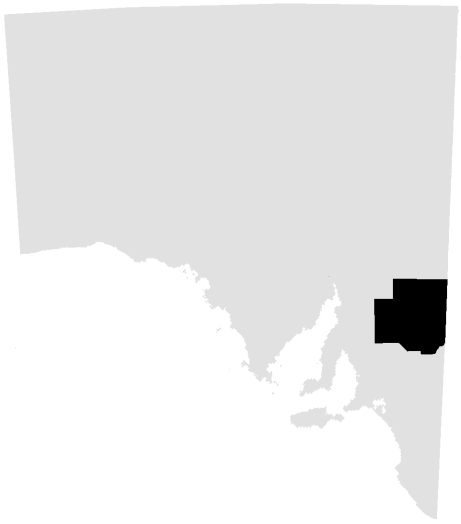
# A BIOLOGICAL SURVEY OF BOX AND BULOKE GRASSY WOODLAND IN THE UPPER SOUTH-EAST OF SOUTH AUSTRALIA

**1995**



BIOLOGICAL SURVEY SOUTH AUSTRALIA


**By**

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**1996**

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**CARTOGRAPHY AND DESIGN**

**Geographical Analysis and Research Unit**
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**Cover Photograph:**
**A typical buloke (*Allocasuarina luehmanii*) grassy woodland.**
**Photo: L. Heard**

# Abstract

A two week survey of the flora and fauna of remnant box and buloke vegetation in the Upper South East was undertaken in December 1995. Vegetation associations visited were buloke *Allocasuarina luehmanii* grassy woodland, grey box *Eucalyptus microcarpa* grassy woodland, peppermint box *E. odorata* grassy woodland, *E. microcarpa* x *E. microcarpa* grassy woodland, black (river) box *E. largiflorens* grassy woodland, broad-leaved box *E. behriana*  white mallee *E. dumosa*  peppermint box open scrub, and associated native grasslands. All of these associations are of high conservation value in South Australia.

Flora was surveyed at forty-eight sites, and fauna was surveyed at eighteen of these. During the survey the following were recorded:

Three hundred and three plant taxa, including four taxa of national conservation significance, forty-three of State significance and sixty-seven of regional significance;
Nine native mammal species;
Eighty-five native bird species;
Fifteen reptile species.

Invertebrates were also sampled, including a search at each fauna site for butterflies (Lepidoptera).

In addition to documenting the flora and fauna of the target vegetation types, this report assesses the importance to conservation of each vegetation remnant visited, provides a relative ranking for each, and thereby identifies the remnants of highest conservation significance. The sites visited represent the few remaining fragments of vegetation types that were once extensive in the area, therefore the protection of as many remnants as possible is encouraged. General management options.

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# People Involved

This survey was coordinated by Adrian Stokes and used personnel from a variety of agencies as well as volunteers. The survey was run through the Biological Survey and Research Branch of the South Australian Department of Environment and Natural Resources (DENR), in collaboration with the Geographical Analysis and Research (GAR) Unit of the Department of Housing and Urban Development (DHUD). This project was funded by the Endangered Species Program of the Australian Nature Conservation Agency.

**Fieldwork**

This survey ran for two one-week periods, with some field staff working for one week and some for two weeks. The following personnel were involved:

Vegetation
P. Lang and T. Croft, with assistance from K. Graham, L. Heard and S. Kenny.

Fauna
Mammals: K. Scriven, G. Carpenter.
Reptiles: M. Bonnett, S. Milne, A. Graham.
Birds: A. Stokes.
General assistants: J. Herriman, S. Botting, B. Pike.
Butterflies: R. Grund.

**Specimen identification**

The assistance of the State Herbarium (SH) and the South Australian Museum (SAM) is gratefully acknowledged.

Plants: R. Taplin (using SH facilities), P. Lang.
Mammals: L. Queale (SAM).
Reptiles: A. Edwards (SAM), M. Hutchinson (SAM).

**Data entry**

K. Scriven, with assistance from K. Graham, S. Kenny and A. Stokes.

**Mapping**

Computer mapping was conducted by L. Heard and J. Phillips using the facilities of the GAR Unit, DHUD.

**Other**

The extensive input of Tim Croft to this project is gratefully acknowledged. His broad knowledge of the flora and fauna of the South East was invaluable throughout all stages of the project. Similarly John Samuel-White was generous in the amount of time spent providing advice and other assistance.

Thanks also to Peter Copley for regular constructive input, and to Peter Lang, Lee Heard and Tony Robinson for their help.

Finally, thank you to the landholders for their cooperativeness and enthusiasm.

# Introduction

## BACKGROUND AND AIMS

For some years now the South Australian National Parks and Wildlife Service (SANPWS) and the South Australian Museum have been carrying out a series of systematic surveys of the vegetation and vertebrate fauna of large regions of South Australia. Previous surveys have been conducted or are currently in progress for the State's Offshore Islands (excluding Kangaroo Island) (1971 - 1982), the South East Coast (1982 - 1983), Cooper Creek (1983, 1991), the Nullarbor Plain (1984), the Gawler Ranges (1985), the Yellabinna Area (1987), Kangaroo Island (1989 - 1990), Strzelecki Dunefields (1988 - 1992), Murray Mallee (1990 - 1991), Anangu Pitjantjatjara Lands (1991 -), the South Olary Plains (1991 - 1992), Diamantina River Area (1994) and the Stony Deserts (1994 -). With the exception of the Offshore Island surveys, the regional boundaries of these surveys have been based on the Environmental Regions and Environmental Associations described and mapped for South Australia by Laut *et al.* (1977). In addition to these vegetation and vertebrate surveys, vegetation sampling analysis and mapping only, by the Geographic Analysis and Research Unit of the Department of Housing and Urban Development, has been completed or is in progress for the following areas:- South Mt Lofty Ranges (1986), Tallaringa Area (1988), Murray Mallee (1990), South East (1991), Western Murray Flats (1991), Mid-North (1992), Burra Hills (1994) and Yorke Peninsula (1994).

Recently, there has been a diversion from the use of the regions of Laut *et al.* (1977) to define the boundaries of surveys. Surveys have now been undertaken in specific areas in response to the need for biological information to assess the possible environmental impact of proposed developments. In 1994 a biological survey of Messent Conservation Park was undertaken to enable assessment of the possible impacts of a surface drain to be cut through the park as part of the Upper South East Dryland Salinity and Flood Management Plan. In 1995 a survey of the Yumbarra Conservation Park was conducted to assess the conservation and wilderness value of the park, particularly with respect to possible mineral exploration. These surveys provided a model for the future collection of detailed biological information on discrete areas of the State, enabling analysis relating to a specific area while contributing systematically to the existing biological database.

The definition of the boundaries of this survey represent a further development in the application of standard procedures to biological surveys in South Australia. This is a survey of remnant box and buloke grassy woodlands and associated communities on heavy clay soils in the Upper South East of South Australia. The selection of sites in this survey was therefore determined primarily by the presence of target vegetation types on appropriate soil, and secondarily by the locality defined by six 1:50 000 mapsheets in the "Upper South East" (Figure 1). The target vegetation associations were buloke (or bulloak) *Allocasuarina luehmanii* (formerly *Casuarina luehmanii*), grey box *Eucalyptus microcarpa*, peppermint box *E. odorata*, black (river) box *E. largiflorens*, broad-leaved box *E. behriana* □ white mallee *E. dumosa* □ peppermint box, and associated native grasslands. All of these associations in the region occur on fertile clay soils and have been disproportionately cleared for agriculture, consequently all are reduced to small remnants and scattered trees. Typically, these associations have a grassy understorey, however non-grassy sites were also included in the survey.

Neagle (1995) (updating Davies (1982)) evaluated the conservation status of the major plant associations of South Australia. These authors assigned conservation priority ratings to each association according to the extent of its protection in SANPWS reserves, the T. G. Osborn Reserve at Koonamore and a significant proportion of the State's Heritage Agreements (areas of private land dedicated in perpetuity to wildlife conservation under the Native Vegetation Act (1991)). Croft and Carpenter (1996a) have also discussed the conservation status of vegetation associations in the South East. Table 1 outlines the conservation status of the vegetation associations targeted in this survey. All are accorded a high conservation priority status in South Australia.

This high conservation status is typical of grassy ecosystems in southern Australia - temperate grasslands and grassy woodlands are the most endangered ecosystems in the country (Kirkpatrick *et al.* 1996). This is because they typically occur on low lying, fertile soils that have been cleared extensively for agriculture. Much of the remnant native grassland has been altered in composition by the use of fertilisers, the sowing of pasture, and the effects of grazing by domestic stock, resulting in the replacement of native grasses with introduced species.

**Table 1 Conservation status in South Australia (SA; Neagle 1995), South East (SE; Croft and Carpenter 1996a) and interstate (Neagle 1995) of target vegetation communities.**

| Plant Association | SA Status | SE Status | Interstate |
|---|---|---|---|
| *E. behriana* □ *E. dumosa* □ *E. odorata* Open Scrub | *Priority 1. Nil conservation. Very rare and endangered. | Vulnerable. | Moderately conserved, Vic. |
| *E. odorata* □ *E. porosa* (Low) Woodland | Priority 3. Poorly conserved. Remaining examples small and/or degraded and/or atypical. | Rare. | Poorly conserved. |
| *E. microcarpa* Woodland | Priority 4. Poorly conserved. Much depleted but a few large examples remain. | Endangered. | Poorly conserved |
| *A. luehmanii* Low Woodland | Priority 6. Nil conservation. Very rare and endangered. | Endangered. | Moderately conserved, Vic. |
| *E. largiflorens* Woodland | Not considered. | Endangered. | Extensive in Western Vic. and R. Murray.** |

*Small areas of *E. behriana* in two heritage agreements declared since Neagle (1995).
**Croft and Carpenter (1996a); personal observations.

Specht (1951) described the soils and vegetation of the Hundreds of Tatiara and Wirrega, surrounding Bordertown (Figure 1). He described the presence of grey soils of heavy texture on low-lying areas of poor drainage on level surfaces between watercourses and along watercourses. These soils are often inundated during winter and subsequently dry in summer to form deep cracks. Characteristic of these soils is the formation of gilgais or crabholes - depressions up to four metres in diameter (Specht 1951) caused by drying and cracking during summer. Specht (1951, p.85) described the characteristic vegetation of these soils as buloke and "*Eucalyptus largiflorens* (box)"; most of the box present on these soils is in fact *E. microcarpa*, with some *E. odorata* and some intergrades between these two species. *E. largiflorens* is not widespread in the region, being restricted mainly to the Tatiara Creek and surrounding areas in the north of the district.

These extensive cracking clay soils are very fertile relative to surrounding soils, particularly the sands of the Big and Little Deserts. The clay soils in this part of South Australia are the western extremity of the extensive Wimmera region, a highly productive agricultural region in western Victoria. A large extension of the Wimmera soil is present south of Bordertown, with a smaller extension further south at Frances (Figures 1, 2 and 3).

Litchfield (1956) described the soil and vegetation relationships north of Bordertown, including the Hundreds of Cannawigara and Senior (Figure 1). Areas of heavy clay soil are found in this area along watercourses and in small pockets where depressions and drainage areas are present. *Eucalyptus behriana*, occurring alone or in association with *E. dumosa* and/or *E. odorata*, is typical of these northern clay soils.

Due to the high fertility of these heavy soils, their associated vegetation types have been extensively cleared for agriculture and, as summarised in Table 1, are now scarce. Most remaining fragments are small and degraded. Consequently, little is known about their biological composition. This survey was instigated to collect biological information from the remnant box and buloke vegetation and to formulate management recommendations for these remnants.

The vegetation considered in this survey lies principally within three of the Environmental Associations of Laut *et al.* (1977a, b) (Figure 3). Most of the sites north of Bordertown occur in the Cannawigara Environmental Association (2.3.2), described by Laut *et al.* (1977b) as "a plain with low dunes and shallow depressions with gilgai. The vegetative cover is predominantly open parkland with remnants of mallee broombush and low woodland, grazed throughout". Other sites in the Bordertown area are in the Bordertown Environmental Association (2.3.1), described as "an undulating plain traversed by the valley of the Tatiara Creek. The soils are poorly drained and carry an open parkland of various eucalypts and bulloak". The southern region of the study area is in the Kybybolite Environmental Association (1.5.1), described by Laut *et al.* (1977a) as "a gently undulating plain of Tertiary sands with local ferruginous cappings and scattered low dunes...There is no integrated surface drainage but much of the water disappears underground".

## PREVIOUS BIOLOGICAL STUDIES

During the vegetation survey of the entire South East in 1991, only three quadrats were placed in box or buloke vegetation due to the limited number and small size of remnants. The list of plant species recorded in these three quadrats is included in this report (Appendix II).

Davies (1983) visited three remnants of *E. behriana* □ *E. dumosa* □ *E. odorata*, and produced a plant species list for each. These sites were revisited during the present survey (quadrats BBG00301, BBG01701, BBG01801). Records of the Native Vegetation Management Branch of the Department of Environment and Natural Resources provide plant lists for all remnants visited during assessment of clearance applications. These records constitute a valuable store of information relating to the distribution of plant species. However, there have been few clearance applications relevant to this survey as the quantity of target vegetation is so small.

Croft and Carpenter (1996a) summarised the information available from many sources, including the records and specimens at the State Herbarium and the South Australian Museum, for the plants, mammals, reptiles, amphibians and birds of the South East. This included a list of the vegetation associations in which each vertebrate species has been recorded, providing a useful accompaniment to the data collected during this survey. Their publication represents a valuable reference to the distribution and conservation status of flora and fauna in the region.

Tim Croft of the Native Vegetation Management Branch, DENR, has mapped the probable pre-European distribution of native vegetation types in the South East. His data have not yet been digitised, therefore were not available at the time of preparation of this report. His records indicate that the target vegetation types were once extensive on the fertile soils of the study area.

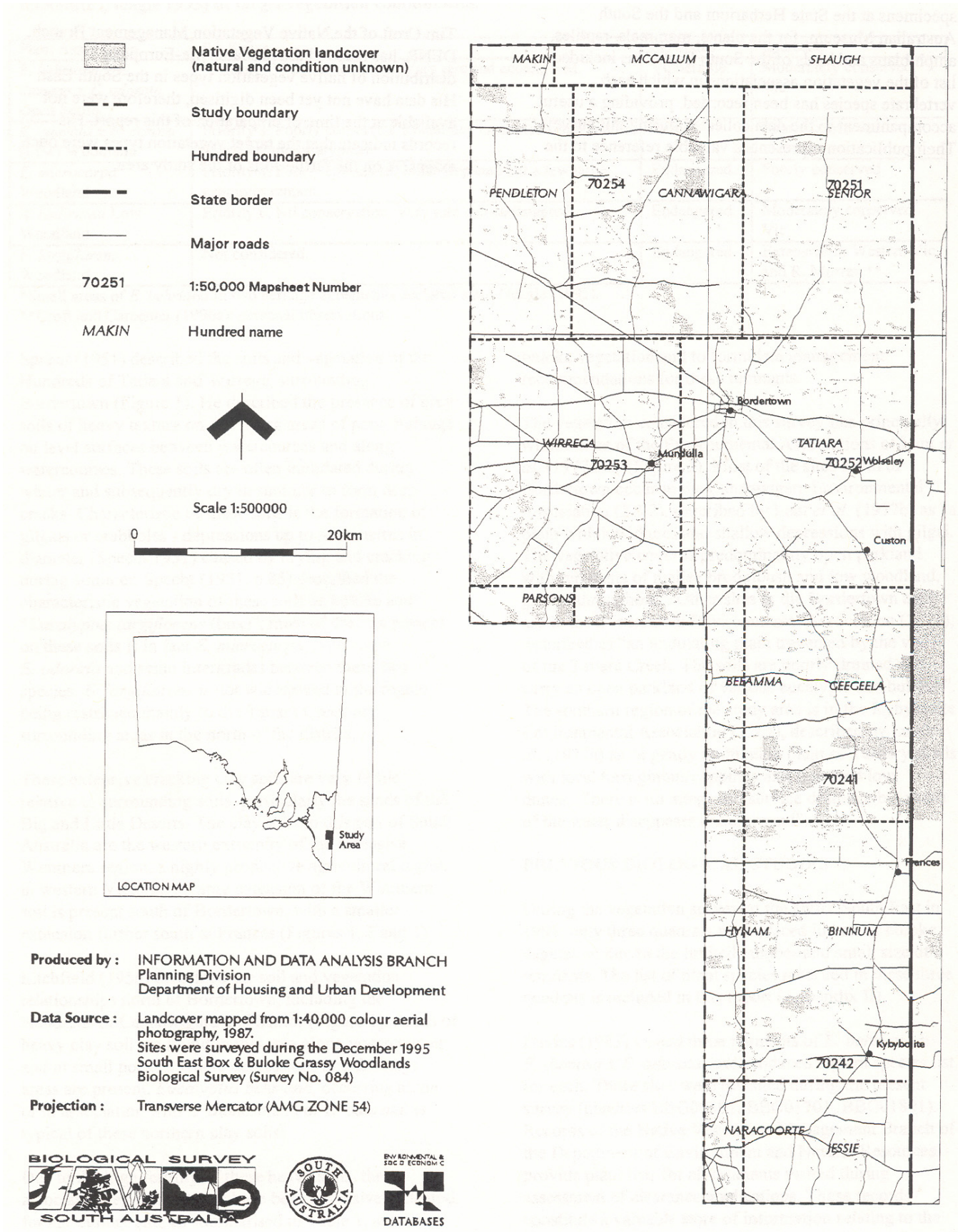


**Figure 1**
**Study Area for the 1995 Box and Buloke Grassy Woodland Biological Survey**

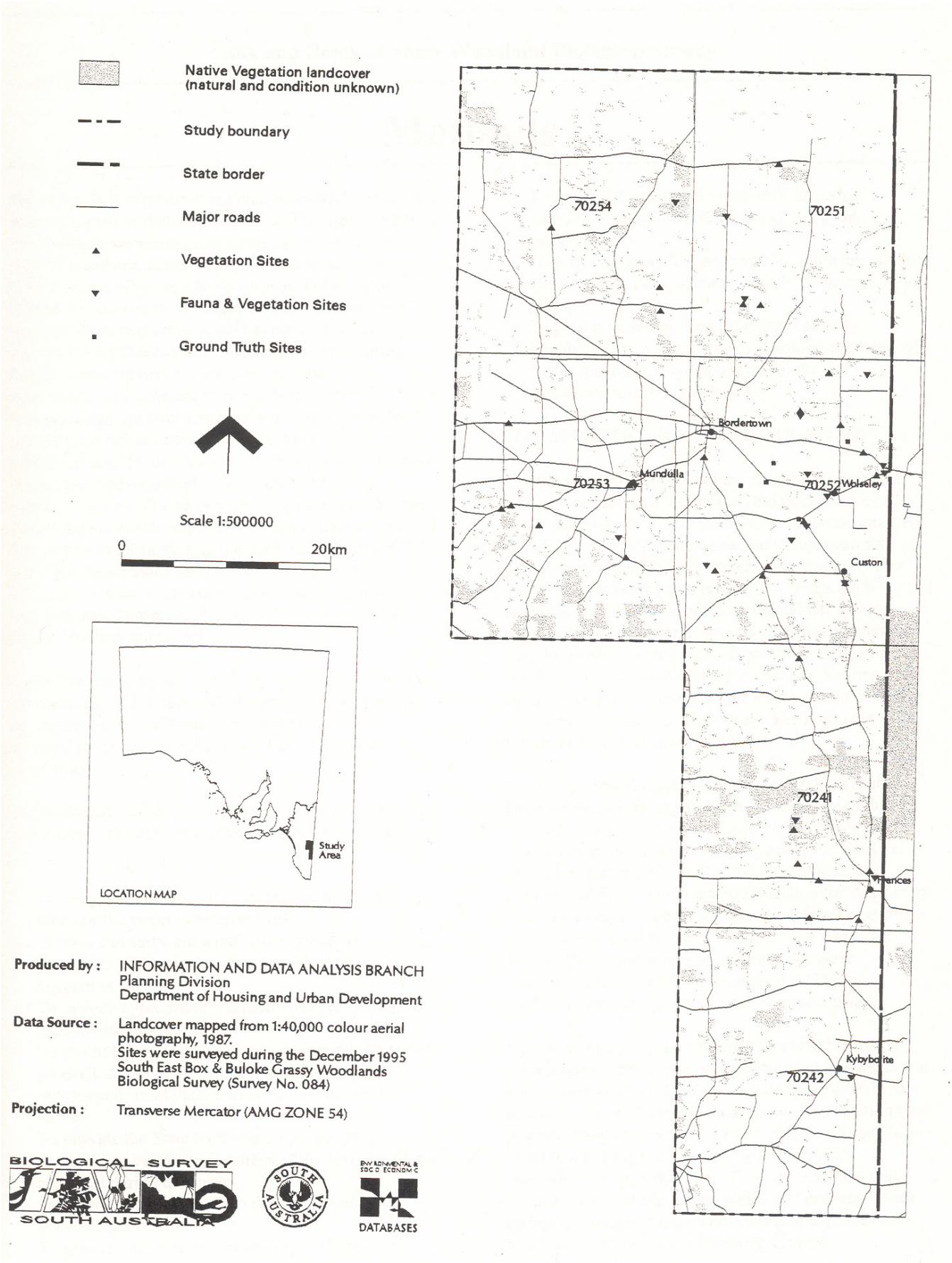


**Figure 2**
**Locations of survey sites for the 1995 Box and Buloke Grassy Woodland Biological Survey.**

# Methods

The rationale behind these regional biological surveys has been explained in detail by Copley and Kemper (1992) for combined vegetation and vertebrate surveys in the semi-arid and arid zones and by Robinson and Canty (1984) for the offshore islands surveys. Owens *et al.* (1995a, b) outlined the changes in approach that were required when two surveys were conducted in more localised areas (Messent and Yumbarra Conservation Parks). These surveys involved an increase in the concentration of quadrats than is normally used for biological surveys over large areas of South Australia. In addition, the present survey was conducted in the agricultural region of the state, where vegetation has been fragmented and degraded by clearance and other practices. The small size of many fragments affected the size of the vertebrate trapping area that could be used. This is true of all surveys in the agricultural districts, therefore the methods used at each site in this survey follow those used in previous surveys in these districts (e.g. Messent Conservation Park, Owens *et al.* 1995b; Murray Mallee, unpublished).

Apart from these minor logistic and sampling differences, the methods used in this and all surveys comprising the Biological Survey of South Australia conform to a standard procedure and data from each are directly comparable.

The biological survey of box and buloke grassy woodland in the Upper South East was designed with the following aims:

1. To collate all previous information on the flora and fauna of the target vegetation types.
2. To plan and carry out a biological survey in December 1995 of selected remnants of the target vegetation.
3. To include appropriately skilled volunteer biologists to assist with the survey.
4. To provide the South Australian Museum with a set of properly documented voucher specimens of the reptiles and small mammals collected during the survey.
5. To provide the State Herbarium with properly documented voucher specimens of the vascular plants collected during the survey.
6. To enter all survey data into the South Australian Survey Database.
7. To upgrade the mapping of the target vegetation already conducted by the Geographical Analysis and Research Unit of the Department of Housing and Urban Development.
8. To assess the conservation value of important remnants in relation to flora, fauna and plant communities.
9. To prioritise areas for conservation action and identify blocks, species and communities requiring recovery plans.
10. To produce a report, using standards already established for reporting on the Biological Survey of South Australia, detailing major results and conservation recommendations.

**SITE SELECTION AND NOMENCLATURE**

The fundamental concept behind most of the regional surveys conducted as part of the Biological Survey of South Australia has been that they are based on intensive sampling at a series of sites selected to represent the biological and geographical diversity of the study area. As the present survey was intended to assess the biota and conservation status of a subset of the habitat within a region, the site selection process was different from that used for general survey work. Financial and logistic considerations dictated that approximately 50 sites could be surveyed for vegetation, of which 18 would comprise the fauna component of the survey. The flora sites were selected initially, as described below.

The Geographical Analysis and Research Unit of the Department of Housing and Urban Development have mapped the distribution of different types of remnant vegetation in the South East, using data from the 1991 vegetation survey, 1:50 000 aerial photographs and ground-truthing. Preliminary site selection for this survey used these maps to locate all remnants of the vegetation communities listed in Table 1. A few sites were also located from other sources, including clearance assessments and the private records of R. Davies. Approximately 200 potential sites were identified.

The second stage of site selection involved the use of aerial photographs to reject any of the 200 fragments that appeared too small, of very poor quality, or contained relatively low representation of the target vegetation type. Approximately 150 sites remained after this stage. Each of these was assigned a ranking as a “definite”, “probable” or “possible” site. Final site selection was made after a field trip during which all “probable” sites and most “possible” sites were visited and qualitatively assessed according to the following criteria:

1. Sites whose understorey were dominated by exotic plant species and contained few natives were rejected;
2. Sites with a relatively dense, healthy overstorey were preferred to more degraded, cleared sites;
3. Sites in which the target tree species was scarce in an overstorey dominated by another species were usually rejected.

A total of 55 sites were finally selected, 45 of which were identified as "definite" sites which must be visited, and a further ten "lower priority" sites that were to be visited if time permitted. Fifty-three sites were finally surveyed, of which forty-eight were full quadrats and five were brief "Ground Truth" surveys (see below). All sites were in woodland or mallee scrub, except one site that consisted of predominantly native grassland.

From the sites that were judged during ground inspections to be in the best condition, the eighteen fauna sites were selected, ensuring that each vegetation type had an approximately equal number of sites. The grassland site was also surveyed for fauna.

Each quadrat was assigned a unique eight digit code, comprised of three parts: a three letter site area code, a three number site code, and a two number quadrat code. The site area code for all quadrats in this survey was BBG (representing Box and Buloke Grassy woodland). The site code represented an arbitrarily assigned unique number for each vegetation remnant that contained a quadrat. The quadrat code was a number for each quadrat within a given patch of vegetation. For example, there were two quadrats in the patch of scrub numbered 010; the full codes for these two sites were BBG01001 and BBG01002. Occasionally botanists renamed quadrats in the field, using nomenclature that did not conform to these standards, although the site code was always BBG.

During this report, the terms "quadrat" and "site" are both used when referring to data. "Quadrat" is used for records from within survey quadrats, and "site" is used for fauna data collected in the immediate vicinity from within the same vegetation type.

Figures 2 and 3 show the location of each quadrat and the distribution of remnant vegetation in the study area.

**DATA COLLECTION**

The vegetation component of these biological surveys is based upon 30 X 30 m quadrats. In this survey, many quadrats were located in linear remnants along roadsides and railways in which a 30 X 30 m quadrat would not fit. At these sites, rectangular quadrats of the same area were used (typically 10 X 90 m).

On the vegetation survey, standard data sheets were filled out which included a description of the location and physical environment and the vegetation within the quadrat. All vascular plants present in the quadrat were recorded and a herbarium specimen of each species encountered was collected. All specimens were lodged with the State Herbarium for identification or checking of field identifications and, depending on specimen quality, as many specimens as possible were incorporated into the Herbarium collection.

Many of the sites selected contained a very high number of exotic understorey species. During field work, botanists had discretion to conduct only a brief survey of a site if they considered it too highly degraded. For such sites a "Ground Truth" survey was done, using data sheets used on DHUD surveys for preliminary site assessment. This involved recording the dominant species, up to eight understorey species and a brief physical description of the site. This provided data describing tree species coverage at these sites, without investing considerable time. All of the Ground Truth sites consisted of buloke over exotic pasture with few native species.

A photograph was taken of each quadrat, using a white board mounted on a range pole to identify each site. No permanent monitoring points were established. Examples of photographs of each vegetation type are provided in Appendix 1.

At each of the eighteen quadrats sampled for fauna, a 50 m long line of six fenced pitfall traps was established. Traps consisted of a 455 mm X 380 mm sheet of white high impact polystyrene joined into a cylinder using a slotted H section plastic strip (HM12). This resulted in a pitfall trap 125 mm in diameter and 380 mm deep.

A separate line of 15 Elliott traps, used to capture small mammals, was run in association with each pitfall line sampling the same habitat within the quadrat. Two possum/cat size traps were placed at each end of the Elliott line. Most traplines were run for four nights, although delays in installing pitfalls due to very hard clay soils meant that three lines were run for only three nights. Reptiles and mammals were also captured or observed by searching each of the eighteen quadrats at least once during the survey period.

A line of 10 micropitfalls consisting of plastic vials measuring 80 X 20 mm and filled with 70% alcohol were set adjacent to the main pitfall line. In addition, a short line of four plastic pitfall buckets of 150 mm diameter and filled with 70% alcohol, joined by solid sheetmetal fences, was established parallel to the micropitfall line. This equipment was supplied by the Entomology Department of the South Australian Museum.

Birds were recorded for each quadrat. An observer spent at least one hour during the best bird observation times of early morning and evening and recorded all birds within or flying over the quadrat during the search period. An attempt was made to put in the same search effort at each quadrat during the best observation times.

Observations of some plants and vertebrates (especially birds and bats) encountered outside quadrats were recorded on special "opportunistic" data sheets. The limited time of sampling prevented any exhaustive inventories of bat communities, however harp-traps and mist-nets were used at some suitable locations in appropriate vegetation types near quadrats.

At least the first specimen of each small mammal and reptile species recorded for the survey area was preserved as a museum specimen. Larger specimens, especially Sleepy Lizards *Tiliqua rugosa*, that had been collected

from the general region in the past and did not present any identification problems were not collected.

Samples of liver tissue were taken from all collected specimens and stored in liquid nitrogen. These tissue samples were lodged with the South Australian Museum.

A small amount of vehicle and walking spotlight searching was carried out both on the quadrats and opportunistically in appropriate vegetation types, but the demands of quadrat sampling and specimen processing did not allow this to be carried out systematically.

A summary of the vertebrate sampling effort over the whole survey is given in Table 2.

Invertebrates were collected from the micropitfalls, the invertebrate macropitfalls ("buckets"), the vertebrate macropitfalls and opportunistically from around each trapline. These samples were also lodged with the South Australian Museum.

At each of the eighteen fauna sites, a search was conducted for butterflies (Order Lepidoptera). This included locating known host plant species (characteristic plant species that are used by lepidopterans as ovipositing sites) and searching for eggs or larvae. This search was conducted by a lepidopteran specialist.

The total number of observations of plants and vertebrates during the survey are shown in Table 3.

Maximum and minimum temperatures in the shade and in the sun were recorded daily at one fauna site during each week. These are presented in Table 4.

**Table 2 Trapping and spotlighting effort during the box and buloke grassy woodland survey, December 1996.**

| SITE | Pit Trap Nights | Elliott Trap Nights | Cage Trap Nights | Spotlight Hours | Harp Trap Nights | Mist Net Hours |
|---|---|---|---|---|---|---|
| BBG01001 | 24 | 60 | 8 | 3 | | 2 |
| BBG01101 | 24 | 60 | 8 | | | |
| BBG00601 | 24 | 60 | 8 | | 1 | |
| BBG02401 | 24 | 60 | 8 | | | |
| BBG02601 | 24 | 60 | 8 | | | |
| BBG02801 | 18 | 45 | 6 | | | |
| BBG02301 | 24 | 60 | 8 | | | 3.5 |
| BBG03701 | 24 | 60 | 8 | 2 | 2 | 4 |
| BBG03201 | 24 | 60 | 8 | | | |
| BBG01201 | 24 | 60 | 8 | | | |
| BBG05801 | 24 | 60 | 8 | | | |
| BBG02A08 | 18 | 45 | 6 | 2 | 1 | |
| BBG00301 | 24 | 60 | 8 | | | |
| BBG01601 | 24 | 60 | 8 | 1 | 1 | 3 |
| BBG01801 | 24 | 60 | 8 | 1 | 1 | |
| BBG02B04 | 24 | 60 | 8 | 2 | | |
| BBG03101 | 24 | 60 | 8 | 2 | | |
| BBG02B08 | 18 | 45 | 6 | 1 | | |
| TOTALS | 414 | 1035 | 138 | 14 | 6 | 12.5 |

**Table 3 Numbers of individual observations of plants and vertebrates recorded during the box and buloke grassy woodland survey, December 1995.**

| | Quadrats | | Opportunistic | Total |
|---|---|---|---|---|
| Plants | 1608 | (48 sites) | - | 1608 |
| Mammals | 55 | (18 sites) | 103 | 158 |
| Birds | 1377 | (18 sites) | 172 | 1549 |
| Reptiles | 28 | (18 sites) | 31 | 59 |
| Amphibians | 7 | (18 sites) | 0 | 7 |

**Table 4 Weather conditions during the box and buloke biological survey, December 1995**

| | Sun | | Shade | | |
|---|---|---|---|---|---|
| | Min°C | Max°C | Min°C | Max°C | Comments |
| 05/12/95 | | | | | Cool, overcast |
| 06/12/95 | 0 | - | 4 | 22 | Fine, mild, some cloud |
| 07/12/95 | 9 | 44 | 8 | 28 | Fine |
| 08/12/95 | | | | | Fine, hot |
| 12/12/95 | 0.5 | 27.5 | 2.5 | 30 | Mild-warm, some cloud, light wind |
| 13/12/95 | 10 | 30 | 11 | 30 | Warm, some cloud |
| 14/12/95 | 9 | 37 | 11 | 36 | Warm-hot, some cloud |
| 15/12/95 | | | | | Hot |

## DATA MANAGEMENT

On return to Adelaide all voucher specimens were checked with the South Australian Museum or the State Herbarium. Any corrections were transferred by the survey coordinator to the data sheets before data entry began.

All data collected on the survey were entered on the appropriate database, Survey or Opportunistic, administered by the Information and Data Analysis Unit, Department of Housing and Urban Development. Data from the Ground Truth sites were entered onto a separate database.

## DATA ANALYSIS

Due to time constraints, multivariate analysis of data was not possible. However, data collected during this survey will ultimately be analysed using the PATN software package in conjunction with data from the 1991 South East flora survey and the South East fauna survey to be completed in 1997.

In the absence of statistical analysis, a variety of qualitative and semi-quantitative approaches were used to highlight patterns of the distribution of flora and fauna recorded during the survey.

## FLORA IN VEGETATION TYPES

Each quadrat was assigned to a category of habitat "association" based upon the dominant plant species found in the overstorey during the survey. The five categories used (where "box" may be *Eucalyptus microcarpa* and/or *E. odorata* and/or *E. largiflorens* and/or intergrades thereof) were: buloke (11 sites); buloke  box (16 sites); box (nine sites); *E. behriana* (11 sites); grassland (one site). The Ground Truth sites were excluded from this analysis. Note that these associations are subjectively based upon the dominant species observed during this survey and are not the result of any objective analysis.

From the species x quadrat table (Appendix II), the number of records for each plant species in each of the above associations was calculated. This enables a preliminary discussion of species' distributions relative to dominant vegetation type.

## COMPARISON OF SITES

Among the aims of this project was the identification of important remnants and the prioritisation of areas for conservation. There is no standard procedure available for assessing the relative quality of a number of sites by integrating data for diverse taxa as were collected in this survey.

Accordingly, a number of approaches were used to objectively assess relative habitat quality, and these were subjectively integrated to finalise overall rankings of all sites. Rankings were made within each of the four habitat associations defined earlier (excluding grassland which comprised only one quadrat), rather than over all habitat types. This avoids any bias due to natural differences between habitat types (e.g. some habitats are naturally more diverse than others).

### Assessment using flora

Proportion of native species present

A feature of all except one of the sites at which this survey was conducted was the presence of exotic plant species. Some indication of the integrity of a site's flora may be obtained using indices that consider the relative proportions of native and exotic species (e.g. Kirkpatrick and Gillfedder 1995). In this analysis, the number of native species and the total number of species present in each quadrat were used to calculate the proportion of species present that were native. This index is referred to as the "nativeness index". The higher the nativeness index, the better the site in terms of prevalence of native plant species.

The nativeness index was calculated for all quadrats, and sites within the four habitat associations were then ranked according to the proportion of native species present.

Native species richness

Sites were ranked within the four associations according to the number of native plant species that were recorded (native species richness).
Number of significant taxa

Many taxa of significant conservation status were recorded in this survey, therefore sites with the greatest number of significant taxa may warrant a higher priority in terms of immediate management. Sites were ranked within the four associations according to the number of significant taxa recorded. The conservation status of species in this survey is discussed later (see **Significant taxa** in Results).

**Assessment using fauna**

Insufficient mammals or reptiles were recorded to enable site comparisons using these taxa.

Bird species richness

The number of bird species recorded at each site (species richness) was used as an index. The eighteen fauna sites were assigned to the five habitat associations as with the flora analysis, and ranked within these groupings according to their bird species richness.

Bird species diversity

During field work, the number of individuals of each observed bird species was recorded. This enabled calculation for each site of the Shannon-Wiener diversity index (D):

$$D = -\sum p_i \log p_i$$

where $p_i$ = the proportion of all birds observed that were from the i-th species. Diversity is a more informative index than richness (i.e. number of species present) as it incorporates the relative numbers of individuals in each species.

The fauna sites were ranked within the habitat associations according to their bird species diversity.
Ant richness

Analysis of the ant fauna can be based only upon the genera present, since at the time of production of this report no species data were available. Sites were ranked within each habitat association according to the number of genera present (referred to hereafter as "generic richness").

Ant functional group

A number of authors have espoused the value of ants as bio-indicators of the relative quality of areas of habitat with respect to land degradation (e.g. Andersen 1987, 1990; Majer 1987). The ant data collected during this survey were analysed according to this body of theory, and a summary of this analysis is presented in Appendix VIII.

**Overall assessment**

An overall flora ranking for each site was calculated from the three flora indices. This was calculated by assigning a rank score to each site for each index (i.e. the highest ranked site had a rank score of 1, the second highest had a rank score of 2, etc.) and averaging the three scores for each site.

An overall ranking for each site was obtained in the same way from the two bird indices.

The relative conservation significance of each site was then assessed considering all of the above criteria and other factors, as described in the Conclusions and Conservation Recommendations.

**VEGETATION MAPPING**

Using data collected from quadrats during the survey and from personal observations during site selection, the information contained on DHUD's vegetation distribution maps of the Upper South East was updated. Remnant boundaries and the vegetation associations present were corrected where necessary onto the original mylar films and the changes digitised accordingly.

# Results

## VEGETATION

303 plant taxa were recorded in quadrats during the survey. The full list of plant species recorded in each quadrat is presented in a species x quadrat table in Appendix II.

The taxon recorded most often during the survey was *Danthonia setacea* var. *setacea*, in 44 of the 48 quadrats. The next most common native species were *Oxalis perennans*, recorded from 33 quadrats, and *Allocasuarina luehmanii*, from 28 quadrats. Exotic grasses were very common, especially *Lolium rigidum* (36 sites), *Avena barbata* (28 sites) and *Vulpia myuros* forma *myuros* (27 sites).

### FLORA IN VEGETATION TYPES

The distribution relative to the five habitat associations for all plant taxa can be assessed from Appendix II, in which sites are grouped according to the habitat association to which they were assigned. This should be viewed only as an interim analysis until formal analysis using PATN.

The two species that were most restricted to the "pure" buloke sites were two mistletoes, *Amyema lysiana* ssp. *orientale* and *Lysiana exocarpi* ssp. *exocarpi*. When the "buloke" and "buloke + box" sites are combined (i.e. when all sites containing buloke are considered), a suite of characteristic species is identified. These species include *Convolvulus* aff. *erubescens* "linear lobes" (19 of 21 records), *Maireana enchylaenoides* (17 of 19), *Calocephalus citreus* (17 of 18), *Elymus scabrus* var. *scabrus* (15 of 16), *Homopholis proluta* (13 of 14), *Templetonia stenophylla* (11 of 11), *Eutaxia microphylla* var. *microphylla* (prostrate) (11 of 12), *Swainsona procumbens* (10 of 11) and *Plantago gaudichaudii* (nine of nine). Many other species that were less common in the survey also showed a strong affinity for buloke (Appendix II). This suite of species in association with buloke appears to be characteristic of clay soils with gilgais.

No species appeared to be strongly associated with "box" sites, although *Lomandra nana*, *Aira cupaniana*, *Acacia farinosa*, *Arctotheca calendula*, *Juncus radula* and *Teucrium racemosum* were relatively common.

The "*E. behriana*" sites did not have any species strongly associated with them, although *Acacia acinacea* and *Dianella revoluta* var. *revoluta* were relatively common and all three records of the significant taxon *Acacia* aff. *halliana* were in this habitat type.

The one grassland quadrat contained 14 native species, including *Themeda triandra*, and 11 exotic species.

### SIGNIFICANT TAXA

**Species of national significance** (Source: Briggs and Leigh 1995; P. Lang pers. comm.)

Four species of national significance were recorded (Appendix III).

*Ptilotus erubescens*

This species is an erect perennial herb to 25 cm high, with a spicate, globose or ovoid terminal inflorescence (Harden 1990). It is characteristic of grasslands and grassy woodlands growing on heavy soils in New South Wales, Victoria and South Australia (P. Lang pers. comm.).

*Ptilotus erubescens* is classified as rare in South Australia, endangered in Victoria (Gullan, Cheal and Walsh 1990), but has no official status in NSW (although probably rare; P. Lang pers. comm.). Although it has no official national status, it has been flagged in the SA FLORA database as requiring assessment for probable national conservation significance (P. Lang pers. comm.). In South Australia, the species is known from the Murray Mallee (rare), the Northern Mt Lofty Ranges (threatened) and the Southern Mt Lofty Ranges (rare). The record from this survey was the first for this species in the South East.

*Ptilotus exaltatus* var. *semilanatus*

This erect perennial shrub grows to 1.5 m high and has a conical inflorescence 3-20 cm in length (Harden 1990). The species *P. exaltatus* is widespread in the eastern states of Australia, and the variety *P. exaltatus* var. *semilanatus* is restricted to heavy clay soils in these states. Due to this restriction to clay soils, the taxon is endangered in South Australia and has been flagged in the SA FLORA database as requiring an assessment of its national conservation significance (P. Lang pers. comm.). In South Australia, the taxon is known only from the South East.

*Stipa multispiculis*

*Stipa multispiculis* is a spear-grass that occurs on heavy red-brown earths and is rated as rare across its Australian range (Briggs and Leigh 1995; Davies 1995). In South Australia, the species is known from Kangaroo Island

(threatened), the Southern and Northern Mt Lofty Ranges (threatened and rare respectively) and Yorke Peninsula (rare). The record from this survey was the first for this species in the South East.

*Acacia* aff. *halliana*

The species *Acacia halliana* is a spreading shrub to 2.5 m high and 4-5 m wide, and occurs on "red-brown sands and light calcareous soils with mallee eucalypts" (Whibley and Symon 1992). The species has no significant conservation status in South Australia and is recorded from Kangaroo Island, the Mt Lofty Ranges and the South East.

*Acacia* aff. *halliana* was found on this survey on heavy gilgai soils at three sites as an understorey shrub in *E. behriana* communities. This taxon differs from typical *A. halliana* in its more open, sprawling habit, and smaller often glaucous phyllodes, although it may only warrant subspecific status. It is believed to be endemic to South Australia, having been recorded on Kangaroo Island, the Western Murray Flats and the South East. Upon resolution of its taxonomy, the conservation status of the taxon will require assessment (P. Lang pers. comm.).

**Species of State significance** (Source: Lang and Kraehenbuehl 1995)

Forty-three species of State significance were recorded (Appendix III).

**Species of regional significance** (Source: Lang and Kraehenbuehl 1995)

Sixty-seven species of regional significance were recorded (Appendix III).

**Significant taxa in Association Types**

The distribution of the 67 taxa of conservation significance in the six habitat associations is summarised in Appendix III.

**NEW FLORA RECORDS**

There were nine new vascular plant records for the South East made during this survey, plus one species *Bothriochloa macra* that was rediscovered after being presumed regionally extinct. The latter record was an opportunistic sighting from outside a formal quadrat. The nine new taxa are *Stipa gibbosa*, *Vittadinia pterochaeta*, *Stipa multispiculis*, *Stipa puberula*, *Ptilotus erubescens* (confirmed - previously doubtful), *Acacia glandulicarpa* (opportunistic record from outside quadrats), *Pimelea curviflora*, *Juncus amabilis* and *Pycnosorus chrysanthus* (confirmed - previously doubtful).

## MAMMALS

No native mammals were captured in pitfall traps, Elliott traps or cage traps during this survey. Common Brushtails *Trichosurus vulpecula*, Common Ringtails *Pseudocheirus peregrinus*, Western Grey Kangaroos *Macropus fuliginosus*, Red-necked Wallabies *Macropus rufogriseus* and Short-beaked Echidnas *Tachyglossus aculeatus* were recorded at various locations during spotlighting. Four species of bat were caught in mistnets and harp traps. The complete list of mammal records for each site is presented in Appendix IV, and opportunistic sightings are listed in Appendix VI.

Exotic mammals were more common than native mammals. Rabbits *Oryctolagus cuniculus* were abundant, and there were many sightings of Brown Hares *Lepus capensis*, Foxes *Vulpes vulpes* and Cats *Felis catus.* Domestic stock, especially Sheep *Ovis aries*, were present at many quadrats. Two House Mice *Mus domesticus* were captured in pitfall traps.

### MAMMALS IN HABITAT ASSOCIATIONS

There were too few records to enable detection of any patterns in the distribution of the mammals recorded during the survey.

### SIGNIFICANT TAXA

No taxa with significant national status were recorded during the survey.

Red-necked Wallaby *Macropus rufogriseus*

*Macropus rufogriseus* is classified as rare in South Australia (Kemper and Queale 1990). The species was recorded three times during this survey, all records coming from the southern portion of the study area. The first record was a roadkill collected west of Frances, in an area containing predominantly buloke trees. The other observations were made during spotlighting near site BBG01001, north-west of Frances, in a region dominated by Blue Gum *Eucalyptus leucoxylon* with some buloke. Although the target vegetation types in this survey may not themselves be critical to the Red-necked Wallaby, the remnant habitat in the southern portion of the study area may be important to maintaining the species in South Australia.

Fat-tailed Dunnart *Sminthopsis crassicaudata*

A skull of *Sminthopsis crassicaudata* was found in an owl pellet at site BBG03201. Owls forage over wide areas, therefore this record provides no information regarding the location in which the *S. crassicaudata* was captured.

*S. crassicaudata* is a ground-dwelling native carnivore that is common in a variety of habitats throughout most of South Australia. Croft and Carpenter (1996a) considered it uncommon in the South East due to a paucity of Museum records from the area.

Bats

Three species of bat were captured that Croft and Carpenter (1996a) considered to be rare in the South East: *Chalinolobus morio*, *Mormopterus planiceps* and *Tadarida australis*. All of these species are rated as common for South Australia (Kemper and Queale 1990).

### NEW MAMMAL RECORDS

There were no new mammal records for the South East from this survey.

## BIRDS

A total of 88 bird species (3 introduced) were recorded in the target vegetation types during this survey. Eighty-two of these were recorded at the eighteen fauna sites, the others were recorded opportunistically at flora sites, mostly by T. Croft. The complete species x site list is presented in Appendix V, with opportunistic records summarised in Appendix VI.

### BIRDS IN HABITAT ASSOCIATIONS

The eighteen fauna sites were assigned to habitat associations according to the dominant plant species present in the overstorey as described earlier. In Appendix V the sites are grouped according to these associations, enabling qualitative assessment of bird-habitat relationships.

The bird fauna in buloke was highly distinctive, characterised by the Yellow Thornbill *Acanthiza nana*, Yellow-rumped Thornbill *A. chrysohrroa*, Chestnut-rumped Thornbill *A. apicalis*, Red-capped Robin *Petroica goodenovii* and Rufous Whistler *Pachycephala rufiventris.* Other species that were restricted to buloke but were recorded only once included Southern Whiteface *Aphelocephala leucopsis* and Blue Bonnett *Northiella haematogaster haematogaster*. This suite of species is characteristic of semi-arid woodlands north of the study area, for example in Black-oak (Belah) *Casuarina pauper* woodland.

The distinctiveness of the buloke avifauna indicates the important contribution of this vegetation type to the biodiversity of the Upper South East. With further decline and perhaps loss of remnant buloke from the region, there would be an associated loss of many bird species. In addition, as the southern geographical limit of this bird community, the viability of bird populations in buloke in the Upper South East is important to the integrity of this bird community at a broader scale.

The avifauna of "box" sites (*Eucalyptus microcarpa, E. odorata, E. largiflorens* and intergrades) was typical of temperate eucalypt woodlands in the South East. The most common species were the White-plumed Honeyeater *Meliphaga penicillata*, Noisy Miner *Manorina melanocephala*, Red Wattlebird *Anthochaera carunculata*, Striated Pardalote *Pardalotus striatus* and Red-rumped Parrot *Psephotus haematonotus*.

The avifauna of *E. behriana* communities varied according to variation of vegetation types within this category. Of most interest was the avifauna at sites BBG00301 and BBG01801, with a number of mallee species such as the Shy Hylacola *Hylacola cauta* and Purple-gaped Honeyeater *Meliphaga cratitia* being present. The bird species at sites BBG01601 and BBG03701 were more generalist species adapted to open woodland habitat.

### SIGNIFICANT TAXA

The conservation status of all significant taxa recorded in the target vegetation types are listed at a national (Garnett 1992), State (Parker and Horton, 1990) and South East (Croft and Carpenter, 1996a) level in Appendices V and VI.

#### Species of national significance

Red-tailed Black Cockatoo (south-eastern subspecies) *Calyptorhynchus banksii graptogyne*

One taxon recorded during the survey, the Red-tailed Black Cockatoo (south-eastern subspecies), is listed as nationally endangered (Garnett 1992). Although not recorded at any fauna sites, two opportunistic observations were recorded for this subspecies. One observation of four birds was recorded in Stringybark *Eucalyptus arenacea* between Frances and Custon. Another observation was recorded of three birds flying over remnant buloke west of Frances.

The wild population of *C. banksii graptogyne* is believed to number approximately 1 000 individuals. The largest part of its range is in western Victoria, with overlap into the South East of South Australia.

*C. banksii graptogyne* feeds mainly on the seeds of Brown Stringybark *E. arenacea* (and possibly *E. baxterii*). During late summer and autumn, flocks of birds are seen in the northern areas of their range feeding on the unripe seeds of buloke. It has been suggested that these seeds may be an important food source for juvenile birds and that the widespread decline of buloke may be a factor that has contributed to the decline of the subspecies.

Another factor that has probably contributed to the decline of *C. banksii graptogyne* is the reduced availability of nesting hollows in large dead trees and dead branches.

Black-chinned Honeyeater *Melithreptus gularis*

The Black-chinned Honeyeater is classified as nationally uncommon (Garnett 1992) and is rare in South Australia (Parker and Horton 1990). The call of this species was detected at site BBG01002, and the bird was probably in *E. leucoxylon* woodland, which is typical habitat for the species. As stated by Croft and Carpenter (1996a), the *E. leucoxylon* woodlands around Bangham and

Padthaway are the main stronghold of this species in South Australia.

**Species of State significance**

Bush Thick-knee *Burhinus gallarius*

The Bush Thick-knee is endangered in South Australia and in the South East. The decline of this ground-dwelling species is due mainly to loss of suitable habitat as the understorey of most grassy woodlands has been modified by stock and weed invasion, and due to predation by foxes and cats. Small populations are known in the Mundulla Common and also in the parklands surrounding Bordertown.

White-winged Chough *Corcorax melanorhamphos*

The White-winged Chough is vulnerable in South Australia. *C. melanorhamphos* is a mudnest-building bird that feeds mainly on the ground and moves noisily through its habitat in small flocks. Numbers of this species have declined due to clearance and degradation of its woodland habitats.

Brown (Swamp) Quail *Coturnix ypsilophora*

The Brown (Swamp) Quail is vulnerable in South Australia. Numbers have declined due to the extensive loss of native grassland, its preferred habitat.

Yellow-rumped Pardalote *Pardalotus xanthopygus*

The Yellow-rumped Pardalote is rated as vulnerable in South Australia. This species of Pardalote is similar to the Spotted Pardalote *Pardalotus punctatus*, replacing this species in mallee habitats.

Shy Heath-wren *Hylacola cauta*

The Shy Heath-wren is vulnerable in South Australia. This species mainly occupies mallee and has declined due to loss of this habitat.

Purple-gaped Honeyeater *Meliphaga cratitia*

The Purple-gaped Honeyeater is vulnerable in South Australia, and is also characteristic of mallee-type vegetation in the study area.

**Species of regional significance**

As described earlier, a suite of birds that are characteristic of semi-arid woodlands was present in buloke communities. As these species are at the southern edge of their ranges, they have been accorded uncommon status for the region by Croft and Carpenter (1996a).

**NEW BIRD RECORDS**

There were no new bird records for the South East from this survey.

## REPTILES AND AMPHIBIANS

Thirteen species of reptile were recorded during the survey, 12 at fauna sites and one opportunistically at another location. The list of species at each site is presented in Appendix IV, with opportunistic data presented in Appendix VI.

Four species of amphibian were recorded (Appendix IV).

### REPTILES AND AMPHIBIANS IN HABITAT ASSOCIATIONS

There were too few records to enable detection of any patterns in the distribution of the reptiles and amphibians recorded during the survey.

### SIGNIFICANT TAXA

No conservation ratings have as yet been assigned to South Australian reptiles or amphibians, although Croft and Carpenter (1996a) listed the State and regional status of all taxa recorded from the South East.

No taxa recorded on the survey had a significant status for South Australia.

Due to a paucity of records in the South Australian Museum, Croft and Carpenter (1996a) rated the Painted Dragon *Ctenophorus pictus* as rare in the South East. In addition, the legless lizard *Delma inornata* collected during the survey was the first of this species for the South East, suggesting that it should also be classified as rare.

No amphibian taxa of conservation significance were recorded.

### NEW REPTILE AND AMPHIBIAN RECORDS

*Delma inornata* and *Morethia adelaidensis* had not been previously confirmed for the South East.

## INVERTEBRATES

### LEPIDOPTERA (BUTTERFLIES)

Five species of butterfly were recorded flying at sites during the survey and a number of others were recorded flying adjacent to sites. A detailed report on the butterfly component of the survey is reproduced in Appendix VII. This was provided by R. Grund and includes a discussion of the value of each site relative to the potential to support butterfly taxa of conservation significance.

No taxa of conservation significance were found, despite the presence of suitable host plants at a number of sites.

### FORMICIDAE (ANTS)

Ants from 24 genera were collected. The most abundant genera (in arbitrary order) were *Iridomyrmex*, *Camponotus*, *Monomorium* and *Melophorous*.

An analysis of the functional groups present at each site is presented in Appendix VIII.

### OTHER ORDERS

Invertebrates from 22 orders were collected in the invertebrate pitfall traps. Sorting of some Orders to lower taxonomic levels is currently in progress at the South Australian Museum. Appendix IX shows the total number of individuals recorded from each Order at each site.

# COMPARISON OF SITES

## FLORA

The rankings of all flora sites according to the nativeness index, the number of significant taxa, native species richness and the combination of these indices are presented in Table 5. The ranking obtained for the different indices for a site are rarely equal and are often widely disparate. For example, the buloke site BBG01002 is ranked first by the nativeness index, second to last by the number of significant taxa, and sixth (out of eleven sites) by native species richness. Its final ranking was sixth. Interpretation of this is not straightforward, so this analysis is most useful for identifying sites that rank highly in one or more indices and especially highly across all indices.

Of the buloke sites, BBG03201 (the Wolseley Parklands), BBG02601 (Pooginagoric - TeaTrick roadside, northern site), BBG02B08 (Lockhardt Rd, eastern site) and BBG00601 (Frances cemetery) score highly in the final rankings and are ranked consistently highly by all three indices. Sites BBG01001 and BBG01002 also rank reasonably highly.

Site BBG03301 (Lockhardt Rd, western site) is clearly ranked as the most significant buloke/box site. Subsequent patterns are less clear among this group. BBG01B10 (Pooginagoric-TeaTrick roadside, southern site) had a high nativeness index, high native richness and a moderate number of significant taxa (12 species). BBG03401 (Dukes Highway roadside) scored consistently with all indices. Sites BBG01A07 (Custon Parklands) and BBG05401 (Pooginagoric-Bordertown roadside) contained high numbers of significant taxa (18 and 16 species respectively). Finally, BBG03901 had 15 taxa of significant status. Many other sites in this group had high numbers of significant taxa: BBG02B14, BBG05802, BBG01B10, BBG02401, BBG00801, BBG01201, BBG02501 and BBG03601 all had ten or more significant taxa.

Among the box sites, BBG00401 (Cannawigara roadside) and BBG02A08 ranked highly due to high nativeness indices and high native richness; they had relatively low numbers of significant taxa (five and seven species respectively). BBG02301 ranked highly overall and had the most number of significant taxa (19 species). Similarly, BBG02801 (TeaTrick Water Reserve) contained many significant taxa (14 species) and was ranked moderately overall. Finally, BBG05801 (Mundulla Parklands), although having a low nativeness index and low native richness, had nine taxa of conservation significance.

BBG01801 (Heritage Agreement) was rated the most significant among the *E. behriana* sites, but contained only three taxa of conservation significance. BBG01601, BBG03701 and BBG03801 ranked equal second overall and contained the most significant taxa (nine, four and six species respectively). Site BBG02A12 (Railtz's track roadside) ranked fifth overall and contained four significant taxa. Finally, BBG00301 (Heritage Agreement) was the only site during the survey with a nativeness index equal to one (i.e. no exotic species), reflecting the very high integrity of this site. This is an important remnant.

It is important to repeat that this approach is not intended as a definitive analysis of the botanical values of the sites.

## FAUNA

The ranking of fauna sites within associations is presented in Table 6, including overall rankings for the 18 sites based upon the vegetation indices above.

The most significant buloke site was BBG03101, which had the highest bird species diversity of all sites in the survey and contained a number of species not recorded elsewhere. In contrast, this site was ranked lowest via the vegetation indices, having a nativeness index of only 0.45 (i.e. 55% of plant species were exotic) and containing only 10 native plant species. BBG01001 also ranked well overall in the bird analysis. The bird species at this site were typical of eucalypt woodland rather than buloke woodland because Blue Gum *E. leucoxylon* was dominant at the site.

Thirteen native bird species were recorded at both of the buloke/box sites, with BBG02401 having the highest diversity.

Among the box sites, site BBG02A08 was ranked as the most significant site by both the flora and bird analyses. This site had the highest native bird species richness of all sites in the survey and also had high species diversity. BBG02301, BBG02801 and BBG05801 ranked equally overall, with similar species present at each (Table 6).

BBG01601 and BBG03701 ranked equally highly among the *E. behriana* sites although the latter contained the most species. However, the analysis is deceptive for this group of sites because, as described earlier, many of the bird species present at BBG01601 and BBG03701 are generalist species whereas the avifauna at BBG01801 and BBG00301 was a mallee-type community of high integrity.

**Table 5 Ranking of sites according to flora indices, including a final ranking from the mean of the rank scores (see text).**

| Association | Nativeness | No. sig. taxa | Native richness | Final Ranking |
|---|---|---|---|---|
| Buloke | 1BBG01002 | 1BBG02601 | 1BBG03201 | 1BBG03201 |
| | 2BBG03201 | 2BBG03201 | 2BBG02601 | 2BBG02601 |
| | 3BBG02B08 | 3BBG00601 | 3.5BBG02B08 | 3BBG02B08 |
| | 4BBG02601 | 5.5BBG02B08 | 3.5BBG01001 | 4.5BBG00601 |
| | 5BBG01001 | 5.5BBG01001 | 5BBG00601 | 4.5BBG01001 |
| | 6BBG00601 | 5.5BBG04301 | 6.5BBG01002 | 6BBG01002 |
| | 7BBG01301 | 5.5BBG00501 | 6.5BBG04301 | 7BBG04301 |
| | 8BBG04301 | 8BBG00901 | 8BBG00501 | 8BBG00501 |
| | 9BBG00501 | 9BBG03101 | 9BBG00901 | 9BBG00901 |
| | 10BBG00901 | 10BBG01002 | 10BBG01301 | 10BBG01301 |
| | 11BBG03101 | 11BBG01301 | 11BBG03101 | 11BBG03101 |
| Buloke/box | 1BBG03301 | 1.5BBG03301 | 1BBG01B10 | 1BBG03301 |
| | 2BBG01B10 | 1.5BBG01A07 | 2BBG03301 | 2BBG01B10 |
| | 3BBG02501 | 3BBG05401 | 3.5BBG03401 | 3BBG03401 |
| | 4BBG03401 | 4BBG03901 | 3.5BBG02401 | 4BBG03901 |
| | 5BBG02B14 | 6BBG03401 | 6BBG05802 | 5.5BBG02401 |
| | 6BBG02401 | 6BBG02B14 | 6BBG05401 | 5.5BBG05401 |
| | 7BBG03901 | 6BBG05802 | 6BBG03901 | 7BBG01A07 |
| | 8.5BBG00701 | 9.5BBG01B10 | 8BBG01A07 | 8BBG02501 |
| | 8.5BBG02101 | 9.5BBG02401 | 9BBG02501 | 9BBG02B14 |
| | 10BBG05401 | 9.5BBG00801 | 11BBG00801 | 10BBG05802 |
| | 11BBG00801 | 9.5BBG01201 | 11BBG00701 | 11BBG00801 |
| | 12BBG01A07 | 12BBG02501 | 11BBG02101 | 12.5BBG00701 |
| | 13BBG04401 | 13BBG03601 | 13.5BBG02B14 | 12.5BBG02101 |
| | 14BBG01201 | 14BBG04401 | 13.5BBG01201 | 14BBG01201 |
| | 15BBG05802 | 15.5BBG00701 | 15BBG04401 | 15BBG04401 |
| | 16BBG03601 | 15.5BBG02101 | 16BBG03601 | 16BBG03601 |
| Box | 1BBG02A08 | 1BBG02301 | 1.5BBG00401 | 1BBG02A08 |
| | 2BBG00401 | 2BBG02801 | 1.5BBG02B04 | 2BBG02301 |
| | 3BBG02301 | 3BBG05801 | 3BBG02001 | 3BBG00401 |
| | 4BBG02001 | 4.5BBG02A08 | 5BBG02801 | 4BBG02B04 |
| | 5BBG02B04 | 4.5BBG02701 | 5BBG02A08 | 5.5BBG02001 |
| | 6BBG02701 | 6BBG01401 | 5BBG02701 | 5.5BBG02801 |
| | 7BBG01401 | 8BBG00401 | 7BBG02301 | 7BBG02701 |
| | 8BBG02801 | 8BBG02001 | 8BBG01401 | 8.5BBG01401 |
| | 9BBG05801 | 8BBG02B04 | 9BBG05801 | 8.5BBG05801 |
| *E. behriana* | 1BBG00301 | 1BBG01601 | 1BBG01801 | 1.5BBG01601 |
| | 2BBG03701 | 2BBG03801 | 2BBG03801 | 1.5BBG03801 |
| | 3BBG01801 | 3.5BBG03701 | 3BBG02A12 | 3.5BBG02A12 |
| | 4BBG02A12 | 3.5BBG02A12 | 4BBG01601 | 3.5BBG03701 |
| | 5BBG01601 | 7BBG01801 | 5BBG03701 | 5BBG01801 |
| | 6BBG03801 | 7BBG00101 | 6BBG00101 | 6BBG00301 |
| | 7BBG00101 | 7BBG01501 | 7BBG00301 | 7BBG00101 |
| | 8BBG01501 | 7BBG01701 | 8.5BBG01701 | 8BBG01701 |
| | 9BBG01701 | 7BBG02002 | 8.5BBG02002 | 9.5BBG01501 |
| | 10BBG02002 | 10BBG00301 | 10.5BBG01501 | 9.5BBG02002 |
| | 11BBG00201 | 11BBG00201 | 10.5BBG00201 | 11BBG00201 |

**Table 6 Ranking of the fauna sites within the main associations according to the bird indices, overall flora index and ant generic richness (see text).**

| Association | Bird richness | Bird diversity | Overall - birds | Overall - flora | Ant richness |
|---|---|---|---|---|---|
| Buloke | 1.5BBG01001 | 1BBG03101 | 1.25BBG03101 | 1BBG03201 | 1BBG02B08 |
| | 1.5BBG03101 | 2BBG01001 | 1.75BBG01001 | 2BBG02601 | 2BBG03101 |
| | 3BBG02B08 | 3BBG03201 | 4BBG02601 | 3BBG02B08 | 4BBG01001 |
| | 4BBG02601 | 4BBG02601 | 4BBG03201 | 4.5BBG00601 | 4BBG03201 |
| | 5BBG03201 | 5BBG00601 | 4.5BBG02B08 | 4.5BBG01001 | 4BBG00601 |
| | 6BBG00601 | 6BBG02B08 | 5.5BBG00601 | 6BBG03101 | 6BBG02601 |
| Buloke/box | 1.5BBG01201 | 1BBG02401 | 1.25BBG02401 | 1BBG02401 | 1BBG02401 |
| | 1.5BBG02401 | 2BBG01201 | 1.75BBG01201 | 2BBG01201 | 2BBG01201 |
| Box | 1BBG02A08 | 1BBG02A08 | 1BBG02A08 | 1BBG02A08 | 1BBG02801 |
| | 2BBG05801 | 2BBG02301 | 3BBG02301 | 2BBG02301 | 2BBG02B04 |
| | 3BBG02801 | 3BBG02801 | 3BBG02801 | 3BBG02801 | 3BBG05801 |
| | 4BBG02301 | 4BBG05801 | 3BBG05801 | 4BBG02B04 | 4BBG02A08 |
| | 5BBG02B04 | 5BBG02B04 | 5BBG02B04 | 5BBG05801 | 5BBG02301 |
| *E. behriana* | 1BBG03701 | 1.5BBG01601 | 2BBG01601 | 1BBG01801 | 1.5BBG03701 |
| | 2.5BBG00301 | 1.5BBG01801 | 2BBG03701 | 2.5BBG01601 | 1.5BBG01801 |
| | 2.5BBG01601 | 3BBG03701 | 2.75BBG01801 | 2.5BBG03701 | 3BBG00301 |
| | 4BBG01801 | 4BBG00301 | 3.25BBG00301 | 4BBG00301 | 4BBG01601 |

# Conclusions and Conservation Recommendations

## NATURAL VALUES

### CONSERVATION VALUES

The sites visited during this survey represent valuable remnants of habitat types that were once extensive in the area. In particular, the buloke remnants represent all that remains of this association in South Australia. As such, they are of very high conservation value and should be managed accordingly.

Grassy woodlands have been extensively cleared in temperate Australia and most remaining fragments are highly degraded (Kirkpatrick *et al.* 1996). Most of the remnants visited during this survey are, therefore, important due to the high conservation status of all habitat in the generic "grassy woodland" category. For further information on the conservation of grassy ecosystems, see Kirkpatrick *et al.* (1996), Hyde (1995) and the references within Bellette *et al.* (1994).

Because of the extensive clearing of these vegetation associations, there are many characteristic plant species of conservation significance, reflected by the high number of significant taxa recorded during the survey. The vegetation associations are clearly important refuges for plants of conservation significance.

Wildlife conservation cannot be restricted to management of a few protected areas. It must be addressed at a landscape scale to enable ecological and evolutionary processes to continue. This requires cooperation between stakeholders in land management, including the promotion of non-wildlife values of native vegetation.

### NON-WILDLIFE VALUES

There are considerable benefits from retaining remnant vegetation on agricultural land. Deep-rooted perennial vegetation is important in maintaining ground water levels and preventing dry-land salinity. Native vegetation binds soil and reduces erosion. It is also instrumental in the maintenance of water quality and catchment health.

Trees and understorey provide shelter and shade for stock. This can produce visible results through reduced mortality and increased health of stock. Many landholders "spell" paddocks containing native vegetation, using them only during shearing and lambing periods when their value is maximised.

Native vegetation can also increase the productivity of adjacent cropland by acting as a windbreak and keeping ground water levels low. It also harbours insectivorous birds and other fauna that may function as natural pesticides.

Native grasses have considerable value as pasture for domestic stock. They are typically perennial, drought adapted species. They do not grow in dense swards as do many exotic pasture species, therefore are a lesser fire hazard. Although the sowing of exotic pasture and the regular application of fertiliser increases maximum stocking rates, the long term value of grazing a perennial, drought resistant native pasture that needs little management requires promotion.

The above factors need to be carefully integrated with a conservation and revegetation program for the remnant box and buloke vegetation.

### OTHER VALUES

Native vegetation can be an important aesthetic and cultural component of a region. For example, in addition to their biological and other values, large scattered gum trees in the South East are an important component of the local identity. Similarly, buloke vegetation is a unique feature of the Frances-Bordertown region and should be valued accordingly. Associated features such as the Red-tailed Black Cockatoo should also be promoted as a local species in which residents should have pride and interest.

The Mundulla Parklands are an example of native vegetation providing local identity and other benefits to a community. These *E. leucoxylon* and *E. microcarpa* woodlands encircle Mundulla and provide a setting that is important to the scenic nature of the town. In addition, the parklands are an important education tool for schools and other community groups, a key element in local tourism, and an important resource for local naturalists. These values have recently been acknowledged through the preparation of an inventory of natural resources and management issues in the parklands (Ker 1995).

## MANAGEMENT OF THREATS TO NATURAL VALUES

Each of the sites visited during this survey has a different suite of management requirements and priorities. The following discussion outlines the main threats to the natural values of the sites, and the subsequent section discusses site specific management requirements. Croft and Carpenter (1996b) addressed these management issues in more detail in their Guidelines for Managing Native Vegetation in the South East of South Australia.

### GRAZING BY DOMESTIC STOCK

Grazing by domestic stock in native vegetation causes the loss of native understorey plants, prevents regeneration of overstorey species, encourages the spread of weeds and causes soil compaction. Grassy woodlands are particularly prone to the loss of understorey species as native grasses and herbs are usually highly palatable to stock. Grazing affects the quality of habitat for fauna through a range of processes including selective plant species loss, alteration of habitat structure and trampling of soil and litter.

Exclusion of stock is perhaps the most readily available means of protecting native vegetation, and is vital to any regeneration program. Many of the remaining stands of buloke on private land, for example, contain domestic stock and have no buloke seedlings. Unless regeneration is encouraged, these remnants will be lost completely upon death of the current trees.

The exclusion of stock should be encouraged at all sites that were visited during this survey. Fencing to exclude stock is the best way of removing grazing, and landholders should be encouraged to become involved in community fencing programs.

Financial assistance is available for the fencing of native vegetation for conservation purposes. To be eligible for funding under the Save the Bush program, landholders must be members of an incorporated group. An early outcome of this survey has been the formation of a group of landholders in the Bordertown district that has applied for funding to fence some of the remnants visited in this survey. Such groups should be expanded in size and/or number to increase the area of vegetation being protected.

The degree of cooperativeness shown by landholders during the planning and execution of this survey was encouraging. Most are aware of the value of remnant vegetation and are willing to take measures to protect it. Indeed, some of the remnants are already free from grazing by domestic stock, either under a Heritage Agreement or simply due to voluntary stock removal. Future protection of remnant vegetation will involve harnessing and coordinating this willingness.

### RABBITS AND HARES

Rabbits browse on native vegetation, altering the structure and preventing regeneration. They are one of the major contributors to land degradation in Australia and are a pest to graziers as they reduce the effective carrying capacity of pasture. Rabbits are common throughout the study area of this survey, and hares are also present in the region. Effective control of these species is greatly beneficial to native vegetation and to regeneration programs.

Control of rabbit numbers is a multifaceted process, with a combination of methods tailored to each particular location to augment the effect of biological control. Such methods include mechanical warren destruction, baiting, shooting, removing debris that may harbour rabbits, and trapping. Rabbit-proof fencing is available, however this is unsympathetic to the movement of native fauna and would only be used in particular circumstances.

### WEEDS

Many species of exotic plant were recorded during this survey. Conservation measures cannot hope to remove all of these and return the sites to a pristine state. Generally, if the number of exotic species is minimised, a greater number of native species may persist. Some exotic species, however, are particularly likely to become dominant in the understorey and, at some sites, urgent action is required. Different weeds are best managed in different ways, and appropriate information and advice are available from the Animal and Plant Control Commission (see also Robertson 1994).

The most significant weeds at sites visited during this survey included phalaris *Phalaris aquatica*, bridal creeper *Myrsiphyllum asparagoides*, perennial veldt grass *Ehrharta calycina*, and a variety of annual grasses including *Avena* spp., *Vulpia* spp., *Bromus* spp. and *Lolium* spp.

Phalaris had invaded many sites visited during this survey including many roadsides. This perennial grass forms dense swards that preclude native understorey species and prevent regeneration. Active management is required at sites with a serious phalaris infestation.

Although removal of domestic stock is a critical measure in the management of remnant vegetation, cessation of grazing can result in the uncontrolled growth of some weed species. This is particularly true of phalaris and other exotic pasture species. However, this disadvantage is generally greatly outweighed by the advantages accruing from the removal of grazing. Clearly, weed control is often required following removal of stock.

Some managers advocate continued light grazing as a means of weed control, a practice that requires research.

The application of fertiliser promotes the replacement of native grasses with exotic species and is an inappropriate practise in native grassland and grassy woodland. Care should be taken to minimise drift when fertiliser is applied in areas adjacent to native vegetation.

**ROADSIDE MANAGEMENT**

Many of the important sites identified during this survey occur on roadsides. Plant taxa of significant conservation status were abundant in roadsides throughout the study area. Such roadsides are very important to the maintenance of local biodiversity, and may be important as corridors through which fauna can disperse across the landscape.

Roadsides are prone to degradation via a range of factors. These include fuel reduction burning for bushfire management, ploughing of firebreaks along fencelines, vegetation removal for thoroughfare maintenance and access, grazing and weed invasion. Most roadsides in the study area are two chains (approx. 40 m) in width, therefore weed invasion from adjacent paddocks is a major threat to their biological integrity. Wide road reserves appear better able to resist weed invasion than narrow reserves.

Most of the roadside sites from this survey are managed by the Tatiara District Council (DC). As the owner of land containing native vegetation, the DC is obliged to manage the native vegetation according to the requirements of the Native Vegetation Act (1991). The Tatiara DC has guidelines for the management of roadside vegetation that have been endorsed by the Native Vegetation Council. This plan establishes appropriate procedures to be followed by users and managers of roadsides under the District Council's care.

All native vegetation in roadsides should be protected from degrading processes and the management guidelines should be applied with sensitivity to natural values. The guidelines permit grazing of stock "where there are native trees only over pasture"; this should be strongly discouraged to enable regeneration of trees and re-establishment of native understorey species. When allowing grazing in such circumstances, the Native Vegetation Management Branch of the Department of Environment and Natural Resources should be consulted to confirm the absence of native understorey species.

The vegetation communities targeted in this survey are in particular need of protection, and roadside remnants should not be grazed. Active management is required for those roadsides identified as being of particular conservation significance. Managers and users should be made aware of these areas via the use of identifying signs.

Invasion by weeds, particularly phalaris, is a degrading process in roadsides that needs particular attention. Such infestations also constitute a fire hazard, demanding control for purposes other than conservation. Again, consultation is important before such management activities are undertaken.

It is recommended that the Tatiara District Council's roadside management plan be amended in recognition of these conclusions.

**REVEGETATION**

Because the vegetation types targeted in this survey were located on the most productive agricultural soils in the region, they have been extensively cleared. The quantity of remaining habitat is insufficient to reliably conserve the associated biodiversity, and many individual remnants are too small and/or too isolated to be of great biological value in the long term. Extensive re-establishment of these habitat types is required. This should be coordinated as part of a regional biodiversity plan and should be integrated with fencing programs, should involve overstorey and understorey species, and should consider the habitat and dispersal requirements of fauna.

## SPECIFIC MANAGEMENT RECOMMENDATIONS

### PRIORITISATION OF SITES

The objective ranking of sites in terms of conservation significance provides the opportunity to assign a conservation priority level to all sites. This stage involves subjective integration of the different approaches and the use of non-quantifiable factors. Final relative rankings depend upon intuitive assessment. Additional factors considered when assigning conservation priorities included remnant size, whether the site was on a roadside or was a remnant block, the location of similar remnants nearby, and connection with other habitat.

A priority rating between one and four was assigned to each site, ranging from level one (of least significance among the sites visited) to level four (of the highest significance among the sites visited) (Table 7). Note that, due to the poor conservation status of all of these vegetation types, **ideally all of the sites visited should be managed for conservation purposes** and would rate highly when compared with other remnant vegetation in the area.

For sites that are rated highest priority for conservation, details of specific actions and their current status are provided. These sites have been identified as potentially suitable for nomination to the Register of the National Estate. Any nomination of remnants on private land should be done with the sanction of the landowners.

The sites of highest conservation priority (in arbitrary order) are:

Wolseley Parklands (BBG03201)
Frances Cemetery (BBG00601)
Pooginagoric-TeaTrick roadside (northern, BBG02601)
Lockhardt Rd, western site (BBG03301)
Hd Geegeela Sn 20 (BBG01001, BBG01002)
Custon Parklands (BBG01A07)
Mundulla Common (BBG05801, BBG05802)
Hd Tatiara Sn 340S (BBG02301)
Hd Cannawigara Sn 28 (BBG00301)
Hd Senior Sn 74 (BBG01801)

**Table 7 Conservation priority ranking for all sites visited during the survey. Hundred (Hd) and Section (Sn) are given for sites on private property. "Comments" column provides brief explanation for ranking. Specific information provided for sites with highest priority. Taxa that have national conservation significance and/or are endangered in South Australia are noted for the sites at which they were found (see Appendix III for explanation of categories of conservation status).**

| Site Code | Location | Priority | Comments |
|---|---|---|---|
| **Buloke** | | | |
| BBG03201 | Wolseley Parklands | 4 | Ranked highly by all flora indices; high integrity avifauna. Large size.<br>**Actions needed:** weed control especially *Phalaris*; fencing.<br>**Status:** owned by Tatiara DC.<br>**Comments:** subject of application for management funding.<br>*Pycnosorus chrysanthus* (E-SA). |
| BBG00601 | Frances Cemetery | 4 | Flora ranking not as high as Wolseley but high quality remnant; 17 sig. taxa; high integrity avifauna; medium size.<br>**Actions needed:** control of localised weed patches.<br>**Status:** owned by Tatiara DC.<br>**Comments:** measures to increase size and/or connectivity desirable. |
| BBG02601 | Pooginagoric-TeaTrick RS - northern site | 3-4 | Equal highest no. significant taxa in survey (19); other indices high; avifauna moderate.<br>**Actions needed:** as for all roadsides.<br>**Status:** DC road.<br>**Comments:** very high quality roadside.<br>*Ptilotus exaltatus* var. *semilanatus* (Q-Aus; R-SA). |

| | | | |
|---|---|---|---|
| BBG01001<br>BBG01002 | Hd Geegeela Sn 20 | 3-4 | Atypical buloke habitat; important example of buloke under overstorey of *E. leucoxylon*; avifauna atypical of buloke.<br>Part of one of largest remnants in study area; remnant has diversity of habitat types.<br>BBG01001 contained 13 sig. taxa.<br>**Actions needed:**<br>**Status:** privately owned.<br>**Comments:** wildlife values of remnant are integral to tourist activities at Host Farm. |
| BBG02B08 | Lockhardt Rd<br>- eastern site | 3 | Ranked highly according to all flora indices. |
| BBG03101 | Hd Tatiara<br>Lot 1 in DP13643 | 3 | Contrast between very poor flora and excellent avifauna.<br>Important to local biodiversity due to bird species not seen elsewhere.<br>Flora/bird patterns have considerable scientific implications. |
| BBG04301 | RS | 2 | 13 sig. taxa. |
| BBG00501 | RS | 1-2 | 13 sig. taxa. |
| BBG00901 | Hd Geegeela Sn 581 | 1-2 | 11 sig. taxa |
| BBG01301 | Hd Wirrega Sn 527 | 1 | Heavily grazed. |
| | | | |
| **Buloke/box** | | | |
| BBG01A07 | Custon Parklands | 3-4 | High priority due to large size, and paucity of other *E. microcarpa* remnants; also 18 sig. taxa.<br>**Actions needed:** grazing removed.<br>**Status:** Tatiara DC.<br>**Comments:** weed growth after grazing removal may be great. |
| BBG05801<br>BBG05802 | Mundulla Common | 3-4 | Important large remnant of *E. microcarpa*, contiguous with large remnant of *E. leucoxylon*. Provides local identity and amenity for Mundulla township.<br>Moderate rankings according to flora and bird indices.<br>Contains breeding Bush Thick-knees.<br>**Actions needed:** a Management Plan should be prepared using information in Ker (1995).<br>**Status:** Tatiara DC.<br>**Comments:** Noisy Miners common, would exclude smaller birds. |
| BBG03301 | Lockhardt Rd -<br>- western site | 3-4 | Ranked highly according to all flora indices.<br>*Ptilotus exaltatus* var. *semilanatus* (Q-Aus; R-SA).<br>*Pycnosorus chrysanthus* (E-SA).<br>**Actions needed:** as for all roadsides.<br>**Status:** Tatiara DC roadside.<br>**Comments:** |
| BBG03901 | Hd Tatiara Sn 888 | 3 | Important *E. largiflorens*/buloke site; good overall ranking from flora indices.<br>Moderate size. |
| BBG01201 | Hd Wirrega Sn 358 | 3 | One of few remaining stands of *E. microcarpa* other than roadsides.<br>12 sig. taxa.<br>*Ptilotus erubescens* (Q-Aus; E-SA). |
| BBG01B10 | Pooginagoric-TeaTrick RS<br>- southern site | 3 | Slightly less significant botanically than northern site. |
| BBG02401 | Custon Railway Reserve | 2-3 | Adjacent to Custon Parkland but smaller, with higher nativeness index and native plant richness; moderate bird diversity.<br>12 sig. taxa. |
| BBG02501 | Hd Tatiara Sn 399 | 2-3 | Stand of *E. microcarpa*/buloke other than roadside.<br>11 sig. taxa. |
| BBG05401 | Pooginagoric-Bordertown RS | 2 | 16 sig. taxa. |
| BBG03401 | Dukes Highway RS | 2 | 13 sig. taxa. |
| BBG02B14 | RS | 2 | 13 sig. taxa. |
| BBG00801 | RS | 2 | 12 sig. taxa. |

| | | | |
|---|---|---|---|
| BBG03601 | Hd Tatiara Sn 835 | 2 | Poor nativeness index and native richness; 10 sig. taxa. |
| BBG04401 | Hd Geegeela Sn 337 | 1 | Poor nativeness index and native richness; 9 sig. taxa. |
| BBG00701 | RS | 1 | Poor nativeness index and native richness; 7 sig. taxa. |
| | | | |
| **Box** | | | |
| BBG02301 | Hd Tatiara Sn 340S | 4 | Ranked highly according to all flora indices; moderate avifauna, although two species of quail.<br>Important remnant of *E. largiflorens* along Tatiara Ck.<br>**Actions Needed:** some weeds; revegetation of *E. largiflorens*?.<br>**Status:** Heritage Agreement.<br>**Comments:** three species of bat. |
| BBG02801 | TeaTrick Water Reserve | 3 | Moderate ranking according to flora and bird indices.<br>Large size; remnant includes areas of *E. leucoxylon*.<br>Currently grazed occasionally under lease from Tatiara DC.<br>Includes rubbish dump harbouring rabbits. |
| BBG02A08 | Hd Tatiara Sn 906 - northwestern site | 3 | High ranking according to flora and bird indices; good diverse patch; valuable as non-roadside *E. odorata*.<br>Grazed; in corner of paddock, unfenced. |
| BBG01401 | RS | 3 | Poor rating according to flora indices but important sig. species: *Stipa multispiculis* (R-Aus; R-SA). |
| BBG00401 | RS | 2-3 | High nativeness index and species richness; 5 sig. taxa. |
| BBG02B04 | Hd Tatiara Sn 334 | 2 | Low ranking according to flora and bird indices; valuable as non-roadside *E. microcarpa* x *odorata*.<br>Unfenced patch. |
| BBG02701 | Hd Tatiara Sn 906 - southeastern site | 2 | Low ranking according to flora indices; valuable as non-roadside *E. microcarpa*.<br>Unfenced patch. |
| BBG02001 | RS | 2 | Low and moderate ranking according to flora indices. |
| | | | |
| ***E. behriana*** | | | |
| BBG00301 | Hd Cannawigara Sn 28 | 4 | Only site in survey with nativeness index = 1.<br>Site with very high biological integrity; whipstick mallee.<br>Part of large fragment including heath.<br>**Actions needed:**<br>**Status:** Heritage Agreement.<br>**Comments:** long term management of HA needs to be addressed. |
| BBG01801 | Hd Senior Sn 74 | 4 | High nativeness index and species richness.<br>Site with high biological integrity; whipstick mallee.<br>Part of large fragment (smaller than BBG00301) including heath.<br>**Actions needed:**<br>**Status:** Heritage Agreement.<br>**Comments:** long term management of HA needs to be addressed. |
| BBG01601 | Hd Senior Sn 86 | 3 | Moderate nativeness index and species richness; highest number sig. taxa of *E. behriana* sites (9).<br>Important example of large *E. behriana* trees.<br>Grazed; needs regeneration. |
| BBG01501 | Hd Senior Sn 96 | 3 | Poorer ranking than BBG01601.<br>Another important example of large *E. behriana* trees.<br>Grazed; needs regeneration. |
| BBG03701 | Hd Tatiara Sn 475 | 3 | Moderate to high ranking according to flora and bird indices.<br>Includes large trees and regrowth.<br>Component of patch with high diversity of vegetation types.<br>Heavy infestation of Veldt Grass.<br>Ungrazed. |
| BBG01701 | Hd Senior Sn 82 | 2-3 | Low ranking according to flora indices.<br>Important example of whipstick mallee at northern edge of *E. behriana* range in SA. |

| | | | |
|---|---|---|---|
| BBG03801 | Hd Tatiara Sn 465 | 2-3 | Moderate to high ranking according to flora indices.<br>Regrowth *E. behriana* adjoining *E. leucoxylon* soak.<br>Grazed, unfenced.<br>*Acacia trineura* (E-SA). |
| BBG00201 | Hd Cannawigara Sn 37 | 2-3 | Low ranking according to flora indices.<br>Important example of large *E. behriana* trees.<br>Grazed, unfenced, needs regeneration. |
| BBG02A12 | Railtz's track RS | 2-3 | Moderate to high ranking according to flora indices.<br>Medium sized trees.<br>Part of important corridor across plain originally covered by *E. behriana*.<br>Narrow. |
| BBG00101 | Hd Cannawigara Sn 116 | 2 | Moderate ranking according to flora indices.<br>Grazed, unfenced, needs regeneration. |
| BBG02002 | RS | 1-2 | Low ranking according to flora indices. |
| | | | |
| **Grassland** | | | |
| BBG01101 | Kybybolite Research Station | 2-3 | Valuable for research into effect of grazing on native grasses.<br>Too small to sustain populations of most native vertebrates.<br>5 sig. taxa.<br>Owned by Primary Industries SA. |
| | | | |
| **Ground Truth Sites** | | | |
| GTBBG02901 | Hd Tatiara Sn 199 | 1 | Buloke over exotic pasture. |
| GTBBG03001 | Hd Tatiara Sn 270 | 1 | Buloke over exotic pasture. |
| GTBBG03501 | Hd Tatiara Sn 344W | 1 | Buloke over exotic pasture. |
| GTBBG05001 | Hd Tatiara Sn 279 | 1 | Buloke over exotic pasture. |
| GTBBG05101 | Hd Tatiara Sn 316N | 1 | Buloke over exotic pasture. |

## SPECIES REQUIRING RECOVERY PLANS

The Red-tailed Black-cockatoo subspecies *C. banksii graptogyne* is a nationally endangered taxon that requires a recovery plan to secure it from extinction. In February 1996 a Recovery Team Meeting was convened to discuss research and management requirements for the taxon. An outcome of this meeting has been the writing of a draft Recovery Plan and the budgeting of funds towards the implementation of necessary steps.

Those involved in the future management of this species must ensure that appropriate research is conducted with minimum delay. In particular, the role of buloke seeds in the diet of the species must be investigated. The dramatic decline in the distribution of this vegetation community may be an important factor in the decline of *C. banksii graptogyne*.

Most areas of buloke regeneration consist of saplings grown from suckering rather than from seed. Trees grown from suckering do not reproduce sexually and, therefore, cannot act as a food source for *C. banksii graptogyne*. This may have grave implications if buloke seeds are important in the ecology of the cockatoos. Research into the factors affecting recruitment of buloke from suckering and from seed should be commenced.

## COMMUNITIES REQUIRING RECOVERY PLANS

*Allocasuarina luehmanii* grassy woodland is an endangered plant community in Australia and a recovery plan is being prepared by workers in Victoria.

In South Australia buloke is restricted to heavy, fertile clay soils with gilgais. The best remaining examples of pure buloke with gilgais are in the Wolseley Parklands and Frances Cemetery. The characteristic understorey of this association was described earlier.

In western Victoria, buloke was also once extensive and has been largely cleared. As in the corresponding region of South Australia, there are two main belts of heavy soils that are separated by a large tract of sandy soil (the Little Desert) (Land Conservation Council 1985). However, buloke is not restricted to clay soils in Victoria, occurring in a wide range of conditions ranging from sandy soils through to heavy clays. During a visit to inspect buloke sites in Victoria, T. Croft and A. Stokes found the typical "pure buloke with gilgais" to be scarce in Victoria and restricted to western areas near the South Australian border. To the east of this habitat, buloke occurred on loamier soils in mixed woodlands with *E. largiflorens* and *E. leucoxylon* (see also Land Conservation Council 1985). The composition of the understorey in buloke woodland in these regions was not typical of that occurring on the gilgai soils of the western regions.

This observation indicated that there was considerable variation within the association "buloke grassy woodland". The form of the association that occurs in South Australia is extensively cleared and very poorly conserved in both states, increasing the relative importance of the remnants in this State.

Remnant buloke in South Australia needs to be protected, rehabilitated and extensively replanted. The extensive application of fertilisers has altered the chemical composition of soils, and extensive cultivation has altered the soil structure and has often levelled out the gilgais that were present. In addition, the limited regrowth of buloke from seed is a major threat to the survival of the community. Clearly, wide-ranging research is required to enable successful regeneration in and re-establishment of buloke habitats.

There are many paddocks in the study area that contain scattered buloke trees over exotic pasture or crops. Most of these have a substantially modified soil structure. A Heritage Agreement is currently being negotiated for one such area (not surveyed for this report). Upon removal of grazing, this remnant should be monitored for regeneration of buloke and native understorey species, and for growth of exotic grasses.

The distinctiveness of buloke avifauna emphasises the importance of the habitat to local biodiversity, and the role of buloke in the ecology of the endangered *C. banksii graptogyne* demands attention.

## POTENTIAL INDICATOR TAXA FOR HABITAT ASSESSMENT

A tool that may assist in habitat management is the use of a taxon or a range of taxa that may provide an indication of the relative quality of comparable areas of habitat. If routine decision making is to be based on the use of such a tool, then selection of the appropriate taxa is critical. At this stage, choosing suitable indicator taxa is fraught with uncertainty. This section discusses the potential use of indicator taxa for the habitats targeted in this survey.

The generic term "grassy woodland" suggests that some index of "grassiness" may be an appropriate indicator for all the sites in this survey. However, some sites (e.g. the *E. behriana* in the Heritage Agreements of Gaden and Koch) in the survey have few grass species present, for reasons other than degradation. Clearly, indicators need to be more specific.

The understorey of many of the sites visited were dominated by exotic species of pasture. The presence or abundance of particular species may have potential as an indicator of weed invasion and/or degradation. However, at the Wosleley Parklands, the most significant buloke site, phalaris is abundant and if used as an indicator may identify Wolseley as a highly degraded site. In this situation the use of an exotic grass species as an indicator provides specific information regarding weed invasion but not regarding other aspects of habitat "quality".

Native understorey species may be more useful indicators. Future rigorous analysis of the vegetation data should pursue relationships between some species and overall habitat integrity. For example, *Maireana*

*enchylaenoides* and *Calocephalus citreus* are two understorey species that are characteristic of clay soils with gilgais, and occur in many of the "better" sites that contain buloke. They appear less likely to be present in areas where the gilgai structure has been disturbed. The potential of these and other taxa as indicators of the quality of such sites should be explored in future analysis. Such indicators are clearly specific to habitat and soil types and would need to be interpreted accordingly.

The results of flora and bird analyses from site BBG03101 provide a warning regarding the nature of the information obtained from such analyses. This site was ranked highest by the analysis of bird data and lowest by the flora analysis. Clearly, a diverse bird fauna may not indicate a "good quality" patch as judged by other criteria. Similarly, sites ranked highly by the flora analysis often had an avifauna of only moderate integrity (e.g. Wolseley Parklands, site BBG03201). On the time scales of such studies, birds and plants appear to respond to different ecological factors.

The distinctiveness of the buloke avifauna provides some potential for assessing the integrity of the avifauna of buloke remnants. In particular, Yellow Thornbills, Red-capped Robins and Rufous Whistlers may be useful. However, such an approach is very specific, assessing only the avifauna of a particular habitat type.

In eucalypt woodland, Noisy Miners are edge specialists that aggressively exclude most smaller species from surrounding habitat. In disturbed woodland they will often occur throughout a remnant, resulting in a severely depauperate avifauna. Site BBG05801 (Mundulla Common) is an example of this, where Noisy Miners are common and the only smaller species present were the Striated Pardalote and White-plumed Honeyeater; thornbills, robins, whistlers and most small honeyeaters were absent. The potential of Noisy Miners as indicators of degraded woodland should be explored.

Finally, the use of ants as bio-indicators should be researched further (Appendix VIII). This may provide information that is tied more tightly to the disturbance factors that are responsible for degradation. Again, this may necessitate preliminary research to identify groups and to define the ecology of ant taxa in different habitat types (Appendix VIII).

In conclusion, a single taxon is unlikely to emerge as a universal indicator of general habitat quality. Indicators are likely to be habitat-specific and possibly relevant to only a subset of the biota of an area. Research should continue into developing means of rapidly assessing habitat quality via an integration of approaches.

## VALUE OF DHUD VEGETATION MAPS

The 1:50 000 maps of remnant vegetation that were produced by the Geographical Analysis and Research (GAR) Unit of the Department of Housing and Urban Development (DHUD) were an important tool in the selection of survey sites in this project. The identification of potential sites was achieved quickly with only brief resort to aerial photographs required.

When visited, some of the sites located from the maps were found to have been incorrectly identified during the aerial photo interpretation. This did not greatly interfere with the planning of this survey. Nevertheless, this limitation indicates that maps at this scale are unlikely to be perfect and should be approached accordingly.

In “fragmented” habitat such as that visited in this survey, the landscape is rarely one of discrete “islands” in a “sea” of cleared land. In the South East, there is a continuum of native habitat condition ranging from cleared open paddocks, through scattered trees in paddocks and finally intact native vegetation. When mapping remnant vegetation from aerial photographs, the choice of a cut-off on this continuum of habitat remnancy, and therefore the identification of habitat “fragments”, is arbitrary. Inconsistencies are likely between different workers and, probably, between mapping done by the same worker at different times. This is an important caveat in the use of these maps: the absence of a particular area of remnant vegetation on a map may not be an accurate indication of its relative quality.

# Resource Material and Bibliography

## MAPS

1:50 000 Topographic

| | |
|---|---|
| Senior | 7025-01 |
| Tatiara | 7025-02 |
| Mundulla | 7025-03 |
| Cannawigara | 7025-04 |
| Frances | 7024-01 |
| Hynam | 7024-02 |

## AERIAL PHOTOGRAPHS

1:40 000 Colour Stereo
(Names plus flight run numbers)

| | |
|---|---|
| Senior | 3564 (6 January 1987) |
| Tatiara | 3565 (6 January 1987) |
| | 3581 (31 January 1987) |
| Mundulla | 3565 (6 January 1987) |
| | 3581 (31 January 1987) |
| Cannawigara | |
| | 3564 (6 January 1987) |
| Frances | 3581 (31 January 1987) |
| | 3582 (31 January 1987) |
| Hynam | 3582 (31 January 1987) |
| | 3591 (1 February 1987) |
| | 3592 (5, 6 February 1987) |

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# Appendices

## Appendix I

**QUADRAT PHOTOGRAPHS FOR REPRESENTATIVE SITES**

Photographs of the photopoints for twelve quadrats. These examples represent the main habitat types covered in the survey and include the ten “high priority” sites identified in the text. The latitudes and longitudes were determined by pin-pricking aerial photographs in the field, marking the points on mylar plots and digitising them at the Geographical Analysis and Research Unit of the Department of Housing and Urban Development.

Data on the physical environment for each quadrat are from the survey database.


Quadrat: BBG00301 Date:12-Dec-1995 Latitude: 36 06’57” Longitude: 140 43’51”
Altitude(m): 100 Landform: open depression Soil:medium clay Surface Strew:

Quadrat: BBG00601 Date:05-Dec-1995 Latitude: 36 42’17” Longitude: 14057’30”
Altitude(m): 104 Landform: plain (incl undulating plain) Soil:sandy clay loam
Surface Strew:none apparent


Quadrat: BBG01001 Date:04-Dec-1995 Latitude: 36 39’17” Longitude: 140 52’20”
Altitude(m): 100 Landform: plain (incl undulating plain) Soil:sandy loam
Surface Strew:none apparent

**PHOTO NOT AVAILABLE**

Quadrat: BBG01101 Date:05-Dec-1995 Latitude: 36 52’46” Longitude: 140 56’16”
Altitude(m): 100 Landform: plain (incl undulating plain) Soil:sandy clay loam
Surface Strew:none apparent


Quadrat: BBG01601 Date:12-Dec-1995 Latitude: 36 11’58” Longitude: 140 48’23”
Altitude(m): 90 Landform: open depression Soil:sandy clay loam Surface Strew:none apparent


Quadrat: BBG01801 Date:12-Dec-1995 Latitude: 36 07’38” Longitude: 140 47’07”
Altitude(m): 100 Landform: open depression Soil:clayey sand Surface Strew:none apparent


Quadrat: BBG02301 Date:13-Dec-1995 Latitude: 36 20’34” Longitude: 140 57’28”
Altitude(m): 100 Landform: open depression Soil:clay loam, sandy Surface Strew:none apparent


Quadrat: BBG02601 Date:05-Dec-1995 Latitude: 36 24’34” Longitude: 140 51’42”
Altitude(m): 100 Landform: plain (incl undulating plain) Soil:sandy loam
Surface Strew:none apparent


Quadrat: BBG03101 Date:07-Dec-1995 Latitude: 36 21’06” Longitude: 140 52’38”
Altitude(m): 100 Landform: plain (incl undulating plain) Soil:clay loam, sandy
Surface Strew:none apparent


Quadrat: BBG03201 Date:07-Dec-1995 Latitude: 36 22’14” Longitude: 140 53’55”
Altitude(m): 110 Landform: plain (incl undulating plain) Soil:clay loam
Surface Strew:none apparent


Quadrat: BBG01A07 Date:06-Dec-1995 Latitude: 36 26’44” Longitude: 140 55’12”
Altitude(m): 110 Landform: plain (incl undulating plain) Soil:clay loam, sandy
Surface Strew:none apparent


Quadrat: BBG01201 Date:12-Dec-1995 Latitude: 36 24’38” Longitude: 140 40’37”
Altitude(m): 76 Landform: plain (include undulating plain) Soil: clayey sand
Surface Strew: none apparent

# Appendices

## Appendix II

### LIST OF PLANT SPECIES RECORDED IN EACH QUADRAT DURING THE SURVEY

Plant taxonomy follows Jessop (1993) but includes some recent taxonomic changes in the SA FLORA Database. Introduced species are indicated with an asterisk.

See Appendix III for information regarding the conservation status of plants recorded during the survey.

Quadrats are grouped into the five habitat associations buloke (Bul), buloke/box (BB), box, *E. behriana* (Beh) and grassland (Gra) (see text for explanation). Three quadrats from previous surveys are also included.

† indicates taxon recorded only on previous survey, not current survey.

| Species | Site | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
| Association | Bul | Bul | Bul | Bul | Bul | Bul | Bul | Bul | Bul | Bul | Bul | | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB | BB |
| ALISMATACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Damasonium minus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AMARANTHACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Alternanthera denticulata* | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | |
| *Ptilotus erubescens* | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| *Ptilotus exaltatus* var. *semilanatus* | | | | | | | X | | | | | | | | | | | | | | | X | | | | | | | |
| *Ptilotus spathulatus* forma *spathulatus* | | | | | | | | | | | | | | | X | | X | | | | | | | | | | | | X |
| CAMPANULACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pratia concolor* | | | | | | | X | | X | | | | | | | | | | | | | X | | | | | | | |
| *Wahlenbergia communis* | | X | X | X | | | X | X | | | | | X | X | | | | | | | | X | | | X | | | | X |
| CARYOPHYLLACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Moenchia erecta* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Stellaria media* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CASUARINACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Allocasuarina luehmannii* | X | X | X | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| CHENOPODIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Atriplex semibaccata* | | | | | | | X | | | | | | | | | | | | | | | | X | | | | | | |
| *Chenopodium desertorum* ssp. *microphyllum* | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | |
| *Chenopodium pumilio* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Einadia nutans* ssp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Einadia nutans* ssp. *nutans* | | X | X | | | | X | | | X | | | | | | | X | | | | | X | X | | | | | | |
| *Maireana enchylaenoides* | | | X | | | X | X | X | X | X | | | | | X | X | X | | X | | X | X | X | X | X | | X | X | X |
| COMPOSITAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Arctotheca calendula* | | | | | | | | | X | | | | | | | | | | | X | | | | X | | | | | |
| *Brachycome basaltica* var. *gracilis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Calocephalus citreus* | X | X | X | | | | X | X | | X | | | | | X | X | X | X | X | | X | X | X | | X | | X | X | X |
| *Calotis scabiosifolia* var. *scabiosifolia* | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Carduus tenuiflorus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Carthamus lanatus* | | X | | | | | | | | X | | | | | | | | | | | | | | | | | | | |
| **Centaurea melitensis* | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| *Centipeda cunninghamii* | | | | | X | | | | | | | | | | | | | | | X | | | | | | | | | |
| *Chrysocephalum apiculatum* | | | X | | | | | X | | | | | | | | | X | X | X | | | | | | | | | | X |
| *Chrysocephalum semipapposum* | | | | | | | | | | X | | | | | | | | | X | | | | X | | | | | | |
| *Eclipta platyglossa* | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | |
| *Euchiton gymnocephalus* | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | |
| *Euchiton sphaericus* | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Hedypnois rhagadioloides* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X |
| *Helichrysum leucopsideum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Helminthotheca echioides* | | | X | | | | X | | | X | | | | | | X | | | | | | | | | | | X | | |
| **Hypochaeris glabra* | | X | | | X | X | | X | X | | | | | | X | | | X | | | | | | X | | | | | |
| **Hypochaeris radicata* | | | | X | | | | | | | | | | X | | | | | | | | | | | X | | | | |
| **Hypochaeris* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Lactuca serriola* | | X | | | | | X | | | | | | | | | | | | | X | | | | | X | | | | |

| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lagenifera huegelii* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| **Leontodon taraxacoides* ssp. *taraxacoides* | | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| *Leptorhynchos squamatus* | | | | | | | | | | X | X | | | | | | | | | | | | | | | | X |
| *Minuria leptophylla* | | | | | | | | | | X | | | | | | | | | | | | | | | | | |
| *Myriocephalus rhizocephalus* var. *rhizocephalus* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Olearia floribunda* var. *floribunda* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Olearia ramulosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Onopordum acaulon* | | | | | | | | | X | | | | | | | | | | | | | | | | | | |
| *Ozothamnus retusus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pycnosorus chrysanthus* | | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| *Senecio picridioides* | | | | X | X | | | | | | | | | | | | | | | | | | | | | | |
| *Senecio quadridentatus* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Senecio squarrosus* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| *Senecio tenuiflorus* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| *Solenogyne dominii* | X | X | | | X | | X | | | | X | | | | | | | | X | | | | | | X | | |
| *Sonchus asper* ssp. *glaucescens* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Sonchus oleraceus* | X | X | | X | | | X | | X | | | | X | | X | | | X | X | X | | X | X | X | | | |
| *Vittadinia australasica* var. *australasica* | | | X | X | | | X | X | | X | | | X | | | | | | | X | X | X | | | | X | |
| *Vittadinia cuneata* var. *cuneata* | | | | | | | | X | | | | | | | | | | | | | | | | | | | X |
| *Vittadinia gracilis* | | | | X | | | | X | | | X | | X | | | X | X | X | | X | X | | | | | X | |
| *Vittadinia pterochaeta* | | | | | | | | | | X | | | | | | | | | | | | | | | | | |
| CONVOLVULACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Convolvulus* aff. *erubescens* "linear lobes" | X | X | X | | | | X | X | | X | X | | | X | X | X | | X | X | X | X | X | X | X | | X | X |
| *Convolvulus erubescens* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Convolvulus remotus* | | | | X | | | | | | X | | | | | | | | | | | | | | | | | |
| CRASSULACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crassula colorata* var. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crassula colorata* var. *acuminata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crassula colorata* var. *colorata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crassula decumbens* var. *decumbens* | | X | | | X | | | | | | | | | | | | | | | | | | | | | | |
| **Crassula natans* var. *minus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Crassula sieberiana* ssp. *tetramera* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CRUCIFERAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Lepidium africanum* | | | | | | | | | | | | | | | | | | | | | | X | X | | | | |
| CUPRESSACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Callitris preissii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CYPERACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Carex breviculmis* | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| *Carex inversa* var. *inversa* | | X | X | | | | | | | X | X | X | X | X | X | | | | X | X | | | | X | X | | |
| *Chorizandra enodis* | | | | | X | | | | | | X | | | | | | | X | | | | | | | | | |
| *Cyperus tenellus* | | | | | X | | | | | | | | | | | | | | X | | | | | | | | |
| *Eleocharis acuta* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Isolepis fluitans* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Isolepis marginata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Isolepis platycarpa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Isolepis stellata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lepidosperma congestum* | X | | | X | | | | | | | | X | | | | | | | | | | | | | | | |
| *Lepidosperma curtisiae* | | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| *Lepidosperma* sp. | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Lepidosperma viscidum* | | | | | | | X | | | X | | | | | X | X | | X | | | X | X | | X | | | |
| *Schoenus apogon* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Schoenus breviculmis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Schoenus tesquorum* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| DILLENIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hibbertia riparia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hibbertia riparia (glabriuscula)* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hibbertia riparia* (long-leaved aff. *H. stricta*) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DIPSACACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Scabiosa atropurpurea* | X | | | | | | | | | | X | | | | | | | | | | | | | | | X | |
| DROSERACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Drosera peltata* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Drosera whittakeri* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EPACRIDACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acrotriche affinis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Astroloma humifusum* | | | | | | | | X | | | | | | | | X | | | | | | | | | | | |
| *Brachyloma ericoides* ssp. *ericoides* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| EUPHORBIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Euphorbia drummondii* | | | | | | | X | | | | | | | X | | | | | | | | | | | | | |
| GENTIANACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Centaurium tenuiflorum* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| GERANIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Erodium botrys* | | | | | | | | | | | | | | X | | | | | | | | | X | | | | X |
| *Geranium solanderi* var. *solanderi* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pelargonium rodneyanum* | | | | | | | | | | | | | | | | | | | | | | | | | | | X |
| GOODENIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Dampiera dysantha* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Goodenia heteromera* | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Goodenia humilis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Goodenia pinnatifida* | X | X | | X | | | X | X | X | X | X | | X | | | X | | | | | X | X | | | X | | X | X |
| *Goodenia varia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| GRAMINEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Agrostis aemula* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Agrostis avenacea* var. *avenacea* | | | X | X | X | | | | | | X | | X | | | | | | | | | | | | | | |
| **Aira cupaniana* | | X | X | X | X | | | | | | X | | | | | | | | | | | | | | | | X |
| *Aira* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Amphibromus macrorhinus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Amphibromus nervosus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Avena barbata* | X | X | X | | | | X | X | | X | X | | X | X | | X | X | X | X | | X | X | X | | X | X | X | X |
| **Brachypodium distachyon* | | | | | | | X | X | X | X | X | | | | | | X | | | | | X | X | | | | X | X |
| **Briza maxima* | | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Briza minor* | | | | X | X | X | | | | | X | | X | | | | | | | | | | | | | | |

| *Bromus diandrus | | | X | | | | | X | | | | | | | X | | | | | | | | X | X | X | X | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
| *Bromus hordeaceus* ssp. *hordeaceus* | X | | X | | | X | | | X | | X | | | X | X | | | X | X | X | | | X | X | X | | X |
| *Bromus madritensis* | X | X | | X | | | | | | | X | X | X | | X | | | | | X | X | | | | | | X |
| *Bromus rigidus* | | | | | | | | | | | | | | X | | | X | | | | | | | | | X | |
| *Bromus rubens* | | | | | | | | | | | | | | | | | | X | | | | | | | | | |
| *Bromus* sp. | | | | | | X | | | | | | | | | | | | | | | | | | | | | |
| *Chloris truncata* | X | | X | | | | | | | | X | | | | | | | | | X | | | | | X | | |
| *Critesion marinum* | | | X | | | | | | | | | | | | X | | | | X | | | | X | | | X | |
| *Critesion murinum* ssp. | | | | | | | | | | | | | | | | | | | | | | | X | | | | |
| *Critesion murinum* ssp. *glaucum* | | | | | | | | | X | | | | | | | | | | | | | | | | | | |
| *Critesion murinum* ssp. *leporinum* | | | | | | | | | | | | | | | | | | | | | | | | | X | | |
| *Cynodon dactylon* | | | | | | | | | | | | | | | | | | | | | | | X | | | | |
| *Cynosurus echinatus* | X | | | | | | | X | | | | X | | | | | | | | | | | | | | | |
| *Dactylis glomerata* | X | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Danthonia caespitosa* | X | | | | | X | | | X | | | | | | | | | X | | | | | | | | | |
| *Danthonia duttoniana* | | | | | | | | | | | | | X | | | | | | X | | | | | | X | | |
| *Danthonia eriantha* | | | | | | | | | | | | | | | | | | | | | | | X | | | | |
| *Danthonia geniculata* | | | | X | X | X | | | | | | X | | | | | X | | X | | | | | | | | |
| *Danthonia linkii* var. *fulva* | X | | X | X | | | X | X | | | X | X | | | X | | X | | | | X | X | X | | | X | X |
| *Danthonia pilosa* var. *pilosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Danthonia racemosa* var. *racemosa* | | | | | | | | | | | | | | X | | | | | | | | | | | | | |
| *Danthonia setacea* var. *setacea* | X | X | X | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| *Ehrharta calycina* | | | X | | | | | X | | | | | | | | X | X | | | | | | | | | | |
| *Ehrharta longiflora* | | | | | | | | X | | | | | | | | | | | | | | | | | | | |
| *Elymus scabrus* var. *scabrus* | X | X | X | | | X | | X | | X | X | | X | X | | X | X | | | | X | X | | X | | | X |
| *Eragrostis infecunda* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hainardia cylindrica* | | | | | | | | | | | | | X | | | | | | | | | | | | | | |
| *Homopholis proluta* | X | X | X | | | | X | X | | X | | | X | | X | X | | | | X | X | X | | | | X | |
| *Lagurus ovatus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lolium perenne* x *rigidum* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lolium rigidum* | X | X | X | X | | X | | | X | | X | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | |
| *Lolium* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Neurachne alopecuroidea* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pentaschistis airoides* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Phalaris aquatica* | | | X | | | | | | | | X | X | | | | | X | X | | | | | X | | X | | |
| *Phalaris paradoxa* | | | | | | | | | | | | | X | | X | | | | | | | | | | | | |
| *Poa bulbosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | X |
| *Poa crassicaudex* | | | | | | X | | X | | | | X | | | | | | | | | | | | | | | |
| *Polypogon monspeliensis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rostraria cristata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Stipa blackii* | | | | | | | | X | | X | | | | | X | | | X | | X | | X | X | X | | X | |
| *Stipa curticoma* | X | X | | | | | | X | | | X | | X | X | | | X | | | | | | | | | | X |
| *Stipa elegantissima* | | | | | | | X | | | X | | | | | X | | | X | | | | X | | | | | |
| *Stipa exilis* | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| *Stipa flavescens* | | | | | | X | | X | | | X | | | | | | | | | | | | | | | | |

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| *Stipa gibbosa* | | | | | | | | X | | | | | | | | | | | | | | | | | | X | | | | | | | |
| *Stipa hemipogon* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 | | | | | |
| *Stipa mollis* | | | | | | | | X | | | | | | | | | X | X | | | | | | | | | | | | | | | |
| *Stipa multispiculis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Stipa mundula* | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | |
| *Stipa nodosa* | | | | | | | | | | | | | | | | | X | | | | | | | | | | X | | | | | | |
| *Stipa puberula* | | | | | | | | | | X | | | | | | X | | | | | | | | X | | | | | | | | | |
| *Stipa scabra* ssp. *falcata* | X | | X | | | X | X | X | | X | | | | | X | | X | X | | | X | X | | | | | X | X | | | | | |
| *Stipa semibarbata* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Stipa* sp. | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Stipa trichophylla* | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Themeda triandra* | X | X | | | | | | X | | | | | | | | | | | | | | | | | | | X | | | | | | |
| **Vulpia bromoides* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Vulpia muralis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Vulpia myuros* forma *megalura* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Vulpia myuros* forma *myuros* | X | X | X | X | X | X | | | X | | X | | X | | X | | | | | X | X | X | | X | X | X | | X | | | | | |
| HALORAGACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Haloragis aspera* | | X | X | X | | | X | X | | X | X | | | X | | X | | | X | | X | X | | | X | X | X | X | | | | |
| *Haloragis heterophylla* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Myriophyllum verrucosum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| IRIDACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Gynandriris setifolia* | | | | | | | | | | | | | | X | | | | | | | | | | X | | | | | | | | | |
| **Romulea minutiflora* | X | X | X | | | | X | | X | X | X | | X | | | X | X | | X | | X | | X | X | | X | X | | | | | | |
| **Romulea* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| JUNCACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Juncus amabilis* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Juncus australis* | | | | | | | | | | | | | | | | | | | | X | | | | | | X | | | | | | | |
| *Juncus bufonius* | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | |
| *Juncus flavidus* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Juncus radula* | | | | | | | | | | | | | | | X | X | | | | X | | | | | | | | | | | | | |
| *Juncus* sp. | | | X | | | | | | | X | X | | | | | | | | | | X | | | | X | | X | | | | | | |
| *Juncus subsecundus* | X | X | | | | | | | | | | | X | | | | | | | X | | | | | | X | | X | | | | | |
| LABIATAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Marrubium vulgare* | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| *Mentha satureioides* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Salvia verbenaca form A* | X | | | | | | X | | | | | | | | | | X | | X | | | | X | | | | X | X | | | | |
| *Teucrium racemosum* | | | | | | | | | | | | | | | | | | | | X | X | X | | | X | | | | | | | | |
| LAURACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cassytha melantha* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LEGUMINOSAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acacia acinacea* | | | X | | | | | | | X | X | | X | | | | | X | X | | | | X | | | | | | | | | | |
| *Acacia* aff. *halliana* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acacia farinosa* | | | | | | | X | | | X | X | | X | | | | X | | | | | | | | | | | | | | | | |
| *Acacia hakeoides* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acacia microcarpa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| *Acacia paradoxa* | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acacia pycnantha* | | | | | | | | | | | | | | | | | | | X | | | | | | | | X | | | | | | |
| *Acacia rigens* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 | | | | | | |
| *Acacia spinescens* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acacia trineura* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Daviesia benthamii* ssp. *humilis* | | | | | | | X | | | | | | | | | X | | | X | | | | X | | | | | | | | | | |
| *Eutaxia microphylla* var. *diffusa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eutaxia microphylla* var. *microphylla* | X | X | | | X | | | | | | | | X | | | X | | | | X | | | | | | | | | | | | | |
| *Eutaxia microphylla* var. *microphylla* (erect) | | | | | | | X | | | X | | | | X | | | | | | | | | | | | | | | | | | | |
| *Eutaxia microphylla* var. *microphylla* (prostrate) | | | X | X | | | X | | | X | X | | | X | | | X | | X | | | X | X | | | | X | | | | | |
| **Medicago polymorpha* var. *polymorpha* | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| *Pultenaea laxiflora* | | X | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pultenaea pedunculata* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Swainsona procumbens* | | X | | | | | X | | | | | | | X | | X | | | | X | X | X | X | | X | | X | | | | | | |
| *Templetonia stenophylla* | | | X | X | | | | X | | X | | | X | X | | | X | | | | | X | X | | | | X | X | | | | | |
| **Trifolium angustifolium* | X | X | X | X | | | X | X | | X | X | | | X | | X | X | X | X | | | X | X | | X | | X | X | | | | | |
| **Trifolium arvense* var. *arvense* | | | | | | X | X | | | | | | | | X | | | | | | | | | X | X | | | X | | | | | |
| **Trifolium campestre* | | | | X | X | | | | | X | X | | X | X | | X | | | X | | | | | | X | | | X | | | | | |
| **Trifolium glomeratum* | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | |
| **Trifolium repens* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Trifolium scabrum* | X | | | | | | X | | X | | X | | | | X | X | X | | | | | X | | | | | X | X | | | | | |
| *Trifolium* sp. | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| **Trifolium subterraneum* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Trifolium tomentosum* | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | |
| LILIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Arthropodium fimbriatum* | X | X | | X | | | X | X | | X | X | | X | X | X | | X | X | X | X | | | X | X | X | X | X | X | | | | | |
| *Arthropodium minus* | | X | | | | | | | | | | | | X | X | X | | | X | X | | | | | X | | | X | | | | | |
| *Arthropodium strictum* | | | | X | | | | X | | | X | | X | | X | | X | X | | | | | | | | | | X | | | | | |
| *Dianella longifolia* var. *grandis* | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | | |
| *Dianella revoluta* var. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Dianella revoluta* var. *revoluta* | X | | X | | X | | X | | | X | | | X | | | X | X | X | X | | | | X | | X | | X | X | | | | | |
| *Lomandra effusa* | | | | | | | | | | X | | | | | | | | | | | | X | X | | | | | | | | | | |
| *Lomandra micrantha* ssp. *micrantha* | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lomandra nana* | | X | | X | | | | X | | | | | | | | | | | | | | | | X | | | X | X | | | | | |
| *Lomandra sororia* | X | X | | X | X | | X | | | | X | | X | X | | X | X | X | X | | X | | | | X | X | | | | | | | |
| **Myrsiphyllum asparagoides* | | X | X | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | |
| *Thysanotus patersonii* | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tricoryne elatior* | | | | X | | | | | | | X | | | | | | | | | | | | | | | X | | | | | | | |
| *Tricoryne tenella* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LINACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Linum marginale* | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| LOGANIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Mitrasacme paradoxa* | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LORANTHACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Amyema linophyllum* ssp. *orientale* | X | X | X | | | | X | | X | | X | | | | | | | | | | | X | | | | X | | | | | | | |

| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lysiana exocarpi* ssp. *exocarpi* | | X | X | | | | X | | X | | X | | | | | | | | | | | | | | | | |
| LYTHRACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lythrum hyssopifolia* | | X | | | X | | | | | | X | | | | | | | | X | | | | | | | | |
| MALVACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sida corrugata* var. *angustifolia* | | | | | | | X | | X | X | | | | | | | | | | X | | | X | X | | X | |
| MARSILEACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Marsilea drummondii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Marsilea* sp. | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| *Pilularia novae-hollandiae* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MENYANTHACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Villarsia reniformis* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| MYOPORACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Myoporum platycarpum* ssp. *perbellum* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MYRTACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Callistemon rugulosus* var. *rugulosus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Calytrix tetragona* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus behriana* | | | | | | X | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus calycogona* var. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus calycogona* var. *calycogona* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus camaldulensis* var. *camaldulensis* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus dumosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus incrassata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus largiflorens* | | | | | | | | | | | | | | | | | | | | | X | | X | X | | | |
| *Eucalyptus leucoxylon* ssp. *pruinosa* | | | | X | X | X | | X | | | | | | | | | X | | | | | | X | | | X | |
| *Eucalyptus microcarpa* | | | | | | | | | | | | X | X | X | X | X | X | X | X | X | | X | | | X | X | X |
| *Eucalyptus microcarpa x odorata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Eucalyptus odorata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Melaleuca acuminata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Melaleuca decussata* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Melaleuca lanceolata* | | | | | | | | | | | | | | | | | | | | | | | | | X | | |
| *Melaleuca uncinata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Melaleuca wilsonii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OLEACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Olea europaea* ssp. | | | | | | | | | | | | | | | | | X | | | | | | | | | | |
| ORCHIDACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Thelymitra pauciflora* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| *Thelymitra* sp. | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| OXALIDACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oxalis perennans* | X | X | X | X | | X | X | X | X | X | X | | X | X | X | X | | X | X | X | X | | X | X | X | | | X |
| PITTOSPORACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Billardiera cymosa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Billardiera* sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Bursaria spinosa* | | | | | | | | | | X | | | | | | X | X | | | | | X | | | | X | X |
| *Cheiranthera alternifolia* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pittosporum phylliraeoides* var. *microcarpa* | | | | | | | | | | | | | | | X | | | | | | | | | | | | |

| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLANTAGINACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Plantago bellardii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Plantago gaudichaudii* | X | X | | X | | | X | X | | X | | | | | | | | X | | | | | | X | | | X |
| *Plantago hispida* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| **Plantago lanceolata* var. | X | | X | | | | | | | | X | | | | | | | | | X | | | | | X | | |
| POLYGALACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Comesperma polygaloides* | | | | X | | | X | | | X | | | X | | X | X | | X | | | | | | X | | | |
| POLYGONACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Polygonum aviculare* | | | | | | | | | | | | | | | | | | | X | | | | X | | | | |
| *Rumex brownii* | | | | | | | | | | | | X | | | | | X | | | | | | | | X | | |
| **Rumex crispus* | | | X | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rumex dumosus* var. | | | | | | | | | | | | | | X | | | | | | | | | | | | | |
| *Rumex dumosus* var. *dumosus* | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Rumex pulcher* ssp. *pulcher* | | | | | | | | | | | | | | | | | | | | | | | X | | | | |
| POTAMOGETONACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Potamogeton tricarinatus* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PRIMULACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Anagallis arvensis* | | | | | X | | | | | X | | | | | | | | | | | | | | | | | X |
| PROTEACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Grevillea ilicifolia* var. *angustiloba* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Grevillea ilicifolia* var. *ilicifolia* | | | | X | X | | | | | | | | | | | | | | | | | | | | | | |
| *Hakea muelleriana* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Hakea rugosa* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| RANUNCULACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Clematis microphylla* | | | | | | | | | | | | | | | | X | | | | | | | | | | | |
| RESTIONACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Leptocarpus brownii* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| RHAMNACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Spyridium eriocephalum* var. *eriocephalum* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROSACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acaena echinata* var. | X | X | | X | X | | | X | | | X | X | X | X | X | X | X | | | | X | | | X | | X | |
| *Aphanes australiana* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RUBIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Asperula conferta* | | | | | | | X | | X | | | | | | | | | X | | | X | | | X | | | |
| *Galium gaudichaudii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Opercularia turpis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RUTACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Correa reflexa* var. *reflexa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SAPINDACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Dodonaea viscosa* ssp. *spatulata* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SCROPHULARIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Limosella australis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Mimulus gracilis* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Veronica calycina* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SOLANACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Species | BBG00501 | BBG00601 | BBG00901 | BBG01001 | BBG01002 | BBG01301 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG04301 | BBG00701 | BBG00801 | BBG01201 | BBG01A07 | BBG01B10 | BBG02101 | BBG02401 | BBG02501 | BBG02B14 | BBG03301 | BBG03401 | BBG03601 | BBG03901 | BBG04401 | BBG05401 | BBG05802 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Solanum nigrum* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| STACKHOUSIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Stackhousia monogyna* | | | | | | | | X | | | | | | | | X | | X | | | | | | | | |
| STERCULIACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lasiopetalum baueri* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Lasiopetalum behrii* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| THYMELAEACEAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pimelea curviflora* var. *gracilis* | | | | | | | | | | | | | | | | | | | X | | | | | | | | |
| *Pimelea glauca* | | | | | | | | X | | X | | | | | | X | | X | | | | X | | | | | |
| *Pimelea humilis* | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| *Pimelea micrantha* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Pimelea stricta* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| UMBELLIFERAE | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Daucus glochidiatus* | | | | | X | | | | | | | | | | | | | | | | | | | | | | |
| *Eryngium rostratum* | X | | | | | | | | | | X | | | | | | | | | | | | | | | | |
| *Eryngium vesiculosum* | | X | | | | | | | | | | | | | | | | | | | | | | X | | | |
| *Hydrocotyle callicarpa* | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| FAMILY NOT ASSIGNED | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Moss sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | 41 | 46 | 41 | 45 | 38 | 19 | 46 | 43 | 22 | 47 | 47 | 31 | 32 | 32 | 38 | 41 | 31 | 39 | 33 | 29 | 39 | 38 | 34 | 38 | 25 | 39 | 42 |

# Appendices

## Appendix III

**PLANTS OF CONSERVATION SIGNIFICANCE RECORDED DURING THE SURVEY**

Plant taxonomy as in Appendix II.

The number of records of each taxon in the five habitat Associations is given.

Conservation status codes are listed for Australia (Aus), South Australia (SA) and the South East (SE).

The status categories are:

**E** **Endangered**: rare and in danger of becoming extinct in the wild.
**V** **Vulnerable**: rare and at risk from potential threats or long term threats which could cause the species to become endangered in the future.
**T** **Threatened**: likely to be either Endangered or Vulnerable but insufficient data for a more precise assessment.
**R** **Rare**: having a low overall frequency of occurrence: confined to a restricted range or scattered sparsely over a wider area. Not currently exposed to significant threats, but warranting monitoring and protective measures to prevent reduction of population sizes.
**K** **Uncertain**: likely to be either Threatened or Rare but insufficient data for a more precise assessment.
**U** **Uncommon**: less common species of interest but not rare enough to warrant special protective measures.
**Q** Not officially assessed but likely to be of significance.

Source: Lang and Kraehenbuehl 1995, Briggs and Leigh 1995.

| Species | Aust | SA | SE | Buloke | Buloke/box | Box | *E.behriana* | Grassland | Total |
|---|---|---|---|---|---|---|---|---|---|
| (No. quadrats) | | | | 11 | 16 | 9 | 11 | 1 | 48 |
| *Acacia trineura* | | E | E | 0 | 0 | 0 | 1 | 0 | 1 |
| *Ptilotus erubescens* | Q | E | E | 0 | 1 | 0 | 0 | 0 | 1 |
| *Pycnosorus chrysanthus* | | E | E | 0 | 1 | 0 | 0 | 0 | 1 |
| *Templetonia stenophylla* | | V | E | 4 | 7 | 0 | 0 | 0 | 11 |
| *Juncus radula* | | V | V | 0 | 3 | 2 | 0 | 0 | 5 |
| *Stipa curticoma* | | V | V | 4 | 4 | 0 | 0 | 1 | 9 |
| *Eryngium rostratum* | | V | T | 2 | 0 | 0 | 0 | 0 | 2 |
| *Stipa gibbosa* | | T | E | 1 | 1 | 1 | 0 | 0 | 3 |
| *Swainsona procumbens* | | K | V | 2 | 8 | 1 | 0 | 0 | 11 |
| *Acacia* aff. *halliana* | K | K | K | 0 | 0 | 0 | 3 | 0 | 3 |
| *Eutaxia microphylla* var. *microphylla* (prostrate) | | K | K | 5 | 6 | 1 | 0 | 0 | 12 |
| *Brachycome basaltica* var. *gracilis* | | R | E | 0 | 0 | 1 | 0 | 0 | 1 |
| *Dianella longifolia* var. *grandis* | | R | E | 1 | 1 | 0 | 0 | 0 | 2 |
| *Mentha satureioides* | | R | E | 0 | 0 | 1 | 0 | 0 | 1 |
| *Ptilotus exaltatus* var. *semilanatus* | Q | R | E | 1 | 1 | 0 | 0 | 0 | 2 |
| *Stipa multispiculis* | R | R | E | 0 | 0 | 1 | 0 | 0 | 1 |
| *Stipa puberula* | | R | E | 1 | 2 | 2 | 0 | 0 | 5 |
| *Goodenia pinnatifida* | | R | V | 8 | 7 | 3 | 0 | 0 | 18 |
| *Pratia concolor* | | R | V | 2 | 1 | 1 | 0 | 0 | 4 |
| *Schoenus tesquorum* | | R | R | 1 | 0 | 0 | 0 | 0 | 1 |
| *Solenogyne dominii* | | R | R | 5 | 2 | 2 | 0 | 0 | 9 |
| *Danthonia eriantha* | | R | K | 0 | 1 | 0 | 0 | 0 | 1 |
| *Carex inversa* var. *inversa* | | R | T | 4 | 8 | 2 | 0 | 0 | 14 |
| *Juncus flavidus* | | R | T | 0 | 0 | 1 | 0 | 0 | 1 |
| *Calotis scabiosifolia* var. *scabiosifolia* | | U | E | 1 | 0 | 0 | 0 | 0 | 1 |
| *Eclipta platyglossa* | | U | E | 1 | 0 | 1 | 0 | 0 | 2 |
| *Calocephalus citreus* | | U | V | 6 | 11 | 1 | 0 | 0 | 18 |
| *Damasonium minus* | | U | V | 0 | 0 | 0 | 2 | 0 | 2 |
| *Allocasuarina luehmannii* | | U | U | 11 | 16 | 1 | 0 | 0 | 28 |
| *Amphibromus nervosus* | | U | U | 0 | 0 | 0 | 2 | 0 | 2 |
| *Convolvulus* aff. *erubescens* "linear lobes" | | U | U | 7 | 12 | 2 | 0 | 0 | 21 |
| *Isolepis fluitans* | | U | U | 1 | 0 | 0 | 0 | 0 | 1 |
| *Lomandra nana* | | U | U | 3 | 3 | 4 | 0 | 1 | 11 |
| *Lomandra sororia* | | U | U | 6 | 9 | 3 | 0 | 1 | 19 |
| *Senecio squarrosus* | | U | U | 1 | 0 | 0 | 0 | 0 | 1 |
| *Stipa mundula* | | U | U | 0 | 2 | 1 | 0 | 0 | 3 |
| *Veronica calycina* | | U | U | 0 | 0 | 1 | 0 | 0 | 1 |
| *Eragrostis infecunda* | | U | K | 0 | 0 | 1 | 0 | 0 | 1 |
| *Eutaxia microphylla* var. *diffusa* | | U | K | 0 | 0 | 0 | 2 | 0 | 2 |
| *Amyema linophyllum* ssp. *orientale* | | U | T | 6 | 2 | 0 | 0 | 0 | 8 |
| *Goodenia heteromera* | | Q | V | 1 | 0 | 1 | 1 | 0 | 3 |
| *Sida corrugata* var. *angustifolia* | | Q | V | 3 | 4 | 2 | 0 | 0 | 9 |
| *Haloragis aspera* | | Q | U | 7 | 9 | 3 | 2 | 0 | 21 |
| *Mimulus gracilis* | | | E | 0 | 0 | 1 | 0 | 0 | 1 |
| *Pittosporum phylliraeoides* var. *microcarpa* | | | E | 0 | 1 | 0 | 0 | 0 | 1 |
| *Vittadinia pterochaeta* | | | E | 1 | 0 | 0 | 0 | 0 | 1 |
| *Alternanthera denticulata* | | | V | 0 | 1 | 0 | 1 | 0 | 2 |
| *Eucalyptus largiflorens* | | | V | 0 | 3 | 1 | 0 | 0 | 4 |
| *Eucalyptus microcarpa* | | | V | 0 | 13 | 4 | 0 | 0 | 17 |
| *Marsilea drummondii* | | | V | 0 | 0 | 1 | 1 | 0 | 2 |
| *Pultenaea laxiflora* | | | V | 2 | 0 | 0 | 0 | 0 | 2 |
| *Stipa blackii* | | | V | 2 | 7 | 1 | 0 | 1 | 11 |

| Species | Aust SA | SE | Buloke | Buloke/box | Box | *E.behriana* | Grassland | Total |
|---|---|---|---|---|---|---|---|---|
| *Arthropodium minus* | | T | 1 | 7 | 1 | 0 | 0 | 9 |
| *Lepidosperma curtisiae* | | T | 0 | 1 | 0 | 0 | 0 | 1 |
| *Minuria leptophylla* | | K | 1 | 0 | 0 | 0 | 0 | 1 |
| *Ptilotus spathulatus* forma *spathulatus* | | K | 0 | 3 | 1 | 0 | 0 | 4 |
| *Stipa nodosa* | | K | 0 | 2 | 0 | 0 | 0 | 2 |
| *Stipa elegantissima* | | R | 2 | 3 | 1 | 1 | 0 | 7 |
| *Stipa exilis* | | R | 0 | 1 | 1 | 1 | 0 | 3 |
| *Stipa trichophylla* | | R | 1 | 0 | 0 | 0 | 0 | 1 |
| *Acacia hakeoides* | | U | 0 | 0 | 1 | 1 | 0 | 2 |
| *Atriplex semibaccata* | | U | 1 | 1 | 0 | 0 | 0 | 2 |
| *Chenopodium desertorum* ssp. *microphyllum* | | U | 1 | 0 | 2 | 2 | 0 | 5 |
| *Chloris truncata* | | U | 3 | 2 | 1 | 0 | 0 | 6 |
| *Danthonia racemosa* var. *racemosa* | | U | 0 | 1 | 0 | 0 | 0 | 1 |
| *Maireana enchylaenoides* | | U | 6 | 11 | 2 | 0 | 0 | 19 |
| *Themeda triandra* | | U | 3 | 1 | 2 | 0 | 1 | 7 |

# Appendices

## Appendix IV

**LIST OF MAMMAL, REPTILE AND AMPHIBIAN SPECIES RECORDED AT EACH SITE DURING THE SURVEY**

Taxonomy follows Kemper and Queale (1990). Introduced species are marked with an asterisk.

The conservation ratings of significant species are shown in bold, the first rating being for the State (Kemper and Queale 1990 - mammals, Croft and Carpenter 1996a - reptiles and amphibians) and the second for the Region (Croft and Carpenter 1996a). No species of national conservation significance were recorded.

The definition for the status codes are as follows:

**R** **Rare**: Taxa with small populations in South Australia that are not at present endangered or vulnerable but are at risk.
**U** **Uncommon**: taxa occurring in relatively low numbers in South Australia, but not rare.
**C** **Common**: the category of greatest abundance; relatively numerous.

† indicates first specimen for South East.

| Scientific Name | Common Name | BBG00601 | BBG01001 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG01201 | BBG02401 | BBG02301 | BBG02801 | BBG02A08 | BBG02B04 | BBG05801 | BBG03701 | BBG00301 | BBG01601 | BBG01801 | BBG01101 | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bul | Bul | Bul | Bul | Bul | Bul | BB | BB | Box | Box | Box | Box | Box | Beh | Beh | Beh | Beh | Gra | |
| **Mammals** | | | | | | | | | | | | | | | | | | | | |
| **Bos taurus* | Cattle | | | | | | | | | | | X | | | X | | | | | 2 |
| *Chalinolobus morio* **U U** | Chocolate Wattled Bat | | | | | | | | | | | | | | | | X | | | 1 |
| **Equus caballus* | Horse | | | | | | | | | | | | | X | | | | | | 1 |
| **Lepus capensis* | Brown Hare | X | | | | | | | | | | X | | | X | | X | | X | 5 |
| *Macropus fuliginosus* | Eastern Grey Kangaroo | X | | X | | | | | | | | X | | | X | X | | X | | 6 |
| *Mormopterus planiceps* **U U** | Little Mastiff Bat | | | | | | | | | | | | | | X | | | | | 1 |
| **Mus domesticus* | House Mouse | | | | | X | X | | | | | | | | | | | | | 2 |
| *Nyctophilus geoffroyi* | Lesser Long-eared Bat | | | | | | | | | X | | | | | | | X | X | | 3 |
| **Oryctolagus cuniculus* | European Rabbit | X | | X | X | X | | | X | X | X | | X | | X | X | X | X | | 12 |
| **Ovis aries* | Sheep | | | | | | X | | | | | X | | | | | | | | 2 |
| *Sminthopsis crassicaudata* **U U** | Fat-tailed Dunnart | | | | | | X | | | | | | | | | | | | | 1 |
| *Tachyglossus aculeatus* | Short-beaked Echidna | X | | X | | | | | X | | X | | | | X | X | | | | 6 |
| *Tadarida australis* **U U** | White-striped Mastiff Bat | | | | | | | | | X | | | | | X | | X | | | 3 |
| *Trichosurus vulpecula* | Common Brushtail | | | | X | | | X | | | | | X | X | X | | | | | 5 |
| **Vulpes vulpes* | Red Fox | | | | | | X | X | X | X | | | | X | | | | | | 5 |
| Total | | 4 | 0 | 3 | 2 | 2 | 4 | 2 | 3 | 4 | 2 | 4 | 2 | 3 | 8 | 3 | 5 | 3 | 1 | 55 |
| **Reptiles** | | | | | | | | | | | | | | | | | | | | |
| *Ctenophorus pictus* **C R** | Painted Dragon | | | | | | | | | | | | | | | X | | | | 1 |
| *Ctenotus sp.* | Skink sp. | | | | X | | | | | | | | X | | | | | | | 2 |
| *Ctenotus uber* | Skink | | | | | | | | | | | | | | | X | | | | 1 |
| *Delma inornata* † | Olive Snake-lizard | | | | | | | | | | X | | | | | | | | | 1 |
| *Lampropholis delicata* | Delicate Skink | | | | | | | | | | | | | | X | | | | | 1 |
| *Lerista bougainvillii* | Bouganville's Skink | | | | | | | | | | | | | | X | X | | | | 2 |
| *Menetia greyii* | Dwarf Skink | | | | | | | | | | X | | | | | | | | | 1 |
| *Morethia adelaidensis* † | Adelaide Snake-eye | | | | | | | | X | | | | | | | | | | | 1 |
| *Morethia obscura* | Mallee Snake-eye | | | | | | | | | | | | | | X | | | | | 1 |
| *Phyllodactylus marmoratus* | Marbled Gecko | | | | | | | X | | | X | | | | X | | | | | 3 |
| *Pogona barbata* | Bearded Dragon | | | | | | | X | | | | | | X | | | X | | | 3 |
| *Pseudonaja textilis* | Eastern Brown Snake | | | | | | | | | X | | | | | | | | | | 1 |
| *Tiliqua rugosa* | Sleepy Lizard | X | | X | | | X | X | | | X | X | | X | | X | | X | X | 10 |
| Total | | 1 | 0 | 1 | 1 | 0 | 1 | 3 | 1 | 1 | 4 | 1 | 1 | 2 | 4 | 4 | 1 | 1 | 1 | 28 |

# Appendices

## Appendix V

### LIST OF BIRD SPECIES RECORDED AT EACH SITE DURING THE SURVEY

Taxonomy follows Parker and Horton (1990). Introduced species are marked with an asterisk.

The conservation ratings of significant species are shown in bold, the first rating being for the State (Parker and Horton 1990) and the second for the Region (Croft and Carpenter 1996a). No species of national significance were recorded at survey sites. † indicates that no regional status has been assigned.

The definition for the status codes are as follows:

**E** **Endangered**: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

**V** **Vulnerable**: Taxa believed likely to move into endangered category in the near future if the causal factors continue operating.

**R** **Rare**: Taxa with small populations in South Australia that are not at present endangered or vulnerable but are at risk.

**U** **Uncommon**: taxa occurring in relatively low numbers in South Australia, but not rare.

| Scientific Name | Common Name | BBG00601 | BBG01001 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG01201 | BBG02401 | BBG02301 | BBG02801 | BBG02A08 | BBG02B04 | BBG05801 | BBG00301 | BBG01601 | BBG01801 | BBG03701 | BBG01101 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bul | Bul | Bul | Bul | Bul | Bul | BB | BB | Box | Box | Box | Box | Box | Beh | Beh | Beh | Beh | Gra | |
| *Acanthagenys rufogularis rufogularis* | Spiny-cheeked Honeyeater | | | X | X | X | X | | | | | X | | | | | X | | | 6 |
| *Acanthiza apicalis* | Inland Thornbill | | | | | | | | | | | X | | | | | | | | 1 |
| *Acanthiza chrysorrhoa* | Yellow-rumped Thornbill | X | | X | X | X | X | | | | | | | | | | | | X | 6 |
| *Acanthiza nana* **U R** | Yellow Thornbill | X | | X | X | X | X | | | | | | | | | | | | | 5 |
| *Acanthiza uropygialis* **U V** | Chestnut-rumped Thornbill | | | | X | X | | | | | | | | | | | | | | 2 |
| *Accipiter fasciatus fasciatus* | Brown Goshawk | | X | | | | | | | | | | | | | | | | | 1 |
| *Anthochaera carunculata carunculata* | Red Wattlebird | | X | | | | X | X | X | X | | X | X | X | | X | | X | | 10 |
| *Aphelocephala leucopsis* **U E** | Southern Whiteface | | | | | X | | | | | | | | | | | | | | 1 |
| *Aquila audax audax* | Wedge-tailed Eagle | | X | | | | | | | X | | | | | | | | | | 2 |
| *Artamus cyanopterus* | Dusky Woodswallow | | | | | | | | | | | X | | | | | | | | 1 |
| *Artamus personatus* | Masked Woodswallow | | | | | | | | | | | X | | | | | X | | | 2 |
| *Artamus superciliosus* | White-browed Woodswallow | | X | | X | X | | | | | | X | | | X | | X | | | 6 |
| *Barnardius zonarius barnardi* | Mallee Ringneck | | | | | | | | | | | | | | | X | | | | 1 |
| *Burhinus grallarius* **E E** | Bush Thick-knee | | | | | | | | | | | | | X | | | | | | 1 |
| *Cacatua galerita galerita* | Sulphur-crested Cockatoo | X | X | | | | | X | | | X | | | | | | | | X | 5 |
| *Cacatua tenuirostris* | Long-billed Corella | | | | | | | | | X | X | | | X | | | | | | 3 |
| **Carduelis carduelis* | Goldfinch | | | | | X | | | | | | | | | | | | | | 1 |
| *Chenonetta jubata* | Wood Duck | | | | | | | | | X | | | | | | | | | | 1 |
| *Cincloramphus mathewsi* | Rufous Songlark | | | | | | | | X | | | | | | | | | | | 1 |
| *Circus assimilis* | Spotted Harrier | | | | | | | | | | | | | | | | | X | | 1 |
| *Climacteris picumnus picumnus* | Brown Treecreeper | | X | | | | | | | | X | | | | | | | | | 2 |
| *Colluricincla harmonica* | Grey Shrike-thrush | | X | | | | | | | | | X | | | X | | X | X | | 5 |
| *Coracina novaehollandiae novaehollandiae* | Black-faced Cuckoo-shrike | | X | | X | | | | | | | X | | X | | | | | | 4 |
| *Corcorax melanorhamphos* **V V** | White-winged Chough | | X | | | | | | | | | | | X | | X | | | | 3 |
| *Corvus coronoides coronoides* | Australian Raven | | | | | | | X | | X | | | | | X | | | X | | 4 |
| *Corvus mellori* | Little Raven | X | | X | | | | X | | | | | | | | | | | | 3 |
| *Corvus* sp. | | X | | | | | | | | | X | | | | | | X | | | 3 |
| *Coturnix novaezelandiae* | Stubble Quail | | | | | | | | | X | | | | | | | | | | 1 |
| *Coturnix ypsilophora* **V V** | Brown (Swamp) Quail | | | | | | | | | X | | | | | | | | | | 1 |
| *Dacelo novaeguineae novaeguineae* | Laughing Kookaburra | | | | | | | | | | X | | | X | | | | | | 2 |
| *Daphoenositta chrysoptera pileata* | Varied Sittella | | | | X | X | | | | | | | | | | | | | | 2 |
| *Dromaius novaehollandiae* | Emu | | X | | | | | | | | | | | | X | | | | | 2 |
| *Drymodes brunneopygia* | Southern Scrub-robin | | | | | | | | | | | | | | X | | | | | 1 |
| *Elanus caeruleus* | Black-shouldered Kite | | | | | | | | | | X | | | | | | | | | 1 |
| *Eolophus roseicapillus* | Galah | | | X | X | X | | | X | X | | X | X | X | X | X | | X | | 11 |
| *Epthianura albifrons albifrons* | White-fronted Chat | | | | | X | | | | | | | | | | | | | | 1 |

| Scientific Name | Common Name | BBG00601 | BBG01001 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG01201 | BBG02401 | BBG02301 | BBG02801 | BBG02A08 | BBG02B04 | BBG05801 | BBG00301 | BBG01601 | BBG01801 | BBG03701 | BBG01101 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Bul | Bul | Bul | Bul | Bul | Bul | BB | BB | Box | Box | Box | Box | Box | Beh | Beh | Beh | Beh | Gra | |
| *Falco berigora* | Brown Falcon | | | | | X | | | | | | | | X | | | | | | 2 |
| *Falco longipennis* | Little Falcon (Australian Hobby) | | | | | | | | | | X | | | | | | | | | 1 |
| *Gliciphila melanops* | Tawny-crowned Honeyeater | | | | | | | | | | | X | | | X | | | | | 2 |
| *Glossopsitta concinna* | Musk Lorikeet | | X | | | X | | X | | X | X | X | X | X | | X | X | X | | 11 |
| *Glossopsitta porphyrocephala* | Purple-crowned Lorikeet | | X | | | | | X | X | | X | | | | | | | | | 4 |
| *Grallina cyanoleuca* | Magpie Lark | | X | | | | | | | | X | X | | X | | X | | | | 5 |
| *Gymnorhina tibicen leuconota* | Australian Magpie | X | X | X | X | X | X | X | X | X | X | X | X | X | | X | X | | X | 16 |
| *Halcyon sancta sancta* | Sacred Kingfisher | | X | | | | | | | | | | | | | | | | | 1 |
| *Hieraaetus morphnoides morphnoides* | Little Eagle | | | | | | | | | | | | | | | | | X | | 1 |
| *Hirundo ariel* | Fairy Martin | | | | | | X | | | | | | | | | | | | | 1 |
| *Hirundo neoxena* | Welcome Swallow | | | | | | X | | | | | | | | | X | | | | 2 |
| *Hirundo nigricans nigricans* | Tree Martin | | | | | | | | | X | | | | | | | | X | | 2 |
| *Hylacola cauta* **V †** | Shy Hylacola (Shy Heath-wren) | | | | | | | | | | | | | | | | X | | | 1 |
| *Malurus cyaneus* | Superb Blue-wren | | | | | | | | X | | | X | | | X | | X | X | | 5 |
| *Manorina melanocephala* | Noisy Miner | | | | | | | X | | X | X | X | X | X | | X | | X | | 8 |
| *Meliphaga cratitia* **V †** | Purple-gaped Honeyeater | | | | | | | | | | | | | | X | | | | | 1 |
| *Meliphaga leucotis* | White-eared Honeyeater | | | | | | | | | | | | | | | | X | | | 1 |
| *Meliphaga penicillata* | White-plumed Honeyeater | | X | | | | | | X | X | X | X | | | | X | X | X | | 8 |
| *Melithreptus brevirostris* | Brown-headed Honeyeater | | | X | | | | | | | | | | | | | | | | 1 |
| *Melithreptus lunatus lunatus* | White-naped Honeyeater | | | | | | | | | | | | X | | | X | | | | 2 |
| *Microeca leucophaea* | Jacky Winter (Brown Flycatcher) | | | | | X | | | | | | | | | | | | | | 1 |
| *Myiagra inquieta inquieta* | Restless Flycatcher | | | | | | | | | | | X | | | | | | | | 1 |
| *Ninox novaeseelandiae* | Boobook Owl (Southern Boobook) | | | | | | | X | X | X | | | | | | | | | | 3 |
| *Northiella haematogaster haematogaster* **U V** | Bluebonnet | | | | | X | | | | | | | | | | | | | | 1 |
| *Nymphicus hollandicus* | Cockatiel | | | | | | X | X | X | X | X | X | X | X | X | | | | | 9 |
| *Ocyphaps lophotes* | Crested Pigeon | | | X | X | X | | | | | | | X | | | | | | | 4 |
| *Oreoica gutturalis* | Crested Bellbird | | | | | | | | | | | | | | | | | X | | 1 |
| *Pachycephala pectoralis* | Golden Whistler | | | | | | | | | | | | | | | | X | | | 1 |
| *Pachycephala rufiventris rufiventris* | Rufous Whistler | X | | | | | | | | | | | | | | | | | | 1 |
| *Pardalotus striatus* | Striated Pardalote | | X | | X | | | X | X | X | X | X | X | X | | | | X | | 10 |
| *Pardalotus xanthopygus* **V V** | Yellow-rumped Pardalote | | | | | | | | | | | | | | X | | X | | | 2 |
| **Passer domesticus domesticus* | House Sparrow | | | | X | X | X | | | | X | | | X | | | | | | 5 |
| *Petroica goodenovii* | Red-capped Robin | X | | | X | | | | | | | | | | | | | | | 2 |
| *Phaps chalcoptera* | Common Bronzewing | | | | | | | | | | | | | | | | | X | | 1 |
| *Phylidonyris albifrons* | White-fronted Honeyeater | | | | | | | | | | | | | | | | | X | | 1 |
| *Platycercus elegans* | Crimson Rosella | X | | X | | | X | | X | | X | X | | | | | | | | 6 |

| Scientific Name | Common Name | BBG00601 | BBG01001 | BBG02601 | BBG02B08 | BBG03101 | BBG03201 | BBG01201 | BBG02401 | BBG02301 | BBG02801 | BBG02A08 | BBG02B04 | BBG05801 | BBG00301 | BBG01601 | BBG01801 | BBG03701 | BBG01101 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Platycercus eximius eximius* | Eastern Rosella | | X | | X | | X | X | X | X | | X | X | X | | X | | X | | 11 |
| *Pomatostomus superciliosus* | White-browed Babbler | | X | | | | | | | | | X | | | X | | | | | 3 |
| *Psephotus haematonotus* | Red-rumped Parrot | | X | X | | X | | X | X | X | | X | X | X | X | X | | X | | 12 |
| *Rhipidura leucophrys leucophrys* | Grey Fantail | | | X | | X | | | | X | | X | | | | X | | X | | 6 |
| *Smicrornis brevirostris* | Weebill | | | | | | | | | | | | | X | | | | | | 1 |
| *Strepera versicolor melanoptera* | Grey Currawong | | | | | | | | | | | | | | X | | | | | 1 |
| **Sturnus vulgaris vulgaris* | Common Starling | | | X | X | X | | | X | | X | X | | | | | | | | 6 |
| *Threskiornis spinicollis* | Straw-necked Ibis | | | X | | X | | | | | | | | X | | | | | | 3 |
| *Trichoglossus haematodus* | Rainbow Lorikeet | | | | | | | | | | | X | | | | | | | | 1 |
| *Zosterops lateralis* | Silvereye | X | | | | | | | | | | | | | | | | | | 1 |
| **Total** | | 10 | 20 | 13 | 15 | 21 | 11 | 13 | 14 | 19 | 18 | 26 | 11 | 19 | 14 | 14 | 13 | 18 | 3 | ## |

# Appendices

## Appendix VI

**LIST OF ADDITIONAL VERTEBRATE SPECIES RECORDED OPPORTUNISTICALLY DURING THE SURVEY**

Taxonomy follows Kemper and Queale (1990) and Parker and Horton (1990). Introduced species are marked with an asterisk.

This list only contains species that were recorded within the survey's target vegetation types.

The conservation ratings of significant species are shown, the first being for Australia (Garnett 1992 - birds), the second for the State (Kemper and Queale 1990 - mammals, Parker and Horton 1990 - birds) and the third for the Region (Croft and Carpenter 1996a).

The definition for the status codes are as follows:

**E** **Endangered**: Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

**R** **Rare**: Taxa with small populations in South Australia that are not at present endangered or vulnerable but are at risk.

**U** **Uncommon**: taxa occurring in relatively low numbers in South Australia, but not rare.

| TAXON | | Aus | SA | SE |
|---|---|---|---|---|
| **Mammals** | | | | |
| *Macropus rufogriseus* | Red-necked Wallaby | | R | R |
| **Felis catus* | Cat | | | |
| *Pseudocheirus peregrinus* | Common Ringtail | | | |
| **Reptiles** | | | | |
| *Tiliqua scincoides* | Eastern Blue-tongue Lizard | | | |
| **Birds** | | | | |
| *Aegotheles cristatus* | Owlet Nightjar | | | |
| *Calyptorhynchus banksii graptogyne* | Red-tailed Black Cockatoo (south-eastern subspecies) | E | E | E |
| *Melithreptus gularis* | Black-chinned Honeyeater | U | R | R |
| *Melopsittacus undulatus* | Budgerigar | | | |
| *Phylidonyris novaehollandiae novaehollandiae* | New Holland Honeyeater | | | |
| *Podargus strigoides* | Tawny Frogmouth | | | |

# Appendices

## Appendix VII

**REPORT FOR BUTTERFLY (LEPIDOPTERA) COMPONENT OF SURVEY**

Roger Grund
9 Parkers Rd
Torrens Park 5062

Further information regarding species mentioned in the following report is available from the author. See also "Butterflies of South Australia" by R.H. Fisher, 1978, which can now be bought from the State Information Centre for $2.50.

**Gaden BBG/003/01:** (11 Dec.-cold, overcast, very windy; 14 Dec.-hot, fine, no wind)
Site is E. behriana/E. dumosa/E. "phenax" gilgai-mallee, dense canopy but sparse understorey, fairly dark aspect except at midday due to canopy, in original condition.
**Time spent at site and adjacent area:** 3 1/2 hrs
**Butterflies flying at site;** none
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma viscidum), Jalmenus icilius (Acacia spp), Candalides hyacinthinus simplex (Cassytha melantha), Neolucia agricola agricola (Eutaxia microphylla diffusa)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area E. incrassata/E. leptophylla sand-dune mallee with diverse understorey, M. uncinata dominant, in mostly original condition)**;** Vanessa kershawi, Candalides acastus, C. hyacinthinus simplex, Zizina labradus labradus
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** Trapezites sciron eremicola (Lomandra collina), Motasingha trimaculata trimaculata (Lepidosperma carphoides, L. viscidum), Acrodipsas brisbanensis, Hypochrysops ignitus ignitus (Choretrum glomeratum, Brachyloma spp), Ogyris olane ocela (Amyema pendulum pendulum), Ogyris otanes (Choretrum glomeratum), Jalmenus icilius (Acacia spp), Candalides cyprotus cyprotus (Conospermum patens, Grevillea ilicifolia), Neolucia agricola agricola (Eutaxia microphylla microphylla and other bush peas)
**Comments:** Only small colonies of Lomandra collina, Choretrum glomeratum, Amyema pendulum, Conospermum patens and Grevillea ilicifolia were observed. Lepidosperma spp were well established. This very large area of fenced off remnant scrub is in pristine condition and although no threatened butterfly species were observed, it does have the potential to further their conservation as food host plants for threatened species are present.

**Koch BBG/018/01:** (11 Dec.-cold, overcast, very windy; 14 Dec.-hot, fine, no wind)
Site is E. behriana/E. odorata gilgai-mallee, moderately open canopy, relatively diverse understorey, in original condition.
**Time spent at site and adjacent area:** 3 1/2 hrs
**Butterflies flying at site;** Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma viscidum), Jalmenus icilius (Acacia spp), Candalides hyacinthinus simplex (Cassytha melantha), Neolucia agricola agricola (Eutaxia microphylla microphylla)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area E. incrassata sand dune mallee with diverse understorey, Banksia/Leptospermum dominant, partly in original condition with some areas regenerating after a previous clearance)**;** Geitoneura klugii klugii,Vanessa kershawi, Candalides acastus, C. cyprotus cyprotus, C. hyacinthinus simplex, Neolucia agricola agricola, Zizina labradus labradus
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** Trapezites sciron eremicola (Lomandra collina), Motasingha trimaculata trimaculata (Lepidosperma carphoides, L. viscidum), Acrodipsas brisbanensis, Hypochrysops ignitus ignitus (Brachyloma spp and others), Paralucia spp (Bursaria spinosa), Ogyris olane ocela (Amyema pendulum pendulum), Jalmenus icilius (Acacia spp).
**Comments:** Only small colonies of Bursaria spinosa and Amyema pendulum were observed, however ant nests were present at the base of the Bursaria which may indicate Paralucia spp are in the area. Lomandra collina and Lepidosperma spp were well established. This very large area of fenced off remnant scrub is in excellent condition and is preserving at least one threatened butterfly species (C. cyprotus), and has the potential to conserve others.

**Sykes BBG/016/01:** (11 Dec.-cold, overcast, very windy)
Site is E. behriana gilgai-woodland, very open, with a sparse understorey of native and exotic grasses. Original understorey removed by clearing or grazing, and the area is presently heavily grazed by sheep.
**Time spent at site and adjacent area:** 1 hr

**Butterflies flying at site;** none
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent areas cleared for farming with a remnant linear creek line containing E. leucoxylon with an understorey of Callistemon rugulosus, continuous with the E. behriana woodland to the west)**;** Geitoneura klugii klugii,Vanessa kershawi, Zizina labradus labradus
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This linear remnant of scrub is a poor habitat for butterflies. Stipa scabra, foodplant for vulnerable Herimosa albovenata, is present but the heavy sheep grazing would prevent the reestablishment of the species unless the area was fenced off.

**Squire BBG/02B/04:** (11 Dec.-cold, overcast, very windy)
Site is E. odorata mallee, moderately open canopy, with a dense understorey of M. uncinata, in fair condition. Perimeter of scrub heavily grazed by cattle, interior light to no grazing due to density of understorey.
**Time spent at site and adjacent area:** 1 1/2 hrs
**Butterflies flying at site;** none
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Lucia limbaria (Oxalis perennans)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area cleared for farming, some remnant roadside vegetation still present)**;** none
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This small area of remnant scrub is in fair condition. Its area is probably too small to sustain viable colonies of threatened butterflies even though Stipa scabra, the foodplant for vulnerable Herimosa albovenata is present.

**Mackay BBG/031/01:** (11 Dec.-cold, overcast, very windy)
Site is monotypical bulloak gilgai-woodland, very open, with a sparse understorey of native and exotic grasses. Original cohabiting eucalypts and understorey removed historically by clearing and grazing, and the area is presently heavily grazed by sheep.
**Time spent at site and adjacent area:** 1 1/2 hrs
**Butterflies flying at site;** none (on site 6 pm, too late for flying butterflies)
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Ogyris amaryllis meridionalis (Amyema linophyllum orientale)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent areas cleared for farming)**;** none
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This large area of remnant bulloak scrub infested with mistletoe should have been an ideal habitat for Ogyris amaryllis meridionalis, but no indications of its prescence was observed on the mistletoe foodplant. Similar barren results were observed at all other bulloak sites during the survey. There are no historical records of this butterfly in the upper Southeast and it might be concluded that the butterfly does not use Amyema linophyllum as a foodplant in this area. Another possibility is that the butterfly has been removed from the area by the use of aerial insecticides, as all remnant stands of bulloak are closely associated with farmland.

**Thomas BBG/037/01:** (12 Dec.-warm, overcast, light wind; 14 Dec.-warm, overcast, no wind)
Site is a small area of remnant E. behriana gilgai-mallee, open canopy but sparse understorey, invaded by veldt grass. Site probably once lightly grazed, is now fenced off and has been allowed to regenerate
**Time spent at site and adjacent area:** 2 1/2 hrs
**Butterflies flying at site;** none
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Jalmenus icilius (Acacia spp), Candalides hyacinthinus simplex (Cassytha melantha)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area to the east is remnant sand dune E. leucoxylon and Callitris preissii woodland with an open but diverse understorey, only lightly invaded by veldt grass)**;** Geitoneura klugii klugii, Heteronympha merope merope, Vanessa kershawi, Ogyris olane ocela, Zizina labradus labradus
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma carphoides, L. viscidum), Jalmenus icilius (Acacia spp), Candalides hyacinthinus simplex (Cassytha melantha), Theclinesthes miskini miskini (Acacia pycnantha)
**Comments:** There is a large infestation of Amyema miquelii developed on the blue gums and which appear to be supporting a strong colony of Ogyris olane, however no live immature stages or flying adults were observed. There are scattered plants of Bursaria spinosa. This scrub is in reasonably good condition but its area is of borderline size to be capable of supporting threatened butterflies, however it is probably worth a try and would require the restablishment of their foodplants. Choretrum glomeratum would be the best choice.

**Wolseley BBG/032/01:** (12 Dec.-warm, broken cloud, light wind)
Site is bulloak woodland, open canopy, good understorey reasonably diverse. Probably cleared historically and has been allowed to regenerate. There has been a recent fire which does not appear to have affected the vegetation and has probably stimulated understorey growth.
**Time spent at site and adjacent area:** 1 hr
**Butterflies flying at site;** Pieris rapae rapae, Vanessa kershawi
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Site has numerous foodplants suitable for supporting butterfly populations but the total lack of breeding indications on the plants would suggest the fire(s) had destroyed all the previous

breeding colonies. Butterflies which should have been at the site, along with their foodplant which was present, include Herimosa albovenata albovenata (Stipa scabra), Motasingha trimaculata trimaculata (Lepidosperma viscidum), Paralucia spp (Bursaria spinosa), Lucia limbaria (Oxalis perennans), Jalmenus icilius (Acacia spp), Neolucia agricola agricola (Eutaxia microphylla microphylla, E. m. diffusa), Theclinesthes miskini miskini (Acacia pycnantha)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area is farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This scub is a common area for the township, and has a reasonable size. It did not appear to have been grazed. Butterfly foodplants including diverse native grasses are well developed and it should have been supporting good populations of a number of butterfly species. Amyema linophyllum was not present on the bulloaks.

**Teatrick Water Reserve BBG/028/01:** (12 Dec.-warm, broken cloud, light wind)
Site is E. microcarpa/E. leucoxylon/ E. camaldulensis woodland, open canopy, grassland understorey, original understorey removed historically.
**Time spent at site and adjacent area:** 1 hr
**Butterflies flying at site;** Junonia villida calybe, Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area is farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** A large area dominated by the native and exotic grassland understorey. Stipa scabra is well developed and capable of supporting a colony of vulnerable Herimosa albovenata if introduced. There were no mistletoes on the eucalypts.

**Teatrick Roadside BBG/026/01:** (12 Dec.-warm, broken cloud, light wind)
Site is mostly a roadside bulloak remnant, open canopy with some understorey. The southern end also includes some eucalypts. Does not appear to be grazed.
**Time spent at site and adjacent area:** 1 hr
**Butterflies flying at site;** Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma viscidum), Lucia limbaria (Oxalis perennans), Jalmenus icilius (Acacia spp), Neolucia agricola agricola (Eutaxia microphylla diffusa)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** A long linear roadside-scrub about 30m wide. Lepidosperma viscidum, Eutaxia microphylla and Acacia spp are well developed. Amyema linophyllum is present on the bulloak, and Stipa scabra is common in the grassland understorey, but no Ogyris amaryllis or Herimosa albovenata were seen. There were scattered bushes of Bursaria spinosa. This site is probably large enough to support some butterflies, particularly skipper butterflies, but is likely to be easily affected by any adverse farming practices that occur in the adjacent farmlands, particularly the use of chemical sprays and the latter may explain the lack of butterflies seen.

**Staude BBG/02A/08:** (12 Dec.-warm, broken cloud, light wind)
Site is E. odorata mallee, moderately open canopy, with an understorey of M. uncinata and M. acuminata. Not fenced off, appears to be lightly grazed by sheep, although historically it was probably heavily grazed judging by the lack of understorey diversity.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** the area of this scrub is fairly small, and the lack of understorey diversity and its closeness to the farmland would preclude this area as having any butterfly conservation significance.

**Custon BBG/01A/07:** (12 Dec.-warm, broken cloud, light wind)
Site is E. microcarpa/bulloak gilgai-woodland, very open, with an understorey of native and exotic grasses, and sedge. Original understorey removed by clearing or grazing. The adjacent rail reserve still has its original understorey component.
**Time spent at site and adjacent area:** 1 1/2 hrs
**Butterflies flying at site;** Vanessa kershawi, Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma viscidum), Lucia limbaria (Oxalis perennans), Jalmenus icilius (Acacia spp)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This large area of fenced scrub is common land to the town but is apparently subleased and lightly grazed by sheep, (excepting the rail reserve). The understorey in the common is dominated by Lepidosperma viscidum and should be ideal breeding grounds for Motasingha trimaculata although no signs of its habitation was evident. Stipa scabra is also present

among the native grasses. No mistletoe was present on any of the trees. This scrub would be an ideal area for the conservation of the skipper butterflies Motasingha trimaculata and Herimosa albovenata although they may have to be reintroduced.

**Edwards Property BBG/023/01:** (13 Dec.-warm, fine, no wind)
Site is E. behriana or E. microcarpa/bulloak gilgai-woodland, open canopy but sparse understorey of bog plants and grasses. Original understorey removed historically.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** none (on site 8 am, too early for flying butterflies)
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Lucia limbaria (Oxalis perennans)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** This is a relatively small area adjacent to the main highway and farmland. Amyema linophyllum was present on the bulloak, but there was no mistletoe on the eucalypts. This scrub has no conservation potential for butterflies.

**Edwards Roadside BBG/02B/08:** (13 Dec.-warm, fine, no wind)
Site is remnant roadside vegetation of eucalypt/bulloak woodland and grassland understorey with occasional shrubs, open canopy.
**Time spent at site and adjacent area:** 1 hr
**Butterflies flying at site;** Lampides boeticus, Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area is farmland)**;** large bulloaks were scattered in the paddocks and were infested with Amyema linophyllum and Lysiana exocarpi, but an extensive look for Ogyris amaryllis did not reveal any habitation.
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** At the site were some stands of Stipa scabra but these were not extensive enough to support vulnerable Herimosa albovenata, and also being close to farmland they would be subject to chemical spraying. Further south along the road towards Wolseley is a large colony of Acacia victoriae, the preferred foodplant of Jalmenus icilius and Theclinesthes miskini, but the acacias were not supporting any Lycaenid butterflies. This type of roadside vegetation adjacent to farmland is too vulnerable to chemical spray drift and is not likely to support viable colonies of butterflies unless the immature stages have means to shelter during the day either underground or beneath thick bark.

**Danby BBG/010/01:** (13 Dec.-warm, fine, no wind)
Site is E. leucoxylon/bulloak gilgai-woodland, moderately dense canopy, with a sparse understorey. The area was probably lightly cleared historically and has been allowed to regenerate. A very large area, presently fenced off and not grazed.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** Vanessa kershawi
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Motasingha trimaculata trimaculata (Lepidosperma sp), Lucia limbaria (Oxalis perennans), Candalides cyprotus cyprotus (Grevillea ilicifolia)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area similar to above)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** not known
**Comments:** Stipa scabra, foodplant for vulnerable Herimosa albovenata, is sparsely present. Acacia acinacea present. No mistletoe was evident on any of the trees. It is doubtful that this type of gilgai or boggy country with a dense canopy and sparse understorey is capable of supporting colonies of butterflies, excepting perhaps Satyrinae (browns) butterflies. There were no indications of butterfly habitation on the above mentioned foodplants.

**Kybybolite BBG/011/01:** (13 Dec.-warm, fine, no wind)
Site is experimental grassland pasture. Original tree and shrub vegetation removed historically. The area is presently lightly grazed by sheep at a density of 2 1/2 sheep per hectare.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** Zizina labradus labradus
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent areas cleared for farming)**;** Large old trees of E. camaldulensis have been left standing in most surrounding paddocks many of which support Muellerina eucalyptoides the foodplant for endangered Ogyris abrota. An examination of the mistletoe where it was accessible indicated the butterfly was probably no longer present in the area.
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** see above
**Comments:** These lightly grazed pasture areas indicate native grasses can coexist with sheep. No foodplants for threatened butterflies were seen in the pasture paddocks. Stipa scabra was not present. There is a Lomandra sp (new?) present but it was not supporting any skipper butterflies.

**Frances Cemetery BBG/006/01:** (13 Dec.-warm, fine, no wind)
Site is a large area of bulloak woodland surrounding the Frances Cemetery. Appears to have been historically cleared and then allowed to regenerate. Bulloak regrowth

is dense with some understorey of shrubs and grasses. Site is fenced off.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** none
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Lucia limbaria (Oxalis perennans), Neolucia agricola agricola (Eutaxia microphylla diffusa)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area is farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** Mistletoe is present on the bulloak but Ogyris amaryllis was not observed near it. Sparse stands of Stipa scabra present but probably insufficient to support Herimosa albovenata. There is a Lomandra sp (new?) which was not supporting any skipper butterflies. This site does not have any butterfly conservation significance.

**Knowling BBG/012/01:** (13 Dec.-warm, overcast, no wind)
Site is E. microcarpa/bulloak woodland, open canopy, grassland understorey, original understorey removed historically. Some remnant understorey on the adjacent roadside. Site grazed by sheep, not fenced off.
**Time spent at site and adjacent area:** 1/2 hr
**Butterflies flying at site;** none (on site 6pm, too late for flying butterflies)
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** none
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area is farmland)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** none
**Comments:** A relatively large area dominated by the native and exotic grassland understorey. Stipa scabra is sparsely present, but in its present condition not suitable to support vulnerable Herimosa albovenata. There was no mistletoe on the trees. Lomandra sp (new?) was present but there were no indications of skipper butterfly habitation. This site has the potential to conserve Herimosa albovenata but only if it were fenced off or lightly grazed.

**Mundulla BBG/058/01:** (13 Dec.-warm, overcast, no wind; 14 Dec.-warm, overcast, no wind)
Site is E. microcarpa woodland, open canopy, degraded grassland understorey, original understorey removed historically. Site is a common area for the town, fenced off and heavily grazed by horses.
**Time spent at site and adjacent area:** 1 hr
**Butterflies flying at site;** Vanessa kershawi
**Butterflies seen breeding at site;** none
**Butterflies (not common species) possibly breeding at site based on foodhost prescence;** Lucia limbaria (Oxalis perennans)
**Butterflies actually occurring adjacent to site, either flying or breeding** (adjacent area farmland and urban development)**;** not examined
**Butterflies (not common species) possibly breeding adjacent to site based on foodhost prescence;** not examined
**Comments:** A large scrub area, but badly degraded. No mistletoe present. Sugar-ants were common which might suggest the area was historically suitable for supporting endangered Ogyris idmo. In its present condition this site has no potential for the conservation of butterflies.

# Appendices

## Appendix VIII

**REPORT FROM ANALYSIS OF ANT DATA**

### Introduction

A number of authors have espoused the value of ants as bio-indicators of the relative quality of areas of habitat with respect to land degradation and habitat restoration (e.g. Andersen 1987, 1990; Majer 1987). Integral to this concept is the fact that ants can be classified readily into functional groups whose relative abundance changes predictably in response to environmental factors including habitat type and level of disturbance. Combined with the relative ease with which ants can be sampled and sorted to the genus level (Andersen 1990), this taxon shows considerable potential for use in assessment of human induced disturbance in natural ecosystems.

This appendix presents a brief analysis of the ant data collected during this survey.

### Methods

The ants captured during this survey were identified to the genus level by staff at the South Australian Museum. The abundance of each genus in each sample was classified as rare (1-5 individuals), few (6-100) or plentiful (>100). As data from all samples were pooled at each site, these abundance measures were retained as indices of "relative abundance". According to the guidelines provided by Andersen (1990), each ant genus was assigned to a functional group. A table was then constructed of the relative abundance of ants in each functional group at each site. Sites were grouped into the four main habitat associations (excluding grassland), and a vector diagram constructed for each association to show the relative locations of sites relative to the features characterising each functional group. This enabled a semi-quantitative assessment of the relative degree of disturbance at each site.

### Results

As an example of the output from this analysis technique, the vector diagram for the buloke sites is presented in Figure A. The relative abundance of hot climate specialists, dominants and opportunists was relatively similar at the six sites. More variability is evident in the numbers of generalised myrmicines, with B (BBG01001)

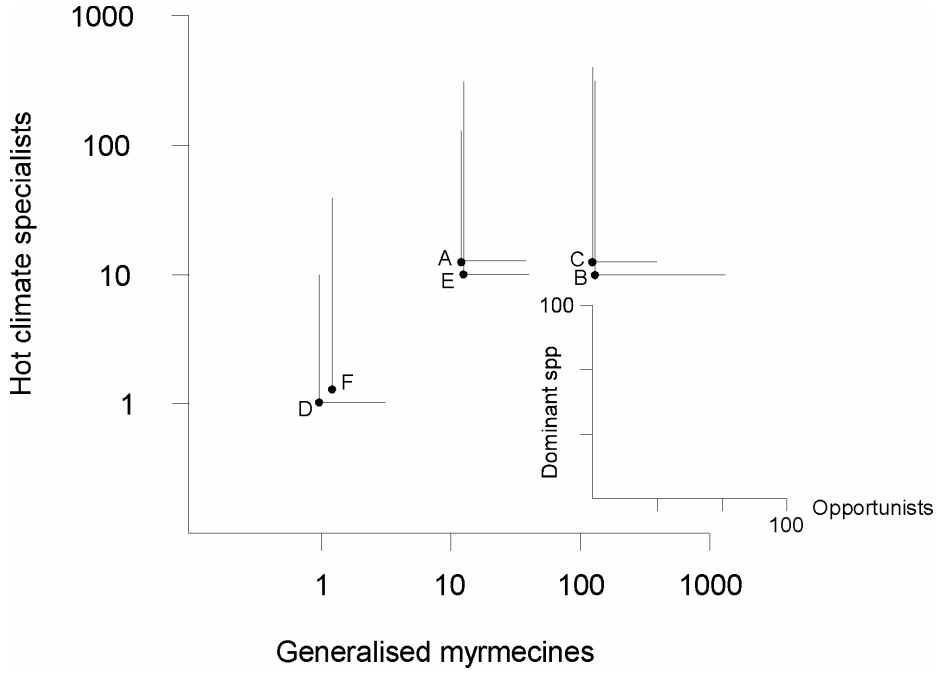


**Figure A: Vector diagram showing the relative location of buloke sites according to the abundance of four functional groups of ants. Dots represent the position relative to the main axes, and the vectors for each site represent abundance relative to the inset axes. Sites: A=BBG00601, B=BBG01001, C=BBG02601, D=BBG02B08, E=BBG03101, F=BBG03201.**

and C (BBG02601) having the most and D (BBG02B08) and F (BBG03201) having the least (Figure A).

**Discussion**

Interpretation of these patterns is unclear. For example, the ant fauna of sites BBG03101 and BBG00601 have very similar composition, yet they are known to be very different in terms of degradation (highly degraded and relatively intact, respectively). Too little is known about the ecology of the functional groups and their constituent genera to enable confident discussion of the extent of degradation based upon these data.

A number of other factors preclude firm conclusions from this analysis. Firstly, data were collected as a component of a general survey procedure, rather than from a structured, systematic sampling system. Future such analyses within the Biological Survey framework should seek to sample a range of disturbance levels within standardised habitat types, should include a larger number of sites within each habitat type, and should attempt to include pre-defined "control" sites with little degradation against which to compare degraded sites. Clearly, the latter will be difficult to achieve in systems that contain little or no habitat that approaches being pristine.

Secondly, ant abundance was classified into three categories, therefore the analysis is sensitive only to gross differences and is unsuitable for detecting subtle variation.

Finally, the use of ants as bioindicators is still in its infancy, and still lies in the realm of research rather than standard survey procedure. In particular, general assumptions regarding the ecology of ant genera may often be invalid - substantial variability in ecology within genera is likely to be common. In addition, ecological information relating to how different groups respond to different disturbances (especially fire and grazing) in different habitat types is not available. Therefore, extensive research into the ecology of different ant species may be required before functional group assignation can be reliable and analyses become robust.

Nevertheless, given the desirability of having means of rapidly assessing the ecological condition of different locations, the potential of ants to fulfil this role should be pursued further. During surveys, the raw data can be readily collected and retained for future analysis. However, this should be in the framework of a structured sampling system and may require some independence of invertebrate and vertebrate sampling during biological surveys.

# Appendices

## Appendix IX

### NUMBER OF INVERTEBRATES RECORDED FROM PITFALL TRAPS AT EACH SITE

The number of individuals from each invertebrate Order collected from invertebrate pitfalls at each site.

* Hymenoptera does not include ants.
† Data not available at time of publication.

| Order | BBG00301 | BBG00601 | BBG01001 | BBG01101 | BBG01201 | BBG01601 | BBG01801 | BBG02301 | BBG02401 | BBG02601 | BBG02801 | BBG02A08 | BBG02B04 | BBG02B08 | BBG03101 | BBG03201 | BBG03701 | BBG05801 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Acarina | 36 | 2 | | | | 7 | 13 | 38 | 22 | 29 | 7 | 3 | 2 | 15 | 12 | | | |
| Blattodea | 1 | | | 5 | | 1 | 3 | 1 | | 4 | 8 | | | 4 | 1 | | | 1 |
| Centipedes | | 1 | | | | | 2 | | 2 | 8 | | | | | | | | |
| Coleoptera | 5 | 10 | | 30 | | 55 | 50 | 18 | 12 | 10 | 24 | 5 | 12 | 12 | 5 | | | 21 |
| Collembola | 10 | 21 | | 73 | | 27 | 6 | 20 | 10 | 97 | 92 | 3 | 46 | 4 | 17 | | | 3 |
| Dermaptera | | | | 5 | | 3 | | | | | 18 | | | | | | | 1 |
| Diptera | 10 | 12 | | 18 | | 19 | 34 | 6 | 30 | 27 | 22 | 10 | 19 | 50 | 10 | | | 8 |
| Hemiptera | 5 | 3 | | 24 | | 2 | 18 | 5 | 51 | 31 | 22 | 14 | 4 | 19 | 4 | | | 6 |
| Hymenoptera* | 1 | 3 | | 7 | | 6 | 7 | 4 | 6 | 7 | 27 | 3 | 4 | 13 | 2 | | | 6 |
| Isoptera | 10 | | | | | | | | 7 | 1 | 3 | | | 1 | | | | |
| Lepidoptera | | | | | | | 1 | | | | | | | | | | | 3 |
| Mantodea | | | | | | | | | 1 | 1 | | | | | | | | |
| Millipedes | | | | | | | 3 | | | | | | | 1 | | | | |
| Neuroptera | | | | | | | | | | | | | | | | | | 1 |
| Orthoptera | | 1 | | 22 | | 3 | 1 | 17 | 6 | 3 | | | | | | | | 1 |
| Phthiraptera | | | | | | | | | | | | 1 | | | | | | |
| Pseudoscorpions | | | | | | 1 | | | 2 | 1 | | | | 1 | | | | |
| Psocoptera | | | | | | | | | | | | | | | 1 | | | |
| Slaters | | | | | | 1 | 6 | | 1 | 3 | | | | | 1 | | | |
| Spiders | 3 | 5 | | 31 | | 11 | 13 | 14 | 21 | 29 | 47 | 2 | 7 | 10 | 3 | | | 3 |
| Thysanoptera | | | | | | 1 | 1 | | | | | | 1 | 2 | | | | |
| Thysanura | 1 | | | | | | | | 6 | 10 | | 2 | 1 | 1 | | | | 1 |
| **Total** | 82 | 58 | † | 215 | † | 137 | 158 | 123 | 177 | 261 | 270 | 43 | 96 | 133 | 56 | † | † | 55 |