>	Australian Sigesbeckia		1						
* <i>Silene gallica</i> var. <i>gallica</i>	French Catchfly		1						
* <i>Silene nocturna</i>	Mediterranean Catchfly		1				1		
* <i>Silene tridentata</i>			1						
* <i>Sisymbrium erysimoides</i>	Smooth Mustard		1	1		1	1		
* <i>Sisymbrium irio</i>	London Mustard		1	1					
* <i>Sisymbrium orientale</i>	Indian hedge Mustard		1	1					
<i>Solanum cleistogamum</i>	Shy Nightshade		1						
<i>Solanum coactiliferum</i>	Tomato-bush		1	1		1	1		
<i>Solanum ellipticum</i>	Velvet Potato-bush		1	1		1	1		
<i>Solanum esuriale</i>	Quena		1			1	1		
<i>Solanum hystrix</i>	Afghan Thistle					1			
<i>Solanum lasiophyllum</i>	Flannel Bush						1		
* <i>Solanum nigrum</i>	Black Nightshade		1	1			1		
<i>Solanum oligacanthum</i>	Desert Nightshade						1		
<i>Solanum orbiculatum</i> ssp. <i>orbiculatum</i>	Round-leaf Nightshade		1				1		
<i>Solanum petrophilum</i>	Rock Nightshade		1			1	1		
<i>Solanum quadrilobulatum</i>	Plains Nightshade						1		
<i>Solanum simile</i>	Kangaroo Apple		1						
<i>Solanum sturtianum</i>	Sturt's Nightshade		1	1			1		
* <i>Solanum triflorum</i>	Three-flower Nightshade		1						
* <i>Sonchus asper</i> ssp. <i>asper</i>	Rough Sow-thistle		1						
* <i>Sonchus oleraceus</i>	Common Sow-thistle		1	1		1	1		
* <i>Sonchus</i> sp.	Sow-thistle	could be 1 of 6 taxa					1		
* <i>Sonchus tenerrimus</i>	Clammy Sow-thistle		1				1		
* <i>Spergularia diandra</i>	Lesser Sand-spurrey		1	1					

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>*Spergularia marina</i>	Salt Sand-spurrey		1				1		
<i>*Spergularia media</i>	Coast Sand-spurrey		1						
<i>Sporobolus actinocladius</i>	Ray Grass		1			1	1		
<i>Spyridium bifidum</i> var. <i>bifidum</i>	Forked Spyridium		1			1			
<i>Spyridium tridentatum</i>	Trident Spyridium						1		
<i>Stackhousia clementii</i>	Limestone Candles		1			1	1		
<i>Stackhousia monogyna</i>	Creamy Candles					1			
<i>Stackhousia muricata</i> ssp. "Perennial" (W.R.Barker 3641)	Yellow Candles		1			1			
<i>Stellaria filiformis</i>	Thread Starwort		1						
<i>*Stellaria media</i>	Chickweed		1						
<i>Stemodia florulenta</i>	Bluerod		1			1	1		
<i>Stenopetalum lineare</i>	Narrow Thread-petal		1			1	1		
<i>Stenopetalum sphaerocarpum</i>	Round-fruit Thread-petal		1						
<i>Stipa acroclita</i>	Graceful Spear-grass	unconfirmed	1			1	1		
<i>Stipa drummondii</i>	Cottony Spear-grass		1			1	1		
<i>Stipa elegantissima</i>	Feather Spear-grass		1			1	1		
<i>Stipa eremophila</i>	Rusty Spear-grass		1			1	1		
<i>Stipa exilis</i>	Heath Spear-grass					1			
<i>Stipa flavescens</i>	Coast Spear-grass		1						
<i>Stipa hemipogon</i>	Half-beard Spear-grass		1						
<i>Stipa mollis</i>	Soft Spear-grass		1						
<i>Stipa nitida</i>	Balcarra Spear-grass		1			1	1		
<i>Stipa nodosa</i>	Tall Spear-grass		1			1	1		
<i>Stipa nullanulla</i>	Club Spear-grass		1					V	V
<i>Stipa platychaeta</i>	Flat-awn Spear-grass		1			1			
<i>Stipa puberula</i>	Fine-hairy Spear-grass		1						R
<i>Stipa scabra</i> group	Falcate-awn Spear-grass		1			1			
<i>Stipa scabra</i> ssp. <i>falcata</i>	Slender Spear-grass	unconfirmed	1			1	1		
<i>Stipa scabra</i> ssp. <i>scabra</i>	Rough Spear-grass		1				1		
<i>Stipa tenuifolia</i>						1			R
<i>Stipa trichophylla</i>			1						
<i>Streptoglossa cylindriceps</i>		unconfirmed	1						
<i>Stuartina muelleri</i>	Spoon Cudweed		1						
<i>Suaeda australis</i>	Austral Seablite		1						
<i>Swainsona canescens</i>	Grey Swainson-pea		1	1			1		
<i>Swainsona colutoides</i>	Bladder Swainson-pea			1					
<i>Swainsona formosa</i>	Sturt Pea		1	1			1		
<i>Swainsona laxa</i>		unconfirmed					1		
<i>Swainsona microcalyx</i>	Wild Violet		1						R
<i>Swainsona microphylla</i>	Small-leaf Swainson-pea		1						
<i>Swainsona oliveri</i>			1						
<i>Swainsona oroboides</i>	Variable Swainson-pea			1					
<i>Swainsona oroboides</i> complex	Variable Swainson-pea		1						
<i>Swainsona phacoides</i>	Dwarf Swainson-pea		1			1	1		
<i>Swainsona pyrophila</i>	Yellow Swainson-pea		1					V	R
<i>Swainsona stipularis</i>	Orange Swainson-pea		1				1		
<i>Templetonia egena</i>	Broombush Templetonia		1	1		1	1		
<i>Templetonia sulcata</i>	Flat Mallee-pea		1						
<i>Tephrosia sphaerospora</i>	Mulga Trefoil						1		
<i>Tetragonia eremaea</i>	Desert Spinach		1				1		
<i>Tetragonia implexicoma</i>	Bower Spinach		1						
<i>Tetragonia tetragonioides</i>	New Zealand Spinach		1				1		
<i>Teucrium corymbosum</i>	Rock Germander		1	1			1		
<i>Teucrium racemosum</i>	Grey Germander		1			1	1		
<i>Teucrium sessiliflorum</i>	Mallee Germander		1			1	1		

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Thelymitra nuda</i>	Scented Sun-orchid		1						
<i>Themeda triandra</i>	Kangaroo Grass		1				1		
<i>Threlkeldia diffusa</i>	Coast Bonefruit		1			1			
<i>Thryptomene elliottii</i>			1						
<i>Thryptomene micrantha</i>	Ribbed Thryptomene		1			1			
<i>Thyridolepis mitchelliana</i>	Window Mulga-grass		1	1		1	1		
<i>Thysanotus baueri</i>	Mallee Fringe-lily		1	1		1	1		
<i>Thysanotus patersonii</i>	Twining Fringe-lily		1			1	1		
<i>Thysanotus tenellus</i>	Grassy Fringe-lily		1						
<i>Trachymene cyanopetala</i>	Purple Trachymene					1			
<i>Trachymene glaucifolia</i>	Blue Parsnip		1				1		
<i>Trachymene ornata</i> var. <i>ornata</i>	Sponge-fruit Trachymene		1			1	1		
<i>Tragus australianus</i>	Small Burr-grass		1			1	1		
<i>Trianthema triquetra</i>	Red Spinach		1				1		
<i>Tribulus eichlerianus</i>	Eichler's Caltrop		1						
<i>Tribulus hystrix</i>	Spiky Caltrop						1		
<i>Tribulus minutus</i>		unconfirmed	1						
* <i>Tribulus terrestris</i>	Caltrop						1		
<i>Trichanthodium skirrophorum</i>	Woolly Yellow-heads		1			1	1		
<i>Trichodesma zeylanicum</i>	Camel Bush						1		
* <i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover		1						
* <i>Trifolium tomentosum</i>	Woolly Clover			1					
<i>Triglochin calcitrapum</i>	Spurred Arrowgrass		1						
<i>Triglochin centrocarpum</i>	Dwarf Arrowgrass		1			1			
<i>Trigonella suavissima</i>	Sweet Fenugreek		1						
<i>Triodia basedowii</i>	Hard Spinifex	unconfirmed					1		
<i>Triodia irritans</i>	Spinifex		1			1	1		
<i>Triodia lanata</i>	Woolly Spinifex		1						
<i>Triodia scariosa</i> ssp. <i>scariosa</i>	Spinifex		1			1			
<i>Tripogon loliiformis</i>	Five-minute Grass		1			1	1		
<i>Triraphis mollis</i>	Purple Plume Grass		1			1	1		
* <i>Urospermum picroides</i>	False Hawkbit		1	1					
* <i>Urtica urens</i>	Small Nettle			1					
<i>Velleia arguta</i>	Toothed Velleia		1	1		1			
<i>Velleia connata</i>	Cup Velleia		1	1					
* <i>Vicia monantha</i>	Spurred Vetch		1						
<i>Vittadinia australasica</i> var. <i>australasica</i>	Sticky New Holland Daisy					1	1		
<i>Vittadinia cervicalis</i> var. <i>cervicalis</i>	Waisted New Holland Daisy		1						
<i>Vittadinia cuneata</i> var.	Fuzzy New Holland Daisy	could be 1 of 2 var.					1		
<i>Vittadinia cuneata</i> var. <i>cuneata</i> forma <i>cuneata</i>	Fuzzy New Holland Daisy		1			1			
<i>Vittadinia dissecta</i> var. <i>hirta</i>	Dissected New Holland Daisy	unconfirmed	1			1	1		
<i>Vittadinia eremaea</i>	Desert New Holland Daisy		1				1		
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy		1	1			1		
<i>Vittadinia pterochaeta</i>	Rough New Holland Daisy		1						
<i>Vittadinia sulcata</i>	Furrowed New Holland Daisy		1						
* <i>Vulpia bromoides</i>	Squirrel-tail Fescue						1		
* <i>Vulpia fasciculata</i>	Sand Fescue		1						
* <i>Vulpia muralis</i>	Wall Fescue		1			1			
* <i>Vulpia myuros</i> forma	Fescue	could be 1 of 2 forma					1		
* <i>Vulpia myuros</i> forma <i>myuros</i>	Rat's-tail Fescue		1						
<i>Wahlenbergia communis</i>	Tufted Bluebell		1	1			1		
<i>Wahlenbergia gracilentia</i>	Annual Bluebell		1			1	1		
<i>Wahlenbergia preissii</i>			1			1			
<i>Wahlenbergia stricta</i> ssp. <i>stricta</i>	Tall Bluebell		1	1			1		
<i>Wahlenbergia tumidifructa</i>	Swollen-fruit Bluebell		1	1					

Species Name	Common Name	Comments	Source					Ratings	
			SU	OP	PP	RE	PM	Aus	SA
<i>Waitzia acuminata</i> var. <i>acuminata</i>	Orange Immortelle		1			1	1		
<i>Westringia dampieri</i>	Shore Westringia						1		
<i>Westringia eremicola</i>	Slender Westringia	unconfirmed					1		
<i>Westringia rigida</i>	Stiff Westringia		1	1		1	1		
<i>Wurmbea centralis</i> ssp. <i>australis</i>	Inland Nancy		1				1		
<i>Wurmbea decumbens</i>	Trailing Nancy		1						R
<i>Wurmbea dioica</i> ssp.		could be 1 of 2 ssp.	1				1		
<i>Wurmbea dioica</i> ssp. <i>dioica</i>	Early Nancy		1						
<i>Wurmbea</i> sp.	Nancy		1				1		
* <i>Xanthium spinosum</i>	Bathurst Burr					1			
<i>Zaleya galericulata</i>	Hogweed						1		
* <i>Zaluzianskya divaricata</i>	Spreading Night-phlox		1						
<i>Zygochloa paradoxa</i>	Sandhill Cane-grass		1			1	1		
<i>Zygophyllum ammophilum</i>	Sand Twinleaf		1	1			1		
<i>Zygophyllum ammophilum</i> complex			1						
<i>Zygophyllum angustifolium</i>	Scrambling Twinleaf		1			1			
<i>Zygophyllum apiculatum</i>	Pointed Twinleaf		1			1	1		
<i>Zygophyllum aurantiacum</i> ssp.		could be 1 of 4 ssp.				1	1		
<i>Zygophyllum aurantiacum</i> ssp. <i>aurantiacum</i>	Shrubby Twinleaf		1			1			
<i>Zygophyllum aurantiacum</i> ssp. <i>cuneatum</i>							1		
<i>Zygophyllum billardiieri</i>	Coast Twinleaf						1		
<i>Zygophyllum confluens</i>	Forked Twinleaf		1			1			
<i>Zygophyllum crenatum</i>	Notched Twinleaf		1				1		
<i>Zygophyllum emarginatum</i>	Notched Twinleaf						1		
<i>Zygophyllum eremaeum</i>	Pale-flower Twinleaf		1	1		1	1		
<i>Zygophyllum glaucum</i>	Pale Twinleaf		1			1	1		
<i>Zygophyllum howittii</i>	Clasping Twinleaf		1				1		
<i>Zygophyllum humillimum</i>	Small-fruit Twinleaf	unconfirmed	1				1		R
<i>Zygophyllum iodocarpum</i>	Violet Twinleaf		1				1		
<i>Zygophyllum ovatum</i>	Dwarf Twinleaf		1	1		1	1		
<i>Zygophyllum prismatothecum</i>	Square-fruit Twinleaf		1			1	1		
<i>Zygophyllum simile</i>	White Twinleaf		1						

# Fauna Recorded in Gawler Bioregion

Source: Neagle (2003).

## Bird species

Taxonomy follows the DEH Vertebrate Taxonomic database and Robinson *et al.* (1990).

Species\* = exotic species.

Source: BA = Birds Australia (1981 Atlas and 2001 Census); DEH = Department for Environment and Heritage (Survey, Opportunistic Sightings and Reserves databases); SAM = South Australian Museum; WMC = Western Mining Corporation Opportune database.

C = current record (ie 1/1/1970 to present); 19 = record from 1/1/1900 to 31/12/1969; 18 = record pre-1900.

Status: SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9).

Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

E = endangered; V = vulnerable; R = rare.

Migratory Birds: Species protected under international agreements. CAMBA = China Australia Migratory Birds Agreement; JAMBA = Japan Australia Migratory Birds Agreement.

## Gawler Bioregion

Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	C	C	C					
Aves	<i>Acanthiza apicalis</i>	Inland Thornbill	C	C	C					
Aves	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	C	C	C					
Aves	<i>Acanthiza iredalei</i>	Slender-billed Thornbill	C	C	C		V	V		
Aves	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	C	C	C					
Aves	<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	C	C	C					
Aves	<i>Accipiter fasciatus</i>	Brown Goshawk	C	C	C					
Aves	<i>Acrocephalus australis</i>	Australian Reed Warbler (Clamorous Reed-Warbler)	C							
Aves	<i>Actitis hypoleucos</i>	Common Sandpiper	C						C	J
Aves	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	C	C	19					
Aves	* <i>Alauda arvensis</i>	Eurasian Skylark	C							
Aves	<i>Amytornis merrotsyi</i> <sup>1</sup>	Short-tailed Grasswren								
Aves	<i>Amytornis striatus</i>	Striated Grasswren	C	C	C		V			
Aves	<i>Amytornis textilis modestus</i>	Thick-billed Grasswren		C			R	V		
Aves	<i>Amytornis textilis myall</i>	Thick-billed Grasswren	C		C		E	V		
Aves	<i>Anas castanea</i>	Chestnut Teal	C							
Aves	<i>Anas gracilis</i>	Grey Teal	C	C	C					
Aves	<i>Anas rhynchotis</i>	Australasian Shoveler	C				R			
Aves	<i>Anas superciliosa</i>	Pacific Black Duck	C							
Aves	<i>Anhinga melanogaster</i>	Darter	C							
Aves	<i>Anthochaera carunculata</i>	Red Wattlebird	C	C	19					
Aves	<i>Anthus novaeseelandiae</i>	Richard's Pipit	C	C	C					
Aves	<i>Aphelocephala leucopsis</i>	Southern Whiteface	C	C	C					
Aves	<i>Aphelocephala pectoralis</i>	Chestnut-breasted Whiteface	C				R			
Aves	<i>Apus pacificus</i>	Fork-tailed Swift	C						C	J
Aves	<i>Aquila audax</i>	Wedge-tailed Eagle	C	C	C					
Aves	<i>Ardea alba</i>	Great Egret (White Egret)	C						C	J
Aves	<i>Ardea ibis</i>	Cattle Egret	C						C	J
Aves	<i>Ardea pacifica</i>	White-necked Heron	C							
Aves	<i>Ardeotis australis</i>	Australian Bustard	C		C	C	V			
Aves	<i>Arenaria interpres</i>	Ruddy Turnstone	C						C	J
Aves	<i>Artamus cinereus</i>	Black-faced Woodswallow	C	C	C					
Aves	<i>Artamus cyanopterus</i>	Dusky Woodswallow	C	C	19					
Aves	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow	C							



Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Artamus minor</i>	Little Woodswallow	C							
Aves	<i>Artamus personatus</i>	Masked Woodswallow	C	C	C					
Aves	<i>Artamus superciliosus</i>	White-browed Woodswallow	C	C	C					
Aves	<i>Ashbyia lovensis</i>	Gibberbird	C							
Aves	<i>Aythya australis</i>	Hardhead (White-eyed Duck)	C	C						
Aves	<i>Barnardius zonarius</i>	Australian Ringneck (Ring-necked Parrot)	C	C	C					
Aves	<i>Biziura lobata</i>	Musk Duck	C				R			
Aves	<i>Burhinus grallarius</i>	Bush Stone-curlew	19				V			
Aves	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	C							
Aves	<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo	C	C	C	C	V			
Aves	<i>Cacatua roseicapilla</i>	Galah	C	C	C					
Aves	<i>Cacatua sanguinea</i>	Little Corella	C	C	C					
Aves	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	C	C						
Aves	<i>Calamanthus campestris</i>	Rufous Fieldwren	C	C	C					
Aves	<i>Calamanthus cautus</i>	Shy Heathwren (Shy Hylacola)	C	C	C					
Aves	<i>Calamanthus pyrrhopygius</i>	Chestnut-rumped Heathwren	C				V			
Aves	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	C	C					C	J
Aves	<i>Calidris canutus</i>	Red Knot	C						C	J
Aves	<i>Calidris ferruginea</i>	Curlew Sandpiper	C						C	J
Aves	<i>Calidris ruficollis</i>	Red-necked Stint	C	19					C	J
Aves	<i>Calidris tenuirostris</i>	Great Knot	C						C	J
Aves	<i>Certhionyx niger</i>	Black Honeyeater	C	C	18					
Aves	<i>Certhionyx variegatus</i>	Pied Honeyeater	C	C	C					
Aves	<i>Charadrius australis</i>	Inland Dotterel	C	C	C					
Aves	<i>Charadrius bicinctus</i>	Double-banded Plover	C							
Aves	<i>Charadrius mongolus</i>	Lesser Sand Plover	C						C	J
Aves	<i>Charadrius ruficapillus</i>	Red-capped Plover	C		C					
Aves	<i>Charadrius veredus</i>	Oriental Plover	19							
Aves	<i>Chenonetta jubata</i>	Australian Wood Duck (Maned Duck)	C	C	19					
Aves	<i>Cheramoeca leucosternus</i>	White-backed Swallow	C	C	19					
Aves	<i>Chlidonias hybridus</i>	Whiskered Tern	C		C					
Aves	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-cuckoo	C	C	C					
Aves	<i>Chrysococcyx osculans</i>	Black-eared Cuckoo	C	C	19					
Aves	<i>Cincloramphus cruralis</i>	Brown Songlark	C	C	C					
Aves	<i>Cincloramphus mathewsi</i>	Rufous Songlark	C	C	19					
Aves	<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	C	C	C		R			
Aves	<i>Cinclosoma cinnamomeum</i>	Cinnamon Quail-thrush	C	C	C					
Aves	<i>Circus approximans</i>	Swamp Harrier	C		19					
Aves	<i>Circus assimilis</i>	Spotted Harrier	C	C	19					
Aves	<i>Cladorhynchus leucocephalus</i>	Banded Stilt	C		C					
Aves	<i>Climacteris affinis</i>	White-browed Treecreeper	C	C	C		R			
Aves	<i>Climacteris picumnus</i>	Brown Treecreeper	C							
Aves	<i>Climacteris rufa</i>	Rufous Treecreeper	C	C	C					
Aves	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	C	C	C					
Aves	* <i>Columba livia</i>	Rock Dove	C	C						
Aves	<i>Coracina maxima</i>	Ground Cuckoo-shrike	C	C	C					
Aves	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	C	C						
Aves	<i>Corcorax melanorhamphos</i>	White-winged Chough	C	C	19					
Aves	<i>Corvus bennetti</i>	Little Crow	C	C	C					
Aves	<i>Corvus coronoides</i>	Australian Raven	C	C	C					
Aves	<i>Corvus mellori</i>	Little Raven	C	C	C					
Aves	<i>Coturnix pectoralis</i>	Stubble Quail	C	C	C					
Aves	<i>Cracticus nigrogularis</i> <sup>2</sup>	Pied Butcherbird	C							
Aves	<i>Cracticus torquatus</i>	Grey Butcherbird	C	C	C					
Aves	<i>Cuculus pallidus</i>	Pallid Cuckoo	C	C	19					

Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Cygnus atratus</i>	Black Swan	C							
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	C							
Aves	<i>Daphoenositta chrysoptera</i>	Varied Sittella	C	C	C					
Aves	<i>Dicaeum hirundinaceum</i>	Mistletoebird	C	C	19					
Aves	<i>Dromaius novaehollandiae</i>	Emu	C	C	C					
Aves	<i>Drymodes brunneopygia</i>	Southern Scrub-robin	C	C	C					
Aves	<i>Egretta garzetta</i>	Little Egret	C							
Aves	<i>Egretta novaehollandiae</i>	White-faced Heron	C	C						
Aves	<i>Egretta sacra</i>	Eastern Reef Egret	C				R		C	
Aves	<i>Elanus axillaris</i>	Black-shouldered Kite	C	C	C					
Aves	<i>Elanus scriptus</i>	Letter-winged Kite	C							
Aves	<i>Elseornis melanops</i>	Black-fronted Dotterel	C	C	19					
Aves	<i>Emblema pictum</i>	Painted Finch	C				R			
Aves	<i>Eopsaltria australis</i>	Eastern Yellow Robin	19							
Aves	<i>Eopsaltria griseogularis</i>	Western Yellow Robin	C	C	C					
Aves	<i>Epthianura albifrons</i>	White-fronted Chat	C	C	C					
Aves	<i>Epthianura aurifrons</i>	Orange Chat	C	C	C					
Aves	<i>Epthianura tricolor</i>	Crimson Chat	C	C	C					
Aves	<i>Erythronys cinctus</i>	Red-kneed Dotterel	C		C					
Aves	<i>Eurostopodus argus</i>	Spotted Nightjar	C	C	C					
Aves	<i>Falco berigora</i>	Brown Falcon	C	C	19					
Aves	<i>Falco cenchroides</i>	Nankeen Kestrel	C	C	C					
Aves	<i>Falco hypoleucos</i>	Grey Falcon	C				R			
Aves	<i>Falco longipennis</i>	Australian Hobby	C	C	18					
Aves	<i>Falco peregrinus</i>	Peregrine Falcon	C	19			R			
Aves	<i>Falco subniger</i>	Black Falcon	C		C					
Aves	<i>Fulica atra</i>	Eurasian Coot	C		C					
Aves	<i>Gallinago hardwickii</i>	Latham's Snipe	C				V		C	J
Aves	<i>Gallinula tenebrosa</i>	Dusky Moorhen	C							
Aves	<i>Gallinula ventralis</i>	Black-tailed Native-hen	C	C	C					
Aves	<i>Gallirallus philippensis</i>	Buff-banded Rail	19		19					
Aves	<i>Geopelia cuneata</i>	Diamond Dove	C	C	19					
Aves	<i>Geopelia placida</i>	Peaceful Dove	C							
Aves	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater	C	C						
Aves	<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	C	C	C					
Aves	<i>Grallina cyanoleuca</i>	Magpie-lark	C	C						
Aves	<i>Gymnorhina tibicen</i>	Australian Magpie	C	C	C					
Aves	<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	C	C						
Aves	<i>Haematopus longirostris</i>	Pied Oystercatcher	C							
Aves	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	C		19		V		C	
Aves	<i>Haliastur sphenurus</i>	Whistling Kite	C		19					
Aves	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	C				R			
Aves	<i>Hieraaetus morphnoides</i>	Little Eagle	C	C	19					
Aves	<i>Himantopus himantopus</i>	Black-winged Stilt	C	C						
Aves	<i>Hirundo neoxena</i>	Welcome Swallow	C	C	C					
Aves	<i>Lalage tricolor</i>	White-winged Triller	C	C	19					
Aves	<i>Larus novaehollandiae</i>	Silver Gull	C							
Aves	<i>Larus pacificus</i>	Pacific Gull	C							
Aves	<i>Leipoa ocellata</i>	Malleefowl	C	C			V	V		
Aves	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	C							
Aves	<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	C	C						
Aves	<i>Lichenostomus leucotis</i>	White-eared Honeyeater	C	C	C					
Aves	<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater	C	C	C					
Aves	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	C		C					
Aves	<i>Lichenostomus plumulus</i>	Grey-fronted Honeyeater)	C	C	C					
Aves	<i>Lichenostomus virescens</i>	Singing Honeyeater	C	C	C					

Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Limosa lapponica</i>	Bar-tailed Godwit	C						C	J
Aves	<i>Limosa limosa</i>	Black-tailed Godwit	C						C	J
Aves	<i>Lophoictinia isura</i>	Square-tailed Kite	C				V			
Aves	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	C	C	C					
Aves	<i>Malurus cyaneus</i> <sup>3</sup>	Superb Fairy-wren	C							
Aves	<i>Malurus lamberti</i>	Variegated Fairy-wren	C	C	C					
Aves	<i>Malurus leucopterus</i>	White-winged Fairy-wren	C	C	C					
Aves	<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	C	C	C		V			
Aves	<i>Malurus splendens</i>	Splendid Fairy-wren	C	C	C					
Aves	<i>Manorina flavigula</i>	Yellow-throated Miner	C	C	C					
Aves	<i>Megalurus gramineus</i>	Little Grassbird	C							
Aves	<i>Melanodryas cucullata</i>	Hooded Robin	C	C	19					
Aves	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	C	C	C					
Aves	<i>Melopsittacus undulatus</i>	Budgerigar	C	C	19					
Aves	<i>Merops ornatus</i>	Rainbow Bee-eater	C	C	C					
Aves	<i>Microeca fascians</i>	Jacky Winter	C	C	C					
Aves	<i>Milvus migrans</i>	Black Kite	C	C	C					
Aves	<i>Mirafra javanica</i>	Horsfield's Bushlark	C	C						
Aves	<i>Morus serrator</i>	Australasian Gannet	19							
Aves	<i>Myiagra cyanoleuca</i>	Satin Flycatcher	C				V			
Aves	<i>Myiagra inquieta</i>	Restless Flycatcher	C	C						
Aves	<i>Neophema chrysostoma</i>	Blue-winged Parrot	C		19	C	V			
Aves	<i>Neophema elegans</i>	Elegant Parrot	C	C	19					
Aves	<i>Neophema petrophila</i>	Rock Parrot	C				R			
Aves	<i>Neophema splendida</i>	Scarlet-chested Parrot	C		19		R			
Aves	<i>Neopsephotus bourkii</i>	Bourke's Parrot	C	C	C					
Aves	<i>Ninox connivens</i>	Barking Owl	19		19		R			
Aves	<i>Ninox novaeseelandiae</i>	Southern Boobook	C	C	C					
Aves	<i>Northiella haematogaster</i>	Blue Bonnet	C	C	C					
Aves	<i>Numenius madagascariensis</i>	Eastern Curlew	C				V		C	J
Aves	<i>Numenius phaeopus</i>	Whimbrel	C						C	J
Aves	<i>Nycticorax caledonicus</i>	Nankeen Night Heron	C							
Aves	<i>Nymphicus hollandicus</i>	Cockatiel	C	C	19					
Aves	<i>Ocyphaps lophotes</i>	Crested Pigeon	C	C	19					
Aves	<i>Oreoica gutturalis</i>	Crested Bellbird	C	C	19					
Aves	<i>Oxyura australis</i>	Blue-billed Duck	C				R			
Aves	<i>Pachycephala inornata</i>	Gilbert's Whistler	C	C	C					
Aves	<i>Pachycephala pectoralis</i>	Golden Whistler	C	C	C					
Aves	<i>Pachycephala rufiventris</i>	Rufous Whistler	C	C	19					
Aves	<i>Pardalotus punctatus</i>	Spotted Pardalote	C	C	19					
Aves	<i>Pardalotus rubricatus</i>	Red-browed Pardalote	C							
Aves	<i>Pardalotus striatus</i>	Striated Pardalote	C	C	C					
Aves	<i>Passer domesticus</i>	House Sparrow	C	C						
Aves	<i>Pedionomus torquatus</i>	Plains-wanderer	19				E	V		
Aves	<i>Pelagodroma marina</i>	White-faced Storm-Petrel			C					
Aves	<i>Pelecanus conspicillatus</i>	Australian Pelican	C		C					
Aves	<i>Petrochelidon ariel</i>	Fairy Martin	C	C	C					
Aves	<i>Petrochelidon nigricans</i>	Tree Martin	C	C						
Aves	<i>Petroica goodenovii</i>	Red-capped Robin	C	C	C					
Aves	<i>Petroica multicolor</i>	Scarlet Robin	C							
Aves	<i>Pezoporus occidentalis</i>	Night Parrot	18		18		E	E		
Aves	<i>Phalacrocorax carbo</i>	Great Cormorant	C							
Aves	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	C	C						
Aves	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	C							
Aves	<i>Phalacrocorax varius</i>	Pied Cormorant	C	C	C					
Aves	<i>Phalaropus lobatus</i>	Red-necked Phalarope	C						C	J

Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Phaps chalcoptera</i>	Common Bronzewing	C	C	19					
Aves	<i>Phaps elegans</i>	Brush Bronzewing	C	C						
Aves	<i>Phaps histrionica</i>	Flock Bronzewing			C	C	V			
Aves	<i>Philomachus pugnax</i>	Ruff	C						C	J
Aves	<i>Phylidonyris albiglans</i>	White-fronted Honeyeater	C	C	C					
Aves	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	C							
Aves	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	C							
Aves	<i>Platalea regia</i>	Royal Spoonbill	C							
Aves	<i>Platycercus elegans</i>	Crimson Rosella	C							
Aves	<i>Plegadis falcinellus</i>	Glossy Ibis	C				R		C	
Aves	<i>Pluvialis dominica</i>	Lesser Golden Plover	C						C	J
Aves	<i>Pluvialis squatarola</i>	Grey Plover	C						C	J
Aves	<i>Podargus strigoides</i>	Tawny Frogmouth	C	C	C					
Aves	<i>Podiceps cristatus</i>	Great Crested Grebe	C				R			
Aves	<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe	C	C	C					
Aves	<i>Pomatostomus ruficeps</i>	Chestnut-crowned Babbler	C	C						
Aves	<i>Pomatostomus superciliosus</i>	White-browed Babbler	C	C	C					
Aves	<i>Porphyrio porphyrio</i>	Purple Swamphen	C							
Aves	<i>Porzana fluminea</i>	Australian Spotted Crake	C		C					
Aves	<i>Porzana pusilla</i>	Baillon's Crake	C		C		R			
Aves	<i>Porzana tabuensis</i>	Spotless Crake	C							
Aves	<i>Psephotus haematonotus</i>	Red-rumped Parrot	C	C	19					
Aves	<i>Psephotus varius</i>	Mulga Parrot	C	C	C					
Aves	<i>Psophodes cristatus</i>	Chirruping Wedgebill	C	C	19					
Aves	<i>Psophodes occidentalis</i>	Chiming Wedgebill	C	C	C					
Aves	<i>Pyrrholaemus brunneus</i>	Redthroat	C	C	C		R			
Aves	<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	C		19					
Aves	<i>Rhipidura albiscapa</i>	Grey Fantail	C	C	C					
Aves	<i>Rhipidura leucophrys</i>	Willie Wagtail	C	C	C					
Aves	<i>Sericornis frontalis</i>	White-browed Scrubwren	C	C						
Aves	<i>Smicromis brevirostris</i>	Weebill	C	C	19					
Aves	<i>Stagonopleura guttata</i>	Diamond Firetail	C				V			
Aves	<i>Sterna bergii</i>	Crested Tern	C	C	19					J
Aves	<i>Sterna caspia</i>	Caspian Tern	C						C	
Aves	<i>Sterna nereis</i>	Fairy Tern	C				V			
Aves	<i>Sterna nilotica</i>	Gull-billed Tern	C							
Aves	<i>Stictonetta naevosa</i>	Freckled Duck	C		C	C	V			
Aves	<i>Stiltia isabellae</i>	Australian Pratincole	C							
Aves	<i>Strepera versicolor</i>	Grey Currawong	C	C	19					
Aves	* <i>Streptopelia chinensis</i>	Spotted Turtle-dove	C		C					
Aves	* <i>Struthio camelus</i>	Ostrich	C				R			
Aves	<i>Sturnus vulgaris</i>	Common Starling	C	C	C					
Aves	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe (Little Grebe)	C	C	19					
Aves	<i>Tadorna tadornoides</i>	Australian Shelduck	C							
Aves	<i>Taeniopygia guttata</i>	Zebra Finch	C	C	19					
Aves	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	C							
Aves	<i>Todiramphus pyrrophygia</i>	Red-backed Kingfisher	C	C	C					
Aves	<i>Todiramphus sanctus</i>	Sacred Kingfisher	C	C						
Aves	<i>Tringa glareola</i>	Wood Sandpiper	C						C	J
Aves	<i>Tringa nebularia</i>	Common Greenshank	C						C	J
Aves	<i>Tringa stagnatilis</i>	Marsh Sandpiper	C						C	J
Aves	* <i>Turdus merula</i>	Eurasian Blackbird	C							
Aves	<i>Turnix varia</i>	Painted Button-quail	C				V			
Aves	<i>Turnix velox</i>	Little Button-quail	C	C	C					
Aves	<i>Tyto alba</i>	Barn Owl	C		C					
Aves	<i>Tyto novaehollandiae</i>	Masked Owl			19		E			

Class	Species Name	Common Name	Source				Status		Migratory Birds	
			BA	DEH	SAM	WMC	SA	Aus	CAMBA	JAMBA
Aves	<i>Vanellus miles</i>	Masked Lapwing	C	C	C					
Aves	<i>Vanellus tricolor</i>	Banded Lapwing	C	C						
Aves	<i>Zosterops lateralis</i>	Silvereye	C	C	C					

1 = Sourced from Schodde and Mason (1999).

2 = Unconfirmed record. Queried with Birds Australia. Possibly Grey Butcherbird (*Cracticus torquatus*) (pers comm., G. Carpenter, DWLBC).

3 = Unconfirmed record. Queried with Birds Australia. Possibly Splendid Fairy-wren (*Malurus splendens*) (pers comm., G. Carpenter, DWLBC).

## Mammal species

Taxonomy follows the DEH Vertebrate Taxonomic database and Robinson *et al.* (1990).

Species\* = exotic species.

Source: DEH = Department for Environment and Heritage (Survey, Opportunistic Sightings and Reserves databases); SAM = South Australian Museum; WMC = Western Mining Corporation Opportune database.

C = current record (ie 1/1/1970 to present); 19 = record from 1/1/1900 to 31/12/1969; 18 = record pre-1900.

Ratings: SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9).

Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

X = Extinct (for SA listed as E in *NPW Act 1972*); CD = critically endangered; E = endangered; V = vulnerable; R = rare;

# = reintroduced.

## Gawler Bioregion

Class	Species Name	Common Name	Source			Ratings	
			DEH	SAM	WMC	SA	Aus
Mammalia	<i>Antechinomys laniger</i>	Kultarr		19			
Mammalia	<i>Bettongia lesueur</i>	Burrowing Bettong		18		E #	E
Mammalia	* <i>Bos taurus</i>	Cattle	C				
Mammalia	<i>Canis lupus dingo</i>	Dingo	C	C			
Mammalia	* <i>Canis lupus familiaris</i>	Dog (domestic or feral)		C			
Mammalia	* <i>Capra hircus</i>	Goat	C				
Mammalia	<i>Cercartetus concinnus</i>	Western Pygmy-possum	C	C			
Mammalia	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	C	C			
Mammalia	* <i>Equus caballus</i>	Horse	C				
Mammalia	* <i>Felis catus</i>	Cat	C				
Mammalia	<i>Lasiorhinus latifrons</i>	Southern Hairy-nosed Wombat	C	C			
Mammalia	<i>Leggadina forresti</i>	Forrest's Mouse	C	C			
Mammalia	<i>Leporillus conditor</i>	Greater Stick-nest Rat				V #	V
Mammalia	<i>Macropus fuliginosus</i>	Western Grey Kangaroo	C	C			
Mammalia	<i>Macropus robustus</i>	Euro	C	C			
Mammalia	<i>Macropus rufus</i>	Red Kangaroo	C	C			
Mammalia	<i>Macrotis lagotis</i>	Bilby				E #	V
Mammalia	<i>Mormopterus</i> spp. (3 species complex)	Southern Freetail-bats	C	C			
Mammalia	* <i>Mus musculus</i>	House Mouse	C	C	C		
Mammalia	<i>Ningauia yvonneae</i>	Southern Ningauia	C	C			
Mammalia	<i>Notomys alexis</i>	Spinifex Hopping-mouse		C	C		
Mammalia	<i>Notomys mitchellii</i>	Mitchell's Hopping-mouse	C	C			
Mammalia	<i>Notoryctes typhlops</i>	Marsupial Mole		C		E	E
Mammalia	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	C	C	C		
Mammalia	<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat	C	C		V	V
Mammalia	* <i>Oryctolagus cuniculus</i>	Rabbit	C	C			

Class	Species Name	Common Name	Source			Ratings	
			DEH	SAM	WMC	SA	Aus
Mammalia	<i>*Ovis aries</i>	Sheep	C				
Mammalia	<i>Perameles bougainville</i>	Western Barred Bandicoot				X #	E
Mammalia	<i>Petrogale xanthopus</i>	Yellow-footed Rock-wallaby	C			V	V
Mammalia	<i>Planigale gilesi</i>	Giles' Planigale	C	C			
Mammalia	<i>Planigale tenuirostris</i>	Narrow-nosed Planigale	C	C	C		
Mammalia	<i>Pseudomys australis</i>	Plains Mouse	C	C		V	V
Mammalia	<i>Pseudomys bolami</i>	Bolam's Mouse	C	C	C		
Mammalia	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse	C	C			
Mammalia	<i>*Rattus rattus</i>	Black Rat		C			
Mammalia	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat		C		R	
Mammalia	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat		C			
Mammalia	<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	C	C			
Mammalia	<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart	C	C			
Mammalia	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart	C	C	C		
Mammalia	<i>Sminthopsis ooldea</i>	Ooldea Dunnart	C	C			
Mammalia	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	C				
Mammalia	<i>Tadarida australis</i>	White-striped Freetail-bat	C	C			
Mammalia	<i>Trichosurus vulpecula</i>	Common Brushtail Possum		C			
Mammalia	<i>Vespadelus baverstocki</i>	Inland Forest Bat	C	C			
Mammalia	<i>Vespadelus regulus</i>	Southern Forest Bat	C	C			
Mammalia	<i>*Vulpes vulpes</i>	Fox	C	C			

## Reptile species

Taxonomy follows the DEH Vertebrate Taxonomic database, Robinson *et al.* (1990) and advice from M. Hutchinson (SA Museum).

Source: DEH = Department for Environment and Heritage (Survey, Opportunistic Sightings and Reserves databases); SAM = South Australian Museum; WMC = Western Mining Corporation Opportune database.

C = current record (ie 1/1/1970 to present); 19 = record from 1/1/1900 to 31/12/1969; 18 = record pre-1900.

Status: SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9).

Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.  
E = endangered; V = vulnerable; R = rare.

## Gawler Bioregion

Class	Species Name	Common Name	Source			Status	
			DEH	SAM	WMC	SA	Aus
Reptilia	<i>Acanthophis antarcticus</i>	Common Death Adder	C	C			
Reptilia	<i>Antaresia stimsoni</i>	Stimson's Python		C	C		
Reptilia	<i>Aprasia inaurita</i>	Red-tailed Worm-lizard		C			
Reptilia	<i>Aspidites ramsayi</i>	Woma		C	C		
Reptilia	<i>Christinus marmoratus</i>	Marbled Gecko	C	C			
Reptilia	<i>Cryptoblepharus plagiocephalus/carnabyi</i>	Desert Wall skink	C	C			
Reptilia	<i>Ctenophorus cristatus</i>	Crested Dragon	C	C	C		
Reptilia	<i>Ctenophorus fionni</i>	Peninsula Dragon	C	C	C		
Reptilia	<i>Ctenophorus fordii</i>	Mallee Dragon	C	C	C		
Reptilia	<i>Ctenophorus gibba</i>	Gibber Dragon	C		C		
Reptilia	<i>Ctenophorus isolepis</i>	Military Dragon	C	C			
Reptilia	<i>Ctenophorus maculosus</i>	Lake Eyre Dragon		C			
Reptilia	<i>Ctenophorus nuchalis</i>	Central Netted Dragon	C	C	C		
Reptilia	<i>Ctenophorus pictus</i>	Painted Dragon	C	C	C		

Class	Species Name	Common Name	Source			Status	
			DEH	SAM	WMC	SA	Aus
Reptilia	<i>Ctenophorus reticulatus</i>	Western Netted Dragon		C			
Reptilia	<i>Ctenotus atlas</i>	Southern Spinifex Ctenotus	C	C	C		
Reptilia	<i>Ctenotus brooksi</i>	Sandhill Ctenotus	C	C	C		
Reptilia	<i>Ctenotus euclae</i>			C			
Reptilia	<i>Ctenotus leae</i>	Centralian Coppertail	C	C	C		
Reptilia	<i>Ctenotus leonhardii</i>	Common Desert Ctenotus	C	C			
Reptilia	<i>Ctenotus olympicus</i>	Saltbush Ctenotus	C	C	C		
Reptilia	<i>Ctenotus orientalis</i>	Eastern Spotted Ctenotus	C	C			
Reptilia	<i>Ctenotus pantherinus</i>	Leopard Skink	C	C			
Reptilia	<i>Ctenotus regius</i>	Eastern Desert Ctenotus	C	C	C		
Reptilia	<i>Ctenotus robustus</i>	Eastern Striped Skink	C	C			
Reptilia	<i>Ctenotus saxatilis</i>	Centralian Striped Skink	C	C			
Reptilia	<i>Ctenotus schomburgkii</i>	Sandplain Ctenotus	C	C	C		
Reptilia	<i>Ctenotus strauchii</i>	Short-legged Ctenotus	C	C	C		
Reptilia	<i>Ctenotus taeniatus</i>			C			
Reptilia	<i>Cyclodomorphus melanops</i>	Spinifex Slender Bluetongue	C	C			
Reptilia	<i>Delma australis</i>	Barred Snake-lizard	C	C			
Reptilia	<i>Delma butleri</i>	Spinifex Snake-lizard	C	C			
Reptilia	<i>Delma fraseri</i>	Fraser's Snake-lizard		C			
Reptilia	<i>Delma malleri</i>	Adelaide Snake-lizard		C			
Reptilia	<i>Demansia psammophis</i>	Yellow-faced Whipsnake	C	C			
Reptilia	<i>Demansia reticulata</i>	Desert Whipsnake	C	C	C		
Reptilia	<i>Diplodactylus byrnei</i>	Pink-blotched Gecko	C	C			
Reptilia	<i>Diplodactylus conspicillatus</i>	Fat-tailed Gecko	C	C	C		
Reptilia	<i>Diplodactylus damaeus</i>	Beaded Gecko	C	C	C		
Reptilia	<i>Diplodactylus granariensis</i>	Western Stone Gecko	C	C			
Reptilia	<i>Diplodactylus stenodactylus</i>	Sandplain Gecko	C	C	C		
Reptilia	<i>Diplodactylus tessellatus</i>	Tessellated Gecko	C	C	C		
Reptilia	<i>Diplodactylus vittatus</i>	Eastern Stone Gecko	C	C			
Reptilia	<i>Diporiphora winneckeii</i>	Canegrass Dragon	C	C	C		
Reptilia	<i>Echiopsis curta</i>	Bardick		C		R	
Reptilia	<i>Egernia inornata</i>	Desert Skink	C	C			
Reptilia	<i>Egernia richardi</i>	Western Tree Skink		C			
Reptilia	<i>Egernia stokesii</i>	Gidgee Skink	C	C	C		
Reptilia	<i>Egernia striolata</i>	Eastern Tree Skink	C	C			
Reptilia	<i>Eremiascincus fasciolatus</i>	Narrow-banded Sandswimmer		19			
Reptilia	<i>Eremiascincus richardsonii</i>	Broad-banded Sandswimmer	C	C	C		
Reptilia	<i>Furina diadema</i>	Red-naped Snake		C			
Reptilia	<i>Gehyra purpurascens</i>	Purple Dtella	C	C			
Reptilia	<i>Gehyra</i> sp. '2n=44'	Southern Rock Dtella		C			
Reptilia	<i>Gehyra variegata</i>	Tree Dtella	C	C			
Reptilia	<i>Hemiergis millewae</i>	Rusty Earless Skink	C	C			
Reptilia	<i>Heteronotia binoei</i>	Bynoe's Gecko	C	C	C		
Reptilia	<i>Lerista bougainvillii</i>	Bougainville's Skink	C	C			
Reptilia	<i>Lerista desertorum</i>	Great Desert Slider	C	C	C		
Reptilia	<i>Lerista distinguenda</i>	Dwarf four-toed Slider	C			R	
Reptilia	<i>Lerista dorsalis</i>	Southern Four-toed Slider	C	C			
Reptilia	<i>Lerista edwardsae</i>	Myall Slider	C	C	C		
Reptilia	<i>Lerista labialis</i>	Eastern Two-toed Slider	C	C	C		
Reptilia	<i>Lerista muelleri</i>	Dwarf Three-toed Slider	C	C			
Reptilia	<i>Lerista taeniata</i>	Ribbon Slider		C		R	
Reptilia	<i>Lerista terdigitata</i>	Southern Three-toed Slider	C	C			
Reptilia	<i>Lerista xanthura</i>	Yellow-tailed Slider		C			
Reptilia	<i>Lialis burtonis</i>	Burton's Legless Lizard	C	C	C		
Reptilia	<i>Menetia greyii</i>	Dwarf Skink	C	C	C		
Reptilia	<i>Moloch horridus</i>	Thorny Devil	C	C			

Class	Species Name	Common Name	Source			Status	
			DEH	SAM	WMC	SA	Aus
Reptilia	<i>Morelia spilota</i>	Carpet Python		C		V	
Reptilia	<i>Morethia adelaidensis</i>	Adelaide Snake-eye	C	C	C		
Reptilia	<i>Morethia boulengeri</i>	Common Snake-eye	C	C	C		
Reptilia	<i>Morethia butleri</i>	Butler's Snake-eye	C	C			
Reptilia	<i>Morethia obscura</i>	Mallee Snake-eye	C	C			
Reptilia	<i>Nephurus deleani</i>	Pernatty Knob-tailed Gecko	C	C		V	V
Reptilia	<i>Nephurus laevis</i>	Pale Knob-tailed Gecko	C	C			
Reptilia	<i>Nephurus levis</i>	Smooth Knob-tailed Gecko	C	C	C		
Reptilia	<i>Nephurus milii</i>	Barking Gecko	C	C	C		
Reptilia	<i>Nephurus stellatus</i>	Starred Knob-tailed Gecko	C	C			
Reptilia	<i>Pogona minor</i>	Dwarf Bearded Dragon	C	C			
Reptilia	<i>Pogona vitticeps</i>	Central Bearded Dragon	C	C	C		
Reptilia	<i>Pseudechis australis</i>	Mulga Snake	C	C	C		
Reptilia	<i>Pseudonaja inframacula</i>	Peninsula Brown Snake		C			
Reptilia	<i>Pseudonaja modesta</i>	Five-ringed Snake	C	C	C		
Reptilia	<i>Pseudonaja nuchalis</i>	Western Brown Snake	C	C	C		
Reptilia	<i>Pygopus lepidopodus</i>	Common Scaly-foot	C	C			
Reptilia	<i>Pygopus nigriceps</i>	Black-headed Scaly-foot	C	C	C		
Reptilia	<i>Pygopus schraderi</i>	Hooded Scaly-foot		C			
Reptilia	<i>Ramphotyphlops australis</i>	Southern Blind Snake	C	C			
Reptilia	<i>Ramphotyphlops bituberculatus</i>	Rough-nosed Blind Snake	C	C	C		
Reptilia	<i>Ramphotyphlops endoterus</i>	Centralian Blind Snake	C	C	C		
Reptilia	<i>Rhynchoedura ornata</i>	Beaked Gecko	C	C	C		
Reptilia	<i>Simoselaps bertholdi</i>	Desert Banded Snake	C	C	C		
Reptilia	<i>Simoselaps fasciolatus</i>	Narrow-banded Snake	C	C	C		
Reptilia	<i>Simoselaps semifasciatus</i>	Half-girdled Snake		C			
Reptilia	<i>Strophurus ciliaris</i>	Northern Spiny-tailed Gecko	C	C	C		
Reptilia	<i>Strophurus elderi</i>	Jewelled Gecko	C	C			
Reptilia	<i>Strophurus intermedius</i>	Southern Spiny-tailed Gecko	C	C			
Reptilia	<i>Suta monachus</i>	Hooded Snake		C			
Reptilia	<i>Suta nigriceps</i>	Mitchell's Short-tailed Snake	C	C			
Reptilia	<i>Suta spectabilis</i>	Mallee Black-headed Snake		C			
Reptilia	<i>Suta suta</i>	Curl Snake	C	C	C		
Reptilia	<i>Tiliqua occipitalis</i>	Western Bluetongue	C	C	C		
Reptilia	<i>Tiliqua rugosa</i>	Sleepy Lizard	C	C	C		
Reptilia	<i>Tiliqua scincoides</i>	Eastern Bluetongue	C	C			
Reptilia	<i>Tympanocryptis houstoni</i>	Nullarbor Earless Dragon		19			
Reptilia	<i>Tympanocryptis intima</i>	Smooth-snouted Earless Dragon	C	C	C		
Reptilia	<i>Tympanocryptis lineata</i>	Five-lined Earless Dragon	C	C	C		
Reptilia	<i>Tympanocryptis tetraporophora</i>	Eyrean Earless Dragon	C	C	C		
Reptilia	<i>Varanus gilleni</i>	Pygmy Mulga Goanna	C	C	C		
Reptilia	<i>Varanus gouldii</i>	Sand Goanna	C	C	C		
Reptilia	<i>Vermicella annulata</i>	Common Bandy-Bandy		19		R	

1 = This taxonomic entity is a combination of *Cryptoblepharus plagiocephalus* and *C. carnabyi*, and includes *Cryptoblepharus* cf *plagiocephalus* (DEH Vertebrate Taxonomic database) and *Cryptoblepharus* "CAC", *Cryptoblepharus* "CS" and *Cryptoblepharus* "pib" (SA Museum data).

## Amphibian species

Taxonomy follows the DEH Vertebrate Taxonomic database and Robinson *et al.* (1990).

Source: DEH = Department for Environment and Heritage (Survey, Opportunistic Sightings and Reserves databases); EPA = Environment Protection Authority Frog Census database; SAM = South Australian Museum; WMC = Western Mining Corporation Opportune database.



C = current record (ie 1/1/1970 to present); 19 = record from 1/1/1900 to 31/12/1969; 18 = record pre-1900.

Status: SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9).

Aus = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

E = endangered; V = vulnerable; R = rare.

### Gawler Bioregion

Class	Species Name	Common Name	Source				Status	
			DEH	EPA	SAM	WMC	SA	Aus
Amphibia	<i>Cyclorana platycephala</i>	Water-holding Frog			C			
Amphibia	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	C	C	C			
Amphibia	<i>Neobatrachus centralis</i>	Trilling Frog	C	C	C	C		
Amphibia	<i>Neobatrachus pictus</i>	Painted Frog			C			

### Fish species

Taxonomy follows the DEH Vertebrate Taxonomic database and Robinson *et al.* (1990).

Species: \* = exotic species.

Status: Aus EP = Australian status under the *Environment Protection and Biodiversity Conservation Act 1999*.

Aus AS = Australian status as per the Australian Society for Fish Biology.

SA - There are no current official conservation status ratings for fish at state level in South Australia.

E = endangered; V = vulnerable; R = rare; LR-N = lower risk - near threatened.

Source: Glov = Glover (1990); Sim = Sim (2000); W&U = Wager & Unmack (2000); Un '02 = Unmack (2002); Ham = M. Hammer (pers comm); Unm = P. Unmack (pers comm); AF = ARIDFLO.

? = uncertain if in bioregion; # = could occur due to flooding, but unlikely to persist due to lack of permanent water and/or suitable habitat; dou = doubtful in bioregion; ext = extirpated from bioregion.

### Gawler Bioregion

Species	Common Name	Status		Source						
		Aus EP	Aus AS	Glov	Sim	W&U	Un '02	Ham	Unm	AF
* <i>Carassius auratus</i>	Goldfish				4					
* <i>Gambusia holbrooki</i>	Eastern Gambusia				4					

## Appendix 3: Threatened Flora Recorded in the Gawler Bioregion

Source: Neagle (2003).

Species	Common Name	Status		Source of Records						
		Aus	SA	SU	OP	PP	RE	PM	PB	OT
<b>Nationally Threatened</b>										
<i>Brachycome muelleri</i>	Corunna Daisy	E	E			4			4	
<i>Frankenia plicata</i>	Sea-heath	E	R	4				4	4	
<i>Grevillea treueriana</i>	Scarlet Grevillea	V	V	4	4				4	
<i>Hibbertia crispula</i>	Ooldea Guinea-flower	V	V			4			4	
<i>Pterostylis xerophila</i>	Desert Greenhood	V	V						4	4
<i>Stipa nullanulla</i>	Club Spear-grass	V	V	4					4	
<i>Swainsona pyrophila</i>	Yellow Swainson-pea	V	R	4		4			4	
<b>Vulnerable in South Australia</b>										
<i>Atriplex kochiana</i>	Koch's Saltbush		V			4				
<i>Cyperus lhotskyanus</i>			V	4*						
<i>Eremocitrus glauca</i>	Desert Lime		V					4		
<i>Malacocera gracilis</i>	Slender Soft-horns		V	4						
<i>Podolepis muelleri</i>	Button Podolepis		V					4*		
<i>Rhodanthe oppositifolia</i> <i>ssp. oppositifolia</i>	Twin-leaf Everlasting		V	4						
<i>Rulingia craurophylla</i>			V				4			
<i>Santalum spicatum</i>	Sandalwood		V	4			4	4		
<b>Rare in South Australia</b>		1.1.1.								
<i>Acacia iteaphylla</i>	Flinders Ranges Wattle		R	4	4			4		
<i>Acacia montana</i>	Mallee Wattle		R				4			
<i>Anthocercis anisantha</i> <i>ssp. anisantha</i>	Port Lincoln Ray-flower		R	4						
<i>Brachycome eriogona</i>			R	4				4		
<i>Calotis lappulacea</i>	Yellow Burr-daisy		R					4		
<i>Ceratogyne obionoides</i>	Wingwort		R	4						
<i>Corynotheca licrota</i>	Sand Lily		R	4						
<i>Crassula exserta</i>	Large-fruit Crassula		R				4			
<i>Eucalyptus lansdowneana</i>	Crimson Mallee		R	4				4		
<i>Goodenia benthamiana</i>	Bentham's Goodenia		R				4			
<i>Goodenia heterochila</i>	Serrated Goodenia		R		4					
<i>Goodenia lobata</i>			R	4						
<i>Gratwickia monochaeta</i>			R	4				4		
<i>Grevillea anethifolia</i>			R	4	4		4	4		
<i>Haeckeria cassiniaeformis</i>	Dogwood Haeckeria		R					4		

<i>Isotoma scapigera</i>	Salt Isotome		R	4						
<i>Lawrencia berthae</i>	Showy Lawrenceia		R				4			
<i>Maireana pentagona</i>	Slender Fissure-plant		R					4		
<i>Maireana rohrlachii</i>	Rohrlach's Bluebush		R					4		
<i>Maireana suaedifolia</i>	Lax Bluebush		R				4			
<i>Melaleuca armillaris</i> ssp. <i>Akineta</i>	Needle-leaf Honey-myrtle		R	4	4			4		
<i>Melaleuca oxyphylla</i>	Pointed-leaf Honey-myrtle		R	4	4					
<i>Podolepis jaceoides</i>	Showy Copper-wire Daisy		R	4				4		
<i>Sclerolaena blackiana</i>	Black's Bindyi		R					4*		
<i>Sclerolaena holtiana</i>	Holt's Bindyi		R					4		
<i>Stipa puberula</i>	Fine-hairy Spear-grass		R	4						
<i>Stipa tenuifolia</i>			R				4			
<i>Swainsona microcalyx</i>	Wild Violet		R	4						
<i>Wurmbea decumbens</i>	Trailing Nancy		R	4						
<i>Zygophyllum humillimum</i>	Small-fruit Twinleaf		R	4				4*		
<b>Significant in South Australia</b>										
<i>Acacia toondulya</i> φ			R#							

Status: Aus = Australian status under the Environment Protection and Biodiversity Conservation Act 1999.

SA = South Australian status under the National Parks and Wildlife Act 1972 (2000 update of Schedules 7, 8 and 9).

E = endangered; V = vulnerable; R = rare; # = unofficial rating.

φ = This species is not rated as rare or threatened under existing legislation but is nonetheless considered to be of conservation significance in the bioregion.

Source of Records: SU = Survey database (DEH); OP = Opportunistic Sightings database (DEH); PP = Plant Population database (DEH); RE = Reserves database (DEH); PM = Pastoral Management Information System database (DWLBC); PB = SA Plant Biodiversity Centre collections; OT = other; \* = uncertain record.

## Appendix 4: Threatened Fauna Recorded in the Gawler Bioregion

Source: Neagle (2003).

Class	Species Name	Common Name	Status		Source of Records			
			Aus	SA	BA	DEH	SAM	OT
Nationally Threatened								
Aves	<i>Acanthiza iredalei iredalei</i>	Slender-billed Thornbill (western)	V	V	4	4	4	4
Aves	<i>Amytornis textilis modestus</i>	Thick-billed Grasswren (eastern)	V	R		4		
Aves	<i>Amytornis textilis myall</i>	Thick-billed Grasswren (Gawler Ranges)	V	E	4		4	
Aves	<i>Leipoa ocellate</i>	Malleefowl	V	V	4	4		
Aves	<i>Pedionomus torquatus</i>	Plains-wanderer	V	E	19			
Aves	<i>Pezoporus occidentalis</i>	Night Parrot	E	E	18		18	
Mammalia	<i>Bettongia lesueur</i>	Burrowing Bettong	E <sup>+</sup>	E			18	
Mammalia	<i>Leporillus conditor</i>	Greater Stick-nest Rat	V <sup>+</sup>	V				
Mammalia	<i>Macrotis lagotis</i>	Bilby	V <sup>+</sup>	E				
Mammalia	<i>Notoryctes typhlops</i>	Marsupial Mole	E	E			4	
Mammalia	<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat	V	V		4	4	
Mammalia	<i>Perameles bougainville</i>	Western Barred Bandicoot	E <sup>+</sup>	X				
Mammalia	<i>Petrogale xanthopus xanthopus</i>	Yellow-footed Rock-wallaby	V	V		4		
Mammalia	<i>Pseudomys australis</i>	Plains Rat	V	V		4	4	4
Reptilia	<i>Nephruurus deleani</i>	Pernatty Knob-tailed Gecko	V	V		4	4	
Endangered in South Australia								
Aves	<i>Tyto novaehollandiae</i>	Masked Owl		E			19	
Vulnerable in South Australia								
Aves	<i>Amytornis striatus</i>	Striated Grasswren		V	4	4	4	
Aves	<i>Ardeotis australis</i>	Australian Bustard		V	4		4	4
Aves	<i>Burhinus grallarius</i>	Bush Stone-curlew		V	19			
Aves	<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo		V	4	4	4	4
Aves	<i>Calamanthus pyrrhopygius</i>	Chestnut-rumped Heathwren		V	4			
Aves	<i>Gallinago hardwickii</i>	Latham's Snipe		V	4			
Aves	<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle		V	4		19	
Aves	<i>Lophoictinia isura</i>	Square-tailed Kite		V	4			
Aves	<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren		V	4	4	4	
Aves	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		V	4			
Aves	<i>Neophema chrysostoma</i>	Blue-winged Parrot		V	4		19	4
Aves	<i>Numenius madagascariensis</i>	Eastern Curlew		V	4			
Aves	<i>Phaps histrionica</i>	Flock Bronzewing		V			4	4
Aves	<i>Stagonopleura guttata</i>	Diamond Firetail		V	4			

Class	Species Name	Common Name	Status		Source of Records			
			Aus	SA	BA	DEH	SAM	OT
Aves	<i>Sterna nereis</i>	Fairy Tern		V	4			
Aves	<i>Stictonetta naevosa</i>	Freckled Duck		V	4		4	4
Aves	<i>Turnix varia</i>	Painted Button-quail		V	4			
Reptilia	<i>Morelia spilota</i>	Carpet Python		V			4	
<b>Rare in South Australia</b>								
Aves	<i>Anas rhynchotis</i>	Australasian Shoveler		R	4			
Aves	<i>Aphelocephala pectoralis</i>	Chestnut-breasted Whiteface		R	4			
Aves	<i>Biziura lobata</i>	Musk Duck		R	4			
Aves	<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush		R	4	4	4	
Aves	<i>Climacteris affinis</i>	White-browed Treecreeper		R	4	4	4	
Aves	<i>Egretta sacra</i>	Eastern Reef Egret		R	4			
Aves	<i>Emblema pictum</i>	Painted Finch		R	4			
Aves	<i>Falco hypoleucos</i>	Grey Falcon		R	4			
Aves	<i>Falco peregrinus</i>	Peregrine Falcon		R	4	19		
Aves	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard		R	4			
Aves	<i>Neophema petrophila</i>	Rock Parrot		R	4			
Aves	<i>Neophema splendida</i>	Scarlet-chested Parrot		R	4		19	
Aves	<i>Ninox connivens</i>	Barking Owl		R	19		19	
Aves	<i>Oxyura australis</i>	Blue-billed Duck		R	4			
Aves	<i>Plegadis falcinellus</i>	Glossy Ibis		R	4			
Aves	<i>Podiceps cristatus</i>	Great Crested Grebe		R	4			
Aves	<i>Porzana pusilla</i>	Baillon's Crake		R	4		4	
Aves	<i>Pyrrholaemus brunneus</i>	Redthroat		R	4	4	4	
Mammalia	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail Bat		R			4	
Reptilia	<i>Echiopsis curta</i>	Bardick		R			4	
Reptilia	<i>Lerista distinguenda</i>	Dwarf Four-toed Slider		R		4		
Reptilia	<i>Lerista taeniata</i>	Ribbon Slider		R			4	
Reptilia	<i>Vermicella annulata</i>	Common Bandy-Bandy		R			19	
<b>Significant in South Australia</b>								
Mammalia	<i>Trichosurus vulpecula</i> $\phi$	Common Brushtail Possum					4	

Status: Aus = Australian status under the Environment Protection and Biodiversity Conservation Act 1999.

SA = South Australian status under the *National Parks and Wildlife Act 1972* (2000 update of Schedules 7, 8 and 9). + = reintroduction

X = Extinct (for SA listed as E in *NPW Act 1972*); CD = critically endangered; E = endangered; V = vulnerable; R = rare.

$\phi$  = This species is not rated as rare or threatened under existing legislation but is nonetheless considered to be of conservation significance in the bioregion.

Source of Records: BA = Birds Australia; DEH = Department for Environment and Heritage (South Australia); SAM = South Australian Museum; OT = other; 4 = current record (ie. 1/1/1970 to present); 19 = record from 1/1/1900 to 31/12/1969; 18 = record pre-1900.

## Appendix 5: Reference Sites and Exclosures across the Gawler Bioregion

### Reference Sites

Source: Fleming *et al.* (undated).

Site	Land system	Location	Date Est.	Easting	Northing	Zone	Custodian
1306	Tent Hill	Cariewerloo	3/11/85	735787	6416822	53	Pastoral Program
2985	Beacon	Nonning	9/11/92	632129	6471672	53	Pastoral Program
2998	Ebunbanie	Yardea	10/25/92	581647	6435141	53	Pastoral Program
2999	Ebunbanie	Yardea	10/25/92	583429	6434672	53	Pastoral Program
3105	Peter Pan	Buckleboo	3/30/92	576392	6383003	53	Pastoral Program
3205	Acraman	Yardea	11/24/86	550029	6449672	53	Pastoral Program
3396	Ebunbanie	Paney	5/27/92	544729	6386472	53	Pastoral Program
3441	Ebunbanie	Siam	3/31/92	663500	6390200	53	Pastoral Program
3966	Bittali	Nonning	4/16/93	614383	6381661	53	Pastoral Program
3967	Bittali	Nonning	4/16/93	613929	6381272	53	Pastoral Program
3970	Bittali	Nonning	4/16/93	614929	6389972	53	Pastoral Program
4165	Roxby	Oakden Hills	6/17/94	697700	6515900	53	Pastoral Program
4552	*	Cultana	11/9/94	761379	6365922	53	Pastoral Program
4557	*	Cultana	11/10/94	754429	6379372	53	Pastoral Program
6935	Roopena	Myola	11/29/99	707275	6339949	53	Pastoral Program
6936	Bittali	Myola	11/29/99	703885	6348004	53	Pastoral Program
Site	Landsystem	Pastoral Lease	11/29/99	Easting	Northing	53	Custodian
6937	Iron knob	Cooyerdoo	11/30/99	681486	6328515	53	Bio-Survey
6938	Kolendo	Siam	12/2/99	653731	6432256	53	Pastoral Program
6939	Eucarro	Kondoolka	12/3/99	507405	6450633	53	Pastoral Program
6940	Yarna	Lake Everade	12/2/99	503790	6497848	53	Pastoral Program
6941	Glendambo	Mahanewo	12/5/99	621071	6505155	53	Pastoral Program
6942	Hesso	Kootaberra	12/5/99	720969	6471810	53	Pastoral Program
6943	Jungle Dam	Yudnapinna	12/6/99	673494	6435028	53	Pastoral Program
6944	Jungle Dam	Yudnapinna	12/6/99	701842	6439832	53	Pastoral Program
6945	Yudnapinna	Cariewerloo	10/1/83	719103	6420000	53	Pastoral Program
58	Glendambo	Parakylia	1/23/71	609600	6614800	53	Pastoral Program
69	Mailgate	Wilgena	10/4/92	395300	6610800	53	Pastoral Program
367	Buckshot	Bulgunnia	10/5/92	517637	6632001	53	Pastoral Program
368	Lookout	Bulgunnia	10/6/92	515329	6651352	53	Pastoral Program

Site	Land system	Location	Date Est.	Easting	Northing	Zone	Custodian
369	Indooroopilly	Bulgunnia	10/6/92	439329	6669542	53	Pastoral Program
370	Christie	Bulgunnia	10/7/92	427389	6677942	53	Pastoral Program
371	Gina	Commwlth Hill	8/1/78	451388	6683782	53	Pastoral Program
656	Commonwealth	Mt. Penrhyn	11/1/87	457400	6749000	53	Pastoral Program
661	Indooroopilly	Mobella	12/1/85	307800	6705300	53	Pastoral Program
1231	Buckshot	Mt. Eba	4/15/99	569000	6668700	53	Pastoral Program
6902	Labyrinth	North Well	4/16/99	506847	6572812	53	Pastoral Program
6903	Wynbring	Wilgena	4/17/99	389882	6603929	53	Pastoral Program
6904	Mailgate	Mulgathing	4/19/99	402058	6642915	53	Pastoral Program
6905	Commonwealth	Commwlth Hill	4/19/99	450037	6730680	53	Pastoral Program
6906	Brumby	Ingomar	4/19/99	487643	6732078	53	Pastoral Program
6907	Gina	McDouall Peak	4/17/99	483350	6699255	53	Pastoral Program
7058	Indooroopilly	Mobella	4/15/99	328572	6644783	53	Bio-Survey
7059	Arcoona	Arcoona	4/1/99	659440	6538953	53	Pastoral Program
ILO101	*	*	4/1/99	650680	6537400	53	Bio-Survey
ILO201	*	*	4/1/99	651340	6538180	53	Bio-Survey
ILO301	*	*	4/1/99	651750	6539320	53	Bio-Survey
ILO401	*	*	4/1/99	654440	6539770	53	Bio-Survey
ILO601	*	*	4/1/99	660960	6538300	53	Bio-Survey
ILO701	*	*	4/1/99	659450	6539700	53	Bio-Survey
ILO807	*	*	10/18/83	647700	6542470	53	Bio-Survey

## Exclosures

Source: Fleming *et al.* (undated).

Exclosure	Site	Location	Date	Easting	Northing	Zone	Custodian	Recorded Methods	Monitoring Purpose
Stanley Flat	*	Gawler Ranges National N.P.	2001	*	*	53	NPWSA	Permanent photopoint established, biomass estimates, perennial plants mapped	Effects of large herbivores on vegetation within the Gawler Ranges National N.P.
Scrubby Valley	*	Gawler Ranges National N.P.	2001	528122	6398040	53	NPWSA	Permanent photopoint established, biomass estimates, perennial plants mapped	Effects of large herbivores on vegetation within the Gawler Ranges National N.P.
Thurlga	*	Thurlga	1995	*	*	53	Pastoral Program	Permanent photopoint established, perennial plants mapped	Effects of large herbivores on vegetation, especially goats.
Cultana	*	Cultana	2000	*	*	53	Pastoral Program	*	Effects of large herbivores on vegetation, especially goats.
G.R.S.C. B.	*	Mt. Ive	*	*	*	53	G.R.S.C.B.	Permanent Photopoint established, cover estimates.	Demonstration of grazing impacts on vegetation.
Bon Bon Ex.	221 & 222	Bon Bon	1976	540129	6600572	53	Pastoral Program	Permanent Photopoint established, perennial's mapped and measured.	Monitor recovery of vegetation after fire. 221 excludes sheep and 222 is control plot
Bon Bon Ex.	223 & 224	Bon Bon	1976	538829	6600572	53	Pastoral Program	Permanent Photopoint established, perennial's mapped and measured.	Monitor recovery of vegetation after fire. 223 excludes sheep and 224 is control plot.
Bon Bon Ex.	225	Bon Bon	1978	540129	6600572	53	Pastoral Program	Permanent Photopoint established, perennial's mapped and measured.	Monitor recovery of vegetation after fire. 225 acts as rabbit proof enclosure for 223 & 224
Parakylia Ex	58	Parakylia	1976	*	*	53	Pastoral Program	Permanent Photopoint established, perennial's mapped and measured.	Monitor recovery of vegetation after fire.
Arid Recovery Reserve		Roxby Downs	1997 extended 99, 2000 & 2001	680000	6635500	53	W.M.C., NPWSA, Billa Kilina, Mulgaria, Uni. Of Adelaide	Bird and mammal surveys, permanent Photopoint established, species lists, jessup transects.	Recovery of vegetation and the reintroduction of native animals to their natural habitats.
Mulga Reg. Plot	*	Stuarts Creek	2001	*	*	53	W.M.C.	*	Monitoring the regeneration of mulga.
Sisters	2917	Roxby Downs	1997	653029	6603372	53	W.M.C.	*	Cattle proof enclosure (28km <sup>2</sup> ).



Exclosure	Site	Location	Date	Easting	Northing	Zone	Custodian	Recorded Methods	Monitoring Purpose
Ram Pdk									

## Appendix 6 – Richards/Green Functionality Index

Australian Collaborative Rangeland Information System

Fundamental product 3b: Change in landscape function <sup>1</sup>

### PROPOSED REPORTING CONCEPT

DERIVED PRODUCT <sup>2</sup>

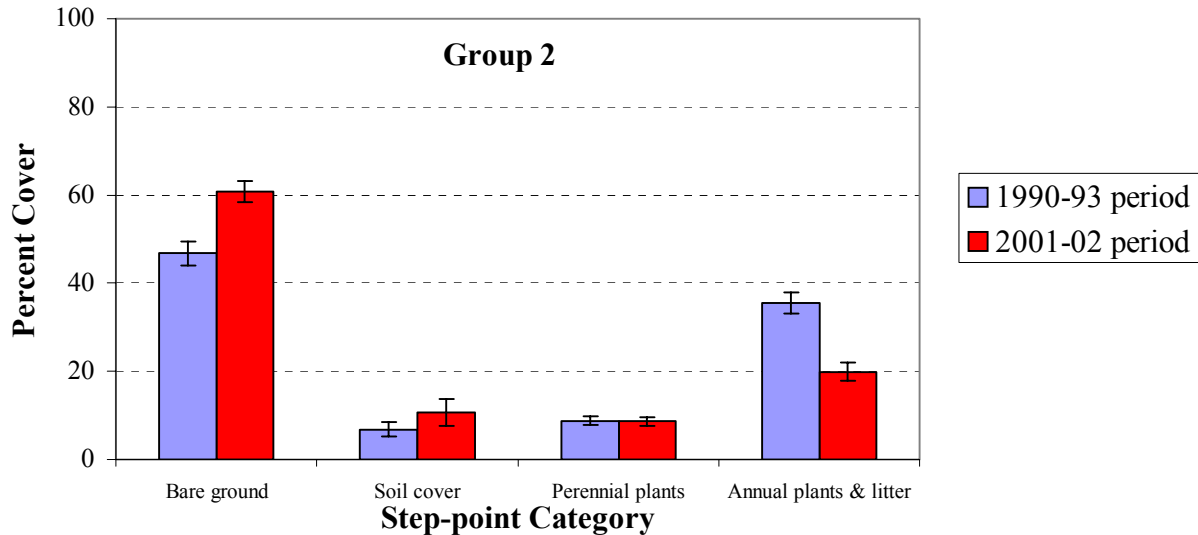
Reporting scale	Reporting media	RICHARDS/GREEN FUNCTIONALITY INDEX			
		Functionality		Trend	
IBRA	ACRIS	1	<b>Highly functional:</b> Low number of invasive species. 'Ideal' species list. Relevant crypto cover. Low soil erosion. High perenniality. Landscape patches undisturbed. Bare soil areas restricted.	1	<b>Improving:</b> Increasing size/frequency of patches; number of "ideal" species; relevant cryptogam cover; perenniality. Decreasing: soil erosion; bare soil areas. Stable or increasing: number of obstructions.
		2	<b>Functional:</b> Some invasive species, average no. of 'ideal' species. Relevant cryptogam cover not to full potential. Some: soil erosion, perennials, undisturbed landscape patches, bare soil areas.	2	<b>Stable:</b> Maintenance of stability or near stability of the above.
		3	<b>Poorly functioning:</b> Many invasive species present. Much soil erosion. Few undisturbed patches, few perennials, large areas of bare soil, few obstructions.	3	<b>Declining:</b> Decreasing: size/frequency of patches; perennials; 'ideal' species; relevant crypto cover; obstructions. Increasing soil erosion, bare areas and number of invasive species.

Notes: <sup>1</sup> Landscape function is defined as the ability of the landscape to effectively trap and utilise moisture and nutrients varying over space and time.

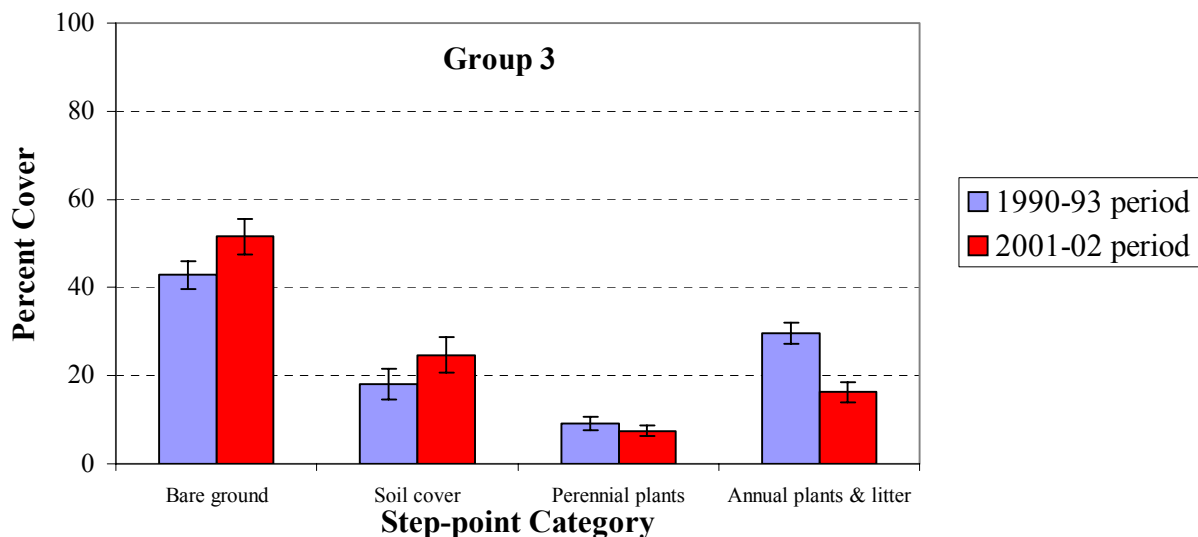
<sup>2</sup> Product produced by the States and NT through expert interpretation of supporting field data.

## Appendix 7 – Change in Step-Point Cover

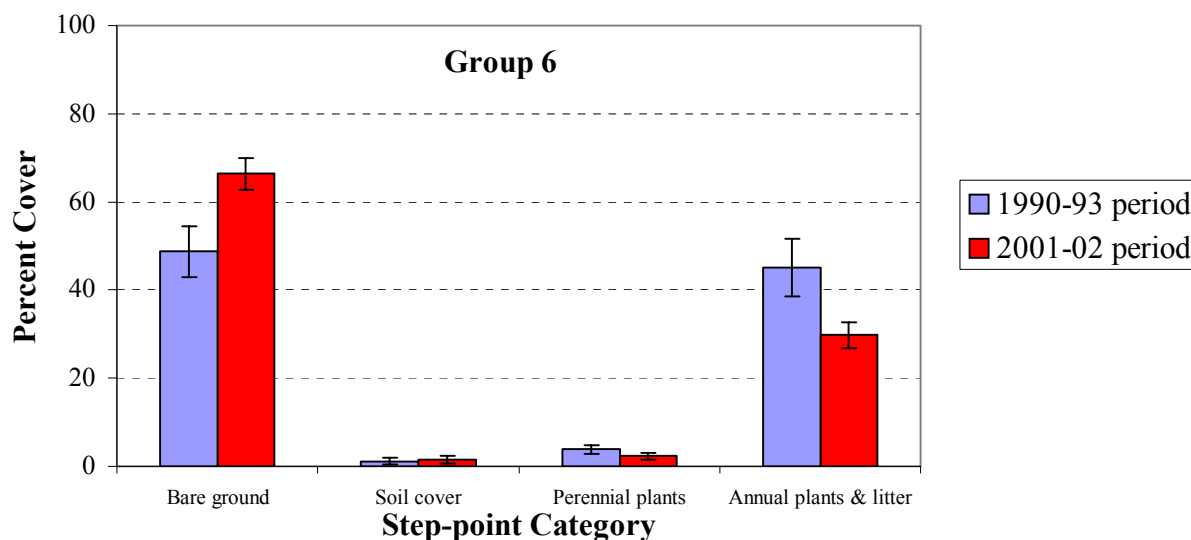
Jones (2002) identified 15 vegetation groups from the 1933 monitoring sites studied in the Kingoonya and Gawler Soil Conservation Districts. The following charts show the change in cover categories measured through step pointing for 11 of the groups where there was a non-significant change in perennial cover over the 1992-2002 reporting period. Group 1 (*Acacia aneura* Open Woodland over Perennial and Annual Grasses) had a significant decrease in perennial cover and the change is shown in Figure 20. There were insufficient sites re-assessed in 2001-02 to report on the other three groups. (Note that the groups are briefly described in Table 1.)



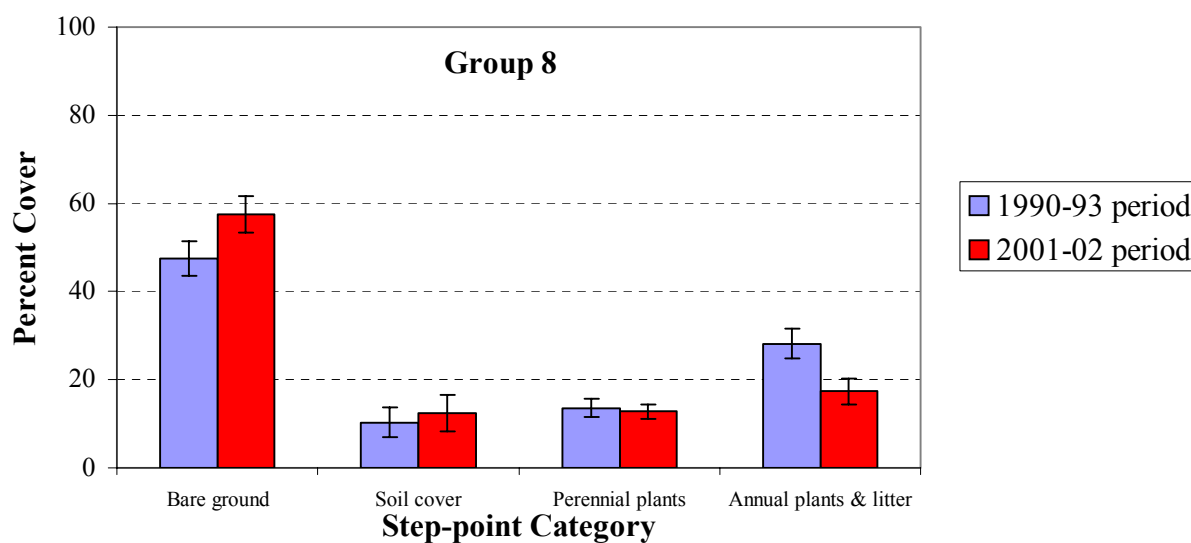
**Figure 27: Comparison of step-point cover estimates for Group 2: *Acacia aneura* Open Woodland over *Maireana sedifolia* in the Gawler and Kingoonya Soil Conservation Districts.**



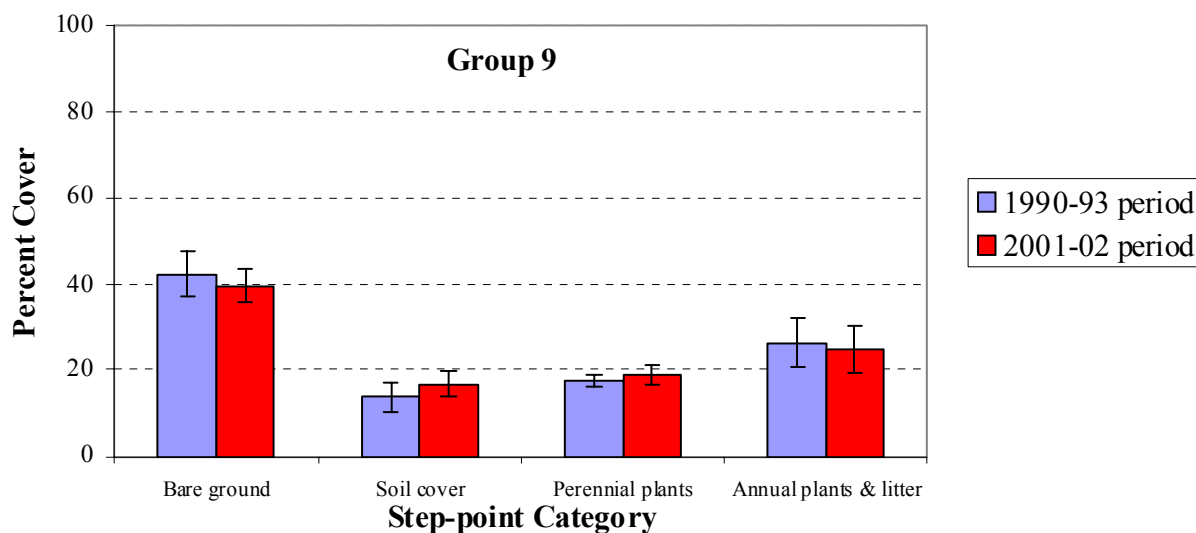
**Figure 28: Comparison of step-point cover estimates for Group 3: *Maireana sedifolia* with *Atriplex vesicaria*, *Maireana astrotricha* and Scattered *Acacia papyrocarpa* in the Gawler and Kingoonya Soil Conservation Districts.**



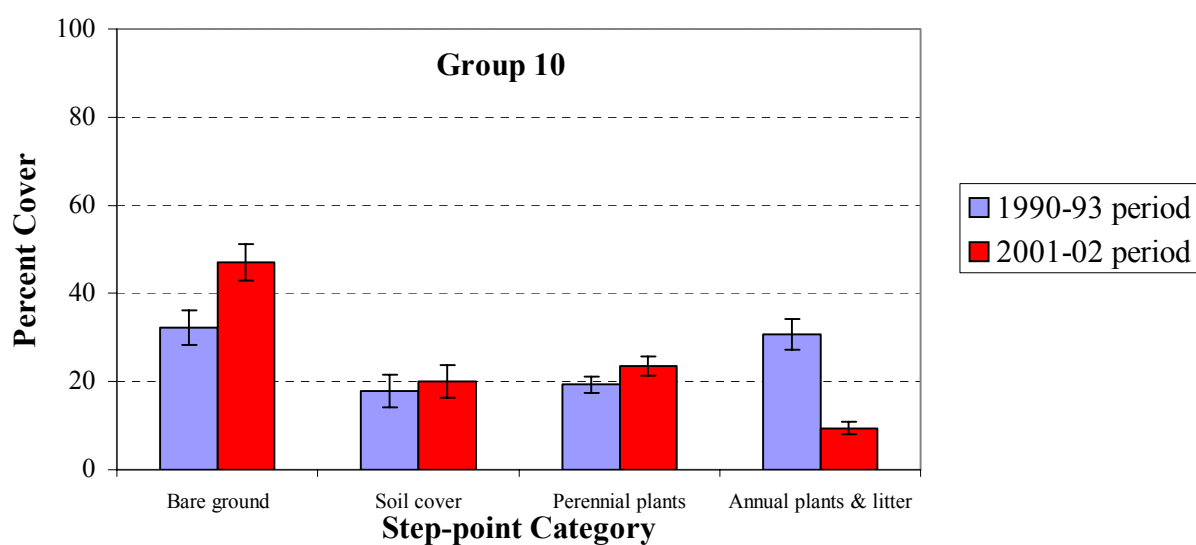
**Figure 29: Comparison of step-point cover estimates for Group 6: *Acacia aneura* Open Woodland over Annual Grasses in the Gawler and Kingoonya Soil Conservation Districts.**



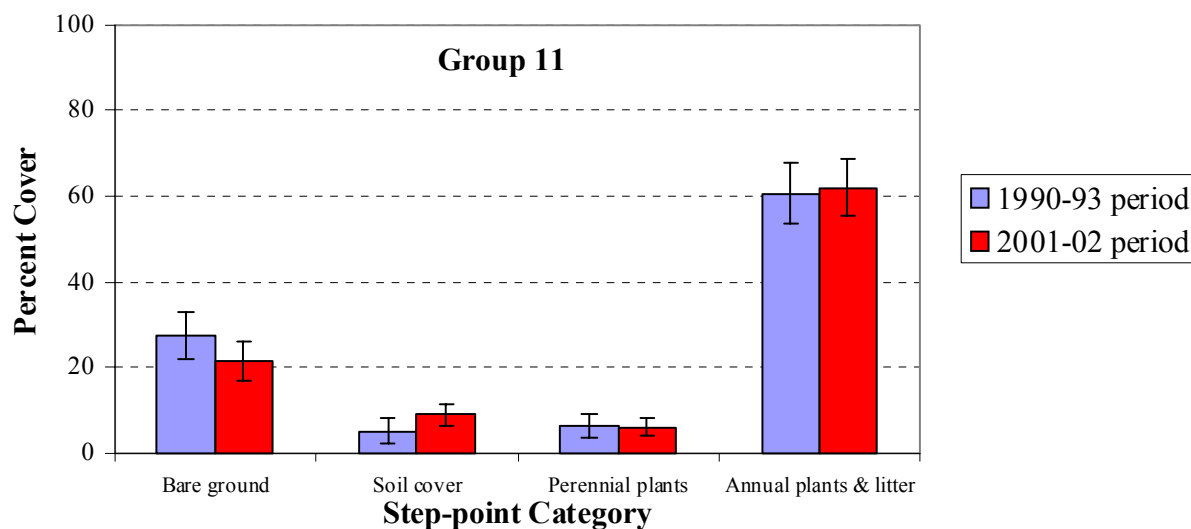
**Figure 30: Comparison of step-point cover estimates for Group 8: *Atriplex vesicaria* and *Maireana astrotricha* Open Shrubland in the Gawler and Kingoonya Soil Conservation Districts.**



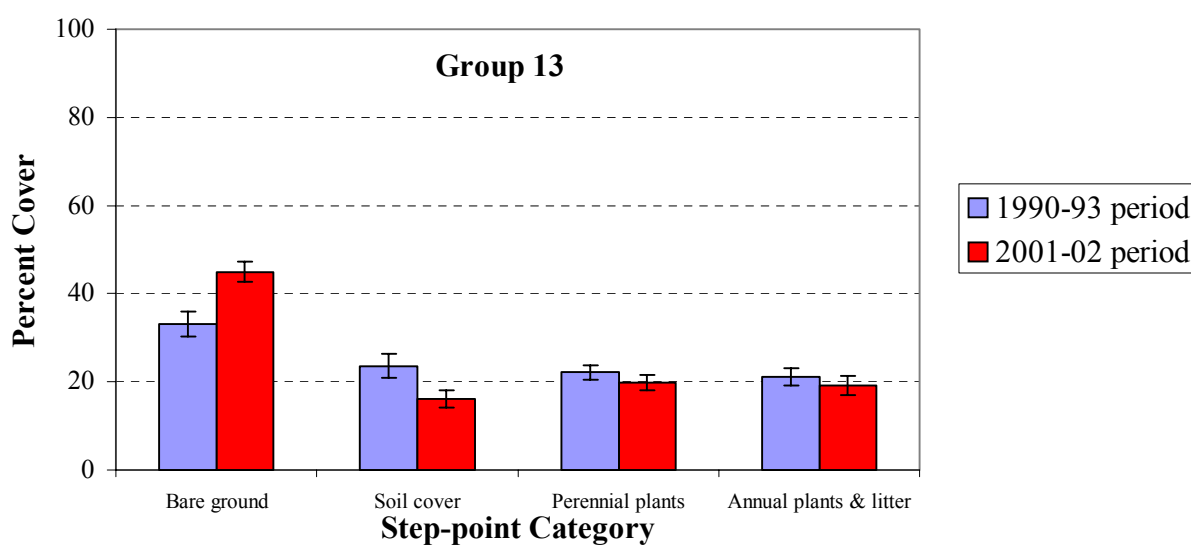
**Figure 31: Comparison of step-point cover estimates for Group 9: Open *Maireana pyramidata*, *Atriplex vesicaria* Shrubland and *Maireana sedifolia* in the Gawler and Kingoonya Soil Conservation Districts.**



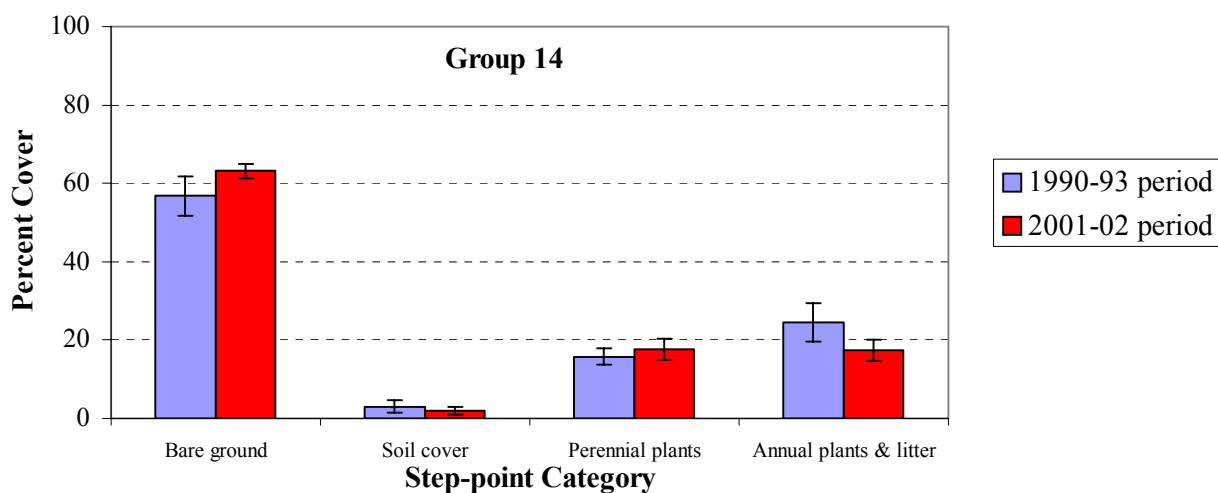
**Figure 32: Comparison of step-point cover estimates for Group 10: *Atriplex vesicaria* and *Sclerostegia tenuis* Low Open Shrubland in the Gawler and Kingoonya Soil Conservation Districts.**



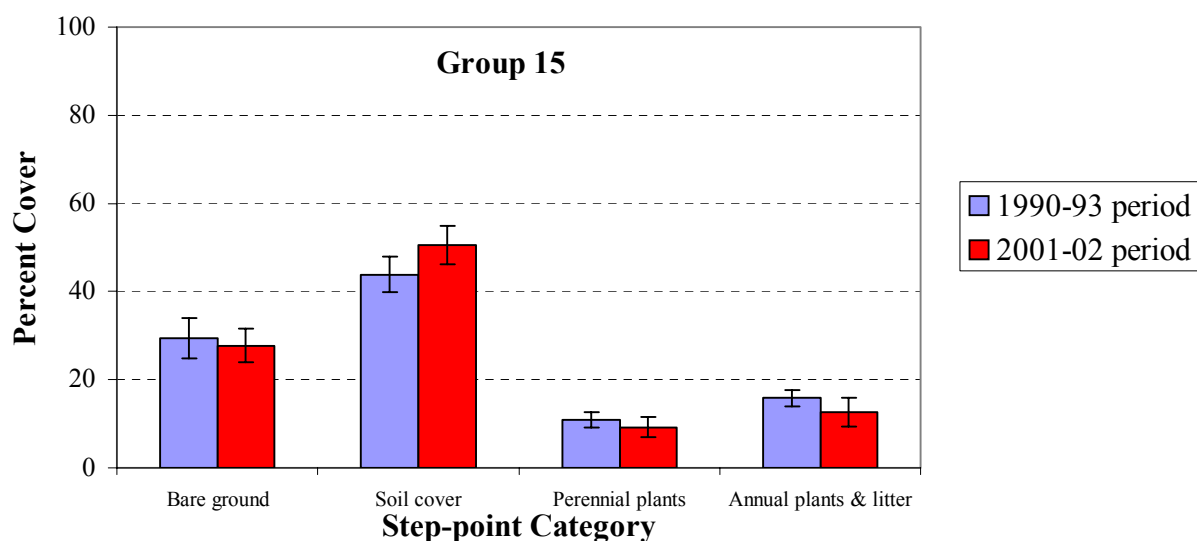
**Figure 33: Comparison of step-point cover estimates for Group 11: *Stipa* spp., *Carrichtera annua* and *Atriplex stipitata* Plains and Valleys in the Gawler and Kingoonya Soil Conservation Districts.**



**Figure 34: Comparison of step-point cover estimates for Group 13: *Acacia papyrocarpa* over *Maireana sedifolia* and *Atriplex vesicaria* in the Gawler and Kingoonya Soil Conservation Districts.**



**Figure 35: Comparison of step-point cover estimates for Group 14: *Acacia papyrocarpa* over *Maireana pyramidata*, *Maireana sedifolia*, *Atriplex vesicaria* and Tall Shrubs in the Gawler and Kingoonya Soil Conservation Districts.**



**Figure 36: Comparison of step-point cover estimates for Group 15: *Atriplex vesicaria* and *Sclerostegia medulosa* Low Open Shrubland in the Gawler and Kingoonya Soil Conservation Districts.**