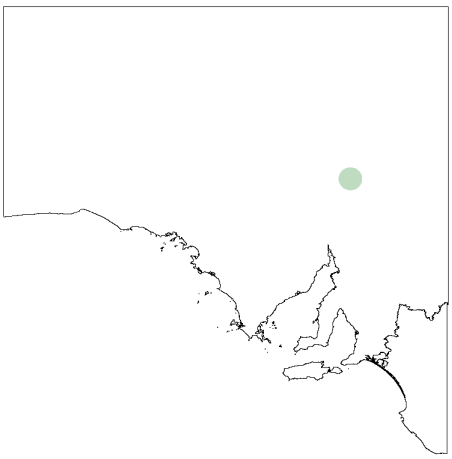
A BIOLOGICAL SURVEY
of the
NORTH WEST FLINDERS RANGES

SOUTH AUSTRALIA

DEC -1997



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and
Optima Energy (Flinders Power Pty Ltd)

1998

OPTIMA
energy

BIOLOGICAL SURVEY
SOUTH AUSTRALIA

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Cover Photograph: Fifteen kilometres south-east of Leigh Creek near Puttapa Gap and Site PUT004 (*Photo: R Brandle*).

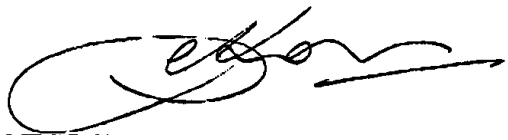
PREFACE

A Biological Survey of the North West Flinders Ranges, South Australia is a further component of the Biological Survey of South Australia

The program of systematic biological surveys to cover the whole of South Australia arose out of a realisation that an effort was needed to increase our knowledge of the remaining vascular plants and vertebrate fauna of the state and to encourage its conservation.

Over the last fifteen years, there has been a strong commitment to the Biological Survey by Government and an impressive dedication from hundreds of volunteer biologists.

It is anticipated that the Biological Survey will achieve complete statewide coverage by 2015 and will be an achievement for which we can be very proud. Biologists in the future will be able to measure the direction of long-term ecological change, and we will have substantially improved our knowledge of the biodiversity of South Australia and our ability to adequately manage nature conservation into the future.



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ABSTRACT

The North West Flinders Ranges Biological Survey aimed to systematically investigate and describe the variety of habitats supporting the vascular plant and vertebrate animal diversity of the region. Invertebrate animals were also collected from each sites but have not been analysed in this report. The study involved the collation of existing data combined with a field survey during December 1997. Thirty-three 1 km^2 quadrats were chosen to reflect the diversity of habitats. Within these a total of 77 1 ha habitat patches were surveyed for vegetation. Thirty-two of the thirty-three quadrats were sampled for fauna (birds, reptiles and mammals) within the main habitat type for which each quadrat was chosen. Information gathered during the survey on the vegetation structure of each habitat, and data from over 100 Pastoral Assessment and Flinders Ranges Management Review sites were used to assist with the vegetation mapping of the area at a 1:100000 scale.

The survey identified 226 plant taxa bringing the total recorded for the area to 354. Twelve percent of these were introduced species. The plant associations sampled were clustered into 14 floristic groups based on similarity of species present at each site. These align themselves with four broad landform types: hills and ranges (4 groups); stony plains, undulating plains and low hills (5 groups); floodouts and drainage lines (4 groups); and dunefields (1 group). Average species richness at sites was 21. The study area was found to contain five species rated as having national conservation significance (Briggs & Leigh 1995), and a further three which are considered as having South Australian conservation significance.

The study area was known to have been visited by at least 159 species of bird, 93 of which were recorded during the survey. Cluster analysis of the bird fauna at the sites linked the six groups chosen to the four broad landform categories mentioned above. The most species rich site contained 19 species with the overall average of 8.5 species per site. Four species have national conservation significance (Garnett 1992) one of which is considered vulnerable to extinction (Thick-billed Grass-wren). Thirty-seven species have South Australian conservation significance (Watts 1990).

The survey located 19 reptile species which had not been previously collected in the study area, bringing the total confirmed for the area to 50. Two additional species of snake (Pythons) were also reported by locals. Cluster analysis of the reptile assemblages at sites aligned six groups into the four broad landform categories mentioned previously. The most species rich sites contained 10 species with the overall average being 5.5 per site. Two of the species recorded represented significant extensions of their known range. Of the four frog species known to occur in the region two were located during the survey.

Thirteen species of native mammal were recorded for the study area. A further nine introduced mammals were also detected. The five small mammal species formed three assemblages aligned with three of the broad landform categories (sand dunes were not adequately sampled to reflect a true assemblage). Species richness was around 1 species per site - the maximum number at a site was three. The only species with a national conservation status is the Yellow-footed Rock-wallaby which is currently the focus of a re-introduction and catchment management project. The two native rodent species recorded in the study area represent a significant contribution to our knowledge of native rodents in the Flinders Ranges.

ACKNOWLEDGEMENTS

This project was funded by Optima Energy and the Government of South Australia, with assistance from the Zoological Society of South Australia.

Thanks to Beat Odermat of Optima Energy and the Leigh Creek Town Management for assistance with logistics and accommodation. Also the managers of the six Pastoral Leases on which we conducted the survey - Beltana, Puttapa, North Moolooloo, Myrtle Springs, Leigh Creek and Burr Well.

The project would not have been possible without the assistance and cooperation of the many people who provided expertise, assistance, equipment and encouragement. Hopefully they are all listed below.

1. Field assistance

1996	BOTANY	BOTANY	MAMMALS	REPTILES	BIRDS	INVERT/EXTRA
WEEK 1 1/12 - 6/12						
GROUP 1	Craig Baulderstone	Jenny Cutten	Tim Hudspith	Jeff Foulkes	Max Possingham	Tim Jenkins, Natasha Hoffman
GROUP 2	Joanne Cutten	David Watts	Martine Long	Robert Brandle	Maya Penk	Jason Cody
				Steve Doyle		
WEEK 2 7/12 - 12/12						
GROUP 3	Tony Robinson	Jenny Cutten	Tim Hudspith	Gavin Kluske	Keith Casperson	Tim Jenkins, James Morrison
GROUP 4	Jack White	Robert Brandle	Jason Cody	Steve Doyle	Bernice Cohen	Quealle, Guy Edwards

2. Extra Technical expertise: David Symon - plant determinations.
Mark Hutchinson and Adrienne Edwards - reptile and amphibian determinations.
Cath Kemper - mammal determinations.
Queale - invertebrate collection .
Jan Forrest and David Hirst - invertebrate collection equipment and identification.

3. Equipment: Deb Hopton, David Armstrong, SA Museum.

4. Data Entry and verification: Nigel Willoughby

5. Comments on drafts and proof reading: Franca Scopacasa, Tony Robinson and Tim Hudspith.

6. Vegetation Mapping: Thanks to Deb Canty for digitising the linework, and Justine Drew, David Hart and other staff from Image Data Services, Resource Information Group, Department for Environment, Heritage and Aboriginal Affairs, for help with satellite imagery used as a basis for vegetation mapping.

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Thanks to Guy Edwards from Native Vegetation Conservation Section, Department for Environment, Heritage and Aboriginal Affairs for offering cartographic advice.

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INTRODUCTION

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The North West Flinders Ranges study, which included the narrow extension of the Flinders Ranges to the Willouran ranges, covered four major landform types:

- Rocky hills, outcrops and ranges;
- clay plains and hill slopes, often covered with stones (strew);
- wetlands (including creeks, flood plains, lakes and mound springs);
- sandy desert (consisting mostly of parallel sand ridges and swales).

For the purposes of this survey the study area refers to the area of land roughly within 30 km of the Township of Leigh Creek South. This area is currently the major source of electric power for the State of South Australia through its brown coal deposits. The other major industry utilising the area is sheep and cattle grazing of native pastures. Tourism is mostly concentrated around the town centres, the coal mine and Aroona Dam.

The first European to visit the study area, the traditional land of the Adnyamathana people, was Edward John Eyre in 1840. Details of the early exploration and settlement by Europeans, the Aboriginal people, the geology, geomorphology, soils and climate of the Flinders Ranges can be found in 'The Natural History of the Flinders Ranges' (Davies *et al* 1996). Rainfall is at the arid end for the Flinders Ranges with variation from 250 mm to less than 200 mm average annual rainfall in a north westerly transect across the study area. Mean monthly maxima and minima at Leigh Creek range from 35^{o}C to 21^{o}C in January and 17^{o}C to 5^{o}C in July. The biological resources of the whole of the Flinders have also been summarised in Davies *et al* (1996) and will be referred to, along with other references, in the introductions to the subsequent chapters of this report.

The impetus for the survey came from collaboration between Optima Energy, the Royal Zoological Society of South Australia and The Biological Survey & Research Section of the Department for Environment, Heritage and Aboriginal Affairs (DEHAA). There was a need for more detailed biological information which would be useful as a baseline for evaluating the effects of a Yellow-footed Rock-wallaby re-introduction, and an associated threat abatement program, on other species and habitats in the area. This culminated in the funding being allocated for a six month project involving two weeks of general biological survey during December 1997.

The survey methodology used has been developed for the Biological Survey of South Australia to systematically document the vascular plants and vertebrate fauna of the various habitats found across the state. To date these surveys have gathered information for South Australia's offshore islands, Kangaroo Island, the eastern agricultural and pastoral lands. This includes areas from the South East of South Australia to the Stony Deserts of the Lake Eyre Basin, the Nullarbor Plain, Yellabinna Region and the Anangu-Pitjantjatjara Lands in the north-west of the state. Areas surveyed purely for vegetation include the Mount Lofty and Flinders Ranges, Yorke Peninsula and southern Eyre Peninsula. Survey titles and dates are listed in Forward & Robinson (1996) and Playfair & Robinson (1997). Survey regions which have been mapped for vegetation adjacent to the study area are shown in Appendix 13.

OBJECTIVES

The principle aim of the Biological Survey of South Australia is to systematically survey a representative sample of the range of ecological habitats to be found in South Australia. The purpose for this being to enhance, with scientific data, integrated land management and the conservation of the South Australia's biological diversity.

The specific objectives of the North West Flinders Ranges Biological Survey were:

- to collate existing information about the flora and vertebrate fauna of North West Flinders Ranges;
- to systematically survey the vertebrate fauna - the mammals, birds, reptiles and frogs - at each site using standard survey methods developed for the Biological Survey of South Australia;
- to sample the terrestrial invertebrates using standard micro- and macro- pitfall trapping techniques;
- to establish a North West Flinders Ranges Biological Survey database;
- to enable distribution maps for the study area's flora and fauna species to be produced using GIS technology;
- to identify characteristic species, communities and habitats of the study area;
- to identify threats to the region's biological diversity
- to summarise all findings in a summary report;
- to produce a structural vegetation map of the study area and other parts of the Copley 1:250,000 mapsheet not already covered by digital linework.

METHODS

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This survey forms part of the Biological Survey of South Australia. The methods are therefore consistent with the methodology developed for the Biological Survey of the Nullarbor Region (McKenzie and Robinson 1987) with some minor alterations. Handbooks detailing these methods are available on request from the South Australian Department for Environment and Natural Resources' Biological Survey and Research Program.

Site Selection

There were existing vegetation sites in the study area from the Flinders Ranges Management Review (Playfair 1992) and the ongoing Pastoral Assessment Program of the Pastoral Management Branch. These sites were taken into account to avoid duplicating survey effort in those locations. Over the remaining area, proposed 'camps' (a group of eight quadrats to be surveyed over one week) were then selected using a combination of 1:50, 000 topographic mapsheets, and Landsat Thematic Mapper (TM) satellite imagery, Environmental Association Unit information (Laut *et al* 1977) and the Pastoral Assessment Officers' knowledge of various areas. The aim was to sample the variety of habitats across the study area. The position of known watering points and in some cases comments from pastoral land managers were taken into account. The proposed areas were investigated by ground reconnaissance survey where liaison with land managers and physical factors such as land condition, accessibility and representativeness of a range of habitats were used to determine final quadrat locations. At each 'camp' the eight quadrats to be surveyed were selected, marked with labelled photopoint posts (two steel star droppers or short jarrah stakes separated by 10 m) and photographed. A global positioning device was used to produce Australian map grid references for relocation of sites. Field location maps were drawn and the habitat types (patches) to be sampled within each 1 km^2 quadrat were described. Each group of eight quadrats were selected to represent all of the major landform and habitat types within the camp area. The distances between quadrats was mostly determined by the location of different habitat types in relation to the presence and condition of access tracks, as the time taken to traverse and check all the quadrats was critical. Traps at quadrats had to be checked before rising temperatures threatened the survival of trapped fauna. Consequently the spread of quadrats within a camp area was usually less than 40 km.

Specific sites were labelled as 'Camp', 'Quadrat', 'Patch' (Copley and Kemper 1992). The 'Camp' was given a three letter code which related to a mapped feature nearby. Each 'Quadrat' was numbered one to eight. The 'Patch' was numbered with the habitat type supporting the permanent photopoint being assigned number one. Other patches within the 1 km^2 quadrat were then arbitrarily assigned sequential numbers. Thus quadrat 5 patch 1 at Mt Deception would become DEC_5_1 which is also referred to as a site in this report. The standard output of this site nomenclature from the database would be DEC00501. This is how they are presented in the report.

Sampling

Quadrats were sampled for vegetation and vertebrate fauna (birds, reptiles and terrestrial mammals). Frogs and bats were only sampled when and where conditions were suitable. The field survey was conducted by two teams of five biologists with one or two extra helpers during the first two weeks of December 1997. The sites are displayed on Figure 1. and are labelled by quadrat number and camp code (eg ARO 1 or 2 or 3...).

Each survey team was completely independent and consisted of six people: two botanists; a herpetologist; a mammalogist; an ornithologist; and one or two technical assistants. Each group attempted to sample a minimum of eight quadrats per week for vertebrate species and vegetation. More quadrats were sampled for vegetation when an eager botanist identified an unsampled habitat type. Details of quadrats are summarised in Table 1 and presented in Appendix 1.

Table 1. - Survey effort for the North West Flinders Ranges Biological Survey.

DATE	PASTORAL LEASE	CAMP	NUMBER OF QUADRATS (veg. only)	NUMBER OF VEGETATION PATCHES
1-6/12/1997	Leigh Creek South	ARO = Aroona Dam	8 (1)	23
	Beltana Station	DEC = Mt Deception	8	12
7 -12/12/1997	Burr Well/North Moolooloo	COF = Mt Coffin	8	23
	North Moolooloo/Puttapa	PUT = Puttapa	8	19
Totals		**4**	**32 (1)**	**77**

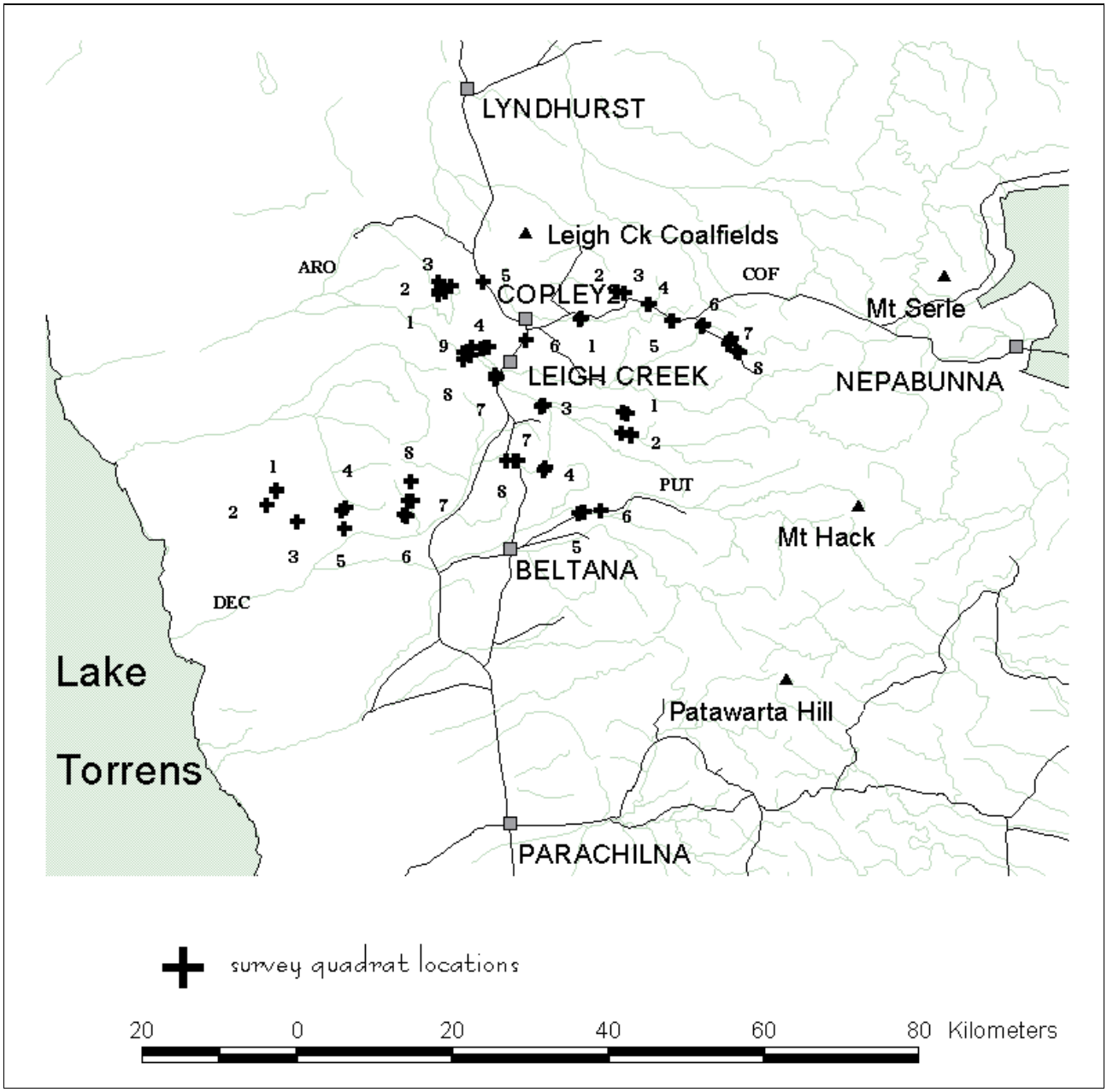

Figure 1. Camp localities.

Vegetation

At each quadrat the primary habitat 'patch' type was surveyed for vegetation over an approximate 100 m x 100 m area consistent with the methods section outlined in 'A Biological Survey of the South Olary Plains' (Forward and Robinson 1996). Some minor differences have occurred in the adapted Braun-Blanquet (Gullen *et al* 1976) cover abundance estimates. Datasheets for physical data collection and vegetation sampling are presented in Appendix 2. After defining the parameters of the primary habitat patch type over the one km^2 quadrat, the botanist had the responsibility for defining secondary patches as well as sampling and numbering them (up to five patches were sampled in particularly diverse areas). The approximate location and extent of each patch type was drawn onto a quadrat map. Photopoints were taken at all patches, though only the primary patch was marked with permanent photopoint posts. Interesting plant species which were observed outside of patches and quadrats were recorded as opportunistic records with precise location details for inclusion into the South Australian Opportune Database.

At each camp area a representative collection of all species was vouchered, and dried, for later verification at the South Australian Herbarium. All data collected was entered into the Biological Survey of South Australia 'Survey Database' which is centrally located and maintained at the Department for Transport, Urban Planning and the Arts. The 'North West Flinders Ranges Biological Survey' is numbered 98 in this system.

Fauna

Fauna sampling took place at all eight of the primary patch types in each quadrat except where extra vegetation quadrats were introduced (ie ARO00901). Sampling at each quadrat involved establishing two sets of pitfall trap-lines consisting of six pits (40cm deep, 15 cm diameter) joined by 50 m of flywire drift-fence. The two traplines were separated by at least 200m. These were used for trapping ground-dwelling vertebrates and macro-invertebrates over four nights. Associated with each pitfall trap-line was a line of 15 baited metal box treddle traps (Elliott Scientific Equipment type A) and two baited wire cage treddle traps (15 cm x 15 cm x 50 cm). Traps were mostly baited with a mixture of peanut butter and rolled oats. Where the landform and rock was unsuited for full pitfall traps, shallower pits were used or pitfall trapping was abandoned. At these sites greater physical search effort, more spotlighting and double the normal quota of Elliott traps were used to compensate for decreased pit-trap effort.

Birds were sampled through one hour search efforts in the primary patch type. Species observed within the 1 km^2 quadrat but in adjacent habitat patches were assigned that patch number. This method was used twice at each primary patch type, in the early morning and late afternoon, except where this proved impractical. Bird data was collected for a number of secondary patches by several ornithologists.

Mammals and reptiles were surveyed by four nights trapping and one to two hours of searching at each quadrat. Attempts were made to check all traps twice a day, particularly in hot weather. Searching involved lifting rocks, branches and other objects, raking leaf litter, digging up burrows and recording tracks, scats, bones, skin, fur and bird of prey pellets. Other predator scats were also collected for analysis. Attempts were made to sample the bat fauna on an opportunistic basis using strategically positioned harp traps and mist nets. All caves and hollow trees were also checked for fauna, their signs and bone deposits. Any fauna observed off quadrat was recorded along with an accurate location for inclusion on the 'Opportune Database'. Frogs were recorded at sites when conditions were suited to their emergence. Separate quadrat datasheets were filled out for each day of sampling and for each discipline even when no captures were made. Amphibian datasheets were only used when frogs were recorded. Representative specimens were collected and vouchered for each species recorded at each camp. Usually a male and a female of each species was collected for positive species determination and lodgement with the South Australian Museum. This is a particularly critical part of fauna surveys in remote locations where many species' distributions and taxonomy are not well defined. Species which were difficult to identify (eg *Lerista spp.* and *Ctenotus spp.*) were collected in greater numbers to gain representative animals for those locations. All information collected in the field was transferred to the Biological Survey of South Australia database following verification of voucher specimens.

Trapping effort for the North West Flinders Ranges Biological Survey is presented in Table 2. Full details of trap effort at each site is provided along with site location information in Appendix 1.

Table 2. Trapping effort for each type of trap used in the standard methods in terms of trapnights (the number of traps times the number of nights for which they were open).

Camp Group	Number of Trap Nights		
	Elliott traps	Pitfall Traps	Cage traps
ARO	990	348	132
DEC	1025	330	110
COF	960	336	128
PUT	1060	336	120
Total	**4035**	**1350**	**490**

Data analysis

The site based data were analysed using PATN exploratory data analysis software (Belbin 1989). This clustered the site species presence/absence data into groups based on similarity for each taxonomic group (vascular plants, birds, reptiles, and small terrestrial mammals). The datasets for each taxonomic group utilised subsets of the total sites sampled. The numbers of sites contributing to these datasets are detailed in the separate chapters.

The method of PATN analysis is similar to that used for the Gawler Ranges Survey (Robinson *et al* 1988) and the Yellabinna Survey (Copley and Kemper 1992) reports. The PATN analysis pathway used for this survey was as follows: ASO - using the Kulkzinski Coefficient to produce an association matrix; FUSE using UPGMA; DEND to produce a dendrogram of similarity between sites; GDEF to define groups of similarity in the dendrogram; and GSTA to produce a species by PATN group frequency table. GDEF and GSTA were repeated

with various numbers of groups chosen by analysing the dendrogram to explore which number of groups best reflected intuitive groups based on field knowledge. Once the number of groups had been determined the data matrix was transposed using DATN and the pathways outlined above were used on this dataset to GDEF step of the process followed by TWAY to produce a species by site two-way table to assist with interpretation. TWAY was also used on the transposed data to produce the [Observed frequency - Expected frequency]/Expected frequency (O-E/E) index values for each species by group. This index is an adaptation of the Chi-squared formula. The Expected frequency for a species in a particular category is determined by dividing the sum of frequencies within one category (ΣX) by the total of the sums of all categories (ΣΣX), multiplied by the sum of the frequency for the species in all categories (ΣY), ie ΣX/ΣΣX*ΣY.

All species assemblage groups defined through PATN are presented for each taxonomic group in the relevant chapters except where a group was defined by less than 1% of the sites contributing to the analysis. Details on presentation of group information can be found at the beginning of the group presentation in each chapter. This group data is also accompanied by site frequency tables of physical and biotic parameters which aid with interpretation of the PATN groupings (ie landform, surface soil texture, surface strew size and cover and vegetation structure). Frequency of occurrence in the floristic groups determined by PATN was also presented for the vertebrate groups. The index is not particularly meaningful when frequencies are below 5, therefore the indicator spp. index was included. This index takes frequency into account: ie (O-E)/E x frequency in group / total frequency x 100.

The average diversity of species at sites within particular physical and biotic parameter categories are also presented in the chapters for each taxonomic group.

Vegetation Mapping

The rationale and methods for vegetation mapping are detailed in Forward and Robinson (1996). The methods are briefly outlined below to include adaptation of the methods for this study.

Vegetation mapping relied on the interpretation of 1:100000 scale rectified Landsat Thematic Mapper (TM) satellite imagery, with reference to topographic maps, geological maps and some 1:40,000 plus 1:89000 scale colour aerial photographs. Site descriptions for Pastoral Assessment sites and the Flinders Ranges Management Review sites in combination with descriptions from Laut *et al* (1977) and the Land Systems Mapping produced by the Pastoral Managment Branch greatly assisted interpretation. Areas for which survey site data and photographs had been obtained were used to determine how the colours of the TM image related to structural vegetation types. Aerial photographs proved to be the most reliable source for mapping boundaries. Boundaries were then marked directly on the laminated image and extrapolated out to areas not visited as part of the survey.

Structural vegetation types thus mapped were transferred to 1:100000 scale mylar transparent overlays containing cadastral and topographic details and these were then used to digitise the boundaries using ARCINFO software. The resulting polygons were then coded using nineteen structural vegetation categories which were considered applicable across the Copley 1:250000 scale mapsheet. Polygons which contained a tight mosaic of structural vegetation types were coded with a combination of a maximum of three of the nineteen groups. The polygon assumes the colour of the first group coded but is cross hatched to identify its mosaic nature. The code combinations for these groups appear as labels on the maps.

The mapping for this study aimed to map the whole of the Copley 1:250,000 mapsheet SH54-09 at 1:100,000 scale, incorporating existing digitised linework from the Flinders Ranges Management Review (Greenwood *et al* 1989). These areas are depicted in Appendix 13. A small area of the Willouran Ranges in the north-west of the map sheet will be mapped after data has been collected for this area.

RESULTS

VEGETATION

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INTRODUCTION

The vegetation of the North West Flinders Ranges survey area brings together elements of the gibber deserts of the Lake Eyre Basin, arid dunefields and the Flinders Ranges. To a large extent these systems meet in the study area and abut each other with minimal overlap and mixing except where the chenopod shrublands of the foothills merge into undulating stony plains. This situation provides for high local diversity of habitats. These habitats are usually thought of in terms of landform or structural vegetation. In South Australia's arid country this concept usually provides a reasonably effective method for description because the landform, soil types and subsequent structural vegetation communities often form similar identifiable boundaries.

On a broad level the high ranges support shrublands and spinifex *Triodia irritans* hummock grasslands on the ridges which grade into woodlands (Native Pine *Callitris glaucophylla*, Blackoak *Casuarina pauper*), *descending* the slopes. The valleys of the central ranges support a mixture of woodland (Native Pine, Blackoak), mallee (Beaked Red-mallee *Eucalyptus socialis*, Curly Mallee *Eucalyptus gillii*), low shrubland (Bladder Saltbush *Atriplex vesicaria*, twin-leaf *Zygophyllum* spp.) and grassland (spear-grass *Stipa* spp., bottle-washers *Enneopogon* spp.)/herbland communities. Towards the edges of the ranges the rolling foothills mostly support chenopod shrublands sometimes with Blackoak woodland or *Acacia* spp. over *Eremophila* spp. tall shrublands on the slopes. Outliers of the central ranges sometimes support spinifex hummock grassland on the ridge crests, but shrublands, dominated by Rock Emubush *Eremophila freelingii*/Brilliant Hopbush *Dodonaea microzyga* with Silver Mulla Mulla *Ptilotus obovatus* low shrubs and emergent *Senna* spp. and *Acacia* spp., are more typical. Mulga *Acacia aneura* is often an overstorey component of these assemblages. The footslopes and pediments of these last vestiges of the central ranges usually support chenopod low shrublands dominated by both Bladder Saltbush and Low Bluebush *Maireana astrotricha*. On the outwash plains chenopod sub-shrubland (bindyi *Sclerolaena* spp., copperbur *Maireana* spp., saltbush *Atriplex* spp.) and grassland (bottle-washers, Mitchell-grass *Astrebla* spp., wallaby-grass *Danthonia* spp.) dominate. Where these plains act as floodout areas from drainage lines a sparse overstorey of Elegant Wattle *Acacia victoriae* over Blackbush *Maireana pyramidata* low shrublands is usual. Major drainage lines throughout the area are dominated by River Red Gums *Eucalyptus camaldulensis* woodland. Where there is insufficient moisture to maintain the gums, Inland Paper-bark *Melaleuca glomerata* or Elegant Wattle form the overstorey. Where the overstorey peters out Blackbush or Old Man Saltbush *Atriplex nummularia* spp. *nummularia* shrublands dominate. Small saline patches are usually dominated by samphire (*Halosarcia* spp., *Sclerostegia* spp.) low shrublands. Sandy soil areas around drainage lines often support a shrubland of Nitre-bush *Nitraria billardierei*. In the west of the study area the stony pediments disappear under a dunefield dominated by a sparse overstorey of Umbrella Bush *Acacia ligulata* with a Sandhill Canegrass *Zygochloa paradoxa* understorey in the less degraded areas.

The vegetation of the north-west Flinders Ranges has been discussed in the context of overviews of the vegetation of the Flinders Ranges in a number of texts. Kuchel in 'A Field Guide to the Flinders Ranges' (Corbett 1980) discusses the main elements of the northern ranges vegetation through a dominant species and notable species approach based on what can be seen along the main public access routes. A sizeable identification key with diagrams is presented for the amateur naturalist. The most comprehensive summary of the ecology and evolution of the vegetation of the northern Flinders Ranges is contained in the 'Natural History of the Flinders Ranges' (Gell and Bickford 1996).

The consideration of the vegetation of parts of the ranges in an ecological sense was first published by Cannon (1921). This included an overview of the physiography, climate and vegetation within a 15 mile radius of the town of Copley (also central to this study). The book provides the reader with a good overview of the landform and vegetation communities by detailing the vegetation of the: "Alkali plains" supporting halophytes (chenopod shrublands); the "Low hills and slopes" supporting a mixture of halophytic and sclerophyllous shrubs (*Senna-Eremophila-Acacia* spp.); the "washes" supporting Red Gums *Eucalyptus rostrata* (now *E. camaldulensis*), *Melaleuca glomerata* and *Acacia sentis* (now *A. victoriae*). Lists of the dominant and

distinctive species for each habitat group are provided along with discussions of morphology of selected species and how it relates to their function in the environment. Specht (1972) mapped the whole of the Flinders Ranges as a complex dominated by an *Acacia-Eremophila-Dodonaea-Cassia* (*Senna*; current nomenclature) association. Greenwood *et al* (1989) determined floristic communities comparing site specific vegetation data using a cluster analyses program (PATN, Belbin 1989) to group sites with similar species and structural composition. Twenty floristic groups were chosen to represent the floristic communities of the bulk of the central and northern Flinders Ranges. Unfortunately no data was collected from the study area to contribute to this analysis as the Flinders Ranges Management Review for which this work was done was wound down before completion. Gell and Bickford (1996) described how these groups fit the more conventional structural description of 11 associations identified for the Flinders Ranges National Park 60 km south of the study area. The study area overlaps three of the environmental provinces described by Laut *et al* (1977) and fits within five of their mapped environmental associations (Environmental Provinces 6,7 and 8; Environmental Associations 6.2.1, 6.2.7, 6.2.8, 7.2.2, 8.3.5). This report uses an environmental/land unit approach to provide a rough description of the structure and some of the dominant species which are found within each environmental association. Other vegetation work which has been conducted in the area includes the Pastoral Assessment Program which surveys the vegetation at a number of sites across pastoral leases to assess the impact and sustainability of stocking rates. Vegetation sites were also surveyed in the east of the study area for the Flinders Ranges Soil Conservation Board and Pastoral Land Management land systems mapping. This data is stored in the Flinders Ranges Management Review Database (held in the Biological Survey of South Australia Database).

This chapter reports on the findings of the 77 vegetation sites surveyed during December 1997. The information from the Pastoral Management Program sites was not included in our analyses because the information was collected over a variety of seasons and conditions and requires updating and verification to be taxonomically compatible. Similarly the Flinders Ranges Management Review sites were omitted from statistical analysis as the data was collected on smaller 30 m x 30 m quadrats. However, these sites provided the bulk of the information for interpreting the vegetation mapping.

SURVEY COVERAGE

The survey aimed to cover the area within a 40 km radius of Aroona Dam. This involved surveying sites on six pastoral leases and the Leigh Creek coal field lease (Optima Energy). The lease names and the survey site locations are presented on Figure 2. Figure 3 indicates the site coverage of the Pastoral Assessment Program and Figure 4 the Flinders Ranges Management Review.

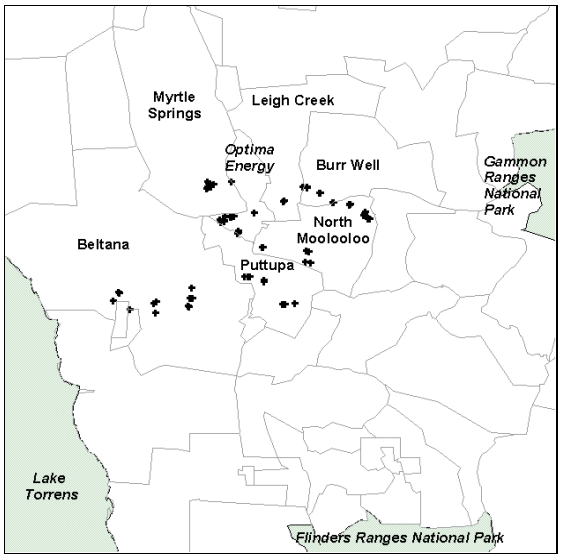


Figure 2. Location of Pastoral Leases and sites.

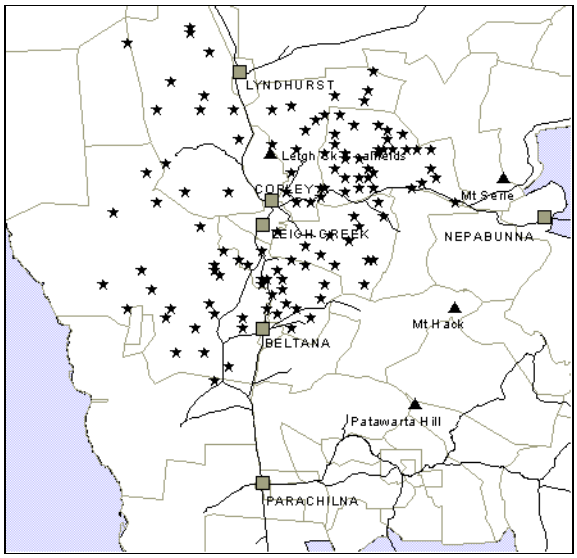


Figure 3. Location of Pastoral Assessment sites.

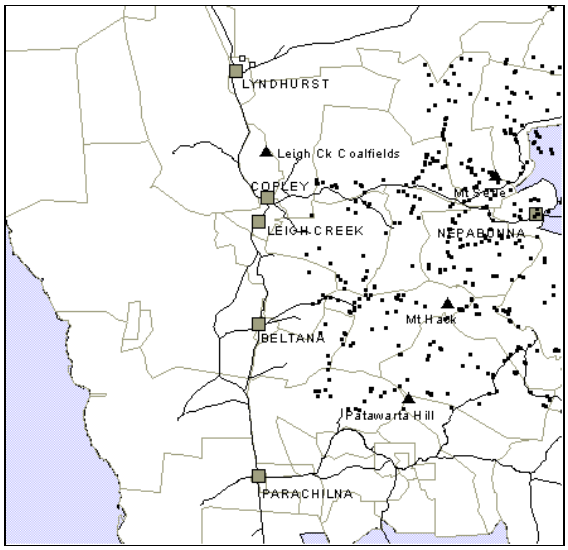


Figure 4. Location of Flinders Management Review sites.

The physical attributes of the North West Flinders Ranges Survey sites have been graphically presented as a percentage of the total survey effort in Figures 5 to 7. The study area is dominated by undulating stony plains and low hills with minor areas of steep ranges, drainage lines and, on the western margin, a dunefield. The survey sites show a bias toward hills and drainage lines. This reflects the attempt to achieve representative sampling from the diversity of habitats in the study area. The extensive stony plains and rises support large areas of similar habitats whilst the other features in the landscape support a higher diversity of habitats for a smaller area.

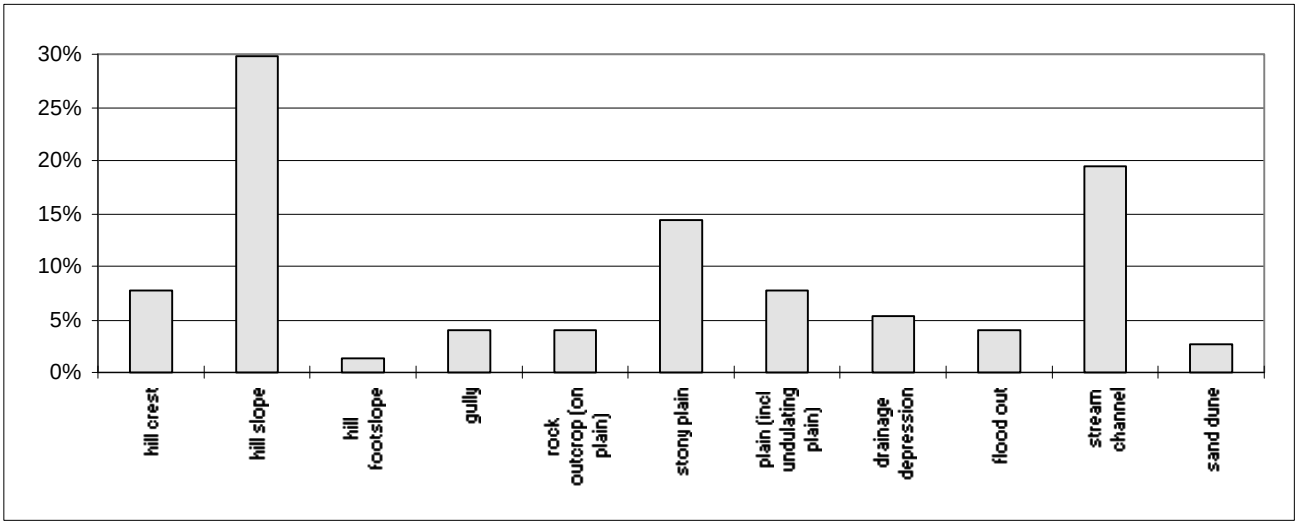


Figure 5. Percentage of sites occurring in landform categories.

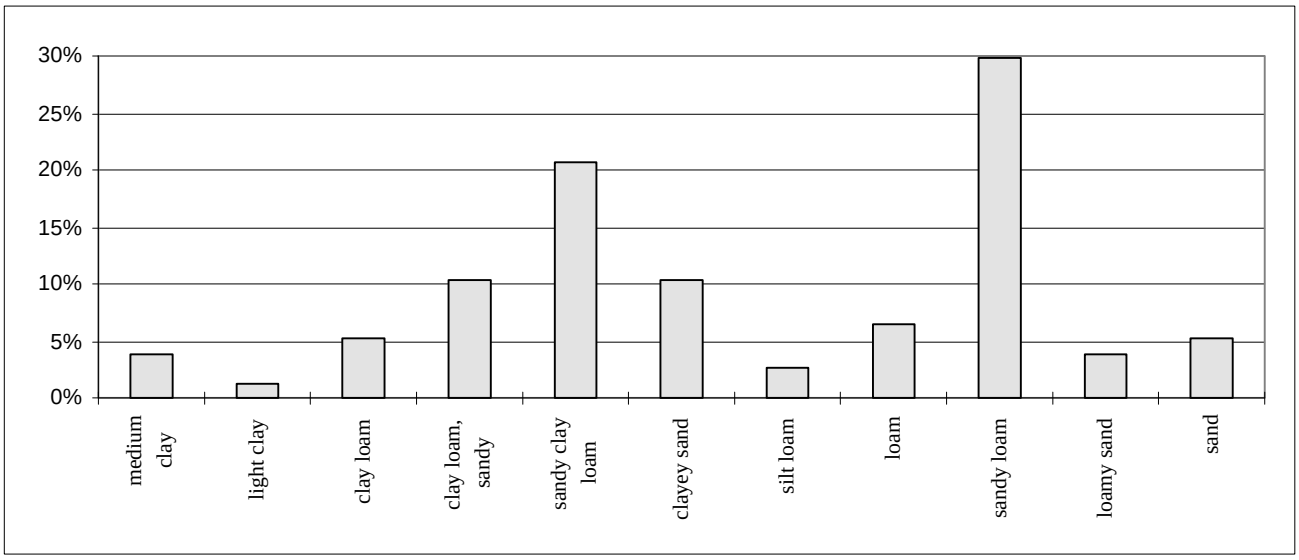


Figure 6. Percentage of sites occurring in surface soil texture categories.

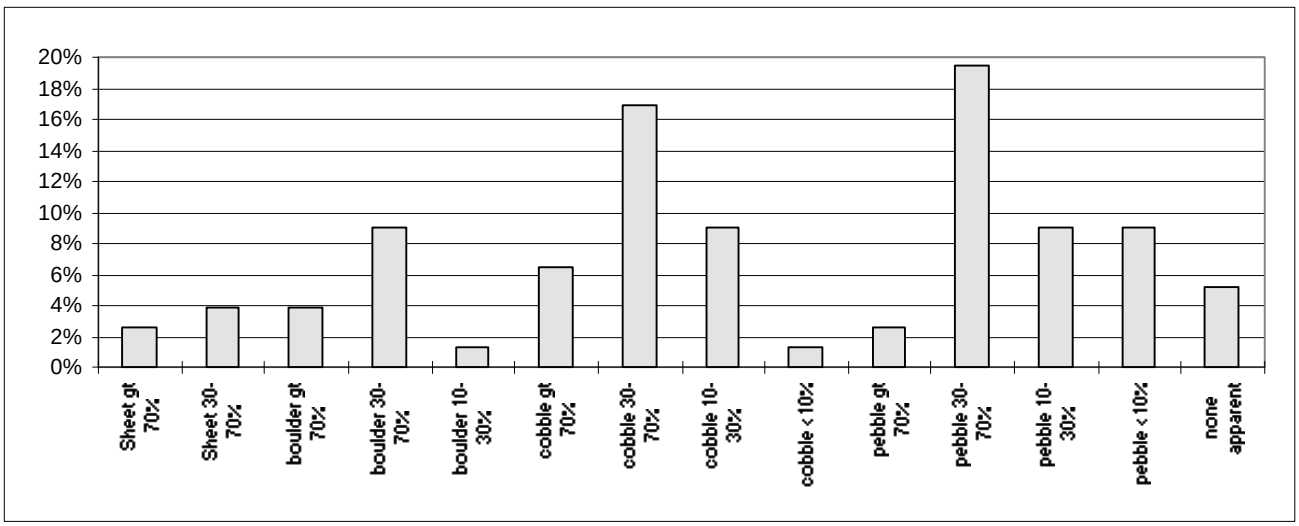


Figure 7. Percentage of sites occurring in surface strew size and cover categories.

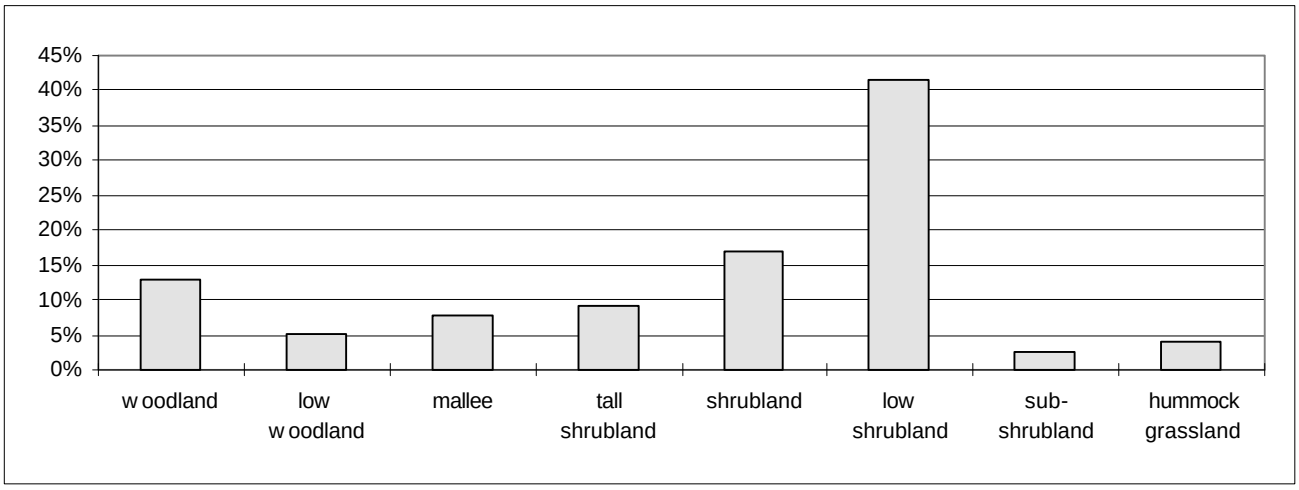


Figure 8. Percentage of sites occurring in dominant structural vegetation categories.

TOTAL SPECIES

The combined surveys have reported 354 distinct taxa for the study area which represents 23% of the 1533 taxa known to occur in the Flinders Ranges botanical region (SA Herbarium records, Jessop 1993). This region ranges from The Bluff near Port Pirie to the northern extent of the Flinders Ranges which varies in rainfall from over 500 mm to less than 200 mm per annum. It is also the most geologically and geographically complex region of South Australia. The study area is only a minor component of this complex which to some extent is reflected in the recorded plant species diversity. A species list incorporating survey efforts tabled can be found in Appendix 2.

Of the 226 taxa recorded for the biological survey 182 species were perennial, with only 45 (20%) species being ephemeral. This probably reflects the dry winter and spring that the region experienced during 1997. Over 55% of species were ephemeral in the stony deserts to the north (Brandle 1998) compared with approximately 35% for the climatically more stable South Olary Plains to the south-east (Forward 1996). The 26 introduced species represent 12% of the species recorded. This compares with 6% in the stony deserts and 15% in the South Olary Plains. Relatively few conservation rated species were detected, three species had Australian conservation ratings and a further three are rated as poorly known in South Australia.

Survey	Number of Species	Number of. Sites	Average sp/site	Max sp. at a site	Min sp. at a site
North West Flinders Ranges Biological Survey	226	77	21.4	50	7
Pastoral Assessment Program	264	126	17.4	50	3
Flinders Ranges Management Review (R. Playfair)	99	54	9.4	20	3

Table 3. Vegetation surveys summaries.

COMMON SPECIES

Only 10 (4%) species occurred at more than 40% of sites which reflects the high diversity of habitat in the region (Table 4). These species are also common within sites and are considered dominant or sub-dominant species in a number of vegetation communities. All are perennial low shrubs with the exception of Elegant Wattle. Bladder Saltbush is probably the most adaptable species occurring in the majority of habitats in the study area, but dominant on hill slopes and stony plains. The dry conditions prior to the survey decreased the detectability of ephemeral species which could be expected to feature at many sites following productive rainfall.

SPECIES	COMMON NAME	LIFESPAN	TOTAL SITE FREQUENCY
Atriplex vesicaria	bladder saltbush	P	48
Ptilotus obovatus	silver mulla mulla	P	47
Enchylaena tomentosa	ruby saltbush	P	46
Rhagodia spinescens	spiny saltbush	P	44
Maireana astrotricha	low bluebush	P	41
Solanum ellipticum	velvet potato-bush	P	40
Acacia victoriae	elegant wattle	P	38
Maireana pyramidata	black bluebush	P	38
Sida petrophila	rock sida	P	36
Eremophila freelingii	rock emubush	P	35

Table 4. Plant species recorded at > 40% of sites sampled.

FLORISTIC COMMUNITIES

Of the 226 distinct plant taxa recorded for the survey, 173 were retained for the floristic analysis. Species which were recorded at only one site were masked out to simplify the analysis. These are marked with a "#" symbol in the species list (Appendix v2). The following dendrogram indicates the similarity of floristics between sites. Fourteen groups were chosen as they appear to best reflect the dominant structural vegetation patterns identifiable from the survey sites.

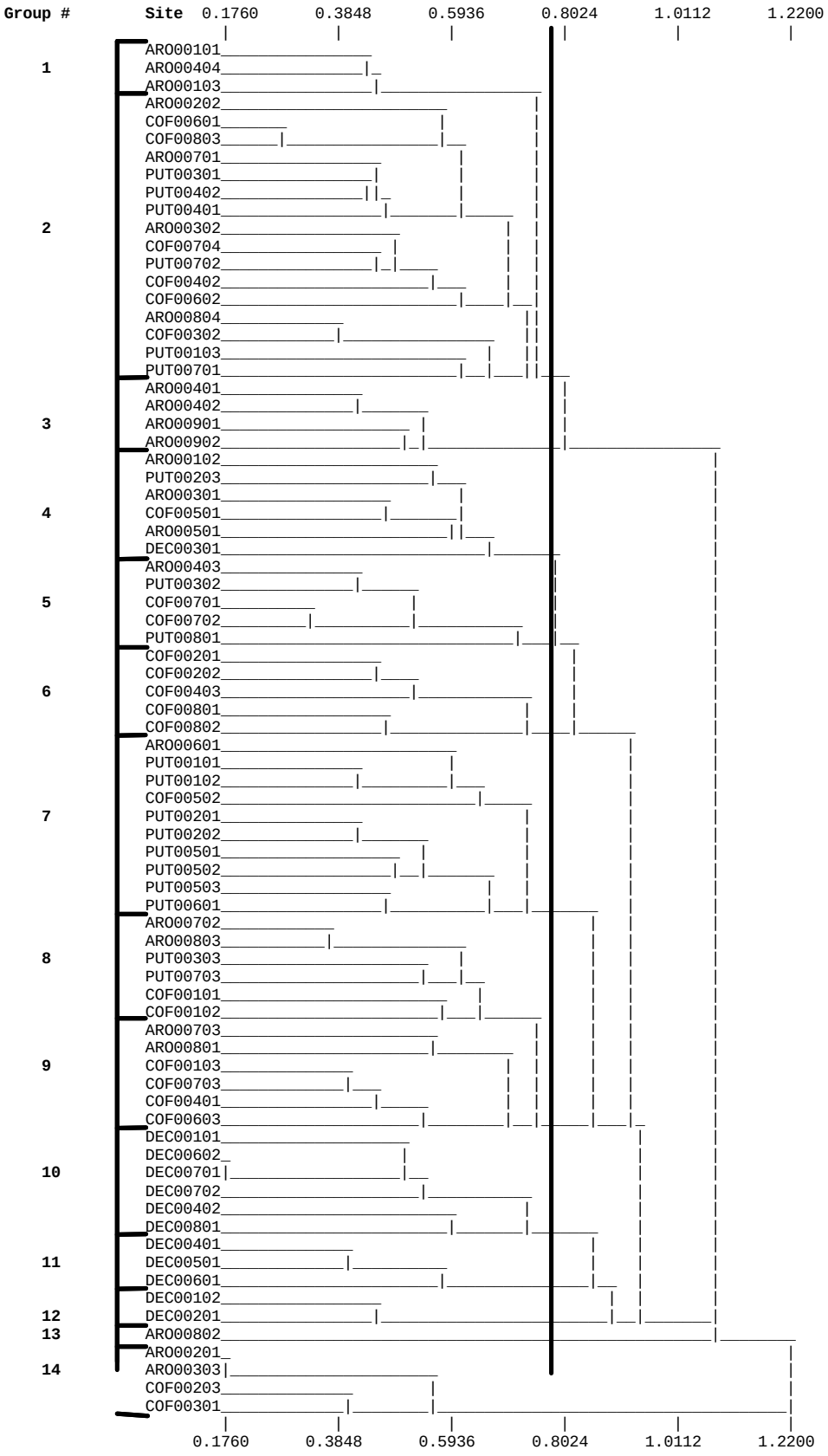
Interpretation of Dendrogram

The first three groups cover the rocky hill slopes of the study area. Group 1 contains a variety of mid to low shrubs with or without an overstorey of low trees and is mostly on the steeper rockiest slopes. Group 2 varies from this in supporting a lower shrub strata with a similar overstorey mix and is the most common hill slope and hill crest vegetation type. Group 3 is restricted to the highest ranges and supports the majority of the spinifex hummock grassland in the study area. Group 4 marks the transition to Bladder Saltbush chenopod shrublands which dominate the low hills and plains of the region. Groups 5 and 6 represent variations on these chenopod shrublands with emergent low trees and shrubs, and occur mostly on lower hill slopes. Group 6 includes the majority of the Blackoak woodland sites. Group 7 represents the first of the drainage/run-on associated habitats which comprise the highest species diversity habitats due to the concentration of moisture and nutrients. Introduced weed species also become a more significant feature of these groups. Group 7 is characteristic of flood plains and drainage depressions on plains supporting a denser chenopod shrub layer and emergent tall shrubs or low trees with a more diverse herbaceous understorey. This group also contains the Low Bluebush/ Bladder Saltbush chenopod shrubland on stony plains sites which were least affected by grazing. Group 8 tall shrublands are more closely related to the more regularly watered floodplains and drainage lines than Group 7. Group 9 is characteristic of major stream channels, the key indicator being a River Red Gum woodland. The Group 10 tall shrublands are typical of the slopes and minor drainage lines of the ranges in the south-western parts of the study area whilst Group 11 represents the open low shrublands and grasslands of the Mt Deception Range outwash plains. This group is strongly associated with stony desert habitats to the north of the study area. Group 12 tall shrublands represent the sandy dunefield to the west of the study area. The permanent wetland Group 13 is a variation of Group 9 with a sedge understorey and is rare in the study area occurring only in creek lines at natural springs and seepage outflow down stream from Aroona Dam. The Group 14 Beaked Red Mallee community occurs on calcareous soils and is restricted to valleys and hill slopes associated with major ranges.

How these assemblages relate to the landform, soil and structural vegetation groups are summarised in Table 5.

	Floristic Groups	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Landform	hill crest		31	25											
	hill slope	**100**	**38**	25	17	**60**	**80**				**50**				**50**
	hill footslope								17						
	rock outcrop (on plain)		19												
	gully			25							17				25
	stony plain		6		33	40		20	17			**100**			
	plain (incl undulating plain)				**50**			10	17						25
	drainage depression						20	10			33				
	flood out							30							
	stream channel		6	25				30	**50**	**100**				**100**	
	dune/consolidated dune												**100**		
Surface soil	medium clay					20		10				33			
	light clay					20									
	clay loam		6					20	17						
	clay loam, sandy	33	13	25	17						33	33			
	sandy clay loam	**67**	25	25	**33**	**40**	20			33					**50**
	clayey sand				17			10		**50**		33		**100**	25
	silt loam				17		20								
	loam		25					10							
	sandy loam		25	25	17	20	**60**	**40**	**83**	17	33				25
	loamy sand		6								33				
	sand			25				10					**100**		
Structural description	woodland			25				20	17	**83**				**100**	
	mallee	33	6												**100**
	low woodland	33		25			20		17		17				
	tall shrubland							20	**33**		17		**100**		
	shrubland		38				20		17	17	**50**	33			
	low shrubland	33	**50**		**100**	**80**	**60**	**60**	17		17	33			
	sub-shrubland					20						33			
	hummock grassland		6	**50**											

Table 5. A summary of the relationship of the floristic groups to habitat parameters. The number of sites in each group are presented against habitat parameters as percentages.



Dissimilarity index

Figure 9. Dendrogram from PATN analysis of vegetation presence/absence data. The solid vertical line indicates the cut-off level for the fourteen groups used to describe the vegetation associations.

Full details of the floristic assemblages defined using PATN follow and are presented in the order described below:

- Group number, title and a brief description of the group including which structural vegetation map groups it relates to;

- the number of sites within the group;

- the number of species used in the analyses which define the group;

- the number of species which were masked out of the analysis because they were only recorded at one site during the survey or were not identified to species level;

- the average number of all species recorded for the group including the maximum and minimum species richness recorded at sites within the group;

- the number of perennial species recorded for all sites comprising the group and the average number of perennial species per site for the group;

- the number of introduced species contributing to the group;

- a list of the sites forming the group and a map showing their location relative to towns, roads and drainage features;

- Species in >30% of sites - the species detected most often within each group:
  Column 1 - species scientific names are listed in order of decreasing indicator species values.
  Column 2 - species common names. An asterisk (*) following the name indicates introduced species.
  Column 3 - presents the percentage of the sites at which a species was recorded.
  Column 4 - O-E/E represents the relative importance of a species to the group. Indicator species are highlighted by their greater proportion of occurrence in the group than would be expected through chance alone (O = observed frequency and E = the expected frequency if the species was randomly distributed through all groups).
  Column 5 - indicator spp. is derived from the 0-E/E value which is multiplied by the ratio of the species frequency within the group to the total frequency of all species within the group multiplied by 100 ([0-E/E] x [freq. of sp.]/[total freq. of sp.] x 100). This formula decreases the bias the 0-E/E formula gives to infrequently encountered species by taking into account the number of sites a species occurs in within the group. This column was used to sort the species from highest to lowest indicator species value.
  Column 6 - presents the total number of sites within the group in which the species was recorded.
  Column 7 - presents the occurrence of species when all sites are considered. This provides an indication of how common a species was throughout the survey area.
  Column 8 - presents the occurrence of a species in other groups which helps to assess the importance of a species to that group;

- Less common indicator species that have 'indicator species' values greater than 0 are presented in columns identical to the above section;

- tables of physical parameters recorded. These include - landform description, surface soil texture description, surface strew (stone) size and cover descriptions, dominant vegetation structure classification and dominant overstorey species. These are presented as frequency tables accompanied by observed minus expected frequency values to help in evaluating which elements are most unique to the group.

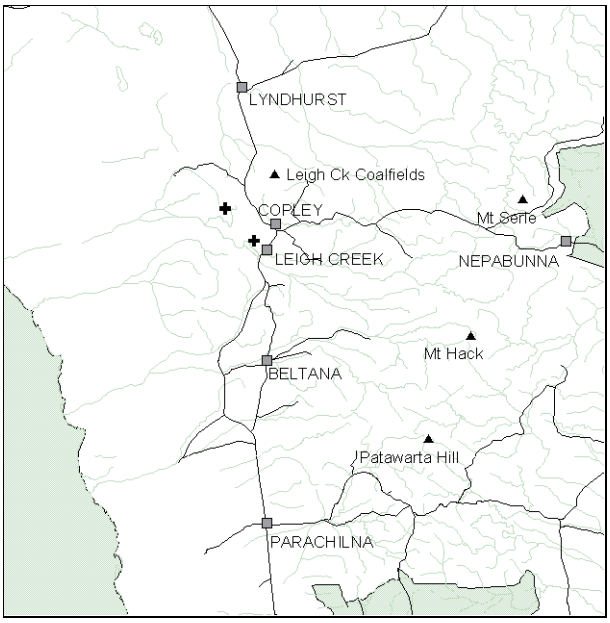
Group 1: *Dodonea microzyga, Rhagodia ulicina* and *Maireana sedifolia*, low shrubland with emergent *Myoporum platycarpum* with or without an open overstorey of *Eucalyptus socialis* or *Casuarina pauper*.

Mixed tall to low shrubland containing Brilliant Hop-bush, Broad-leaf Desert Senna and Rock Emubush over low shrubs including Intricate Saltbush, Low Bluebush, Pearl Bluebush and Silver Mulla Mulla with emergent False Sandalwood and other low woodland species. Occurs on lower hillslopes of steep ridges such as the Aroona Range with moderately cobbled sandy clay loam surface soils. Important indicator species include the Spiny Fanflower, Radiate Bluebush, Umbrella Wattle and Cotton Panic-grass. This assemblage presents a complex of structural vegetation map groups and best fits 12, 14 and 15.

Number of sites in group:	**3**				
Number of species in group:	**30**				
Number of species not used in analysis:	**1**				
Average number of species at sites:	**17.7**	**Max.**	**19**	**Min.**	**17**
Number of perennial species in group:	**29**	**Ave.**	**17.3**		
Number of introduced species in group:	**1**	**Ave.**	**1**		

Sites

ARO00101 ARO00404 ARO00103



Species at > 30% of sites	Common name	% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Rhagodia ulicina	intricate saltbush	100	14.1	6.1	3	6	3
Scaevola spinescens	spiny fanflower	67	19.1	5.5	2	3	2
Myoporum platycarpum	false sandalwood	100	11.9	5.2	3	7	5
Dodonaea microzyga microzyga	brilliant hop-bush	100	8	3.5	3	10	4
Maireana radiata	radiate bluebush	67	9.1	2.6	2	6	4
Acacia oswaldii	umbrella wattle	33	14.1	2.0	1	2	2
Digitaria brownii	cotton panic-grass	33	14.1	2.0	1	2	2
Senna artemisioides coriacea	broad-leaf desert senna	100	4.3	1.9	3	17	8
Maireana erioclada	rosy bluebush	67	5	1.4	2	10	4
Maireana sedifolia	pearl bluebush	67	4	1.2	2	12	5
Eremophila freelingii	rock emubush	100	1.6	0.7	3	35	11
Eremophila oppositifolia	opposite-leaved emubush	33	4	0.6	1	6	4
Maireana ovata		33	4	0.6	1	6	3
Maireana astrotricha	low bluebush	100	1.2	0.5	3	41	12
Eucalyptus socialis	beaked red mallee	33	3.3	0.5	1	7	4
Maireana georgei	satiny bluebush	33	2.8	0.4	1	8	6
Ptilotus obovatus	silver mulla mulla	100	0.9	0.4	3	47	11

Alectryon oleifolius canescens	bullock bush	67	1.3	0.4	2	26	9
Sclerolaena obliquicuspis	oblique-spined bindyi	67	1.3	0.4	2	26	7
Sauropus rigens	stiff spurge	33	1.7	0.2	1	11	2
Sclerolaena diacantha	grey bindyi	33	1.7	0.2	1	11	4
Carrichtera annua	Ward's weed	33	1.2	0.2	1	14	6
Solanum ellipticum	velvet potato-bush	67	0.5	0.1	2	40	8
Senna artemisioides artemisioides	silver senna	33	0.9	0.1	1	16	6
Eremophila alternifolia	narrow-leaf emubush	33	0.7	0.1	1	18	7
Atriplex vesicaria	bladder saltbush	67	0.3	0.1	2	48	11
Casuarina pauper	black oak	33	0.5	0.1	1	20	8
Sclerolaena ventricosa	salt bindyi	33	0.5	0.1	1	20	7
Acacia victoriae	elegant wattle	33	-0.2	0.0	1	38	10
Maireana pyramidata	black bluebush	33	-0.2	0.0	1	38	11

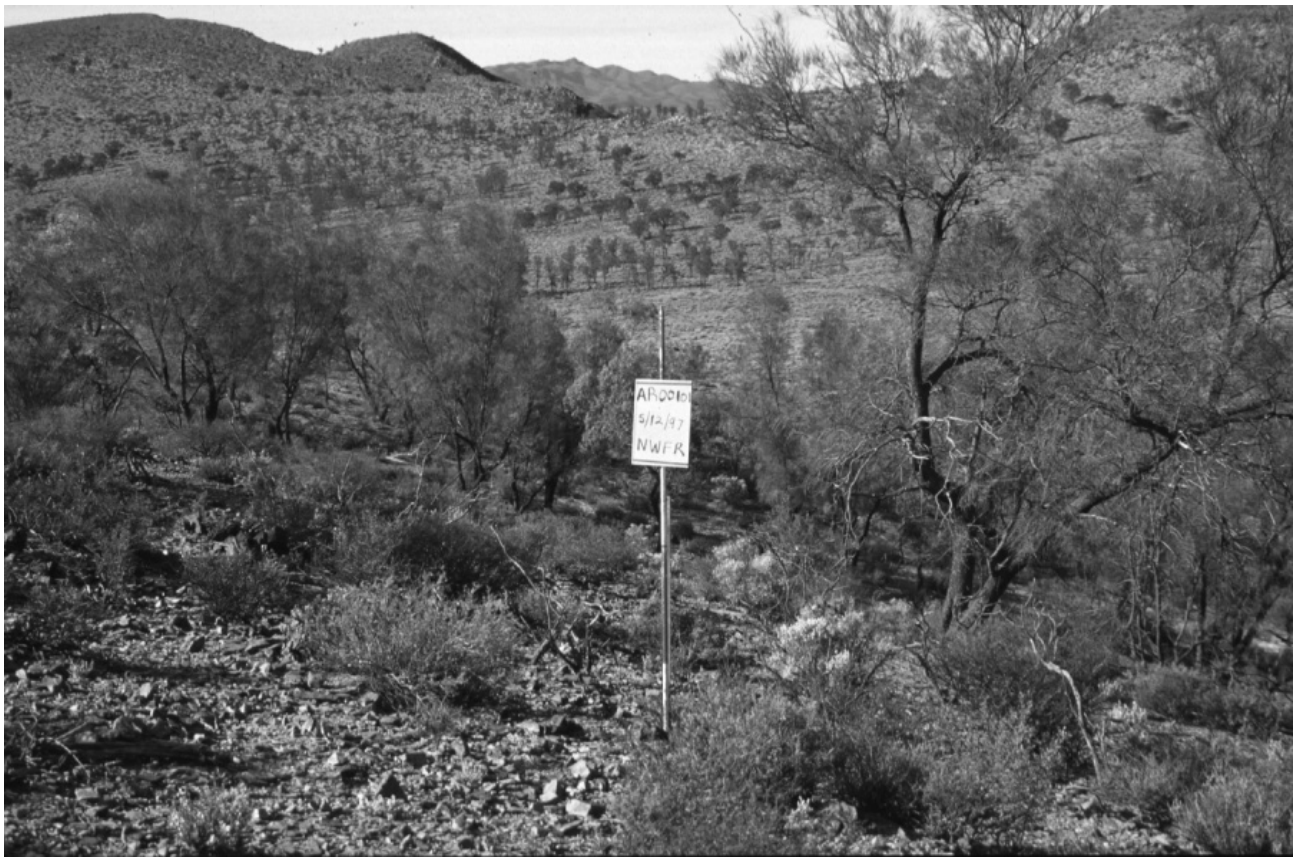
Landform	**Frequency**	**O-E**
hill slope	3	2.10

Surface soil	**Frequency**	**O-E**
sandy clay loam	2	1.38
clay loam, sandy	1	0.69

Strew	**Frequency**	**O-E**
cobble (51-250mm) 30-70%	3	2.49

Structural description	**Frequency**	**O-E**
low woodland	1	7.03
mallee	1	4.26
low shrubland	1	-0.26

Dominant Overstorey Species	**Frequency**
Casuarina pauper	1
Dodonaea microzyga	1
Eucalyptus socialis	1



Site ARO 001 01 in the Aroona Range. Blackoak overstorey.

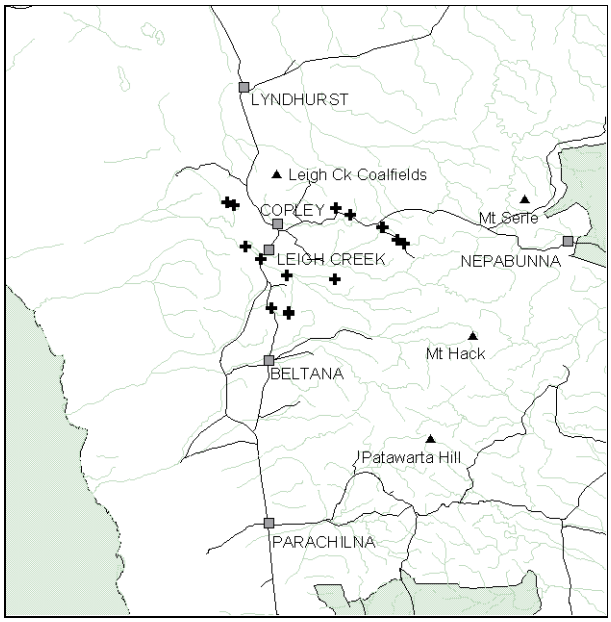
Group 2: *Ptilotus obovatus, Sida petrophila, Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.

Low to medium shrublands supporting Velvet Potato-bush, Rock Sida, Silver Mulla Mulla, Rock Emubush and Bladder Saltbush. Emergent species include Silver Senna, Narrow-leaf Emubush, Dead Finish, Mulga, Bullock Bush and Blackoak. Occurs mostly on hillslopes, crests and rocky outcrops on a variety of rocky loam surface soils. Important indicator species include the Stiff Spurge, Woolly Cloak-fern, Hairy-fruit Bluebush, Pearl Bluebush and Striated Mintbush. This assemblage relates mostly to structural vegetation map group 12.

Number of sites in group:	**16**				
Number of species in group:	**85**				
Number of species not used in analysis:	**12**				
Average number of species at sites:	**19.1**	**Max.**	**29**	**Min.**	**9**
Number of perennial species in group:	**81**	**Ave.**	**18.5**		
Number of introduced species in group:	**1**	**Ave.**	**1.1**		

Sites

ARO00202	COF00601	COF00803	ARO00701
PUT00301	PUT00402	PUT00401	ARO00302
COF00704	PUT00702	COF00402	COF00602
ARO00804	COF00302	PUT00103	PUT00701



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Sauropus rigens	stiff spurge	63	3.9	5.7	10	11	2
Cheilanthes lasiophylla	woolly cloak-fern	44	2.7	2.7	7	10	2
Solanum ellipticum	velvet potato-bush	100	1.1	2.6	16	40	8
Sida petrophila	rock sida	88	1.1	2.2	14	36	9
Maireana sedifolia	pearl bluebush	44	2.1	2.1	7	12	5
Prostanthera striatiflora	striated mintbush	31	2.8	2.0	5	7	3
Senna artemisioides artemisioides	silver senna	50	1.7	2.0	8	16	6
Dodonaea lobulata	lobed-leaf hop-bush	38	2.2	1.9	6	10	5
Eremophila freelingii	rock emubush	81	1	1.9	13	35	11
Sclerolaena diacantha	grey bindyi	38	1.9	1.7	6	11	4
Eremophila alternifolia	narrow-leaf emubush	50	1.4	1.6	8	18	7
Exocarpos aphyllus	leafless cherry	38	1.7	1.5	6	12	4
Ptilotus obovatus	silver mulla mulla	88	0.6	1.2	14	47	11
Solanum sturtianum	Sturt's nightshade	44	1.1	1.1	7	18	6
Acacia aneura	mulga	31	1.1	0.8	5	13	5
Maireana astrotricha	low bluebush	69	0.4	0.6	11	41	12
Atriplex vesicaria	bladder saltbush	75	0.3	0.5	12	48	11
Acacia tetragonophylla	dead finish	44	0.4	0.4	7	27	9
Sclerolaena obliquicuspis	oblique-spined bindyi	38	0.2	0.2	6	26	7
Alectryon oleifolius canescens	bullock bush	31	0	0.0	5	26	9
Enchylaena tomentosa	ruby saltbush	50	-0.1	-0.1	8	46	13

Maireana pyramidata	black bluebush	31	-0.3	-0.2	5	38	11
Rhagodia spinescens	spiny saltbush	38	-0.3	-0.3	6	44	11

Species at < 30% of sites with indicator value > 0		**% of sites in group**	**O-E/E**	**indicator spp.**	**Frequency in group**	**frequency all sites**	**occurrence in groups**
Maireana trichoptera	hairy-fruit bluebush	25	4.4	2.6	4	4	1
Eremophila latrobei	crimson emubush	13	4.4	1.3	2	2	1
Olearia decurrens	winged daisy-bush	13	4.4	1.3	2	2	1
Rhyncharrhena linearis	climbing purple-star	13	4.4	1.3	2	2	1
Stipa scabra	rough spear-grass	13	4.4	1.3	2	2	1
Zygophyllum confluens	forked twinleaf	13	4.4	1.3	2	2	1
Abutilon fraseri	dwarf lantern-bush	19	1.7	0.7	3	6	3
Dodonaea microzyga microzyga	brilliant hop-bush	25	1.1	0.6	4	10	4
Danthonia caespitosa	common wallaby-grass	13	1.1	0.3	2	5	3
Pittosporum phylliraeoides microcarpa	native apricot	13	1.1	0.3	2	5	3
Maireana erioclada	rosy bluebush	19	0.6	0.3	3	10	4
Amyema maidenii maidenii	pale-leaf mistletoe	6	1.7	0.2	1	2	2
Anemocarpa podolepidium	rock everlasting	6	1.7	0.2	1	2	2
Brachycome ciliaris ciliaris	variable daisy	6	1.7	0.2	1	2	2
Bromus arenarius	sand brome	6	1.7	0.2	1	2	2
Digitaria brownii	cotton panic-grass	6	1.7	0.2	1	2	2
Enneapogon cylindricus	jointed bottle-washers	6	1.7	0.2	1	2	2
Euphorbia tannensis eremophila	desert spurge	6	1.7	0.2	1	2	2
Melaleuca lanceolata lanceolata	dryland tea-tree	6	1.7	0.2	1	2	2
Rhagodia ulicina	intricate saltbush	13	0.8	0.2	2	6	3
Sida fibulifera	pin sida	19	0.5	0.2	3	11	5
Lepidium sp.	Peppercress	6	0.8	0.1	1	3	3
Senna artemisioides sturtii	grey senna	6	0.8	0.1	1	3	3
Maireana georgei	satiny bluebush	13	0.3	0.1	2	8	6
Casuarina pauper	black oak	25	0.1	0.1	4	20	8

Landform	**Frequency**	**O-E**
hill slope	6	1.22
hill crest	5	3.75
rock outcrop (on plain)	3	2.38
stream channel	1	0.17
stony plain	1	-1.29

Surface soil	**Frequency**	**O-E**
sandy clay loam	4	0.68
loam	4	2.96
sandy loam	4	-0.78
clay loam, sandy	2	0.34
clay loam	1	0.17
loamy sand	1	0.38

Strew	**Frequency**	**O-E**
boulder (gt 250mm) 30-70%	4	2.55
cobble (51-250mm) gt 70%	4	2.96
Sheet 30-70%	3	2.38
boulder (gt 250mm) gt 70%	2	1.38
cobble (51-250mm) 10-30%	2	0.55
cobble (51-250mm) 30-70%	1	-1.70

Structural description	**Frequency**	**O-E**
low shrubland	8	2.11
shrubland	6	9.52
mallee	1	-0.26
hummock grassland	1	0.78

Dominant Overstorey Species	**Frequency**
Eremophila freelingii	3
Atriplex vesicaria/Maireana astrotricha	2
Sida petrophila	2
Casuarina pauper	1
Acacia aneura	1
Atriplex vesicaria	1
Eucalyptus socialis/E. Intertexta	1
Maireana astrotricha	1
Maireana astrotricha/Atriplex vesicaria	1
Maireana sedifolia/Eremophila latrobei	1
Maireana sedifolia/Ptilotus obovatus	1
Triodia irritans	1

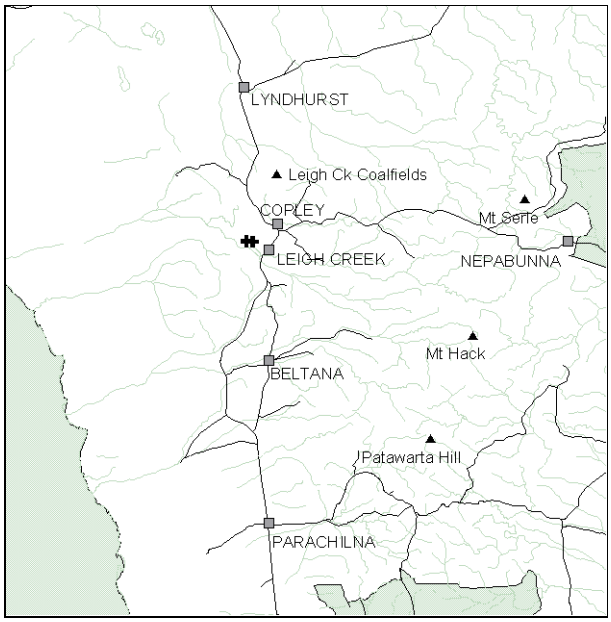
Group 3: *Triodia irritans* hummock grassland with a *Casuarina pauper* sparse to open low woodland.

Spinifex hummock grassland with a sparse to emergent Blackoak low open woodland with Velvet Potato-bush, Silver Mulla Mulla, Ruby Saltbush low shrubs and emergent Silver Senna shrubs plus Bullock Bush low trees. Occurs on hill slopes, crests and drainage lines of steep quartzite ranges with very rocky loam to sand surface soils. Within the study area this group was confined to the Aroona Range and possibly the crest of the Bayley Range. Important indicator species include Pointed Twinleaf, Pink Mulla Mulla and Flinders Ranges Corkwood. This assemblage best reflects structural vegetation map group 13.

Number of sites in group:	**4**				
Number of species in group:	**56**				
Number of species not used in analysis:	**8**				
Average number of species at sites:	**28.3**	**Max.**	**34**	**Min.**	**24**
Number of perennial species in group:	**48**	**Ave.**	**7**		
Number of introduced species in group:	**7**	**Ave.**	**4**		

Sites

ARO00401 ARO00402 ARO00901 ARO00902



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Triodia irritans	spinifex	100	10.9	6.3	4	5	2
Zygophyllum apiculatum	pointed twinleaf	50	13.9	4.0	2	2	1
Ptilotus exaltatus	pink mulla mulla	75	8	3.5	3	5	3
Hakea ednieana	Flinders Ranges corkwood	50	6.5	1.9	2	4	3
Senna artemisioides artemisioides	silver senna	100	2.7	1.6	4	16	6
Cheilanthes lasiophylla	woolly cloak-fern	75	3.5	1.5	3	10	2
Exocarpos aphyllus	leafless cherry	75	2.7	1.2	3	12	4
Casuarina pauper	black oak	100	2	1.2	4	20	8
Sclerolaena lanicuspis	spinach bindyi	50	4	1.2	2	6	4
Sclerolaena longicuspis	long-spine bindyi	75	2.4	1.0	3	13	9
Myoporum montanum	native myrtle	50	2.7	0.8	2	8	6
Alectryon oleifolius canescens	bullock bush	100	1.3	0.8	4	26	9
Senna artemisioides coriacea	broad-leaf desert senna	75	1.6	0.7	3	17	8
Eremophila alternifolia	narrow-leaf emubush	75	1.5	0.7	3	18	7
Oxalis perennans	native sorrel	50	2	0.6	2	10	4
Sclerolaena diacantha	grey bindyi	50	1.7	0.5	2	11	4
Acacia aneura	mulga	50	1.3	0.4	2	13	5
Abutilon leucopetalum	desert lantern-bush	50	1.1	0.3	2	14	6
Carrichtera annua	Ward's weed	50	1.1	0.3	2	14	6
Frankenia serpyllifolia	thyme sea-heath	50	1.1	0.3	2	14	7
Solanum ellipticum	velvet potato-bush	100	0.5	0.3	4	40	8

Solanum sturtianum	Sturt's nightshade	50	0.7	0.2	2	18	6
Enchylaena tomentosa	ruby saltbush	100	0.3	0.2	4	46	13
Ptilotus obovatus	silver mulla mulla	100	0.3	0.2	4	47	11
Eremophila freelingii	rock emubush	75	0.3	0.1	3	35	11
Acacia victoriae	elegant wattle	75	0.2	0.1	3	38	10
Sida petrophila	rock sida	50	-0.2	-0.1	2	36	9

Species at < 30% of sites with indicator value > 0		**% of sites in group**	**O-E/E**	**indicator spp.**	**Frequency in group**	**frequency all sites**	**occurrence in groups**
Anagallis arvensis	pimpernel*	25	6.5	0.9	1	2	2
Callitris glaucophylla	white cypress-pine	25	6.5	0.9	1	2	2
Chrysocephalum semicalvum	hill button-bush	25	6.5	0.9	1	2	2
Eremophila glabra	tar bush	25	6.5	0.9	1	2	2
Euphorbia tannensis eremophila	desert spurge	25	6.5	0.9	1	2	2
Senna artemisioides filifolia	fine-leaf desert senna	25	6.5	0.9	1	2	2
Datura leichhardtii	native thorn-apple	25	4	0.6	1	3	3
Dodonaea viscosa angustissima	sticky hop-bush	25	4	0.6	1	3	3
Portulaca oleracea	common purslane	25	2.7	0.4	1	4	3
Danthonia caespitosa	common wallaby-grass	25	2	0.3	1	5	3
Sisymbrium erysimoides	smooth mustard	25	2	0.3	1	5	4
Eremophila scoparia	broom emubush	25	1.5	0.2	1	6	3
Nicotiana glauca	tree tobacco*	25	1.5	0.2	1	6	4
Nicotiana velutina	velvet tobacco	25	1.5	0.2	1	6	3
Rhagodia ulicina	intricate saltbush	25	1.5	0.2	1	6	3
Eucalyptus socialis	beaked red mallee	25	1.1	0.2	1	7	4
Citrullus colocynthis	colocynth*	25	0.9	0.1	1	8	4
Marrubium vulgare	horehound*	25	0.7	0.1	1	9	3
Sclerolaena cuneata	tangled bindyi	25	0.7	0.1	1	9	6
Dodonaea lobulata	lobed-leaf hop-bush	25	0.5	0.1	1	10	5
Pterocaulon sphacelatum	apple-bush	25	0.4	0.1	1	11	4

Landform	**Frequency**	**O-E**
gully	1	0.84
stream channel	1	0.79
hill crest	1	0.69
hill slope	1	-0.19

Surface soil	**Frequency**	**O-E**
sand	1	0.79
clay loam, sandy	1	0.58
sandy clay loam	1	0.17
sandy loam	1	-0.19

Strew	**Frequency**	**O-E**
Sheet gt 70%	1	0.95
boulder (gt 250mm) gt 70%	1	0.84
cobble (51-250mm) 30-70%	1	0.32
pebble (5-50mm) 30-70%	1	0.22

Structural description	**Frequency**	**O-E**
hummock grassland	2	1.84
low woodland	1	0.79
woodland	1	0.48

Dominant Overstorey Species	**Frequency**
Triodia irritans	2
Casuarina pauper	1
Eucalyptus camaldulensis	1

Site ARO 009 01 in the Aroona Range near Aroona Dam. Spinifex hummock grassland.

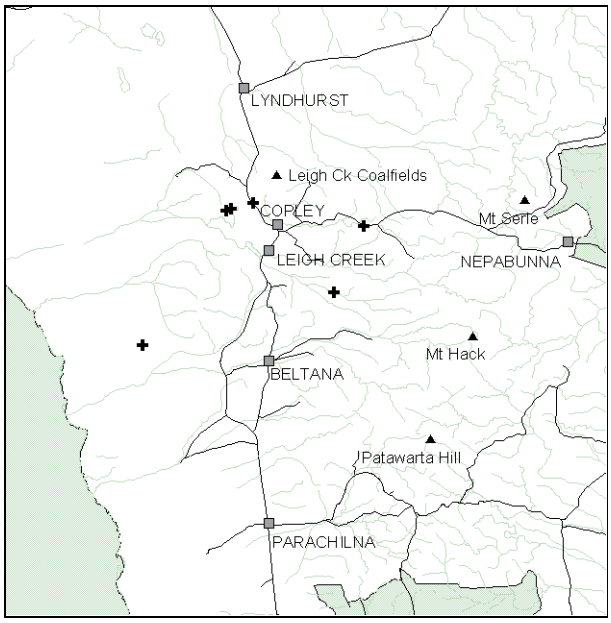
Group 4: *Atriplex vesicaria, Maireana astrotricha* low shrubland.

Low shrubland of Bladder Saltbush and Low Bluebush over Oblique-spined Bindyi and other chenopods. This community may support emergent Elegant Wattle and False Sandalwood in drainage depressions and is characteristic of undulating plains containing sandy clay-loam soils, usually with a sparse covering of cobbles or pebbles. Important indicator species include the Woolly Variable Daisy, Leafy Bottle-washers, Pearl and Salt Bindyi. This assemblage contributes to structural vegetation map group 8.

Number of sites in group:	**6**				
Number of species in group:	**50**				
Number of species not used in analysis:	**4**				
Average number of species at sites:	**16**	**Max.**	**25**	**Min.**	**11**
Number of perennial species in group:	**46**	**Ave.**	**14.2**		
Number of introduced species in group:	**1**	**Ave.**	**1**		

Sites

ARO00102 PUT00203 ARO00301 COF00501
ARO00501 DEC00301



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Sclerolaena brachyptera	short-wing bindyi	83	3.5	2.5	5	19	6
Sclerolaena obliquicuspis	oblique-spined bindyi	100	2.9	2.5	6	26	7
Brachycome ciliaris lanuginosa	woolly variable daisy	33	7.5	2.2	2	4	3
Enneapogon polyphyllus	leafy bottle-washers	83	2	1.4	5	28	9
Sclerolaena limbata	pearl bindyi	50	3.3	1.4	3	12	8
Sclerolaena ventricosa	salt bindyi	67	2.4	1.4	4	20	7
Maireana astrotricha	low bluebush	100	1.5	1.3	6	41	12
Atriplex vesicaria	bladder saltbush	100	1.1	1.0	6	48	11
Sclerolaena cuneata	tangled bindyi	33	2.8	0.8	2	9	6
Sida fibulifera	pin sida	33	2.1	0.6	2	11	5
Salsola kali	buckbush	33	1.8	0.5	2	12	7
Acacia victoriae	elegant wattle	67	0.8	0.5	4	38	10
Maireana pyramidata	black bluebush	67	0.8	0.5	4	38	11
Sclerolaena longicuspis	long-spine bindyi	33	1.6	0.5	2	13	9
Rhagodia spinescens	spiny saltbush	33	-0.2	-0.1	2	44	11
Enchylaena tomentosa	ruby saltbush	33	-0.3	-0.1	2	46	13
Ptilotus obovatus	silver mulla mulla	33	-0.3	-0.1	2	47	11

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Atriplex fissivalvis	gibber saltbush	17	7.5	1.1	1	2	2
Dissocarpus biflorus	two-horn saltbush	17	7.5	1.1	1	2	2
Enneapogon cylindricus	jointed bottle-washers	17	7.5	1.1	1	2	2

Gunniopsis quadrifida	Sturt's pigface	17	7.5	1.1	1	2	2
Ixiolaena leptolepis	narrow plover-daisy	17	4.7	0.7	1	3	2
Maireana campanulata	bell-fruit bluebush	17	4.7	0.7	1	3	2
Chenopodium desertorum	desert goosefoot	17	3.3	0.5	1	4	3
Sclerolaena decurrens	green bindyi	17	3.3	0.5	1	4	4
Sporobolus actinocladus	ray grass	17	3.3	0.5	1	4	3
Eremophila oppositifolia	opposite-leaved emubush	17	1.8	0.3	1	6	4
Halosarcia halocnemoides	grey samphire	17	1.8	0.3	1	6	5
Maireana radiata	radiate bluebush	17	1.8	0.3	1	6	4
Citrullus lanatus	bitter melon	17	1.4	0.2	1	7	3
Maireana brevifolia	short-leaf bluebush	17	1.4	0.2	1	7	4
Maireana coronata	crown fissure-plant	17	1.4	0.2	1	7	5
Myoporum platycarpum	false sandalwood	17	1.4	0.2	1	7	5
Maireana georgei	satiny bluebush	17	1.1	0.2	1	8	6
Aristida nitidula	brush threeawn	17	0.9	0.1	1	9	5
Malvastrum americanum	malvastrum	17	0.9	0.1	1	9	6
Solanum quadriloculatum	plains nightshade	17	0.9	0.1	1	9	3
Minuria cunninghamii	bush minuria	17	0.7	0.1	1	10	5
Sida intricata	twiggy sida	17	0.7	0.1	1	10	6
Sida trichopoda	high sida	17	0.5	0.1	1	11	6
Stipa nitida	Balcarra spear-grass	17	0.5	0.1	1	11	6
Senecio magnificus	showy groundsel	17	0.4	0.1	1	12	6

Landform	**Frequency**	**O-E**
plain (include undulating plain)	3	2.53
stony plain	2	1.14
hill slope	1	-0.79

Surface soil	**Frequency**	**O-E**
sandy clay loam	2	0.75
silt loam	1	0.69
clay loam, sandy	1	0.38
clayey sand	1	0.38
sandy loam	1	-0.79

Strew	**Frequency**	**O-E**
cobble (51-250mm) 10-30%	2	1.45
pebble (5-50mm) 30-70%	1	-0.17
cobble (51-250mm) <10%	1	0.92
pebble (5-50mm) <10%	1	0.45
pebble (5-50mm) 10-30%	1	0.45

Structural description	**Frequency**
low shrubland	6

Dominant Overstorey Species	**Frequency**
Atriplex vesicaria/Maireana astrotricha	2
Maireana astrotricha/Atriplex vesicaria	2
Atriplex vesicaria	1
Zygophyllum aurantiacum	1

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Site ARO 005 01 on the edge of the Leigh Creek Coalfields area. Bladder Saltbush and Low Bluebush low shrubland.

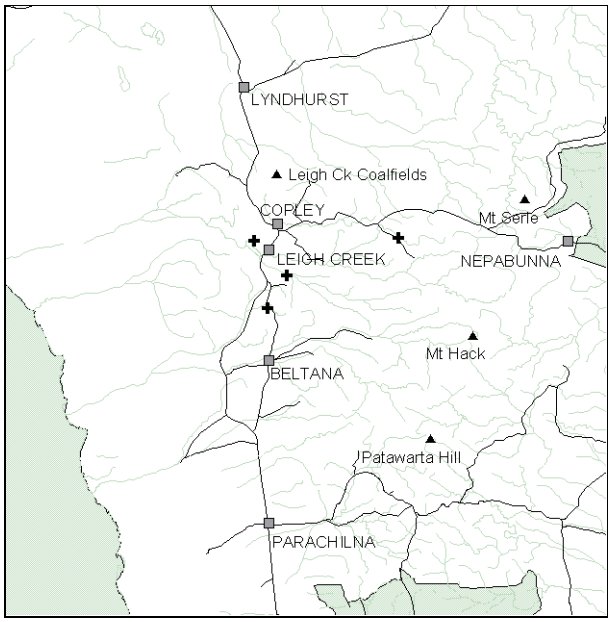
Group 5: *Atriplex lindleyi, Atriplex vesicaria, Sclerolaena divaricata* low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.

Low shrubland containing Baldoo with Bladder Saltbush or Tangled Bindyi over Bonefruit and Short-winged Bindyi with emergent individuals or clonal clumps of Bullock Bush and Blackoak. Occurs on hill slopes and adjacent stony plains with moderate to lightly pebbled sandy clay loam to clay surface soils. Important indicator species include the Grey Samphire, Spinach Bindyi and Thyme Sea-heath. This assemblage relates to structural vegetation map group 8 and 15.

Number of sites in group:	**5**				
Number of species in group:	**41**				
Number of species not used in analysis:	**1**				
Average number of species at sites:	**16.6**	**Max.**	**26**	**Min.**	**12**
Number of perennial species in group:	**40**	**Ave.**	**16.4**		
Number of introduced species in group:	**0**	**Ave.**	**0**		

Sites

ARO00403 PUT00302 COF00701 COF00702 PUT00801



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Atriplex lindleyi conduplicata	baldoo	100	6.4	4.6	5	13	5
Sclerolaena divaricata	tangled bindyi	80	4.5	2.6	4	14	8
Osteocarpum acropterum	bonefruit	80	3.5	2.0	4	17	6
Alectryon oleifolius canescens	bullock bush	100	2.7	2.0	5	26	9
Sclerolaena brachyptera	short-wing bindyi	80	3	1.7	4	19	6
Casuarina pauper	black oak	80	2.8	1.6	4	20	8
Halosarcia halocnemoides	grey samphire	40	5.4	1.6	2	6	5
Sclerolaena lanicuspis	spinach bindyi	40	5.4	1.6	2	6	4
Frankenia serpyllifolia	thyme sea-heath	60	3.1	1.3	3	14	7
Sclerolaena ventricosa	salt bindyi	60	1.9	0.8	3	20	7
Dissocarpus paradoxus	ball bindyi	40	1.7	0.5	2	14	6
Enchylaena tomentosa	ruby saltbush	80	0.7	0.4	4	46	13
Rhagodia spinescens	spiny saltbush	80	0.7	0.4	4	44	11
Atriplex vesicaria	bladder saltbush	80	0.6	0.3	4	48	11
Maireana pyramidata	black bluebush	60	0.5	0.2	3	38	11
Sclerolaena obliquicuspis	oblique-spined bindyi	40	0.5	0.1	2	26	7
Maireana astrotricha	low bluebush	40	-0.1	0.0	2	41	12
Ptilotus obovatus	silver mulla mulla	40	-0.2	-0.1	2	47	11

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Atriplex fissivalvis	gibber saltbush	20	8.6	1.2	1	2	2
Euphorbia stevenii	bottletree spurge	20	8.6	1.2	1	2	2
Indigofera sp.	indigo	20	8.6	1.2	1	2	2
Sclerolaena patenticuspis	spear-fruit bindyi	20	3.8	0.6	1	4	2
Amyema miraculosum boormanii	fleshy mistletoe	20	2.2	0.3	1	6	5
Sclerolaena parallelicuspis	western bindyi	20	2.2	0.3	1	6	5
Maireana georgei	satiny bluebush	20	1.4	0.2	1	8	6
Sclerolaena cuneata	tangled bindyi	20	1.1	0.2	1	9	6
Santalum lanceolatum	plumbush	20	0.9	0.1	1	10	7
Sida trichopoda	high sida	20	0.7	0.1	1	11	6
Exocarpos aphyllus	leafless cherry	20	0.6	0.1	1	12	4
Sclerolaena limbata	pearl bindyi	20	0.6	0.1	1	12	8
Sclerolaena longicuspis	long-spine bindyi	20	0.5	0.1	1	13	9
Pimelea microcephala	shrubby riceflower	20	0.4	0.1	1	14	6

Landform	Frequency	O-E
hill slope	3	1.51
stony plain	2	1.29

Surface soil	Frequency	O-E
sandy clay loam	2	0.96
sandy loam	1	-0.49
light clay	1	0.94
medium clay	1	0.81

Strew	Frequency	O-E
pebble (5-50mm) 10-30%	2	1.55
pebble (5-50mm) 30-70%	1	0.03
pebble (5-50mm) <10%	1	0.55
cobble (51-250mm) 30-70%	1	0.16

Structural description	Frequency	O-E
low shrubland	4	1.92
sub-shrubland	1	0.87

Dominant Overstorey Species	Frequency
Atriplex vesicaria/Maireana astrotricha	1
Casuarina pauper	1
Atriplex vesicaria/Sclerolaena spp.	1
Halosarcia halocnemoides	1
Sclerolaena spp.	1

Site COF 007 01 in the east of the study area. Mixed Saltbushes and Bindyi with emergent Blackoaks and Bullock Bush

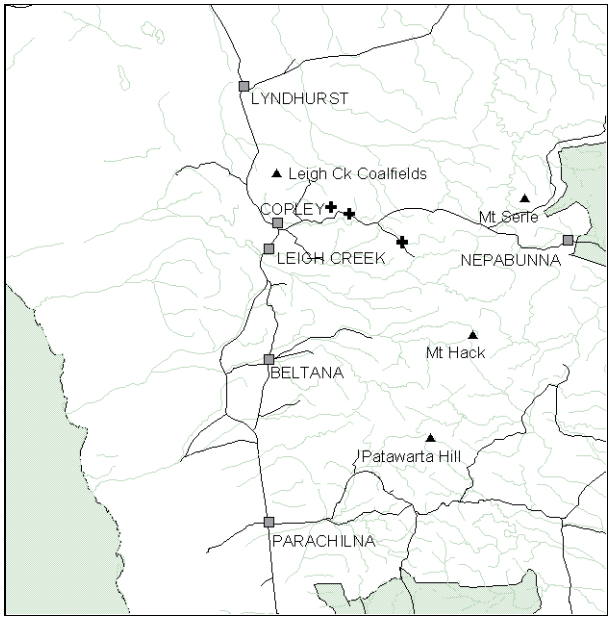
Group 6: *Atriplex vesicaria, Rhagodia spinescens* low shrubland with *Casuarina pauper* low open woodland overstorey or emergent *Acacia victoriae, Alectryon oleifolius* and *Eremophila* spp..

Low open shrublands of Bladder Saltbush with Spiny Saltbush, Silver Mulla Mulla and mixed bluebush species. A variety of emergent shrub (Elegant Wattle, Opposite-leaved and Rock Emubush) and tree (Blackoak and Bullock Bush) species may give this community a tall open shrubland or low open woodland character. Occurs on lower hill slopes with sandy loam soils with a moderate to light cover of pebbles. Important indicator species include the Woolly Bluebush, Bell-fruit Bluebush, Cottony Bluebush, Shrubby Groundsel and Variable Daisy. This assemblage relates to structural vegetation map groups 8, 10 and 15.

Number of sites in group:	**5**				
Number of species in group:	**38**				
Number of species not used in analysis:	**0**				
Average number of species at sites:	**14.2**	**Max.**	**15**	**Min.**	**12**
Number of perennial species in group:	**34**	**Ave.**	**13.4**		
Number of introduced species in group:	**1**	**Ave.**	**1**		

Sites

COF00201 COF00202 COF00403 COF00801 COF00802



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Maireana eriantha	woolly bluebush	40	21.1	6.1	2	2	1
Eremophila oppositifolia	opposite-leaved emubush	60	10	4.3	3	6	4
Maireana campanulata	bell-fruit bluebush	40	13.7	4.0	2	3	2
Maireana carnosa	cottony bluebush	40	13.7	4.0	2	3	2
Senecio cunninghamii	shrubby groundsel	40	5.3	1.5	2	7	4
Rhagodia spinescens	spiny saltbush	100	1.5	1.1	5	44	11
Sida intricata	twiggy sida	40	3.4	1.0	2	10	6
Atriplex vesicaria	bladder saltbush	100	1.3	0.9	5	48	11
Sida petrophila	rock sida	80	1.5	0.9	4	36	9
Enchylaena tomentosa	ruby saltbush	80	0.9	0.5	4	46	13
Ptilotus obovatus	silver mulla mulla	80	0.9	0.5	4	47	11
Sclerolaena brachyptera	short-wing bindyi	40	1.3	0.4	2	19	6
Casuarina pauper	black oak	40	1.2	0.3	2	20	8
Acacia victoriae	elegant wattle	60	0.7	0.3	3	38	10
Maireana astrotricha	low bluebush	60	0.6	0.3	3	41	12
Alectryon oleifolius canescens	bullock bush	40	0.7	0.2	2	26	9
Eremophila freelingii	rock emubush	40	0.3	0.1	2	35	11
Solanum ellipticum	velvet potato-bush	40	0.1	0.0	2	40	8

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Brachycome ciliaris ciliaris	variable daisy	20	10	1.4	1	2	2
Echium plantagineum	Salvation Jane	20	6.4	0.9	1	3	3
Wahlenbergia aridicola	dryland bluebell	20	3.4	0.5	1	5	2
Amyema miraculosum boormanii	fleshy mistletoe	20	2.7	0.4	1	6	5
Prostanthera striatiflora	striated mintbush	20	2.2	0.3	1	7	3
Myoporum montanum	native myrtle	20	1.8	0.3	1	8	6
Convolvulus remotus	grassy bindweed	20	1.2	0.2	1	10	3
Dodonaea microzyga microzyga	brilliant hop-bush	20	1.2	0.2	1	10	4
Lysiana exocarpi exocarpi	harlequin mistletoe	20	1	0.1	1	11	7
Stipa nitida	Balcarra spear-grass	20	1	0.1	1	11	6
Maireana sedifolia	pearl bluebush	20	0.8	0.1	1	12	5
Sclerolaena limbata	pearl bindyi	20	0.8	0.1	1	12	8
Sclerolaena longicuspis	long-spine bindyi	20	0.7	0.1	1	13	9
Frankenia serpyllifolia	thyme sea-heath	20	0.6	0.1	1	14	7
Senna artemisioides artemisioides	silver senna	20	0.4	0.1	1	16	6

Landform	Frequency	O-E
hill slope	4	2.51
drainage depression	1	0.74

Surface soil	Frequency	O-E
sandy loam	3	1.51
sandy clay loam	1	-0.04
silt loam	1	0.87

Strew	Frequency	O-E
pebble (5-50mm) 30-70%	2	1.03
pebble (5-50mm) <10%	2	1.55
pebble (5-50mm) 10-30%	1	0.55

Structural description	Frequency	O-E
low shrubland	3	0.92
low woodland	1	0.74
shrubland	1	0.16

Dominant Overstorey Species	Frequency
Casuarina pauper	1
Atriplex vesicaria	1
Maireana astrotricha	1
Dodonaea microzyga	1
Acacia victoriae	1

Site COF 002 01 on the flank of Mount Coffin. Blackoak low woodland over Bladder Saltbush.

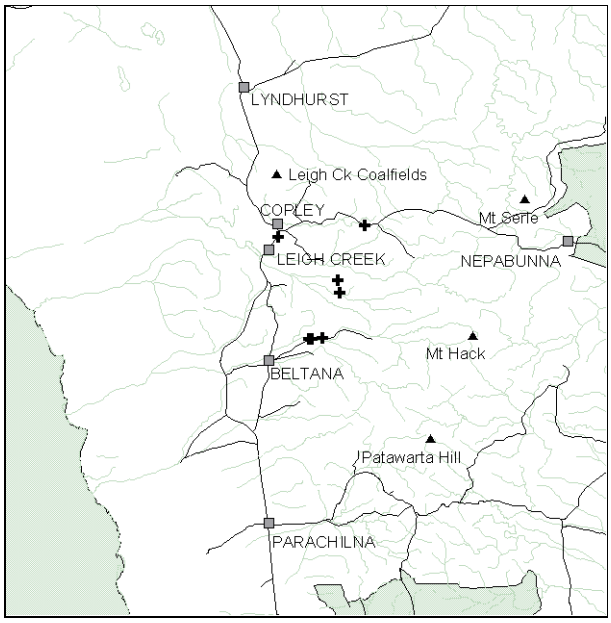
Group 7: *Maireana pyramidata, Atriplex vesicaria* low shrubland with emergent *Acacia victoriae*.

Low shrublands containing Black Bluebush, Bladder Saltbush, Spiny Saltbush and Ruby Saltbush with emergent Elegant Wattle which can form substantial thickets in areas where water accumulates. Common understorey species include Grassy Bindweed and Salty Bindyi. This community is characteristic of floodplains of the major drainage lines, floodouts, drainage depressions and the stony plains of the low foothills of the ranges. Occurs on a variety of clay to sandy loam surface soils supporting from none to a moderate cover of pebbles or (less frequently) cobbles. Important indicator species include the Woolly New Holland Daisy, Bush Minuria, Native Sorrel and the introduced Common Sow-thistle, Malta Thistle and Bitter Melon. This assemblage relates to structural vegetation map groups 4 and 5.

Number of sites in group:	**10**				
Number of species in group:	**94**				
Number of species not used in analysis:	**12**				
Average number of species at sites:	**29.2**	**Max.**	**50**	**Min.**	**19**
Number of perennial species in group:	**69**	**Ave.**	**21.9**		
Number of introduced species in group:	**14**	**Ave.**	**4.1**		

Sites

ARO00601 PUT00101 PUT00102 COF00502
PUT00201 PUT00202 PUT00501 PUT00502
PUT00503 PUT00601



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Convolvulus remotus	grassy bindweed	80	3.5	4.1	8	10	3
Sonchus oleraceus	common sow-thistle	40	4.6	2.7	4	4	1
Vittadinia gracilis	woolly New Holland daisy	40	4.6	2.7	4	4	1
Centaurea melitensis	Malta thistle	50	3	2.2	5	7	2
Citrullus lanatus	bitter melon	50	3	2.2	5	7	3
Minuria cunninghamii	bush minuria	60	2.4	2.1	6	10	5
Oxalis perennans	native sorrel	60	2.4	2.1	6	10	4
Wahlenbergia aridicola	dryland bluebell	40	3.5	2.0	4	5	2
Dittrichia graveolens	stinkweed	50	2.5	1.8	5	8	3
Solanum petrophilum	rock nightshade	40	2.7	1.6	4	6	2
Boerhavia schomburgkiana	Schomburgk's tar-vine	50	1.8	1.3	5	10	4
Maireana brevifolia	short-leaf bluebush	40	2.2	1.3	4	7	4
Pterocaulon sphacelatum	apple-bush	50	1.5	1.1	5	11	4
Stipa nitida	Balcarra spear-grass	50	1.5	1.1	5	11	6
Euphorbia drummondii	caustic weed	60	1.2	1.0	6	15	4
Sclerolaena ventricosa	salt bindyi	70	1	1.0	7	20	7
Senecio magnificus	showy groundsel	50	1.3	0.9	5	12	6
Marrubium vulgare	horehound	40	1.5	0.9	4	9	3

Maireana pyramidata	black bluebush	100	0.5	0.7	10	38	11
Carrichtera annua	Ward's weed	50	1	0.7	5	14	6
Pimelea microcephala	shrubby riceflower	50	1	0.7	5	14	6
Santalum lanceolatum	plumbush	40	1.2	0.7	4	10	7
Atriplex angulata	fan saltbush	50	0.9	0.7	5	15	7
Atriplex lindleyi conduplicata	baldoo	40	0.7	0.4	4	13	5
Acacia victoriae	elegant wattle	80	0.2	0.2	8	38	10
Atriplex vesicaria	bladder saltbush	90	0.1	0.1	9	48	11
Sclerolaena brachyptera	short-wing bindyi	40	0.2	0.1	4	19	6
Cymbopogon ambiguus	lemon-grass	50	0.1	0.1	5	26	9
Sclerolaena obliquicuspis	oblique-spined bindyi	50	0.1	0.1	5	26	7
Enneapogon polyphyllus	leafy bottle-washers	50	0	0.0	5	28	9
Enchylaena tomentosa	ruby saltbush	70	-0.1	-0.1	7	46	13
Rhagodia spinescens	spiny saltbush	70	-0.1	-0.1	7	44	11
Maireana astrotricha	low bluebush	60	-0.2	-0.2	6	41	12
Sida petrophila	rock sida	40	-0.4	-0.2	4	36	9
Solanum ellipticum	velvet potato-bush	40	-0.4	-0.2	4	40	8

Species at < 30% of sites with indicator value > 0		**% of sites in group**	**O-E/E**	**indicator spp.**	**frequency in group**	**frequency all sites**	**occurrence in groups**
Sclerolaena patenticuspis	spear-fruit bindyi	30	3.2	1.4	3	4	2
Boerhavia dominii	tar-vine	20	4.6	1.3	2	2	1
Goodenia fascicularis	silky goodenia	20	4.6	1.3	2	2	1
Medicago minima minima	little medic	20	4.6	1.3	2	2	1
Carthamus lanatus	saffron thistle	30	2.4	1.0	3	5	2
Ixiolaena leptolepis	narrow plover-daisy	20	2.7	0.8	2	3	2
Danthonia caespitosa	common wallaby-grass	20	1.2	0.3	2	5	3
Sida intricata	twiggy sida	30	0.7	0.3	3	10	6
Nicotiana velutina	velvet tobacco	20	0.9	0.3	2	6	3
Bromus arenarius	sand brome	10	1.8	0.3	1	2	2
Cyperus gymnocaulos	spiny flat-sedge	10	1.8	0.3	1	2	2
Dissocarpus biflorus	two-horn saltbush	10	1.8	0.3	1	2	2
Enneapogon avenaceus	common bottle-washers	10	1.8	0.3	1	2	2
Euphorbia stevenii	bottletree spurge	10	1.8	0.3	1	2	2
Indigofera sp.	Indigo	10	1.8	0.3	1	2	2
Minuria integerrima	smooth minuria	10	1.8	0.3	1	2	2
Mukia maderaspatana	snake vine	10	1.8	0.3	1	2	2
Tribulus terrestris	caltrop	10	1.8	0.3	1	2	2
Sida trichopoda	high sida	30	0.5	0.2	3	11	6
Salsola kali	buckbush	30	0.4	0.2	3	12	7
Atriplex velutinella	sandhill saltbush	10	0.9	0.1	1	3	2
Datura leichhardtii	native thorn-apple	10	0.9	0.1	1	3	3
Dodonaea viscosa angustissima	sticky hop-bush	10	0.9	0.1	1	3	3
Echium plantagineum	Salvation Jane	10	0.9	0.1	1	3	3
Hibiscus krichauffianus	velvet-leaf hibiscus	10	0.9	0.1	1	3	3
Nitraria billardierei	nitre-bush	10	0.9	0.1	1	3	3
Santalum acuminatum	quandong	10	0.9	0.1	1	3	2
Dissocarpus paradoxus	ball bindyi	30	0.2	0.1	3	14	6
Frankenia serpyllifolia	thyme sea-heath	30	0.2	0.1	3	14	7
Aristida nitidula	brush threeawn	20	0.2	0.1	2	9	5
Brachycome ciliaris lanuginosa	woolly variable daisy	10	0.4	0.1	1	4	3

Landform	**Frequency**	**O-E**
stream channel	3	1.05
flood out	3	2.61
stony plain	2	0.57
drainage depression	1	0.48
plain (incl undulating plain)	1	0.22

Surface soil	**Frequency**	**O-E**
sandy loam	4	1.01
clay loam	2	1.48
medium clay	1	0.61
clayey sand	1	-0.04
sand	1	0.48
loam	1	0.35

Strew	Frequency	O-E
pebble (5-50mm) 30-70%	3	1.05
pebble (5-50mm) <10%	2	1.09
cobble (51-250mm) 10-30%	2	1.09
none apparent	2	1.48
cobble (51-250mm) 30-70%	1	-0.69

Structural description	Frequency	O-E
low shrubland	6	1.84
woodland	2	0.70
tall shrubland	2	1.09

Dominant Overstorey Species	Frequency
Acacia victoriae	2
Atriplex vesicaria/Maireana astrotricha	2
Eucalyptus camaldulensis	2
Atriplex vesicaria	1
Pittosporum phylleraeoides	1
Rhagodia spinescens/ Maireana pyramidata	1
Maireana pyramidata/ Rhagodia spinescens	1

Site ARO 006 01 between Copley and Leigh Creek South. Blackbush and Spiny Saltbush low shrubland

Site PUT 007 03 (Group 8) in the Bayley Range. Wattles and Inland Paperbark over Spiny Saltbush.

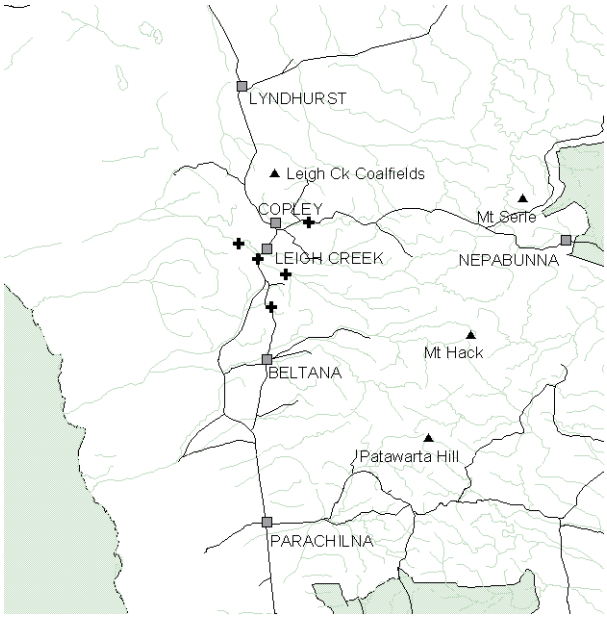
Group 8: *Acacia victoriae, Acacia tetragonophylla* tall shrubland with or without *Melaleuca glomerata* and *Eucalyptus camaldulensis* open woodland over *Maireana pyramidata* and *Rhagodia spinescens*.

Mixed tall shrublands of Elegant Wattle and Dead Finish with or without an overstorey of Bullock Bush, Blackoak, Inland Paper-bark or River Red Gum, over low shrubs dominated by Black Bluebush, Spiny Saltbush and Velvet Potato-bush. This community most commonly occurs along drainage lines but may also be found on floodout plains with sandy loam soils with a moderate cover of pebbles or cobbles. Important indicator species include the Ball Bindyi, Native Pear, Shrubby Riceflower and Caustic Weed. This assemblage relates to structural vegetation map groups 3 and 4.

Number of sites in group:	**6**				
Number of species in group:	**71**				
Number of species not used in analysis:	**4**				
Average number of species at sites:	**26.7**	**Max.**	**36**	**Min.**	**20**
Number of perennial species in group:	**62**	**Ave.**	**24.2**		
Number of introduced species in group:	**5**	**Ave.**	**2**		

Sites

ARO00702 ARO00803 PUT00303 PUT00703
COF00101 COF00102



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Dissocarpus paradoxus	ball bindyi	83	2.6	1.9	5	14	6
Marsdenia australis	native pear	67	3	1.7	4	10	4
Pimelea microcephala	shrubby riceflower	67	1.9	1.1	4	14	6
Euphorbia drummondii	caustic weed	67	1.7	1.0	4	15	4
Osteocarpum acropterum	bonefruit	67	1.4	0.8	4	17	6
Lysiana exocarpi exocarpi	harlequin mistletoe	50	1.7	0.7	3	11	7
Abutilon fraseri	dwarf lantern-bush	33	2.4	0.7	2	6	3
Maireana radiata	radiate bluebush	33	2.4	0.7	2	6	4
Acacia tetragonophylla	dead finish	83	0.9	0.7	5	27	9
Maireana coronata	crown fissure-plant	33	1.9	0.6	2	7	5
Acacia victoriae	elegant wattle	100	0.6	0.5	6	38	10
Maireana pyramidata	black bluebush	100	0.6	0.5	6	38	11
Solanum ellipticum	velvet potato-bush	100	0.5	0.4	6	40	8
Maireana georgei	satiny bluebush	33	1.5	0.4	2	8	6
Rhagodia spinescens	spiny saltbush	100	0.4	0.3	6	44	11
Aristida nitidula	brush threeawn	33	1.2	0.3	2	9	5
Melaleuca glomerata	inland paper-bark	33	1.2	0.3	2	9	5
Sclerolaena cuneata	tangled bindyi	33	1.2	0.3	2	9	6
Alectryon oleifolius canescens	bullock bush	67	0.5	0.3	4	26	9

Sclerolaena obliquicuspis	oblique-spined bindyi	67	0.5	0.3	4	26	7
Boerhavia schomburgkiana	Schomburgk's tar-vine	33	1	0.3	2	10	4
Dodonaea microzyga microzyga	brilliant hop-bush	33	1	0.3	2	10	4
Sida fibulifera	pin sida	33	0.8	0.2	2	11	5
Casuarina pauper	black oak	50	0.5	0.2	3	20	8
Eucalyptus camaldulensis	river red gum	33	0.7	0.2	2	12	5
Exocarpos aphyllus	leafless cherry	33	0.7	0.2	2	12	4
Salsola kali	buckbush	33	0.7	0.2	2	12	7
Sclerolaena limbata	pearl bindyi	33	0.7	0.2	2	12	8
Atriplex lindleyi conduplicata	baldoo	33	0.5	0.1	2	13	5
Abutilon leucopetalum	desert lantern-bush	33	0.4	0.1	2	14	6
Sclerolaena divaricata	tangled bindyi	33	0.4	0.1	2	14	8
Cymbopogon ambiguus	lemon-grass	50	0.2	0.1	3	26	9
Sida petrophila	rock sida	67	0.1	0.1	4	36	9
Senna artemisioides coriacea	broad-leaf desert senna	33	0.2	0.1	2	17	8
Eremophila alternifolia	narrow-leaf emubush	33	0.1	0.0	2	18	7
Solanum sturtianum	Sturt's nightshade	33	0.1	0.0	2	18	6
Eremophila freelingii	rock emubush	50	-0.1	0.0	3	35	11
Ptilotus obovatus	silver mulla mulla	67	-0.1	-0.1	4	47	11
Enneapogon polyphyllus	leafy bottle-washers	33	-0.3	-0.1	2	28	9
Maireana astrotricha	low bluebush	50	-0.3	-0.1	3	41	12
Atriplex vesicaria	bladder saltbush	33	-0.6	-0.2	2	48	11
Enchylaena tomentosa	ruby saltbush	33	-0.6	-0.2	2	46	13

Species at < 30% of sites with indicator value > 0		**% of sites in group**	**O-E/E**	**indicator spp.**	**frequency in group**	**frequency all sites**	**occurrence in groups**
Acacia oswaldii	umbrella wattle	17	4	0.6	1	2	2
Mukia maderaspatana	snake vine	17	4	0.6	1	2	2
Hibiscus krichauffianus	velvet-leaf hibiscus	17	2.4	0.3	1	3	3
Scaevola spinescens	spiny fanflower	17	2.4	0.3	1	3	2
Amyema miraculosum boormanii	fleshy mistletoe	17	0.7	0.1	1	6	5
Amyema preissii	wire-leaf mistletoe	17	0.7	0.1	1	6	4
Eremophila duttonii	harlequin emubush	17	0.7	0.1	1	6	5
Halosarcia halocnemoides	grey samphire	17	0.7	0.1	1	6	5
Heliotropium europaeum	common heliotrope	17	0.7	0.1	1	6	3
Nicotiana glauca	tree tobacco	17	0.7	0.1	1	6	4
Sclerolaena parallelicuspis	western bindyi	17	0.7	0.1	1	6	5
Citrullus lanatus	bitter melon	17	0.4	0.1	1	7	3
Maireana brevifolia	short-leaf bluebush	17	0.4	0.1	1	7	4
Myoporum platycarpum	false sandalwood	17	0.4	0.1	1	7	5
Dittrichia graveolens	stinkweed	17	0.3	0.0	1	8	3
Myoporum montanum	native myrtle	17	0.3	0.0	1	8	6
Malvastrum americanum	malvastrum	17	0.1	0.0	1	9	6

Landform	**Frequency**	**O-E**
stream channel	3	1.83
stony plain	1	0.14
plain (incl undulating plain)	1	0.53
hill footslope	1	0.92

Surface soil	**Frequency**	**O-E**
sandy loam	5	3.21
clay loam	1	0.69

Strew	**Frequency**	**O-E**
pebble (5-50mm) 30-70%	2	0.83
cobble (51-250mm) 30-70%	2	0.99
pebble (5-50mm) <10%	1	0.45
pebble (5-50mm) 10-30%	1	0.45

Structural description	**Frequency**	**O-E**
tall shrubland	2	1.45
low shrubland	1	-1.49
woodland	1	0.22
low woodland	1	0.69
shrubland	1	-0.01

Dominant Overstorey Species	**Frequency**
Acacia victoriae	1
Eucalyptus camaldulensis	1
Casuarina pauper	1
Acacia victoriae/Alectryon oleifolius	1
Melaleuca glomerata	1
Ptilotus obovatus	1

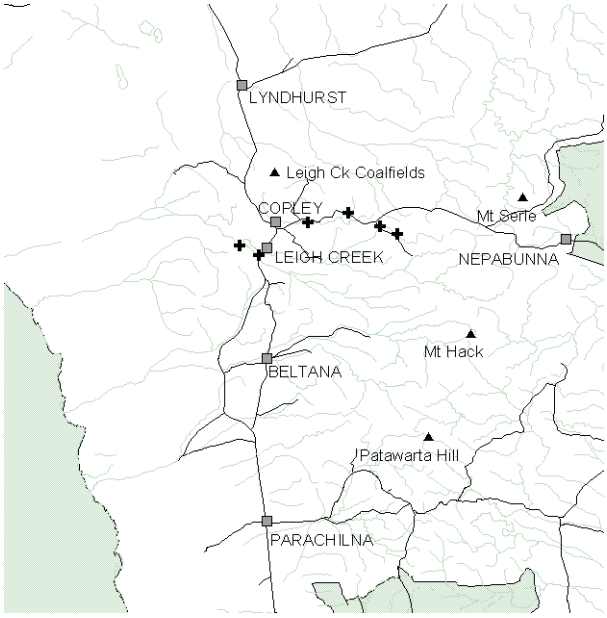
Group 9: *Eucalyptus camaldulensis* open woodland.

Open River Red Gum woodland over scattered individuals or dense clumps of Elegant Wattle and Inland Paper-bark low trees or tall shrubs with Ruby Saltbush, Velvet Potato-bush, Silver Mulla Mulla over Lemon-grass and Colocynth. Occurs only in stream channels on mixed sandy soils with variable cover and size of rocks ranging from pebbles to boulders. Introduced species dominate the indicator species for this group. These include the Colocynth, Common Heliotrope, Nettle-leaf Goosefoot, Long-spine Thorn-apple, Horehound and Tree Tobacco as well as the native Butterfly Bush, Velvet Tobacco and Apple-bush. This assemblage is typical of structural vegetation map group 3.

Number of sites in group:	**6**				
Number of species in group:	**70**				
Number of species not used in analysis:	**8**				
Average number of species at sites:	**29.7**	**Max.**	**43**	**Min.**	**20**
Number of perennial species in group:	**55**	**Ave.**	**24**		
Number of introduced species in group:	**13**	**Ave.**	**5.3**		

Sites

ARO00703 ARO00801 COF00103 COF00703
COF00401 COF00603



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Petalostylis labicheoides	butterfly bush	50	8.3	3.6	3	3	1
Citrullus colocynthis	colocynth	83	4.8	3.5	5	8	4
Eucalyptus camaldulensis	river red gum	100	3.6	3.1	6	12	5
Heliotropium europaeum	common heliotrope	67	5.2	3.0	4	6	3
Marrubium vulgare	horehound	67	3.1	1.8	4	9	3
Melaleuca glomerata	inland paper-bark	67	3.1	1.8	4	9	5
Nicotiana glauca	tree tobacco	50	3.6	1.6	3	6	4
Nicotiana velutina	velvet tobacco	50	3.6	1.6	3	6	3
Pterocaulon sphacelatum	apple-bush	67	2.4	1.4	4	11	4
Senecio cunninghamii	shrubby groundsel	50	3	1.3	3	7	4
Solanum sturtianum	Sturt's nightshade	83	1.6	1.2	5	18	6
Abutilon leucopetalum	desert lantern-bush	67	1.7	1.0	4	14	6
Cymbopogon ambiguus	lemon-grass	100	1.1	1.0	6	26	9
Aristida nitidula	brush threeawn	50	2.1	0.9	3	9	5
Malvastrum americanum	malvastrum	50	2.1	0.9	3	9	6
Osteocarpum acropterum	bonefruit	67	1.2	0.7	4	17	6
Atriplex angulata	fan saltbush	50	0.9	0.4	3	15	7
Acacia victoriae	elegant wattle	83	0.2	0.1	5	38	10
Solanum ellipticum	velvet potato-bush	83	0.2	0.1	5	40	8
Enchylaena tomentosa	ruby saltbush	83	0	0.0	5	46	13
Ptilotus obovatus	silver mulla mulla	83	0	0.0	5	47	11

Sida petrophila	rock sida	67	0	0.0	4	36	9
Acacia tetragonophylla	dead finish	50	0	0.0	3	27	9
Rhagodia spinescens	spiny saltbush	67	-0.2	-0.1	4	44	11
Maireana pyramidata	black bluebush	50	-0.3	-0.1	3	38	11

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Chenopodium murale	nettle-leaf goosefoot	33	8.3	2.4	2	2	1
Datura ferox	long-spine thorn-apple	33	8.3	2.4	2	2	1
Abutilon halophilum	plains lantern-bush	33	3.6	1.0	2	4	3
Chenopodium desertorum	desert goosefoot	33	3.6	1.0	2	4	3
Maireana aphylla	cotton-bush	33	3.6	1.0	2	4	2
Carthamus lanatus	saffron thistle	33	2.7	0.8	2	5	2
Pittosporum phylliraeoides microcarpa	native apricot	33	2.7	0.8	2	5	3
Sisymbrium erysimoides	smooth mustard	33	2.7	0.8	2	5	4
Amyema miraculosum boormanii	fleshy mistletoe	33	2.1	0.6	2	6	5
Solanum petrophilum	rock nightshade	33	2.1	0.6	2	6	2
Callitris glaucophylla	white cypress-pine	17	3.6	0.5	1	2	2
Jasminum didymum lineare	native jasmine	17	3.6	0.5	1	2	2
Senna artemisioides filifolia	fine-leaf desert senna	17	3.6	0.5	1	2	2
Tribulus terrestris	caltrop	17	3.6	0.5	1	2	2
Centaurea melitensis	Malta thistle	33	1.7	0.5	2	7	2
Dittrichia graveolens	stinkweed	33	1.3	0.4	2	8	3
Myoporum montanum	native myrtle	33	1.3	0.4	2	8	6
Datura leichhardtii	native thorn-apple	17	2.1	0.3	1	3	3
Echium plantagineum	Salvation Jane	17	2.1	0.3	1	3	3
Hibiscus krichauffianus	velvet-leaf hibiscus	17	2.1	0.3	1	3	3
Nitraria billardierei	nitre-bush	17	2.1	0.3	1	3	3
Senna artemisioides sturtii	grey senna	17	2.1	0.3	1	3	3
Boerhavia schomburgkiana	Schomburgk's tar-vine	33	0.9	0.3	2	10	4
Sida intricata	twiggy sida	33	0.9	0.3	2	10	6
Lysiana exocarpi exocarpi	harlequin mistletoe	33	0.7	0.2	2	11	7
Sida fibulifera	pin sida	33	0.7	0.2	2	11	5
Senecio magnificus	showy groundsel	33	0.5	0.1	2	12	6
Acacia ligulata	umbrella bush	17	0.9	0.1	1	5	4
Dissocarpus paradoxus	ball bindyi	33	0.3	0.1	2	14	6
Pimelea microcephala	shrubby riceflower	33	0.3	0.1	2	14	6
Halosarcia halocnemoides	grey samphire	17	0.5	0.1	1	6	5

Landform	Frequency	O-E
stream channel	6	4.83

Surface soil	Frequency	O-E
clayey sand	3	2.38
sandy clay loam	2	0.75
sandy loam	1	-0.79

Strew	Frequency	O-E
cobble (51-250mm) 30-70%	2	0.99
pebble (5-50mm) 10-30%	1	0.45
cobble (51-250mm) 10-30%	1	0.45
boulder (gt 250mm) 30-70%	1	0.45
boulder (gt 250mm) 10-30%	1	0.92

Structural description	Frequency	O-E
woodland	5	4.22
shrubland	1	-0.01

Dominant Overstorey Species	Frequency
Eucalyptus camaldulensis	5
Melaleuca glomerata	1

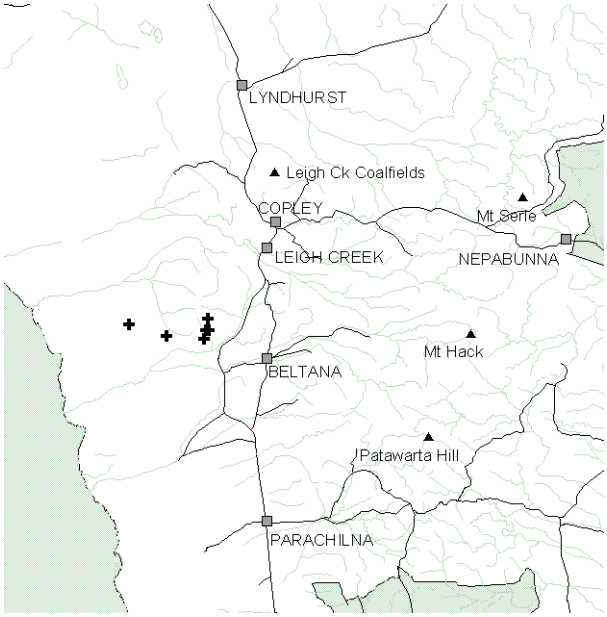
Group 10: *Acacia tetragonophylla/Acacia victoriae/Acacia aneura* tall shrubland over scattered shrubs and tussock grasses.

Open Dead Finish Shrubland to Woodland often with Elegant Wattle and scattered Mulga over low shrubs of Rock Emubush with sparse Plains Nightshade, Ruby Saltbush, Silver Mulla Mulla and Spiny Saltbush and/or tussock grasses dominated by Lemon-grass with Leafy Bottle-washers. This assemblage is typical of hill slopes, and minor drainage lines in the Mount Deception and Ediacra Range area on shale soils or loamy sands amongst rock sheets. Important indicator species include the Wire-leaf Mistletoe and Native Pear. This assemblage relates to structural vegetation map group 10 and 12.

Number of sites in group:	**6**				
Number of species in group:	**53**				
Number of species not used in analysis:	**10**				
Average number of species at sites:	**19.7**	**Max.**	**27**	**Min.**	**13**
Number of perennial species in group:	**42**	**Ave.**	**15.7**		
Number of introduced species in group:	**4**	**Ave.**	**2.5**		

Sites

DEC00101 DEC00602 DEC00701 DEC00702
DEC00402 DEC00801



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Solanum quadriloculatum	plains nightshade	100	8.9	7.7	6	9	3
Amyema preissii	wire-leaf mistletoe	50	6.4	2.8	3	6	4
Acacia tetragonophylla	dead finish	100	2.3	2.0	6	27	9
Enneapogon polyphyllus	leafy bottle-washers	100	2.2	1.9	6	28	9
Marsdenia australis	native pear	50	3.4	1.5	3	10	4
Acacia aneura	mulga	50	2.4	1.0	3	13	5
Euphorbia drummondii	caustic weed	50	2	0.9	3	15	4
Cymbopogon ambiguus	lemon-grass	67	1.3	0.8	4	26	9
Enchylaena tomentosa	ruby saltbush	83	0.6	0.4	5	46	13
Ptilotus obovatus	silver mulla mulla	83	0.6	0.4	5	47	11
Eremophila freelingii	rock emubush	67	0.7	0.4	4	35	11
Acacia victoriae	elegant wattle	67	0.6	0.3	4	38	10
Rhagodia spinescens	spiny saltbush	67	0.3	0.2	4	44	11
Maireana pyramidata	black bluebush	50	0.2	0.1	3	38	11
Maireana astrotricha	low bluebush	50	0.1	0.0	3	41	12

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Aristida contorta	curly wire-grass	17	6.4	0.9	1	2	2
Chrysocephalum semicalvum	hill button-bush	17	6.4	0.9	1	2	2
Enneapogon avenaceus	common bottle-washers	17	6.4	0.9	1	2	2

Phyllanthus lacunarius	lagoon spurge	17	6.4	0.9	1	2	2
Sclerolaena cuneata	tangled bindyi	33	2.3	0.7	2	9	6
Brassica tournefortii	wild turnip	17	3.9	0.6	1	3	2
Lepidium sp.	peppercress	17	3.9	0.6	1	3	3
Senna artemisioides sturtii	grey senna	17	3.9	0.6	1	3	3
Senecio magnificus	showy groundsel	33	1.5	0.4	2	12	6
Hakea ednieana	Flinders Ranges corkwood	17	2.7	0.4	1	4	3
Portulaca oleracea	common purslane	17	2.7	0.4	1	4	3
Sclerolaena decurrens	green bindyi	17	2.7	0.4	1	4	4
Sporobolus actinocladus	ray grass	17	2.7	0.4	1	4	3
Carrichtera annua	Ward's weed	33	1.1	0.3	2	14	6
Acacia ligulata	umbrella bush	17	2	0.3	1	5	4
Pittosporum phylliraeoides microcarpa	native apricot	17	2	0.3	1	5	3
Sisymbrium erysimoides	smooth mustard	17	2	0.3	1	5	4
Sclerolaena lanicuspis	spinach bindyi	17	1.5	0.2	1	6	4
Eremophila alternifolia	narrow-leaf emubush	33	0.6	0.2	2	18	7
Citrullus colocynthis	colocynth	17	0.8	0.1	1	8	4
Aristida nitidula	brush threeawn	17	0.6	0.1	1	9	5
Malvastrum americanum	malvastrum	17	0.6	0.1	1	9	6
Melaleuca glomerata	inland paper-bark	17	0.6	0.1	1	9	5
Boerhavia schomburgkiana	Schomburgk's tar-vine	17	0.5	0.1	1	10	4
Dodonaea lobulata	lobed-leaf hop-bush	17	0.5	0.1	1	10	5
Santalum lanceolatum	plumbush	17	0.5	0.1	1	10	7
Sida intricata	twiggy sida	17	0.5	0.1	1	10	6

Landform	**Frequency**	**O-E**
hill slope	3	1.21
drainage depression	2	1.69
gully	1	0.77

Surface soil	**Frequency**	**O-E**
sandy loam	2	0.21
clay loam, sandy	2	1.38
loamy sand	2	1.77

Strew	**Frequency**	**O-E**
pebble (5-50mm) gt 70%	2	1.84
cobble (51-250mm) 30-70%	1	-0.01
pebble (5-50mm) 10-30%	1	0.45
pebble (5-50mm) 30-70%	1	-0.17
Sheet gt 70%	1	0.84

Structural description	**Frequency**	**O-E**
shrubland	3	1.99
tall shrubland	1	0.45
low shrubland	1	-1.49
low woodland	1	0.69

Dominant Overstorey Species	**Frequency**
Acacia tetragonophylla/Eremophila freelingii	2
Melaleuca glomerata	1
Acacia victoriae	1
Eremophila freelingii	1
Acacia tetragonophylla/A. aneura/A. victoriae	1

Site DEC 007 01 east slope of Mount Deception. Deadfinish and Mulga over bluebush and grasses

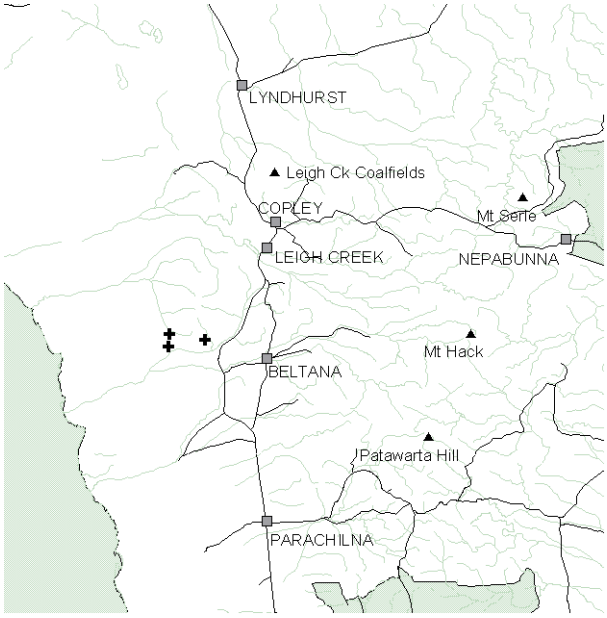
Group 11: *Sclerolaena ventricosa, Sclerolaena brachyptera* sub-shrubland with tussock grasses and emergent shrubs.

Sub-shrubland of Salt Bindyi, Short-wing Bindyi and Fan Saltbush with scattered shrubs of Spiny Saltbush and High Sida with isolated Elegant Wattle and *Eremophila* spp. tall shrubs. This association is restricted to stony plains with mixed clay soils and a moderate cover of pebbles to cobbles. Important indicator species include Barley Mitchell-grass, Bristly Love-grass, Cottonbush and Spidery Button-flower. This assemblage relates mostly to structural vegetation group 9 but may grade into group 10 where emergent shrubs dominate.

Number of sites in group:	**3**				
Number of species in group:	**40**				
Number of species not used in analysis:	**5**				
Average number of species at sites:	**24.3**	**Max.**	**27**	**Min.**	**22**
Number of perennial species in group:	**35**	**Ave.**	**20**		
Number of introduced species in group:	**0**	**Ave.**	**0**		

Sites

DEC00401 DEC00501 DEC00601



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Astrebla pectinata	barley Mitchell-grass	67	22.1	6.4	2	2	1
Eragrostis setifolia	bristly love-grass	67	22.1	6.4	2	2	1
Gnephosis arachnoidea	spidery button-flower	67	22.1	6.4	2	2	1
Maireana aphylla	cotton-bush	67	10.5	3.0	2	4	2
Portulaca oleracea	common purslane	67	10.5	3.0	2	4	3
Sporobolus actinocladus	ray grass	67	10.5	3.0	2	4	3
Sida trichopoda	high sida	100	5.3	2.3	3	11	6
Eremophila duttonii	harlequin emubush	67	6.7	1.9	2	6	5
Sclerolaena parallelicuspis	western bindyi	67	6.7	1.9	2	6	5
Atriplex angulata	fan saltbush	100	3.6	1.6	3	15	7
Malvastrum americanum	malvastrum	67	4.1	1.2	2	9	6
Solanum quadriloculatum	plains nightshade	67	4.1	1.2	2	9	3
Sclerolaena brachyptera	short-wing bindyi	100	2.6	1.1	3	19	6
Sclerolaena ventricosa	salt bindyi	100	2.5	1.1	3	20	7
Sclerolaena limbata	pearl bindyi	67	2.8	0.8	2	12	8
Frankenia serpyllifolia	thyme sea-heath	67	2.3	0.7	2	14	7
Sclerolaena divaricata	tangled bindyi	67	2.3	0.7	2	14	8
Acacia victoriae	elegant wattle	100	0.8	0.3	3	38	10
Rhagodia spinescens	spiny saltbush	100	0.6	0.3	3	44	11
Acacia tetragonophylla	dead finish	67	0.7	0.2	2	27	9
Enneapogon polyphyllus	leafy bottle-washers	67	0.6	0.2	2	28	9
Eremophila freelingii	rock emubush	67	0.3	0.1	2	35	11

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Aristida contorta	curly wire-grass	33	10.5	1.5	1	2	2
Gunniopsis quadrifida	Sturt's pigface	33	10.5	1.5	1	2	2
Jasminum didymum lineare	native jasmine	33	10.5	1.5	1	2	2
Minuria integerrima	smooth minuria	33	10.5	1.5	1	2	2
Lepidium sp.	peppercress	33	6.7	1.0	1	3	3
Abutilon halophilum	plains lantern-bush	33	4.8	0.7	1	4	3
Brachycome ciliaris lanuginosa	woolly variable daisy	33	4.8	0.7	1	4	3
Sclerolaena decurrens	green bindyi	33	4.8	0.7	1	4	4
Senna artemisioides petiolaris	flat-stalk senna	33	4.8	0.7	1	4	3
Maireana coronata	crown fissure-plant	33	2.3	0.3	1	7	5
Minuria cunninghamii	bush minuria	33	1.3	0.2	1	10	5
Santalum lanceolatum	plumbush	33	1.3	0.2	1	10	7
Lysiana exocarpi exocarpi	harlequin mistletoe	33	1.1	0.2	1	11	7
Salsola kali	buckbush	33	0.9	0.1	1	12	7
Sclerolaena longicuspis	long-spine bindyi	33	0.8	0.1	1	13	9

Landform	Frequency	O-E
stony plain	3	2.57

Surface soil	Frequency	O-E
clay loam, sandy	1	0.69
clayey sand	1	0.69
medium clay	1	0.88

Strew	Frequency	O-E
pebble (5-50mm) 30-70%	2	1.42
cobble (51-250mm) 30-70%	1	0.49

Structural description	Frequency	O-E
shrubland	1	0.49
low shrubland	1	-0.25
sub-shrubland	1	0.92

Dominant Overstorey Species	Frequency
Sclerolaena spp.	1
Eremophila duttonii	1
Maireana aphylla	1

Site DEC 006 01 near Mount Deception. Bindyi sub-shrubland.

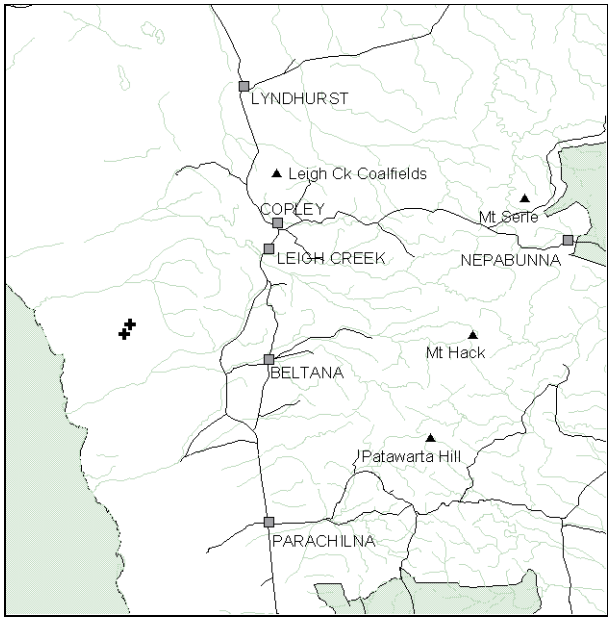
Group 12: *Acacia ligulata* tall shrubland over *Senna* spp. shrubs and *Atriplex velutinella* low shrubs.

Tall shrubland of Umbrella Bush over Flat-stalked and Broad-leaf Desert Senna shrubs with low shrubs of Sandhill Saltbush and Buckbush. Silver Needlewood and Mulga occur as emergent low trees. Occurs on sand dunes with no strew in the west of the study area. Other important indicators include Downy Loose-flowered Rattlepod and the introduced Wild Turnip. This assemblage relates to structural vegetation map group 6.

Number of sites in group:	**2**				
Number of species in group:	**29**				
Number of species not used in analysis:	**2**				
Average number of species at sites:	**21**	**Max.**	**23**	**Min.**	**19**
Number of perennial species in group:	**25**	**Ave.**	**17.5**		
Number of introduced species in group:	**1**	**Ave.**	**1**		

Sites

DEC00102 DEC00201



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Crotalaria eremaea eremaea	downy loose-flowered rattlepod	100	38.2	11.1	2	2	1
Hakea leucoptera leucoptera	silver needlewood	100	38.2	11.1	2	2	1
Atriplex velutinella	sandhill saltbush	100	25.1	7.3	2	3	2
Brassica tournefortii	wild turnip	100	25.1	7.3	2	3	2
Senna artemisioides petiolaris	flat-stalk senna	100	18.6	5.4	2	4	3
Acacia ligulata	umbrella bush	100	14.7	4.3	2	5	4
Salsola kali	buckbush	100	5.5	1.6	2	12	7
Acacia aneura	mulga	100	5	1.4	2	13	5
Senna artemisioides coriacea	broad-leaf desert senna	100	3.6	1.0	2	17	8
Enneapogon polyphyllus	leafy bottle-washers	100	1.8	0.5	2	28	9
Enchylaena tomentosa	ruby saltbush	100	0.7	0.2	2	46	13
Amyema maidenii maidenii	pale-leaf mistletoe	50	18.6	2.7	1	2	2
Eremophila glabra	tar bush	50	18.6	2.7	1	2	2
Phyllanthus lacunarius	lagoon spurge	50	18.6	2.7	1	2	2
Dodonaea viscosa angustissima	sticky hop-bush	50	12.1	1.8	1	3	3
Nitraria billardierei	nitre-bush	50	12.1	1.8	1	3	3
Sclerolaena decurrens	green bindyi	50	8.8	1.3	1	4	4
Amyema preissii	wire-leaf mistletoe	50	5.5	0.8	1	6	4
Eremophila duttonii	harlequin emubush	50	5.5	0.8	1	6	5
Minuria cunninghamii	bush minuria	50	2.9	0.4	1	10	5
Santalum lanceolatum	plumbush	50	2.9	0.4	1	10	7
Lysiana exocarpi exocarpi	harlequin mistletoe	50	2.6	0.4	1	11	7
Sclerolaena limbata	pearl bindyi	50	2.3	0.3	1	12	8

Osteocarpum acropterum	bonefruit	50	1.3	0.2	1	17	6
Eremophila freelingii	rock emubush	50	0.1	0.0	1	35	11
Maireana astrotricha	low bluebush	50	0	0.0	1	41	12
Maireana pyramidata	black bluebush	50	0	0.0	1	38	11
Rhagodia spinescens	spiny saltbush	50	-0.1	0.0	1	44	11
Atriplex vesicaria	bladder saltbush	50	-0.2	0.0	1	48	11

Landform	**Frequency**	**O-E**
dune/consolidated dune	2	1.95

Surface soil	**Frequency**	**O-E**
sand	2	1.90

Strew	**Frequency**	**O-E**
none apparent	2	1.90

Structural description	**Frequency**	**O-E**
tall shrubland	2	1.82

Dominant Overstorey Species	**Frequency**
Acacia ligulata	2

Site DEC 002 01 in the wetern dunefield. Umbrella Bush with a Sandhill Saltbush understorey.

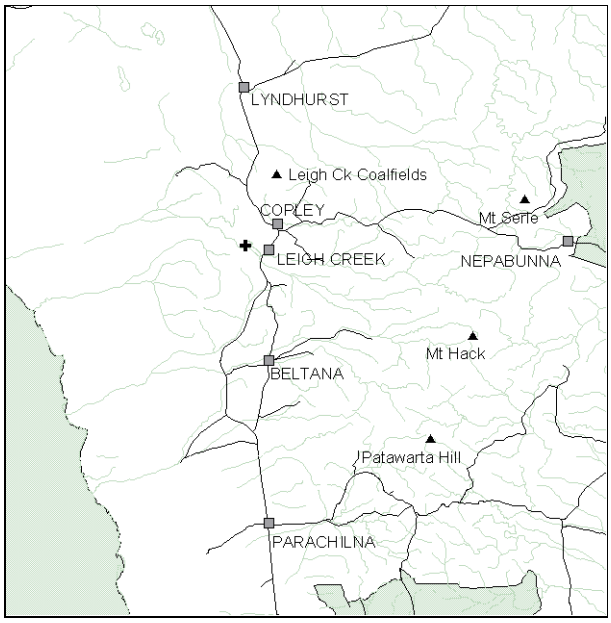
Group 13: *Typha domingensis* and *Cyperus gymnocaulos* sedgeland with a sparse overstorey of *Eucalyptus camaldulensis* and *Melaleuca glomerata*.

Sedgeland supporting Narrow-leaf Bulrush and Spiny Flat-sedge with a sparse overstorey of River Red Gums and Inland Paper-bark trees. Occurs with permanent wetlands and as such is extremely rare in the study area and often the result of wetland creation. Three species unique to this one site were masked out of the PATN analysis because they occurred at one site only including the Narrow-leaf Bulrush *Typha domingensis*. This rare assemblage would contribute to structural vegetation map group 3.

Number of sites in group:	**1**				
Number of species in group:	**10**				
Number of species not used in analysis:	**3**				
Average number of species at sites:	**na**	**Max.**	**Na**	**Min.**	**Na**
Number of perennial species in group:	**8**	**Ave.**	**Na**		
Number of introduced species in group:	**2**	**Ave.**	**Na**		

Sites

ARO00802



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Anagallis arvensis	pimpernel	100	77.4	11.2	1	2	2
Cyperus gymnocaulos	spiny flat-sedge	100	77.4	11.2	1	2	2
Acacia ligulata	umbrella bush	100	30.4	4.4	1	5	4
Nicotiana glauca	tree tobacco	100	25.1	3.6	1	6	4
Senecio cunninghamii	shrubby groundsel	100	21.4	3.1	1	7	4
Myoporum montanum	native myrtle	100	18.6	2.7	1	8	6
Melaleuca glomerata	inland paper-bark	100	16.4	2.4	1	9	5
Lysiana exocarpi exocarpi	harlequin mistletoe	100	13.3	1.9	1	11	7
Eucalyptus camaldulensis	river red gum	100	12.1	1.8	1	12	5
Enchylaena tomentosa	ruby saltbush	100	2.4	0.3	1	46	13

Landform	Frequency	O-E
stream channel	1	0.81

Surface soil	Frequency	O-E
clayey sand	1	0.90

Strew	Frequency	O-E
cobble (51-250mm) gt 70%	1	0.94

Structural description	Frequency	O-E
woodland	1	0.87

Dominant Overstorey Species	Frequency
Eucalyptus camaldulensis	1

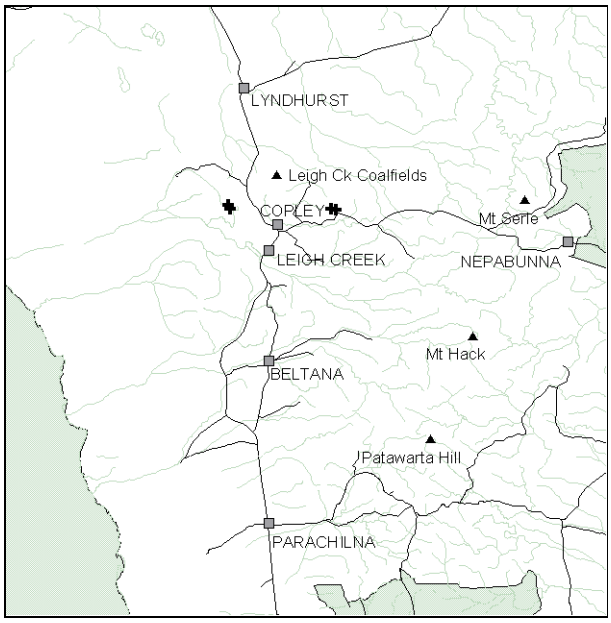
Group 14: *Eucalyptus socialis* mallee.

Mallee low woodland dominated by Beaked Red Mallee over scattered Broom Emubush and low shrubs dominated by Bladder Saltbush. Occurs on lower hillslopes undulating plains and gullies usually on calcareous loams with moderate surface cover of pebbles or cobbles. Usually occurs adjacent to higher ranges. Other important indicator species include *Maireana ovata*, Clustered Lawrencia, Rosy Bluebush and Quandong. This assemblage is typical of structural vegetation group 14.

Number of sites in group:	**4**				
Number of species in group:	**23**				
Number of species not used in analysis:	**1**				
Average number of species at sites:	**11.3**	**Max.**	**18**	**Min.**	**17**
Number of perennial species in group:	**21**	**Ave.**	**10.8**		
Number of introduced species in group:	**0**	**Ave.**	**0**		

Sites

ARO00201 ARO00303 COF00203 COF00301



Species at > 30% of sites ordered by indicator spp.	Common name	% of sites in group	O-E/E	indicator spp.	Frequency in group	frequency all sites	occurrence in groups
Eremophila scoparia	broom emubush	100	22.8	13.2	4	6	3
Maireana ovata		100	22.8	13.2	4	6	3
Eucalyptus socialis	beaked red mallee	100	19.4	11.2	4	7	4
Lawrencia glomerata	clustered lawrencia	50	34.6	10.0	2	2	1
Maireana erioclada	rosy bluebush	100	13.3	7.7	4	10	4
Santalum acuminatum	quandong	50	22.8	6.6	2	3	2
Maireana coronata	crown fissure-plant	50	9.2	2.7	2	7	5
Sclerolaena diacantha	grey bindyi	50	5.5	1.6	2	11	4
Atriplex vesicaria	bladder saltbush	100	2	1.2	4	48	11
Senna artemisioides coriacea	broad-leaf desert senna	50	3.2	0.9	2	17	8
Rhagodia spinescens	spiny saltbush	50	0.6	0.2	2	44	11

Species at < 30% of sites with indicator value > 0		% of sites in group	O-E/E	indicator spp.	frequency in group	frequency all sites	occurrence in groups
Anemocarpa podolepidium	rock everlasting	25	16.8	2.4	1	2	2
Melaleuca lanceolata lanceolata	dryland tea-tree	25	16.8	2.4	1	2	2
Maireana carnosa	cottony bluebush	25	10.9	1.6	1	3	2
Prostanthera striatiflora	striated mintbush	25	4.1	0.6	1	7	3
Santalum lanceolatum	plumbush	25	2.6	0.4	1	10	7
Maireana sedifolia	pearl bluebush	25	2	0.3	1	12	5
Salsola kali	buckbush	25	2	0.3	1	12	7
Alectryon oleifolius canescens	bullock bush	25	0.4	0.1	1	26	9

Landform	Frequency	O-E
hill slope	2	0.81
gully	1	0.84
plain (incl undulating plain)	1	0.69

Surface soil	Frequency	O-E
sandy clay loam	2	1.17
clayey sand	1	0.58
sandy loam	1	-0.19

Strew	Frequency	O-E
pebble (5-50mm) 30-70%	2	1.22
boulder (gt 250mm) 30-70%	2	1.64

Structural description	Frequency	O-E
mallee	4	3.69

Dominant Overstorey Species	Frequency
Eucalyptus socialis	4

Site ARO 002 01 in the Aroona Range. Beaked Red Mallee over Broom Emubush and Bladder Saltbush

Floristic Group Diversity Summary

Figure 10 compares average species richness for the 14 floristic groups. The floristic groups with the highest average species richness include the steep range group 3 (spinifex hummock grasslands), and the floodplain/drainage line groups 7 to 9 which receive the highest input of water and nutrients. The mallee woodland floristic group appears to support the lowest diversity of plant species followed by the chenopod shrubland groups 4 to 6 which are characteristic of the undulating stony plains and low hills. In comparison the low open chenopod shrublands/grassland community of the outwash plains (floristic group 11) has a relatively high average species richness. The average diversity of ephemeral species reflects the trends evident with all species. Figure 11 presents the average introduced species richness for each floristic group. Groups with the highest numbers of exotic species reflect the structural diversity of the sites and the presence of areas that concentrate water and nutrients through collection of runoff. The drainage line and floodplain groups 7, 9 and 13 dominate. Floristic group 3 contains the majority of steep range sites with a diversity of slope aspects and includes a drainage line site. The four sites in this group were also in the vicinity of Aroona Dam and Copley with their permanent water and exotic plant seed sources.

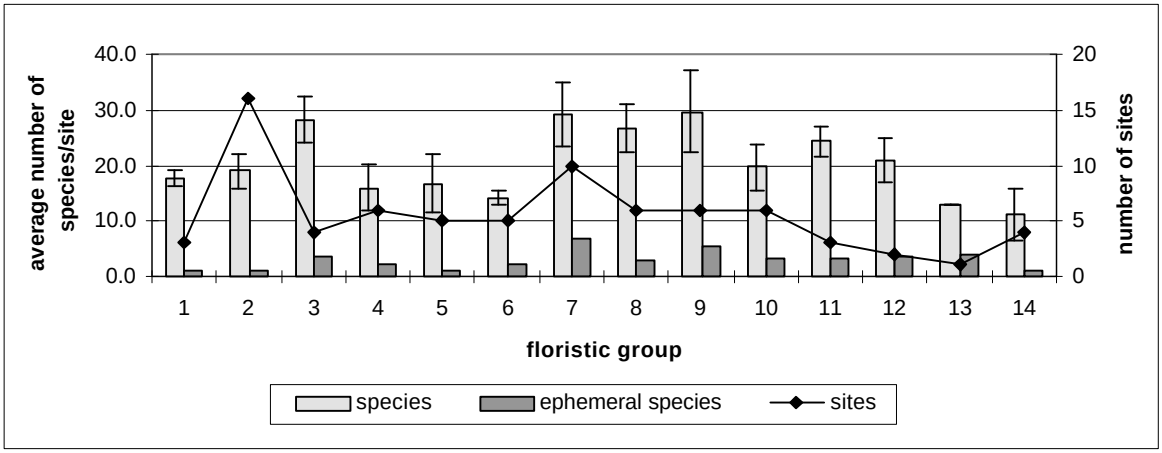


Figure 10. Average species richness (all species [with 95% confidence intervals] and ephemerals only) for the 14 floristic groups.

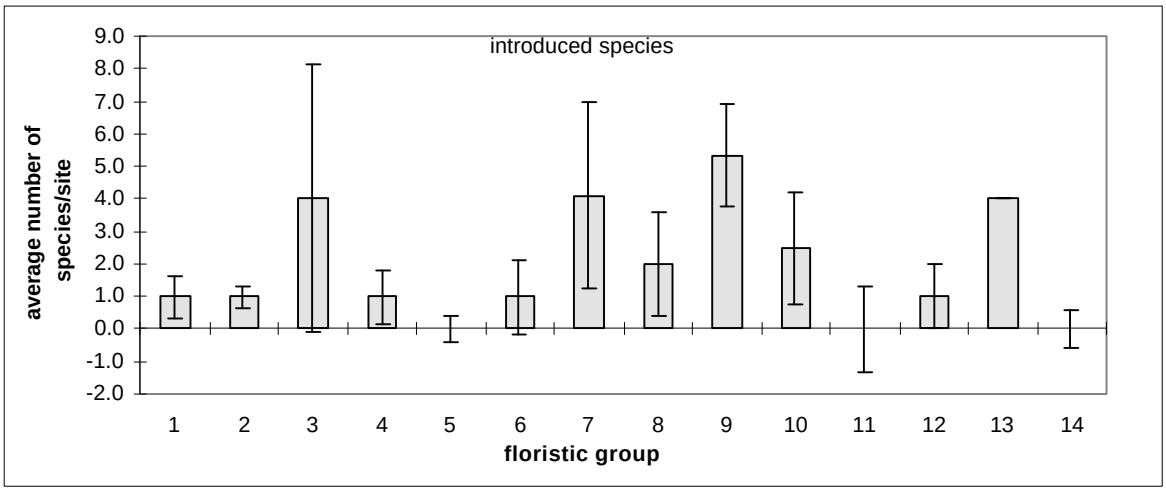


Figure 11. Average introduced species richness of the 14 floristic groups.

SPECIES WITH CONSERVATION SIGNIFICANCE

Eight species considered to be of conservation significance were located within the study area. Five are rated nationally (Briggs and Leigh 1995) and three have a state conservation rating (Lang and Kraehenbuhl 1997). These are listed in Table 6 which details whether they are perennial or ephemeral. For the five species detected at sites, the number of sites at which they were detected in each floristic group is shown. The two species with a national conservation rating were not detected at survey sites, were located by the Pastoral Assessments Program (*Codonocarpus pyramidalis* Slender Bell-fruit and *Maireana melanocarpa* Black-fruited Bluebush - populations of these species are detailed in the Threatened Species Database held by DEHAA, [Davies 1995]). Sandlewood *Santalum spicatum* is considered rare in SA and was detected by the Flinders Ranges Management Review.

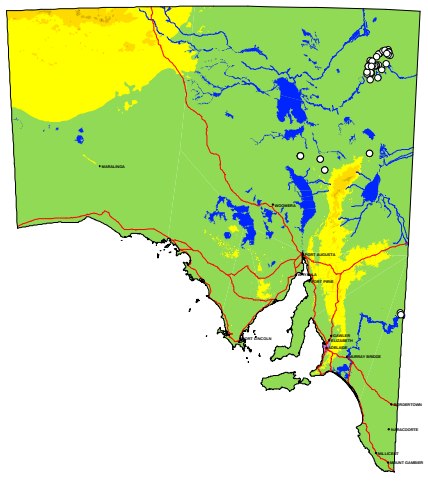
SPECIES	COMMON NAME	LIFESPAN	SA STATUS	AUST STATUS	FLORISTIC GROUPS 1	2	3	4	5	6	7	8	9	10	11	12	13	14	FREQUENCY
Codonocarpus pyramidalis	slender bell-fruit	P	V	3Vci															0
Maireana melanocarpa	black-fruited bluebush	P	V	3V															0
Frankenia cupularis		P	K	3K				1											1
Frankenia subteres		P	K	2K									1						1
Sclerolaena holtiana	Holt's bindyi	P	K	3K										1					1
Wahlenbergia aridicola	dryland bluebell	A	R							1	4								5
Santalum spicatum	Sandlewood	P	R																0
Jasminum didymum ssp. lineare	native jasmine	P	Q										1		1				2

Table 6. Species with conservation ratings and their recorded frequency in the floristic groups.

Species descriptions

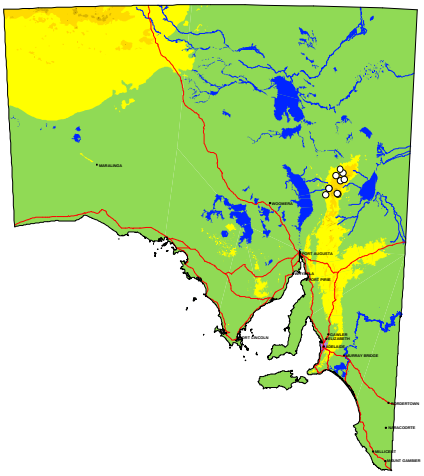
***Frankenia cupularis* (sea-heath)**

This densely branched small herb was detected at only one site on the survey. It is widely distributed across the Lake Eyre Basin occurring in all the associated States (Hnatiuk 1990). In SA it also occurs in the Lake Eyre (LE), Gairdener-Torrens (GT) and Eastern (EA) botanical regions (Jessop 1993). This species appears to be most common in the Cooper Creek wetlands in the vicinity of Coongie Lakes (Reid and Gillen 1988). The species was also recorded as an isolated population on the Chowilla Floodplain on the Murray River (O'Malley and Sheldon 1990). On the present survey the species was rarely recorded from an *Atriplex vesicaria*/*Maireana astrotricha* low shrubland (Floristic group 4) in the Mount Coffin area east of Leigh Creek.



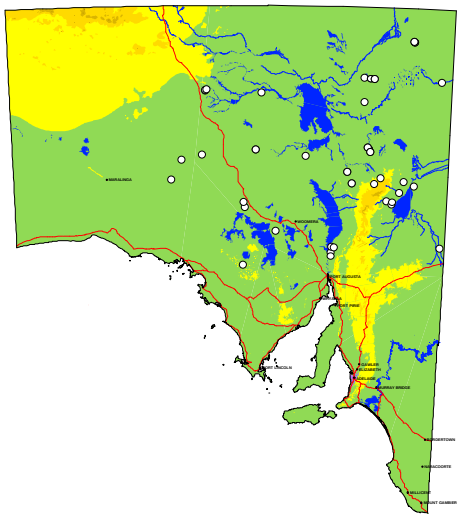
***Frankenia subteres* (sea-heath)**

This South Australian endemic small shrub was recorded at three sites in the study area. Most records come from the Northern Flinders Ranges (Flinders Ranges Management Review data). Badman (1995) notes this as rarely occurring in the Lake Eyre botanical region associated with the saline clay soils of creek banks and mound springs. In the study area it was found in a Red Gum lined creek (Floristic group 9). The other two records come from the Flinders Ranges Management Review. These were both located south-west of Leigh Creek in low shrublands, on a hill slope with *Maireana pyramidata* dominant and a hill footslope dominated by *Frankenia serpyllifolia*.



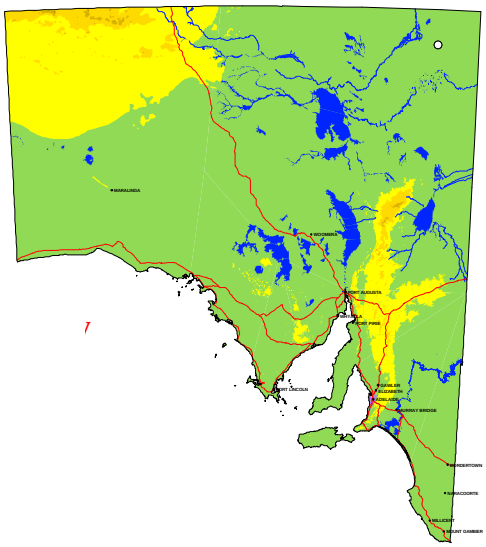
***Sclerolaena holtiana* Holt's Bindyi**

This small hairy perennial shrub was located at one site by the survey and at two pastoral assessment sites. The species was found to be widespread in the LE botanical region (Badman 1995, Brandle 1998). It also occurs in the Gairdener-Torrens and Eye Peninsula botanical regions (Robinson *et al* 1988, Copley and Kemper 1992). The survey record was made in a drainage depression supporting *Acacia victoriae* over *Maireana aphylla* south-west of Leigh Creek (Floristic group 10). The two pastoral assessment sites were north-east of Leigh Creek on Burr Well Station at pediment sites dominated by *Sclerolaena* spp. sub-shrublands with *Zygophyllum* spp..

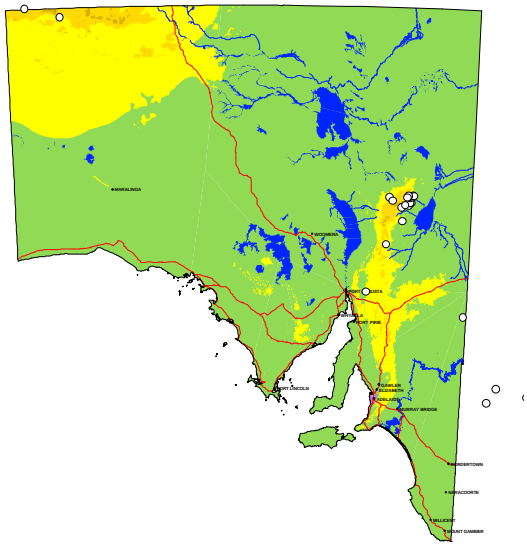


***Wahlenbergia aridicola* Dryland Bluebell**

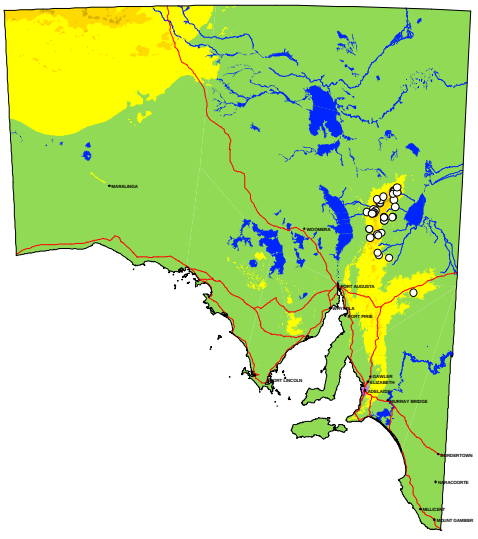
This perennial herb was found at two sites by this study and is known only from arid South Australia and Western New South Wales (Hnatiuk 1990). This species was rarely recorded by surveys north of the study area with only one record in the stony deserts (Brandle 1998). The two sites were spread over the eastern side of the study area, both were characterised by *Acacia victoriae* in a floodout/drainage depression situation (Floristic groups 6 and 7). *Wahlenbergia* spp. were also collected at three other sites in creeklines (Floristic group 7), unfortunately these were not identifiable to species level .



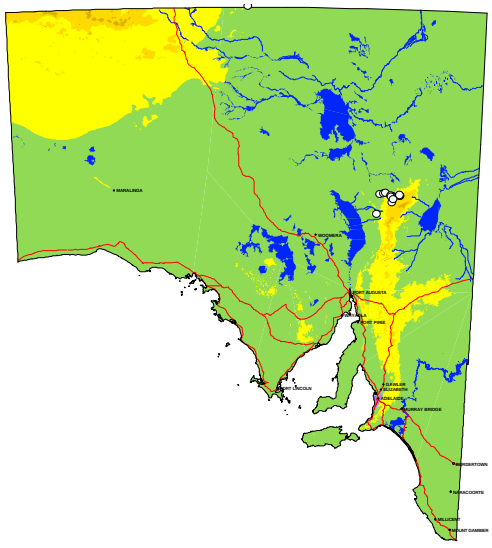
***Jasminum didymum* ssp. *lineare* Native Jasmine**
This widespread species is known from all States except Tasmania (Hnatiuk 1990). The majority of records in South Australia come from the north-western Flinders Ranges. It was recorded in an *Eremophila duttonii* open shrubland over grasses and chenopod sub-shrubs (Floristic group 11) south-west of Leigh Creek.



***Codonocarpus pyramidalis* Slender Bell-fruit**
This nationally vulnerable tree has the bulk of its restricted distribution in the Flinders and Olary Ranges and extends into New South Wales along the Olary Spur. Whilst the species was not recorded during the survey, several populations have been recorded on Warraweena and Manners Well Pastoral Leases on low hills and ridges at the eastern edge of the study area (Davies 1995). These are at the north western limits of the distribution for this species.



***Maireana melanocarpa* Black-fruited Bluebush**
This nationally vulnerable low shrub is restricted to a small area which includes the study area in the southern range of its distribution. Whilst not recorded at sites on the survey, the species is known to grow in association with low chenopod shrublands near Puttapa gap and along the Leigh Creek to Balcanoona road near Mt Coffin (Burr Well Pastoral Lease) (Davies 1995, Davies pers comm).



Species rated as having regional conservation significance

The surveys also detected a further 18 species which have a regional rating (Lang and Kraehenbuhl 1997) for the Flinders Ranges botanical region. The majority of these species are listed because of their affinities to the plain or dunefield habitats of the surrounding regions and as such only occur around the edge of the Flinders Ranges botanical region, much of which is yet to be systematically surveyed. The areas where these species appear to be most commonly encountered are presented in Table v5 by the symbols for the direction from the study area. Two of the species are at a geographical extreme of their known distribution in the study area. These include *Chenopodium curvispicatum* which is at a northern extreme and *Glinus lotoides* which represents a very southerly record. Three species were identified as being commonly recorded by the Flinders Ranges Management Review surveys of the central and northern Flinders. These are marked FR in Table 7.

SPECIES	Regionally rated	North West Flinders Ranges	Pastoral Assessments Program	Total
Abutilon otocarpum NW	r	1	1	2
Aristida holathera holathera NW	r	1	0	1
Atriplex fissivalvis NW	r	1	1	2
Chenopodium curvispicatum SE	k	1	0	1
Dichanthium sericeum NE	r	0	1	1
Enneapogon polyphyllus NW FR	k	1	1	2
Eragrostis australasica NWES	u	0	1	1
Euphorbia stevenii NW	r	1	1	2
Glinus lotoides N	k	1	0	1
Hibiscus krichauffianus NW	k	1	1	2
Mukia maderaspatana N	u	1	0	1
Phyllanthus lacunarius N	u	1	0	1
Polygonum plebeium N	T	1	0	1
Rhyncharrhena linearis WS	u	1	0	1
Sclerolaena convexula W FR	r	0	1	1
Sclerolaena intricata NWES	k	1	1	2
Sclerolaena tricuspis WS FR	k	0	1	1
Sida ammophila NWE	x	0	1	1

Table 7. Regionally rated species detected in the region by survey. x = extinct, T = threatened, r = rare, u = uncommon, k = poorly known. N = north, E = east, S = south, W = west from the study area. Species labelled FR should be down listed as they are common in the ranges.

INTRODUCED SPECIES

The proportion of exotic to native species detected in the study area (12%) reflects the climatic influence of the ranges (higher rainfall) when compared with surrounding survey efforts (6% in the Stony Deserts immediately to the north and 9% across the North Olary Pains to the east). In comparison, more southerly survey efforts such as the South Olary Plains had a higher percentage of the total flora being exotic (15%).

The most common introduced species was Ward's Weed *Charrichtera annua* which was detected at 14 (18%) sites. This understorey species was present on hillslope and drainage related sites, particularly floodplains. The frequency table of species by floristic groups (Table 8) highlights the affinity of most introduced species to the better watered and probably also the more highly disturbed drainage associated habitats, groups 7 to 9.

SPECIES	COMMON NAME	LIFESPAN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	FREQUENCY
Anagallis arvensis	pimpernel	A			1										1		2
Argemone subfusiformis ssp. *subfusiformis*	Mexican poppy	A								1							1
Brassica tournefortii	wild turnip	A										1		2			3
Carrichtera annua	Ward's weed	A	1	3	2				5	1		2					14
Carthamus lanatus	saffron thistle	A							3		2						5
Centaurea melitensis	Malta thistle	A							5		2						7
Centaurium spicatum	spike centaury	A													1		1
Chenopodium murale	nettle-leaf goosefoot	A									2						2
Citrullus colocynthis	colocynth	A			1				1		5	1					8
Citrullus lanatus	bitter melon	A				1			5	1							7
Datura ferox	long-spine thorn-apple	A									2						2
Datura leichhardtii	native thorn-apple	A			1				1		1						3
Dittrichia graveolens	stinkweed	A							5	1	2						8
Echium plantagineum	Salvation Jane	A						1	1		1						3
Heliotropium europaeum	common heliotrope	A							1	1	4						6
Marrubium vulgare	horehound	P			1				4		4						9
Medicago minima var. *minima*	little medic	A							2								2
Nicotiana glauca	tree tobacco	P			1					1	3				1		6
Onopordum acaulon	horse thistle	A							1								1
Rostraria pumila	tiny bristle-grass	A													1		1
Schinus areira	pepper-tree	P									1						1
Sisymbrium erysimoides	smooth mustard	A			1				1		2	1					5
Sisymbrium sp.	wild mustard	A							1								1
Solanum nigrum	black nightshade	P									1						1
Sonchus oleraceus	common sow-thistle	A							4								4
Tribulus terrestris	caltrop	A							1		1						2

Table 8. Introduced species frequency in each floristic group.

MAMMALS

R Brandle

INTRODUCTION

The mammal fauna of the Flinders Ranges have been summarised in at least three popular publications. These are: 'A Field Guide to the Flinders Ranges' (P Aitken in Corbett 1980); 'The Story of the Flinders Ranges Mammals' (1991); 'Natural History of the Flinders Ranges' (M Smith in Davies *et al* 1996). Despite the proximity of the Ranges to the populated parts of South Australia and the strong public interest, surprisingly little systematic field evaluation of the fauna of the region has occurred. The existing publications cite references to the once rich Flinders Ranges mammal fauna from the basis of the specimen collection of the South Australian Museum, historic accounts from both Aboriginal and European sources as well as skeletal remains. Many of the latter come from the historic owl pellet deposits analysed by G. Medlin (Medlin 1993, Tunbridge 1991). The most recent summary (Smith 1996) suggests that the likely pre-European mammal species count for the Flinders Ranges and adjacent plains was about 50 species. The extensive ecological degradation that has occurred in many of the habitats of the ranges since then has pruned this diverse assemblage back to 27 native species.

These include: one monotreme - the echidna; five carnivorous marsupials - of these the Common Dunnart *Sminthopsis murina* is restricted to the south-eastern regions; three species of possum - the Common Ringtail *Pseudocherinus peregrinus* has a southern distribution and the Common Brushtail *Trichosurus vulpecula* is now extinct in the northern regions; four kangaroo/wallaby species - the Eastern Grey *Macropus fuliginosus* is restricted to the south-east; five rodents - three of which do not occur in the northern flinders (the Water Rat *Hydromys chrysogaster* is restricted to the southern ranges, the Dusky Hopping-mouse has never been recorded in close proximity to the ranges except from historic owl pellet material, and the Long-haired Rat *Rattus villosissimus* may be a rare vagrant into the ranges during exceptional seasons); and nine species of bat. This indicates that only twenty species of native mammal would now be expected to reside in the northern Flinders ranges area. A recent finding of a Sandy Inland Mouse *Pseudomys hermannsburgensis* amongst the ranges south-east of Blinman (C Holden pers com) adds an extra species to this list.

Smith's (1996) summary also lists nine species of introduced or exotic mammals as occurring in the ranges. Excluded are domestic stock (Cattle, Sheep) and the dog. The Dingo *Canis familiaris dingo* is described as an introduced species (though be it over 3000 years ago) in this text, and is now considered rare in the region. It is still considered a pest and eradicated when noticed in this area south of the dingo proof fence. Two species, the Black Rat *Rattus rattus* and the Hare *Lepus capensis* occur only in the most southerly ranges.

The loss of mammal species from the ranges has been attributed to ecologically unsustainable land management and introduced herbivores and predators (Tunbridge 1991). Smith (1996) suggests that these factors are still exerting pressure on the remaining fauna. The broader realisation of this problem has prompted a shift in community attitudes which has facilitated the planning and procurement of resources to attempt to reverse these trends. Areas in the ranges have recently become the focus of major large-scale 'threat abatement programs' designed to protect habitats and encourage regeneration and recolonisation of native species (Operation Bounceback in the Flinders Ranges and Gammon Ranges National Parks and the Aroona Catchment Protection Project).

The study area represents a small but representative part of the northern Flinders Ranges containing a subset of many habitats that are a feature of this diverse region. Some species found in the higher ranges, such as the Western Pygmy Possum *Cercartetus concinnus* are unlikely to find suitable habitat in the study area. This chapter reports the findings of trapping over four nights at 32 sites and attempts to describe the relationship of the mammal fauna to the habitat types encountered in the region.

TOTAL SPECIES

Twenty two species of mammals are known to occur, independent from human habitation, in the study area. Of these, 13 are native to the area with the remaining eight exotic species having taken up residence since European settlement

The native species fall into six Families (echidna TACHYGLOSSIDAE 1 species, carnivorous marsupials DASYURIDAE 2 species, kangaroos and wallabies MACROPODIDAE 3 species, rodents MURIDAE 2 species, mastiff-bats MOLOSIDAE 3 species, evening bats VESPERTILIONIDAE 2 species). These species are displayed in Table 9, firstly the 17 species that were known for the study area from existing South Australian Museum and Biological Survey records prior to this study, followed by the five additional species recorded during this study.

Table 9. Mammal species known to occur in the study area based on SA Museum and DEHAA biological survey databases and Reardon and Flavel (1987) for bats. Species recorded during this survey are marked with an hash (#). Introduced species are marked with an asterisk (*). Conservation status categories include V = vulnerable, U = uncommon, K = poorly known.

North-West Flinders Mammals						
SUBCLASS **Aust status**	SA status	Introduced	**FAMILY**	**Scientific Name**	**Common Name**	**Recorded on survey**
PROTOTHERIA						
			TACHYGLOSSIDAE	*Tachyglossus aculeatus*	Echidna	#
MARSUPALIA						
			DASYURIDAE	*Sminthopsis crassicaudata*	Fat-tailed Dunnart	#
				Sminthopsis macroura	Stripe-faced Dunnart	#
			MACROPODIDAE	*Macropus robustus*	Euro	#
				Macropus rufus	Red Kangaroo	#
PV	V			*Petrogale xanthopus*	Yellow-footed Rock-Wallaby	
EUTHERIA						
		*	BOVIDAE	*Bos taurus*	cattle	#
		*		*Capra hircus*	Goat	#
		*		*Ovis aries*	sheep	#
		*	CANIDAE	*Vulpes vulpes*	Fox	#
		*	EQUIDAE	*Equus caballus*	horse	#
		*	FELIDAE	*Felis cattus*	Cat	#
		*	LEPORIDAE	*Oryctolagus cunniculus*	rabbit	#
			MOLOSSIDAE	*Tadarida australis*	White-striped Mastiff Bat	#
		*	MURIDAE	*Mus domesticus*	House Mouse	#
			VESPERTILIONIDAE	*Chalinolobus gouldii*	Gould's Wattled Bat	#
				Nyctophilus geoffroyi	Lesser Long-eared Bat	#
Number of mammals recorded for the study area prior to the survey					17	
Additions to the species list following the NWFR survey						
			MOLOSSIDAE	*Mormopterus planiceps* (big penis)	Little Mastiff Bat	#
				Mormopterus planiceps (little penis)	Little Mastiff Bat	#
	U		MURIDAE	*Leggadina forresti*	Forrest's Mouse	#
	K			*Pseudomys bolami*	Bolam's Mouse	#
			VESPERTILIONIDAE	*Vespadelus baverstocki*	Inland Brown Bat	#
Total number of mammals known from the study area					22	

Trapping proved rewarding with regards to the two native rodent species (Muridae) still utilising the study area. Rodents as a group have been significantly diminished throughout their former range since European settlement (Watts and Aslin 1981). However, no small mammals were recorded from the site in the dunefield in the west of study area. With respect to the carnivorous marsupials (Dasyuridae), the apparent lack of *Planigales* or the marsupial hopping-mouse (Kultarr *Antechinomys laniger*) was a disappointment, given the significant areas of apparently suitable habitat in the west of the study area. It is possible that some of these species were present at undetectable levels given the amount of survey effort expended in these areas. All of the larger native and exotic mammals known to still occur in the area were detected throughout the study area. The Yellow-footed Rock-wallaby has been reintroduced into the Aroona Range and is currently being monitored by the Adelaide Zoo for survival and population expansion. The eastern margins of the study area, where it abuts the main body of the Flinders Ranges, are known by the land managers, to support small colonies of this species. All cattle, sheep and horses within the study area were domestic stock, it is unlikely that there are any self sustaining feral populations. No wild dogs were recorded in the area.

COMMON SPECIES

Two species, the Stripe-faced Dunnart and the exotic House Mouse were recorded at over 50% of sites and were both detected with the approximate frequency of every fourth animal encountered. Four other species, two native and two introduced species, were encountered at more than 10% of sites (Table 10). Domestic stock, sheep *Ovis aries* and cattle *Bos taurus* were recorded inconsistently at sites and are not included in the following table.

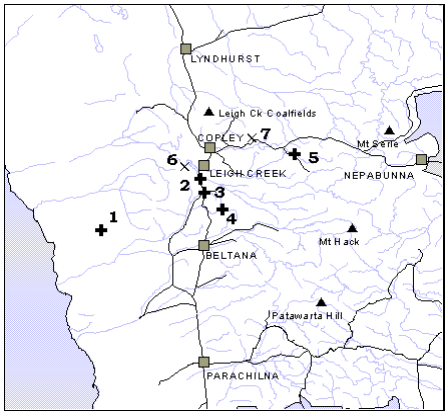
Table 10. Species recorded at sites ordered by the number of sites at which each species was detected. The overall abundance of each species and the detection rate are also displayed. An asterisk (*) denotes introduced species.

SPECIES	Common name	Site frequency	Abundance	Detection rate
Mus domesticus	House Mouse *	18	48	25.67%
Sminthopsis macroura	Stripe-faced Dunnart	16	48	25.67%
Sminthopsis crassicaudata	Fat-tailed Dunnart	10	29	15.51%
Macropus robustus	Common Wallaroo (Euro)	10	21	11.23%
Oryctolagus cuniculus	(European) Rabbit *	14	17	9.09%
Capra hircus	Goat *	5	7	3.74%
Macropus rufus	Red Kangaroo	3	5	2.67%
Vulpes vulpes	Fox (Red Fox) *	4	5	2.67%
Equus caballus	Horse *	2	2	1.07%
Pseudomys bolami	Bolam's Mouse	2	2	1.07%
Felis catus	Cat *	1	1	0.53%
Leggadina forresti	Forrest's Mouse *	1	1	0.53%
Tachyglossus aculeatus	Short-beaked Echidna (Spiny Anteater)	1	1	0.53%

Bat species were not included in the above table because bats were detected off sites (opportunistically) using a variety of mist-net configurations over dams, tanks, borrow pits and old mine entrances. Harp traps were set at some quadrats in strategic locations. All bats were captured over or adjacent to water. Table 11 indicates the abundance of species captured at five locations along with trapping effort. Mist netting/Bat trapping below Aroona Dam and across some old mine shafts in the Mt Coffin area was unsuccessful.

Table 11. Bat species captured at different locations. 1 = Gap Well (35 km south-west of Leigh Ck on edge of dunefield), 2 = borrow pit (10 km south of Leigh Ck in a chenopod shrubland), 3 = borrow pit (5 km south of Leigh Ck in a Pearl Bluebush shrubland with emergent Blackoak), 4 = Boulder Dam (13 km south-south-east of Leigh Ck in a chenopod shrubland adjacent to a Blackoak woodland), 5 = Nobbler Dam (25 km east of Leigh Ck adjacent to scrubby hill slopes and sparse Blackoak woodland). These sites are marked with a bold + on the map. The two unsuccessful sites 6 = Aroona dam and 7 = Mt Coffin are marked with an X.

Species	Common name	1	2	3	4	5	Total
Mormopterus planiceps	Little Mastiff Bat	4	12	4	4	4	**24**
Chalinolobus gouldii	Gould's Wattled Bat	1		1			**2**
Nyctophilus geoffroyi	Lesser Long-eared Bat	1					**1**
Tadarida australis	White-striped Mastiff Bat				1		**1**
Vespadelus baverstocki	Inland Brown Bat					1	**1**
	number of species	**3**	**1**	**2**	**2**	**2**	**5**
	number of individuals	**6**	**12**	**5**	**5**	**5**	**29**



SPECIES PATTERNS

The patterns of the larger native species are well established (Smith 1996). Euros *Macropus robustus* are usually associated with the steeper hillslopes and rocky outcrops whilst Red Kangaroos *M. rufus* are widespread through the low hills and plains habitats. The Yellow-footed Rock-wallaby *Petrogale xanthopus* is restricted to the steepest gorges and rocky outcrops. This habitat partitioning was supported by our observations which are presented for landform types. The majority of observations of Red Kangaroos were opportunistic with only a few being observed on sites. However the presence of either species was evident at many sites through their droppings (these were only identified to genus level).

Landform	***M. robustus***	***M. rufus***
drainage depression	0	1
hill crest	2	0
hill slope	6	1
plain (incl undulating plain)	1	1
stream channel	1	0

The only echidna encountered was through tracks in the dunefield in the west of the study area but it has also been reported in the Aroona Dam area (B Odermatt pers com).

Of the exotic species only goats *Capra hircus*, rabbits *Oryctolagus cunniculus* and foxes *Vulpes vulpes* were recorded in sufficient numbers to detect trends. Goats were observed mostly on hill slopes and associated drainage lines and depressions. Particularly the Mt Deception Range and also the Rugged Aroona Range. Foxes were observed in the dunefield, creeks, floodouts and hillslopes and are likely to visit all habitat types in the study area. Similarly rabbits were recorded in all landforms but were more often observed on the plains in looser sandier soils.

Species community patterns were investigated using PATN (Belbin 1989) only for the smaller mammals because data recording is based on trapping efforts which are comparable between sites. Twenty-six sites contained small mammal data. All sites including those with only one small mammal species were included in the analysis, as many sites only support a single species for extended periods. All five terrestrial small mammals including the introduced House Mouse were used in the analysis.

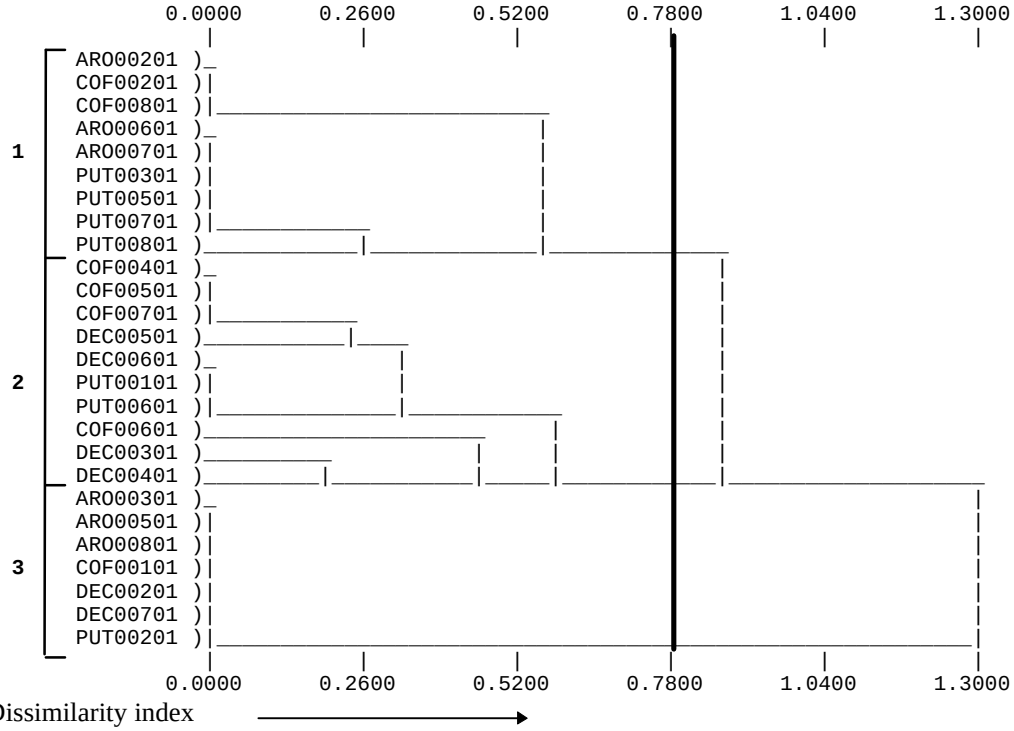


Figure 12. Dendrogram of site association matrix displaying similarity between sites. The three groups reflect the dissimilarity at the level of dissimilarity shown by the thick vertical line. These three groups were felt to be useful for discussing the mammal assemblage patterns of the study area.

The PATN analysis highlighted three major groups of similar sites, two of these supported native small mammal species. The first group comprised of the first nine sites is characterised by the Stripe-faced Dunnart and takes in the bulk of the steeper hill sites supporting medium to tall shrublands. Mammal assemblage group 2 characterises the low chenopod shrubland sites, the most important indicator species being the Stripe-faced Dunnart, though all other species were present at some sites. The last seven sites supported only the introduced House Mouse and are typical of drainage line woodlands in the study area.

Table 12. Site frequency in mammal assemblage groups for the biophysical parameters recorded.

	Mammal assemblage group	**1**	**2**	**3**
Landform	hill crest	2	1	0
	hill slope	2	2	1
	gully	1	0	0
	stony plain	1	4	1
	plain (incl undulating plain)	0	2	1
	flood out	2	0	0
	drainage depression	1	0	0
	stream channel	0	1	3
	dune/consolidated dune	0	0	1
Surface soil texture	medium clay	1	2	0
	clay loam, sandy	0	1	1
	clayey sand	1	2	1
	sandy clay loam	1	2	0
	silt loam	1	1	0
	loam	2	0	1
	sandy loam	3	2	2
	loamy sand	0	0	1
	sand	0	0	1
Strew size and cover	Sheet 30-70%	0	1	0
	boulder (gt 250mm) gt 70%	1	0	0
	boulder (gt 250mm) 30-70%	1	0	1
	cobble (51-250mm) gt 70%	1	0	0
	cobble (51-250mm) 30-70%	2	1	0
	cobble (51-250mm) 10-30%	1	1	2
	pebble (5-50mm) gt 70%	0	0	1
	pebble (5-50mm) 30-70%	0	4	1
	pebble (5-50mm) 10-30%	1	2	1
	pebble (5-50mm) <10%	1	1	0
	none apparent	1	0	1
Dominant vegetation strata	woodland	0	1	2
	low woodland	1	0	0
	mallee	1	0	0
	tall shrubland	1	0	2
	shrubland	2	2	0
	low shrubland	3	5	3
	sub-shrubland	0	2	0
	hummock grassland	1	0	0

Detailed descriptions of the groups identified are set out in the following format:

- the mammal assemblage group number;
- the number of sites comprising the group;
- the number of species recorded for that group;
- the average number of species at sites for the group including the maximum and minimum species diversity recorded at sites within the group;
- a brief description of the group;
- a list of the sites forming the group and a map showing their location relative to the towns, roads and drainage features;
- a table of species group statistics;
  - Column 1 - species occurring in greater than 30% of the sites within the group are listed in order of percent frequency of occurrence (the number of sites supporting the species within the group).
  - Column 2 - lists the common name of the species.
  - Column 3 - presents the percentage of the sites at which a species was recorded.
  - Column 4 - O-E/E represents the relative importance of a species to the group. Indicator species are highlighted by their greater proportion of occurrence in the group than would be expected through chance alone (O = observed frequency and E = the expected frequency if the species was randomly distributed through all groups).
  - Column 5 - indicator spp. is derived from the 0-E/E value which is multiplied by the ratio of the species frequency within the group to the total frequency of all species within the group multiplied by 100 ([0-E/E] x [freq. of sp.]/[total freq. of sp.] x 100). This formula decreases the bias the 0-E/E formula gives to infrequently encountered species by taking into account the number of sites a species occurs in within the group. This column was used to sort the species from highest to lowest.
  - Column 6 - presents the total number of sites within the group in which the species was recorded.
  - Column 7 - presents the occurrence of species when all sites are considered. This provides an indication of how common a species was throughout the survey area.
  - Column 8 - presents the occurrence of a species in other groups which helps to assess the importance of a species to that group;
- the frequency of occurrence of sites within a mammal assemblage group in the floristic groups identified in the vegetation analysis. Similar tables are presented for landform, soil surface texture and strew size and cover.

An alphabetical listing of mammal species and the number of sites at which they were recorded within each floristic group is presented in Appendix m1. Descriptions of the floristic groups are presented in the vegetation chapter.

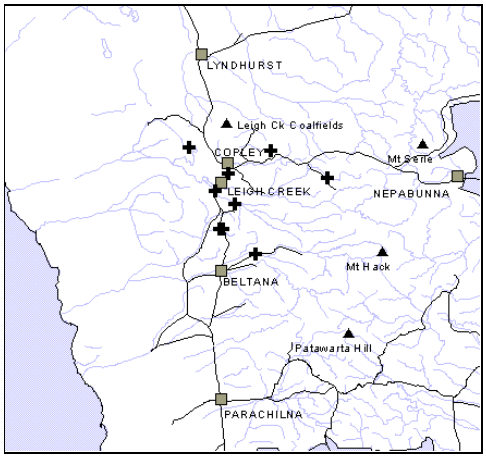
Group number 1

Number of sites 9
Number of species 3
Average # sp at sites 1.8 **Max** 3 **Min** 1

This assemblage is characterised by the Stripe-faced Dunnart and occurs over a wide variety of landforms and habitats. These include rocky hill slopes and drainage lines supporting a variety of shrublands usually with emergent taller strata or a woodland overstorey.

Sites

ARO00201 COF00201 COF00801 ARO00601
ARO00701 PUT00301 PUT00701 PUT00801
PUT00501



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Sminthopsis macroura	Stripe-faced Dunnart	100	0.7	13.40	9	16	3
Pseudomys bolami	Bolam's Mouse	11	0.5	1.06	1	2	2
Mus domesticus	House Mouse	67	0	0.00	6	18	4

Floristic group

	# sites
Ptilotus obovatus, Sida petrophila, Solanum ellipticum low open shrubland with emergent tall shrubs and low trees.	3
Atriplex vesicaria, Rhagodia spinescens low shrubland with *Casuarina pauper* low open woodland overstorey or emergent *Acacia victoriae, Alectryon oleifolius* and *Eremophila* spp.	2
Maireana pyramidata, Atriplex vesicaria low shrubland with emergent *Acacia victoriae*.	2
Atriplex lindleyi, Atriplex vesicaria, Sclerolaena divaricata low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.	1
Eucalyptus socialis Mallee.	1

Landform	# sites
flood out	2
hill crest	2
hill slope	2
drainage depression	1
gully	1
stony plain	1

Surface soil texture	# sites
sandy loam	3
loam	2
clayey sand	1
medium clay	1
sandy clay loam	1
silt loam	1

Strew size and cover	# sites
cobble (51-250mm) 30-70%	2
boulder (gt 250mm) 30-70%	1
boulder (gt 250mm) gt 70%	1
cobble (51-250mm) 10-30%	1
cobble (51-250mm) gt 70%	1
none apparent	1
pebble (5-50mm) <10%	1
pebble (5-50mm) 10-30%	1

Dominant vegetation strata	# sites
low shrubland	3
shrubland	2
tall shrubland	1
hummock grassland	1
low woodland	1
mallee	1

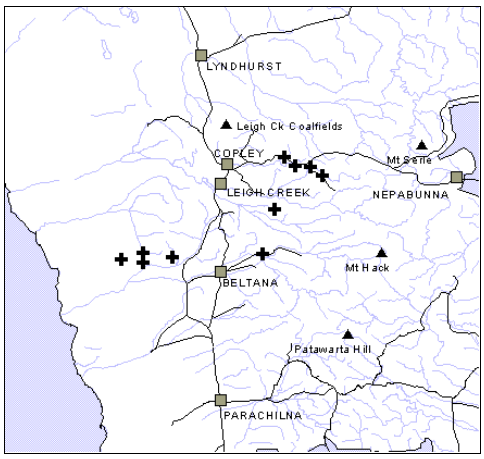
Group number 2

Number of sites 10
Number of species 5
Average # sp at sites 2.4 **Max** 3 **Min** 1

This group is characterised by the Fat-tailed dunnart and more rarely, Forrest's Mouse. This group is the most diverse assemblage and is typical of the low chenopod shrublands and sub-shrublands of the plains and gentle hill slopes common across the study area.

Sites

COF00401 COF00701 DEC00601 DEC00501
COF00501 PUT00101 PUT00601 COF00601
DEC00301 DEC00401



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Sminthopsis crassicaudata	Fat-tailed Dunnart	100	1	21.28	10	10	3
Leggadina forresti	Forrest's Mouse	10	1	2.13	1	1	1
Pseudomys bolami	Bolam's Mouse	10	0	0.00	1	2	2
Sminthopsis macroura	Stripe-faced Dunnart	70	-0.1	-1.49	7	16	3
Mus domesticus	House Mouse	50	-0.5	-5.32	5	18	4

Floristic group	# sites
Sclerolaena ventricosa, Sclerolaena brachyptera sub-shrubland with tussock grasses and emergent shrubs.	3
Maireana pyramidata, Atriplex vesicaria low shrubland with emergent *Acacia victoriae*.	2
Atriplex vesicaria, Maireana astrotricha low shrubland.	2
Ptilotus obovatus, Sida petrophila, Solanum ellipticum low open shrubland with emergent tall shrubs and low trees.	1
Atriplex lindleyi, Atriplex vesicaria, Sclerolaena divaricata low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.	1
Eucalyptus camaldulensis open woodland.	1

Landform	# sites
stony plain	4
hill slope	2
plain (incl undulating plain)	2
hill crest	1
stream channel	1

Surface soil texture	# sites
sandy loam	2
clayey sand	2
medium clay	2
sandy clay loam	2
silt loam	1
clay loam, sandy	1

Strew size and cover	# sites
pebble (5-50mm) 30-70%	4
pebble (5-50mm) 10-30%	2
cobble (51-250mm) 30-70%	1
cobble (51-250mm) 10-30%	1
pebble (5-50mm) <10%	1
Sheet 30-70%	1

Dominant vegetation strata	# sites
low shrubland	5
shrubland	2
sub-shrubland	2
woodland	1

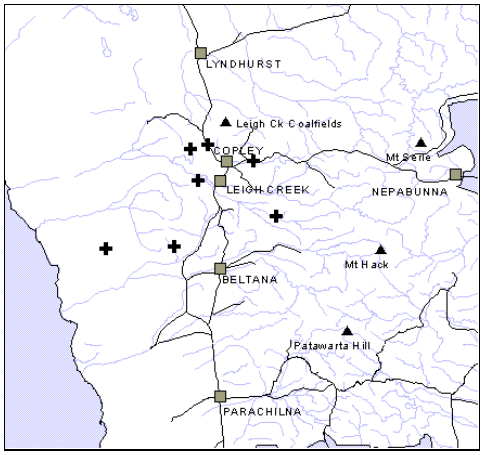
Group number 3

Number of sites 7
Number of species 1
Average # sp at sites 1 **Max** 1 **Min** 1

This group comprises the sites at which only the House Mouse was recorded and therefore includes the variety of habitat which can support this often ephemeral species. However it would be reasonable to conclude that this species depauperate group is typical of the majority of creekline woodlands throughout the study area.

Sites

ARO00301 ARO00501 ARO00801 COF00101
DEC00201 DEC00701 PUT00201



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Mus domesticus	House Mouse	100	1.6	23.83	7	18	4

Floristic group	# sites
Atriplex vesicaria, Maireana astrotricha low shrubland.	2
Maireana pyramidata, Atriplex vesicaria low shrubland with emergent *Acacia victoriae*.	1
Eucalyptus camaldulensis open woodland.	1
Acacia victoriae, Acacia tetragonophylla tall shrubland with or without *Melaleuca glomerata* and *Eucalyptus camaldulensis* open woodland over *Maireana pyramidata* and *Rhagodia spinescens*.	1
Acacia tetragonophylla/Acacia victoriae/Acacia aneura tall shrubland over scattered shrubs and tussock grasses.	1
Acacia ligulata Tall Shrubland over *Senna* spp. shrubs and *Atriplex velutinella* low shrubs.	1

Landform	# sites
stream channel	3
stony plain	1
hill slope	1
plain (incl undulating plain)	1
dune/consolidated dune	1

Surface soil texture	# sites
sandy loam	2
clayey sand	1
clay loam, sandy	1
loam	1
loamy sand	1
sand	1

Strew size and cover	# sites
cobble (51-250mm) 10-30%	2
pebble (5-50mm) 30-70%	1
pebble (5-50mm) 10-30%	1
boulder (gt 250mm) 30-70%	1
none apparent	1
pebble (5-50mm) gt 70%	1

Dominant vegetation strata	# sites
low shrubland	3
woodland	2
tall shrubland	2

SPECIES RICHNESS

Native mammal species richness is generally low per site with a maximum species richness of three, when compared to the adjacent stony deserts, where some habitats will regularly support five or more species of small native mammals (Morton *et al* 1994, Brandle 1998). However the median for small mammals in Australia's arid zone is two species per site (Morton *et al* 1994). In the study area (even including the larger species) only four sites had three of the seven terrestrial native mammals present, ten sites had two, eleven sites had one and eight sites had none. This provides a median species richness of two if the eight sites with no native mammals are excluded. The diversity of the mammal fauna is also similar in structure to other arid zone regions in that carnivorous marsupials (Dasyurids), Murid rodents and Kangaroos (Macropods), dominate.

Bat species diversity appears to be reasonably high, with the six species recorded likely to be an underestimate. None of the rarer species of bats were noted but species such as the Little Brown Bat *Vespadelus finlaysonii* are likely to roost in caves and old mine shafts which are common in the study area. A number of other bat species which have been recorded in other parts of the northern Flinders may also be periodically present in the study area.

The following charts (Figures 13 to 16) indicate how the biophysical parameters recorded relate to native terrestrial mammal diversity within the study area. Stony plains to drainage depressions generally supported more species than hill slopes and drainage lines. This is reflected in the soils (Figure m4) with clay to loams being more diverse and productive than sand. The strew analysis (Figure m5) indicates that sites with a moderate strew of small stones or sheet rock support higher diversities and abundances. Figure m6 indicates that low shrubland sites are the most species rich and productive in the study area. This was supported by the small mammal productivity in these habitats noted in the species pattern section and the number of species recorded in those habitats (low shrublands and shrublands supported up to five species as opposed to three species in most others, mallee only supported two species).

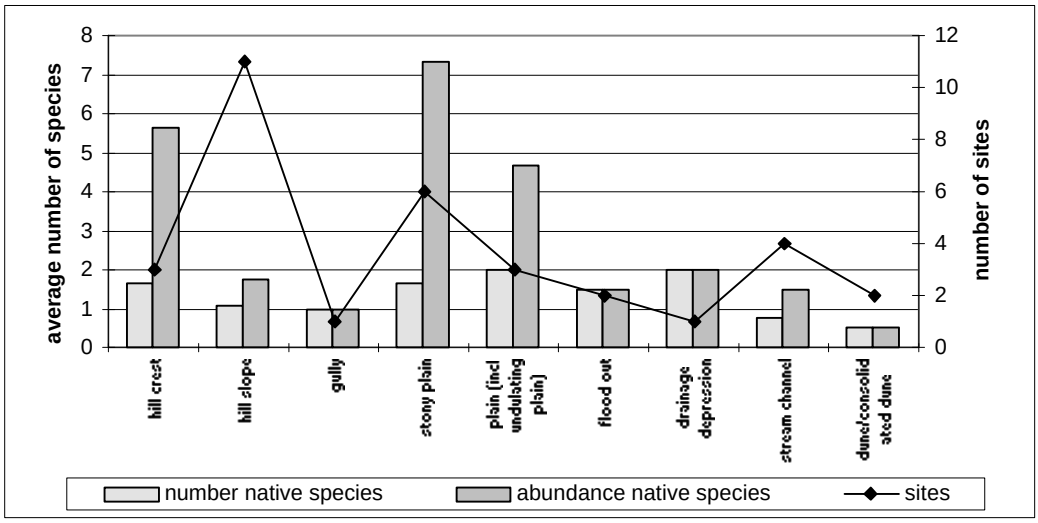


Figure 13. The average native mammal species richness and abundance for sites in each of the landform categories.

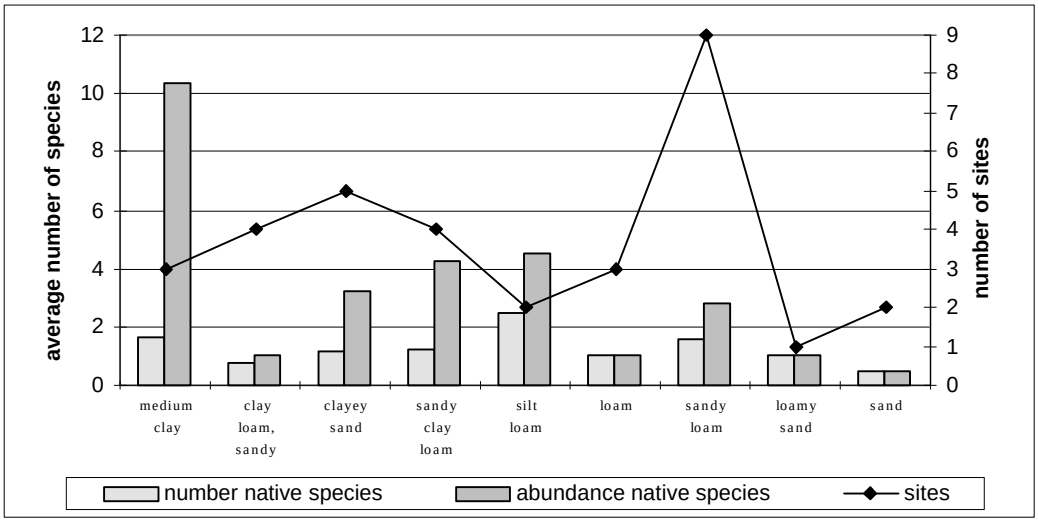


Figure 14. The average native mammal species richness and abundance for sites in each of the surface soil texture categories.

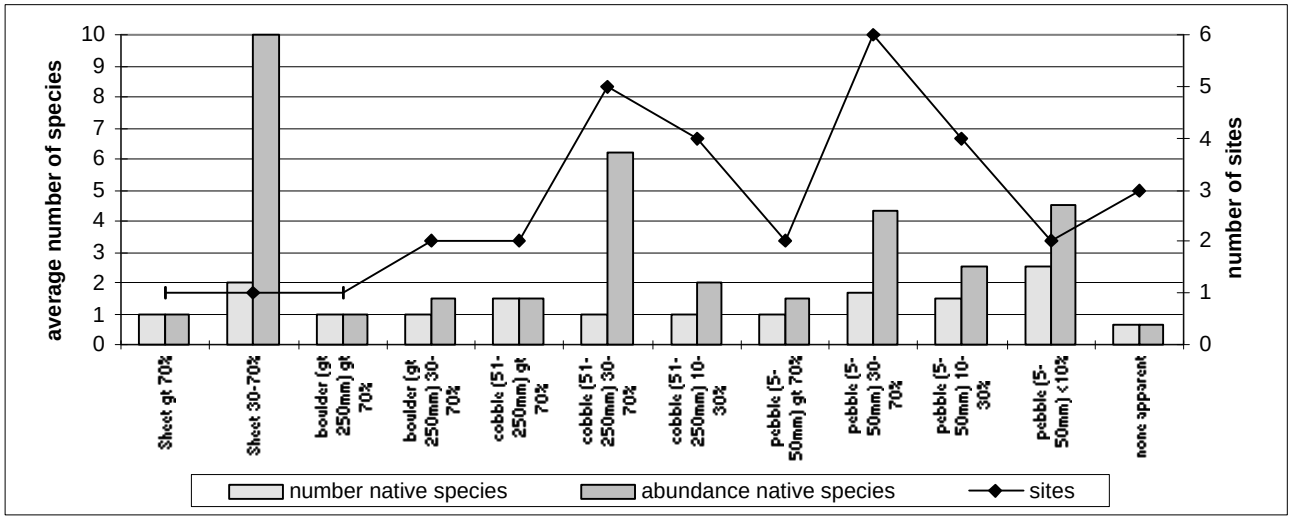


Figure 15. The average native mammal species richness and abundance for sites in each of the strew size and cover categories.

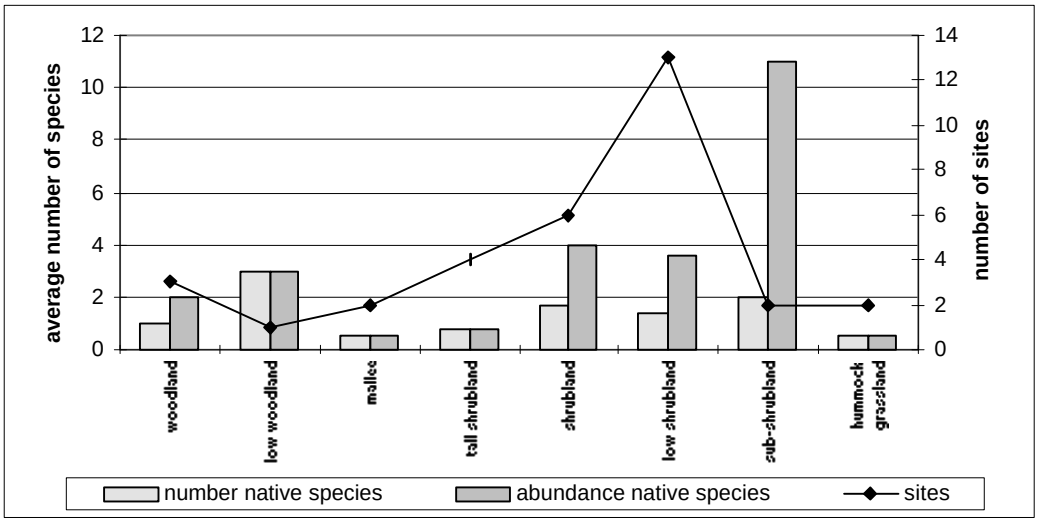


Figure 16. The average native mammal species richness and abundance for sites in each of the overstorey vegetation strata categories.

SPECIES WITH CONSERVATION SIGNIFICANCE

Only one species recorded in the study area has a national conservation rating. The Yellow-footed Rock-wallaby is considered to be vulnerable under the IUCN criteria and has had a recovery outline prepared in the Action Plan for Australian Marsupials and Monotremes (Maxwell *et* al 1996). The species was likely to have been more common in the study region as it was recorded by Eyre and Babbage last century (Copley 1988) in the Aroona Range but this population disappeared in recent times. The current reintroduction and feral predator/competitor control program should see the species recover. The still extant populations towards the east of the study area would also benefit from a similar goat, rabbit and fox control program.

One species of rodent, the Forrest's Mouse *Leggadina forresti* is rated as rare (Watts 1990) in South Australia. Bolam's Mouse whilst rated as common in a number of other regions was not until recently recorded in the Flinders Ranges. The only other record of this species come from the plains adjacent to the Olary Ranges. Records of both these species in the study area are significant contributions to our knowledge about rodents in the Flinders Ranges.

INTRODUCED SPECIES

Introduced species comprised 41% of the total mammal fauna recorded during the survey. Introduced species are a significant component of the assemblages in each landform (Appendix 4) and vegetation type (Appendix 5) at most sites. Very few areas in the region would not be regularly visited by both introduced predators and herbivores. Integrated preditor and competitor control programs are likely to have beneficial impacts on native flora and fauna in the region.

BIRDS

R Brandle

INTRODUCTION

The natural history of birds in the Flinders Ranges has been summarised by Reid, Carpenter and Pedler in 'A Natural History of the Flinders Ranges' (Davies *et al* 1996). This account summarises the ornithological literature and the distributional trends of species in relation to geography and habitat, and also discuss the regional avian biogeography. There is a paucity of published material relating to the Leigh Creek area, despite its focus for human habitation and services in the region. This may reflect its position on the edge of several major landform types and the allure of the main body of the Flinders Ranges to the east.

Four of the six broad habitat bird assemblage groups discussed for the Flinders Ranges by Reid *et al* (1996) are relevant to the study area.

1. The watercourses with River Red Gum habitats are described as supporting a rich and distinctive bird community. This bird assemblage shows the least amount of variation on a north-south gradient when compared to assemblages of other habitats, and is characterised by the number of species which nest in hollows, as well as large sized birds. These species depend on River Red Gums for nesting and roosting habitat.
2. The mallee, mallee-heath and Native Pine woodlands are treated as a group, highlighting the point that - distinctive Mallee assemblages are difficult to discern using objective multivariate analyses. This assemblage supports the many species at the northern limits of their range. These are considered to have Bassian (southern cool wet winters) biogeographic affinities. Mallee often intergrades with Blackoak, and in the study area only the Mallee and Mallee / Blackoak habitats are present.
3. Blackoak / Mulga / Bullockbush low woodland habitats are described as having a relatively depauperate bird assemblage (particularly where they form mono-specific stands), reflecting their location in the most arid parts of the ranges. However, during exceptionally wet years breeding birds may invade these habitats in spring from the adjacent arid regions. Where Blackoak forms an open woodland with a chenopod understorey a more complex assemblage may occur. These habitats are well represented in the study area.
4. The chenopod shrubland assemblage is described as being small and distinctive with floristics and vegetative cover being strong determinants in the mix of species with Eyrean (central arid) biogeographic affinities. This habitat group dominates the study area.

Chenopod shrubland bird assemblages were considered the least species rich with the temperate woodland/forest communities of the south being the most species rich. In the study area only the riverine Red Gum habitats come close to being a woodland. The habitats present in the study area fall predominantly into those described as being dominated by species with Eyrean biogeographic affinities.

This chapter reports on the findings at 47 habitat patches in 32 quadrats surveyed during December 1997. Other sources of information for the study area include the South Australian Museum and the Biological Survey of South Australia Databases. Bird lists collected for the region by other ornithologists have not been included due to time constraints but would be most welcome for future analysis as part of the Biological Survey of the Flinders Ranges planned for 1998 to 2000.

TOTAL SPECIES

At least 159 bird species from 49 Families have been reliably recorded in the study area based on the records of the South Australian Museum, the Biological Survey of South Australia databases and this survey. Ninety-three species were recorded during the survey, of which 65 were observed at sites and the other 28 were noted opportunistically away from sites. Ten of these had not previously been recorded by the museum or biological survey prior to this survey. Six species, recorded by specimens in the museum, were not detected by recent biological survey activity (refer to Appendix 6). The South Australian Museum hold 70 species of birds from the study area in its collection.

All species are listed by Family in Appendix 6, which provides details of conservation status and denotes introduced species. Table 13 lists the number of species from each Family and totals the conservation significant species in each.

Table 13. List of Families reliably recorded in the study area, the numbers of species and the number of conservation significant species (South Australian 'SA' and Australian '(Aus)') in each family. V= vulnerable, R= rare, U= uncommon, I= indeterminate or poorly known.

		Status: SA (Aus)				
FAMILY	**# species**	**I**	**R**	**U**	**V**	**Total**
ACCIPITRIDAE	**9**			1	1	**2**
AEGOTHELIDAE	**1**					**0**
ALAUDIDAE	**2**					**0**
ALCEDINIDAE	**2**					**0**
ANATIDAE	**10**		1	2	1	**4**
ANHINGIDAE	**1**			1		**1**
APODIDAE	**1**					**0**
ARDEIDAE	**7**			1		**1**
ARTAMIDAE	**7**			1		**1**
CACATUIDAE	**3**					**0**
CAPRIMULGIDAE	**1**			1		**1**
CASUARIIDAE	**1**					**0**
CHARADRIIDAE	**7**			1		**1**
CINCLOSOMATIDAE	**3**					**0**
CLIMACTERIDAE	**2**			1		**1**
COLUMBIDAE	**5**		1			**1**
CORVIDAE	**3**					**0**
CUCULIDAE	**3**			1		**1**
DICRURIDAE	**3**					**0**
EOPSALTRIIDAE	**1**					**0**
FALCONIDAE	**4**			1	1	**2**
GLAREOLIDAE	**1**					**0**
HIRUNDINIDAE	**4**					**0**
LARIDAE	**3**					**0**
MALURIDAE	**3**				1 (1)	**1 (1)**
MELIPHAGIDAE	**11**			1		**1**
MEROPIIDAE	**1**					**0**
MOTAACILLIDAE	**1**					**0**
NECTARINIIDAE	**1**					**0**
ORIOLIDAE	**2**			1		**1**
PACHYCEPHALIDAE	**3**					**0**
PARDALOTIDAE	**9**	0 (1)		3		**3 (1)**
PASSERIDAE	**3**					**0**
PELECANIDAE	**1**					**0**
PETROICIDAE	**2**					**0**
PHALACROCORACIDAE	**4**					**0**
PHASIANIDAE	**1**					**0**
PODARGIDAE	**1**					**0**
PODICIPEDIDAE	**3**			1		**1**
POMATOSTOMIDAE	**2**					**0**
PSITTACIDAE	**9**	1	0 (1)		1	**2 (1)**
RALLIDAE	**3**			1		**1**
RECURVIROSTRIDAE	**2**					**0**
SCOLOPACIDAE	**5**			2		**2**
STRIGIDAE	**1**					**0**
STURNIDAE	**1**					**0**
SYLVIIDAE	**4**					**0**
THRESKIORNITHIDAE	**1**			1		**1**
TYTONIDAE	**1**					**0**
Totals = 49	**159**	**1 (1)**	**2 (1)**	**21**	**5 (1)**	**29(3)**

COMMON SPECIES

The Galah was observed at the most sites, 43% of the 47 sites. Only three species were detected at more than 30% of sites. The number of sites at which a species was recorded, its abundance and the detection rate (abundance of species over abundance of all species) is displayed in Table 14 for all species detected at more than 10% of the sites. The most frequently recorded species represent a diversity of feeding strategists: granivore (Galah); carnivore (Australian Raven); insectivore (White-winged Wren); and nectivore (Singing Honey-eater). Granivorous species appear to have the highest detection rates due to their habit of moving about in large flocks. Their size, plumage and raucous nature also makes them more readily detectable.

Table 14. Bird species detected at more than 10% of sites and their reported abundance. The detection rate represents the abundance of a species divided by the sum of all abundance (1154).

SPECIES	Common name	Site frequency	Abundance at all sites	Detection Rate
Cacatua roseicapilla	Galah	20	127	11.01%
Corvus coronoides	Australian Raven	17	44	3.81%
Malurus leucopterus	White-winged Wren	16	71	6.15%
Lichenostomus virescens	Singing Honeyeater	14	29	2.51%
Acanthiza uropygialis	Chestnut-rumped Thornbill	12	57	4.94%
Gymnorhina tibicen	Australian Magpie	12	20	1.73%
Cacatua sanguinea	Little Corella	10	185	16.03%
Manorina flavigula	Yellow-throated Miner	10	48	4.16%
Psophodes cristatus	Chirruping Wedgebill	10	21	1.82%
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	9	16	1.39%
Barnardius zonarius	Ring-necked Parrot	9	61	5.29%
Falco cenchroides	Nankeen Kestrel	8	15	1.30%
Smicrornis brevirostris	Weebill	8	33	2.86%
Coracina novaehollandiae	Black-faced Cuckooshrike	7	14	1.21%
Cracticus torquatus	Grey Butcherbird	7	9	0.78%
Dromaius novaehollandiae	Emu	7	12	1.04%
Malurus lamberti	Variegated Wren	7	27	2.34%
Ocyphaps lophotes	Crested Pigeon	7	32	2.77%
Aquila audax	Wedge-tailed Eagle	6	7	0.61%
Artamus cinereus	Black-faced Woodswallow	6	20	1.73%
Petroica goodenovii	Red-capped Robin	6	9	0.78%
Rhipidura leucophrys	Willie Wagtail	6	10	0.87%
Taeniopygia guttata	Zebra Finch	6	63	5.46%
Aphelocephala leucopsis	Southern Whiteface	5	14	1.21%
Cinclosoma cinnamomeum	Cinnamon Quailthrush	5	11	0.95%
Melanodryas cucullata	Hooded Robin	5	11	0.95%
Todiramphus pyrrhopygia	Red-backed Kingfisher	5	5	0.43%

BIRD SPECIES PATTERNS

Of the 65 species of bird recorded at sites 50 were used for the PATN analyses. Sixteen species were masked out of the analysis because only one animal was observed at a site during the study. The presence data from 35 sites make up the association matrix dendrogram displayed in Figure 17. The other 12 sites containing bird data were either not sampled systematically or contained fewer than three species.

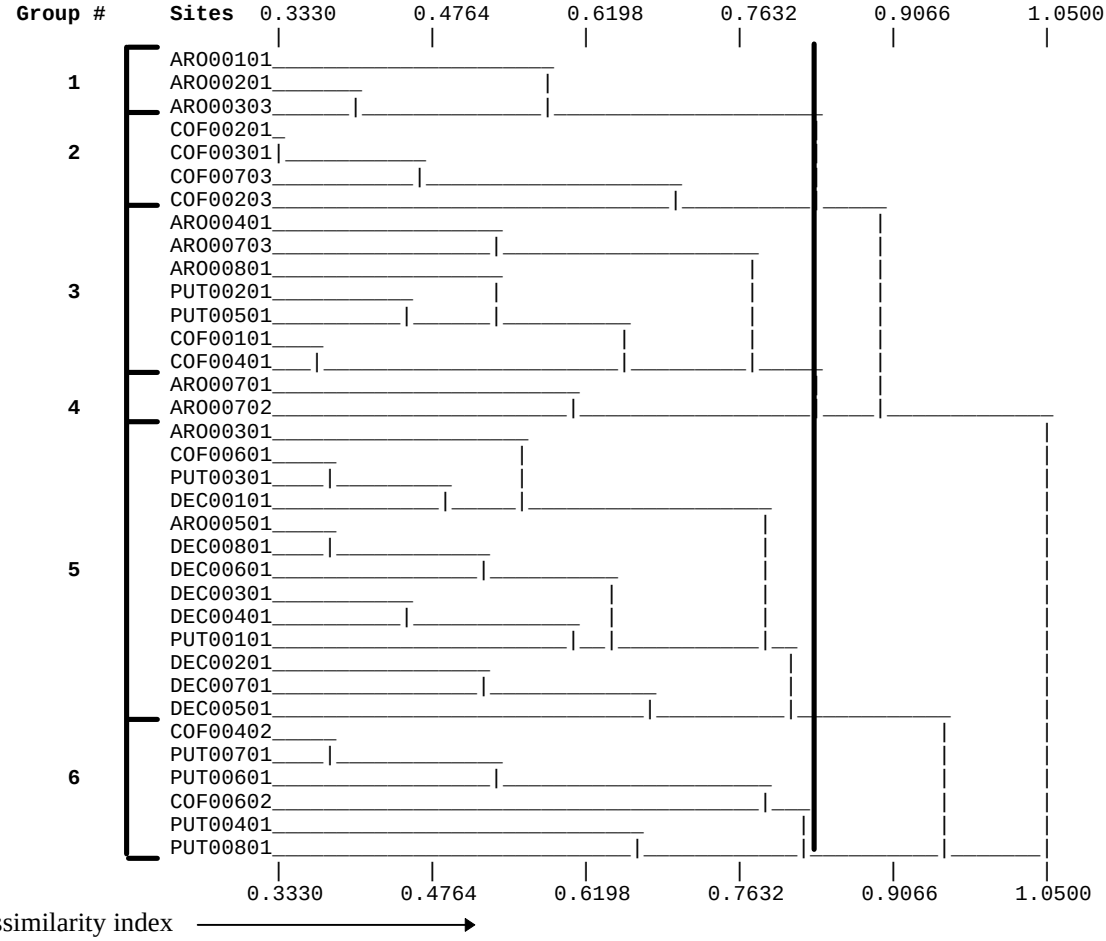


Figure 17. Dendrogram of site similarity for bird species. Six groups were chosen to reflect typical bird assemblages present at the time of survey.

The analysis clustered the survey sites into four main blocks from a habitat perspective. The first seven sites represent the two areas of mallee and associated Blackoak woodland that were surveyed. Assemblage 1 represented the Aroona Range area whilst assemblage 2 represented the Mt Coffin area. The next nine sites reflect the birds present in drainage lines and associated floodplain habitats. These were separated into two groups by the analysis (assemblage 3 and 4). The chenopod shrublands and tall open shrublands with chenopod and grass understorey were represented by the 13 sites comprising assemblage 5. Assemblage 6 is made up a diverse mix of sites representing the scrubby hill slopes of the lower ranges and the odd chenopod site. How the assemblage groups relate to habitat variables are displayed in Table 15.

Table 15. The relationship between physical site variables and bird assemblages defined by the analysis. Numbers relate to site frequency in each category.

	Bird Assemblage	1	2	3	4	5	6
Vegetation structure	woodland		1	4			
	mallee	2	2				
	low woodland	1	1		1	1	2
	tall shrubland			2		1	
	shrubland				1	4	
	hummock grassland			1			1
	low shrubland					6	3
	sub-shrubland					1	
Landform	hill slope	1	3	1		5	2
	hill crest				1	1	2
	stony plain					4	1
	plain (incl undulating plain)	1			1	2	
	dune/consolidated dune					1	
	stream channel		1	5			
	flood out			1			
	gully	1					
Surface soil texture	sandy loam		2	3	2	3	2
	loam			1		1	1
	sandy clay loam	3	1			1	1
	medium clay					1	1
	clay loam, sandy			1		3	
	clayey sand		1	2		2	
	loamy sand					1	
	sand					1	

Detailed descriptions of the groups identified are set out in the following format:

- the bird assemblage group number;
- the number of sites comprising the group;
- the number of species recorded for that group;
- the average number of species at sites for the group including the maximum and minimum species diversity recorded at sites within the group;
- a brief description of the group;
- a list of the sites forming the group and a map showing their location relative to towns, roads and drainage features;
- a table of species group statistics;
  - Column 1 - species occurring in greater than 30% of the sites within the group are listed in order of percent frequency of occurrence (the number of sites supporting the species within the group).
  - Column 2 - lists the common name of the species.
  - Column 3 - presents the percentage of the sites at which a species was recorded.
  - Column 4 - O-E/E represents the relative importance of a species to the group. Indicator species are highlighted by their greater proportion of occurrence in the group than would be expected through chance alone (O = observed frequency and E = the expected frequency if the species was randomly distributed through all groups).

Column 5 - indicator spp. is derived from the 0-E/E value which is multiplied by the ratio of the species frequency within the group to the total frequency of all species within the group multiplied by 100 ([0-E/E] x [freq. of sp.]/[total freq. of sp.] x 100). This formula decreases the bias the 0-E/E formula gives to infrequently encountered species by taking into account the number of sites a species occurs in within the group. This column was used to sort the species from highest to lowest.

Column 6 - presents the total number of sites within the group in which the species was recorded.

Column 7 - presents the occurrence of species when all sites are considered. This provides an indication of how common a species was throughout the survey area.

Column 8 - presents the occurrence of a species in other groups which helps to assess the importance of a species to that group;

- a table of species occurring in less than 30% (if more than 3 sites in the group) of the sites within the group but which have a higher than expected occurrence determined from the 0-E/E column values that are greater than one. These less commonly encountered species are referred to as indicator species for that group. The list is presented in order of the highest 0-E/E value. The table columns are the same as described for the more common species.

- the frequency of occurrence of sites within a bird assemblage group in the floristic groups identified in the vegetation analysis. Similar tables are presented for landform, soil surface texture and strew size and cover.

An alphabetical listing of bird species and the number of sites at which they were recorded within each floristic group is presented in Appendix b2. Descriptions of the floristic groups are presented in the vegetation chapter.

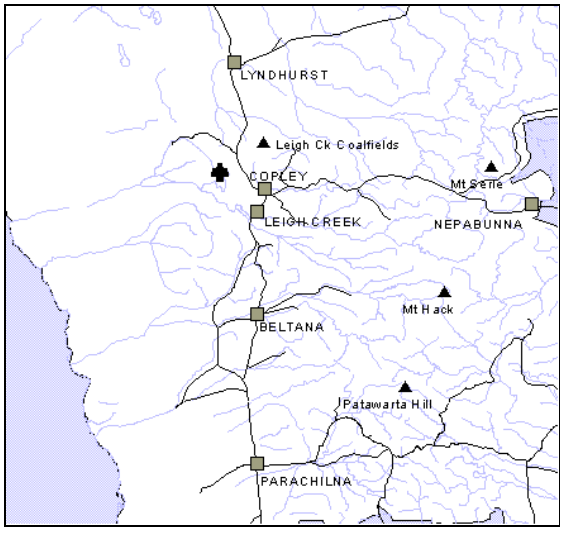
Group number 1:

Number of sites in group: **3**
Number of species in group: **13**
Average number of species at sites: **7.3** **Max 11 Min 5**

This bird assemblage was confined to mallee and Blackoak low open woodland habitats in the Aroona Range during the survey.

Sites

ARO00101 ARO00201 ARO00303



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Oreoica gutturalis	Crested Bellbird	67	5.7	4.0	2	4	2
Todiramphus pyrrhopygia	Red-backed Kingfisher	67	5.7	4.0	2	4	3
Smicrornis brevirostris	Weebill	100	3.5	3.7	3	9	3
Cracticus torquatus torquatus	Grey Butcherbird	67	2.4	1.7	2	8	3
Corvus coronoides coronoides	Australian Raven	100	1.5	1.6	3	16	5
Psephotus varius	Mulga Parrot	33	3.5	1.2	1	3	3
Gymnorhina tibicen	Australian Magpie	67	1.2	0.8	2	12	6
Pardalotus striatus	Striated Pardalote	33	2.4	0.8	1	4	4
Artamus cinereus cinereus	Black-faced Woodswallow	33	1.2	0.4	1	6	3
Petroica goodenovii	Red-capped Robin	33	0.9	0.3	1	7	5
Barnardius zonarius	Ring-necked Parrot	33	0.5	0.2	1	9	4
Acanthiza uropygialis	Chestnut-rumped Thornbill	33	0.2	0.1	1	11	5
Malurus leucopterus	White-winged Wren	33	0.2	0.1	1	11	4

	Floristic group	# Sites
14	*Eucalyptus socialis* Mallee.	2
1	*Dodonea microzyga, Rhagodia ulicina and Maireana sedifolia*, low shrubland with emergent *Myoporum platycarpum* with or without an open overstorey of *Eucalyptus socialis* or *Casuarina pauper*.	1

Landform	# Sites
gully	1
hill slope	1
plain (incl undulating plain)	1

Strew size	cover	# Sites
boulder (gt 250mm)	30-70%	2
cobble (51-250mm)	30-70%	1

Surface soil texture	# Sites
sandy clay loam	3

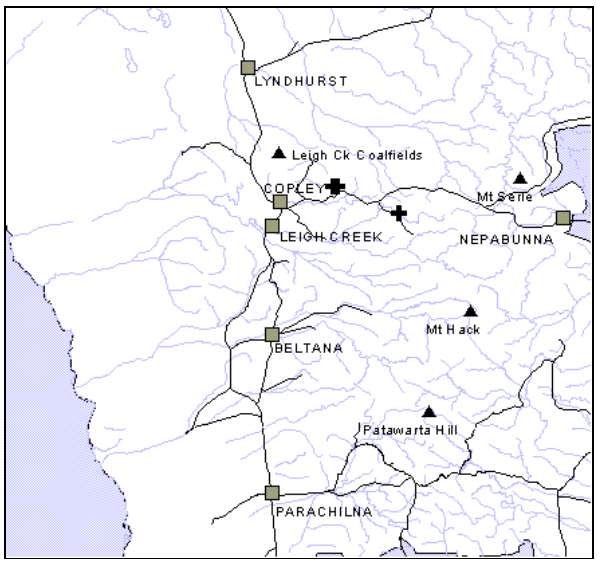
Group number 2:

Number of sites in group: **4**
Number of species in group: **12**
Average number of species at sites: **6.2** **Max** **9** **Min** **5**

This bird assemblage was most strongly associated with mallee on hillslopes, but also occurred in Blackoak low woodland and Red Gum creek woodland in the Mount Coffin area.

Sites

COF00201 COF00301 COF00703 COF00203



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Gymnorhina tibicen	Australian Magpie	100	3.5	4.9	4	12	6
Smicrornis brevirostris	Weebill	75	3.5	3.7	3	9	3
Manorina flavigula flavigula	Yellow-throated Miner	75	2.4	2.5	3	12	4
Eolophus roseicapillus	Galah	75	1.1	1.2	3	19	4
Species at < 30% of sites							
Psephotus haematonotus	Red-rumped Parrot	25	12.5	4.4	1	1	1
Phaps chalcoptera	Common Bronzewing	25	3.5	1.2	1	3	3
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	25	2.4	0.8	1	4	3
Pardalotus striatus	Striated Pardalote	25	2.4	0.8	1	4	4
Coracina novaehollandiae novaehollandiae	Black-faced Cuckooshrike	25	1.2	0.4	1	6	3
Petroica goodenovii	Red-capped Robin	25	0.9	0.3	1	7	5
Barnardius zonarius	Ring-necked Parrot	25	0.5	0.2	1	9	4
Malurus lamberti	Variegated Wren	25	0.2	0.1	1	11	4

	Floristic group	# Sites
14	*Eucalyptus socialis* Mallee.	2
6	*Atriplex vesicaria, Rhagodia spinescens* low shrubland with *Casuarina pauper* low open woodland overstorey or emergent *Acacia victoriae, Alectryon oleifolius* and *Eremophila* spp.	1
9	*Eucalyptus camaldulensis* open woodland.	1

Landform	# Sites
hill slope	3
stream channel	1

Surface soil texture	# Sites
sandy loam	2
clayey sand	1
sandy clay loam	1

Strew size	cover	# Sites
pebble (5-50mm)	30-70%	2
cobble (51-250mm)	10-30%	1
pebble (5-50mm)	10-30%	1

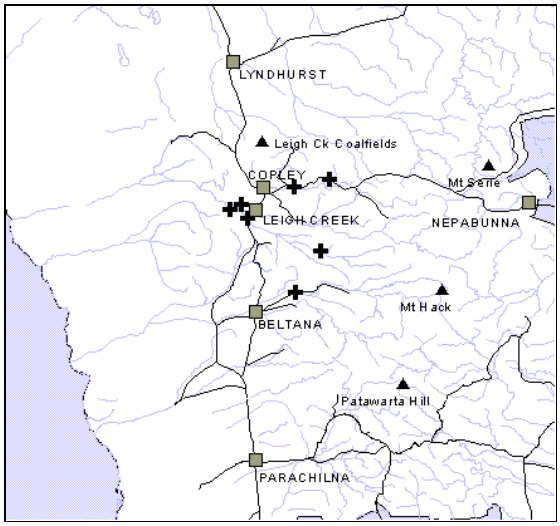
Group number 3:

Number of sites in group: 7
Number of species in group: 36
Average number of species at sites: 13.7 Max 19 Min 5

This widespread Red Gum creek woodland bird assemblage was also noted in tall shrublands of Elegant Wattle on creeks and associated floodplains and a hummock grassland with scattered Blackoak woodland site.

Sites

ARO00401 ARO00703 ARO00801 PUT00201
PUT00501 COF00101 COF00401



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	Frequency in group	frequency in all groups	number of groups in which species occurs
Barnardius zonarius	Ring-necked Parrot	86	1.2	2.5	6	9	4
Cacatua sanguinea	Little Corella	86	1.2	2.5	6	9	3
Hirundo nigricans nigricans	Tree Martin	43	2.3	2.4	3	3	1
Cracticus torquatus torquatus	Grey Butcherbird	71	1.1	1.9	5	8	3
Coracina novaehollandiae novaehollandiae	Black-faced Cuckooshrike	57	1.2	1.7	4	6	3
Rhipidura leucophrys leucophrys	Willie Wagtail	43	1	1.1	3	5	3
Manorina flavigula flavigula	Yellow-throated Miner	71	0.4	0.7	5	12	4
Petroica goodenovii	Red-capped Robin	43	0.4	0.4	3	7	5
Acanthagenys rufogularis rufogularis	Spiny-cheeked Honeyeater	43	0.1	0.1	3	9	3
Smicrornis brevirostris	Weebill	43	0.1	0.1	3	9	3
Acanthiza uropygialis	Chestnut-rumped Thornbill	43	-0.1	-0.1	3	11	5
Eolophus roseicapillus	Galah	71	-0.1	-0.2	5	19	4
Corvus coronoides coronoides	Australian Raven	57	-0.2	-0.3	4	16	5
Lichenostomus virescens	Singing Honeyeater	43	-0.3	-0.3	3	14	3
Species at < 30% of sites							
Geopelia placida placida	Peaceful Dove	29	2.3	1.6	2	2	1
Merops ornatus	Rainbow Bird	29	2.3	1.6	2	2	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	29	0.7	0.5	2	4	3
Pomatostomus superciliosus	White-browed Babbler	29	0.3	0.2	2	5	3
Taeniopygia guttata	Zebra Finch	29	0.1	0.1	2	6	2
Anas gracilis gracilis	Australasian Grey Teal	14	2.3	0.8	1	1	1
Apus pacificus pacificus	Fork-tailed Swift	14	2.3	0.8	1	1	1
Ardea alba	Great Egret	14	2.3	0.8	1	1	1
Pachycephala rufiventris rufiventris	Rufous Whistler	14	2.3	0.8	1	1	1
Falco longipennis	Little Falcon	14	0.7	0.2	1	2	2
Psephotus varius	Mulga Parrot	14	0.1	0.0	1	3	3
Pyrrholaemus brunneus	Redthroat	14	0.1	0.0	1	3	3

	Floristic group	# Sites
9	*Eucalyptus camaldulensis* open woodland.	3
7	*Maireana pyramidata*, *Atriplex vesicaria* low shrubland with emergent *Acacia victoriae*.	2
3	*Triodia irritans* hummock grassland with a *Cauarina pauper* sparse to open low woodland.	1
8	*Acacia victoriae*, *Acacia tetragonophylla* tall shrubland with or without *Melaleuca glomerata* and *Eucalyptus camaldulensis* open woodland over *Maireana pyramidata* and *Rhagodia spinescens*.	1

Landform	# Sites
stream channel	5
hill slope	1
flood out	1

Surface soil texture	# Sites
sandy loam	3
clayey sand	2
clay loam, sandy	1
loam	1

Strew size	cover	# Sites
cobble (51-250mm)	30-70%	2
pebble (5-50mm)	10-30%	2
pebble (5-50mm)	30-70%	1
cobble (51-250mm)	10-30%	1
boulder (gt 250mm)	30-70%	1

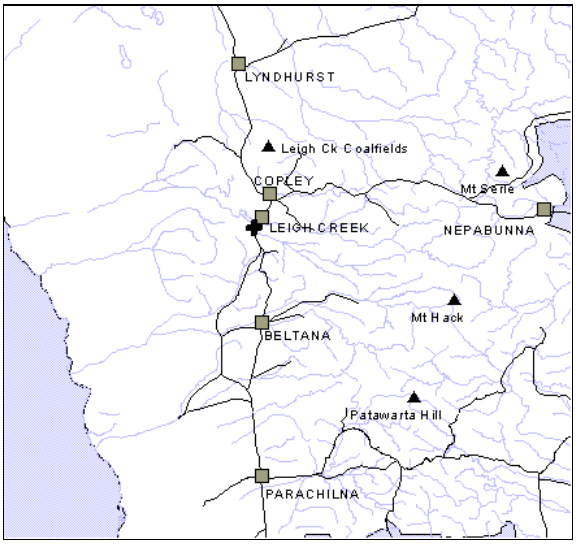
Group number 4:

Number of sites in group: **2**
Number of species in group: **12**
Average number of species at sites: **7.5** **Max** **10** **Min** **5**

This assemblage of species represents the last of the drainage line sites and marks the transition in the association matrix from the Mallee and Red Gum bird assemblages to the low chenopod shrubland and grassland groups.

Sites

ARO00701 ARO00702



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Nycticorax caledonicus	Nankeen Night Heron	100	17.9	12.7	2	2	1
Pomatostomus superciliosus	White-browed Babbler	100	6.5	4.6	2	5	3
Melanodryas cucullata	Hooded Robin	50	5.3	1.9	1	3	2
Pyrrholaemus brunneus	Redthroat	50	5.3	1.9	1	3	3
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	50	3.7	1.3	1	4	3
Corvus coronoides coronoides	Australian Raven	100	1.4	1.0	2	16	5
Aphelocephala leucopsis	Southern Whiteface	50	2.8	1.0	1	5	3
Coracina novaehollandiae novaehollandiae	Black-faced Cuckooshrike	50	2.1	0.7	1	6	3
Petroica goodenovii	Red-capped Robin	50	1.7	0.6	1	7	5
Cacatua sanguinea	Little Corella	50	1.1	0.4	1	9	3
Acanthiza uropygialis	Chestnut-rumped Thornbill	50	0.7	0.2	1	11	5
Gymnorhina tibicen	Australian Magpie	50	0.6	0.2	1	12	6

	Floristic group	# Sites
8	*Acacia victoriae, Acacia tetragonophylla* tall shrubland with or without *Melaleuca glomerata* and *Eucalyptus camaldulensis* open woodland over *Maireana pyramidata* and *Rhagodia spinescens*.	1
2	*Ptilotus obovatus, Sida petrophila, Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.	1

Landform	# Sites
hill crest	1
plain (incl undulating plain)	1

Strew size	cover	# Sites
cobble (51-250mm)	30-70%	1
pebble (5-50mm)	<10%	1

Surface soil texture	# Sites
sandy loam	2

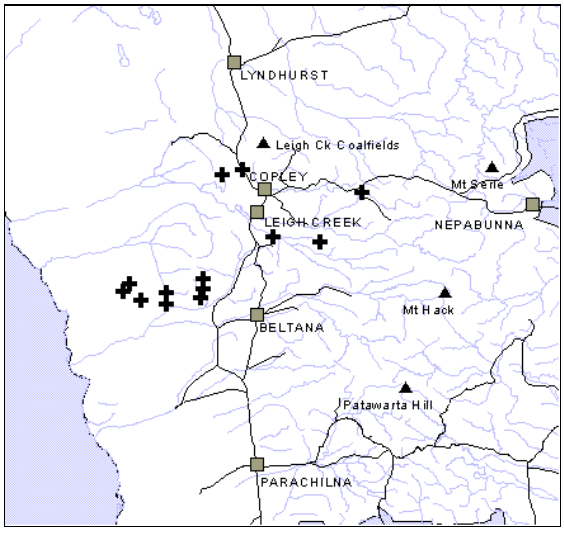
Group number 5:

Number of sites in group: **13**
Number of species in group: **30**
Average number of species at sites: **7.5** **Max** **13** **Min** **4**

This was the most common bird assemblage in the study area, representing the majority of low chenopod shrubland, sub-shrublands with grasses and sparse *Acacia* spp. tall shrubland over grass habitats.

Sites

ARO00301 COF00601 PUT00301 DEC00101
ARO00501 DEC00801 DEC00601 DEC00301
DEC00401 PUT00101 DEC00201 DEC00701
DEC00501



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Psophodes cristatus	Chirruping Wedgebill	62	1.4	4.0	8	10	3
Cinclosoma cinnamomeum	Cinnamon Quailthrush	38	1.9	3.4	5	5	1
Lichenostomus virescens	Singing Honeyeater	69	0.9	2.9	9	14	3
Malurus lamberti	Variegated Wren	54	0.9	2.2	7	11	4
Eolophus roseicapillus	Galah	77	0.6	2.1	10	19	4
Artamus cinereus cinereus	Black-faced Woodswallow	31	1	1.4	4	6	3
Taeniopygia guttata	Zebra Finch	31	1	1.4	4	6	2
Acanthagenys rufogularis rufogularis	Spiny-cheeked Honeyeater	38	0.6	1.1	5	9	3
Ocyphaps lophotes	Crested Pigeon	31	0.7	1.0	4	7	3
Acanthiza uropygialis	Chestnut-rumped Thornbill	38	0.3	0.5	5	11	5
Malurus leucopterus	White-winged Wren	38	0.3	0.5	5	11	4
Corvus coronoides coronoides	Australian Raven	31	-0.3	-0.4	4	16	5

Species at < 30% of sites

Anthus novaeseelandiae	Richard's Pipit	15	1.9	1.3	2	2	1
Falco berigora	Brown Hawk	15	1.9	1.3	2	2	1
Aphelocephala leucopsis	Southern Whiteface	23	0.8	0.8	3	5	3
Melanodryas cucullata	Hooded Robin	15	1	0.7	2	3	2
Amytornis textilis	Thick-billed Grasswren	8	1.9	0.7	1	1	1
Oreoica gutturalis	Crested Bellbird	15	0.5	0.4	2	4	2
Calamanthus campestris	Western Fieldwren	8	0.5	0.2	1	2	2
Aquila audax audax	Wedge-tailed Eagle	15	0	0.0	2	6	3

	Floristic group	**# Sites**
4	*Atriplex vesicaria, Maireana astrotricha* low shrubland.	3
10	*Acacia tetragonophylla/Acacia victoriae/Acacia aneura* tall shrubland over scattered shrubs and tussock grasses.	3
11	*Sclerolaena ventricosa, Sclerolaena brachyptera* sub-shrubland with tussock grasses and emergent shrubs.	3
2	*Ptilotus obovatus, Sida petrophila, Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.	2
7	*Maireana pyramidata, Atriplex vesicaria* low shrubland with emergent *Acacia victoriae*.	1
12	*Acacia ligulata* Tall Shrubland over *Senna* spp. shrubs and *Atriplex velutinella* low shrubs.	1

Landform	**# Sites**
hill slope	5
stony plain	4
plain (incl undulating plain)	2
hill crest	1
dune/consolidated dune	1

Surface soil texture	**# Sites**
sandy loam	3
clay loam, sandy	3
clayey sand	2
loam	1
sandy clay loam	1
loamy sand	1
medium clay	1
sand	1

Strew size	**cover**	**# Sites**
pebble (5-50mm)	30-70%	3
cobble (51-250mm)	10-30%	2
pebble (5-50mm)	gt 70%	2
cobble (51-250mm)	30-70%	1
pebble (5-50mm)	10-30%	1
none apparent		1
cobble (51-250mm)	gt 70%	1
Sheet	30-70%	1
Sheet	gt 70%	1

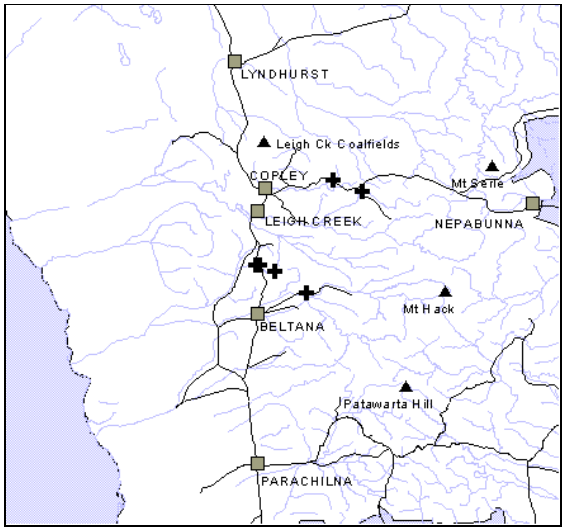
Group number 6:

Number of sites in group: **6**
Number of species in group: **26**
Average number of species at sites: **8.0** **Max** **12** **Min** **6**

This bird assemblage represents an agglomeration of species occurring at sites on shrubby hillslopes and crests that are not dominated by low chenopod shrubs. Only three species were common to more than half the sites indicating that a diverse range of assemblages have been brought together in this group.

Sites

COF00402 PUT00701 PUT00601 COF00602
PUT00401 PUT00801



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	Frequency in group	frequency in all groups	number of groups in which species occurs
Falco cenchroides cenchroides	Nankeen Kestrel	100	4.4	9.3	6	7	2
Dromaius novaehollandiae	Emu	33	3.2	2.3	2	3	2
Pomatostomus ruficeps	Chestnut-crowned Babbler	33	3.2	2.3	2	3	2
Aquila audax audax	Wedge-tailed Eagle	50	2.1	2.2	3	6	3
Malurus leucopterus	White-winged Wren	67	1.3	1.8	4	11	4
Ocyphaps lophotes	Crested Pigeon	33	0.8	0.6	2	7	3
Cacatua sanguinea	Little Corella	33	0.4	0.3	2	9	3
Corvus coronoides coronoides	Australian Raven	50	0.2	0.2	3	16	5
Gymnorhina tibicen	Australian Magpie	33	0	0.0	2	12	6
Manorina flavigula flavigula	Yellow-throated Miner	33	0	0.0	2	12	4
Lichenostomus virescens	Singing Honeyeater	33	-0.1	-0.1	2	14	3
Species at < 30% of sites							
Artamus minor	Little Woodswallow	17	5.3	1.9	1	1	1
Calamanthus campestris	Western Fieldwren	17	2.1	0.7	1	2	2
Falco longipennis	Little Falcon	17	2.1	0.7	1	2	2
Phaps chalcoptera	Common Bronzewing	17	1.1	0.4	1	3	3
Pardalotus striatus	Striated Pardalote	17	0.6	0.2	1	4	4
Pomatostomus superciliosus	White-browed Babbler	17	0.3	0.1	1	5	3
Rhipidura leucophrys leucophrys	Willie Wagtail	17	0.3	0.1	1	5	3

	Floristic group	# Sites
2	*Ptilotus obovatus, Sida petrophila, Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.	4
7	*Maireana pyramidata, Atriplex vesicaria* low shrubland with emergent *Acacia victoriae*.	1
5	*Atriplex lindleyi, Atriplex vesicaria, Sclerolaena divaricata* low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.	1

Landform	# Sites
hill slope	2
hill crest	2
stony plain	1

Surface soil texture	# Sites
sandy loam	2
loam	1
sandy clay loam	1
medium clay	1

Strew size	cover	# Sites
cobble (51-250mm)	10-30%	2
cobble (51-250mm)	gt 70%	1
boulder (gt 250mm)	30-70%	1
boulder (gt 250mm)	gt 70%	1

SPECIES RICHNESS

Figure 18 displays the relationship between species richness, abundance and the major bird assemblages recorded during the survey. Species diversity was almost double for bird assemblage 3 when compared with the other groups, particularly the mallee/Blackoak assemblages 1 and 2, and the chenopod shrubland and scrubby hillslope assemblages 5 and 6. Assemblage 4 has a wide confidence interval and also represents drainage associated assemblages. The abundance of birds on sites follows a similar pattern and probably reflects the higher structural diversity of the vegetation in the most productive parts of the landscape. Figures 19 to 21 illustrate which aspects of the vegetation species, structure and landform contribute to the most productive habitats for birds. Stream channel and dunefield habitats support the highest average diversities of bird species. Floodout sites were highly variable. Floristic groups supporting *Acacia* spp. tall shrubs (floristic groups 7,8 and 12) and Red Gum Woodlands (floristic group 9) appear to support the highest diversities of species. This is emphasised by the vegetation structure analysis (Figure 21) which indicates that tall shrubland and open woodland sites supported the highest diversities and abundances of bird species during the survey.

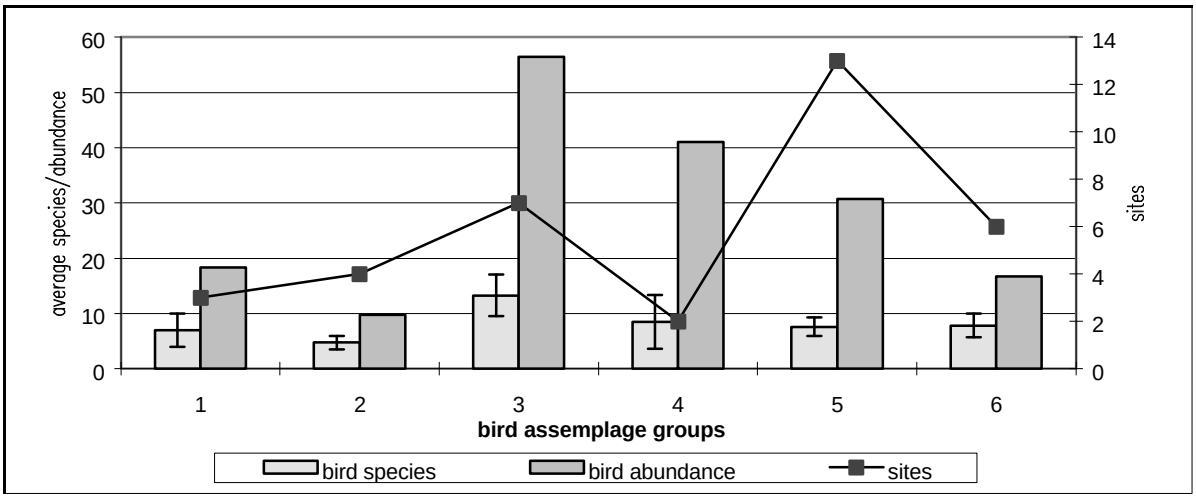


Figure 18. Average species richness and abundance for the six bird assemblages determined from PATN. The 95% confidence intervals are shown for the average number of bird species per site for each group.

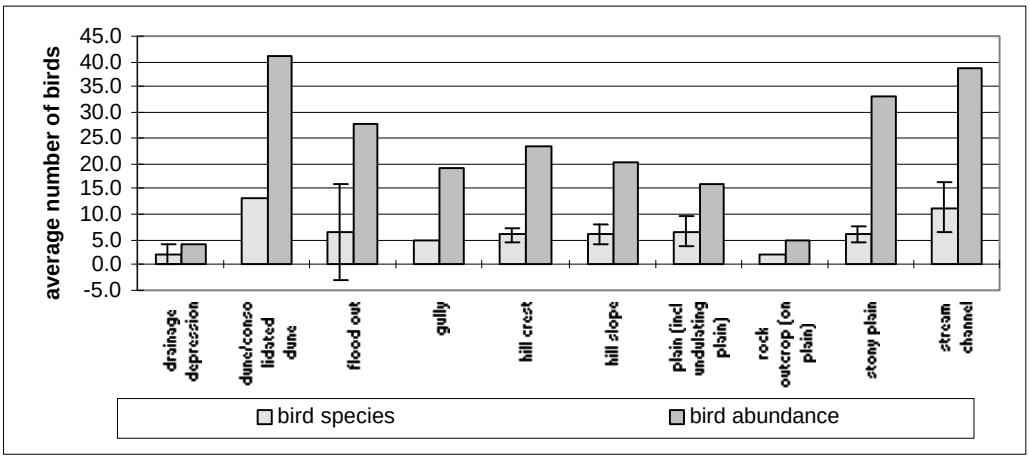


Figure 19. Average species richness and abundance for the landform categories recorded for the sites. The 95% confidence intervals are shown for the average number of bird species per site for each category.

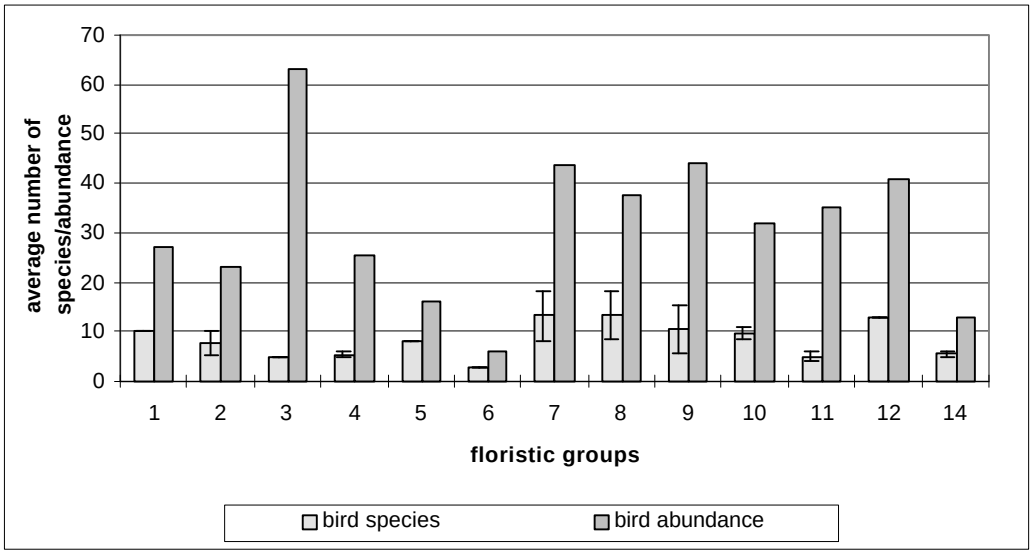


Figure 20. Average species richness and abundance for the floristic groups. The 95% confidence intervals are shown for the average number of bird species per site for each category.

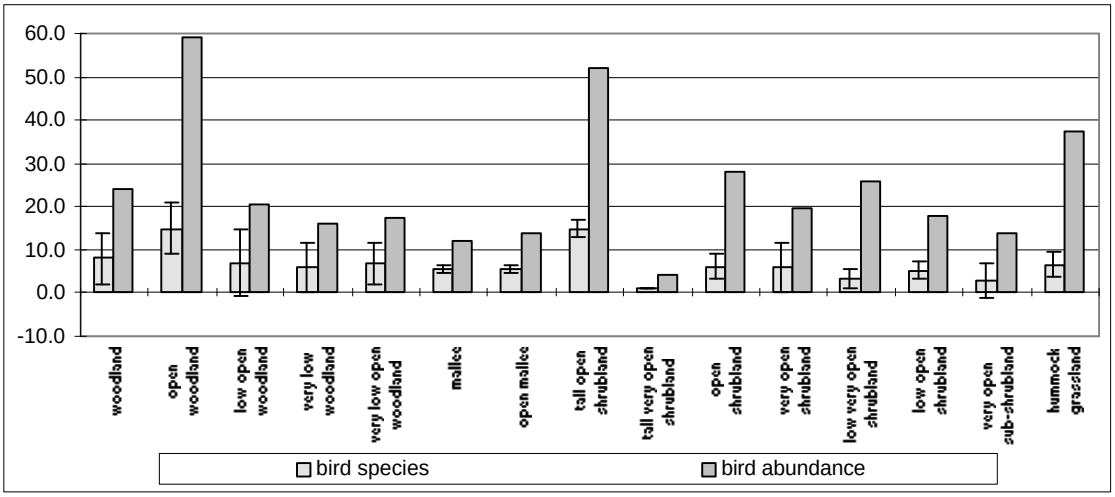


Figure 21. Average species richness and abundance for the structural vegetation categories recorded for the sites. The 95% confidence intervals are shown for the average number of bird species per site for each category.

SPECIES WITH CONSERVATION SIGNIFICANCE.

The region is known to support one species considered to be vulnerable to extinction in the 'Action Plan for Australian Birds' (Garnett 1992), the eastern form of the Thick-billed Grasswren *Amytornis textillis* ssp. *modestus*. The South Australian Museum also holds specimens from early this century of the Slender-billed Thornbill *Acanthiza iredalei* (rated as poorly known) and one Scarlet-chested Parrot *Neophema splendida* (rated as rare) from 1974. Table b1 indicates that there were 37 bird species which were assigned a South Australian conservation rating (Watts 1990). Of these, the 'V' vulnerable to extinction rating is the most important, and was assigned to nine species including the Thick-billed Grasswren and Slender-billed Thornbill. The other seven species were Yellow-plumed Honey-eater *Lichenostomus ornatus*, Little Egret *Aredea garzetta*, Musk Duck *Biziura lobata*, Peregrine Falcon *Falco peregrinus*, Black-breasted Buzzard *Hamirostra melanosternon*, Blue-winged Parrot *Neophema chrysostoma* and Chestnut Quailthrush *Cinclosoma castanotus*. Only four of these species were recorded during the survey with only the Thick-billed Grasswren present at sites. Species such as the Blue-winged Parrot are seasonal visitors and would not be expected in the area during summer. Refer to Appendix 6 and 7 for details of which species were recorded on the survey or otherwise.

The 'R' rare and 'U' uncommon categories apply to species which are detected at low rates throughout South Australia or are restricted in range. Of the four rare species noted for the study area only one, the Peaceful Dove *Geopelia placida*, was recorded during the survey and at sites. Of the 23 uncommon species 10 were recorded this survey, seven of these were recorded at sites. Only one species, the Elegant Parrot *Neophema elegans*, which was recorded opportunistically on the survey is considered to be poorly known. Appendix b2 lists all bird species recorded at sites by the bird assemblage groups, including those species not included in the PATN analysis. Appendix b3 lists all bird species at sites by the floristic groups.

INTRODUCED SPECIES

Three exotic birds species are noted for the study area: Feral Pigeons, House Sparrows and Starlings. Only the House Sparrow was recorded during the survey in the vicinity of human dwellings. None were recorded at sites.

REPTILES

R Brandle

INTRODUCTION

The Flinders Ranges as a region has been described as supporting a diverse reptile fauna (86 taxa at present) including endemic species and others which have their centres of abundance in the region (Hutchinson and Tyler 1996). Hutchinson and Tyler (1996) assign each species to a possible seven broad habitat types which they consider important for reptile distributions over the whole of the Flinders Ranges. Of these six are represented in the study area (temperate woodlands and grasslands being restricted to the southern parts of the ranges. Their categories relate to a mixture of landform and vegetation which include: stream channels and claypans (common in the study area); mallee (sparse and of limited size in the study area); sheoak-pine woodlands (only Blackoak open to sparse woodlands are present in the study area); sandplains and dunes (present at the western edge of the study area); chenopod shrublands and gibber plains (the former dominates the study area, and minor areas of the latter occur in the west); and rock outcrops and screes (whilst rock outcrops are common they are often of minor extent - the major areas of outcrop also support the most scree, the Aroona and Bayley Ranges).

Of the 85 species listed for the Flinders Ranges: 10 are dragons AGAMIDAE, 15 are geckos GEKKONIDAE, seven are legless lizards PYGOPODIDAE, 33 are skinks SCINCIDAE, two are goannas VARANIDAE, two are blind snakes TYPHLOPIDAE, two are pythons BOIDAE, and the remaining 14 are venomous snakes ELAPIDAE. The high diversity of species reflects the high diversity of habitats due to variations in topography, geomorphology and climate over the length of the ranges. The study area only represents a small part of the north-western edge of the Flinders Ranges and does not include the extensive areas of high quartzite ridges and the associated native pine woodlands and grasslands.

TOTAL SPECIES

As a result of this survey, 50 species of reptiles have now been verified by the South Australian Museum as occurring in the study area. This represents a significant proportion of the species known for the whole of the ranges. Forty-three of these were recorded during the survey in December 1997. Prior to this survey only 31 species were definitely known to occur in this area. Of these, seven were not recorded by the survey. These include the Winneck's Dragon *Diporiphora winneckii* a species which is restricted to sand dunes in the west of the study area, four species of snake which are often cryptic and only detectable during certain weather conditions. The Marbled Gecko *Phyllodactylus marmoratus* is a species with a southerly 'Bassian' biogeographic affiliation and is unlikely to occur in the study area except maybe as a vagrant from higher rainfall areas in the main body of the Flinders Ranges. The other two species are skinks (the Four-toed Earless Skink *Hemiergis peronii* and the Spinifex Slender Bluetongue). Of these the Four-toed Earless Skink also has a 'Bassian' distribution and the presence of the species at the edge of lake Frome last century is a doubtful locality record. The Spinifex Slender Bluetongue is likely to occur in the limited areas of Spinifex *Triodia* spp. which occur towards the tops of the steepest ranges. In addition to the 50 verified species, residents at Leigh Creek and Aroona Dam provided verbal accounts of other species, two Pythons, Family BOIDAE and two species of CHELIDAE side-necked tortoises in Aroona Dam (Appendix R1). The survey proved to be very effective in recording previously unreported species of *Ctenotus* spp. (sliders or lined skinks) and Gekkonidae (geckoes), the two largest Families with the smallest species.

Table 16. Reptile family list for the North West Flinders Ranges study area with the numbers of species recorded at the South Australian Museum prior to this study and by the survey

Family	MUSEUM ONLY	MUSEUM and SURVEY	SURVEY ONLY	Total
AGAMIDAE	1	6	1	8
CHELIDAE	0	0	1	1
ELAPIDAE	2	3	1	6
GEKKONIDAE	1	6	5	12
PYGOPODIDAE	0	1	1	2
SCINCIDAE	1	7	10	18
TYPHLOPIDAE	2	0	0	2
VARANIDAE	0	1	0	1
Total	**7**	**24**	**19**	**50**

COMMON SPECIES

The diversity of the reptile fauna of the study area is reflected by the fact that no species was present at more than 40% of the survey sites sampled. Geckoes dominated the most common and abundant species table (Table 17). The most common species during the survey, both in the number of sites and number of animals, was the Pink-blotched Gecko. The two Dtella *Gehyra* species were the next most common with a combined detection rate still five percent lower than the prolific Pink-blotched Gecko. Of interest is the presence of three medium to large skinks towards the top of the list when compared to the more arid stony deserts where the larger species of skinks were sparse.

Table 17. Reptile species detected at more than 10% of sites and their reported abundance. The detection rate represents the abundance of a species divided by the sum of all abundance values (433).

SPECIES	Common name	Site frequency	Abundance at all sites	Detection Rate
Diplodactylus byrnei	Pink-blotched Gecko	13	76	17.55%
Gehyra variegata	Tree Dtella	12	28	6.47%
Tiliqua rugosa	Sleepy Lizard	10	22	5.08%
Eremiascincus richardsonii	Broad-banded Sandswimmer	8	10	2.31%
Gehyra purpurascens	Purple Dtella	8	26	6.00%
Heteronotia binoei	Bynoe's Gecko	8	14	3.23%
Tympanocryptis tetraporophora	Eyrean Earless Dragon	8	19	4.39%
Ctenotus robustus	Eastern Striped Skink	7	9	2.08%
Ctenotus uber	Spotted Ctenotus	7	20	4.62%
Morethia boulengeri	Common Snake-eye	7	16	3.70%
Cryptoblepharus plagiocephalus	Desert Wall Skink	6	8	1.85%
Ctenotus regius	Eastern Desert Ctenotus	6	18	4.16%
Ctenotus strauchii	Short-legged Ctenotus	6	11	2.54%
Rhynchoedura ornata	Beaked Gecko	6	29	6.70%
Pogona vitticeps	Central Bearded Dragon	5	5	1.15%
Varanus gouldii	Sand Goanna	5	6	1.39%
Lerista muelleri	Dwarf Three-toed Slider	4	4	0.92%
Nephurus milii	Barking Gecko	4	6	1.39%

REPTILE SPECIES PATTERNS

Thirty-eight identifiable taxa were detected at 32 quadrats (the other 12 species were detected opportunistically in the study area). All species and sites were retained for the analysis, the minimum number of species at a site was two. The presence data from the 32 sites make up the association matrix dendrogram displayed in Figure 22.

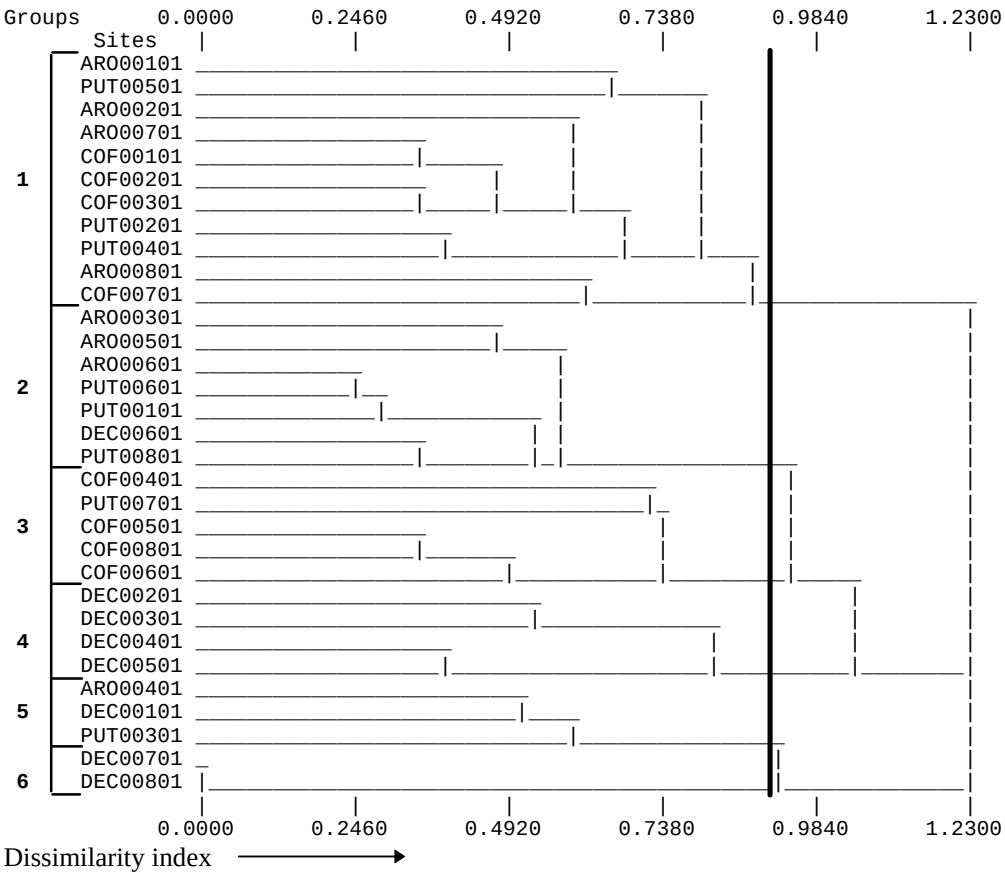


Figure 22. Dendrogram of site association matrix displaying similarity between sites. The six groups reflect the dissimilarity at the level of dissimilarity shown by the thick vertical line. These six groups were felt to be useful for discussing the reptile assemblage patterns of the study area.

Reptile assemblage 1 comprises the first 11 sites in the site/species association dendrogram and includes the bulk of sites supporting well established woodland or mallee overstorey which occurred along drainage landforms and a number of hill slope/valley sites. The transition to reptile assemblage 2 marks the biggest division in the dendrogram. The species composition of the next seven sites characterise the chenopod low shrublands and sub-shrublands of the stony plains with clay to loam soils. Reptile assemblage 3 represents a shrubland reptile community occurring on hill crests and drainage associated landforms towards the main body of the Flinders Ranges in the east of the study area. Reptile assemblage 4 is associated with the sandier soils of the study area and includes the dunefield community and those which occur at sites where sand spreads overly stony clay plain. This situation occurred adjacent to the dunefield in the west of the study area. Reptile assemblage 5 represents the shrubby hill slope reptile community characteristic of the western hills in the study area. The final reptile assemblage 6 represents a depauperate community of only two species which occurred in the *Acacia* shrub/low woodlands growing on the purple Bunyeroo shales adjacent to the Mt Deception Range in the west of the study area. Table 18 displays the frequency of sites for the reptile assemblages against the major biophysical parameters. Descriptions of each group follow.

Table 18. Biophysical parameter site frequency for each reptile assemblage.

	Reptile assemblage	1	2	3	4	5	6
Landform	hill crest	1		2			
	hill slope	5			1	3	2
	stony plain		4		2		
	plain (incl undulating plain)		2	1			
	drainage depression			1			
	flood out	1	1				
	stream channel	3		1			
	gully	1					
	dune/consolidated dune				1		
Surface soil texture	medium clay		3				
	clay loam, sandy		1		1	2	
	sandy clay loam	3		1			
	clayey sand	2	1		2		
	silt loam			2			
	loam	1		1		1	
	sandy loam	5	2	1			1
	loamy sand						1
	sand				1		
Vegetation structure	woodland	2		1			
	mallee	2					
	low woodland	3					1
	tall shrubland	2			1		
	shrubland	1		2	1	1	1
	hummock grassland			1		1	
	low shrubland		6	1	2	1	
	sub-shrubland	1	1				
Strew size and cover	none apparent		1		1		
	pebble (5-50mm) <10%			2			
	pebble (5-50mm) 10-30%	2		1	1		
	pebble (5-50mm) 30-70%	3	1		2		
	pebble (5-50mm) gt 70%						2
	cobble (51-250mm) 10-30%	1	3				
	cobble (51-250mm) 30-70%	2	2			1	
	cobble (51-250mm) gt 70%	1				1	
	boulder (gt 250mm) 30-70%	2					
	boulder (gt 250mm) gt 70%			1			
	Sheet 30-70%			1			
	Sheet gt 70%					1	

Detailed descriptions of the groups identified are set out in the following format:

- the reptile assemblage group number;
- the number of sites comprising the group;
- the number of species recorded for that group;
- the average number of species at sites for the group including the maximum and minimum species diversity recorded at sites within the group;
- a brief description of the group;
- a list of the sites forming the group and a map showing their location relative to the towns, roads and drainage features;
- a table of species group statistics;
  - Column 1 - species occurring in greater than 30% of the sites within the group are listed in order of percent frequency of occurrence (the number of sites supporting the species within the group).
  - Column 2 - lists the common name of the species.
  - Column 3 - presents the percentage of the sites at which a species was recorded.
  - Column 4 - O-E/E represents the relative importance of a species to the group. Indicator species are highlighted by their greater proportion of occurrence in the group than would be expected through chance alone (O = observed frequency and E = the expected frequency if the species was randomly distributed through all groups).
  - Column 5 - indicator spp. is derived from the 0-E/E value which is multiplied by the ratio of the species frequency within the group to the total frequency of all species within the group multiplied by 100 ([0-E/E] x [freq. of sp.]/[total freq. of sp.] x 100). This formula decreases the bias the 0-E/E formula gives to infrequently encountered species by taking into account the number of sites a species occurs in within the group. This column was used to sort the species from highest to lowest.
  - Column 6 - presents the total number of sites within the group in which the species was recorded.
  - Column 7 - presents the occurrence of species when all sites are considered. This provides an indication of how common a species was throughout the survey area.
  - Column 8 - presents the occurrence of a species in other groups which helps to assess the importance of a species to that group;
- a table of species occurring in less than 30% (if more than 3 sites in the group) of the sites within the group but which have a higher than expected occurrence determined from the 0-E/E column values that are greater than one. These less commonly encountered species are referred to as indicator species for that group. The list is presented in order of the highest 0-E/E value. The table columns are the same as described for the more common species.
- the frequency of occurrence of sites within a reptile assemblage group in the floristic groups identified in the vegetation analysis. Similar tables are presented for landform, soil surface texture and strew size and cover.

An alphabetical listing of reptile species and the number of sites at which they were recorded within each floristic group is presented in Appendix 11. Descriptions of the floristic groups are presented in the vegetation chapter.

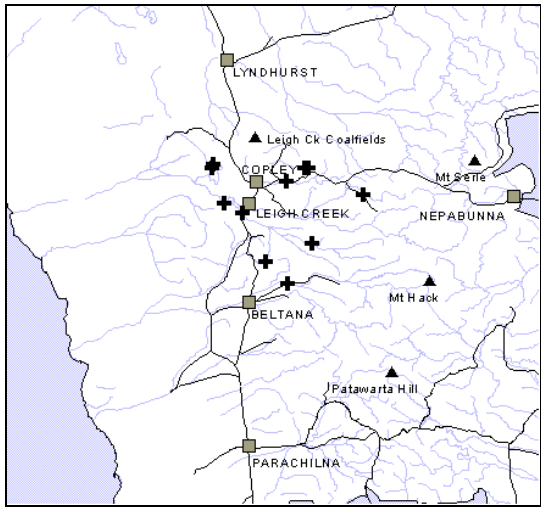
Goup number : 1

Number of sites in group: 11
Number of species in group: 24
Average number of species at sites: 5.5 **Max** 8 **Min** 3

This group was typical of the reptile assemblages found in well wooded drainage lines and other woodland sites across the study area. The most common species in this group were small skinks and geckos. A number of these species were confined to woodland habitats which also support the highest diversity of the leaf litter and soil dwelling species such as the sliders *Lerista* spp.. This included two of the larger representatives of the genus, the Great Desert Slider at the eastern extreme of its range and the Spotted Slider at the western extent of its range. This assemblage was also notable for not supporting any of the small dragon species which were a salient, and often common, aspect of the other assemblages.

Sites

ARO00101 PUT00501 ARO00201 ARO00701
COF00101 COF00201 COF00301 PUT00201
PUT00401 ARO00801 COF00701



Species	Common Name	% of sites in group	(O-E)/E	indicator species	frequency in group	frequency in all groups	# of groups in which species occurs
Morethia boulengeri	Common Snake-eye	64	1.8	7.46	7	7	1
Cryptoblepharus plagiocephalus	Desert Wall Skink	55	1.8	6.39	6	6	1
Eremiascincus richardsonii	Broad-banded Sandswimmer	64	1.4	5.8	7	8	2
Gehyra variegata	Tree Dtella	73	0.8	3.79	8	12	3
Heteronotia binoei	Bynoe's Gecko	45	0.7	2.07	5	8	2
Species at <30% of sites with	**indicator species values >0.**						
Lerista desertorum	Great Desert Slider	18	1.8	2.13	2	2	1
Lerista punctatovittata	Spotted Slider	18	1.8	2.13	2	2	1
Lerista muelleri	Dwarf Three-toed Slider	27	1.1	1.95	3	4	2
Demansia psammophis	Yellow-faced Whipsnake	9	1.8	1.07	1	1	1
Nephurus milii	Barking Gecko	18	0.4	0.47	2	4	3
Suta suta	Curl Snake	9	0.4	0.24	1	2	2
Pogona vitticeps	Central Bearded Dragon	18	0.1	0.12	2	5	2

Floristic group	# sites
Ptilotus obovatus, Sida petrophila, Solanum ellipticum low open shrubland with emergent tall shrubs and low trees.	2
Maireana pyramidata, Atriplex vesicaria low shrubland with emergent *Acacia victoriae*.	2
Eucalyptus socialis Mallee.	2
Dodonea microzyga, Rhagodia ulicina and *Maireana sedifolia*, low shrubland with emergent *Myoporum platycarpum* with or without an open overstorey of *Eucalyptus socialis* or *Casuarina pauper*.	1
Atriplex lindleyi, Atriplex vesicaria, Sclerolaena divaricata low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.	1

Atriplex vesicaria, Rhagodia spinescens low shrubland with *Casuarina pauper* low open woodland overstorey or emergent *Acacia victoriae, Alectryon oleifolius* and *Eremophila* spp.	1
Acacia victoriae, Acacia tetragonophylla tall shrubland with or without *Melaleuca glomerata* and *Eucalyptus camaldulensis* open woodland over *Maireana pyramidata* and *Rhagodia spinescens*.	1
Eucalyptus camaldulensis open woodland.	1

Landform	**# sites**
hill slope	5
stream channel	3
flood out	1
gully	1
hill crest	1

Surface soil texture	**# sites**
sandy loam	5
sandy clay loam	3
clayey sand	2
loam	1

Strew size	**cover**	**# sites**
pebble (5-50mm)	30-70%	3
boulder (gt 250mm)	30-70%	2
cobble (51-250mm)	30-70%	2
pebble (5-50mm)	10-30%	2
cobble (51-250mm)	10-30%	1
cobble (51-250mm)	gt 70%	1

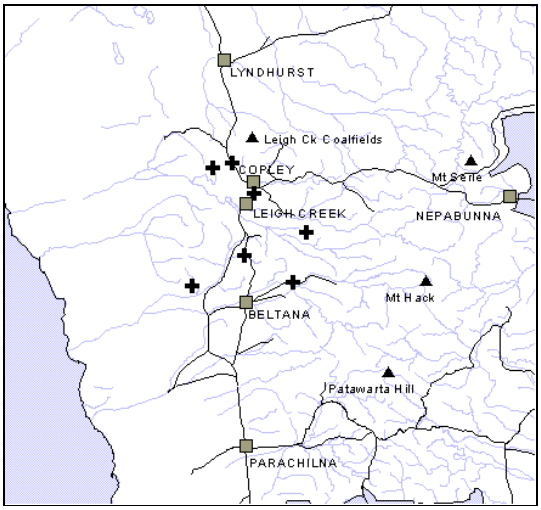
Goup number : 2

Number of sites in group: 7
Number of species in group: 11
Average number of species at sites: 4.6 **Max** 7 **Min** 3

This reptile assemblage was characteristic of stony plains and hill slopes supporting chenopod low shrublands and sub-shrublands. A number of species are typically found in the stony desert shrublands to the north (ie Eyrean Earless Dragon, Short-legged Ctenotus, Spotted Ctenotus, Tessellated Gecko).

Sites

ARO00301 ARO00501 ARO00601 PUT00601
PUT00101 DEC00601 PUT00801



Species	**Common Name**	**% of sites in group**	**(O-E)/E**	**indicator spp.**	**frequency in group**	**frequency in all groups**	**# of groups in which species occurs**
Tympanocryptis tetraporophora	Eyrean Earless Dragon	86	3	10.7	6	8	3
Diplodactylus byrnei	Pink-blotched Gecko	100	1.8	7.46	7	13	4
Ctenotus strauchii	Short-legged Ctenotus	57	2.5	5.92	4	6	3
Ctenotus uber 'olympicus'	Spotted Ctenotus	57	2	4.73	4	7	2

Tiliqua rugosa	Sleepy Lizard	43	0.6	1.07	3	10	5
Species at <30% of sites with	**indicator species values >0.**						
Diplodactylus tessellatus	Tessellated Gecko	29	2.5	2.96	2	3	2
Rhynchoedura ornata	Beaked Gecko	29	0.8	0.95	2	6	3
Lerista muelleri	Dwarf Three-toed Slider	14	0.3	0.18	1	4	2
Nephurus milii	Barking Gecko	14	0.3	0.18	1	4	3
Varanus gouldii	Sand Goanna	14	0.1	0.06	1	5	4

Floristic group	**# sites**
Maireana pyramidata, *Atriplex vesicaria* low shrubland with emergent *Acacia victoriae*.	3
Atriplex vesicaria, *Maireana astrotricha* low shrubland.	2
Atriplex lindleyi, *Atriplex vesicaria*, *Sclerolaena divaricata* low open shrubland with emergent *Alectryon oleifolius* and *Casuarina pauper*.	1
Sclerolaena ventricosa, *Sclerolaena brachyptera* sub-shrubland with tussock grasses and emergent shrubs.	1

Landform	**# sites**
stony plain	4
plain (incl undulating plain)	2
flood out	1

Strew size	**cover**	**# sites**
cobble (51-250mm)	10-30%	3
cobble (51-250mm)	30-70%	2
pebble (5-50mm)	30-70%	1
none apparent		1

Surface soil texture	**# sites**
medium clay	3
sandy loam	2
clayey sand	1
clay loam, sandy	1

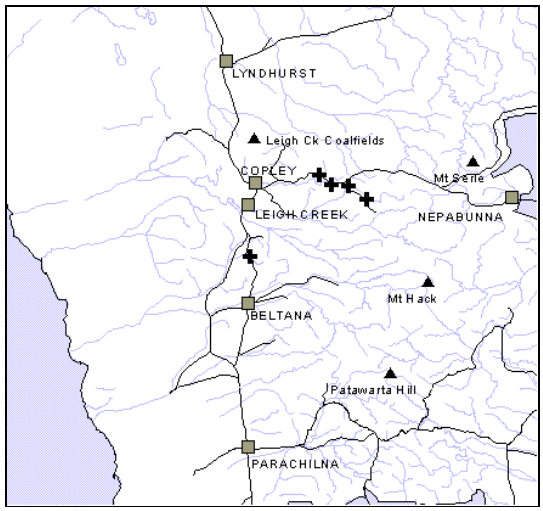
Goup number : 3

Number of sites in group: 5
Number of species in group: 15
Average number of species at sites: 6.2 **Max** 10 **Min** 3

This group was comprised of reptile assemblages occurring on hill crests and drainage associated habitats, towards the main body of the Flinders Ranges, in the east of the study area. The Southern Spiny-tailed Gecko appeared to be restricted to this region. The other indicator species which occurred more widely on rocky hill slopes were the Eastern Striped Skink and the Red-barred Dragon. This assemblage was notable for being the only group to support Legless Lizards (Spinifex Snake-lizard and the Black-headed Scaly-foot).

Sites

COF00401 PUT00701 COF00501 COF00801
COF00601



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	# of groups in which species occurs
Strophurus intermedius	Southern Spiny-tailed Gecko	40	4.5	5.33	2	2	1
Ctenotus robustus	Eastern Striped Skink	80	2.1	4.97	4	7	3
Pogona vitticeps	Central Bearded Dragon	60	2.3	4.08	3	5	2
Tiliqua rugosa	Sleepy Lizard	80	1.2	2.84	4	10	5
Ctenotus uber	Spotted Ctenotus	60	1.3	2.31	3	7	2
Heteronotia binoei	Bynoe's Gecko	60	1	1.78	3	8	2
Gehyra variegata	Tree Dtella	60	0.4	0.71	3	12	3
Diplodactylus byrnei	Pink-blotched Gecko	40	-0.2	-0.2	2	13	4
Species at <30% of sites with	**indicator species values >0.**						
Delma butleri	Spinifex Snake-lizard	20	4.5	2.66	1	1	1
Pygopus nigriceps	Black-headed Scaly-foot	20	4.5	2.66	1	1	1
Suta suta	Curl Snake	20	1.7	1.01	1	2	2
Ctenophorus vadnappa	Red-barred Dragon	20	0.8	0.47	1	3	3
Nephurus milii	Barking Gecko	20	0.4	0.24	1	4	3

Floristic group	**# sites**
Ptilotus obovatus, *Sida petrophila*, *Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.	2
Atriplex vesicaria, *Maireana astrotricha* low shrubland.	1
Atriplex vesicaria, *Rhagodia spinescens* low shrubland with *Casuarina pauper* low open woodland overstorey or emergent *Acacia victoriae*, *Alectryon oleifolius* and *Eremophila* spp.	1
Eucalyptus camaldulensis open woodland.	1

Landform	**# sites**
hill crest	2
plain (incl undulating plain)	1
stream channel	1
drainage depression	1

Strew size	**cover**	**# sites**
pebble (5-50mm)	<10%	2
pebble (5-50mm)	10-30%	1
boulder (gt 250mm)	gt 70%	1
Sheet	30-70%	1

Surface soil texture	**# sites**
silt loam	2
sandy loam	1
sandy clay loam	1
loam	1

Goup number : 4

Number of sites in group: 4

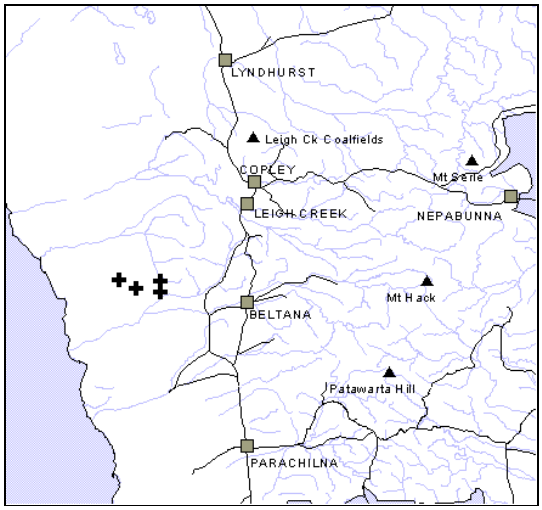
Number of species in group: 17

Average number of species at sites: 7.8 **Max** 10 **Min** 6

This reptile assemblage was associated with the sandier soils of the study area and included a dunefield site and those where sand spreads overlay clay soils. This group supported the highest diversity of small dragon species (4), including two which are restricted to sandy habitats (Painted and Mallee Dragons). The Central Netted Dragon is a generalist species that occurs widely across arid South Australia on sand to loam and sometimes clay soils. On the harder soils it is usually in the vicinity of areas of sand or loose soil which enable it to burrow. The Smooth-snouted Earless Dragon is most commonly associated with very sparsely vegetated stony plains to the north of the study area. Its occurrence in this group probably relates more to the non-sand parts of the stony plain sites which in the west of study area most closely resemble their stony desert counterparts (both in form and floristically). Sites comprising this assemblage have the highest average species richness. This reflects the ecotonal nature of the sandy patches over the essentially stony clay plains present at three of the four sites in this group.

Sites

DEC00201 DEC00301 DEC00401 DEC00501



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	Frequency in group	frequency in all groups	number of groups in which species occurs
Ctenotus brooksi	Sandhill Ctenotus	75	4.6	8.17	3	3	1
Ctenophorus nuchalis	Central Netted Dragon	50	4.6	5.44	2	2	1
Lerista labialis	Eastern Two-toed Slider	50	4.6	5.44	2	2	1
Tympanocryptis intima	Smooth-snouted Earless Dragon	50	4.6	5.44	2	2	1
Ctenophorus pictus	Painted Dragon	50	2.8	3.31	2	3	2
Diplodactylus stenodactylus	Sandplain Gecko	50	2.8	3.31	2	3	2
Rhynchoedura ornata	Beaked Gecko	75	1.8	3.2	3	6	3
Varanus gouldii	Sand Goanna	50	1.3	1.54	2	5	4
Ctenotus regius	Eastern Desert Ctenotus	50	0.9	1.07	2	6	3
Diplodactylus byrnei	Pink-blotched Gecko	75	0.3	0.53	3	13	4
Species at <30% of sites with indicator species values >0.							
Ctenophorus fordi	Mallee Dragon	25	4.6	2.72	1	1	1
Diplodactylus damaeus	Beaded Gecko	25	4.6	2.72	1	1	1
Nephrurus levis	Smooth Knob-tailed Gecko	25	4.6	2.72	1	1	1

Floristic group	**# sites**
Sclerolaena ventricosa, Sclerolaena brachyptera sub-shrubland with tussock grasses and emergent shrubs.	2
Atriplex vesicaria, Maireana astrotricha low shrubland.	1
Acacia ligulata Tall Shrubland over *Senna* spp. shrubs and *Atriplex velutinella* low shrubs.	1

Landform	**# sites**
stony plain	2
hill slope	1
dune/consolidated dune	1

Strew size	**cover**	**# sites**
pebble (5-50mm)	30-70%	2
pebble (5-50mm)	10-30%	1
none apparent		1

Surface soil texture	**# sites**
clayey sand	2
clay loam, sandy	1
sand	1

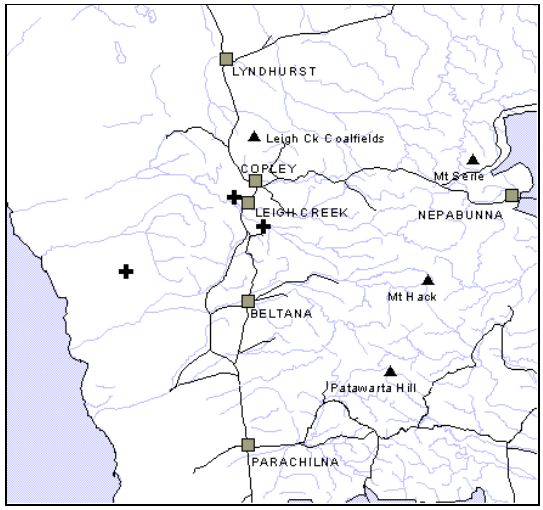
Goup number : 5

Number of sites in group: 3
Number of species in group: 7
Average number of species at sites: 4 **Max** 6 **Min** 3

This reptile assemblage represented the shrubby hill slope reptile communities characteristic of the western hills in the study area. The major indicator species in this group were typically found in rocky areas (eg Gidgee Skink). Of interest in this group was the occurrence of the Centralian Striped Skink (probably the most south-easterly record of this species) which was sympatric with the closely related Eastern Striped Skink (towards the northern extent of it's range in South Australia). An interesting difference between this assemblage and the other hill shrubland reptile assemblage 3, was the dominance of the Purple Dtella as opposed to the Tree Dtella.

Sites

ARO00401 DEC00101 PUT00301



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Egernia stokesii	Gidgee Skink	100	14.4	25.6	3	3	1
Ctenotus saxatilis	Centralian Striped Skink	33	14.4	8.52	1	1	1
Ctenotus robustus	Eastern Striped Skink	67	3.4	4.02	2	7	3
Gehyra purpurascens	Purple Dtella	67	2.8	3.31	2	8	4
Ctenophorus vadnappa	Red-barred Dragon	33	4.1	2.43	1	3	3
Varanus gouldii	Sand Goanna	33	2.1	1.24	1	5	4
Tiliqua rugosa	Sleepy Lizard	33	0.5	0.3	1	10	5

Floristic group	# sites
Ptilotus obovatus, *Sida petrophila*, *Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees.	1
Triodia irritans hummock grassland with a *Cauarina pauper* sparse to open low woodland overstorey.	1
Acacia tetragonophylla/Acacia victoriae/Acacia aneura tall shrubland over scattered shrubs and tussock grasses.	1

Landform	# sites
hill slope	3

Surface soil texture	# sites
clay loam, sandy	2
loam	1

Strew size	cover	# sites
cobble (51-250mm)	30-70%	1
cobble (51-250mm)	gt 70%	1
Sheet	gt 70%	1

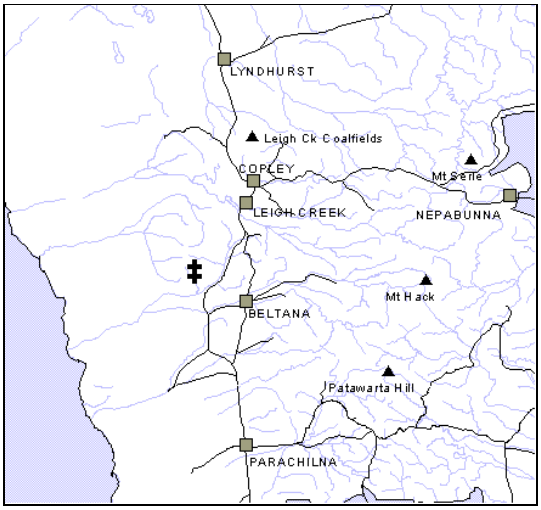
Goup number : 6

Number of sites in group: 2
Number of species in group: 2
Average number of species at sites: 2 **Max** 2 **Min** 2

This reptile assemblage represented a depauperate community of only two species, which occurred in the *Acacia* shrub/low woodlands growing on the purple Bunyaroo shales adjacent to the Mt Deception Range, in the west of the study area. Of interest was the suitability of the shale substrate to the Eastern Desert Ctenotus which is more usually associated with sandy soils (Brandle and Hutchinson 1998). Also the Purple Dtella was the main inhabitant of the dead timber and loose bark present in this shrubland, a microhabitat dominated by the Tree Dtella in similar situations in the northern deserts.

Sites

DEC00701 DEC00801



Species	Common Name	% of sites in group	(O-E)/E	indicator spp.	frequency in group	frequency in all groups	number of groups in which species occurs
Ctenotus regius	Eastern Desert Ctenotus	100	13.1	15.5	2	6	3
Gehyra purpurascens	Purple Dtella	100	9.6	11.4	2	8	4

Floristic group **# sites**

Acacia tetragonophylla/Acacia victoriae/Acacia aneura tall shrubland over scattered shrubs and tussock grasses. 2

Landform	# sites
hill slope	2

Strew size	cover	# sites
pebble (5-50mm)	gt 70%	2

Surface soil texture	# sites
sandy loam	1
loamy sand	1

SPECIES RICNESS

The most species rich sites contained ten species of reptile. These two sites ranged from tall shrubland along a narrow drainage line to low open shrublands on sand over clay. Sites with eight species included well wooded drainage lines, a low shrubland and sand dune. Figure 23 displays the relationship between species richness, abundance and the reptile assemblages recorded during the survey. The highest average reptile species richness and abundance were evident for reptile assemblage 4. This group included the dunefield site and a number of sites supporting sand patches over clay, providing a suitable substrate for a diverse mix of clay and sand dwelling species.

The other groups from woodland to low shrublands supported a similar range of species richness. This lack of clear distinction in species richness between different groups of sites is highlighted by a lack of clear trends when site species richness is analysed by landform, soil type and vegetation structure (Figures 24 to 27. The variability between sites appears to be dependent on factors other than the broad parameters recorded. The only consistent trend is that sites covered with a light to medium strew of pebbles have consistently higher species richness and abundance (Figure 26). The complexity of a site in terms of soil types, vegetation and strew cover are likely to provide the variety of factors that lead to high reptile diversity.

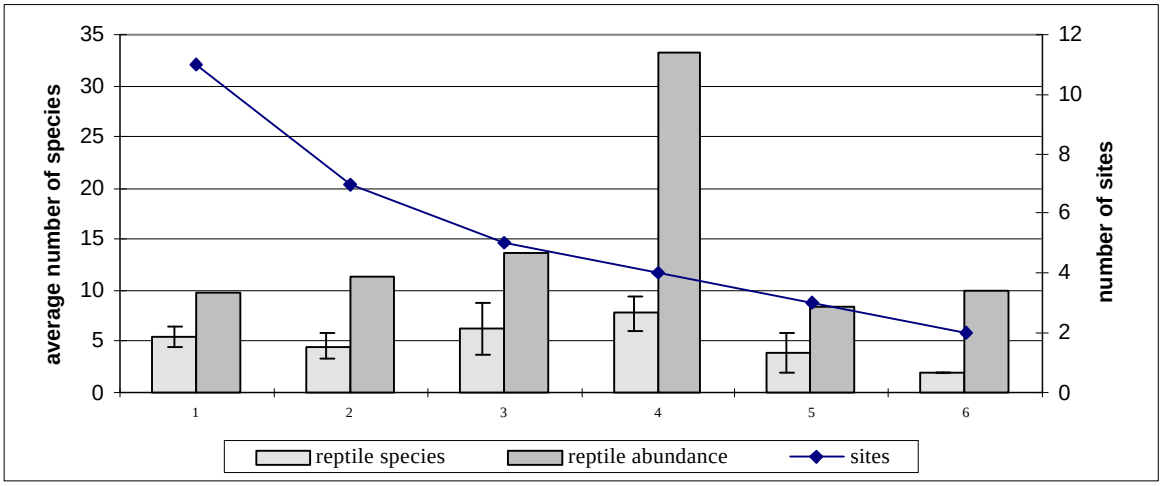


Figure 23. The average number of reptile species per site and abundance are displayed for the reptile assemblages. Confidence intervals at 95% significance levels are displayed for species richness.

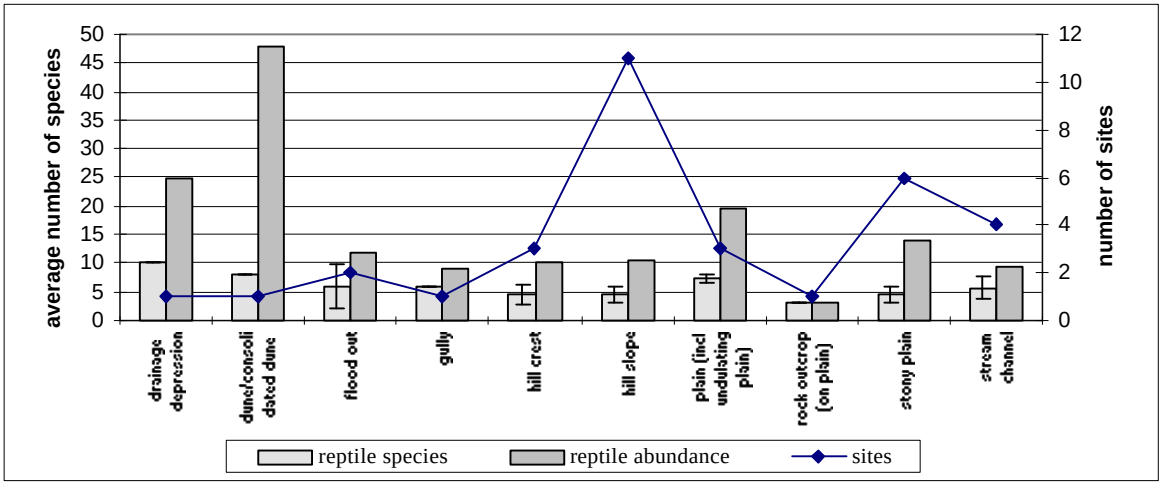


Figure 24. The average number of reptile species per site and abundance are displayed for the landform categories. Confidence intervals at 95% significance levels are displayed for species richness.

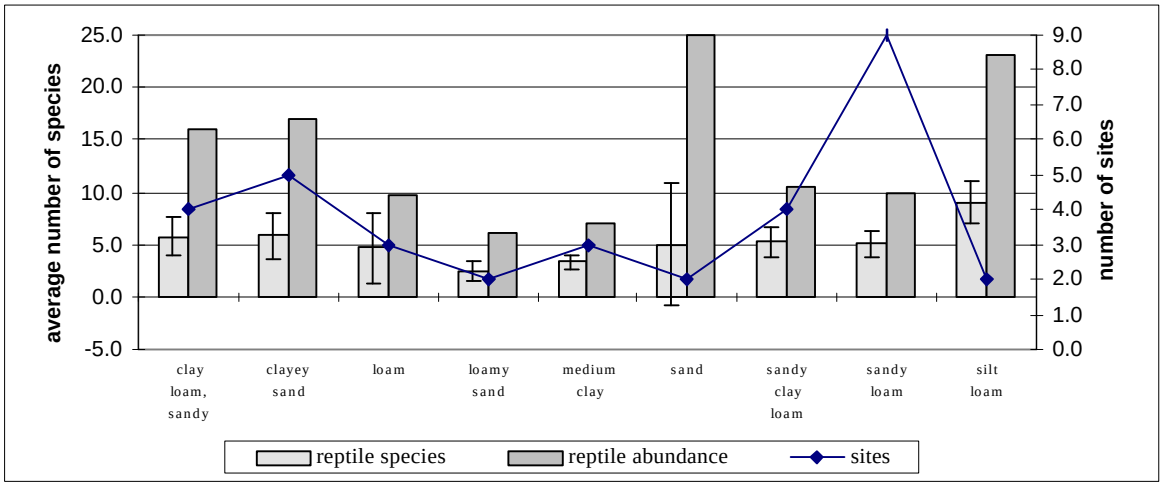


Figure 25. The average number of reptile species per site and abundance are displayed for the surface soil texture categories. Confidence intervals at 95% significance levels are displayed for species richness.

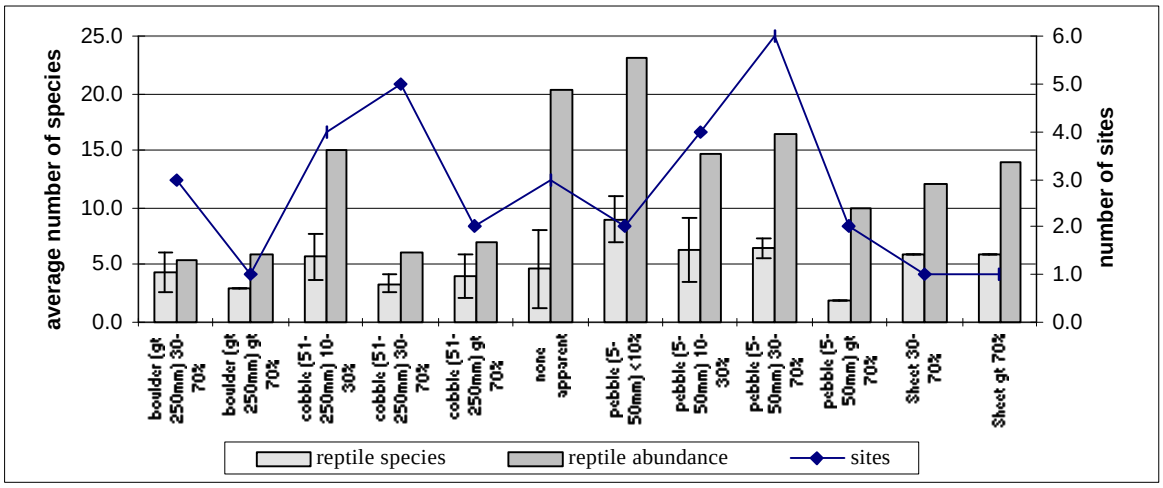


Figure 26. The average number of reptile species per site and abundance are displayed for the strew size and cover categories. Confidence intervals at 95% significance levels are displayed for species richness.

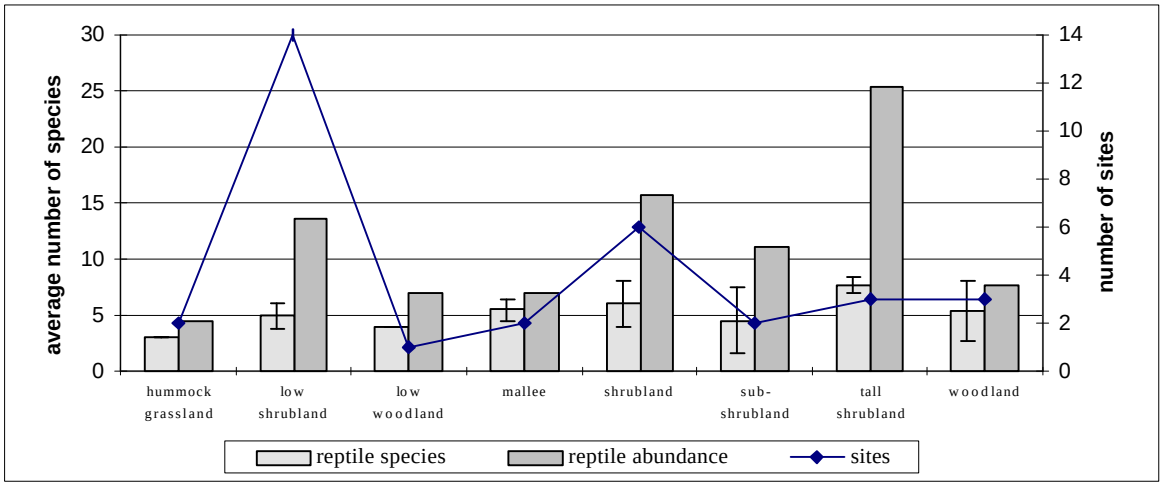


Figure 27. The average number of reptile species per site and abundance are displayed for the dominant vegetation strata categories. Confidence intervals at 95% significance levels are displayed for species richness.

SPECIES WITH CONSERVATION SIGNIFICANCE

Reptile species, until recently have not been rated for conservation status in the same way as birds and mammals. This in part reflects a lesser empathy of the general public with all things reptilian and the lack of knowledge about the distribution, taxonomy and status of the majority of reptile species. In 1993 an 'Action Plan for Australian Reptiles' (Cogger *et al* 1993) was published for the Commonwealth environmental conservation agency. No species known to occur in the study area are rated in this plan. At a South Australian level the most up-to-date ratings were provided by M Hutchinson (Curator of Reptiles with the South Australian Museum) in an unpublished report for the South Australian Advisory Committee on Threatened Species in 1993. This document includes the Carpet and Stimson Pythons as vulnerable and rare in this State. Neither species have been confirmed for the area with a museum specimen. However, residents of Leigh Creek, reported to the author, that they had received a small road killed python which was collected to show the children at the school. This was considered to be a Childrens Pythons based on matches against identification books. This would now be considered to be a Stimson Python. Reports of larger pythons inhabiting Redgum creek lines came from landholders at Burr Well and Puttapa Stations and most likely refer to the Carpet Python.

Whilst the reptile fauna of the study area may not be considered threatened with decline or extinction the area contains small population isolates of species which are endemic to the northern Flinders Ranges or at at the edge of their known range. Endemic species include the Masked Rock Skink *Egernia margaretae* which is probably restricted to the Aroona Range within the study area and may represent the north-western most population. The other north Flinders Ranges endemic, the Red-barred Dragon *Ctenophorus vadnappa* is more widely spread throughout the rocky outcrops of the study area. The study area is likely to be an important zone for genetic transfer between the Flinders Ranges and Willouran Ranges populations.

A couple of species records represented significant range extensions. The three records of the Great Desert Slider *Lerista desertorum* represents an easterly extension of over 100 km to their known distribution. The Centralian Striped Skink *Ctenotus saxatilis* represents a south-easterly extension of over 300 km to their known distribution. The low chenopod shrubland habitats common in the study region would have to represent a centre of abundance for the Pink-blotched Gecko.

AMPHIBIANS

Two of the four amphibians known to occur in the study area were recorded during the survey despite the dry conditions during spring. The water-holding Trilling Frog *Neobatrachus centralis* was only recorded as tadpoles, which were numerous in a rapidly drying borrow pit beside the main road south of Leigh Creek. This species is probably the most widespread and abundant frog in South Australia, having an ability to survive long dry spells buried beneath clay plains and dunefields. The more restricted and Streambank Froglet was recorded in the permanently moist part of windy creek below Aroona Dam. This species is endemic to the Flinders Ranges and is widespread along major watercourses.

Table 19. Amphibian species list for the North West Flinders Ranges.

North-West Flinders Amphibians			
Family	**Scientific Name**	**Common Name**	**Recorded on survey**
HYLIDAE	*Litoria rubella*	Red Tree Frog	
MYOBATRACHIDAE	*Crinia riparia*	Streambank Froglet	*
MYOBATRACHIDAE	*Limnodynastes tasmaniensis*	Marbled Frog	
MYOBATRACHIDAE	*Neobatrachus centralis*	Trilling Frog	*

SUMMARY AND CONCLUSIONS

R Brandle

VEGETATION

The biological survey investigated the flora and fauna of a diverse range of vegetation communities on a number of landform types and substrates. The 33 quadrats with 77 vegetation patches support dynamic and overlapping floristic assemblages which were clustered into 14 groups based on similarities of species present at sites. These align themselves to the four broad landform types.

Hills and Ranges

Group 1: Brilliant Hopbush *Dodonea microzyga*, Intricate saltbush *Rhagodia ulicina* and Pearl Bluebush *Maireana sedifolia*, low shrubland with emergent False Sandlewood *Myoporum platycarpum* with or without an open overstorey of Beaked Red Mallee *Eucalyptus socialis* or Blackoak *Casuarina pauper* (mapped under structural vegetation groups 12, 14 and 15).

Group 2: Silver Mulla Mulla *Ptilotus obovatus*, Rock Sida *Sida petrophila*, Velvet Potato-Bush *Solanum ellipticum* low open shrubland with emergent tall shrubs and low trees (mapped under structural vegetation group 12).

Group 3: Spinifex *Triodia irritans* hummock grassland with Blackoak *Cauarina pauper* sparse to open low woodland (mapped under structural vegetation group 13).

Group 10: Dead Finish *Acacia tetragonophylla*/ Elegant Wattle *Acacia victoriae*/Mulga *Acacia aneura* tall shrubland over scattered shrubs and tussock grasses (mapped under structural vegetation groups 10 and 12).

Stony plains, undulating plains and low hills

Group 4: Bladder Saltbush *Atriplex vesicaria*, Low Bluebush *Maireana astrotricha* low shrubland (mapped under structural vegetation group 8).

Group 5: Baldoo *Atriplex lindleyi*, Bladder Saltbush *Atriplex vesicaria*, Tangled Bindyi *Sclerolaena divaricata* low open shrubland with emergent Bullock Bush *Alectryon oleifolius* and Blackoak *Casuarina pauper* (mapped under structural vegetation groups 8 and 15).

Group 6: Bladder Saltbush *Atriplex vesicaria*, Spiny Saltbush *Rhagodia spinescens* low shrubland with Blackoak *Casuarina pauper* low open woodland overstorey or emergent Elegant Wattle *Acacia victoriae*, Bullock Bush *Alectryon oleifolius* and Emubush *Eremophila* spp. (mapped under structural vegetation groups 8,10 and 15).

Group 11: Salt Bindyi *Sclerolaena ventricosa*, Short-wing Bindyi *Sclerolaena brachyptera* sub-shrubland with tussock grasses and emergent shrubs (mapped under structural vegetation group 9 and grading into 10).

Group 14: Beaked Red Mallee *Eucalyptus socialis* Mallee (mapped under structural vegetation group 14).

Floodouts and Drainage lines

Group 7: Black Bluebush *Maireana pyramidata*, Bladder Saltbush *Atriplex vesicaria* low shrubland with emergent Elegant Wattle *Acacia victoriae* (mapped under structural vegetation groups 4 and 5).

Group 8: Elegant Wattle *Acacia victoriae*, Dead Finish *Acacia tetragonophylla* tall shrubland with or without Inland Paper-bark *Melaleuca glomerata* and River Red Gum *Eucalyptus camaldulensis* open woodland over Black Bluebush *Maireana pyramidata* and Spiny Saltbush *Rhagodia spinescens* (mapped under structural vegetation groups 3 and 4).

Group 9: River Red Gum *Eucalyptus camaldulensis* open woodland (mapped under structural vegetation group 3).

Group 13: Narrow-leaf Bulrush *Typha domingensis* and Spiny Flat-sedge *Cyperus gymnocaulos* Sedgeland with a sparse overstorey of River Red Gum *Eucalyptus camaldulensis* and Inland Paper-bark *Melaleuca glomerata* (mapped under structural vegetation group 3).

Dunefields

Group 12: Umbrella Bush *Acacia ligulata* Tall Shrubland over *Senna* spp. shrubs and Sandhill Saltbush *Atriplex velutinella* low shrubs (mapped under structural vegetation group 6).

Vegetation was mapped on the basis of structure, as this was the most consistently discernable pattern observable from aerial photographs. Satellite imagery proved to be highly complex and variable in interpreting vegetation associations across the mapsheet. Nineteen structural vegetation categories were chosen to represent the diversity of vegetation communities comprising the flora of the Copley

1:250,000 mapsheet. Ten of these were noted to occur in the study area. The descriptions above show how these relate to the 14 floristic groups and the major landforms. Descriptions of the structural vegetation categories are provided with the map in the back of the report.

At least 354 plant taxa are known to occur in the study area, 226 of which were recorded during the December 1997 survey. Twelve percent of these were introduced exotic species which have established themselves throughout the best watered habitats. The most common plants were predominantly chenopods shrubs such as the Bladder Saltbush *Atriplex vesicaria* of the stony plains and hill slopes. The average number of species at sites was greatest at sites associated with floodouts and drainage lines at around 30 species per site, compared with an average of 21 species per site for the whole study. Eight species known from the area are considered to be of conservation significance in South Australia, five of which also have a national rating. The two nationally vulnerable species were not recorded at sites and have restricted distributions (Slender Bell-fruit *Codonocarpus pyramidalis* and the Black-fruited Bluebush *Maireana melanocarpa*). The other species were all rarely recorded with the exception of the Dryland Bluebush *Wahlenbergia aridicola* which was present at five of the 77 vegetation patches sampled.

MAMMALS

Thirteen of the 20 species of native mammals still likely to occur in the northern Flinders Ranges were recorded within the study area. A further nine exotic species were also recorded. The most common species at sites were the introduced House Mouse *Mus domesticus*, and the native Stripe-faced Dunnart *Sminthopsis macroura*. These were also the two most abundant species making up more than half the records. The five species of bats recorded were trapped over water away from the survey sites. The five small mammal species fell into three major assemblage groups aligned with broad habitat types. These were steeper hill slopes and ranges with medium to tall shrublands (characterised by the Stripe-faced Dunnart), low chenopod shrublands on plains and low hills (characterised by the Fat-tailed Dunnart *S. crasicaudata*) and the mono-specific House Mouse group that was typical of woodlands along drainage lines and sand dunes. Species richness was low by the standards of more remote arid regions. The Yellow-footed Rock-wallaby *Petrogale xanthopus* which was considered common by Eyre in 1840 is being reintroduced to the Aroona Range and is the only species with a national conservation rating (potentially vulnerable). Two native rodent species were recorded for the first time in the study area and represent significant records for these species in the Flinders Ranges. Forrest's Mouse was considered rare in South Australia (Watts 1990) whilst Bolam's Mouse has only been recorded on the eastern side of the ranges. Some of the nine introduced species represent significant ongoing threats to the biological diversity and habitat integrity of the study area if they are not managed to reduce their impacts on these systems.

BIRDS

The study area is known to support up to 159 species of birds, 93 of which were recorded during the December 1997 survey. A significant proportion of the total species list, particularly the 34 waterbird species, are non resident visitors to the area. A number of migratory birds pass through the area in summer (eg the Rainbow Bird *Merops ornatus*) or winter (eg the Blue-winged Parrot *Neophema chrysostoma*). The most common birds were Galahs *Cacatua roseicapilla*, Australian Ravens *Corvus coronoides* and White-winged Wrens *Malurus leucopterus*. Fifty species were recorded with sufficient frequency at sites to enable the bird communities to be defined. Six groups were chosen to describe the assemblages typical of the four major habitat types in the study area. The most species rich sites supported structurally diverse woodlands, usually along drainage lines but also on the dunefield. The most diverse site contained 19 species. Four species were recorded which are listed as having National conservation significance. Only one, the Thick-billed Grasswren *Amytornis textillis*, is considered to be vulnerable in the 'Action Plan for Australian Birds' (Garnett 1992). Thirty-seven species have some form of South Australian conservation rating (Watts 1990). These included nine species which are considered to be vulnerable to extinction, four that are rare, 23 that are uncommon and one that is still to be determined. Three species of exotic bird have been recorded in the area. However, only the House Sparrow was noted during the survey and none were recorded at sites. It is unlikely that any of the introduced species have established themselves in the natural habitats of the region.

REPTILES

The December 1997 survey increased the number of reptiles that had been reliably recorded in the region from 31 to 50 species. An additional two species of python were described to the survey team by local residents and landholders. The most commonly encountered species were nocturnal geckos (the Pink-blotched Gecko *Diplodactylus byrnei* and the Tree Dtella *Gehyra variegata*). These were closely followed by the ever-present Sleepy Lizard *Tiliqua rugosa*. Thirty-eight species were recorded on sites and were used to analyse reptile community patterns. The six reptile assemblage groups described aligned themselves to the major landform/habitat groups, with some variation from east to west (reflecting changes in topography and geomorphology). Reptile diversity at a site appeared to be more related to the complexity of

substrates present (ie areas which have overlapping habitat variables in them. For example a stony plain with overlying sand patches). The two highest species rich sites contained ten species each, the average for the study was between five and six species per site. No species of national conservation significance were recorded in the area. Only Stimsons Python *Antaresia stimsoni* (rare) and Carpet Python *Morelia spilota* (vulnerable) have existing ratings of South Australian conservation significance (Hutchinson 1993). Significant range extensions were recorded for the Great Desert Slider *Lerista desertorum* and the Centralian Striped Skink *Ctenotus saxatilis*. The record of the Masked Rock Skink *Egernia margaretae* was the most north-western record for this endemic of the Flinders Ranges.

AMPHIBIANS

Only two of the four species of frogs known to occur in the region were recorded during the survey. These were the widespread and seasonably abundant water-holding frog species, the Central Trilling Frog *Neobatrachus centralis* and the small Streambank Froglet *Crinia riparia*, a Flinders Ranges endemic that lives under boulders in creeklines. Neither of these species were recorded at sites.

CONSERVATION

The various habitats of the area are spread unevenly across the region with a marked contrast between the east, close to the main ranges, and the west at the furthest edge of the Flinders block. For this reason no one representative area can be specifically managed in a way which covers the range of habitats and species represented in the study area. The highest diversity of landforms and vegetation types are predictably associated with the larger ranges such as the Aroona Range, however even this area is distinctively different from the Mt Deception Range and the Mt Coffin area, these different habitats are connected through the chenopod shrublands which dominate the plains and low hills of the region. Many of the species utilizing the rarer habitats, require this connectivity through the more common habitats to maintain viable populations within any one area. Therefore, any future developments that introduce fragmentation or isolation of habitats into this region would lead to further reductions in biological diversity.

Current efforts to reduce the impacts of domestic stock as well as feral predators and herbivores need to be maintained and expanded if the goal of maintaining and enhancing biological diversity is to be achieved.

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Site	Landform	Nearest named place	Distance from	Direction from	AMG zone	Easting	Northing	Elliot trap nights	Pitfall trap nights	Cage trap nights
ARO00101	hill slope	MT AROONA	7.6	NNW	54	242660	6620560	120	48	16
ARO00102	plain (incl undulating plain)	MT AROONA	7.5	NNW	54	242570	6620330			
ARO00103	hill slope	MT AROONA	7.8	NW	54	242670	6620710			
ARO00201	gully	AROONA DAM	8.5	NNW	54	242920	6621470	120	48	16
ARO00202	stream channel	MT AROONA	7.6	NNW	54	242620	6621980			
ARO00301	plain (incl undulating plain)	MT AROONA	7.5	NNW	54	243360	6620810	120	48	16
ARO00302	hill crest	MT AROONA	7.6	NNW	54	243900	6621400			
ARO00303	plain (incl undulating plain)	MT AROONA	7.5	NNW	54	243300	6620800			
ARO00401	hill slope	MT AROONA	1	SE	54	247700	6613500	180	24	24
ARO00402	stream channel	MT AROONA	0.9	SE	54	247600	6613550			
ARO00403	hill slope	MT AROONA	1	SE	54	247920	6613700			
ARO00404	hill slope	MT AROONA	1	SE	54	248240	6613790			
ARO00501	stony plain	MT AROONA	8.2	N	54	247500	6622100	90	36	12
ARO00601	flood out	MT AROONA	5.7	E	54	252400	6614700	120	48	16
ARO00701	hill crest	MT AROONA	4.9	SE	54	249300	6609800	120	48	16
ARO00702	plain (incl undulating plain)	MT AROONA	5	SE	54	249200	6609600			
ARO00703	stream channel	MT AROONA	5	SE	54	249200	6610200			
ARO00801	stream channel	MT AROONA	1.8	SSW	54	245610	6612140	120	48	16
ARO00802	stream channel	MT AROONA	1.5	S	54	246260	6612720			
ARO00803	stony plain	MT AROONA	1.7	SSW	54	245510	6612950			
ARO00804	hill slope	MT AROONA	1.5	SSW	54	246400	6612580			
ARO00901	hill crest	MT AROONA	0.6	SSW	54	246400	6613600			
ARO00902	gully	MT AROONA	0.4	SW	54	246430	6613770			
COF00101	stream channel	LEIGH CK HOMESTEAD	1	ESE	54	258400	6617700	120	48	16
COF00102	hill footslope	LEIGH CK HOMESTEAD	1	ESE	54	258440	6617680			
COF00103	stream channel	LEIGH CK HOMESTEAD	1	ESE	54	258280	6617610			
COF00201	hill slope	MT COFFIN	0.6	E	54	262190	6621230	120	24	16
COF00202	hill slope	MT COFFIN	0.7	E	54	262200	6621200			
COF00203	hill slope	MT COFFIN	0.8	E	54	262260	6621210			
COF00301	hill slope	MT COFFIN	1.5	E	54	263140	6621050	120	48	16
COF00302	rock outcrop (on plain)	MT COFFIN	1.5	E	54	263150	6621070			
COF00401	stream channel	MT COFFIN	4	ESE	54	265810	6619700	120	48	16
COF00402	hill crest	MT COFFIN	4	ESE	54	265860	6619760			
COF00403	hill slope	MT COFFIN	3.9	ESE	54	265710	6619700			
COF00501	plain (incl undulating plain)	MT COFFIN	8.3	ESE	54	268400	6617500	120	48	16
COF00502	drainage depression	MT COFFIN	8.4	ESE	54	268590	6617540			
COF00601	hill crest	MT COFFIN	11.1	ESE	54	271920	6617150	120	24	16
COF00602	hill slope	MT COFFIN	11.1	ESE	54	271890	6617120			
COF00603	stream channel	MT COFFIN	11.1	ESE	54	271880	6617030			
COF00701	hill slope	MT COFFIN	14.7	ESE	54	274850	6614980	120	48	16
COF00702	hill slope	MT COFFIN	14.7	ESE	54	274940	6615050			
COF00703	stream channel	MT COFFIN	14.7	ESE	54	275060	6615340			
COF00704	hill slope	MT COFFIN	14.7	ESE	54	274700	6614640			
COF00801	drainage depression	MT COFFIN	16	ESE	54	275760	6613840	120	48	16
COF00802	hill slope	MT COFFIN	16	ESE	54	275760	6613880			
COF00803	rock outcrop (on plain)	MT COFFIN	16	ESE	54	275980	6613690			
DEC00101	hill slope	HIJACK BORE	1.2	SSE	54	225300	6594700	200	0	0
DEC00102	dune/consolidated dune	HIJACK BORE	1	SSE	54	225200	6594900			
DEC00201	dune/consolidated dune	GAP WELL	2	NNW	54	224200	6592800	105	42	14
DEC00301	hill slope	GAP WELL	3	E	54	227700	6590800	120	48	16
DEC00401	stony plain	SUNDOWN BORE	2.5	ENE	54	232900	6592700	120	48	16
DEC00402	drainage depression	SUNDOWN BORE	2.2	ENE	54	232500	6592300			
DEC00501	stony plain	SUNDOWN BORE	2.4	SE	54	232800	6590000	120	48	16
DEC00601	stony plain	MT DECEPTION	9	SSE	54	239700	6591800	120	48	16
DEC00602	drainage depression	MT DECEPTION	9	SSE	54	239400	6592000			
DEC00701	hill slope	MT DECEPTION	7	SSE	54	240300	6593800	120	48	16
DEC00702	gully	MT DECEPTION	7	SSE	54	239800	6593700			
DEC00801	hill slope	MT DECEPTION	4	SE	54	240100	6596300	120	48	16
PUT00101	plain (incl undulating plain)	NORTH MOOLOOLOO	4.2	SSE	54	263700	6605500	120	48	16
PUT00102	stream channel	NORTH MOOLOOLOO	4.1	SSE	54	263700	6605600			
PUT00103	rock outcrop (on plain)	NORTH MOOLOOLOO	4	SSE	54	263300	6605700			
PUT00201	stream channel	NORTH MOOLOOLOO	6.8	SSE	54	264200	6602800	120	48	16
PUT00202	flood out	NORTH MOOLOOLOO	6.7	SSE	54	264300	6602900			
PUT00203	stony plain	NORTH MOOLOOLOO	6.7	SSE	54	263200	6603000			
PUT00301	hill slope	QUARRY HILL	1.8	NE	54	254200	6606300	200	24	16
PUT00302	stony plain	QUARRY HILL	2	NE	54	254300	6606400			
PUT00303	stream channel	QUARRY HILL	2.1	NE	54	254500	6606500			
PUT00401	hill slope	PUTTUPA GAP	3.5	ESE	54	254700	6598000	120	48	16
PUT00402	stony plain	PUTTUPA GAP	3.4	ESE	54	254800	6598400			
PUT00501	flood out	PUTTUPA HOMESTEAD	3.5	N	54	259300	6592800	120	48	16
PUT00502	stream channel	PUTTUPA HOMESTEAD	4.4	N	54	259100	6592800			
PUT00503	stony plain	PUTTUPA HOMESTEAD	4.3	N	54	258700	6592700			
PUT00601	stony plain	PUTTUPA HOMESTEAD	4	NE	54	261100	6593000	120	48	16
PUT00701	hill crest	PUTTUPA GAP	0.7	S	54	251600	6599300	140	24	8
PUT00702	hill slope	PUTTUPA GAP	0.6	S	54	251500	6599300			
PUT00703	stream channel	PUTTUPA GAP	0.7	S	54	251800	6599200			
PUT00801	stony plain	PUTTUPA GAP	1.5	SW	54	250700	6599300	120	48	16

APPENDIX 2.
Plant species known to occur in the study area.

Regional Significance	SPECIES	North West Flinders Ranges	Pastoral Assessments	Flinders Ranges Review	Total
	Abutilon fraseri	1	1	0	2
	Abutilon halophilum	1	1	0	2
	Abutilon leucopetalum	1	1	0	2
r	*Abutilon otocarpum*	1	1	0	2
	Acacia aneura	1	1	0	2
	Acacia burkittii	0	1	1	2
	Acacia calamifolia	0	1	0	1
	Acacia ligulata	1	1	0	2
	Acacia oswaldii	1	1	1	3
	Acacia rivalis	1	1	1	3
	Acacia salicina	1	0	0	1
	Acacia tetragonophylla	1	1	1	3
	Acacia victoriae	1	1	1	3
	Acetosa vesicaria	0	1	1	2
	Actinobole uliginosum	0	1	0	1
	Aizoon sp.	0	1	0	1
	Alectryon oleifolius canescens	1	1	1	3
	Allocasuarina verticillata	0	1	0	1
	Amyema maidenii maidenii	1	1	1	3
	Amyema miquelii	0	1	0	1
	Amyema miraculosum boormanii	1	0	0	1
	Amyema preissii	1	0	0	1
	Amyema quandang quandang	0	0	1	1
	Anagallis arvensis	1	0	1	2
	Anemocarpa podolepidium	1	0	0	1
	Arabidella glaucescens	1	1	0	2
	Arabidella nasturtium	0	0	1	1
	Arabidella trisecta	0	1	0	1
	Argemone subfusiformis subfusiformis	1	0	0	1
	Aristida contorta	1	1	0	2
r	*Aristida holathera holathera*	1	0	0	1
	Aristida nitidula	1	1	0	2
	Asphodelus fistulosus	0	1	0	1
	Astrebla lappacea	0	1	0	1
	Astrebla pectinata	1	1	0	2
	Atriplex acutibractea	0	1	0	1
	Atriplex angulata	1	1	0	2
r	*Atriplex fissivalvis*	1	1	0	2
	Atriplex holocarpa	0	1	0	1
	Atriplex limbata	1	1	0	2
	Atriplex lindleyi conduplicata	1	1	0	2
	Atriplex nummularia nummularia	0	1	0	1
	Atriplex spongiosa	0	1	1	2
	Atriplex stipitata	1	1	1	3
	Atriplex velutinella	1	1	0	2
	Atriplex vesicaria	1	1	0	2
	Boerhavia diffusa	0	1	0	1
	Boerhavia dominii	1	1	0	2
	Boerhavia schomburgkiana	1	0	0	1
	Brachycome ciliaris ciliaris	1	1	0	2
	Brachycome ciliaris lanuginosa	1	0	0	1
	Brachycome linearriloba	0	1	1	2
	Brassica tournefortii	1	1	0	2
	Bromus arenarius	1	1	0	2
	Bromus rubens	0	1	1	2
	Bulbine semibarbata	0	1	0	1
	Bursaria spinosa	0	0	1	1
	Calandrinia sp.	0	1	0	1
	Callitris glaucophylla	1	1	1	3
	Calotis hispidula	1	1	0	2
	Carrichtera annua	1	1	1	3
	Carthamus lanatus	1	1	1	3
	Cassinia laevis	0	1	1	2
	Cassinia uncata	1	0	0	1
	Cassytha melantha	1	0	0	1
	Casuarina pauper	1	1	1	3
	Centaurea melitensis	1	1	1	3
	Centaurium spicatum	1	0	0	1
	Centipeda thespidioides	1	0	0	1
	Cheilanthes lasiophylla	1	1	1	3
	Cheilanthes sieberi sieberi	0	0	1	1

APPENDIX 2.
Plant species known to occur in the study area.

Regional Significance	SPECIES	North West Flinders Ranges	Pastoral Assessments	Flinders Ranges Review	Total
k	*Chenopodium curvispicatum*	1	0	0	1
	Chenopodium desertorum	1	0	0	1
	Chenopodium murale	1	0	0	1
	Chloris truncata	0	1	0	1
	Chrysocephalum semicalvum	1	0	1	2
	Chrysocephalum semipapposum	0	0	1	1
	Citrullus colocynthis	1	1	0	2
	Citrullus lanatus	1	0	0	1
	Clianthus formosus	0	1	0	1
	Codonocarpus pyramidalis	0	1	0	1
	Convolvulus remotus	1	1	1	3
	Craspedia pleiocephala	0	1	0	1
	Crassula sp.	0	1	0	1
	Crotalaria eremaea eremaea	1	1	0	2
	Cucumis melo	0	1	0	1
	Cucumis myriocarpus	0	1	0	1
	Cullen australasica	0	1	0	1
	Cullen cinerea	0	1	0	1
	Cullen pallidum	1	0	0	1
	Cymbopogon ambiguus	1	1	1	3
	Cyperus gymnocaulos	1	0	0	1
	Dactyloctenium radulans	0	1	0	1
	Danthonia caespitosa	1	1	0	2
	Datura ferox	1	0	0	1
	Datura leichhardtii	1	0	0	1
	Daucus glochidiatus	1	1	0	2
	Desmazeria rigida	0	1	0	1
r	*Dichanthium sericeum*	0	1	0	1
	Digitaria brownii	1	0	0	1
	Dissocarpus biflorus	1	1	0	2
	Dissocarpus latifolius	0	1	0	1
	Dissocarpus paradoxus	1	1	1	3
	Dittrichia graveolens	1	1	0	2
	Dodonaea lobulata	1	1	1	3
	Dodonaea microzyga microzyga	1	1	1	3
	Dodonaea stenozyga	0	1	0	1
	Dodonaea viscosa angustissima	1	1	1	3
	Echium plantagineum	1	1	1	3
	Einadia nutans	1	0	0	1
	Enchylaena tomentosa	1	1	1	3
	Enneapogon avenaceus	1	1	0	2
	Enneapogon cylindricus	1	1	0	2
k	*Enneapogon polyphyllus*	1	1	0	2
	Enteropogon acicularis	0	1	0	1
u	*Eragrostis australasica*	0	1	0	1
	Eragrostis dielsii	0	1	0	1
	Eragrostis laniflora	0	1	0	1
	Eragrostis setifolia	1	1	0	2
	Eremophila alternifolia	1	1	1	3
	Eremophila duttonii	1	1	1	3
	Eremophila freelingii	1	1	1	3
	Eremophila glabra	1	1	0	2
	Eremophila latrobei	1	1	0	2
	Eremophila longifolia	0	1	0	1
	Eremophila oppositifolia	1	1	0	2
	Eremophila rotundifolia	0	1	0	1
	Eremophila scoparia	1	1	1	3
	Eremophila serrulata	1	1	1	3
	Eriochiton sclerolaenoides	0	1	1	2
	Erodium cicutarium	0	0	1	1
	Erodium cygnorum glandulosum	0	0	1	1
	Erodium malacoides	0	1	0	1
	Eucalyptus camaldulensis	1	1	0	2
	Eucalyptus intertexta	1	1	0	2
	Eucalyptus socialis	1	1	1	3
	Euphorbia australis	1	1	0	2
	Euphorbia drummondii	1	1	0	2
r	*Euphorbia stevenii*	1	1	0	2
	Euphorbia tannensis eremophila	1	0	0	1
	Exocarpos aphyllus	1	1	1	3
	Frankenia cupularis	1	0	0	1
	Frankenia foliosa	0	1	0	1
	Frankenia pauciflora	0	1	0	1

APPENDIX 2.
Plant species known to occur in the study area.

Regional Significance	SPECIES	North West Flinders Ranges	Pastoral Assessments	Flinders Ranges Review	Total
	Frankenia serpyllifolia	1	1	1	3
	Frankenia subteres	1	0	1	2
	Galium gaudichaudii	1	0	0	1
k	*Glinus lotoides*	1	0	0	1
	Glycine clandestina	1	0	0	1
	Gnephosis arachnoidea	1	1	1	3
	Gnephosis eriocarpa	1	0	0	1
	Gnephosis foliata	0	1	0	1
	Goodenia fascicularis	1	1	0	2
	Goodenia pinnatifida	0	1	0	1
	Goodenia vernicosa	1	0	1	2
	Gunniopsis quadrifida	1	1	0	2
	Hakea ednieana	1	1	1	3
	Hakea leucoptera leucoptera	1	1	0	2
	Haloragis aspera	1	0	0	1
	Halosarcia halocnemoides	1	1	0	2
	Halosarcia indica leiostachya	1	0	0	1
	Helichrysum ambiguum	0	1	0	1
	Helichrysum podolepidium	0	1	0	1
	Helichrysum polygalifolium	0	1	0	1
	Heliotropium europaeum	1	1	0	2
	Helipterum corymbiflorum	0	1	0	1
	Helipterum jessenii	0	1	0	1
	Helipterum microglossum	0	1	0	1
	Helipterum moschatum	0	1	0	1
	Helipterum pygmaeum	0	1	0	1
	Hibiscus brachysiphonius	1	0	0	1
k	*Hibiscus krichauffianus*	1	1	0	2
	Indigofera leucotricha	0	0	1	1
	Indigofera sp.	1	0	0	1
	Isotoma petraea	1	0	0	1
	Ixiochlamys cuneifolia	1	0	0	1
	Ixiolaena brevicompta	0	1	0	1
	Ixiolaena leptolepis	1	1	1	3
	Ixiolaena tomentosa	0	1	0	1
	Jasminum didymum lineare	1	0	0	1
	Lawrencia glomerata	1	0	0	1
	Lawrencia squamata	0	1	1	2
	Leichardtia australis	0	1	0	1
	Lepidium oxytrichum	0	1	0	1
	Lepidium phlebopetalum	0	1	0	1
	Lepidium sp.	1	0	0	1
	Limonium binervosum	0	1	0	1
	Lotus cruentus	0	1	0	1
	Lycium australe	0	1	0	1
	Lysiana exocarpi exocarpi	1	1	1	3
	Maireana aphylla	1	1	0	2
	Maireana appressa	0	1	1	2
	Maireana astrotricha	1	1	1	3
	Maireana brevifolia	1	1	0	2
	Maireana campanulata	1	0	0	1
	Maireana carnosa	1	0	0	1
	Maireana coronata	1	0	0	1
	Maireana eriantha	1	1	1	3
	Maireana erioclada	1	0	0	1
	Maireana georgei	1	1	0	2
	Maireana integra	0	1	0	1
	Maireana lobiflora	0	1	0	1
	Maireana melanocarpa	0	1	0	1
	Maireana ovata	1	1	0	2
	Maireana pentatropis	0	1	1	2
	Maireana pyramidata	1	1	1	3
	Maireana radiata	1	0	0	1
	Maireana sedifolia	1	1	1	3
	Maireana spongiocarpa	1	1	1	3
	Maireana tomentosa	0	1	0	1
	Maireana trichoptera	1	1	0	2
	Maireana turbinata	0	1	1	2
	Maireana villosa	0	1	0	1
	Malacocera tricornis	0	1	0	1
	Malvastrum americanum	1	1	0	2
	Marrubium vulgare	1	1	0	2
	Marsdenia australis	1	1	1	3

APPENDIX 2.
Plant species known to occur in the study area.

Regional Significance	SPECIES	North West Flinders Ranges	Pastoral Assessments	Flinders Ranges Review	Total
	Melaleuca glomerata	1	1	0	2
	Melaleuca lanceolata lanceolata	1	1	0	2
	Minuria cunninghamii	1	1	1	3
	Minuria integerrima	1	0	0	1
u	*Mukia maderaspatana*	1	0	0	1
	Myoporum montanum	1	0	0	1
	Myoporum platycarpum	1	1	0	2
	Myriocephalus stuartii	0	1	0	1
	Nicotiana glauca	1	1	0	2
	Nicotiana velutina	1	0	0	1
	Nitraria billardierei	1	1	0	2
	Olearia decurrens	1	0	1	2
	Olearia muelleri	0	1	0	1
	Olearia pimeleoides	0	1	0	1
	Omphalolappula concava	0	1	0	1
	Onopordum acaulon	1	0	0	1
	Osteocarpum acropterum	1	1	0	2
	Oxalis perennans	1	0	1	2
	Panicum decompositum	0	1	0	1
	Panicum effusum	0	1	0	1
	Paraceterach reynoldsii	0	0	1	1
	Paractaenum refractum	1	0	0	1
	Petalostylis labicheoides	1	0	0	1
	Phyllanthus fuernrohrii	0	1	0	1
u	*Phyllanthus lacunarius*	1	0	0	1
	Pimelea microcephala	1	1	1	3
	Pimelea simplex simplex	0	1	1	2
	Pittosporum phylliraeoides microcarpa	1	1	0	2
	Plantago drummondii	0	1	1	2
	Pleurosorus rutifolius	1	0	0	1
	Polycalymma stuartii	0	1	0	1
T	*Polygonum plebeium*	1	0	0	1
	Portulaca intraterranea	0	1	0	1
	Portulaca oleracea	1	0	0	1
	Prostanthera striatiflora	1	1	1	3
	Pterocaulon sphacelatum	1	1	0	2
	Ptilotus exaltatus	1	1	0	2
	Ptilotus obovatus	1	1	0	2
	Rhagodia parabolica	0	1	0	1
	Rhagodia spinescens	1	1	1	3
	Rhagodia ulicina	1	1	1	3
	Rhodanthe corymbiflora	0	1	0	1
	Rhodanthe floribunda	0	1	0	1
	Rhodanthe moschata	0	1	0	1
	Rhodanthe pygmaea	0	1	1	2
	Rhodanthe uniflora	0	1	0	1
u	*Rhyncharrhena linearis*	1	0	0	1
	Ricinus communis	0	1	0	1
	Rostraria pumila	1	1	0	2
	Salsola kali	1	1	0	2
	Santalum acuminatum	1	1	0	2
	Santalum lanceolatum	1	1	0	2
v	*Santalum spicatum*	0	0	1	1
	Sauropus rigens	1	1	1	3
	Scaevola spinescens	1	0	1	2
	Schinus areira	1	0	0	1
	Schismus barbatus	0	1	0	1
	Sclerolaena bicornis	0	0	1	1
	Sclerolaena brachyptera	1	1	1	3
	Sclerolaena constricta	0	1	0	1
r	*Sclerolaena convexula*	0	1	0	1
	Sclerolaena cuneata	1	0	0	1
	Sclerolaena decurrens	1	1	0	2
	Sclerolaena diacantha	1	1	1	3
	Sclerolaena divaricata	1	1	1	3
	Sclerolaena holtiana	1	1	0	2
k	*Sclerolaena intricata*	1	1	0	2
	Sclerolaena lanicuspis	1	1	1	3
	Sclerolaena limbata	1	1	1	3
	Sclerolaena longicuspis	1	1	1	3
	Sclerolaena obliquicuspis	1	1	1	3
	Sclerolaena parallelicuspis	1	0	1	2
	Sclerolaena patenticuspis	1	1	1	3

APPENDIX 2.
Plant species known to occur in the study area.

Regional Significance	SPECIES	North West Flinders Ranges	Pastoral Assessments	Flinders Ranges Review	Total
	Sclerolaena ventricosa	1	1	1	3
	Sclerostegia disarticulata	0	1	1	2
	Sclerostegia medullosa	0	1	0	1
	Sclerostegia tenuis	0	1	0	1
	Senecio cunninghamii	1	0	0	1
	Senecio magnificus	1	1	1	3
	Senna artemisioides artemisioides	1	1	1	3
	Senna artemisioides coriacea	1	1	1	3
	Senna artemisioides filifolia	1	1	0	2
	Senna artemisioides helmsii	0	1	0	1
	Senna artemisioides oligophylla	1	0	0	1
	Senna artemisioides petiolaris	1	1	0	2
	Senna artemisioides sturtii	1	1	0	2
	Senna artemisioides zygophylla	0	1	0	1
	Senna artemissioides "phyllodinea"	1	0	0	1
x	*Sida ammophila*	0	1	0	1
	Sida calyxhymenia	0	1	0	1
	Sida corrugata	0	1	0	1
	Sida cunninghamii	0	1	0	1
	Sida fibulifera	1	1	0	2
	Sida intricata	1	1	1	3
	Sida petrophila	1	1	1	3
	Sida trichopoda	1	0	0	1
	Sisymbrium erysimoides	1	1	0	2
	*Sisymbrium sp. **	1	0	0	1
	Solanum ellipticum	1	1	0	2
	Solanum nigrum	1	0	0	1
	Solanum petrophilum	1	1	1	3
	Solanum quadriloculatum	1	0	0	1
	Solanum sturtianum	1	1	1	3
	Sonchus oleraceus	1	1	0	2
	Sporobolus actinocladus	1	1	0	2
	Stipa nitida	1	1	0	2
	Stipa nodosa	0	1	0	1
	Stipa scabra	1	1	0	2
	Swainsona stipularis	0	1	0	1
	Templetonia egena	0	1	1	2
	Tetragonia eremaea	1	0	0	1
	Tetragonia tetragonoides	0	1	0	1
	Teucrium racemosum	1	0	0	1
	Thysanotus baueri	0	1	0	1
	Tragus australianus	0	1	0	1
	Trianthema triquetra	1	0	0	1
	Tribulus occidentalis	0	1	0	1
	Tribulus terrestris	1	0	0	1
	Triodia irritans	1	1	0	2
	Tripogon loliiformis	1	0	0	1
	Triraphis mollis	0	1	0	1
	Typha domingensis	1	0	0	1
	Velleia arguta	0	1	0	1
	Vittadinia cuneata	0	1	0	1
	Vittadinia gracilis	1	0	0	1
	Wahlenbergia aridicola	1	1	0	2
	Westringia rigida	1	0	1	2
	Zygophyllum apiculatum	1	0	1	2
	Zygophyllum aurantiacum verticillatum	1	1	0	2
	Zygophyllum confluens	1	0	0	1
	Zygophyllum crenatum	0	1	0	1
	Zygophyllum iodocarpum	0	1	0	1
	Zygophyllum ovatum	0	1	0	1
	Zygophyllum prismatothecum	0	1	1	2
	Total	**226**	**263**	**99**	**588**

APPENDIX 3.
Plant species frequency by floristic group number. Refer to the vegetation chapter for details.

SPECIES	COMMON NAME	INTRODUCED	LIFESPAN	SA STATUS	AUST STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL SITE FREQUENCY
Abutilon fraseri	dwarf lantern-bush		P				3					1	2							6
Abutilon halophilum	plains lantern-bush		P				1							2		1				4
Abutilon leucopetalum	desert lantern-bush		P				3	2				2	2	4	1					14
Abutilon otocarpum #	desert lantern-bush		P				1													1
Acacia aneura	mulga		P				5	2					1		3		2			13
Acacia ligulata	umbrella bush		P											1	1		2	1		5
Acacia oswaldii	umbrella wattle		P			1							1							2
Acacia rivalis #	silver wattle		P												1					1
Acacia salicina #	willow wattle		P											1						1
Acacia tetragonophylla	dead finish		P				7	1		1	1		5	3	6	2			1	27
Acacia victoriae	elegant wattle		P			1		3	4	1	3	8	6	5	4	3				38
Alectryon oleifolius ssp. canescens	bullock bush		P			2	5	4	1	5	2		4	2					1	26
Amyema maidenii ssp. maidenii	pale-leaf mistletoe		P				1										1			2
Amyema miraculosum ssp. boormanii	fleshy mistletoe		P							1	1	1	1	2						6
Amyema preissii	wire-leaf mistletoe		P									1	1		3		1			6
Anagallis arvensis	pimpernel	*	A					1										1		2
Anemocarpa podolepidium	rock everlasting		A				1												1	2
Arabidella glaucescens #			P					1												1
Argemone subfusiformis ssp. subfusiformis #	Mexican poppy	*	A										1							1
Aristida contorta	curly wire-grass		P												1	1				2
Aristida holathera var. holathera #	tall kerosene grass		P												1					1
Aristida nitidula	brush threeawn		P						1			2	2	3	1					9
Aristida sp. #	threeawn/wire-grass														2					2
Astrebla pectinata	barley Mitchell-grass		P													2				2
Atriplex angulata	fan saltbush		P				1		1	1		5	1	3		3				15
Atriplex fissivalvis	gibber saltbush		P						1	1										2
Atriplex limbata #	spreading saltbush		P									1								1
Atriplex lindleyi ssp. conduplicata	baldoo		P				1		1	5		4	2							13
Atriplex sp. #	saltbush											1				1				2
Atriplex stipitata #	bitter saltbush		P										1							1
Atriplex velutinella	sandhill saltbush		P									1					2			3
Atriplex vesicaria	bladder saltbush		P			2	12		6	4	5	9	2	1	2		1		4	48
Boerhavia dominii	tar-vine		A									2								2
Boerhavia schomburgkiana	Schomburgk's tar-vine		A									5	2	2	1					10
Boerhavia sp. #	tar-vine													1	1					2
Brachycome ciliaris var. ciliaris	variable daisy		P				1				1									2
Brachycome ciliaris var. lanuginosa	woolly variable daisy		P						2			1				1				4
Brassica tournefortii	wild turnip	*	A												1		2			3
Bromus arenarius	sand brome		A				1					1								2
Callitris glaucophylla	white cypress-pine		P					1						1						2
Calotis hispidula #	hairy burr-daisy		A												1					1
Carrichtera annua	Ward's weed	*	A			1	3	2				5	1		2					14
Carthamus lanatus	saffron thistle	*	A									3		2						5
Cassinia uncata #	sticky cassinia		P					1												1
Cassytha melantha #	coarse dodder-laurel		P											1						1
Casuarina pauper	black oak		P			1	4	4	1	4	2		3	1						20
Centaurea melitensis	Malta thistle	*	A									5		2						7
Centaurium spicatum #	spike centaury	*	A															1		1
Centipeda thespidioides #	desert sneezeweed		P													1				1
Cheilanthes lasiophylla	woolly cloak-fern		P				7	3												10
Chenopodium cristatum #	crested goosefoot		A									1								1
Chenopodium curvispicatum #	cottony goosefoot		P					1												1
Chenopodium desertorum	desert goosefoot		P				1		1					2						4
Chenopodium murale	nettle-leaf goosefoot	*	A											2						2
Chrysocephalum semicalvum	hill button-bush		A					1							1					2
Citrullus colocynthis	colocynth	*	A					1				1		5	1					8
Citrullus lanatus	bitter melon	*	A						1			5	1							7
Convolvulus remotus	grassy bindweed		P				1				1	8								10
Crotalaria eremaea ssp. eremaea	downy loose-flowered rattlepod		P														2			2
Cullen pallidum #	white scurf-pea		P														1			1
Cymbopogon ambiguus	lemon-grass		P				4	1	1	1	1	5	3	6	4					26

APPENDIX 3.
Plant species frequency by floristic group number. Refer to the vegetation chapter for details.

SPECIES	COMMON NAME	INTRODUCED	LIFESPAN	SA STATUS	AUST STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL SITE FREQUENCY
Datura ferox	long-spine thorn-apple	*	A											2						2
Datura leichhardtii	native thorn-apple	*	A					1				1		1						3
Daucus glochidiatus #	native carrot		A									1								1
Digitaria brownii	cotton panic-grass		P			1	1													2
Dissocarpus biflorus	two-horn saltbush		P						1			1								2
Dissocarpus paradoxus	ball bindyi		P					1	1	2		3	5	2						14
Dittrichia graveolens	stinkweed	*	A									5	1	2						8
Dodonaea lobulata	lobed-leaf hop-bush		P				6	1				1		1	1					10
Dodonaea microzyga var. microzyga	brilliant hop-bush		P			3	4				1		2							10
Dodonaea viscosa ssp. angustissima	narrow-leaf hop-bush		P					1				1					1			3
Echium plantagineum	Salvation Jane	*	A								1	1		1						3
Einadia nutans #	climbing saltbush		P												1					1
Enchylaena tomentosa	ruby saltbush		P				8	4	2	4	4	7	2	5	5	1	2	1	1	46
Enneapogon avenaceus	common bottle-washers		A									1			1					2
Enneapogon cylindricus	jointed bottle-washers		P				1		1											2
Eragrostis setifolia	bristly love-grass		P													2				2
Eremophila alternifolia	narrow-leaf emubush		P			1	8	3		1		1	2		2					18
Eremophila duttonii	harlequin emubush		P				1					1	1			2	1			6
Eremophila freelingii	rock emubush		P			3	13	3		1	2	1	3	2	4	2	1			35
Eremophila glabra	tar bush		P					1									1			2
Eremophila latrobei ssp.	crimson emubush		P				2													2
Eremophila oppositifolia var.	opposite-leaved emubush		P			1	1		1		3									6
Eremophila scoparia	broom emubush		P				1	1											4	6
Eremophila serrulata #	green emubush		P				1													1
Eucalyptus camaldulensis	river red gum		P					1				2	2	6				1		12
Eucalyptus intertexta #	gum-barked coolibah		P					1												1
Eucalyptus socialis	beaked red mallee		P			1	1	1											4	7
Euphorbia australis #	hairy caustic weed		P				1					1								2
Euphorbia drummondii	caustic weed		P				2					6	4		3					15
Euphorbia stevenii	bottletree spurge		P							1		1								2
Euphorbia tannensis ssp. eremophila	desert spurge		P				1	1												2
Exocarpos aphyllus	leafless cherry		P				6	3		1			2							12
Frankenia cupularis #			P	K	3K				1											1
Frankenia serpyllifolia	thyme sea-heath		P				2	2		3	1	3			1	2				14
Frankenia subteres #			P	K	2K									1						1
Galium gaudichaudii #	rough bedstraw		P									1								1
Glinus lotoides #	hairy carpet-weed		A					1												1
Glycine clandestina #	twining glycine		P										1							1
Gnephosis arachnoidea	spidery button-flower		A													2				2
Gnephosis eriocarpa #	native camomile		A												1					1
Goodenia fascicularis	silky goodenia		P									2								2
Goodenia sp. #	goodenia															1				1
Goodenia vernicosa #	wavy goodenia		P					1												1
Gramineae sp. #	grass family						1					1								2
Gunniopsis quadrifida	Sturt's pigface		P						1							1				2
Hakea ednieana	Flinders Ranges corkwood		P				1	2							2					5
Hakea leucoptera ssp. leucoptera	silver needlewood		P														2			2
Haloragis aspera #	rough raspwort		P											1						1
Halosarcia halocnemoides	grey samphire		P						1	2		1	1	1						6
Halosarcia indica ssp. leiostachya #	brown-head samphire		P									1								1
Heliotropium europaeum	common heliotrope	*	A									1	1	4						6
Hibiscus brachysiphonius #	low hibiscus		P				1													1
Hibiscus krichauffianus	velvet-leaf hibiscus		P									1	1	1						3
Indigofera sp.	indigo		A							1		1								2
Isotoma petraea #	rock isotome		P				1													1
Ixiochlamys cuneifolia #	Silverton daisy		P												1					1
Ixiolaena leptolepis	narrow plover-daisy		P						1			2								3
Jasminum didymum ssp. lineare	native jasmine		P	Q										1		1				2
Lawrencia glomerata	clustered lawrencia		P																2	2
Lepidium sp.	peppercress						1								1	1				3
Lysiana exocarpi ssp. exocarpi	harlequin mistletoe		P								1	2	3	2		1	1	1		11

APPENDIX 3.
Plant species frequency by floristic group number. Refer to the vegetation chapter for details.

SPECIES	COMMON NAME	INTRODUCED	LIFESPAN	SA STATUS	AUST STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL SITE FREQUENCY
Maireana brevifolia	short-leaf bluebush		P						1			4	1	1						7
Maireana campanulata	bell-fruit bluebush		P						1		2									3
Maireana carnosa	cottony bluebush		P								2								1	3
Maireana coronata	crown fissure-plant		P				1		1				2			1			2	7
Maireana eriantha	woolly bluebush		P								2									2
Maireana eriosclada	rosy bluebush		P			2	3						1						4	10
Maireana georgei	satiny bluebush		P			1	2		1	1		1	2							8
Maireana ovata			P			1	1												4	6
Maireana pyramidata	black bluebush		P			1	5	1	4	3		10	6	3	3	1	1			38
Maireana radiata	radiate bluebush		P			2	1		1				2							6
Maireana sedifolia	bluebush		P			2	7				1		1						1	12
Maireana sp. #	bluebush/fissure-plant		P			1	1					1								3
Maireana spongiocarpa #	spongy-fruit bluebush		P				1													1
Maireana trichoptera	hairy-fruit bluebush		P				4													4
Malvastrum americanum	malvastrum		P						1			1	1	3	1	2				9
Marrubium vulgare	horehound	*	P					1				4		4						9
Marsdenia australis	native pear		P				1					2	4		3					10
Medicago minima var. minima	little medic	*	A									2								2
Melaleuca glomerata	inland paper-bark		P									1	2	4	1			1		9
Melaleuca lanceolata ssp. lanceolata	dryland tea-tree		P				1												1	2
Minuria cunninghamii	bush minuria		P						1			6	1			1	1			10
Minuria integerrima	smooth minuria		P									1				1				2
Minuria sp. #	minuria								1							1				2
Mukia maderaspatana	snake vine		P									1	1							2
Myoporum montanum	native myrtle		P					2			1	1	1	2				1		8
Myoporum platycarpum	false sandalwood		P			3	1		1			1	1							7
Nicotiana glauca	tree tobacco	*	P					1					1	3				1		6
Nicotiana velutina	velvet tobacco		A					1				2		3						6
Nitraria billardierei	nitre-bush		P									1		1			1			3
Olearia decurrens	winged daisy-bush		P				2													2
Onopordum acaulon #	horse thistle	*	A									1								1
Osteocarpum acropterum	bonefruit		P				1			4		3	4	4			1			17
Oxalis perennans	native sorrel		P				1	2				6	1							10
Paractaenum refractum #	bristle-brush grass		P														1			1
Petalostylis labicheoides	butterfly bush		P											3						3
Phyllanthus lacunarius	lagoon spurge		P												1		1			2
Pimelea microcephala	shrubby riceflower		P				1			1		5	4	2	1					14
Pittosporum phylliraeoides var. microcarpa	native apricot		P				2							2	1					5
Pleurosorus rutifolius #	blanket fern		P				1													1
Polygonum plebeium #	small knotweed		A					1												1
Portulaca oleracea	common purslane		A					1							1	2				4
Prostanthera striatiflora	striated mintbush		P				5				1								1	7
Pterocaulon sphacelatum	apple-bush		P					1				5		4	1					11
Ptilotus exaltatus	pink mulla mulla		P				1	3				1								5
Ptilotus obovatus	silver mulla mulla		P			3	14	4	2	2	4	3	4	5	5				1	47
Rhagodia spinescens	spiny saltbush		P				6		2	4	5	7	6	4	4	3	1		2	44
Rhagodia ulicina	intricate saltbush		P			3	2	1												6
Rhyncharrhena linearis	climbing purple-star		P				2													2
Rostraria pumila #	tiny bristle-grass	*	A															1		1
Salsola kali	buckbush		A						2			3	2		1	1	2		1	12
Santalum acuminatum	quandong		P									1							2	3
Santalum lanceolatum	plumbush		P							1		4		1	1	1	1		1	10
Sauropus rigens	stiff spurge		P			1	10													11
Scaevola spinescens	spiny fanflower		P			2							1							3
Schinus areira #	pepper-tree	*	P											1						1
Sclerolaena brachyptera	short-wing bindyi		P				1		5	4	2	4				3				19
Sclerolaena cuneata	tangled bindyi		P				1	1	2	1			2		2					9
Sclerolaena decurrens	green bindyi		P						1						1	1	1			4
Sclerolaena diacantha	grey bindyi		P			1	6	2											2	11
Sclerolaena divaricata	tangled bindyi		P				1		1	4		2	2	1	1	2				14
Sclerolaena holtiana #	Holt's bindyi		P	K	3K										1					1

APPENDIX 3.
Plant species frequency by floristic group number. Refer to the vegetation chapter for details.

SPECIES	COMMON NAME	INTRODUCED	LIFESPAN	SA STATUS	AUST STATUS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL SITE FREQUENCY
Sclerolaena limbata	pearl bindyi		P						3	1	1		2	1	1	2	1			12
Sclerolaena longicuspis	long-spine bindyi		P				1	3	2	1	1	2	1		1	1				13
Sclerolaena obliquicuspis	oblique-spined bindyi		P			2	6		6	2		5	4	1						26
Sclerolaena parallelicuspis	western bindyi		P				1			1		1	1			2				6
Sclerolaena patenticuspis	spear-fruit bindyi		P							1		3								4
Sclerolaena ventricosa	salt bindyi		P			1		1	4	3		7		1		3				20
Senecio cunninghamii var.	shrubby groundsel		P								2	1		3				1		7
Senecio magnificus	showy groundsel		P					1	1			5	1	2	2					12
Senna artemisioides nothossp. artemisioides	silver senna		P			1	8	4			1		1	1						16
Senna artemisioides nothossp. coriacea	broad-leaf desert senna		P			3	3	3	1		1		2				2		2	17
Senna artemisioides nothossp. sturtii	grey senna		P				1							1	1					3
Senna artemisioides ssp. filifolia	fine-leaf desert senna		P					1						1						2
Senna artemisioides ssp. oligophylla #	limestone senna		P				1													1
Senna artemisioides ssp. petiolaris	flat-stalk senna		P				1									1	2			4
Senna artemissioides "phyllodinea" #			P													1				1
Sida fibulifera	pin sida		P				3		2			2	2	2						11
Sida intricata	twiggy sida		P				1		1		2	3		2	1					10
Sida petrophila	rock sida		P				14	2		1	4	4	4	4	2				1	36
Sida sp. #	sida		P				1	1						2						4
Sida trichopoda	high sida		P				2		1	1		3	1			3				11
Sisymbrium erysimoides	smooth mustard	*	A					1				1		2	1					5
Sisymbrium sp. #	wild mustard	*	A									1								1
Solanum ellipticum	velvet potato-bush		P			2	16	4		1	2	4	6	5						40
Solanum nigrum #	black nightshade	*	P											1						1
Solanum petrophilum	rock nightshade		P									4		2						6
Solanum quadriloculatum	plains nightshade		P						1						6	2				9
Solanum sturtianum	Sturt's nightshade		P				7	2		1	1		2	5						18
Sonchus oleraceus	common sow-thistle	*	A									4								4
Sporobolus actinocladus	ray grass		A						1						1	2				4
Stipa nitida	Balcarra spear-grass		P				2		1		1	5	1		1					11
Stipa scabra	rough spear-grass		P				2													2
Stipa sp. #	spear-grass		P				1													1
Tetragonia eremaea #	desert spinach		A									1								1
Teucrium racemosum #	grey germander		P										1							1
Trianthema triquetra #	red spinach		A												1					1
Tribulus terrestris	caltrop	*	A									1		1						2
Triodia irritans	spinifex		P				1	4												5
Tripogon loliiformis #	five-minute grass		A						1											1
Typha domingensis #	narrow-leaf bulrush		P															1		1
Vittadinia gracilis	woolly New Holland daisy		A									4								4
Wahlenbergia aridicola	dryland bluebell		A	R							1	4								5
Westringia rigida #	stiff westringia		P																1	1
Zygophyllum apiculatum	pointed twinleaf		P					2												2
Zygophyllum aurantiacum ssp. verticillatum #	shrubby twinleaf		P						1											1
Zygophyllum confluens	forked twinleaf		P				2													2
	NUMBER OF TAXA	226		8	6	31	96	64	53	42	37	105	74	77	62	44	30	13	24	234
	ADDITIONAL TAXA NOT IDENT	9																		
	NUMBER OF PERENNIALS	182																		
	NUMBER OF ANNUALS	45																		
	NUMBER OF INTRODUCED	29																		
	NUMBER OF TAXA NOT USED IN THE ANALYSIS	62																		
	SA RARE	1																		
	SA POORLY KNOWN	3																		
	SA QUESTIONABLE	1																		
	AUST 2K	1																		
	AUST 3K	2																		

APPENDIX 4.
Mammal species site frequency for each landform category.

SPECIES	Common name	drainage depression	dune/consolidated dune	flood out	gully	hill crest	hill slope	plain (incl undulating plain)	stony plain	stream channel	Total
Bos taurus	Cattle	0	0	0	0	0	1	0	0	0	1
Capra hircus	Goat	1	0	0	0	0	2	0	1	1	5
Equus caballus	Horse	0	0	0	0	0	0	2	0	0	2
Felis catus	Cat	0	0	0	1	0	0	0	0	0	1
Leggadina forresti	Forrest's Mouse	0	0	0	0	0	0	0	1	0	1
Macropus robustus	Common Wallaroo (Euro)	0	0	0	0	2	6	1	0	1	10
Macropus rufus	Red Kangaroo	1	0	0	0	0	1	1	0	0	3
Macropus sp.		0	0	1	1	0	3	1	1	2	9
Mus domesticus	House Mouse	0	1	2	0	2	3	3	4	3	18
Oryctolagus cuniculus	(European) Rabbit	1	1	1	1	1	3	2	2	2	14
Ovis aries	Sheep	0	0	0	0	0	0	1	0	0	1
Pseudomys bolami	Bolam's Mouse	0	0	1	0	0	0	0	1	0	2
Sminthopsis crassicaudata	Fat-tailed Dunnart	0	0	0	0	1	2	2	4	1	10
Sminthopsis macroura	Stripe-faced Dunnart	1	0	2	1	2	3	2	4	1	16
Tachyglossus aculeatus	Short-beaked Echidna (Spiny Anteater)	0	1	0	0	0	0	0	0	0	1
Vulpes vulpes	Fox (Red Fox)	0	1	1	0	0	1	0	0	1	4
	Number of species	**4**	**4**	**6**	**4**	**5**	**9**	**8**	**8**	**7**	
	Number of native species	**2**	**1**	**3**	**2**	**3**	**4**	**4**	**5**	**4**	

APPENDIX 5.
Mammal species site frequency for each floristic group (details are in the vegetation chapter).

SPECIES	Common name	1	2	3	4	5	6	7	8	9	10	11	12	14	Total
Bos taurus	Cattle										1				1
Capra hircus	Goat		1	1	1		1			1					5
Equus caballus	Horse				1			1							2
Felis catus	Cat													1	1
Leggadina forresti	Forrest's Mouse											1			1
Macropus robustus	Common Wallaroo (Euro)		4				1	1		1	3				10
Macropus rufus	Red Kangaroo				1		2								3
Macropus sp.		1			2	1		1	1	1				2	9
Mus domesticus	House Mouse		3		4	1		5	1	1	1	1	1		18
Oryctolagus cuniculus	(European) Rabbit	1	1		2		1	2	1	1	1	1	1	2	14
Ovis aries	Sheep							1							1
Pseudomys bolami	Bolam's Mouse							1				1			2
Sminthopsis crassicaudata	Fat-tailed Dunnart		1		2	1		2		1		3			10
Sminthopsis macroura	Stripe-faced Dunnart		3		1	2	2	4		1		2		1	16
Tachyglossus aculeatus	Short-beaked Echidna (Spiny Anteater)												1		1
Vulpes vulpes	Fox (Red Fox)							1		1	1		1		4
	Number of species	**2**	**6**	**1**	**8**	**4**	**5**	**10**	**3**	**7**	**5**	**6**	**4**	**4**	
	Number of native species	**1**	**3**	**0**	**3**	**3**	**3**	**5**	**1**	**3**	**1**	**4**	**1**	**2**	

APPENDIX 6.

Bird species list in alphabetical Family order.

North-West Flinders Fauna				based on SA Museum, SA Biological Survey and Opportune Databases only		
Aus status	SA status	Intriduced	Family	Scientific Name	Common Name	Recorded on survey
			ACCIPITRIDAE	*Accipiter cirrhocephalus cirrhocephalus*	Collared Sparrowhawk	*
				Accipiter fasciatus fasciatus	Brown Goshawk	
				Aquila audax audax	Wedge-tailed Eagle	*
				Circus assimilis	Spotted Harrier	
				Elanus caeruleus	Black-shouldered Kite	*
				Haliastur sphenurus	Whistling Eagle	*
	V			*Hamirostra melanosternon*	Black-breasted Buzzard	
	U			*Hieraaetus morphnoides morphnoides*	Little Eagle	*
				Milvus migrans	Black Kite	*
			AEGOTHELIDAE	*Aegotheles cristatus*	Australian Owlet-nightjar	
			ALAUDIDAE	*Mirafra javanica*	Singing Bushlark	
				Myiagra inquieta inquieta	Restless Flycatcher	*
			ALCEDINIDAE	*Halcyon pyrrhopygia*	Red-backed Kingfisher	*
				Halcyon sancta sancta	Sacred Kingfisher	*
	U		ANATIDAE	*Anas castanea*	Chestnut Teal	
				Anas gracilis gracilis	Australasian Grey Teal	*
	R			*Anas rhynchotis rhynchotis*	Blue-winged (Australasian) Shoveller	
				Anas superciliosa superciliosa	Pacific Black Duck	
	U			*Aythya australis*	Hardhead	*
	V			*Biziura lobata*	Musk Duck	*
				Chenonetta jubata	Wood Duck	*
				Cygnus atratus	Black Swan	
	U		ANHINGIDAE	*Anhinga melanogaster*	Darter	
			ARDEIDAE	*Ardea novaehollandiae novaehollandiae*	White-faced Heron	*
				Ardea pacifica	Pacific Heron	*
	U			*Nycticorax caledonicus*	Nankeen Night Heron	*
			ARTAMIDAE	*Artamus cinereus cinereus*	Black-faced Woodswallow	*
				Artamus personatus	Masked Woodswallow	
	U			*Cracticus nigrogularis*	Pied Butcherbird	
				Cracticus torquatus torquatus	Grey Butcherbird	*
				Gymnorhina tibicen	Australian Magpie	*
			CACATUIDAE	*Cacatua sanguinea*	Little Corella	*
				Eolophus roseicapillus	Galah	*
				Nymphicus hollandicus	Cockatiel	
	U		CAPRIMULGIDAE	*Eurostopodus argus*	Spotted Nightjar	
			CASUARIIDAE	*Dromaius novaehollandiae*	Emu	*
	U		CHARADRIIDAE	*Charadrius australis*	Inland Dotterel	*
				Charadrius ruficapillus	Red-capped Dotterel	
				Elseyornis melanops	Black-fronted Dotterel	*
				Erythogonys cinctus	Red-kneed Dotterel	*
				Himantopus leucocephalus	White-headed Stilt	
				Hoplopterus miles	Masked Plover and Spur-winged	
				Hoplopterus tricolor	Banded Plover	
			CINCLOSOMATIDAE	*Cinclosoma cinnamomeum*	Cinnamon Quailthrush	*
				Psophodes cristatus	Chirruping Wedgebill	*
	U		CLIMACTERIDAE	*Climacteris affinis*	White-browed Treecreeper	
				Climacteris picumnus picumnus	Brown Treecreeper	
		*	COLUMBIDAE	*Columba livia*	Feral Pigeon	
				Geopelia cuneata	Diamond Dove	
	R			*Geopelia placida placida*	Peaceful Dove	*
				Ocyphaps lophotes	Crested Pigeon	*
				Phaps chalcoptera	Common Bronzewing	*
			CORVIDAE	*Corvus bennetti*	Little Crow	*
				Corvus coronoides coronoides	Australian Raven	*
				Lalage sueurii	White-winged Triller	
			CUCULIDAE	*Chrysococcyx basalis*	Horsfield's Bronze Cuckoo	*
	U			*Chrysococcyx osculans*	Black-eared Cuckoo	
				Cuculus pallidus	Pallid Cuckoo	
				Grallina cyanoleuca	Magpie-lark	*
				Rhipidura fuliginosa	Grey Fantail	
				Rhipidura leucophrys leucophrys	Willie Wagtail	*
			EOPSALTRIIDAE	*Microeca leucophaea*	Jacky Winter	
			FALCONIDAE	*Falco berigora*	Brown Hawk	*
				Falco cenchroides cenchroides	Nankeen Kestrel	*
	U			*Falco longipennis*	Little Falcon	*
	V			*Falco peregrinus*	Peregrine Falcon	
			GLAREOLIDAE	*Stiltia isabella*	Australian Pratincole	
			HIRUNDINIDAE	*Cheramoeca leucosternum*	White-backed Swallow	*
				Hirundo ariel	Fairy Martin	*
				Hirundo neoxena	Welcome Swallow	
				Hirundo nigricans nigricans	Tree Martin	*
			LARIDAE	*Chlidonias hybridus*	Whiskered (Marsh) Tern	*
				Hydroprogne caspia	Caspian Tern	
				Larus novaehollandiae novaehollandiae	Silver Gull	*

APPENDIX 6.
Bird species list in alphabetical Family order.

Aus status	SA status	Intriduced	Family	Scientific Name	Common Name	Recorded on survey
V	V		MALURIDAE	*Amytornis textilis*	Thick-billed Grasswren	*
				Malurus lamberti	Variegated Wren	*
				Malurus leucopterus	White-winged Wren	*
			MELIPHAGIDAE	*Acanthagenys rufogularis rufogularis*	Spiny-cheeked Honeyeater	*
				Epthianura albifrons albifrons	White-fronted Chat	
				Epthianura aurifrons	Orange Chat	
				Epthianura tricolor	Crimson Chat	
				Manorina flavigula flavigula	Yellow-throated Miner	*
				Meliphaga penicillata	White-plumed Honeyeater	*
	U			*Meliphaga plumula*	Grey-fronted Honeyeater	
				Meliphaga virescens	Singing Honeyeater	*
			MEROPIIDAE	*Merops ornatus*	Rainbow Bird	*
			MOTAACILLIDAE	*Anthus novaeseelandiae*	Richard's Pipit	*
				Dicaeum hirundinaceum hirundinaceum	Mistletoe Bird	
			ORIOLIDAE	*Coracina novaehollandiae novaehollandiae*	Black-faced Cuckooshrike	*
	U			*Pteropodocys maxima*	Ground Cuckooshrike	
			PACHYCEPHALIDAE	*Colluricincla harmonica*	Grey Shrikethrush	
				Oreoica gutturalis	Crested Bellbird	*
				Pachycephala rufiventris rufiventris	Rufous Whistler	*
			PARDALOTIDAE	*Acanthiza apicalis*	Inland Brown Thornbill	*
				Acanthiza chrysorrhoa	Yellow-rumped Thornbill	*
				Acanthiza uropygialis	Chestnut-rumped Thornbill	*
	U			*Aphelocephala leucopsis*	Southern Whiteface	*
	U			*Calamanthus campestris*	Western Calamanthus(Fieldwren)	*
				Pardalotus striatus	Striated Pardalote	*
	U			*Pyrrholaemus brunneus*	Redthroat	*
				Smicrornis brevirostris	Weebill	*
		*	PASSERIDAE	*Passer domesticus domesticus*	House Sparrow	*
				Poephila guttata	Zebra Finch	*
			PELECANIDAE	*Pelecanus conspicillatus*	Australian Pelican	*
				Melanodryas cucullata	Hooded Robin	*
				Petroica goodenovii	Red-capped Robin	*
			PHALACROCORACIDAE	*Phalacrocorax carbo*	Great (Black) Cormorant	*
				Phalacrocorax melanoleucos melanoleucos	Little Pied Cormorant	*
				Phalacrocorax sulcirostris	Little Black Cormorant	
				Phalacrocorax varius	Pied Cormorant	
			PHASIANIDAE	*Coturnix novaezelandiae*	Stubble Quail	
			PODARGIDAE	*Podargus strigoides*	Tawny Frogmouth	*
	U		PODICIPEDIDAE	*Podiceps cristatus*	Great Crested Grebe	
				Poliocephalus poliocephalus	Hoary-headed Grebe	*
				Tachybaptus novaehollandiae	Black-throated Grebe	
			POMATOSTOMIDAE	*Pomatostomus ruficeps*	Chestnut-crowned Babbler	*
				Pomatostomus superciliosus	White-browed Babbler	*
			PSITTACIDAE	*Barnardius zonarius*	Ring-necked Parrot	*
				Glossopsitta porphyrocephala	Purple-crowned Lorikeet	
				Melopsittacus undulatus	Budgerigar	*
	V			*Neophema chrysostoma*	Blue-winged Parrot	
	I			*Neophema elegans*	Elegant Parrot	*
				Northiella haematogaster	Bluebonnet	
				Psephotus haematonotus	Red-rumped Parrot	*
				Psephotus varius	Mulga Parrot	*
			RALLIDAE	*Fulica atra*	Coot	*
	U			*Gallinula tenebrosa tenebrosa*	Dusky Moorhen	
				Gallinula ventralis	Black-tailed Native-hen	*
			RECURVIROSTRIDAE	*Cladorhynchus leucocephalus*	Banded Stilt	
				Recurvirostra novaehollandiae	Red-necked Avocet	
	U		SCOLOPACIDAE	*Actitis hypoleucos*	Common Sandpiper	
				Calidris acuminata	Sharp-tailed Sandpiper	
				Calidris ferruginea	Curlew Sandpiper	
	U			*Tringa glareola*	Wood Sandpiper	
				Tringa nebularia	Greenshank	
			STRIGIDAE	*Ninox novaeseelandiae*	Boobook Owl	*
		*	STURNIDAE	*Sturnus vulgaris vulgaris*	Common Starling	
			SYLVIIDAE	*Acrocephalus stentoreus*	Clamorous Reedwarbler	
				Cincloramphus cruralis	Brown Songlark	
				Cincloramphus mathewsi	Rufous Songlark	
				Megalurus gramineus	Little Grassbird	
	U		THRESKIORNITHIDAE	*Plegadis falcinellus*	Glossy Ibis	*
			TYTONIDAE	*Tyto alba*	Barn Owl	
				The number of bird species recorded through SA Museum and DEHAA Databases		143
				The Number of bird species recorded this survey		83

APPENDIX 6.

Bird species list in alphabetical Family order.

Additions to the species list following the NWFR survey						
Aus status	**SA status**	**Intriduced**	**Family**	**Scientific Name**	**Common Name**	**Recorded on survey**
			ANATIDAE	*Cygnus atratus*	Black Swan	*
				Malacorhynchus membranaceus	Pink-eared Duck	*
			APODIDAE	*Apus pacificus*	Fork-tailed Swift	*
			ARDEIDAE	*Ardea alba*	Great Egret	*
	V			*Aredea garzetta*	Little Egret	*
	U		ARTAMIDAE	*Artamus minor*	Little Woodswallow	*
	V		MELIPHAGIDAE	*Lichenostomus ornatus*	Yellow-plumed Honey-eater	*
				Phylidonyris albifrons	White-fronted Honey-eater	*
			THRESKIORNITHIDAE	*Plalatea flavipes*	Yellow-billed Spoonbill	*
				Platalea regia	Royal Spoonbill	*
				The number of additional species recorded by survey		10
				The total number of species known to inhabit the study area		153
Species only known from Museum Records (Total 70)						
Aus status	**SA status**	**Intriduced**	**Family**	**Scientific Name**	**Common Name**	**Recorded on survey**
			ARTAMIDAE	*Artamus supercilliosus*	White-browed Woodswallow	
	V		CINCLOSOMATIDAE	*Cinclosoma castanotus*	Chestnut Quailthrush	
	U		MELIPHAGIDAE	*Asbyia lovensis*	Gibber Bird	
K	V		PARDALOTIDAE	*Acanthiza iredalei*	Slender-billed Thornbill	
	R		PASSERIDAE	*Emblema pictum*	Painted Finches	
R	R		PSITTACIDAE	*Neophema splendida*	Scarlet-chested Parrot	
				Total number of species recorded in the study area		159

SPECIES	Common name	1	2	3	4	5	6	number of groups	site frequency	abundance
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			3		5	1	3	9	16
Acanthiza apicalis	Inland Brown Thornbill						1	1	1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill		1	2	1			3	4	9
Acanthiza pusilla	Brown Thornbill		1					1	1	1
Acanthiza sp.				1				1	1	1
Acanthiza uropygialis	Chestnut-rumped Thornbill	1		3	1	5	1	5	11	57
Amytornis textilis	Thick-billed Grasswren					1		1	1	2
Anas gracilis	Australasian Grey Teal			1				1	1	2
Anthus novaeseelandiae	Richard's Pipit					2		1	2	2
Aphelocephala leucopsis	Southern (Common) Whiteface			1	1	3		3	5	14
Apus pacificus	Fork-tailed Swift			1				1	1	2
Aquila audax	Wedge-tailed Eagle			1		2	3	3	6	7
Ardea alba	Great (White) Egret			1				1	1	2
Ardea novaehollandiae	White-faced Heron			1				1	1	1
Artamus cinereus	Black-faced Woodswallow	1				4	1	3	6	20
Artamus minor	Little Woodswallow						1	1	1	2
Barnardius zonarius	Ring-necked Parrot	1	1	6			1	4	9	61
Cacatua roseicapilla	Galah		3	5		10	1	4	19	127
Cacatua sanguinea	Little Corella			6	1		2	3	9	185
Calamanthus campestris	Western Fieldwren (Rufous Fieldwren, Calamanthus)					1	1	2	2	3
Chrysococcyx basalis	Horsfield's Bronze Cuckoo (Rufous-tailed Bronze Cuckoo)						1	1	1	1
Cinclosoma cinnamomeum	Cinnamon Quailthrush					5		1	5	11
Coracina novaehollandiae	Black-faced Cuckooshrike		1	4	1			3	6	14
Corvus bennetti	Little Crow					1		1	1	1
Corvus coronoides	Australian Raven	3		4	2	4	3	5	16	44
Corvus sp.						1	1	2	2	4
Cracticus torquatus	Grey Butcherbird	2		5			1	3	8	9
Dromaius novaehollandiae	Emu		1	4	1	3	2	5	11	12
Elanus caeruleus	Black-shouldered Kite			1				1	1	1
Falco berigora	Brown Hawk (Brown Falcon)					2		1	2	2
Falco cenchroides	Nankeen Kestrel			1			6	2	7	15
Falco longipennis	Little Falcon (Australian Hobby)			1			1	2	2	2
Geopelia placida	Peaceful Dove			2				1	2	11
Gymnorhina tibicen	Australian Magpie	2	4	2	1	1	2	6	12	20
Hieraaetus morphnoides							1	1	1	1
Hirundo ariel	Fairy Martin			1				1	1	0
Hirundo nigricans	Tree Martin			3				1	3	10
Lichenostomus virescens	Singing Honeyeater			3		9	2	3	14	29
Malurus lamberti	Variegated Wren		1	2		7	1	4	11	48
Malurus leucopterus	White-winged Wren	1		2		5	4	4	12	71
Malurus sp.					1			1	1	8
Manorina flavigula	Yellow-throated Miner		3	5		2	2	4	12	48
Melanodryas cucullata	Hooded Robin				1	2		2	3	11
Melopsittacus undulatus	Budgerigah					1		1	1	1
Merops ornatus	Rainbow Bird (Rainbow Bee-eater)			2				1	2	3
Milvus migrans	Black Kite	1						1	1	1
Myiagra inquieta	Restless Flycatcher (Scissor-grinder)			1				1	1	1
Ninox novaeseelandiae	Boobook Owl (Southern Boobook)			1				1	1	1
Nycticorax caledonicus	Nankeen (Rufous) Night Heron				2			1	2	3
Ocyphaps lophotes	Crested Pigeon			1		4	2	3	7	32
Oreoica gutturalis	Crested Bellbird	2				2		2	4	5
Pachycephala rufiventris	Rufous Whistler			1				1	1	2
Pardalotus striatus	Striated Pardalote	1	1	1			1	4	4	5
Petroica goodenovii	Red-capped Robin	1	1	3	1	1		5	7	9
Phaps chalcoptera	Common Bronzewing		1			1	1	3	3	3
Phylidonyris novaehollandiae	New Holland Honeyeater			1				1	1	1
Podargus strigoides	Tawny Frogmouth					1		1	1	1
Pomatostomus ruficeps	Chestnut-crowned Babbler					1	2	2	3	18
Pomatostomus superciliosus	White-browed Babbler			2	2		1	3	5	21
Psephotus haematonotus	Red-rumped Parrot		1					1	1	4
Psephotus varius	Mulga Parrot (Many-coloured Parrot)	1		1		1		3	3	12
Psophodes cristatus	Chirruping Wedgebill			1		8	1	3	10	21
Pyrrholaemus brunneus	Redthroat			1	1	1		3	3	12
Rhipidura leucophrys	Willie Wagtail			3		1	1	3	5	10
Smicrornis brevirostris	Weebill	3	3	3				3	9	33
Taeniopygia guttata	Zebra Finch			2		4		2	6	63
Todiramphus pyrrhopygia	Red-backed Kingfisher	2		1		1		3	4	5
Todiramphus sancta	Sacred Kingfisher			1				1	1	1
	number of species	**14**	**14**	**45**	**14**	**34**	**30**			
	abundance	**55**	**39**	**395**	**82**	**399**	**100**			**1156**

APPENDIX 8.

Bird species frequency at sites by floristic groups summary.

SPECIES	Common name	1	2	3	4	5	6	7	8	9	10	11	12	14	number of groups	site frequency	abundance
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		3		1			1	1	1	2				6	9	16
Acanthiza apicalis	Inland Brown Thornbill		1												1	1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill			1				1	1	1					4	4	9
Acanthiza pusilla	Brown Thornbill													1	1	1	1
Acanthiza sp.								1							1	1	1
Acanthiza uropygialis	Chestnut-rumped Thornbill	1	3	1	1		1		2	1	2				8	12	57
Amytornis textilis	Thick-billed Grasswren							1							1	1	2
Anas gracilis	Australasian Grey Teal									1					1	1	2
Anthus novaeseelandiae	Richard's Pipit				1							1			2	2	2
Aphelocephala leucopsis	Southern (Common) Whiteface		2					1	1		1				4	5	14
Apus pacificus	Fork-tailed Swift							1							1	1	2
Aquila audax	Wedge-tailed Eagle		2		1			2			1				4	6	7
Ardea alba	Great (White) Egret									1					1	1	2
Ardea novaehollandiae	White-faced Heron									1					1	1	1
Artamus cinereus	Black-faced Woodswallow		2								2		1	1	4	6	20
Artamus minor	Little Woodswallow					1									1	1	2
Barnardius zonarius	Ring-necked Parrot	1	2				1	2	1	3					6	10	61
Cacatua roseicapilla	Galah		3		2	1	1	3	1	3	2	2	1	1	11	20	127
Cacatua sanguinea	Little Corella		2	1		1		3		3					5	10	185
Calamanthus campestris	Western Fieldwren (Calamanthus)							2							1	2	3
Chrysococcyx basalis	Horsfield's Bronze Cuckoo					1									1	1	1
Cinclosoma cinnamomeum	Cinnamon Quailthrush							1				3	1		3	5	11
Coracina novaehollandiae	Black-faced Cuckooshrike		1			1		2	1	1				1	6	7	14
Corvus bennetti	Little Crow											1			1	1	1
Corvus coronoides	Australian Raven	1	4		3	1		2	2	2	1	1		2	10	19	44
Corvus sp.			2												1	2	4
Cracticus torquatus	Grey Butcherbird		1	1				2		2				2	5	8	9
Dromaius novaehollandiae	Emu		2		1	1		3	1	2			1		7	11	12
Elanus caeruleus	Black-shouldered Kite									1					1	1	1
Falco berigora	Brown Hawk (Brown Falcon)							1			1				2	2	2
Falco cenchroides	Nankeen Kestrel		4			2		2							3	8	15
Falco longipennis	Little Falcon (Australian Hobby)		1							1					2	2	2
Geopelia placida	Peaceful Dove								1	1					2	2	11
Gymnorhina tibicen	Australian Magpie	1	1		1	1	1	2	1	2				3	9	13	20
Hieraaetus morphnoides								1							1	1	1
Hirundo ariel	Fairy Martin									1					1	1	0
Hirundo nigricans	Tree Martin		1					1	1	1					4	4	10
Lichenostomus virescens	Singing Honeyeater		3		2			2	1	1	2	2	1		8	14	48
Malurus lamberti	Variegated Wren		3		1			2			2	1	1	1	7	11	19
Malurus leucopterus	White-winged Wren	1	3		2	2	1	3	1	1	1	1			10	16	71
Malurus sp.								1	1						2	2	8
Manorina flavigula	Yellow-throated Miner		1	1		1	1	2		3	1		1	1	9	12	48
Melanodryas cucullata	Hooded Robin		1			1			1		2				4	5	11
Melopsittacus undulatus	Budgerigah												1		1	1	1
Merops ornatus	Rainbow Bird (Rainbow Bee-eater)								1	1					2	2	3
Milvus migrans	Black Kite													1	1	1	1
Myiagra inquieta	Restless Flycatcher (Scissor-grinder)								1						1	1	1
Ninox novaeseelandiae	Boobook Owl (Southern Boobook)									1					1	1	1
Nycticorax caledonicus	Nankeen (Rufous) Night Heron		1						1						2	2	3
Ocyphaps lophotes	Crested Pigeon		1		1			2		1	1		1		6	7	32
Oreoica gutturalis	Crested Bellbird	1									1		1	1	4	4	5
Pachycephala rufiventris	Rufous Whistler									1					1	1	2
Pardalotus striatus	Striated Pardalote	1	1							2					3	4	5
Petroica goodenovii	Red-capped Robin	1	1				1	2	1	1					6	7	9
Phaps chalcoptera	Common Bronzewing		1								1			1	3	3	3
Phylidonyris novaehollandiae	New Holland Honeyeater									1					1	1	1
Podargus strigoides	Tawny Frogmouth		1												1	1	1
Pomatostomus ruficeps	Chestnut-crowned Babbler		1			1							1		3	3	18
Pomatostomus superciliosus	White-browed Babbler		2						2	1					3	5	21
Psephotus haematonotus	Red-rumped Parrot													1	1	1	4
Psephotus varius	Mulga Parrot (Many-coloured Parrot)	1						2				1			3	4	12
Psophodes cristatus	Chirruping Wedgebill		1		1		1	3			3	2	1		7	12	21
Pyrrholaemus brunneus	Redthroat		1					1	1						3	3	12
Rhipidura leucophrys	Willie Wagtail		1			1		1	1	1	1				6	6	10
Smicrornis brevirostris	Weebill	1					1	2		1				4	5	9	33
Taeniopygia guttata	Zebra Finch				1			1	1	1	2	1	1		7	8	63
Todiramphus pyrrhopygia	Red-backed Kingfisher	1					1	1					1	1	5	5	5
Todiramphus sancta	Sacred Kingfisher									1					1	1	1
	number of species	**11**	**34**	**5**	**14**	**14**	**10**	**35**	**24**	**34**	**19**	**11**	**14**	**15**			
	abundance	**27**	**162**	**63**	**76**	**16**	**6**	**174**	**75**	**176**	**96**	**106**	**41**	**52**			**1146**

APPENDIX 9.

Reptile species list for the study area in alphabetical Family order.

North-West Flinders Reptiles		based on SA Museum and Biological Survey of SA databases only			
Aus status	**SA status**	**Family**	**Scientific Name**	**Common Name**	**Recorded on survey**
		AGAMIDAE	*Ctenophorus nuchalis*	Central Netted Dragon	*
			Ctenophorus pictus	Painted Dragon	*
			Ctenophorus vadnappa	Red-barred Dragon	*
			Diporiphora winneckei	Canegrass Dragon	
			Pogona vitticeps	Central Bearded Dragon	*
			Tympanocryptis intima	Smooth-snouted Earless Dragon	*
			Tympanocryptis tetraporophora	Centralian Earless Dragon	*
		ELAPIDAE	*Furina diadema*	Red-naped Snake	
			Pseudechis australis	Mulga Snake	*
			Pseudonaja modesta	Five-ringed Snake	
			Pseudonaja nuchalis	Western Brown Snake	*
			Suta suta	Curl Snake	*
		GECKONIDAE	*Diplodactylus byrnei*	Pink-blotched Gecko	*
			Diplodactylus stenodactylus	Sandplain Gecko	*
			Diplodactylus tessellatus	Tessellated Gecko	*
			Gehyra variegata	Tree Dtella	*
			Heteronotia binoei	Bynoe's Gecko	*
			Nephrurus milii	Thick-tailed Gecko	*
			Phyllodactylus marmoratus	Marbled Gecko	
		PYGOPODIDAE	*Pygopus nigriceps*	Black-headed Scaly-foot	
		SCINCIDAE	*Cryptoblepharus plagiocephalus*	Desert Wall Skink	*
			Ctenotus brooksi	Sandhill Ctenotus	*
			Cyclodomorphus melanops	Spinifex Slender Bluetongue	
			Egernia stokesii	Gidgee Skink	*
			Hemiergis peronii	Four-toed Earless Skink	
			Lerista muelleri	Dwarf Three-toed Slider	*
			Menetia greyii	Dwarf Skink	*
			Morethia boulengeri	Common Snake-eye	*
			Tiliqua rugosa	Sleepy Lizard	*
		TYPHLOPIDAE	*Ramphotyphlops australis*	Southern Blind Snake	
			Ramphotyphlops bituberculatus	Rough-nosed Blind Snake	
		VARANIDAE	*Varanus gouldii*	Sand Goanna	*
		The number of reptile species recorded through SA Museum and DEHAA Databases			32
		The Number of previously recorded species detected this survey			23
Additions to the reptile species list following the NWFR survey					
Aus status	**SA status**	**Family**	**Scientific Name**	**Common Name**	**Recorded on survey**
		AGAMIDAE	*Ctenophorus fordi*	Mallee Dragon	*
		CHELIDAE	*Chelidae longicolis/macquarii*	Tortoise	*
		ELAPIDAE	*Demansia psammophis*	Yellow-faced Whip-snake	*
		GEKKONIDAE	*Diplodactylus damaeus*	Beaded Gecko	*
			Gehyra purpurescens	Purple Dtella	*
			Nephrurus levis	Smooth Knob-tailed Gecko	*
			Rhynchodeura ornata	Beaked Gecko	*
			Strophurus intermedius	Southern Spiny-tailed Gecko	*
		PYGOPODIDAE	*Delma butleri*	Spinifex Snake-lizard	*
			Pygopus nigriceps	Black-headed Scaly-foot	*
		SCINCIDAE	*Ctenotus olympicus*	Northern Spotted Ctenotus	*
			Ctenotus regius	Eastern Desert Ctenotus	*
			Ctenotus robustus	Eastern Striped Skink	*
			Ctenotus saxatilis	Centralian Striped Skink	*
			Ctenotus strauchii	Short-legged Ctenotus	*
			Egernia margaretae	Masked Rock Skink	*
			Eremiascincus richardsonii	Broad-banded Sand-swimmer	*
			Lerista desertorum	Great Desert Slider	*
			Lerista labialis	Eastern Two-toed Slider	*
			Lerista punctatovittata	Spotted Slider	*
		The number of additional reptile species recorded by survey			20
		The total number of reptile species known to definately inhabit the study area			52
Reptile species reported in area by locals					
Aus status	**SA status**	**Family**	**Scientific Name**	**Common Name**	
K	V	BOIDAE	*Antaresia stimpsoni*		
	V		*Morelia spilota*		
		CHELIDAE	*Emydura macquarii*		
			Chelodina longicolis		

APPENDIX 10.

Reptile species site frequency for each reptile assemblage. Totals include the number of sites supporting each species, the total recorded abundance of each species and the detection rate (abundance/total abundnce).

SPECIES	Common name	1	2	3	4	5	6	Site frequency	Abundance at all sites	Detection Rate
Cryptoblepharus plagiocephalus	Desert Wall Skink	6						6	8	1.85%
Ctenophorus fordi	Mallee Dragon				1			1	14	3.23%
Ctenophorus nuchalis	Central Netted Dragon				2			2	3	0.69%
Ctenophorus pictus	Painted Dragon	1			2			3	6	1.39%
Ctenophorus vadnappa	Red-barred Dragon	1		1		1		3	3	0.69%
Ctenotus brooksi	Sandhill Ctenotus				3			3	14	3.23%
Ctenotus regius	Eastern Desert Ctenotus	2			2		2	6	18	4.16%
Ctenotus robustus	Eastern Striped Skink	1		4		2		7	9	2.08%
Ctenotus saxatilis	Centralian Striped Skink					1		1	1	0.23%
Ctenotus strauchii	Short-legged Ctenotus		4	1	1			6	11	2.54%
Ctenotus uber	Spotted Ctenotus		4	3				7	20	4.62%
Delma butleri	Spinifex Snake-lizard			1				1	1	0.23%
Demansia psammophis	Yellow-faced Whipsnake	1						1	1	0.23%
Diplodactylus byrnei	Pink-blotched Gecko	1	7	2	3			13	76	17.55%
Diplodactylus damaeus	Beaded Gecko				1			1	14	3.23%
Diplodactylus stenodactylus	Sandplain Gecko	1			2			3	8	1.85%
Diplodactylus tessellatus	Tessellated Gecko	1	2					3	4	0.92%
Egernia stokesii	Gidgee Skink					3		3	4	0.92%
Eremiascincus richardsonii	Broad-banded Sandswimmer	7			1			8	10	2.31%
Gehyra purpurascens	Purple Dtella	3			1	2	2	8	26	6.00%
Gehyra variegata	Tree Dtella	8	1	3				12	28	6.47%
Heteronotia binoei	Bynoe's Gecko	5		3				8	14	3.23%
Lerista desertorum	Great Desert Slider	2						2	3	0.69%
Lerista labialis	Eastern Two-toed Slider				2			2	9	2.08%
Lerista muelleri	Dwarf Three-toed Slider	3	1					4	4	0.92%
Lerista punctatovittata	Spotted Slider	2						2	4	0.92%
Lerista sp.					1	1		2	2	0.46%
Morethia boulengeri	Common Snake-eye	7						7	16	3.70%
Nephrurus levis	Smooth Knob-tailed Gecko				1			1	6	1.39%
Nephurus milii	Barking Gecko	2	1	1				4	6	1.39%
Pogona vitticeps	Central Bearded Dragon	2		3				5	5	1.15%
Pygopus nigriceps	Black-headed Scaly-foot			1				1	1	0.23%
Rhynchoedura ornata	Beaked Gecko	1	2		3			6	29	6.70%
Strophurus intermedius	Southern Spiny-tailed Gecko			2				2	4	0.92%
Suta suta	Curl Snake	1		1				2	2	0.46%
Tiliqua rugosa	Sleepy Lizard	1	3	4	1	1		10	22	5.08%
Tympanocryptis intima	Smooth-snouted Earless Dragon				2			2	2	0.46%
Tympanocryptis tetraporophora	Eyrean Earless Dragon	1	6	1				8	19	4.39%
Varanus gouldii	Sand Goanna	1	1		2	1		5	6	1.39%
	Totals	**24**	**11**	**15**	**18**	**8**	**2**	**38**	**433**	

APPENDIX 11.
Reptile species site frequency for the floristic groups. Refer to the vegetation chapter for explanation of floristic groups.

SPECIES	Common name	1	2	3	4	5	6	7	8	9	10	11	12	14
Cryptoblepharus plagiocephalus	Desert Wall Skink		2			1	1	1		1				1
Ctenophorus fordi	Mallee Dragon												1	
Ctenophorus nuchalis	Central Netted Dragon											2		
Ctenophorus pictus	Painted Dragon				1								2	1
Ctenophorus vadnappa	Red-barred Dragon	1	1							1	1			
Ctenotus brooksi	Sandhill Ctenotus				1							1	1	
Ctenotus regius	Eastern Desert Ctenotus				1			1		1	2		1	
Ctenotus robustus	Eastern Striped Skink		2	1			1	1		1	1			
Ctenotus saxatilis	Centralian Striped Skink			1										
Ctenotus strauchii	Short-legged Ctenotus				2	1		1				2		
Ctenotus uber	Spotted Ctenotus		1		2		1	3						
Delma butleri	Spinifex Snake-lizard		1											
Demansia psammophis	Yellow-faced Whipsnake					1								
Diplodactylus byrnei	Pink-blotched Gecko				4	2	1	3				3		
Diplodactylus damaeus	Beaded Gecko												1	
Diplodactylus stenodactylus	Sandplain Gecko				1			1				1		
Diplodactylus tessellatus	Tessellated Gecko							3						
Egernia stokesii	Gidgee Skink		2	1							1			
Eremiascincus richardsonii	Broad-banded Sandswimmer	1	1		1		1	2	1					1
Gehyra purpurascens	Purple Dtella		2					2			3	1		
Gehyra variegata	Tree Dtella	1	2		2	1	2	1	1					2
Heteronotia binoei	Bynoe's Gecko		1		1	1	1	1	1	2				
Lerista desertorum	Great Desert Slider									1				1
Lerista labialis	Eastern Two-toed Slider											2		
Lerista muelleri	Dwarf Three-toed Slider		1		1				1					1
Lerista punctatovittata	Spotted Slider							1	1					
Lerista sp.					1						1			
Morethia boulengeri	Common Snake-eye		2				1	1	1					2
Nephrurus levis	Smooth Knob-tailed Gecko												1	
Nephurus milii	Barking Gecko		1					1	1					1
Pogona vitticeps	Central Bearded Dragon		1		1		1	1		1			1	
Pygopus nigriceps	Black-headed Scaly-foot				1									
Rhynchoedura ornata	Beaked Gecko				3			1				2		
Strophurus intermedius	Southern Spiny-tailed Gecko		1				1							
Suta suta	Curl Snake						1	1						
Tiliqua rugosa	Sleepy Lizard		4		1	1	1	2					1	
Tympanocryptis intima	Smooth-snouted Earless Dragon				1							1		
Tympanocryptis tetraporophora	Eyrean Earless Dragon				2	1	1	3				1		
Varanus gouldii	Sand Goanna				2						1		1	1
	Species per group	**3**	**16**	**3**	**19**	**8**	**13**	**20**	**7**	**7**	**7**	**10**	**9**	**9**

APPENDIX 12.
Frogs of the North-west Flinders Ranges.

North-West Flinders Amphibians					
Aus status	SA status	**Family**	**Scientific Name**	**Common Name**	**Recorded on survey**
		HYLIDAE	*Litoria rubella*	Red Tree Frog	
		MYOBATRACHIDAE	*Crinia riparia*		*
			Limnodynastes tasmaniensis	Marbled Frog	
			Neobatrachus centralis	Trilling Frog	*

APPENDIX 13.
Regions mapped for structural vegetation surrounding and including the study area.