Department for Environment and Heritage

A Biological Survey of the Nantawarrina Indigenous Protected Area South Australia

NANTAWARRINA
INDIGENOUS PROTECTED AREA

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Department for Environment and Heritage

A BIOLOGICAL SURVEY OF THE NANTAWARRINA INDIGENOUS PROTECTED AREA, SOUTH AUSTRALIA 2009

BIOLOGICAL SURVEY SOUTH AUSTRALIA

N. Neagle and D. Armstrong

Science Resource Centre
Information, Science and Technology Directorate
Department for Environment and Heritage, South Australia
2010

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The views and opinions expressed in this report are those of the authors and do not necessarily represent the views or policies of the Nipapanha Community or the Government of South Australia.

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Cover Photograph:
Mulga [Malka] (*Acacia aneura* var. *aneura*) covered hillside overlooking Alerumba Creek.
Photo: N. Neagle

EXECUTIVE SUMMARY

A biological survey was conducted in the Nantawarrina Indigenous Protected Area (IPA) in April/May 2009 with funding received from the Indigenous Protected Areas Program (Department of the Environment, Water, Heritage and the Arts) via the Nipapanha Community (Nepabunna) and the South Australian Department for Environment and Heritage. The Nantawarrina IPA is in the northern Flinders Ranges and its major landforms consist of high quartzite ridges, steep sided gorges with permanent waterholes, low limestone hills and undulating siltstone plains.

The main aim of this survey was to sample the major habitats and associated flora and fauna for the Nipapanha Community to assist with the management of the area for biodiversity. A total of 21 sites were sampled for mammals and reptiles and 22 for birds and vascular plants. Data from two other surveys conducted in the region were included in a floristic vegetation analysis of site data for the IPA. This resulted in the identification and description of 17 floristic vegetation communities.

A total of 270 unique plant taxa were recorded during the survey, comprising 251 natives and 19 exotics. Significantly, exotic taxa accounted for only 5.2% of all records, or 7% of species. Fifteen plant species of conservation significance were recorded, of which one is considered Vulnerable at the national level (Slender Bell-fruit [Alunga]) and one Rare at State level (Leafy Twig-rush), as well as 57 (49 native and eight exotic) species not previously listed as occurring in the Nantawarrina IPA.

Nineteen mammal species were recorded during the survey, of which 13 were native and six exotic. The Yellow-footed Rock-wallaby [Andu], rated Vulnerable at both State and national level, was recorded at both Moro and Waukla Woodna Gorges. Despite dry conditions at the time of the survey four small native mammal species were captured at sites, including eight individuals of Bolam's Mouse and the first record of Forrest's Mouse in the IPA. Five species of bat were detected – one heard, three captured and one only detected via calls using 'Anabat' call recording equipment. The latter was a Free-tailed bat (*Mormopterus* sp. [Wadnimikanha]) not previously recorded in the IPA.

The survey recorded 73 bird species (all native), 28 of which had not previously been recorded in the IPA. Five species were of conservation significance – the Australian Bustard [Walha] and Blue-winged Parrot are both rated Vulnerable and the White-browed Treecreeper, Elegant Parrot and Gilbert's Whistler are all rated Rare in South Australia. Other notable sightings were the Slaty-backed Thornbill (first record for the Flinders Ranges), Spotted Pardalote (considerable northward range extension) and Short-tailed Grasswren (confirmed presence of this cryptic species).

All but six of the 33 species of reptiles known to occur in the IPA were recorded during the Nantawarrina IPA Survey. This includes nine species that had not previously been recorded in the IPA. One species of conservation significance was recorded – the Marbled Velvet Gecko [Munga]. This and the Red-barred Dragon [Itivadnappa] are two colourful and prominent lizards with limited distributions that occur in the IPA. Two frog species were also recorded – Flinders Ranges Froglet and Desert Tree Frog.

The total number of records contributed to the Department for Environment and Heritage's Biological Databases of South Australia (BDBSA) from sites as a result of this survey were – 807 plants, 128 mammals, 495 birds, 143 reptiles and one frog. A further 733 records were collected away from sites as opportunistic sightings, comprising 278 plants, 102 mammals, 166 birds, 77 reptiles and 110 frogs.

The ranges, in particular the upper slopes and ridge tops, have been identified as a major gap in the biological survey sampling effort in the IPA owing to the logistical difficulties associated with access. In addition, a number of flora and fauna species requiring further study and/or targeted searching have also been identified, including seven plant species of conservation significance whose presence in the IPA requires confirmation, four others that have not been recorded in the IPA in over 30 years, the condition and long term viability of Mulga Woodlands in the IPA, Yellow-footed Rock-wallaby, Slaty-backed Thornbill, Short-tailed Grasswren and Spotted Pardalote.

Figure 1. River Red Gums [Wira] (*Eucalyptus camaldulensis* ssp. *minima*) beside cliff in Waukla Woodna Gorge (Photo: N. Neagle).

Figure 2. Spinifex [Vakirri] (*Triodia irritans*) Hummock Grassland on Uro Range (Photo: N. Neagle).

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ACKNOWLEDGEMENTS

Funding Source
This survey was jointly funded by the Nipapanha Community (Nepabunna) and the Department for Environment and Heritage.

Survey Field Staff
The following people participated in the fieldwork component of this survey, without whom this report would not be possible:- Dave Armstrong, Brian Blaylock, Joanne Blaylock, Andrew Graham, Nerissa Haby, Justin Jay, Lynne Kajar, Gavin Kluske, Tony Latz, Kate Lloyd, Ben McCallum, Nick Neagle, Christina Pahl, Lynn Pedler and Ian Williams.

Special mention must be made of the extra effort Lynn Pedler put in on the survey trip (and after) to collect and skin bird specimens for the SA Museum. This represents a significant extra contribution to their collection of specimens from the northern Flinders Ranges.

Nepabunna Community
Simon Duke, the Nepabunna Municipal Services officer, was a vital contact at the Community and provided valuable advice on a range of matters concerning the IPA.

Previous Biological Surveys in the Area
This survey has built on previous biological survey work conducted in and around the Nantawarrina IPA. Use of data from the following surveys has been extremely valuable in producing this report:-

Flinders Management Review (1988 - 1991) coordinated by Graham Greenwood (1988) and Roger Playfair (1991).
Flinders Ranges (1999) coordinated by Robert Brandle.

Preparation of Vehicles and Field Gear
Lynne Kajar

Specimen Identification
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Robert Brandle provided advice with the floristic vegetation analysis as well as proof reading the final draft.

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INTRODUCTION

D. Wallace-Ward[1] and N. Neagle[1]

Background and Aims

The Nantawarrina Indigenous Protected Area (IPA) is approximately 500km north of Adelaide in the northern Flinders Ranges. It abuts the southern boundary of the Vulkathunha-Gammon Ranges National Park and covers an area of 580km^2 featuring high quartzite ridges, steep-sided gorges, limestone hills, undulating siltstone flats and permanent waterholes.

Nantawarrina was declared Australia's first Indigenous Protected Area in August 1998. It is managed by the traditional owners, the Adnyamathanha people of the Nepabunna Aboriginal Community, to whom the area is of great cultural significance as a birthplace, traditional tribal territory and a place of mythologically important sites. The focus of the community's management of the IPA is to maintain a balance between the conservation of natural and cultural heritage, and economic sustainability for the benefit of future generations (DEWHA 2009).

The Nepabunna Community (Nipapanha Community Incorporated) commissioned the Science Resource Centre of the Department for Environment and Heritage (DEH) to conduct the Nantawarrina IPA Biological Survey to inform and guide their management of the area.

The Biological Survey of SA

The Biological Survey of South Australia is a program of systematic surveys, established in 1971 by the Biological Survey Coordinating Committee (BSCC) with the aim of providing a broad baseline inventory of the State's vascular plants and vertebrate fauna. The BSCC is an interdepartmental committee with representatives from Environment and Heritage, SA Museum, SA Research and Development Institute (SARDI), and Primary Industries and Resources SA (Foulkes and Gillen 2000). The objectives of these surveys are to systematically and consistently sample the range of ecological habitats located in South Australia (Brandle 2001). The comprehensive data and information collected supports the long-term natural resource management and conservation of the biological diversity of South Australia (Neagle 2009).

The specific aims of this survey were:

1. To observe, collect and identify species of vascular plants and vertebrate fauna present in the area by sampling an array of fixed quadrats representing the geographical and biological diversity of the region.
2. To systematically collect data on the relative abundances of plants at the fixed quadrats as well as a description of the soil, landform and degree of disturbance.
3. To establish a comprehensive database of the flora and fauna communities of the Nantawarrina IPA that is amenable to ecological analyses.
4. To establish a set of permanently marked relocatable sites to enable revisits to take place.
5. To document and clarify the various assemblages/communities of plants and animals that occur in the Nantawarrina IPA.
6. To provide the South Australian Plant Biodiversity Centre and South Australian Museum with collections representative of the diversity of plants, vertebrates and invertebrates in the region.
7. To provide broad conservation recommendations on the basis of data collected.

Biological Surveys Included in this Report

As well as information collected on the current survey, data from two previous surveys have been used in this report. Field data for all of these surveys has been extracted from DEH's Survey database. This contains biological data collected from both standardised survey sites and opportunistic sightings.

The three surveys (all conducted by DEH) and their scope are:

- Flinders, 1984-1991 (based on 1:50,000 mapsheets between Moralana and Yudnamutana [refer Greenwood *et al.* 1989] plus sites between Port Pirie and Port Augusta) – broad regional vegetation survey (vegetation only).
- Flinders Ranges, 1997-1999 (Brandle 2001) (Moolawatana to Crystal Brook) – broad regional vertebrate fauna survey conducted across the range of habitats comprising the Flinders Ranges in order to relate this data to existing vegetation information (vegetation and vertebrates).
- Nantawarrina IPA, 2009 - conducted within the IPA for the Nipapanha Community Incorporated (vegetation and vertebrates).

A complete list of all 110 sites from these surveys, including the date of survey, AMG coordinates, location, landform pattern and element, surface soil texture, dominant overstorey plant species and vegetation structural description are provided in Appendix 1.

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PHYSICAL ENVIRONMENT

IBRA Bioregions, Subregions and Environmental Associations.

The Nantawarrina Indigenous Protected Area (IPA) lies within one Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion - the Flinders Lofty Block (Thackway and Cresswell 1995). The bioregions are geographically diverse zones of land and/or water that contain a characteristic collection of ecosystems structuring familiar patterns on the landscape (Bastin & ACRIS Management Committee 2008).

Each Bioregion may be subdivided into subregions which, in turn, are further subdivided into environmental associations. The Nantawarrina IPA is contained within one subregion – Northern Flinders. This subregion is described as semi-arid to arid and supports White Cypress-pine (*Callitris glaucophylla*), Black Oak (*Casuarina pauper*) and mallee Open Woodlands, *Acacia* spp. shrublands, bluebush/saltbush chenopod shrublands and extensive native grasslands on shallow, well-drained loams and moderately deep, well-drained red duplex soils (Australian Natural Resources Atlas 2009).

The Nantawarrina IPA contains portions of five environmental associations (Gammon, Yerelina, Warraweena, Erragoona and Outouie), as listed in Table 1 and mapped in Figure 3 (Thackway and Cresswell 1995). Each environmental association is described below (adapted from Laut *et al*. 1977).

Gammon Environmental Association

The northern end of the IPA lies within the Gammon Environmental Association. This is the steep sided quartzite range that includes Mt. Rowe (at 900m the highest point in the IPA) to the north of Nepabunna. On the ridge top and upper slopes of the range the vegetation is principally emergent White Cypress-pine (*Callitris glaucophylla*) Low Open Woodland and/or Flinders Grey Mallee (*Eucalyptus flindersii*) and/or Beaked Red Mallee (*E. socialis* ssp. *socialis*) Low Open Woodland over Broombush (*Melaleuca uncinata*), Rock Grass-tree (*Xanthorrhoea quadrangulata*) and Curry Bush (*Cassinia laevis*), as well as Mulga (*Acacia aneura*) Low Open Woodland.

The lower slopes have mixed mallee communities of Beaked Red Mallee and Curly Mallee (*E. gillii*) plus Black Oak (*Casuarina pauper*) Low Open Woodland. The creeklines emanating from the range are lined with River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) at lower altitudes.

Yerelina Environmental Association

Within the IPA the Yerelina Environmental Association covers the low hills and undulating plains around Nepabunna and on the western side of the Uro Range. There is a diverse vegetative cover of Mulga (*Acacia aneura*) or Black Oak (*Casuarina pauper*) Low Open Woodland with a sparse shrub understorey; Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee (*E. gillii*) Open Mallee; Elegant Wattle (*Acacia victoriae* ssp. *victoriae*), Dead Finish (*A. tetragonophylla*) Open Shrubland; River Red Gum (*E. camaldulensis* ssp. *minima*) Open Woodland on the major watercourses; and, particularly on the western flanks of the Uro Range, a sparse open grassland with Lemon-grass (*Cymbopogon ambiguus*), Bakarra Spear-grass (*Austrostipa nitida*), Bottle-washers (*Enneapogon* spp.) and/or Three-awns (*Aristida* spp.).

Warraweena Environmental Association

The Warraweena Environmental Association takes in the rugged Uro and Campbell Bald Hill Ranges as well as the range extending south from Hawker Hill. Apart from where the main access track into the IPA follows the course of the Mount McKinlay Creek, this is an area largely inaccessible to vehicles. These high quartzite strike ridges feature extensive low open woodlands variously dominated by Mulga (*Acacia aneura*), White Cypress-pine (*Callitris glaucophylla*) and Black Oak (*Casuarina pauper*) and low open mallee communities of Flinders Grey Mallee (*Eucalyptus flindersii*), Curly Mallee (*E. gillii*), Gum-barked Coolibah (*E. intertexta*) or Beaked Red Mallee (*E. socialis* ssp. *socialis*). Much of the understorey is dominated by Spinifex (*Triodia irritans*), Needle Wattle (*Acacia havilandiorum*) and Broombush (*Melaleuca uncinata*).

Beaked Red Mallee, Curly Mallee Open Mallee and Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) Tall Open Shrubland are common on the lower hills and the major watercourses are lined with impressive stands of River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodlands.

Erragoona Environmental Association

The Erragoona Environmental Association lies almost entirely within the Nantawarrina IPA and corresponds to the low hills and undulating plains of limestone and siltstone between the main ranges, and encompasses most of the south-eastern half of the IPA. Again there is a diverse range of vegetation communities. There are extensive areas of Mulga (*Acacia aneura*) Low Open Woodland with a sparse shrub and ephemeral understorey. However, much of this is degraded with many dead trees and an absence of seedlings. There are also patches of Black Oak (*Casuarina pauper*) Low Open Woodland, particularly at the base of the Stirrup Iron Range. Shrublands variously dominated by Elegant Wattle (*Acacia victoriae* ssp. *victoriae*), Dead Finish (*A. tetragonophylla*), Fine-leaf Desert Senna (*Senna artemisioides* ssp. *filifolia*), Broad-leaf Desert Senna (*S. artemisioides* ssp. X *coriacea*) and Brilliant Hop-bush (*Dodonaea microzyga* var.

microzyga) are also prevalent and scattered throughout this area. Chenopod shrublands, particularly Low Bluebush (*Maireana astrotricha*) Low Open Shrubland, are also present but appear to have been degraded in the past due to grazing by stock and feral herbivores.

Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee (*E. gillii*) Open Mallee appears to be confined to low hills in the north, while open areas of Bindyi (*Sclerolaena* spp.) can be found throughout the area and may relate to past grazing disturbance. The creeklines are lined with River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Open Woodland which grades to Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland on the minor watercourses.

Outouie Environmental Association

The Outouie Environmental association includes that portion of the Stirrup Iron Range that occurs along the south-eastern margin of the IPA. Mulga (*Acacia aneura*) Low Open woodland dominates on this range with large areas of Black Oak (*Casuarina pauper*) Low Open Woodland on the lower slopes. Shrublands of Elegant Wattle (*Acacia victoriae* ssp. *victoriae*), Dead Finish (*A. tetragonophylla*) and/or Broad-leaf Desert Senna (*Senna artemisioides* ssp. X *coriacea*) are common on the lower hills in the south west.

Table 1. IBRA Bioregions, Subregions and Environmental Associations (plus codes) in the Nantawarrina IPA.

IBRA BIOREGION	SUBREGION	ENVIRONMENTAL ASSOCIATION
Flinders Lofty Block	Northern Flinders (FLB5)	Warraweena (6.2.2) Outouie (6.2.4) Erragoona (6.2.6) Yerelina (6.2.7) Gammon (6.2.9)

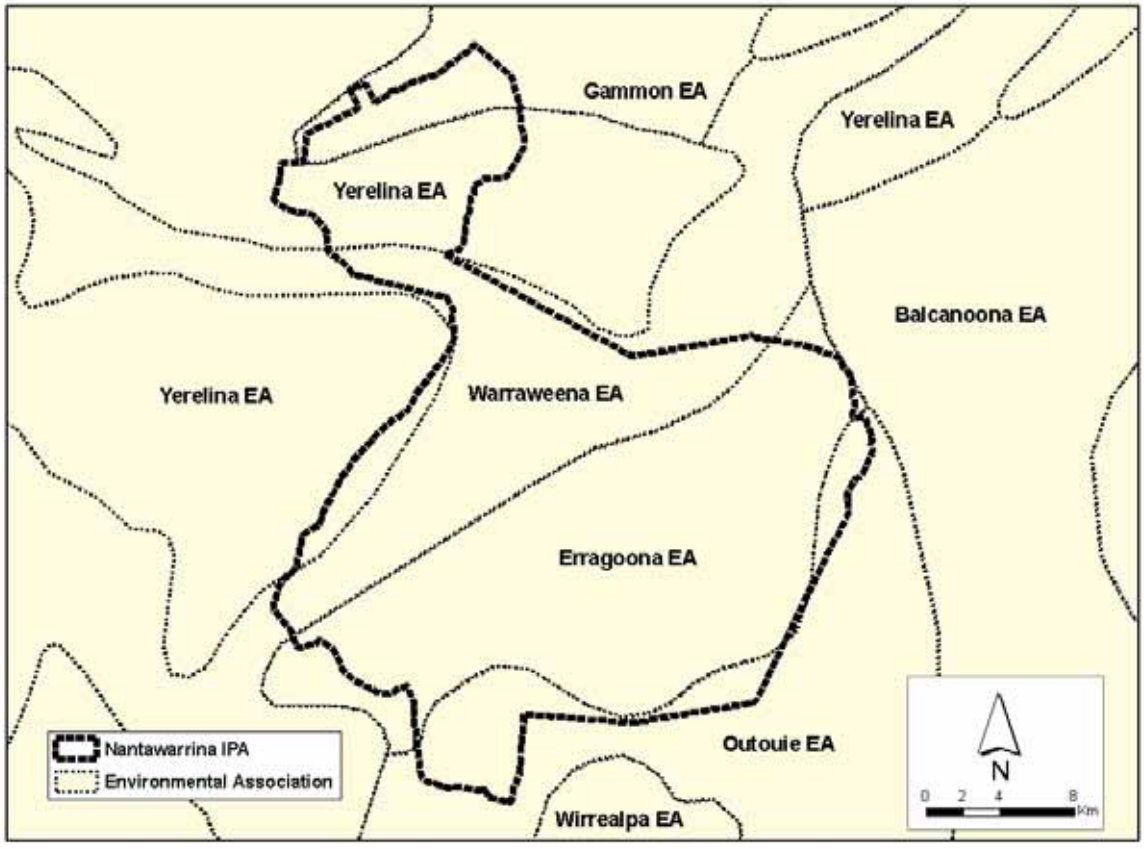


Figure 3. Environmental Associations present in the Nantawarrina IPA.

Past Land Use

Nantawarrina operated as a pastoral lease from the 1850s. The impact of this long history of sheep and cattle grazing (plus the presence of feral goats, donkeys, horses and rabbits) is now particularly evident in areas around historic stock watering points and in Mulga woodlands and chenopod shrublands on low hills and undulating plains.

During 1995 the Aboriginal Lands Trust became concerned over the pressure of stock and the high numbers of feral animals within Nantawarrina. The Aboriginal Lands Trust Board considered that if this situation were to continue unrestricted further destruction of vegetation over large areas of the region would occur, and soil erosion problems already evident in the area would be magnified (Australian Bureau of Statistics 2009).

As a result the Lands Trust began a program of culling feral animals and vermin, particularly rabbits, which have been a significant factor in the destruction of vegetation at Nantawarrina. This action was carried out in conjunction with representatives of the Department of Environment and Heritage, the Northern Flinders Ranges Soil Board, the Sporting Shooters Association, the Animal and Plant Control Commission and neighbouring landholders (Australian Bureau of Statistics 2009).

Since the creation of the area as an IPA in 1998 all domestic stock have been removed and an ongoing program of feral animal control is in place.

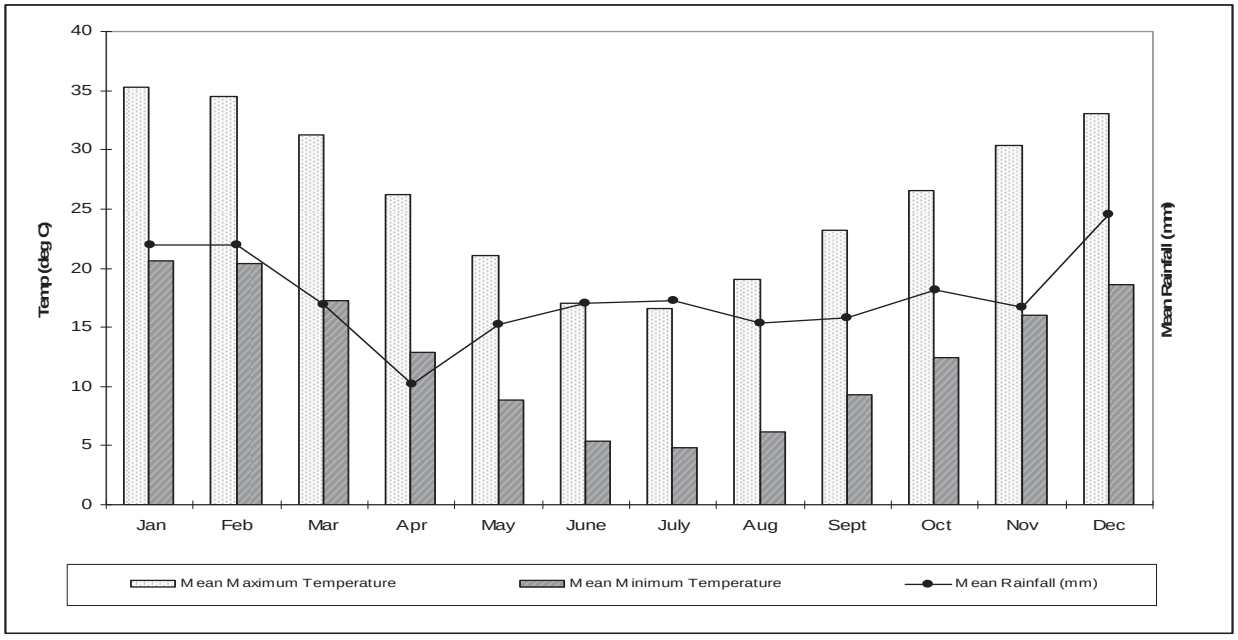
Climate and Rainfall

The climate at Nantawarrina IPA is semi-arid to arid with hot summers and cool mild winters. Rainfall is, however, strongly influenced by unpredictable summer storms, which is reflected in the differences between the chart of mean monthly annual rainfall records (refer to Figure 4) (Brandle, 2001). The mean annual rainfall for the Flinders Ranges as a whole increases from 150mm in the north to 300-350mm in the southern ranges. The mean monthly evaporation is very high in summer and mean annual evaporation in the south increases from 2800mm to approximately 3600mm in the north. The temperatures present high seasonal and diurnal variation (Laut *et al.* 1977).

The nearest weather station sites to Nantawarrina are Leigh Creek Airport (situated north west of the IPA) and Arkaroola to the north. The Leigh Creek Airport collection of statistical climate data (temperature and rainfall) commenced in 1982. In winter the average monthly minimum ranges between 5°C and 6°C and the average monthly maximum from 17°C to 19°C. For summer the average monthly minimum is between 18°C and 20°C and the average maximum between 33°C and 35°C (BOM 2009) (refer Figure 4).

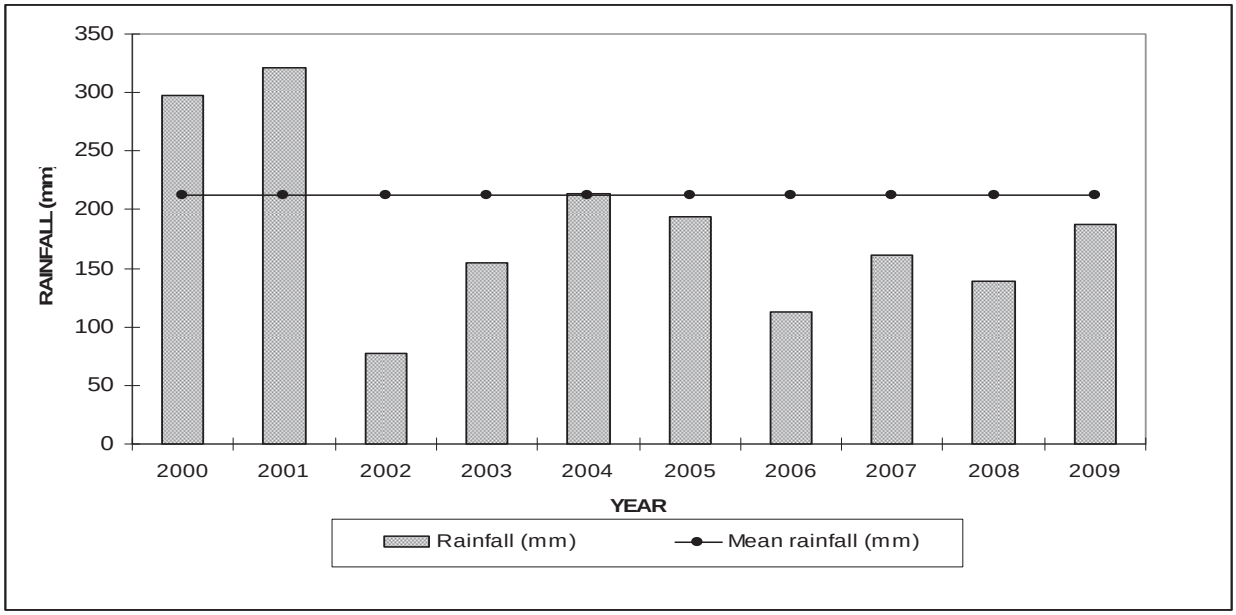
The mean annual rainfall at Leigh Creek Airport is 211.0mm. For the winter months it ranges between 15mm to 17mm and during summer from 22mm to 24mm (BOM 2009).

The annual rainfall at Leigh Creek Airport for each of the last ten years is shown in Figure 5. This highlights the run of three comparatively dry years immediately preceding the 2009 Survey in the Nantawarrina IPA.



Source: Bureau of Meteorology, http://www.bom.gov.au/climate/averages/tables/cw_017110.shtml

Figure 4. Mean monthly maximum and minimum temperatures and mean monthly rainfall for Leigh Creek Airport from 1982-2009.



Source: Bureau of Meteorology, http://reg.bom.gov.au/jsp/ncc/cdio/cvg/av

Figure 5. Annual rainfall at Leigh Creek Airport for the period 2000-2009 plus the long term mean annual rainfall.

Figure 6. View west to the Uro Range from near Bald Hill (Photo: N. Neagle).

Figure 7. Inland Paperbark [Alaru] (*Melaleuca glomerata*) surrounding a waterhole at Moro Gorge (Photo: A. Graham).

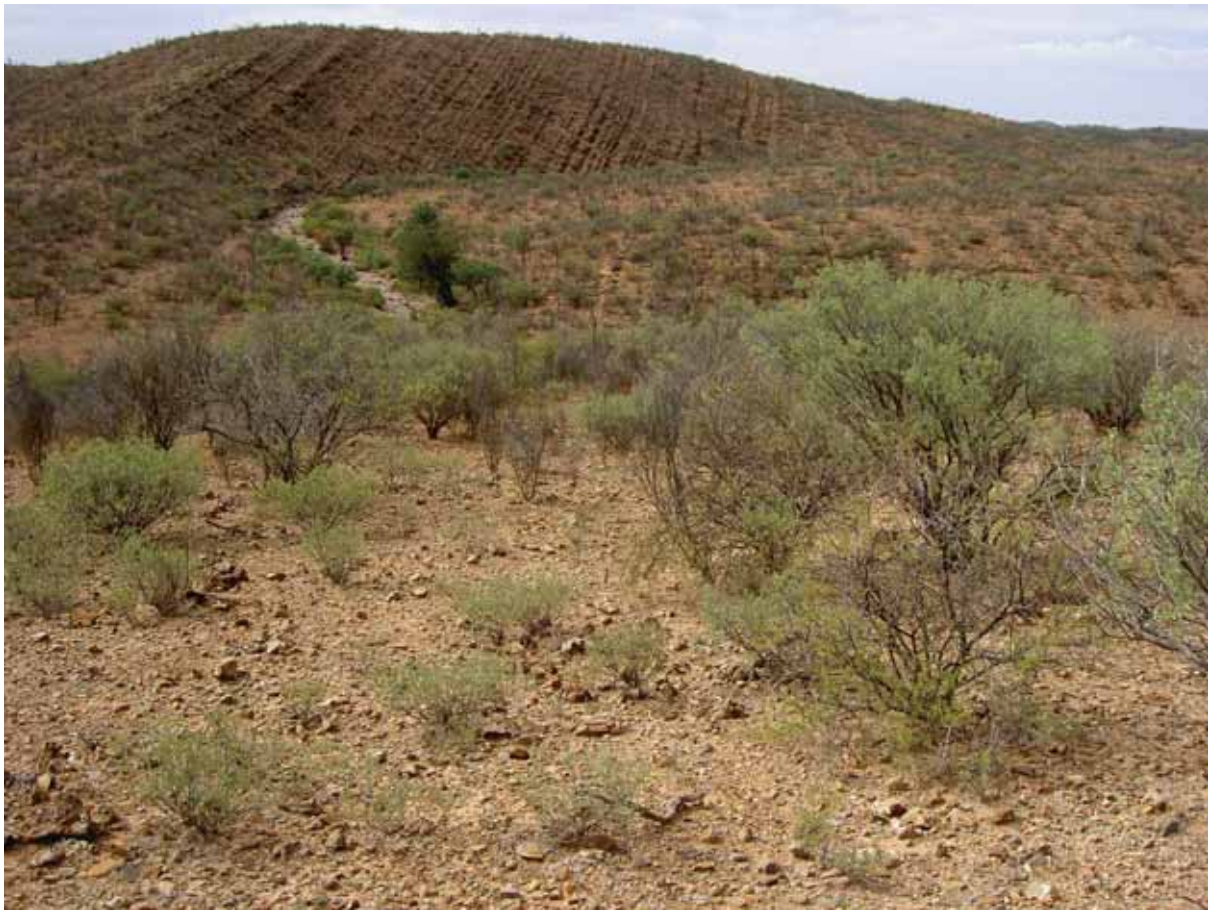


Figure 8. Broad-leaf Desert Senna [Murku] (*Senna artemisioides* ssp. X *coriacea*) Open Shrubland on stony hills west of Irish Well (Photo: N. Neagle).

METHODS

D. Wallace-Ward[1] and N. Neagle[1]

The Nantawarrina IPA Biological Survey

This survey forms part of the Biological Survey of South Australia. The methods used for it are consistent with the methodologies outlined for vegetation surveys in 'Guide to a Native Vegetation Survey Using the Biological Survey of South Australia' (Heard and Channon 1997) and vertebrate fauna surveys in 'Guidelines for Vertebrate Surveys in South Australia Using the Biological Survey of South Australia' (Owens 2000). Both of these manuals are available for download from the South Australian Department for Environment and Heritage (DEH) website under 'Science – Species and Populations – Biological Survey Programs – Biological Survey of South Australia - Surveys' at http://www.environment.sa.gov.au/science/species/surveys.html

Site Selection and Nomenclature

As with other biological surveys conducted in South Australia by DEH, sites were chosen to represent the biological and geographical diversity of the study area. In addition, the location of sites where biological data had already been collected (using the same or very similar methodology) was taken into consideration to avoid the duplication of sampling effort. A relatively high number of sites had been sampled for vegetation within the IPA for the Flinders Survey between 1988 and 1991. Not surprisingly, these were mostly located at lower altitudes and close to tracks to enable easy access. Site-based fauna sampling had been scarce in the Nantawarrina IPA prior to the 2009 survey, with only six fauna sites having previously been sampled as part of the Flinders Ranges Biological Survey in 1999.

Information was gained from satellite imagery, 1:250,000 topographic maps, the Flinders Ranges regional vegetation map and existing sites in the IPA prior to visiting the area to determine the range of landform types and vegetation communities likely to occur and their potential distribution across the IPA.

A total of 22 sites were then selected for vegetation and fauna sampling during a reconnaissance trip in March 2009. Survey Co-ordinators also met with members of the Nepabunna Community on that trip to discuss survey activities, access tracks and whether there were any areas of cultural sensitivity.

The sites were selected around three central camps which were named from a local feature - (1) Orange Tree Well, (2) Irish Well, and (3) Plaque. Each quadrat was selected to represent the major landform and habitat types displayed within the camp area.

Site identification codes followed the Biological Survey of South Australia standard eight character alpha-numeric code. The first three characters are alphabetic and generally refer to either the map sheet or camp location. The next three are numeric and refer to the site number, where sites are numbered sequentially within a map sheet or associated with a camp. The final two numeric characters allow for the sequential numbering of patches associated with one site. The vegetation and fauna sites sampled in May 2009 were all numbered sequentially following the camp names IRI (Irish Well), ORA (Orange Tree Dam), PLA (Plaque) prefix, hence IRI00101 to IRI00701, ORA00101 to ORA00801 and PLA00101 to PLA00701. For general location of all 22 sites on this survey refer Figure 10 and Appendix 1.

Sampling

At each site a 100m x 100m vegetation quadrat was sampled and physical information recorded following the method described in Heard and Channon (1997). The physical description of a site included information on its location (using 1:250,000 topographic maps, AMG zone and coordinates and a hand drawn 'mud map') and the physical landscape (landform pattern and element, slope, aspect, outcrop and surface strew lithology, and the surface soil texture) using standard data sheets (Figure 9). All vascular plants were recorded along with a measure of their cover/abundance and a structural classification of life form. Dominant species in both the overstorey and understorey were also noted at each site.

Figure 9. Survey biologists analysing the physical landscape (Photo: L. Kajar).

[1] Science Resource Centre, Information, Science and Technology Directorate, Department for Environment and Heritage, GPO Box 1047, Adelaide SA 5001.

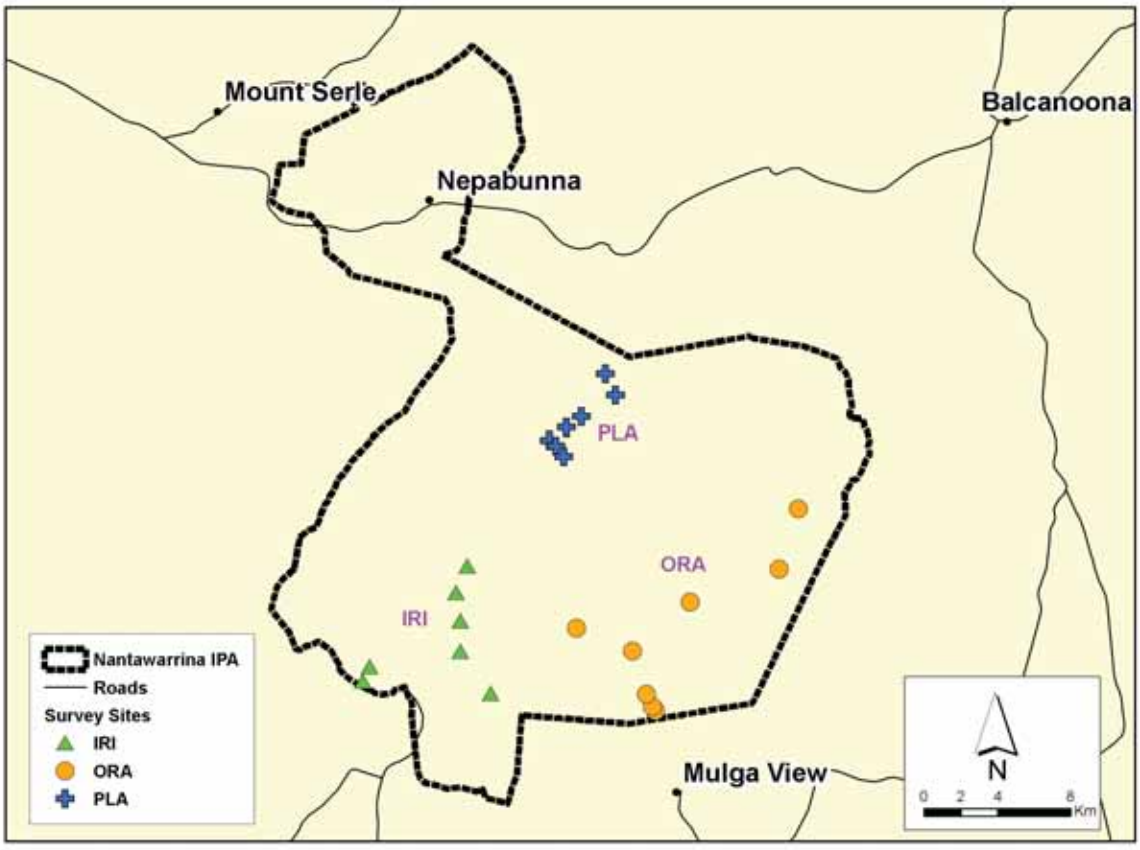


Figure 10. General location of Nantawarrina IPA Survey Sites based on camp locations (ORA = Orange Tree Well; IRI = Irish Well; PLA = Plaque).

Two star droppers were placed 10m apart to permanently mark each site, with a photopoint disc (with the site identification code) attached to one.

For each camp area a representative collection of all plant species recorded was vouchered for later verification and incorporation into the State Herbarium of South Australia collection. Interesting plant species observed outside the specified quadrats were also collected, but recorded as opportunistic sightings on separate data sheets with location and habitat details.

Figure 11. A pitfall line at site PLA00501 showing the drift fence positioned across the top of one of the pitfall traps (Photo: I. Williams).

Fauna sampling followed the standard Biological Survey method described in Owens (2000). At each site reptiles and small terrestrial mammals were sampled using two fenced pitfall lines (approximately 200m apart) consisting of six pits (40cm deep and 15cm in diameter) dug 10m apart along a 55m flywire drift fence (Figure 11). Funnel traps were used instead of pits at five sites (IRI00701, ORA00701, PLA00201, PLA00301 and PLA00401) at rocky hill locations distant to vehicles where digging was not possible. They were placed either side of the drift fence at 10m intervals (as per pits) and weighted down with rocks (Figure 12).

Figure 12. Funnel trap weighted down with rocks by drift fence (Photo: N. Neagle).

In addition to each pitfall or funnel trap-line was a line of 15 baited Elliott traps (Figure 13) with a baited wire cage trap at each end. The bait used was a mixture of peanut butter and rolled oats. Each site was sampled for 4 days and nights and trapping was consistent for most of the 22 sites.

Due to the time constraints during the survey two sites did not have fauna sampling consistent with the rest. At site ORA00401 the standard number of Elliott and cage traps was used but no drift fence, pits or funnel traps. Extra search effort was, however, employed for mammals and reptiles. At site PLA00701 no traps at all were used, though an Anabat was employed for one night. Both these sites did receive standard bird and vegetation sampling. A summary of trapping effort at sites is provided in Table 2.

Figure 13. An Elliott trap placed in the shade of bush and marked with flagging tape (Photo: N. Neagle).

Mammals and reptiles were also recorded by an hour of active searching at each site for individuals or signs, such as scats, diggings or burrows. Spotlight searches were made at night at some sites where time, weather and habitat permitted.

Figure 14. An Anabat kit (yellow box) with microphone in plastic tube (in bush) for recording bat calls (Photo: I. Williams).

Bats were sampled using harp traps, mist nets and 'Anabat' recording equipment (Figures 14 and 15). It was not possible to have consistent effort with this across all sites due to the number of harp traps and Anabat kits available, weather conditions at time of survey, access to sites (several were located in steep hills over one kilometre from vehicle access, thus preventing the carrying in of heavy and cumbersome harp traps), suitability of habitat at sites and presence of preferable opportunistic locations (particularly for harp traps).

Figure 15. Harp trap set up between River Red Gums at ORA00201 on Rainwater Creek (Photo: I. Williams).

Birds were sampled via two one hour search efforts, one in the early morning and one in the late afternoon.

All fauna observations were recorded on standard data sheets and included location, method of capture or sighting, microhabitat, number of individuals and (for small mammals) weight. Generally one specimen of each reptile and small mammal species from each camp area was preserved as a museum specimen, depending on the advice of museum curators.

Standard collection, euthanasing and preservation methods were employed with approval from the Department for Environment and Heritage's Animal Ethics Committee (Figure 16). Samples of liver tissue were taken from all specimens collected, plus tissue samples from some released animals, and stored in liquid nitrogen for the Evolutionary Biology Unit of the South Australian Museum to use in DNA studies.

Figure 16. Survey herpetologist setting reptiles (Photo: I. Williams).

In addition to this, any fauna encountered outside the specific sites were recorded as opportunistic sightings on separate data sheets with location and habitat details. These records provide a more thorough inventory of the fauna of each camp area, particularly species using smaller or more heterogeneous habitats not sampled by the sites. This was particularly the case for birds, for which many significant observations were made away from sites, and for the Yellow-footed Rock Wallaby (*Petrogale xanthopus*) which was only observed at Moro and Waukla Woodna Gorges.

Table 2. Trapping effort at sites at each camp. Trap effort is summarised as trap nights (number of traps x number of nights) and the number of nights that Anabats were used.

Camp	Cage Trap Nights	Elliott Trap Nights	Pit Trap Nights	Funnel Trap Nights	Harp Trap Nights	Anabat Nights
Irish Well	112	840	288	48	8	7
Orange Tree Dam	128	960	288	48	4	6
Plaque	96	720	144	144	9	8
Total	**336**	**2520**	**720**	**240**	**21**	**21**

Data Analysis

The vegetation site data from the Nantawarrina IPA Biological Survey were analysed in conjunction with that from 88 previously sampled sites in the IPA using PC-ORD exploratory data analysis software (McCune and Mefford 1999) to detect patterns in the data. Unfortunately there were insufficient fauna records at sites for numerical analysis to be undertaken and for clear patterns to be detectable.

In the PC-ORD floristic vegetation analysis the Sorensen (Bray Curtis) Distance measure and Flexible Beta group linkage method were used to cluster sites into groups based on the similarity of cover/abundance scores for perennial species present at 107 sites sampled in the IPA. Cover/abundance data rather than merely species presence was used as this generally provides more information on vegetation community composition.

The complete plant species matrix from sites in the IPA contained 2,811 records, 314 plant taxa and 110 sites. In preparation for the analysis a number of sites and species (particularly annuals) were masked out. For full details of this process refer to the Vegetation Chapter. The final matrix used in the analysis contained 2,303 records, 239 species and 107 sites.

The results displayed a dendrogram of similarity between sites. The dendrogram can be cut at any level of dissimilarity to display a desired number of groupings and should be cut at a level where the vegetation groups represented by the sites in these groupings reflect ecologically meaningful entities (Robertson 1998). The purpose of such a classification is to identify vegetation groups in which many species commonly and repeatedly occur together (and in similar relative abundances) due to particular environmental factors (Robertson 1998).

RESULTS

VEGETATION

N. Neagle[1]

Physical Attributes of Sites

A total of 22 vegetation sites were sampled during the Nantawarrina IPA Biological Survey. Site selections were made to represent the range of biological and geographical diversity occurring across the area and to supplement the set of 88 sites previously sampled (refer to Methods chapter for details of earlier surveys conducted in the area). A summary of sites sampled per survey is provided in Table 3 and their distribution is shown in Figure 17. Of the total 110 sites, the 30 sampled in 1999 and 2009 were standard Biological Survey of South Australia vegetation sites (refer Heard and Channon 1997), i.e. 100m x 100m quadrats. The remaining 80 sampled in 1988-1991 followed a similar method except the quadrat size was 50m x 50m.

Surface soil textures ranged from skeletal to medium clay (Table 4). Soils of mixed sand, loam and clay were the most common (37% of sites where soil type recorded) followed by mixed sand and loam (20%) and skeletal (14%).

Sites with mixed sand/loam/clay and sand/loam soil types were both widespread across hills and plains, while those with skeletal soils were only in the hills (Table 5). Sites on clay, loam/clay, loam or sand/clay were also predominantly in hills.

Table 3. Number of vegetation sites surveyed within the Nantawarrina IPA.

Survey Name	Year	Survey Number	No. of Sites Within Nantawarrina IPA
Flinders	1988 - 91	6	80
Flinders Ranges	1999	104	8
Nantawarrina IPA	2009	636	22
Total Sites			**110**

Broad landform patterns and the more localised landform elements recorded for each site are shown in Table 6. Landform patterns in the IPA may be broadly split between hills and plains, with 86 sites (78%) located in the former and 24 (22%) in the latter. Low hills (33%) and hills (31%) were recorded most commonly followed by plains/peneplains (15%). Hill slopes were by far the most frequently recorded landform element (58% of sites). Despite this the high ranges, particularly the extensive Uro Range, remain inadequately sampled due to the difficulties of access.

Table 4. Frequency of soil types and surface soil texture class summary for sites in the Nantawarrina IPA.

General Soil Type	Sites	Soil Surface Texture	Sites
skeletal	15	skeletal	15
sand	1	sand	1
sand/loam	21	loamy sand	4
		fine sandy loam	1
		loam fine sandy	6
		sandy loam	10
loam	7	loam	4
		silty loam	3
sand/loam/clay	40	fine sandy clay loam	10
		lt. sandy clay loam	4
		sandy clay loam	20
		clay loam, sandy	6
loam/clay	7	clay loam	7
sand/clay	9	clayey sand	7
		sandy clay	2
clay	7	light clay	5
		medium clay	2
not recorded	3	not recorded	3
Total Sites	**110**		**110**

[1] Science Resource Centre, Information, Science and Technology Directorate, Department for Environment and Heritage, GPO Box 1047, Adelaide SA 5001.

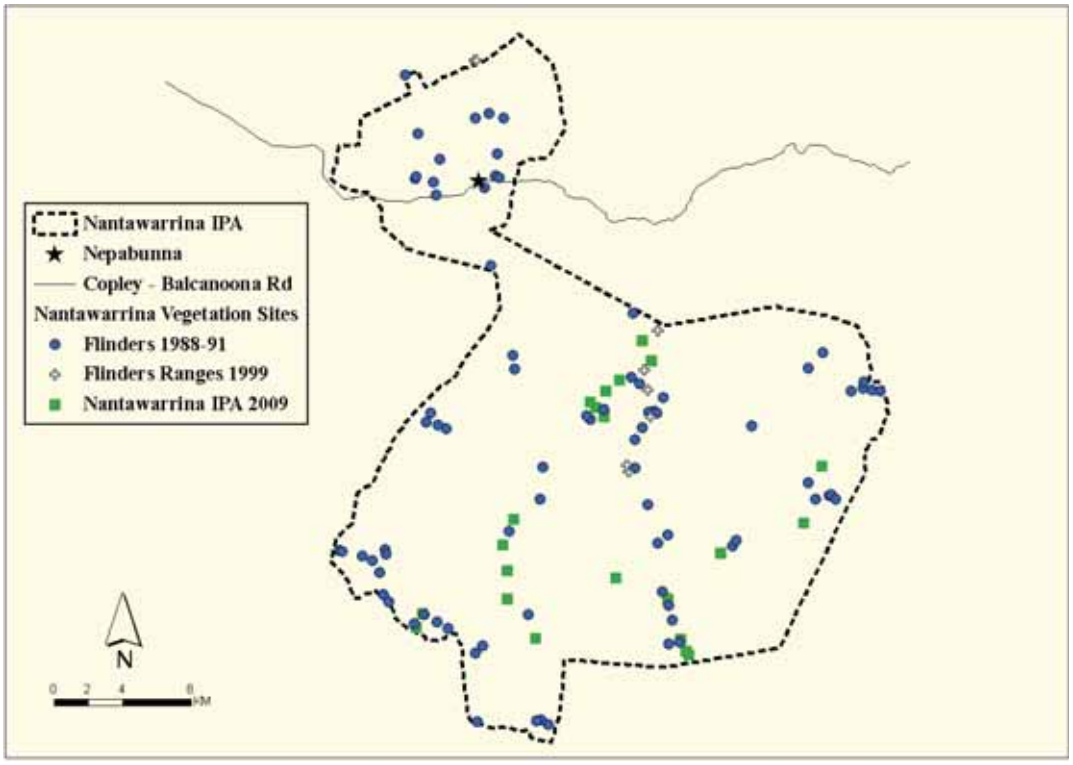


Figure 17. Distribution of all 110 sites where vegetation has been sampled in the Nantawarrina IPA.

Table 5. Frequency of general soil types recorded within landform patterns in the Nantawarrina IPA.

Soil Type	Landform Pattern								Total Sites
	Plain	Peneplain	Alluvial plain	Drainage line	Rises	Low hills	Hills	Mountains	
skeletal						3	12		**15**
sand				1					**1**
sand/loam	2	3	1	1	5	6	3		**21**
loam			1			2	4		**7**
sand/loam/clay	2	8			5	14	10	1	**40**
loam/clay	1				2	1	1	2	**7**
sand/clay				2		3	3	1	**9**
clay	1					6			**7**
not recorded				1		1	1		**3**
Total Sites	**6**	**11**	**2**	**5**	**12**	**36**	**34**	**4**	**110**

Table 6. Vegetation sampling effort within landform patterns and elements in the Nantawarrina IPA.

Landform Element	Landform Pattern								Total Sites
	Plain	Peneplain	Alluvial plain	Drainage line	Rises	Low hills	Hills	Mountains	
closed depression					1				**1**
open depression				4					**4**
stream channel	1					4	2		**7**
flat	2	3	1	1		1			**8**
plain (incl. undulating plain)	2		1						**3**
ridge								1	**1**
hill footslope					1	5	4		**10**
hill slope	1	8			9	19	25	2	**64**
hill crest					1	6	3	1	**11**
stony plain						1			**1**
Total Sites	**6**	**11**	**2**	**5**	**12**	**36**	**34**	**4**	**110**

Figure 18. Steep rocky hill slopes are a characteristic feature of the IPA (Photo: N. Neagle).

Figure 19. Mulga [Malka] (*Acacia aneura*) Very Low Woodland occurs widely on hill slopes in the IPA (Photo: N. Neagle).

Vegetation Structure

The structural vegetation formations at sites ranged from an ephemeral herbland dominated by the exotic annual Ward's Weed (*Carrichtera annua*) to River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodlands (Table 7).

The most commonly recorded (generalised) structural formation was shrubland (26% of sites sampled). These were variously dominated by Dead Finish (*Acacia tetragonophylla*) and Narrow-leaf Emubush (*Eremophila alternifolia*), Elegant Wattle (*Acacia victoriae* ssp. *victoriae*), Silver Senna (*Senna artemisioides* ssp. X *artemisioides*) and/or Broad-leaf Desert Senna (*S. artemisioides* ssp. X *coriacea*) on low hills throughout the IPA. Also prominent are the very low woodlands (25% of sites), particularly Mulga (*Acacia aneura* var.) and Black Oak (*Casuarina pauper*) on the higher ridges and hills, and low shrublands of either Bindyi (*Sclerolaena* spp.) or Bluebush (*Maireana* spp.) (17% of sites) on plains.

Table 7. Vegetation structural formation summary for vegetation survey sites in the Nantawarrina IPA.

Generalised Structural Formation	Sites	Structural Formation	Sites
Herbland	1	Open Herbland	1
(Tussock) Grassland	1	Open (Tussock) Grassland	1
Low Shrubland	19	Low Very Open Shrubland	8
		Low Open Shrubland	10
		Low Shrubland	1
Shrubland	29	Very Open Shrubland	15
		Open Shrubland	14
Tall Shrubland	7	Tall Very Open Shrubland	4
		Tall Shrubland	3
Low Mallee	1	Open Low Mallee	1
Mallee	8	Very Open Mallee	4
		Open Mallee	2
		Mallee	2
Very Low Woodland	28	Very Low Open Woodland	17
		Very Low Woodland	11
Low Woodland	8	Low Open Woodland	2
		Low Woodland	6
Woodland	8	Open Woodland	2
		Woodland	6
Total Sites	**110**		**110**

Taxonomic Summary

The 110 vegetation survey sites in the Nantawarrina IPA represent 2811 plant records. A further 733 records come from opportunistic sightings, including 433 specimens held by the State Herbarium of South Australia. A total of 505 plant taxa have been recorded, of which 463 (91.7%) are native and 42 (8.3%) are introduced.

Table 8. Number of plant taxa per Family recorded on the Nantawarrina IPA Biological Survey.

Family Name	Total No. of Taxa	No. of Native Taxa	No. of Exotic Taxa	No. of Records (SU & OP)
ADIANTACEAE	4	4		11
ASPLENIACEAE	1	1		1
CUPRESSACEAE	1	1		6
CASUARINACEAE	1	1		9
MORACEAE	1		1	1
PROTEACEAE	2	2		9
SANTALACEAE	3	3		20
LORANTHACEAE	4	4		28
GYROSTEMONACEAE	1	1		2
NYCTAGINACEAE	1	1		6
AIZOACEAE	2	2		12
PORTULACACEAE	2	2		9
CARYOPHYLLACEAE	1	1		1
CHENOPODIACEAE	37	36	1	168
AMARANTHACEAE	7	7		38
PAPAVERACEAE	1		1	1
CAPPARACEAE	1	1		8
CRUCIFERAE	4	2	2	19
PITTOSPORACEAE	2	2		5
LEGUMINOSAE	27	27		144
OXALIDACEAE	1	1		4
ZYGOPHYLLACEAE	6	6		18
EUPHORBIACEAE	6	6		22
SAPINDACEAE	6	6		44
RHAMNACEAE	1	1		2
MALVACEAE	14	14		54
STERCULIACEAE	1	1		1
THYMELAEACEAE	2	2		4
FRANKENIACEAE	1	1		1
CUCURBITACEAE	2		2	8
MYRTACEAE	8	8		47
HALORAGACEAE	1	1		1
PRIMULACEAE	1		1	1
OLEACEAE	1	1		2
GENTIANACEAE	1	1		1
ASCLEPIADACEAE	4	4		22
CONVOLVULACEAE	1	1		8
BORAGINACEAE	4	3	1	13
LABIATAE	5	4	1	11
SOLANACEAE	8	6	2	54
ACANTHACEAE	2	2		2
MYOPORACEAE	17	17		75
PLANTAGINACEAE	1	1		1
CAMPANULACEAE	3	3		9
GOODENIACEAE	6	6		15
COMPOSITAE	27	21	6	77
LILIACEAE	4	3	1	10
JUNCACEAE	2	2		2
GRAMINEAE	26	26		71
TYPHACEAE	2	2		2
CYPERACEAE	3	3		5
No. of Taxa	**270**	**251**	**19**	
No. of Records				**1085**

The Nantawarrina IPA Biological Survey alone sampled 22 sites and collected 807 plant records. An additional 278 plant records came from opportunistic sightings. This resulted in a total of 270 unique plant taxa from 51 families (Table 8). Of these, 251 (93%) were native and 19 (7%) introduced. During the survey 714 plant specimens were collected and lodged with the State Herbarium. This adds significantly to existing Herbarium collections from the IPA.

Chenopodiaceae (chenopods - with 37 taxa), Leguminosae (wattles and legumes - 27 taxa), Compositae (daisies - 27 taxa) and Gramineae (grasses - 26 taxa) were the most commonly recorded Families on the Nantawarrina IPA Biological Survey, comprising 41% of the total plant taxa recorded. In terms of the number of individual records, Chenopodiaceae (168 records) and Leguminosae (144) were the most frequently recorded Families, accounting for 29% of all records.

Appendix 2 provides a full list of all plant taxa recorded in the Nantawarrina IPA with some taxonomic notes. Appendix 3 provides the frequency of recordings for each taxon from a variety of sources. Appendix 4 lists all taxa (and an estimate of their cover/abundance) recorded per site for this survey.

Adnyamathanha Plant Names

Adnyamathanha names of plant species recorded in the Nantawarrina IPA have been sourced from Cleland and Johnston (1939), McEntee (1986), Tunbridge (1988) and personal communication with Simon Duke at Nepabunna. The most common and distinctive species are listed in Table 9 with a more extensive list provided in Appendix 5.

The lack of documented plant names means only a subset of the flora can be included in these lists. It is also difficult to know to what level traditional Adnyamathanha people may have distinguished some species, as in several cases one name appears to cover several distinct species.

Table 9. Adnyamathanha names of the most common and distinctive plant species recorded in the Nantawarrina IPA

Adnyamathanha Name	Species Name	Common Name	Notes
Alaru	*Melaleuca glomerata*	Inland Paper-bark	same as *M. uncinata*
Alaru	*Melaleuca uncinata*	Broombush	same as *M. glomerata*
Alda	*Eremophila freelingii*	Rock Emubush	
Alku	*Casuarina pauper*	Black Oak	
Alunga	*Codonocarpus pyramidalis*	Slender Bell-fruit	
Ata	*Xanthorrhoea quadrangulata*	Rock Grass-tree	
Atara	*Exocarpos aphyllus*	Leafless Cherry	
Iga	*Capparis mitchellii*	Native Orange	
Ilka	*Salsola tragus*	Buckbush	
Malka	*Acacia aneura*	Mulga	
Manduwarra	*Eucalyptus gillii*	Curly Mallee	
Matu	*Pittosporum angustifolium*	Native Apricot	
Minga	*Acacia victoriae* ssp. *victoriae*	Elegant Wattle	
Murku	*Senna artemisioides* ssp.	Desert Senna	general name for several *Senna* taxa
Nandi	*Marsdenia australis*	Native Pear	
Narapana	*Swainsona formosa*	Sturt Pea	
Natumi	*Callistemon teretifolius*	Needle Bottlebrush	
Unamburru	*Typha orientalis*	Broad-leaf Bulrush	
Unarru	*Maireana* sp.	Bluebush	general name for *Maireana* spp.
Urtu	*Dissocarpus paradoxus*	Ball Bindyi	
Uti	*Santalum acuminatum*	Quandong	
Vakirri	*Triodia irritans*	Spinifex	
Vara	*Acacia tetragonophylla*	Dead Finish	
Vinba	*Callitris glaucophylla*	White Cypress-pine	
Vulami wata	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush	
Wilvilvi	*Gossypium sturtianum* var. *sturtianum*	Sturt's Desert Rose	
Wira	*Eucalyptus camaldulensis* ssp. *minima*	River Red Gum	
Yalkirri-ita	*Sclerolaena longicuspis*	Long-spine Bindyi	
Yandana	*Hakea ednieana*	Flinders Ranges Corkwood	
Yulpu	*Cassinia laevis*	Curry Bush	
Yumburra	*Myoporum platycarpum* ssp.	False Sandalwood	
Yumura	*Solanum ellipticum*	Velvet Potato-bush	
Yundu	*Eucalyptus intertexta*	Gum-barked Coolibah	

Common Species

There were 28 taxa recorded at more than one third of the 22 sites sampled on this survey and 13 at more than 50% (Table 10). The frequency of occurrence of chenopods and legumes (in particular Acacias and Sennas) is again evident, though daisies (Family Compositae) are not, indicating the latter, while common as a Family, are much less so at an individual species level. No daisy was recorded at more than seven sites.

The most commonly recorded species were Silver Mulla Mulla (*Ptilotus obovatus* var. *obovatus*) at 21 sites (95%), Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*) at 19 sites (86%), Dead Finish (*Acacia tetragonophylla*) and Velvet Potato-bush (*Solanum ellipticum*) at 18 sites each (82%), and Oblique-spined Bindyi (*Sclerolaena obliquicuspis*) at 17 sites (77%). Ward's Weed (**Carrichtera annua*) was the most commonly recorded introduced species (9 sites - 41%). No other exotic species were recorded at more than six sites.

Several species with high site frequencies were only ever recorded with low cover/abundance scores,

Figure 20. Silver Mulla Mulla (*Ptilotus obovatus* var. *obovatus*) was the most commonly recorded species at sites during the Nantawarrina IPA Survey (Photo: A. Robinson).

particularly Velvet Potato-bush (*Solanum ellipticum*) at 18 sites and Harlequin Mistletoe (*Lysiana exocarpi* ssp. *exocarpi*) at 15 sites (both never more than sparsely present), and Native Pear (*Marsdenia australis*) at 14 sites (but less than 10 plants observed at all but one of these).

Table 10. The most commonly recorded plant taxa at the 22 vegetation survey sites sampled for the Nantawarrina IPA Biological Survey, and their cover/abundance scores at those sites.

Family Name	Species Name	Common Name	No. Sites	% of Sites	Cover/abundance at Sites				
					N	T	1	2	3
AMARANTHACEAE	*Ptilotus obovatus* var. *obovatus*	Silver Mulla Mulla	21	95	3	16	2		
CHENOPODIACEAE	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush	19	86	5	9	5		
LEGUMINOSAE	*Acacia tetragonophylla*	Dead Finish	18	82	7	6	4	1	
SOLANACEAE	*Solanum ellipticum*	Velvet Potato-bush	18	82	7	11			
CHENOPODIACEAE	*Sclerolaena obliquicuspis*	Oblique-spined Bindyi	17	77	3	12	2		
CHENOPODIACEAE	*Salsola tragus*	Buckbush	16	73	1	9	4	2	
LEGUMINOSAE	*Senna artemisioides* ssp. X *artemisioides*	Silver Senna	16	73	9	4	2	1	
SAPINDACEAE	*Alectryon oleifolius* ssp. *canescens*	Bullock Bush	15	68	7	7	1		
MYOPORACEAE	*Eremophila freelingii*	Rock Emubush	15	68	7	4	3	1	
LORANTHACEAE	*Lysiana exocarpi* ssp. *exocarpi*	Harlequin Mistletoe	15	68	12	3			
LEGUMINOSAE	*Acacia victoriae* ssp. *victoriae*	Elegant Wattle	14	64	4	5	3	2	
ASCLEPIADACEAE	*Marsdenia australis*	Native Pear	14	64	13	1			
LEGUMINOSAE	*Senna artemisioides* ssp. X *coriacea*	Broad-leaf Desert Senna	13	59	7	4		2	
CHENOPODIACEAE	*Dissocarpus paradoxus*	Ball Bindyi	11	50		8	2	1	
SANTALACEAE	*Exocarpos aphyllus*	Leafless Cherry	11	50	9	1	1		
LEGUMINOSAE	*Acacia aneura* var. *aneura*	Mulga	9	41	4	1	2	2	
CRUCIFERAE	**Carrichtera annua*	Ward's Weed	9	41		7	2		
CASUARINACEAE	*Casuarina pauper*	Black Oak	9	41	4	1		3	1
SAPINDACEAE	*Dodonaea lobulata*	Lobed-leaf Hop-bush	9	41	4	5			
SOLANACEAE	*Solanum sturtianum*	Sturt's Nightshade	9	41	2	7			
MALVACEAE	*Abutilon leucopetalum*	Desert Lantern-bush	8	36	1	6	1		
EUPHORBIACEAE	*Chamaesyce australis*		8	36	4	4			
MYOPORACEAE	*Eremophila glabra* ssp. *glabra*	Tar Bush	8	36	6	2			
BORAGINACEAE	*Heliotropium europaeum*	Common Heliotrope	8	36		8			
MALVACEAE	*Malvastrum americanum* var. *americanum*	Malvastrum	8	36		7	1		
CHENOPODIACEAE	*Sclerolaena diacantha*	Grey Bindyi	8	36	1	6	1		
LEGUMINOSAE	*Senna artemisioides* ssp. *filifolia*	Fine-leaf Desert Senna	8	36	3	3	2		
MALVACEAE	*Sida petrophila*	Rock Sida	8	36	2	6			

Note: N = Not many (1-10 plants & <5% cover); T = sparsely present (cover <5%); 1 = plentiful, but of small cover (<5%); 2 = any number of individuals covering 5-25% of area; 3 = any number of individuals covering 25-50% of area.

Figure 21. Ruby Saltbush [Vulami wata] (*Enchylaena tomentosa* var. *tomentosa*) was recorded at 19 of the 22 sites sampled during the Nantawarrina IPA Survey (Photo: A. Robinson).

By contrast, several species that were recorded less frequently had comparatively high cover/abundance scores when present, and tend to be the species that characterise the vegetation of the IPA. The main examples of these are River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*), both varieties of Mulga (*Acacia aneura* var. *aneura* and *A. aneura* var. *tenuis*), Black Oak (*Casuarina pauper*) and, to a lesser degree, Inland Paper-bark (*Melaleuca glomerata*).

These results are consistent with those for all 110 vegetation sites sampled in the IPA (Table 11). One notable difference is the absence of introduced taxa in the list. The most commonly recorded introduced species at sites were Malta Thistle (**Centaurea melitensis*) at 33 sites (30%). Ward's Weed and Rosy Dock (**Acetosa vesicaria*) (at 23 sites – 21%) were the only others to be recorded at more than 20% of sites. Malta Thistle was recorded at only two sites in 2009 and Rosy Dock not at all.

Figure 22. Being restricted to major watercourses River Red Gums [Wira] (*Eucalyptus camaldulensis* ssp. *minima*) were recorded infrequently at sites, but were relatively abundant when present (Photo: N. Neagle).

Several other taxa were also seen less frequently during the 2009 survey, particularly the small shrubs Pin Sida (*Sida fibulifera*) and Fuzzy New Holland Daisy (*Vittadinia cuneata* var. *cuneata* f. *cuneata*), and the grasses Jointed Bottle-washers (*Enneapogon cylindricus*), Rough Spear-grass (*Austrostipa scabra* ssp.), Cotton Panic-grass (*Digitaria brownii*) and Brush Three-awn (*Aristida nitidula*). This may be the result of several factors – the prolonged drought prior to the 2009 survey, its timing in autumn rather than spring, and the impact of grazing by introduced herbivores (goats, rabbits and donkeys) in the intervening years.

Table 11. The most commonly recorded plant taxa at all 110 vegetation survey sites sampled in the Nantawarrina IPA.

Family Name	Species Name	Common Name	BS6 (n=80)	BS104 (n=8)	BS636 (n=22)	Total Sites	% of Sites
AMARANTHACEAE	*Ptilotus obovatus* var. *obovatus*	Silver Mulla Mulla	45	5	21	71	65
LEGUMINOSAE	*Acacia tetragonophylla*	Dead Finish	44	4	18	66	60
CHENOPODIACEAE	*Sclerolaena obliquicuspis*	Oblique-spined Bindyi	46		17	63	57
SOLANACEAE	*Solanum ellipticum/quadriloculatum*		42	3	18	63	57
LEGUMINOSAE	*Acacia victoriae* ssp. *victoriae*	Elegant Wattle	43	5	14	62	56
CHENOPODIACEAE	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush	33	3	19	55	50
LEGUMINOSAE	*Senna artemisioides* ssp. X *coriacea*	Broad-leaf Desert Senna	36	3	13	52	47
CHENOPODIACEAE	*Salsola tragus*	Buckbush	28	6	16	50	45
LEGUMINOSAE	*Senna artemisioides* ssp. X *artemisioides*	Silver Senna	27	3	16	46	42
LEGUMINOSAE	*Acacia aneura* var.	Mulga	32		12	44	40
MYOPORACEAE	*Eremophila freelingii*	Rock Emubush	27	2	15	44	40
MALVACEAE	*Sida petrophila*	Rock Sida	32	4	8	44	40
SAPINDACEAE	*Alectryon oleifolius* ssp. *canescens*	Bullock Bush	24	4	15	43	39
CASUARINACEAE	*Casuarina pauper*	Black Oak	31	2	9	42	38
SANTALACEAE	*Exocarpos aphyllus*	Leafless Cherry	26	2	11	39	35
GRAMINEAE	*Cymbopogon ambiguus*	Lemon-grass	28	4	6	38	35

BS6 = 1988-91 Flinders Survey (80 sites in IPA); BS104 = 1999 Flinders Ranges Biological Survey (8 sites in IPA); BS636 = Nantawarrina IPA Biological Survey (22 sites in IPA).

Plant Species of Conservation Significance

Two plant species known to definitely occur within the Nantawarrina IPA have a national conservation rating under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) as at November 2009 (Table 12). These are Slender Bell-fruit (*Codonocarpus pyramidalis*) and Small-leaved Xerothamnella (*Xerothamnella parvifolia*). Both are considered nationally vulnerable.

A further 11 taxa are either vulnerable or rare at state level and 27 others are considered to be of conservation significance in the Flinders Ranges Herbarium Region. Fifteen of these were recorded during the Nantawarrina IPA Biological Survey, including six not previously known to occur in the IPA. All are discussed in detail below.

Of these 40 species of conservation significance, there are six whose presence cannot be confirmed because the exact location of the collection cannot be determined accurately enough to positively locate it within the IPA.

For definitions of conservation ratings refer to the notes at the bottom of Table 12.

***Codonocarpus pyramidalis* (Slender Bell-fruit - Alunga) V - Aus; E - SA; E - FR**

A low tree, rarely more than 8m tall and often with more than one relatively short-lived trunk of light, pithy wood (Toelken 1986a, Davies 1995, Davies 2000), this species is known to grow on steep rocky or slaty hills, or stony ridges. Less frequently it has been recorded on lower slopes and plains, and even less frequently in drainage depressions (Badman 2006).

Figure 23. Slender Bell-fruit [Alunga] (*Codonocarpus pyramidalis*) was recorded twice during the Nantawarrina IPA Survey growing in a minor watercourse near Irish Well (Photo: A. Robinson).

Its distribution in South Australia is centred on the northern and central Flinders Ranges and the Olary District, with scattered occurrences as far south as Tourilie Gorge near Hallett (R. Brandle, pers comm).

Within the Nantawarrina IPA it is known from six opportunistic sightings – once beside the road 4.5km west of Nepabunna, twice in the vicinity of Nepabunna itself and three times in the low hills near Irish Well. The latter include the two most recent sightings (during the 2009 Nantawarrina IPA Biological Survey) – in minor watercourses in low hills in Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) +/- Dead Finish (*A. tetragonophylla*) Very Open Shrubland.

***Xerothamnella parvifolia* (Small-leaved Xerothamnella) V - Aus; E - SA; E - FR**

A straggling shrub to about 1m high with divaricate branches and small leaves (Cunningham *et al.* 1992, Everett 1992), this species is known from limited records in south west Queensland, north western New South Wales and one location near Moro Gorge in South Australia (Davies 1995).

The area that the Moro Gorge population occupies straddles the boundary of the Wertaloona Pastoral Lease and the Nantawarrina IPA. Recent searching has identified two more sub-populations within the IPA (K. Brewer, pers comm, Feb 2009). In this area it occurs on sandy clay loam on rocky slopes and minor drainage lines in Black Oak (*Casuarina pauper*) Low Open Woodland and/or Curly Mallee (*Eucalyptus gillii*) Open Mallee (SA Plant Biodiversity Information System database) on characteristic blue shale (K. Brewer, pers comm, Feb 2009).

Figure 24. New sub-populations of Small-leaved Xerothamnella (*Xerothamnella parvifolia*) have recently been located near Moro Gorge within the Nantawarrina IPA (Photo: K. Brewer).

***Santalum spicatum* (Sandalwood - Vudlura) V - SA; V - FR**

A shrub or tree to 8m high that occurs throughout much of semi-arid South Australia in the North-Western, Nullarbor, Gairdner-Torrens, Eyre Peninsula, Flinders Ranges and Eastern Herbarium Regions. It has been extensively harvested for its timber and is considered threatened in all of these regions (Jessop 1986a). Its presence within the Nantawarrina IPA is uncertain and based on a single specimen held in the State Herbarium of SA. This was collected in 1963 "30 miles NE of Blinman". This location is most likely on the road from Blinman to Balcanoona and therefore outside the IPA.

Table 12. Plant species of National, State and Regional conservation significance recorded within the Nantawarrina IPA.

Species Name	Common Name	Cons Rating			Source of Nantawarrina IPA Collections			
		Aus	SA	FR	BS6	BS104	SA Herb	BS636
Codonocarpus pyramidalis	Slender Bell-fruit	V	E	E		+	+	+
Xerothamnella parvifolia	Small-leaved Xerothamnella	V	E	E			+	
Santalum spicatum	Sandalwood		V	V			+[1]	
Austrostipa pilata	Prickly Spear-grass		V	K		+		
Ozothamnus scaber	Rough Bush-everlasting		V	K		+		
Lythrum salicaria	Purple Loosestrife		R	X[2]			+	
Cladium procerum	Leafy Twig-rush		R	K		+		+
Frankenia subteres	no common name		R	K	+			
Swainsona leeana	Lee's Swainson-pea		R	K			+	
Daviesia stricta	Flinders Ranges Bitter-pea		R	R		+		
Philotheca angustifolia ssp. *angustifolia*	Narrow-leaf Wax-flower		R	R		+		
Eucalyptus polybractea	Flinders Ranges Box		R	U		+		
Velleia cycnopotamica	no common name		R	#[3]			+[1]	
Chenopodium curvispicatum	Cottony Goosefoot			K				+
Lythrum paradoxum	no common name			K			+	
Swainsona oliveri	no common name			K			+	
Austrostipa platychaeta	Flat-awn Spear-grass			R				+
Baumea arthrophylla	Swamp Twig-rush			R			+	
Cynoglossum australe	Australian Hound's-tongue			R			+	
Goodia medicaginea	Western Golden-tip			R			+[1]	
Radyera farragei	Desert Rose Mallow			R		+		
Sclerolaena convexula	Tall Bindyi			R	+			+
Sporobolus caroli	Yakka Grass			R	+		+[1]	
Swainsona tephrotricha	Ashy-haired Swainson-pea			R			+	
Velleia connata	Cup Velleia			R				+
Wahlenbergia aridicola	Dryland Bluebell			R				+
Acacia pravifolia	Coil-pod Wattle			U			+	
Alyogyne hakeifolia	Hakea-leaf Hibiscus			U			+[1]	
Amyema linophylla ssp. *orientale*	Casuarina Mistletoe			U	+			
Anacampseros australiana	Australian Anacampseros			U				+
Brachyscome dentata	Lobe-seed Daisy			U			+	+
Daviesia genistifolia	Broom Bitter-pea			U		+		+
Goodenia albiflora	White Goodenia			U				+
Jasminum didymum ssp. *lineare*	Native Jasmine			U		+		+
Phyllanthus saxosus	Rock Spurge			U		+		
Rhyncharrhena linearis	Bush Bean			U		+		+
Sarcostemma viminale ssp. *australe*	Caustic Bush			U	+			+
Schoenoplectus litoralis	Shore Club-rush			U	+			
Templetonia aculeata	Spiny Mallee-pea			U		+		+
Swainsona burkittii	Woolly Darling Pea			Q			+[1]	
	Total Taxa	**2**	**13**	**40**	**6**	**13**	**17**	**15**

Aus — Australian status under the Environment Protection and Biodiversity Conservation Act 1999 as at November 2009.
SA — South Australian status under the National Parks and Wildlife Act 1972 (2007 update of schedules 7, 8 and 9).
FR — Regional status for the Flinders Ranges Herbarium Region as per the SA FLORA database (November 2009), which provides an update of the original assessments of Lang and Kraehenbuehl (1987).
Status Codes: X = extinct; E = endangered; V = vulnerable; R = rare; K = uncertain (either rare or threatened but insufficient data to enable accurate assessment); U = uncommon; Q = not yet assessed but considered to be of possible significance.
Notes: 1 = record possibly from outside IPA.
2 = extinct rating for region based on a single 19th Century collection in Melbourne Herbarium.
3 = no rating yet applied as only recently recognised as occurring in the region.

***Austrostipa pilata* (Prickly Spear-grass) V - SA; K - FR**

Prickly Spear-grass is a tussock grass that occurs mainly in the Flinders Ranges, with outliers in the Murray Mallee and on Yorke and Eyre Peninsulas (Jessop *et al*. 2006, State Herbarium of SA 2010). It has been recorded as growing on "rocky steep slopes on dolomites, limestone and other slightly calcareous or gypseous bases" (Bates, cited in Jessop *et al*. 2006).

At Nantawarrina it was collected at site GAP00601 during the Flinders Ranges Biological Survey in 1999 in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee. This site is on clay loam soil on a high ridge top on the northern boundary of the IPA north east of Mount Rowe.

***Ozothamnus scaber* (Rough Bush-everlasting) V - SA; K - FR**

Rough Bush-everlasting is an erect shrub daisy to 1.5m tall that grows on rocky hillsides (Haegi 1986b) and which is endemic to the Flinders Ranges and Olary Spur. It has been recorded twice in the IPA, at two closely located sites on a high ridge near Mount Rowe on the northern boundary. Here it was found growing in Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*) Mallee as a dominant understorey species

with Winged Daisy-bush (*Olearia decurrens*), Wavy Goodenia (*Goodenia vernicosa*) and Narrow-leaf Hop-bush (*Dodonaea viscosa* ssp. *angustissima*), and also in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee.

***Lythrum salicaria* (Purple Loosestrife) R - SA; X - FR**
An erect, frequently pubescent perennial to 1.5m high, this species grows in drains or damp areas as well as some dryland habitats, such as small islands in streams (Sainty and Jacobs 1981). In South Australia it occurs along the River Murray, Fleurieu Peninsula and Lower South East. It is considered to be extinct in the Flinders Ranges based on a sole collection made in the 19th Century at Mt Serle by P.E. Warburton. This specimen is held in the National Herbarium of Victoria.

There has, however, been a subsequent collection made in the region, at "Wide Gorge, 10km south of Big Moro Gorge" in 1990. It was found growing "on edge of rockpools..…in tall bullrushes" (State Herbarium of SA 2010). This description suggests it is possibly within the IPA, but the exact location is difficult to determine. As a result the presence of this species in the IPA cannot be confirmed, but it does warrant further investigation.

***Cladium procerum* (Leafy Twig-rush) R - SA; K - FR**
A perennial sedge to 2.5m tall, this species occurs in swampy areas and the margins of streams and lakes (Wilson 1994). There has been one collection of Leafy Twig-rush made in the IPA - at Moro Gorge in 1999 during the Flinders Ranges Biological Survey. A single plant was found growing by a flowing spring in the gorge. This is the most northerly record in South Australia, with the nearest collection from Mount Remarkable National Park (State Herbarium of SA 2010). In SA it is more commonly observed in the South East, Mount Lofty Ranges and the Fleurieu Peninsula (State Herbarium of SA 2010).

***Frankenia subteres* (no common name) R - SA; K - FR**
In South Australia this small shrub is known to occur in the Lake Eyre, Flinders Ranges and Gairdner-Torrens Herbarium Regions. However, most collections in the State Herbarium of SA are from the northern Flinders Ranges. There is one record of it in the IPA, from the 1988 Flinders Survey site ANG1700 on a hill slope approximately 2.5km north west of Nepabunna. It was recorded as plentiful, but of low cover, in White Mallee (*Eucalyptus dumosa*) Very Open Mallee.

***Swainsona leeana* (Lee's Swainson-pea) R - SA; K - FR**
Lee's Swainson-pea is a small, slender, prostrate herb (Weber 1986) that is known (in South Australia) from only a few locations in the northern Flinders Ranges. It was collected from within the IPA at Moro Gorge in 1973 (State Herbarium of SA 2010).

***Daviesia stricta* (Flinders Ranges Bitter-pea) R - SA; R - FR**
An open shrub to 1.5m tall (Weber 1986), this species is endemic to South Australia where it mainly occurs in the central and northern Flinders Ranges, though it has also been recorded in Mount Remarkable National Park and at Burra Gorge (State Herbarium of SA 2010).

It was recorded as sparsely present at site GAP00601 in 1999 on the Flinders Ranges Biological Survey in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee. This site is on clay loam soil on a high ridge top on the northern boundary of the IPA north east of Mount Rowe.

***Philotheca angustifolia* ssp. *angustifolia* (Narrow-leaf Wax-flower) R - SA; R - FR**
A small shrub to 60cm high, this species occurs in the higher rainfall parts of the State, from the Upper South East to the northern Flinders Ranges (State Herbarium of SA 2010). The one record in the IPA is from Flinders Ranges Biological Survey site GAP00601 on clay loam soil on a high ridge top on the northern boundary of the IPA north east of Mount Rowe. Here it was growing in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee. There is also a 1941 specimen in the State Herbarium of SA with a collection locality given as simply Mount Rowe (State Herbarium of SA 2010), which may be from within the IPA.

Figure 25. The only record of Narrow-leaf Wax-flower (*Philotheca angustifolia* ssp. *angustifolia*) within the IPA is from high on the range north east of Mount Rowe (Photo: P. Lang).

***Eucalyptus polybractea* (Flinders Ranges Box) R - SA; U - FR**
Previously known as '*Eucalyptus* sp. Flinders Ranges (D.Nicolle 562)', this mallee to 6m, often with thin stems, was previously considered to be restricted to the northern Flinders Ranges from about Mount Arden in the south to the Gammon Ranges in the north (Nicolle 1997). Although having recently been included within *E. polybractea* taxonomic uncertainty still remains with this taxon. Brooker and Kleinig (2001) suggest it may be a locally evolved (or evolving), quite variable endemic to the northern Flinders Ranges, or a western form of *E. polybractea*, or even a hybrid.

The description of its preferred habitat in the Flinders Ranges differs markedly to that of *E. polybractea* in Victoria and New South Wales – 'the slopes and high ridges of the ranges in gravelly loams or very rocky soils' (Nicolle 1997) for the Flinders Ranges Box, compared with 'better soils on flats, and near drainage areas in poor rocky country' (Brooker and Slee 1996) for *E. polybractea*.

It has been collected three times within the IPA, all in 1999 during the Flinders Ranges Biological Survey and all from a high rocky ridge north east of Mount Rowe on the boundary of the IPA north of Nepabunna.

***Velleia cycnopotamica* (no common name) R - SA; no rating yet in FR**
Velleia cycnopotamica is a low growing annual that, in South Australia, is largely restricted to rocky sites on the lower slopes of hills on northern Eyre Peninsula (Cooke 1986a, State Herbarium of SA 2010, T. Croft pers comm). The State Herbarium of SA has a single specimen from the Flinders Ranges Herbarium Region – collected from "Mount McKinlay Creek, 6km E of Nepabunna Mission" in November 1979. This is most likely outside the IPA and hence the presence of this species within the IPA cannot be confirmed, particularly as the next nearest record is several hundred kilometres away in the Gawler Ranges.

***Chenopodium curvispicatum* (Cottony Goosefoot) K - FR**
Cottony Goosefoot is a weak intricately branched shrub to 1m tall found throughout semi-arid South Australia (Wilson 1986). There are, however, few collections in the State Herbarium of SA from the northern Flinders Ranges (State Herbarium of SA 2010).

The first records for this species for the Nantawarrina IPA were collected during the current survey in 2009 – as isolated plants at site IRI00101 in Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) Tall Very Open Shrubland in medium clay on a stony plain, and as sparsely present at IRI00401 in Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland in loamy sand on a creekline. Both sites were between Bald Hill and Irish Well.

***Lythrum paradoxum* (no common name) K - FR**
An erect herb to 60cm, this species grows in sandy or alluvial soils along creeks or drainage lines in arid areas (Hewson 1990, Lepschi 2000). In South Australia it is only known to occur in the Flinders and Musgrave Ranges. Within the IPA it has twice been collected from damp areas in Moro Gorge - in 1976 and 1990, the latter following good rains (State Herbarium of SA 2010).

***Swainsona oliveri* (no common name) K - FR**
Swainsona oliveri is a small prostrate annual that has a broad distribution in semi-arid and arid South Australia (Weber 1986). It grows on loamy or sandy soil and often on calcareous plains (Thompson and James 1991).

The State Herbarium has only two collections from the Flinders Ranges, one from the Vulkathunha-Gammon Ranges National Park and the other from Moro Gorge in the Nantawarrina IPA. The latter was collected in 1973.

***Austrostipa platychaeta* (Flat-awn Spear-grass) R - FR**
A tussock grass that is widespread in South Australia, this species is often recorded in red sands, but also on limestone, loam and clay in drier agricultural areas, as well as in open bluebush country and mallee communities (Jessop *et al*. 2006). There are few records of this species from the northern Flinders Ranges (State Herbarium of SA 2010) and it was first recorded in the Nantawarrina IPA during this survey, at site PLA00101 in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland on the Alerumba Creek.

***Baumea arthrophylla* (Swamp Twig-rush) R - FR**
Swamp Twig-rush is a perennial sedge with stems to 2m high that grows in freshwater swamps (Jessop and Weber 1986, Wilson 1994). While this species is widespread in the higher rainfall areas of the State there have been few collections north of Mambray Creek (in the southern Flinders Ranges). In fact, the one collection in the Nantawarrina IPA (from Moro Gorge in 1990) is the only record in the northern Flinders Ranges in over 40 years (State Herbarium of SA 2010).

***Cynoglossum australe* (Australian Hound's-tongue) R - FR**
A hairy annual with one or more stems rising to 60cm from a basal rosette (Toelken 1986b), Australian Hound's-tongue occurs more commonly in the higher rainfall areas of the State, but is patchily distributed across the arid zone, where it is found mainly in the Flinders Ranges and far north west (State Herbarium of SA 2010). The one record for the IPA is a collection made at Moro Gorge in 1973.

Figure 26. Australian Hound's Tongue (*Cynoglossum australe*) has been recorded once in the IPA – at Moro Gorge in 1973 (Photo: A. Robinson).

***Goodia medicaginea* (Western Golden-tip) R - FR**
An open shrub to 3m high, this species is widespread in the higher rainfall areas of South Australia (Weber

1986, State Herbarium of SA 2010). There are two State Herbarium of SA collections that are possibly from the IPA, though both have very non-specific location descriptions. The first was collected in 1954 at Nepabunna and the second from "10km south of Italowie Gorge" in 1994. As such the presence of this species in the IPA cannot be confirmed.

Figure 27. There are two records of Western Golden-tip (*Goodia medicaginea*) from the Nepabunna area, but its presence in the IPA is unconfirmed (Photo: A. Robinson).

***Radyera farragei* (Desert Rose Mallow) R - FR**
A velvety shrub to 1m high with stout annual stems rising from a woody base (Jessop 1986b, Cunningham *et al.* 1992), Desert Rose Mallow occurs in sandy, calcareous soils in open mallee communities and along roadsides, creek levees and floodout areas (Mitchell and Norris 1990, Cunningham *et al.* 1992). It is widely distributed in South Australia, though mainly found in semi-arid areas (State Herbarium of SA 2010).

There is a single record from the IPA – a specimen collected opportunistically on the Flinders Ranges Biological Survey in 1999 at Nantawarrina Spring.

Figure 28. Desert Rose Mallow (*Radyera farragei*) was recorded at Nantawarrina Spring in 1999 (Photo: P. Canty).

***Sclerolaena convexula* (Tall Bindyi) R - FR**
A small, dense shrub to 40cm high (Wilson 1986, Cunningham *et al.* 1992), Tall Bindyi is widely distributed in arid areas of the State (State Herbarium of SA 2010). It has been recorded at six sites in the IPA, four in 1988 during the Flinders Survey and two in 2009 as part of the Nantawarrina IPA Biological Survey. All were recorded in sandy clay loam or clay loam soils on rocky hillsides, and mainly in Mulga (*Acacia aneura*) Very Low Woodland.

Figure 29. Tall Bindyi (*Sclerolaena convexula*) was recorded twice in Mulga (*Acacia aneura*) Very Low Woodland on rocky hill slopes during the Nantawarrina IPA Survey (Photo: A. Robinson).

***Sporobolus caroli* (Yakka Grass) R - FR**
A tufted annual or short-lived perennial grass that occurs in a wide range of soil types but especially on gibber plains. Unlike many species of *Sporobolus* it has less association with seasonally wet places (Jessop *et al*. 2006). It has been recorded in the North-Western, Lake Eyre, Gairdner-Torrens, Flinders Ranges and Eastern Herbarium Regions.

Within the Nantawarrina IPA it was recorded at site NEP0952 during the Flinders Survey in 1988 in Long-spined Bindyi (*Sclerolaena longicuspis*) Low Open Shrubland in fine sandy clay loam on an undulating plain beside the Alerumba Creek south west of the Plaque. This record is, however, unsupported by a collected specimen. There is also one State Herbarium of SA record from "East of Big Moro" collected in 1990 (State Herbarium of SA 2010), which is most likely from outside the IPA. The nearest confirmed record is from a site not far over the IPA boundary into Mulga View from Deep Bore, sampled in 1999 as part of the Flinders Ranges Biological Survey.

***Swainsona tephrotricha* (Ashy-haired Swainson-pea) R - FR**
An ascending or sub-erect perennial with stems to 30cm (Weber 1986), this species is endemic to South Australia where it occurs along the length of the Flinders and Northern Mount Lofty Ranges (State Herbarium of SA 2010). Information on its preferred habitat is scarce, though one population in the Northern Mount Lofty Ranges has been described as growing "on the gentle north to west facing slope of a hill amongst scattered limestone and shale rocks" (Davies 1986).

The one record of this species from the Nantawarrina IPA was collected at a creek 1km west of Nepabunna in 1990 (State Herbarium of SA 2010).

***Velleia connata* (Cup Velleia) R - FR**
A smooth erect herb to 90cm tall with distinctive leaf-like bracts fused into a cup shape below each branching point of the stems (Cooke 1986a, Cunningham *et al.* 1992). This species has been recorded from a number of areas across semi-arid and arid South Australia, though rarely in the northern Flinders Ranges (State Herbarium of SA 2010).

It was recorded for the first time in the IPA during the Nantawarrina IPA Biological Survey in 2009 in Broombush (*Melaleuca uncinata*) Open Shrubland over Spinifex (*Triodia irritans*) on a high rocky ridge approximately 6km south west of the Plaque.

Figure 30. Cup Velleia (*Velleia connata*) was collected for the first time in the IPA during the 2009 survey (Photo: A. Robinson).

***Wahlenbergia aridicola* (Dryland Bluebell – Wari-wirra) R - FR**
A perennial tufted herb with a fleshy rootstock, Dryland Bluebell has mainly been recorded from dry inland sand dune swales (Smith 1986). It is known to occur across much of the arid zone of SA, as well as western New South Wales (State Herbarium of SA 2010).

It was recorded in the IPA for the first time in 2009 during the Nantawarrina IPA Biological Survey at six sites (IRI00101, IRI00301, IRI00401, IRI00601, PLA00101 and PLA00601) plus one opportunistic sighting (at Orange Tree Dam). These were mostly associated with either major or minor stream channels in loam or clay soils.

***Acacia pravifolia* (Coil-pod Wattle) U - FR**
A small, erect, prickly shrub to 2m high, this species occurs in woodlands and shrublands on rocky hillsides, valleys and creek banks throughout the Flinders Ranges (Whibley and Symon 1992). Within the Nantawarrina IPA it has been recorded once at Moro Gorge in 1976, and this collection is held in the State Herbarium of SA.

***Alyogyne hakeifolia* (Hakea-leaf Hibiscus) U - FR**
An open, erect shrub to 3m with long willowy stems and narrow leaves (like a Hakea) (Jessop 1986b), this species mainly occurs (in South Australia) in the Flinders Ranges and Eyre Peninsula Herbarium Regions where it appears to be associated with rocky areas (State Herbarium of SA 2010).

The presence of Hakea-leaf Hibiscus in the Nantawarrina IPA is uncertain, as it is based on two specimens in the State Herbarium that were both collected in November 1954 that have no verifiable associated information. The collector's name was not recorded and the location was given only as Nepabunna. This may have simply been the nearest named locality to where it was collected and not the actual location. It has, however, been collected nearby at Italowie and Weetootla Gorges in the Vulkathunha-Gammon Ranges National Park, so there is a possibility it may occur within the IPA.

***Amyema linophylla* ssp. *orientale* (Casuarina Mistletoe) U - FR**
This mistletoe is usually densely covered in white down (particularly the flowers) and exclusively parasitises species of the Casuarinaceae family, especially Black Oak (*Casuarina pauper*) and Bull Oak (*Allocasuarina luehmannii*) (Barlow 1986, Cunningham *et al.* 1992).

It has been recorded twice in the IPA, as isolated plants on Black Oaks at two sites sampled in 1988 and 1991 as part of the Flinders Survey – site ANG1697 on the footslopes of Mt Rowe and WER1167 on the footslopes of the Stirrup Iron Range.

***Anacampseros australiana* (Australian Anacampseros) U - FR**
A procumbent perennial succulent with tuberous roots, this species grows in arid areas, usually in skeletal soils on rocky hillsides and plains (West 1986). While its above ground growth is somewhat ephemeral, it can respond rapidly to favourable conditions by resprouting from the rootstock (Cunningham *et al.* 1992).

It has been recorded six times in the IPA, all at sites in the 2009 Nantawarrina Biological Survey. Most of these sites were on loam or clay soils on rocky hill slopes in either Mulga (*Acacia aneura*) or Black Oak (*Casuarina pauper*) Low Open Woodland. However, one was on light clay on a stony plain in Long-spined Bindyi (*Sclerolaena longicuspis*), Tangled Bindyi (*S. cuneata*), Curly Mitchell-grass (*Astrebla lappacea*) Low Open Shrubland.

***Brachyscome dentata* (Lobe-seed Daisy) U - FR**
An erect perennial daisy to 45cm high, Lobe-seed Daisy has been recorded in a variety of habitats. For example, in Victoria it occurs in grasslands on basalt, mallee woodlands on sandy loam and South Australian Blue Gum (*Eucalyptus leucoxylon*) Woodlands on heavy clay (Short 1999). In South Australia it is known to occur in the Lake Eyre, Flinders Ranges, Eastern and Murray Herbarium Regions.

The first confirmed record of this species in the IPA was collected on the Nantawarrina IPA Biological Survey at site ORA00501 in Long-spined Bindyi

(*Sclerolaena longicuspis*), Tangled Bindyi (*S. cuneata*), Curly Mitchell-grass (*Astrebla lappacea*) Low Open Shrubland on light clay on a stony plain south of Orange Tree Dam. There is also an earlier collection from 1990 in the State Herbarium of SA from "Big Moro" that may be from within the IPA (State Herbarium of SA 2010).

***Daviesia genistifolia* (Broom Bitter-pea) U - FR**
Broom Bitter-pea is a tangled shrub to 2m high (Weber 1986, Cunningham *et al.* 1992) that, in South Australia, mainly occurs in the Flinders Ranges (State Herbarium of SA 2010). There are three records from the IPA, all from the crests of tall ridges. The first of these was in 1999 when it was recorded as plentiful, but of low cover, at Flinders Ranges Biological Survey site GAP00601 on clay loam soil on a high ridge top on the northern boundary of the IPA north east of Mount Rowe. Here it was growing in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee. Two subsequent collections were made during the Nantawarrina IPA Biological Survey in 2009 in Spinifex (*Triodia irritans*) Hummock Grassland on the crest of the Uro Range approximately 6.5km south east of the Plaque.

***Goodenia albiflora* (White Goodenia) U - FR**
A low shrub to 70cm that grows in stony soils on steep slopes (Carolin and Cooke 1986), this species occurs throughout the Mount Lofty and Flinders Ranges (State Herbarium of SA 2010). The first record for this species in the Nantawarrina IPA was collected in 2009 on the Nantawarrina IPA Biological Survey in Rock Emubush (*Eremophila freelingii*) Shrubland on a rocky ridge south west of the Plaque.

Figure 31. White Goodenia (*Goodenia albiflora*) was collected on a rocky hillside in Rock Emubush (*Eremophila freelingii*) Shrubland in 2009 (Photo: P. Lang).

***Jasminum didymum* ssp. *lineare* (Native Jasmine - Namurku) U - FR**
A tangled shrub to 2m, or prostrate or scrambling over trees or shrubs, this species is found in semi-arid and arid areas growing as isolated plants in woodlands, sometimes in small thickets, and often among boulders (Green 1986, Cunningham *et al.* 1992, Hardin 1992).

Native Jasmine has been recorded three times in the IPA. In 1999 isolated plants were recorded at Flinders Ranges Biological Survey site NAN00201 on loamy sand in a stream channel in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland north of the Plaque. During the 2009 Nantawarrina IPA Biological Survey it was recorded at two sites south west of the Plaque (also as isolated plants) – at PLA00301 sandy clay loam on a rocky hill slope in Mulga (*Acacia aneura*) Very Low Woodland and at PLA00601 on sandy loam in a stream channel in River Red Gum (*E. camaldulensis* ssp. *minima*) Woodland.

***Phyllanthus saxosus* (Rock Spurge) U - FR**
A tall shrub to 2m, this species occurs throughout the Flinders and Mount Lofty Ranges, as well as on Kangaroo Island and north eastern Eyre Peninsula (State Herbarium of SA 2010). In the IPA it is known from a single collection – at Flinders Ranges Biological Survey site GAP00601 on clay loam on a high ridge top north east of Mount Rowe in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee.

***Rhyncharrhena linearis* (Bush Bean) U - FR**
Bush Bean is a slender twining shrub with purple star-like flowers and narrow cylindrical pods (Pearce 1986, Cunningham *et al.* 1992, Harden and Williams 1992). It has a widespread distribution across the arid zone of South Australia.

There are three records of it in the IPA. It was collected on the Flinders Ranges Biological Survey in 1999 at site NAN00301 on clayey sand on a rocky hill slope near the Plaque in Black Oak (*Casuarina pauper*) Low Woodland. Specimens were also collected on the 2009 Nantawarrina IPA Biological Survey, at sites ORA00701 (near Deep Bore) and PLA00301 (south west of the Plaque). These were both on sandy clay loam on rocky hill slopes in Mulga (*Acacia aneura*) Very Low Woodland.

Figure 32. Bush Bean (*Rhyncharrhena linearis*) was recorded twice on this survey (Photo: A. Robinson).

***Sarcostemma viminale* ssp. *australe* (Caustic Bush) U - FR**
A leafless perennial shrub to 2m high and wide or with longer, prostrate, semi-succulent stems, this species grows in rocky sites and in saline areas (Pearce 1986, Cunningham *et al.* 1992, Harden and Williams 1992). It has a widespread distribution across semi-arid and arid South Australia, but is rarely abundant.

It is known from two records in the Nantawarrina IPA – at Flinders Survey site NEP0977 on sandy clay loam on a hill crest overlooking Moro Gorge in Rock Emubush (*Eremophila freelingii*) Very Open Shrubland, and an opportunistic sighting during the 2009 Nantawarrina IPA Biological Survey on a rocky hillside, also at Moro Gorge.

***Schoenoplectus litoralis* (Shore Club-rush) U - FR**
A perennial sedge with stems to 1.5m tall, this species grows in fresh or brackish swamps (Jessop and Weber 1986, Wilson 1993). It has been recorded once within the IPA, as sparsely present at site NEP0979 in 1988 during the Flinders Survey, in a waterhole in Moro Gorge in Inland Paper-bark (*Melaleuca glomerata*) Very Low Woodland. The State Herbarium of SA also holds collections of Shore Club-rush from nearby locations in the Vulkathunha-Gammon Ranges National Park and Angepeena and Mt Serle Pastoral Leases.

***Templetonia aculeata* (Spiny Mallee-pea) U - FR**
Spiny Mallee-pea is a low tangled shrub to 40cm high (Weber 1986, Cunningham *et al.* 1992) that, in South Australia, mainly occurs in the Flinders Ranges (State Herbarium of SA 2010). There are four records from within the IPA, all from the crests of tall ridges. One was collected in 1999 at Flinders Ranges Biological Survey site GAP00601, on clay loam soil on a high ridge top on the northern boundary of the IPA north east of Mount Rowe, where it was growing in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee. Three specimens were collected during the 2009 Nantawarrina IPA Biological Survey in Spinifex (*Triodia irritans*) Hummock Grassland on the crest of the Uro Range approximately 6.5km south east of the Plaque.

***Swainsona burkittii* (Woolly Darling Pea) Q - FR**
A perennial sub-erect shrub to about 1m tall and wide (Weber 1986, Cunningham *et al.* 1992), Woolly Darling Pea is confined to the northern Flinders Ranges in South Australia (State Herbarium of SA 2010). There is one collection of this species in the State Herbarium of SA from "east of Moro Gorge" in 1990 (State Herbarium of SA 2010). It is impossible to determine whether this was collected within the IPA or not, but it does warrant further searching in the area.

Figure 33. Black Oak [Alku] (*Casuarina pauper*) Low Open Woodland on the footslope of low hills south of Bald Hill (Photo: N. Neagle)

Figure 34. Broombush [Alaru] (*Melaleuca uncinata*) Low Shrubland over Spinifex [Vakirri] (*Triodia irritans*) on the crest of the Uro Range (Photo: N. Neagle).

New Species Records for the Nantawarrina IPA

A total of 57 plant taxa not previously listed for the Nantawarrina IPA were recorded on this survey (Table 13). Of these, 12 are grasses (Family Gramineae), nine are daisies (Family Compositae) and five are wattles or legumes (Family Leguminosae).

The relatively high number of new species' records is surprising given the previous survey site coverage in the IPA. Higher species diversity was recorded at sites on the 2009 survey (36.7 taxa per site) compared to the 1999 Flinders Ranges Biological Survey (29.4 taxa per site) and the 1988-91 Flinders Survey (24.8 taxa per site), though the latter used a smaller quadrat size. This might suggest that the season was more favourable in 2009. However, the survey was conducted in mid-Autumn following a very dry summer and three years of well below average rainfall (refer Figure 5 in Physical Environment chapter).

Figure 35. Crimson Emubush (*Eremophila latrobei* ssp. *glabra*) was recorded at site ORA00401 on a hill crest in Rock Emubush [Alda] (*Eremophila freelingii*), Broad-leaf Desert Senna [Murku] (*Senna artemisioides* ssp. X *coriacea*) Low Open Shrubland (Photo: A. Robinson).

The high number of new species is possibly due to the effort made in the current survey to sample the range of major habitats, landforms and soil types present in the IPA. Time was also spent on this survey sampling minor habitats not included in the site coverage. In this way the vegetation sampling was conducted over a wide area and covered most habitat types present in the IPA. Further sampling in the ranges and the steeper, shady, south-facing slopes is likely to yield yet more new species.

It should be noted that these "new" records are only new in relation to data stored in the Department for Environment and Heritage's Biological Databases of South Australia and collections held in the State Herbarium of SA. While these datasets are extensive they are not necessarily a comprehensive record of the flora of the area and it is acknowledged that locals and regular visitors to the IPA may have been aware of the presence of some or all of these species already.

There is one species of particular interest amongst this list, as the collections made in 2009 were the first for it in the Flinders Ranges Herbarium Region. This is:-

***Aristida strigosa* (Rough Three-awn)**

A tufted perennial grass that may grow to 1.5m tall, this species has been recorded mainly from skeletal or clay soils in seasonally wet areas, especially rocky creek banks, as well as on stony flats (Jessop *et al.* 2006). Previously in South Australia it had mainly been recorded from Coober Pedy north to the Northern Territory border. There are also isolated records from south of Lake Eyre South, Cordillo Downs in the far north east of the State and near Cockburn on the New South Wales border.

Rough Three-awn was recorded at four sites on the Nantawarrina IPA Biological Survey in a variety of habitats:-

- Site IRI00101 (3.1km south west of Bald Hill) - sparsely present on medium clay on a stony plain by a minor creek in Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) Tall Very Open Shrubland.
- Site ORA00201 (on Rainwater Creek 4km east of Orange Tree Dam) - sparsely present on sandy loam by a stream channel in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland.
- Site ORA00301 (1.2km east of One Tree Bore) - isolated plants on sandy clay loam on a hill footslope in Mulga (*Acacia aneura* var. *aneura*) Low Open Woodland.
- Site ORA00801 (at Deep Bore) - isolated plants on sandy clay loam by a stream channel in Gum-barked Coolibah (*Eucalyptus intertexta*) Mallee.

Table 13. New plant species records for the IPA recorded during the Nantawarrina IPA Biological Survey.

Species Name	Common Name	FR	Sites	OP	Total	Location
Acacia beckleri ssp. *megaspherica*	Beckler's Rock Wattle			1	1	In *Triodia* on crest of Uro Range
Amaranthus mitchellii	Boggabri Weed		3		3	IRI00301, IRI00401, PLA00601
Anacampseros australiana	Australian Anacampseros	U	6	1	7	ORA00501, ORA00601, ORA00701, PLA00201, PLA00301, PLA00401, Red Gum creekline at Waukla Woodna Gorge
Arabidella glaucescens				1	1	Rainwater Creek E of Orange Tree Dam
Aristida strigosa	Rough Three-awn	#	4		4	IRI00101, ORA00201, ORA00301, ORA00801
Astrebla lappacea	Curly Mitchell-grass		1		1	ORA00501
Austrodanthonia setacea	Small-flower Wallaby-grass		1		1	ORA00101
Austrostipa eremophila	Rusty Spear-grass		1		1	IRI00101

Species Name	Common Name	FR	Sites	OP	Total	Location
Austrostipa platychaeta	Flat-awn Spear-grass	R	1		1	PLA00101
Brachyscome dentata	Lobe-seed Daisy	U	1		1	ORA00501
Cassinia complanata	Sticky Cassinia		1	5	6	ORA00701, 3 x Red Gum creekline, 2 x *Triodia* on crest of Uro Range
Cheilanthes austrotenuifolia	Annual Rock-fern		1	1	2	ORA00701, Waukla Woodna Gorge
Chenopodium curvispicatum	Cottony Goosefoot	K	2		2	IRI00101, IRI00401
**Chenopodium murale*	Nettle-leaf Goosefoot		2	1	3	IRI00401, ORA00201, overflow from tank
Chrysocephalum eremaeum	Sand Button-bush		4	2	6	IRI00301, IRI00501, PLA00401, PLA00601, Mulga woodland 4.5km E of Irish Well
**Citrullus colocynthis*	Colocynth		5	1	6	IRI00101, IRI00301, IRI00401, PLA00101, PLA00601, track on W boundary
Cryptandra propinqua	Silky Cryptandra			2	2	In *Triodia* on crest of Uro Range
**Cucumis myriocarpus*	Paddy Melon		2		2	ORA00201, PLA00601
Cymbopogon obtectus	Silky-head Lemon-grass			1	1	Rainwater Creek E of Orange Tree Dam
Dactyloctenium radulans	Button-grass		1		1	ORA00501
Enteropogon ramosus	Umbrella Grass		1	2	3	PLA00601; Rainwater Creek E of Orange Tree Dam; Waukla Woodna Gorge
Eremophila latrobei ssp. *glabra*	Crimson Emubush		1		1	ORA00401
Eremophila maculata ssp.	Spotted Emubush		2		2	ORA00601, ORA00701
**Ficus carica*	Edible Fig			1	1	Under windmill at Irish Well
**Glaucium corniculatum*	Bristly Horned-poppy		1		1	IRI00401
Goodenia albiflora	White Goodenia	U		1	1	*Eremophila freelingii* Shrubland on rocky ridge near PLA00201
Goodenia calcarata	Streaked Goodenia		1		1	PLA00201
Gossypium sturtianum var. *sturtianum*	Sturt's Desert Rose			1	1	Alerumba Creek
**Heliotropium curassavicum*	Smooth Heliotrope			1	1	Overflow from tank at Angas Hut Well
Juncus aridicola	Inland Rush		1		1	ORA00201
Juncus kraussii	Sea Rush			1	1	Moro Gorge
Maireana aphylla	Cotton-bush		1	1	2	ORA00501 and cracking clay plain nearby
Myoporum montanum	Native Myrtle		1	1	2	ORA00201; under windmill at Irish Well
**Onopordum acaulon*	Horse Thistle		1		1	IRI00401
Panicum decompositum var. *decompositum*	Native Millet		1		1	ORA00501
Phyllanthus maderaspatensis var. *angustifolius*			1		1	PLA00101
Portulaca oleracea	Common Purslane		2		1	IRI00401, PLA00601
Ptilotus polystachyus var. *polystachyus*	Long-tails		1		1	ORA00701
Rhynchosia minima	Rhynchosia		1		1	ORA00201
Rostellularia adscendens ssp. *adscendens* var.	Pink Tongue			1	1	Rainwater Creek E of Orange Tree Dam
Schenkia australis	Spike Centaury			1	1	Overflow from tank at Angus Hut Well
Sclerolaena cuneata	Tangled Bindyi		1	2	4	ORA00601, Mulga woodland on rocky footslope near PLA00201; channel leading to dam near IRI00401
Senecio lanibracteus	Inland Shrubby Groundsel			2	2	2 at Orange Tree Dam
Senna artemisioides ssp. *alicia*	Desert Senna		2		2	ORA00101, PLA00701
Senna artemisioides ssp. X *sturtii*	Grey Senna		1		1	PLA00201
Setaria basiclada			3		3	IRI00201, IRI00301, ORA00801
Sporobolus actinocladus	Ray Grass		1	1	2	ORA00601, Black Oak near PLA00201
Swainsona formosa	Sturt Pea		2		2	IRI00401, IRI00501
Thyridolepis mitchelliana	Window Mulga-grass		1		1	PLA00401
Trianthema triquetra	Red Spinach		6		6	IRI00301, IRI00401, IRI00501, ORA00501, PLA00201, PLA00601
Tribulus eichlerianus	Eichler's Caltrop		3		3	IRI00401, IRI00501, PLA00501
Trichanthodium skirrophorum	Woolly Yellow-heads		1		1	PLA00201
Velleia connata	Cup Velleia	R		1	1	*Melaleuca uncinata* Low Open Shrubland over *Triodia irritans* on rocky hillside in Uro Range
Vittadinia australasica var.	Sticky New Holland Daisy		7		7	IRI00401, PLA00101, PLA00301, PLA00401, PLA00501, PLA00601, PLA00701
Wahlenbergia aridicola	Dryland Bluebell	R	6	1	7	IRI00101, IRI00301, IRI00401, IRI00601, PLA00101, PLA00601
**Xanthium spinosum*	Bathurst Burr		2	2	4	ORA00201, PLA00601; Red Gum creekline 1km W of Irish Well; at Angas Hut Well
Xerochrysum bracteatum	Golden Everlasting		1		1	PLA00401
	Total Records		**89**	**36**	**125**	
	Total Taxa	9	44	26	57	

FR Regional status for the Flinders Ranges Herbarium Region as per the SA FLORA database (November 2009), which provides an update of the original assessments of Lang and Kraehenbuehl (1987).
Status Codes: R = rare; K = uncertain (either rare or threatened but insufficient data to enable accurate assessment); U = uncommon; # = no rating yet applied as these are the first records for the region.

Sites Number of site records. OP Number of opportunistic sighting records.

Introduced Species

A total of 19 introduced plant species were recorded during the Nantawarrina IPA Biological Survey, 14 of which were seen at sites and ten opportunistically (Table 14). In addition, a further 23 introduced species had previously been recorded in the IPA, either on earlier DEH surveys or lodged as specimens at the State Herbarium of SA.

On this survey introduced species accounted for 42 (5.2%) of all 807 plant records at sites and 57 (5.3%) of all 1085 records collected. Of these, Ward's Weed (**Carrichtera annua*) was the most frequently recorded, being found at nine sites (41% of the 22 sites sampled). Thorn-apple (**Datura leichhardtii*) and Smooth Mustard (**Sisymbrium erysimoides*) at 6 sites each (27%) were the next most commonly encountered. As the majority of the introduced species recorded in the IPA are annuals, conducting the survey at the end of a very dry summer no doubt had a major influence on their relatively low percentage occurrences.

Table 14. Introduced plant species recorded during the Nantawarrina IPA Biological Survey.

Species Name	Common Name	Pre-2009	Nantawarrina IPA Survey			Total Records
			Sites	OP	Total	
**Anagallis arvensis*	Pimpernel	3		1	1	4
**Asphodelus fistulosus*	Onion Weed	1	1		1	2
**Carrichtera annua*	Ward's Weed	15	9	1	10	25
**Carthamus lanatus*	Saffron Thistle	2	1		1	3
**Centaurea melitensis*	Malta Thistle	33	2		2	35
**Chenopodium murale*	Nettle-leaf Goosefoot		2	1	3	3
**Citrullus colocynthis*	Colocynth		5	1	6	6
**Cucumis myriocarpus*	Paddy Melon		2		2	2
**Datura leichhardtii*	Thorn-apple	1	6	1	7	8
**Dittrichia graveolens*	Stinkweed	3		4	4	7
**Ficus carica*	Edible Fig			1	1	1
**Glaucium corniculatum*	Bristly Horned-poppy		1		1	1
**Heliotropium curassavicum*	Smooth Heliotrope			1	1	1
**Marrubium vulgare*	Horehound	6	3		3	9
**Nicotiana glauca*	Tree Tobacco	3		2	2	5
**Onopordum acaulon*	Horse Thistle		1		1	1
**Sisymbrium erysimoides*	Smooth Mustard	11	6		6	17
**Sonchus oleraceus*	Common Sow-thistle		1		1	1
**Xanthium spinosum*	Bathurst Burr		2	2	4	4
	Total Taxa	**10**	**14**	**10**	**19**	**19**
	Total Records	78	42	15	57	135

The tally of cover/abundance estimates for introduced species at sites on the Nantawarrina IPA Survey are provided in Table 15. On virtually all occasions they were only recorded at relatively low densities, except for four instances where individual introduced species were estimated as being plentiful, but with cover less than 5%.

These were:-

- Ward's Weed at site IRI00101 south of Bald Hill in medium clay in Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) Tall Very Open Shrubland.
- Ward's Weed and Thorn-apple at IRI00401 in loamy sand in Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland on a creekline north east of Irish Well. At this site both were recognised as being dominant understorey species.
- Smooth Mustard at PLA00101 on the Alerumba Creek in silty loam in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland.

Nearly half of the sites sampled on this survey (10 of 22) had no introduced species (Table 16). Of the remainder, the highest numbers were found at sites in stream channels (30 records or 71%) where persistent moisture and shade enables herbs to survive longer.

Table 15. Tally of cover/abundance estimates for introduced plant taxa at sites on the Nantawarrina IPA Biological Survey.

Species Name	Common Name	No. of Sites	Cover/Abundance		
			N	T	1
**Carrichtera annua*	Ward's Weed	9		7	2
**Datura leichhardtii*	Thorn-apple	6	1	4	1
**Sisymbrium erysimoides*	Smooth Mustard	6	1	4	1
**Citrullus colocynthis*	Colocynth	5	3	2	
**Marrubium vulgare*	Horehound	3	2	1	
**Chenopodium murale*	Nettle-leaf Goosefoot	2		2	
**Cucumis myriocarpus*	Paddy Melon	2		2	
**Centaurea melitensis*	Malta Thistle	2	1	1	
**Xanthium spinosum*	Bathurst Burr	2	1	1	
**Carthamus lanatus*	Saffron Thistle	1		1	
**Glaucium corniculatum*	Bristly Horned-poppy	1		1	
**Asphodelus fistulosus*	Onion Weed	1	1		
**Onopordum acaulon*	Horse Thistle	1	1		
**Sonchus oleraceus*	Common Sow-thistle	1	1		

Cover/abundance codes: N = very sparsely present (1-10 plants and <5% cover; T = sparsely present (<5% cover); 1 = plentiful, but of small cover (<5%).

Descriptions of Significant Introduced Species Present in the Nantawarrina IPA

***Carrichtera annua* (Ward's Weed)**

A rough erect herb to 40cm tall, this species is a common weed of roadsides and degraded pastures in semi-arid areas (Hewson 1986, Auld and Medd 1992) and is, unfortunately, widespread and abundant in the Flinders Ranges. It was recorded at nine sites and once opportunistically on this survey, in addition to 15 previous sightings for the IPA. These records are mainly restricted to low hills and undulating plains and are grouped around Nepabunna and between Bald Hill and Irish Well.

***Datura leichhardtii* (Thorn-apple)**

A stout bushy annual to 1.2m tall, this species is widespread on river systems in the north of the State, usually in sandy alluvial soil (Haegi 1986a). Thorn-apple responds well to spring and early summer rain by forming dense stands in creeklines (Kutsche and Lay 2003).

Figure 36. Thorn-apple (*_Datura leichhardtii_) has been recorded growing in several creeklines in the IPA (Photo: P. Lang).

Its status as an exotic species is uncertain. It is considered to be an early introduction to Australia from Central America (Mexico and Guatemala) (Haegi 1976 and 1986a) despite having been first described by Mueller in 1854 from an early collection by Leichhardt.

In the Nantawarrina IPA it has been recorded eight times - in Alerumba and Mount McKinlay Creeks in the vicinity of the Plaque, at two sites on a creekline south of Bald Hill, and in Rainwater Creek on the track east of Orange Tree Dam.

***Marrubium vulgare* (Horehound)**

A perennial spreading shrub to 60cm (Toelken 1986c), Horehound is a widespread weed that is particularly prevalent in disturbed areas, such as rabbit warrens and borrow pits (Cunningham *et al.* 1992). Once established, plants are extremely hardy and can suppress the establishment of native species (Cunningham *et al.* 1992).

It has been recorded nine times in the IPA, including three sites in the current survey. These are scattered throughout the IPA in low hills and undulating plains, and most are associated with creeklines.

Figure 37. Horehound (*_Marrubium vulgare_) is a particularly hardy weed species that is difficult to eradicate (Photo: A. Robinson).

Table 16. Number of introduced species recorded per site in each camp group during the Nantawarrina IPA Biological Survey.

Irish Well			Orange Tree Dam			Plaque		
SiteID	Landform	No. of Weeds	SiteID	Landform	No. of Weeds	SiteID	Landform	No. of Weeds
IRI00101	stony plain	4	ORA00101	plain		PLA00101	stream channel	6
IRI00201	hill slope	1	ORA00201	stream channel	4	PLA00201	hill slope	1
IRI00301	stream channel	6	ORA00301	hill footslope		PLA00301	hill slope	1
IRI00401	stream channel	8	ORA00401	hill crest		PLA00401	hill slope	
IRI00501	hill footslope	2	ORA00501	plain		PLA00501	hill slope	
IRI00601	hill footslope	2	ORA00601	hill slope		PLA00601	stream channel	6
IRI00701	hill crest	1	ORA00701	hill slope		PLA00701	hill footslope	
			ORA00801	stream channel				

***Xanthium spinosum* (Bathurst Burr)**
Bathurst Burr is a much-branched, erect, often bushy annual to 1m high that grows on land subject to occasional flooding (Cooke 1986b, Cunningham *et al.* 1992). It is one of the most common and economically serious weeds in Australia (Auld and Medd 1992). The burrs catch easily on animal fur (particularly sheep wool) and are thus readily dispersed.

This species had not been recorded in the IPA until the 2009 survey, when it was recorded twice at sites and twice opportunistically. All were in watercourses in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland communities. It was recorded as sparsely present (cover <5%) at ORA00201 on Rainwater Creek east of Orange Tree Dam and as isolated plants at PLA00601 in a broad watercourse north of the Plaque. The opportunistic collections came from a creekline west of Irish Well and one at Angas Hut Well.

Species Richness

Species richness at the 110 sites sampled in the Nantawarrina IPA ranged from 4 to 76. The spread of species richness at sites within this range is shown in Figure 39. Just over two thirds (67.3%) of sites had between 11 and 30 species, with the average for all sites being 25.6. For the Nantawarrina IPA Biological Survey alone, species richness ranged from 19 to 76 species and the average was 36.7 species per site.

The least species rich site was sampled in 1991 as part of the Flinders Survey. This was NAR2001 (approximately 800m west of Irish Well) in sandy clay loam on a hill footslope in Shrubby Twinleaf (*Zygophyllum aurantiacum* ssp.) Low Very Open Shrubland. This is in an area close to a former watering point that has probably been degraded historically by stock grazing. Most of the least diverse sites fall within two clusters, one around Irish Well and the other in the vicinity of Nepabunna, another area likely to have experienced high grazing pressure historically.

The site with the highest species diversity was PLA00601 in sandy loam on a broad watercourse near the Plaque in River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland. Most of the sites with highest plant diversity were on watercourses, with two interesting exceptions – NEP1393 and NEP1394. These two sites were sampled in 1988 as part of the Flinders Survey and are some of the few sites located well within the Uro Range, approximately 5.5km north east of Cable Creek Bore and over 1.2km from the western footslopes of the range. Recent rain was reported at the time of survey in May, which no doubt increased the number of herbs present.

Figure 38. River Red Gum [Wira] (*Eucalyptus camaldulensis* ssp. *minima*) Woodlands had the highest plant species diversity of any community in the IPA (Photo: A. Graham).

Although an examination of the species richness of the Floristic Vegetation Communities identified in the IPA (refer next section) is limited by the low numbers of sites sampled in some communities, some significant observations can be made. By far the most species rich communities are the two associated with watercourses (refer Table 17) – River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland and Inland paper-bark (*Melaleuca glomerata*) Tall Shrubland with emergent River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*).

At the other extreme the community with the lowest species richness is Elegant Wattle (*Acacia victoriae*

ssp. *victoriae*) Very Open Shrubland over Spear-grass (*Austrostipa* spp.). This community was recorded in three areas in close proximity to former watering points where historical grazing pressure from domestic stock would have been highest – near Irish Well, Cable Creek Bore and Nepabunna.

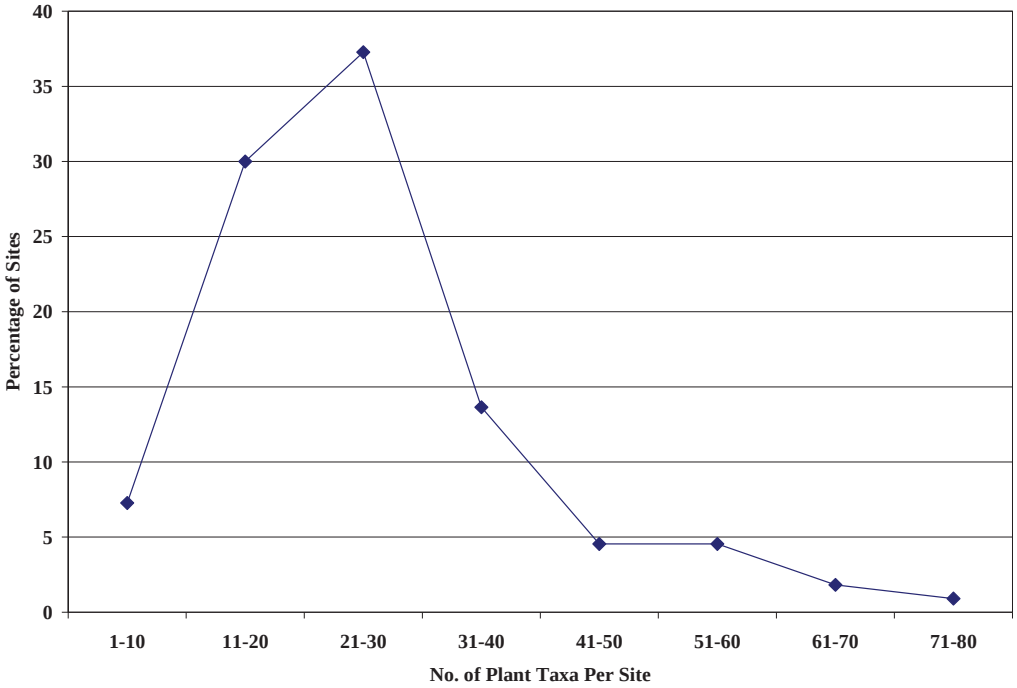


Figure 39. Plant species richness at all 110 sites sampled in the Nantawarrina IPA.

Table 17. Average number and range of plant species recorded per site in each Floristic Vegetation Community within the Nantawarrina IPA.

Com Nr	Floristic Vegetation Community	No. of Sites	Ave Spp	Low	High
16	River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*) Woodland	6	48.3	14	76
15	Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland with emergent River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*)	3	46.0	22	70
13	Flinders Grey Mallee (*Eucalyptus flindersii*), Broombush (*Melaleuca uncinata*) +/- Gum-barked Coolibah (*Eucalyptus intertexta*) Open Low Mallee over *Triodia* sp.	2	33.0	12	54
11	Mulga (*Acacia aneura* var.) Very Low Woodland	7	30.7	15	59
4	Rock Emubush (*Eremophila freelingii*) Open Shrubland over Rock Sida (*Sida petrophila*)	5	29.2	11	64
7	Dead Finish (*Acacia tetragonophylla*), Rock Emubush (*Eremophila freelingii*) Very Open Shrubland with emergent Mulga (*Acacia aneura*)	13	29.2	18	43
8	Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) +/- Dead Finish (*Acacia tetragonophylla*) Very Open Shrubland with emergent Mulga (*Acacia aneura*)	16	27.8	18	38
3	Long-spined Bindyi (*Sclerolaena longicuspis*) Low Open Shrubland	2	24.5	21	28
14	Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee (*Eucalyptus gillii*) Open Mallee	3	24.3	21	30
5	Low Bluebush (*Maireana astrotricha*) Low Open Shrubland with emergent Harlequin Emubush (*Eremophila duttonii*)	3	23.7	12	33
17	Black Oak (*Casuarina pauper*) Very Low Woodland	9	23.7	7	37
6	Fine-leaf Desert Senna (*Senna artemisioides* ssp. *filifolia*), Broad-leaf Desert Senna (*Senna artemisioides* ssp. X *coriacea*), Brilliant Hop-bush (*Dodonaea microzyga* var. *microzyga*) Open Shrubland	2	22.0	16	28
2	Black Oak (*Casuarina pauper*) +/- Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*) Very Low Open Woodland	8	20.8	11	41
9	Oblique-spined Bindyi (*Sclerolaena obliquicuspis*) Low Open Shrubland with emergent mixed shrubs	6	19.0	13	24
12	White Cypress-pine (*Callitris glaucophylla*) Very Low Open Woodland over Spinifex (*Triodia* sp.)	4	18.8	11	29
10	Dead Finish (*Acacia tetragonophylla*) Very Open Shrubland over Rock Sida (*Sida petrophila*)	11	17.1	8	26
1	Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) Very Open Shrubland over Spear-grass (*Austrostipa* spp.)	7	10.6	4	16

Figure 40. The least diverse community in the IPA - Elegant Wattle [Minga] (*Acacia victoriae* ssp. *victoriae*) Very Open Shrubland west of Irish Well (Photo: N. Neagle).

Figure 41. Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee (*E. gillii*) Open Mallee averaged 24 taxa per site (Photo: N. Neagle).

Consistent with the findings above, sites on watercourses had higher numbers of species (55.9 per site) than any other landform element (Table 18), with plains (18.7 species per site) and hill crests (17.8 species per site) being the least species rich.

Table 18. Frequency of sites and average number of plant species per site for each landform element.

Landform Element	No. of Sites	Ave No. of Spp Per Site
stream channel	7	55.9
ridge	1	54.0
hill slope	64	25.1
depression	5	24.8
hill footslope	10	21.7
plain	12	18.7
hill crest	11	17.8

Figure 42. Sites on stream channels in communities such as Inland Paper-bark [Alaru] (*Melaleuca glomerata*) Tall Shrubland had higher species diversity than those in any other landform element (Photo: N. Neagle).

Figure 43. Communities on hill crests such as this Dead Finish [Vara] (*Acacia tetragonophylla*), Fine-leaf Desert Senna [Murku] (*Senna artemisioides* ssp. *filifolia*) Open Shrubland were among the least diverse (Photo: N. Neagle).

There is little discernible difference in species richness between soil types (Table 19) beyond skeletal soils supporting the lowest number of species (17.8 species per site). Sites on sand had slightly higher species numbers (30.1 per site) compared to those on either clay (27.2 species) or loam (26.7).

Table 19. Frequency of sites and average number of plant species per site for each surface soil texture.

Soil	No. of Sites	Ave No. of Spp Per Site
sand	12	30.1
clay	9	27.2
loam	71	26.7
skeletal	15	17.8
not recorded	3	14.0

Floristic Vegetation Communities

The aim of the floristic analysis was to determine patterns in vascular plant species' distributions based on the presence and cover/abundance of perennial species. It is acknowledged that in reality vegetation communities rarely exist as discrete entities as they are influenced by various environmental factors (such as depth and type of soil, available moisture, slope and aspect) and tend to grade into one another across the landscape. However, distinct patterns of species associations can be detected and provide a basis for the description of the flora (Neagle 2009).

In preparation for the data analysis a number of taxa and sites were excluded, while some taxa were combined. Most taxa identified to generic level only were excluded. The only two exceptions to this were *Austrostipa* sp. (Spear-grass) and *Triodia* sp. (Spinifex) because they were often only recorded to genus in the field owing to difficulties in identification, particularly if no seeds were present. Annuals were also excluded from the analysis as they are not present year round and therefore do not consistently define a vegetation community. Reference was made to the DEH FLORA database and the Flora of South Australia (Jessop and Toelken 1986) to determine the annual/perennial status of plant species.

The lumping of some taxa up to a broader taxonomic entity was required. This was done in instances where either identification to subspecies level had not occurred consistently, or where changes in taxonomy since sampling occurred for the other surveys used (1988-91 for the Flinders Survey and 1999 for the Flinders Ranges Biological Survey) now makes it difficult to accurately interpret the current name of the taxon recorded.

This process resulted in a total of 2303 records of 239 plant taxa from 107 vegetation survey sites being available for hierarchical cluster analysis using PC-ORD, Version 4.25. Seventeen floristic groups were chosen to best represent the range of vegetation communities present in the IPA (refer Table 20.). The site dendrogram produced in the analysis is presented in Appendix 6 showing the point at which it was cut to delineate the 17 floristic groups. The frequency of occurrence of all species (both annual and perennial) per Floristic Vegetation Community is shown for the 107 sites used in the analysis in Appendix 7.

It is important to note that there is no definitive point at which to cut the dendrogram and that the resultant classification used here could be one of many that could equally well summarise the data (Heard 2003). For the Nantawarrina IPA the decision to make the cut at 17 floristic groups was based on this providing the most useful and ecologically meaningful set of floristic groups to best represent the flora of the region. These are described in detail in the following section.

Table 20. Floristic Vegetation Communities identified in the Nantawarrina IPA.

Group No.	Floristic Vegetation Community	No. of Sites
1	*Acacia victoriae* ssp. *victoriae* Very Open Shrubland over *Austrostipa* spp.	7
2	*Casuarina pauper* +/- *Eucalyptus socialis* ssp. *socialis* Very Low Open Woodland	8
3	*Sclerolaena longicuspis* Low Open Shrubland	2
4	*Eremophila freelingii* Open Shrubland over *Sida petrophila*	5
5	*Maireana astrotricha* Low Open Shrubland with emergent *Eremophila duttonii*	3
6	*Senna artemisioides* ssp. *filifolia*, *Senna artemisioides* ssp. X *coriacea*, *Dodonaea microzyga* var. *microzyga* Open Shrubland	2
7	*Acacia tetragonophylla*, *Eremophila freelingii* Very Open Shrubland with emergent *Acacia aneura*	13
8	*Acacia victoriae* ssp. *victoriae* +/- *Acacia tetragonophylla* Very Open Shrubland with emergent *Acacia aneura*	16
9	*Sclerolaena obliquicuspis* Low Open Shrubland with emergent mixed shrubs	6
10	*Acacia tetragonophylla* Very Open Shrubland over *Sida petrophila*	11
11	*Acacia aneura* var. Very Low Woodland	7
12	*Callitris glaucophylla* Very Low Open Woodland over *Triodia* sp.	4
13	*Eucalyptus flindersii*, *Melaleuca uncinata* +/- *Eucalyptus intertexta* Open Low Mallee over *Triodia* sp.	2
14	*Eucalyptus socialis* ssp. *socialis*, *Eucalyptus gillii* Open Mallee	3
15	*Melaleuca glomerata* Tall Shrubland with emergent *Eucalyptus camaldulensis* ssp. *minima*	3
16	*Eucalyptus camaldulensis* ssp. *minima* Woodland	6
17	*Casuarina pauper* Very Low Woodland	9

Floristic Vegetation Community Descriptions

Detailed descriptions of the 17 Floristic Vegetation Communities are provided in the following format.

Floristic group number as per Table 20.

Floristic Vegetation Community name is the descriptive title that includes the dominant (and possibly co-dominant and/or subdominant) overstorey species, the vegetation structural formation classification for South Australia (as per Heard and Channon 1997) and, in many cases, the dominant understorey species.

Description of community: a summary of the most common overstorey, mid-stratum (if necessary) and ground layer taxa (perennial and annual), the soil types and landforms where it typically occurs, and a general description of where it has been recorded within the IPA.

Distribution map: displays the location of all sites sampled in the Nantawarrina IPA (small white circles) and the site(s) that represent the Floristic Vegetation Community (larger black circles).

Number of sites in the group as determined in the analysis.

Total taxa in group: the total number of unique plant taxa recorded at sites representing the group.

Annual: the total number of unique annual taxa recorded at sites representing the group.

Perennial: the total number of unique perennial taxa recorded at sites representing the group.

Exotic: the total number of unique exotic taxa recorded at sites representing the group.

Average number of taxa per group and **range**: the average number of unique taxa per site, plus minimum and maximum, for sites representing the group.

Species of conservation significance: taxa with a state or regional conservation rating that were recorded at sites representing the group. The South Australian ratings are based on the *National Parks and Wildlife Act 1972* (2007 update of schedules 7, 8 and 9) and the regional ratings are for the Flinders Ranges Herbarium Region as per the SA FLORA database (November 2009), which provides an update of the original assessments of Lang and Kraehenbuehl (1987).

Sites: a list of the site identifier codes for all sites representing a group. All site codes are preceded by their survey number, e.g. 636ORA00301 refers to site ORA00301 sampled on Survey 636 (Biological Survey of the Nantawarrina IPA).

Group taxa list: provides a list with statistics of all perennial and annual taxa that were recorded at 30% or more of sites representing the Floristic Vegetation Community.

The statistics provided for each taxon are:-

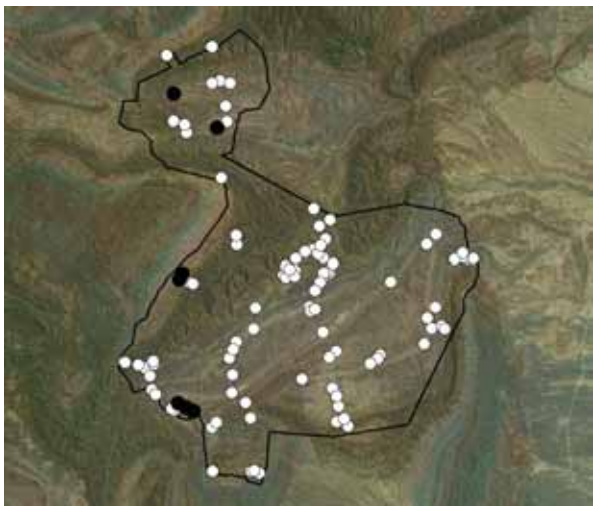
- frequency of occurrence at sites in the group (**Freq**),
- percentage of all sites in the group at which they occurred (**% Freq**),
- frequency of occurrence in each cover/abundance category (**N**, **T**, **1**, **2** and **3**),
- average cover/abundance for sites at which they were recorded (N scored as 0.01 and T as 0.1) (**C/A Ave**),
- total number of records at sites in the Nantawarrina IPA (**Tot Recs**),
- number of records at sites in this group as a percentage of all site records in the Nantawarrina IPA (**% Recs**),
- total number of floristic groups in which they were recorded (**Tot Grps**), and
- an indicator value (derived in PC-ORD) for taxa, representing the percentage of perfect indication of a Floristic Vegetation Group, based on each taxon's abundance in a particular group and the faithfulness of its occurrence in that group. Values range from 0 (no indication) to 100 (perfect indication, that presence of a taxon points to this particular group without error, at least with the data provided) (McCune and Mefford 1999). A figure in bold denotes the highest indicator value for this taxon was achieved for that Floristic Vegetation Group (**Ind Val**).

Figure: image of a site (where possible) representing the Floristic Vegetation Community. In some instances representative site photos were unavailable and a general image of the Floristic Community has been used instead.

Floristic Group 1 *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) Very Open Shrubland over *Austrostipa* spp. (Spear-grass)

This Very Open Shrubland community is associated with skeletal, sandy loam and sandy clay loam soils on plains and the lower slopes of low hills. It has been recorded in the vicinity of the Nepabunna township, the western side of the Uro Range near Cable Bore and in the low hills west of Irish Well. These are three areas in close proximity to former watering points where historical grazing pressure from domestic stock would have been highest, resulting in a noticeable loss of species richness.

The community is dominated by a very sparse shrub layer of *Acacia victoriae* ssp. *victoriae* (Elegant Wattle). The understorey is also very sparse with *Austrostipa* spp. (Spear-grass), and occasionally the exotic herb **Carrichtera annua* (Ward's Weed), being most prominent amidst a scattering of low shrubs. This community has low species diversity and no plants of conservation significance were recorded.



No. of sites in group: 7
Total taxa in group: 34
Annual: 7
Perennial: 27
Exotic: 4
Average no. of taxa per site: 9.7
Range: 4 - 16

Species of conservation significance: nil

Soils: skeletal, sandy loam and sandy clay loam
Landforms: plains, hill footslopes and hill slopes

Sites: 6ANG1692, 6ANG1703, 6ANG1745, 6ANG1748, 6NAR2000, 6NAR2001, 6NAR2002

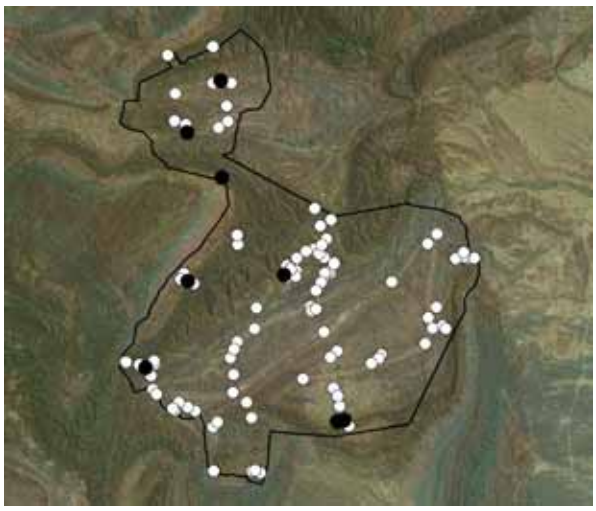
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Austrostipa sp.	Spear-grass	7	100.0			7		1.00	21	33.3	10	**45**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	7	100.0		6	1		0.23	61	11.5	15	9
Senecio magnificus	Showy Groundsel	4	57.1	3	1			0.03	33	12.1	11	4
Zygophyllum aurantiacum ssp.	Shrubby Twinleaf	3	42.9	1	1	1		0.37	11	27.3	4	14
Solanum sturtianum	Sturt's Nightshade	3	42.9	1	2			0.07	22	13.6	10	4
Annual taxa occurring at >30% of sites												
**Carrichtera annua*	Ward's Weed	4	57.1			2	2	1.50	23	17.4	8	
**Centaurea melitensis*	Malta Thistle	4	57.1		3	1		0.33	32	12.5	12	

Figure 44. *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) Very Open Shrubland on the footslope of a low hill west of Irish Well (Floristic Vegetation Community 1) (Photo: N. Neagle).

Floristic Group 2 *Casuarina pauper* (Black Oak) +/- *Eucalyptus socialis* ssp. *socialis* (Beaked Red Mallee) Very Low Open Woodland over *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna), *Exocarpos aphyllus* (Leafless Cherry), *Ptilotus obovatus* ssp. *obovatus* (Silver Mulla Mulla), *Dodonaea lobulata* (Lobed-leaf Hop-bush) +/- *Maireana sedifolia* (Pearl Bluebush)

This Very Low Open Woodland community is found on a range of soil types from skeletal to sandy loam and clay loam on hill footslopes and hill slopes, and was recorded from scattered sites throughout the IPA. *Casuarina pauper* (Black Oak) dominates the very sparse overstorey, while *Eucalyptus socialis* ssp. *socialis* (Beaked Red Mallee) occurs as an occasional co-dominant. The shrubs *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna), *Exocarpos aphyllus* (Leafless Cherry), *Ptilotus obovatus* ssp. *obovatus* (Silver Mulla Mulla) and *Dodonaea lobulata* (Lobed-leaf Hop-bush) form a very sparse understorey. On occasions *Maireana sedifolia* (Pearl Bluebush) may dominate the shrub layer with the Black Oak reduced to an occasional emergent tree. The mistletoe species *Amyema linophylla* ssp. *orientale* (Casuarina Mistletoe), considered Uncommon in the Flinders Ranges Herbarium Region, was only recorded within this community in the IPA.

This community differs from *Casuarina pauper* (Black Oak) Very Low Woodland in that the overstorey is more open and occasionally includes Beaked Red Mallee, and the mix of understorey species is slightly different, in particular the occasional dominance of Pearl Bluebush.



No. of sites in group: 8
Total taxa in group: 77
Annual: 10
Perennial: 67
Exotic: 4
Average no. of taxa per site: 19.5
Range: 11 - 41

Species of conservation significance: *Amyema linophylla* ssp. *orientale* (Casuarina Mistletoe) FR:U

Soils: skeletal, sandy loam, sandy clay loam and clay loam
Landforms: hill footslopes and hill slopes

Sites: 6ANG1697, 6ANG1698, 6ANG1747, 6ANG1758, 6NAR1993, 6NEP0953, 6WER1167, 6WER1168

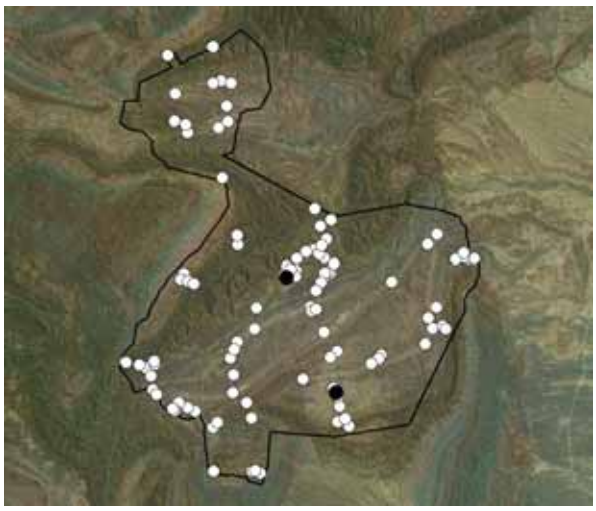
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Casuarina pauper	Black Oak	8	100.0		2	6		0.78	41	19.5	11	6
Exocarpos aphyllus	Leafless Cherry	8	100.0		8			0.10	37	21.6	11	**24**
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	6	75.0		5	1		0.25	50	12.0	14	3
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	5	62.5	1	2	2		0.44	70	7.1	16	3
Dodonaea lobulata	Lobed-leaf Hop-bush	4	50.0	2		2		0.51	30	13.3	12	6
Alectryon oleifolius ssp. *canescens*	Bullock Bush	4	50.0		4			0.10	42	9.5	13	3
Dissocarpus paradoxus	Ball Bindyi	4	50.0	2	2			0.06	32	12.5	12	1
Convolvulus remotus	Grassy Bindweed	4	50.0	4				0.01	29	13.8	11	3
Maireana sedifolia	Bluebush	3	37.5	1	1		1	0.70	11	27.3	5	**30**
Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee	3	37.5		1	2		0.70	11	27.3	7	1
Acacia aneura var.	Mulga	3	37.5		2	1		0.40	40	7.5	10	1
Austrostipa sp.	Spear-grass	3	37.5		2	1		0.40	21	14.3	10	4
Senna artemisioides ssp. X *artemisioides*	Silver Senna	3	37.5		2	1		0.40	45	6.7	16	2
Ptilotus propinquus	Small-leaf Mulla Mulla	3	37.5	1	1	1		0.37	5	60.0	3	15
Sclerolaena longicuspis	Long-spine Bindyi	3	37.5	1	1	1		0.37	8	37.5	4	1
Eremophila oppositifolia ssp. *oppositifolia*	Opposite-leaved Emubush	3	37.5		3			0.10	8	37.5	6	**16**
Rhagodia ulicina	Intricate Saltbush	3	37.5		3			0.10	11	27.3	6	**17**
Eremophila freelingii	Rock Emubush	3	37.5	1	2			0.07	44	6.8	12	
Solanum ellipticum/ quadriloculatum		3	37.5	1	2			0.07	62	4.8	15	1

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Annual taxa occurring at >30% of sites												
**Carrichtera annua*	Ward's Weed	3	37.5		1	1	1	1.03	23	13.0	8	

Figure 45. *Casuarina pauper* (Black Oak) Very Low Open Woodland at site WER1168 on the northern footslopes of the Stirrup Iron Range south of Orange Tree Dam (Floristic Vegetation Community 2).

Floristic Group 3 *Sclerolaena longicuspis* (Long-spine Bindyi) Low Open Shrubland

This Low Open Shrubland community occurs on sandy clay loam and light clay soils on plains and was recorded on flats near the Alerumba Creek and south of Orange Tree Dam. It is dominated by a sparse low shrub layer of *Sclerolaena longicuspis* (Long-spine Bindyi). Associated species include *Solanum ellipticum/quadriloculatum* and the annuals *Salsola tragus* (Buckbush) and *Nicotiana velutina* (Velvet Tobacco). Few shrubs taller than 50cm were recorded in this community.



No. of sites in group: 2
Total taxa in group: 45
Annual: 8
Perennial: 37
Exotic: 2
Average no. of taxa per site: 24.0
Range: 21 - 27

Species of conservation significance: *Sporobolus caroli* (Yakka Grass) FR:R; *Anacampseros australiana* (Australian Anacampseros) FR:U; *Brachyscome dentata* (Lobe-seed Daisy) FR:U

Soils: sandy clay loam and light clay
Landforms: plains and hill slopes

Sites: 6NEP0952, 636ORA00501

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Sclerolaena longicuspis	Long-spine Bindyi	2	100				2	2.00	8	25.0	4	**97**
Solanum ellipticum/ quadriloculatum		2	100		2			0.10	62	3.2	15	14
Euphorbia tannensis ssp. *eremophila*	Desert Spurge	1	50			1		1.00	3	33.3	2	**36**
Minuria cunninghamii	Bush Minuria	1	50			1		1.00	4	25.0	4	**40**
Sclerolaena brachyptera	Short-wing Bindyi	1	50			1		1.00	10	10.0	7	**21**
Sclerolaena divaricata	Tangled Bindyi	1	50			1		1.00	8	12.5	5	**29**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	1	50		1			0.10	61	1.6	15	2
Alectryon oleifolius ssp. *canescens*	Bullock Bush	1	50		1			0.10	42	2.4	13	3
Astrebla lappacea	Curly Mitchell-grass	1	50		1			0.10	1	100.0	1	**50**
Austrostipa nitida	Balcarra Spear-grass	1	50		1			0.10	18	5.6	9	5
Dissocarpus paradoxus	Ball Bindyi	1	50		1			0.10	32	3.1	12	2
Enneapogon avenaceus	Common Bottle-washers	1	50		1			0.10	7	14.3	6	**17**
Enneapogon cylindricus	Jointed Bottle-washers	1	50		1			0.10	27	3.7	8	7
Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee	1	50		1			0.10	11	9.1	7	1
Frankenia foliosa	Leafy Sea-heath	1	50		1			0.10	4	25.0	4	8
Maireana aphylla	Cotton-bush	1	50		1			0.10	1	100.0	1	**50**
Malvastrum americanum var. *americanum*	Malvastrum	1	50		1			0.10	25	4.0	9	7
Panicum decompositum var. *decompositum*	Native Millet	1	50		1			0.10	1	100.0	1	**50**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	1	50		1			0.10	70	1.4	16	2
Ptilotus propinquus	Small-leaf Mulla Mulla	1	50		1			0.10	5	20.0	3	**25**
Sclerolaena obliquicuspis	Oblique-spined Bindyi	1	50		1			0.10	61	1.6	14	2
Senecio magnificus	Showy Groundsel	1	50		1			0.10	33	3.0	11	8
Sida trichopoda	High Sida	1	50		1			0.10	1	100.0	1	**50**
Sporobolus caroli	Yakka Grass	1	50		1			0.10	1	100.0	1	**50**
Amyema miquelii	Box Mistletoe	1	50	1				0.01	10	10.0	7	4
Austrostipa scabra ssp.	Rough Spear-grass	1	50	1				0.01	24	4.2	10	2
Brachyscome ciliaris var. *ciliaris*	Variable Daisy	1	50	1				0.01	4	25.0	4	9
Brachyscome dentata	Lobe-seed Daisy	1	50	1				0.01	1	100.0	1	**50**
Cymbopogon ambiguus	Lemon-grass	1	50	1				0.01	38	2.6	15	1
Dodonaea lobulata	Lobed-leaf Hop-bush	1	50	1				0.01	30	3.3	12	1
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	1	50	1				0.01	35	2.9	12	

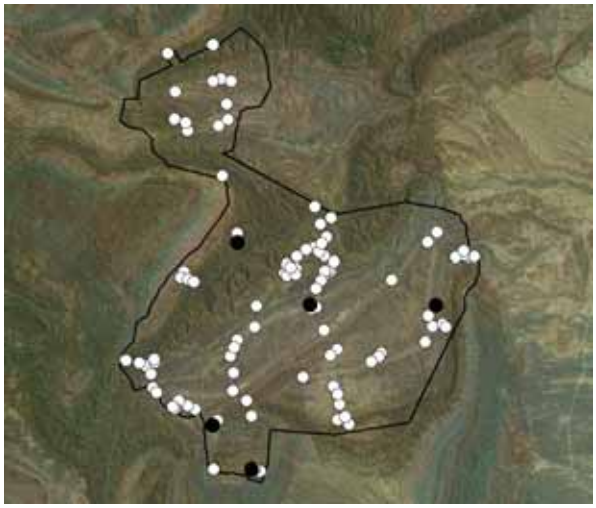
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	1	50	1				0.01	52	1.9	13	1
Maireana astrotricha	Low Bluebush	1	50	1				0.01	12	8.3	7	
Maireana georgei	Satiny Bluebush	1	50	1				0.01	6	16.7	5	**10**
Ptilotus nobilis var.	Yellow-tails	1	50	1				0.01	2	50.0	2	**21**
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	1	50	1				0.01	50	2.0	14	
Sida fibulifera	Pin Sida	1	50	1				0.01	35	2.9	11	1
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	2	100		1	1		0.55	50	4.0	13	
Nicotiana velutina	Velvet Tobacco	1	50			1		1.00	4	25.0	4	
Dactyloctenium radulans	Button-grass	1	50		1			0.10	1	100.0	1	
Anacampseros australiana	Australian Anacampseros	1	50	1				0.01	6	16.7	3	
Calotis hispidula	Hairy Burr-daisy	1	50	1				0.01	3	33.3	3	
**Centaurea melitensis*	Malta Thistle	1	50	1				0.01	32	3.1	12	
**Eragrostis barrelieri*	Pitted Love-grass	1	50	1				0.01	3	33.3	2	
Trianthema triquetra	Red Spinach	1	50	1				0.01	6	16.7	5	

Figure 46. *Sclerolaena longicuspis* (Long-spine Bindyi) Low Open Shrubland with emergent *Maireana aphylla* (Cotton-bush) near site ORA00501 on a cracking clay plain south of Orange Tree Dam (Floristic Vegetation Community 3) (Photo: N. Neagle).

Floristic Group 4 *Eremophila freelingii* (Rock Emubush) Open Shrubland over *Sida petrophila* (Rock Sida), *Ptilotus obovatus* ssp. *obovatus* (Silver Mulla Mulla), *Acacia tetragonophylla* (Dead Finish)

This Open Shrubland community is dominated by *Eremophila freelingii* (Rock Emubush). It occurs on a range of loamy soils on hill slopes and crests of mostly low hills across the IPA. The understorey is dominated by *Sida petrophila* (Rock Sida), with *Ptilotus obovatus* ssp. *obovatus* (Silver Mulla Mulla), *Acacia tetragonophylla* (Dead Finish) and *Solanum ellipticum*/*quadriloculatum* also common. *Salsola tragus* (Buckbush) was the most commonly recorded annual species.

The community differs from *Acacia tetragonophylla* (Dead Finish), *Eremophila freelingii* (Rock Emubush) Very Open Shrubland with emergent *Acacia aneura* var. (Mulga) in that Rock Emubush occurs more densely here and Dead Finish and Mulga less frequently, and less prominently.



No. of sites in group: 5
Total taxa in group: 88
Annual: 15
Perennial: 73
Exotic: 5
Average no. of taxa per site: 28.4
Range: 9 - 63

Species of conservation significance: *Sclerolaena convexula* (Tall Bindyi) FR:R

Soils: loam, silty loam, sandy clay loam and clay loam
Landforms: hill slopes and hill crests

Sites: 6NAR2004, 6NEP1393, 6WER1184, 104NAN00602, 636ORA00401

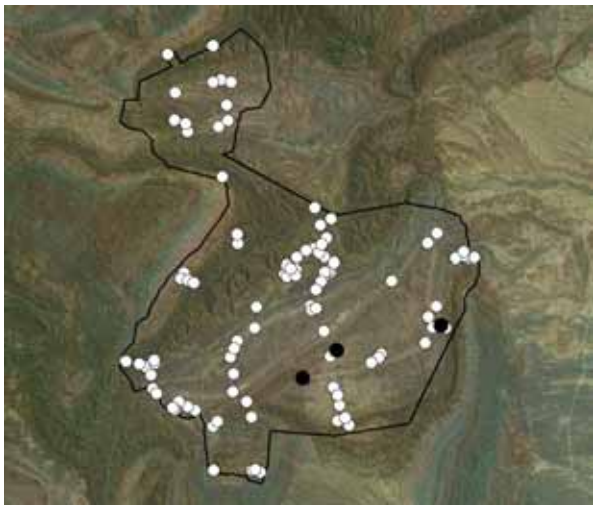
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Eremophila freelingii	Rock Emubush	5	100	1			4	1.60	44	11.4	12	**74**
Sida petrophila	Rock Sida	5	100	1	1	1	2	1.02	44	11.4	12	**59**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	5	100	1	2	2		0.44	70	7.1	16	7
Acacia tetragonophylla	Dead Finish	5	100	1	3	1		0.26	65	7.7	13	11
Solanum ellipticum/ *quadriloculatum*		4	80	1	2	1		0.30	62	6.5	15	9
Acacia victoriae ssp. *victoriae*	Elegant Wattle	4	80	1	3			0.08	61	6.6	15	4
Senna artemisioides ssp. X *artemisioides*	Silver Senna	4	80	1	3			0.08	45	8.9	16	7
Casuarina pauper	Black Oak	3	60	2		1		0.34	41	7.3	11	1
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	3	60	2		1		0.34	35	8.6	12	2
Alectryon oleifolius ssp. *canescens*	Bullock Bush	3	60		3			0.10	42	7.1	13	5
Acacia aneura var.	Mulga	3	60	2	1			0.04	40	7.5	10	1
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	2	40		1		1	1.05	50	4.0	14	7
Sclerolaena diacantha/uniflora	Grey Bindyi	2	40		1	1		0.55	24	8.3	10	5
Sida fibulifera	Pin Sida	2	40		1	1		0.55	35	5.7	11	6
Abutilon leucopetalum	Desert Lantern-bush	2	40		2			0.10	28	7.1	8	5
Cheilanthes lasiophylla	Woolly Cloak-fern	2	40		2			0.10	24	8.3	9	4
Enneapogon avenaceus	Common Bottle-washers	2	40		2			0.10	7	28.6	6	11
Eremophila alternifolia	Narrow-leaf Emubush	2	40		2			0.10	20	10.0	9	7
Exocarpos aphyllus	Leafless Cherry	2	40		2			0.10	37	5.4	11	4
Capparis mitchellii	Native Orange	2	40	1	1			0.06	9	22.2	7	**12**
Cymbopogon ambiguus	Lemon-grass	2	40	1	1			0.06	38	5.3	15	2
Enneapogon cylindricus	Jointed Bottle-washers	2	40	1	1			0.06	27	7.4	8	3
Sclerolaena obliquicuspis	Oblique-spined Bindyi	2	40	1	1			0.06	61	3.3	14	1
Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush	2	40	2				0.01	12	16.7	7	4
Convolvulus remotus	Grassy Bindweed	2	40	2				0.01	29	6.9	11	2
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	2	40	2				0.01	52	3.8	13	1
Marsdenia australis	Native Pear	2	40	2				0.01	29	6.9	12	2

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Sauropus rigens	Stiff Spurge	2	40	2				0.01	11	18.2	6	3
Senecio magnificus	Showy Groundsel	2	40	2				0.01	33	6.1	11	1
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	3	60	1	1		1	0.70	50	6.0	13	
**Sisymbrium erysimoides*	Smooth Mustard	2	40	1	1			0.06	17	11.8	6	

Figure 47. *Eremophila freelingii* (Rock Emubush) Low Open Shrubland at site NAN00602 on the crest of a low hill between the Plaque and Bald Hill (Floristic Vegetation Community 4).

Floristic Group 5 *Maireana astrotricha* (Low Bluebush) Low Open Shrubland with emergent *Eremophila duttonii* (Harlequin Emubush)

This chenopod shrubland community is dominated by *Maireana astrotricha* (Low Bluebush) and is found on a variety of loam soils on plains and the lower slopes of low hills. It occurs in isolated patches north of Orange Tree Dam and on the footslopes of the Iron Stirrup Range south of Moro Gorge, but is most prominent along the track south west from Orange Tree Dam. Occasional shrubs occur as emergents above the Low Bluebush, particularly *Eremophila duttonii* (Harlequin Emubush) and, to a lesser extent, *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) and *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna). The understorey is sparse with *Enneapogon cylindricus* (Jointed Bottle-washers) being most prominent. Few annuals and only one exotic species were recorded in this community.



No. of sites in group: 3
Total taxa in group: 49
Annual: 2
Perennial: 47
Exotic: 1
Average no. of taxa per site: 23.7
Range: 12 - 33

Species of conservation significance: nil

Soils: sandy loam, silty loam and sandy clay loam
Landforms: plains and hill slopes

Sites: 6NEP1158, 6WER1171, 636ORA00101

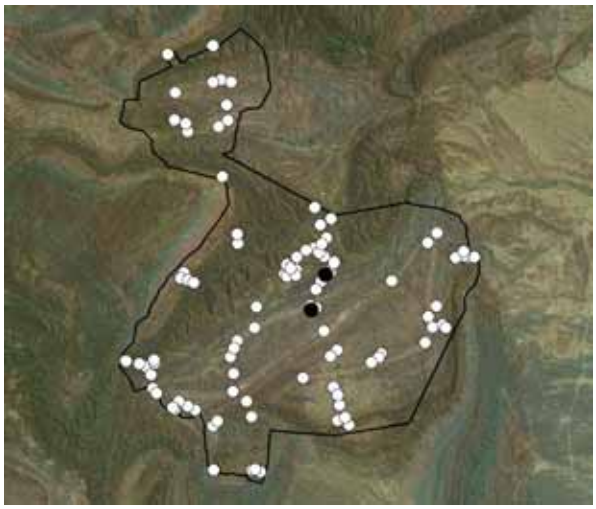
Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Maireana astrotricha	Low Bluebush	3	100.0				2	1	2.33	12	25.0	7	**97**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	3	100.0		2	1			0.40	61	4.9	15	11
Enneapogon cylindricus	Jointed Bottle-washers	3	100.0		2	1			0.40	27	11.1	8	**35**
Eremophila duttonii	Harlequin Emubush	3	100.0		3				0.10	5	60.0	3	**85**
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	3	100.0	1	2				0.07	50	6.0	14	3
Sida fibulifera	Pin Sida	3	100.0	2	1				0.04	35	8.6	11	**12**
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	2	66.7		1	1			0.55	35	5.7	12	4
Sclerolaena diacantha/uniflora	Grey Bindyi	2	66.7		1	1			0.55	24	8.3	10	**13**
Scaevola spinescens	Spiny Fanflower	2	66.7	1		1			0.51	18	11.1	9	**18**
Sclerolaena obliquicuspis	Oblique-spined Bindyi	2	66.7		2				0.10	61	3.3	14	4
Acacia tetragonophylla	Dead Finish	2	66.7	1	1				0.06	65	3.1	13	3
Alectryon oleifolius ssp. *canescens*	Bullock Bush	2	66.7	1	1				0.06	42	4.8	13	4
Exocarpos aphyllus	Leafless Cherry	2	66.7	1	1				0.06	37	5.4	11	7
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	2	66.7	1	1				0.06	70	2.9	16	2
Solanum ellipticum/ quadriloculatum		2	66.7	1	1				0.06	62	3.2	15	4
Marsdenia australis	Native Pear	2	66.7	2					0.01	29	6.9	12	5
Eremophila freelingii	Rock Emubush	1	33.3			1			1.00	44	2.3	12	1
Senna artemisioides ssp. *alicia*	Desert Senna	1	33.3			1			1.00	2	50.0	2	**29**
Abutilon leucopetalum	Desert Lantern-bush	1	33.3		1				0.10	28	3.6	8	3
Aristida nitidula	Brush Three-awn	1	33.3		1				0.10	16	6.3	7	7
Atriplex stipitata	Bitter Saltbush	1	33.3		1				0.10	7	14.3	5	**17**
Austrostipa scabra ssp.	Rough Spear-grass	1	33.3		1				0.10	24	4.2	10	4
Casuarina pauper	Black Oak	1	33.3		1				0.10	41	2.4	11	
Cymbopogon ambiguus	Lemon-grass	1	33.3		1				0.10	38	2.6	15	2
Dissocarpus paradoxus	Ball Bindyi	1	33.3		1				0.10	32	3.1	12	1
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	1	33.3		1				0.10	52	1.9	13	2
Eucalyptus gillii	Curly Mallee	1	33.3		1				0.10	15	6.7	7	1
Malvastrum americanum var. *americanum*	Malvastrum	1	33.3		1				0.10	25	4.0	9	3
Rhagodia spinescens	Spiny Saltbush	1	33.3		1				0.10	19	5.3	10	3
Sclerolaena brachyptera	Short-wing Bindyi	1	33.3		1				0.10	10	10.0	7	5
Senecio magnificus	Showy Groundsel	1	33.3		1				0.10	33	3.0	11	4

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	1	33.3		1				0.10	20	5.0	12	
Sida petrophila	Rock Sida	1	33.3		1				0.10	44	2.3	12	1
Solanum sturtianum	Sturt's Nightshade	1	33.3		1				0.10	22	4.5	10	4
Vittadinia cuneata var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy	1	33.3		1				0.10	12	8.3	7	**10**
Acacia oswaldii	Umbrella Wattle	1	33.3	1					0.01	8	12.5	5	4
Austrodanthonia setacea	Small-flower Wallaby-grass	1	33.3	1					0.01	1	100.0	1	**33**
Brachyscome ciliaris var. *ciliaris*	Variable Daisy	1	33.3	1					0.01	4	25.0	4	4
Eremophila sturtii	Turpentine Bush	1	33.3	1					0.01	3	33.3	3	**13**
Lotus cruentus	Red-flower Lotus	1	33.3	1					0.01	4	25.0	3	6
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	1	33.3	1					0.01	35	2.9	12	1
Rhagodia ulicina	Intricate Saltbush	1	33.3	1					0.01	11	9.1	6	3
Santalum lanceolatum	Plumbush	1	33.3	1					0.01	11	9.1	7	2
Senna artemisioides ssp. X *artemisioides*	Silver Senna	1	33.3	1					0.01	45	2.2	16	
Sida corrugata var.	Corrugated Sida	1	33.3	1					0.01	11	9.1	6	4
Vittadinia gracilis	Woolly New Holland Daisy	1	33.3	1					0.01	11	9.1	8	2
Zygophyllum apiculatum	Pointed Twinleaf	1	33.3	1					0.01	9	11.1	5	2
Annual taxa occurring at >30% of sites													
**Centaurea melitensis*	Malta Thistle	1	33.3		1				0.10	32	3.1	12	
Salsola tragus	Buckbush	1	33.3		1				0.10	50	2.0	13	

Figure 48. *Maireana astrotricha* (Low Bluebush) Low Shrubland at site ORA00101 on a plain south west of Orange Tree Dam (Floristic Vegetation Community 5).

Floristic Group 6 *Senna artemisioides* ssp. *filifolia* (Fine-leaf Desert Senna), *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna), *Dodonaea microzyga* var. *microzyga* (Brilliant Hop-bush) Open Shrubland

This is a community of limited extent occurring on sandy clay loam soils on hill slopes of low rocky hills. It is most apparent on the track between the Plaque and Orange Tree Dam but is likely to occur in patches on the lower hills throughout the IPA. The overstorey is sparse and dominated by *Senna artemisioides* ssp. *filifolia* (Fine-leaf Desert Senna), *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna) and *Dodonaea microzyga* var. *microzyga* (Brilliant Hop-bush). On occasions *Acacia tetragonophylla* (Dead Finish) and *A. victoriae* ssp. *victoriae* (Elegant Wattle) may occur as emergents (that is, they are of low abundance but stand out because they are taller than the dominant overstorey layer). The shrub species *Sida petrophila* (Rock Sida) and *Dodonaea lobulata* (Lobed-leaf Hop-bush) form an open understorey, while *Cymbopogon ambiguus* (Lemon-grass) and *Salsola tragus* (Buckbush) are prominent in the ground layer. No exotic species and only one annual were recorded in this community with low species diversity.



No. of sites in group: 2
Total taxa in group: 31
Annual: 1
Perennial: 30
Exotic: 0
Average no. of taxa per site: 20.5
Range: 15 - 26

Species of conservation significance: nil

Soils: sandy clay loam
Landforms: hill slopes

Sites: 104NAN00501, 104NAN00601

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	2	100				2	2.00	20	10.0	12	**87**
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	2	100			1	1	1.50	35	5.7	12	**70**
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	2	100			1	1	1.50	50	4.0	14	**47**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	2	100		1	1		0.55	61	3.3	15	12
Sida petrophila	Rock Sida	2	100	1		1		0.51	44	4.5	12	8
Cymbopogon ambiguus	Lemon-grass	2	100		2			0.10	38	5.3	15	18
Dodonaea lobulata	Lobed-leaf Hop-bush	2	100		2			0.10	30	6.7	12	**23**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	2	100	1	1			0.06	70	2.9	16	4
Maireana sedifolia	Bluebush	2	100	2				0.01	11	18.2	5	6
Acacia tetragonophylla	Dead Finish	1	50			1		1.00	65	1.5	13	5
Eremophila freelingii	Rock Emubush	1	50		1			0.10	44	2.3	12	1
Eremophila scoparia	Broom Emubush	1	50		1			0.10	11	9.1	8	14
Hibiscus sturtii var. *grandiflorus*	Sturt's Hibiscus	1	50		1			0.10	11	9.1	8	**20**
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	1	50		1			0.10	35	2.9	12	12
Ptilotus exaltatus var.	Pink Mulla Mulla	1	50		1			0.10	15	6.7	9	**19**
Sclerolaena diacantha/uniflora	Grey Bindyi	1	50		1			0.10	24	4.2	10	5
Sclerolaena patenticuspis	Spear-fruit Bindyi	1	50		1			0.10	12	8.3	7	**13**
Senna artemisioides ssp. X *artemisioides*	Silver Senna	1	50		1			0.10	45	2.2	16	3
Sida fibulifera	Pin Sida	1	50		1			0.10	35	2.9	11	7
Solanum sturtianum	Sturt's Nightshade	1	50		1			0.10	22	4.5	10	8
Alectryon oleifolius ssp. *canescens*	Bullock Bush	1	50	1				0.01	42	2.4	13	1
Boerhavia dominii	Tar-vine	1	50	1				0.01	13	7.7	6	4
Eremophila alternifolia	Narrow-leaf Emubush	1	50	1				0.01	20	5.0	9	2
Eremophila duttonii	Harlequin Emubush	1	50	1				0.01	5	20.0	3	4
Glossocardia bidens	Native Cobbler's-pegs	1	50	1				0.01	3	33.3	2	**30**
Maireana pyramidata	Black Bluebush	1	50	1				0.01	4	25.0	4	**33**
Rhagodia spinescens	Spiny Saltbush	1	50	1				0.01	19	5.3	10	1
Santalum acuminatum	Quandong	1	50	1				0.01	8	12.5	6	**7**
Scaevola spinescens	Spiny Fanflower	1	50	1				0.01	18	5.6	9	2

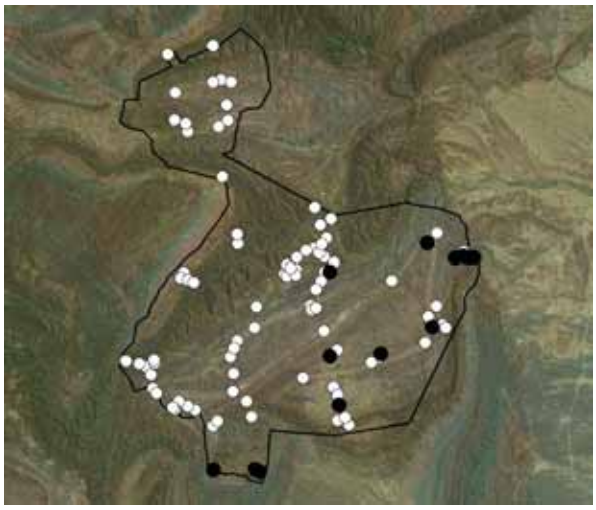
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Solanum ellipticum/ quadriloculatum		1	50	1				0.01	62	1.6	15	1
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	2	100		1	1		0.55	50	4.0	13	

Figure 49. *Senna artemisioides* ssp. *filifolia* (Fine-leaf Desert Senna), *Dodonaea microzyga* var. *microzyga* (Brilliant Hop-bush) Low Open Shrubland at site NAN00601 on a hill slope between the Plaque and Bald Hill (Floristic Vegetation Community 6).

Floristic Group 7 *Acacia tetragonophylla* (Dead Finish), *Eremophila freelingii* (Rock Emubush) Very Open Shrubland with emergent *Acacia aneura* var. (Mulga)

This Very Open Shrubland community is widespread in the IPA, particularly south east of the higher ranges, on sandy loam to sandy clay soils on the rocky slopes and crests of low hills. The overstorey is very sparse and dominated by the shrubs *Acacia tetragonophylla* (Dead Finish) and *Eremophila freelingii* (Rock Emubush) and, very occasionally, *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna) and *Dodonaea microzyga* var. *microzyga* (Brilliant Hop-bush). *Acacia aneura* var. (Mulga) is often present as an emergent. On occasions there may be many more dead Mulga than live. In these instances the community may represent a disturbance state (or degraded example) of Floristic Group 11 – *Acacia aneura* var. (Mulga) Low Woodland.

The understorey is also very sparse and generally dominated by the low shrubs *Solanum ellipticum*/*quadriloculatum*, *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla) and *Sida petrophila* (Rock Sida) and ground cover species such as *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) and *Digitaria brownii* (Cotton Panic-grass). Taller shrubs such as *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) and *Senna artemisioides* ssp. X *artemisioides* (Silver Senna) also occur frequently, but in very low numbers.



No. of sites in group: 13
Total taxa in group: 111
Annual: 10
Perennial: 101
Exotic: 6
Average no. of taxa per site: 28.8
Range: 18 - 43

Species of conservation significance: *Sclerolaena convexula* (Tall Bindyi) FR:R; *Sarcostemma viminale* ssp. *australe* (Caustic Bush) FR:U

Soils: sandy loam, sandy clay loam and sandy clay
Landforms: hill slopes and hill crests

Sites: 6NAR1185, 6NEP0948, 6NEP0975, 6NEP0976, 6NEP0977, 6NEP0978, 6NEP0980, 6NEP1164, 6WER1162, 6WER1169, 6WER1170, 6WER1181, 6WER1182

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Acacia tetragonophylla	Dead Finish	13	100.0		11	2		0.24	65	20.0	13	**12**
Solanum ellipticum/ *quadriloculatum*		12	92.3		9	3		0.33	62	19.4	15	**15**
Eremophila freelingii	Rock Emubush	11	84.6	1	4	6		0.58	44	25.0	12	5
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	11	84.6	2	5	4		0.41	70	15.7	16	5
Sclerolaena obliquicuspis	Oblique-spined Bindyi	10	76.9		5	5		0.55	61	16.4	14	8
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	10	76.9	3	5	2		0.25	35	28.6	12	4
Acacia aneura var.	Mulga	10	76.9		9	1		0.19	40	25.0	10	3
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	9	69.2		5	4		0.50	50	18.0	14	3
Sida petrophila	Rock Sida	9	69.2	1	6	2		0.29	44	20.5	12	4
Acacia victoriae ssp. *victoriae*	Elegant Wattle	9	69.2		8	1		0.20	61	14.8	15	4
Digitaria brownii	Cotton Panic-grass	9	69.2		8	1		0.20	17	52.9	6	**39**
Sida fibulifera	Pin Sida	9	69.2	3	5	1		0.17	35	25.7	11	11
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	9	69.2	5	4			0.05	52	17.3	13	5
Senna artemisioides ssp. X *artemisioides*	Silver Senna	8	61.5		6	2		0.33	45	17.8	16	6
Austrostipa scabra ssp.	Rough Spear-grass	8	61.5	1	5	2		0.31	24	33.3	10	**15**
Enneapogon cylindricus	Jointed Bottle-washers	7	53.8		5	2		0.36	27	25.9	8	10
Scaevola spinescens	Spiny Fanflower	7	53.8	3	2	2		0.32	18	38.9	9	10
Abutilon leucopetalum	Desert Lantern-bush	7	53.8	3	3	1		0.19	28	25.0	8	7
Casuarina pauper	Black Oak	7	53.8	1	6			0.09	41	17.1	11	1
Aristida nitidula	Brush Three-awn	7	53.8	2	5			0.07	16	43.8	7	**13**
Eriochiton sclerolaenoides	Woolly-fruit Bluebush	6	46.2	2	3	1		0.22	12	50.0	6	**15**
Exocarpos aphyllus	Leafless Cherry	6	46.2		6			0.10	37	16.2	11	5

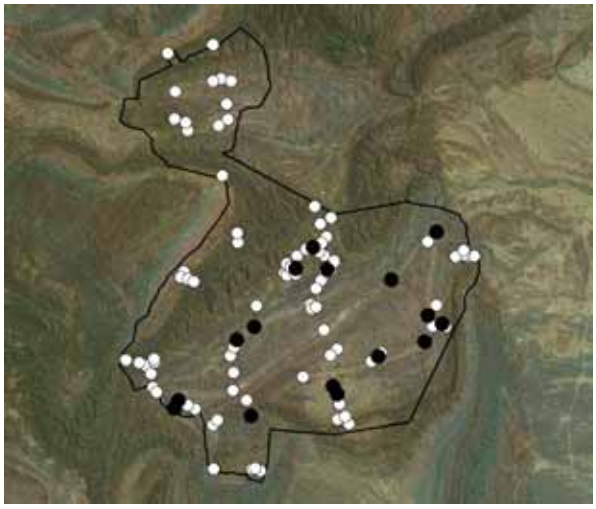
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Alectryon oleifolius ssp. *canescens*	Bullock Bush	5	38.5	1	4			0.08	42	11.9	13	2
Maireana astrotricha	Low Bluebush	4	30.8		3	1		0.33	12	33.3	7	
Sclerolaena patenticuspis	Spear-fruit Bindyi	4	30.8		3	1		0.33	12	33.3	7	6
Dissocarpus paradoxus	Ball Bindyi	4	30.8	1	2	1		0.30	32	12.5	12	1
Cheilanthes lasiophylla	Woolly Cloak-fern	4	30.8		4			0.10	24	16.7	9	2
Hakea ednieana	Flinders Ranges Corkwood	4	30.8		4			0.10	16	25.0	7	5
Cymbopogon ambiguus	Lemon-grass	4	30.8	1	3			0.08	38	10.5	15	1
Vittadinia cuneata var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy	4	30.8	1	3			0.08	12	33.3	7	7
Senecio magnificus	Showy Groundsel	4	30.8	3	1			0.03	33	12.1	11	1
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	4	30.8	4				0.01	35	11.4	12	1
Other significant perennial taxa												
Austrostipa nitida	Balcarra Spear-grass	3	23.1		1		2	1.37	18	16.7	9	**14**
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	8	61.5	2	5	1		0.19	50	16.0	13	
**Acetosa vesicaria*	Rosy Dock	5	38.5		4	1		0.28	23	21.7	10	
**Schismus barbatus*	Arabian Grass	4	30.8		4			0.10	9	44.4	5	

Figure 50. ***Acacia tetragonophylla*** **(Dead Finish) Very Open Shrubland at site NEP0978 on a hill slope near Moro Gorge (Floristic Vegetation Community 7).**

Floristic Group 8 *Acacia victoriae* ssp. v*ictoriae* (Elegant Wattle) +/- *Acacia tetragonophylla* (Dead Finish) Very Open Shrubland with emergent *Acacia aneura* var. (Mulga) over *Sclerolaena obliquicuspis* (Oblique-spined Bindyi)

This Very Open Shrubland community occurs on the low hills and undulating plain south east of the main ranges in the IPA. It is found on a variety of soil types ranging from sandy loam through to medium clay reflecting the variation within the group. In most instances the overstorey is very sparse and dominated by *Acacia victoriae* ssp. v*ictoriae* (Elegant Wattle), with *Acacia tetragonophylla* (Dead Finish) occurring as an occasional co-dominant. On rare occasions *Acacia aneura* var. (Mulga) is present as an overstorey dominant, though more often as merely an emergent above the dominant shrub layer. Where Mulga does occur there are often (as with some sites in Floristic Group 7) many dead trees suggesting these areas, too, are degraded Mulga woodlands (Floristic Group 11). A third sub-group within this community contains sites associated with minor watercourses where the Elegant Wattle shrub layer may (though not always) be sub-dominant to *Eucalyptus camaldulensis* ssp. *minima* (River Red Gum) Open Woodland.

Overall this community tends to occur lower in the landscape than Floristic Group 7, being found on plains, hill footslopes and hill slopes. The understorey is also very sparse and is dominated by the low shrubs *Sclerolaena obliquicuspis* (Oblique-spined Bindyi), *Enchylaena tomentosa* var. *tomentosa* (Ruby Saltbush), *Sida fibulifera* (Pin Sida), *Solanum ellipticum*/*quadriloculatum* and *Malvastrum americanum* var. *americanum* (Malvastrum), as well as the grasses *Enneapogon cylindricus* (Jointed Bottle-washers) and *Cymbopogon ambiguus* (Lemon-grass). The most frequently recorded herbs were *Salsola tragus* (Buckbush) and the exotic **Centaurea melitensis* (Malta Thistle).



No. of sites in group: 16
Total taxa in group: 130
Annual: 16
Perennial: 114
Exotic: 10
Average no. of taxa per site: 27.3
Range: 18 - 37

Species of conservation significance: *Chenopodium curvispicatum* (Cottony Goosefoot) FR:K; *Wahlenbergia aridicola* (Dryland Bluebell) FR:R

Soils: sandy loam, sandy clay loam, clay loam, light clay and medium clay
Landforms: plains, hill footslopes and hill slopes

Sites: 6NEP0942, 6NEP0944, 6NEP0973, 6NEP0974, 6NEP1159, 6NEP1163, 6NEP1173, 6WER1161, 6WER1165, 6WER1166, 6WER1174, 636IRI00101, 636IRI00501, 636IRI00601, 636IRI00701, 636ORA00301

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Sclerolaena obliquicuspis	Oblique-spined Bindyi	16	100.0		7	7	2	0.73	61	26.2	14	**33**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	15	93.8		10	3	2	0.53	61	24.6	15	**26**
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	12	75.0	5	7			0.06	52	23.1	13	7
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	12	75.0	7	5			0.05	35	34.3	12	**14**
Sida fibulifera	Pin Sida	11	68.8	1	10			0.09	35	31.4	11	12
Solanum ellipticum/ *quadriloculatum*		11	68.8	1	10			0.09	62	17.7	15	6
Malvastrum americanum var. *americanum*	Malvastrum	11	68.8	3	8			0.08	25	44.0	9	10
Enneapogon cylindricus	Jointed Bottle-washers	10	62.5		10			0.10	27	37.0	8	10
Cymbopogon ambiguus	Lemon-grass	10	62.5	1	9			0.09	38	26.3	15	6
Acacia tetragonophylla	Dead Finish	9	56.3		6	2	1	0.51	65	13.8	13	11
Acacia aneura var.	Mulga	9	56.3	3	3	3		0.37	40	22.5	10	1
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	9	56.3	2	5	2		0.28	70	12.9	16	2
Senecio magnificus	Showy Groundsel	9	56.3	1	8			0.09	33	27.3	11	9
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	8	50.0	1	7			0.09	50	16.0	14	1
Alectryon oleifolius ssp. *canescens*	Bullock Bush	8	50.0	2	6			0.08	42	19.0	13	3

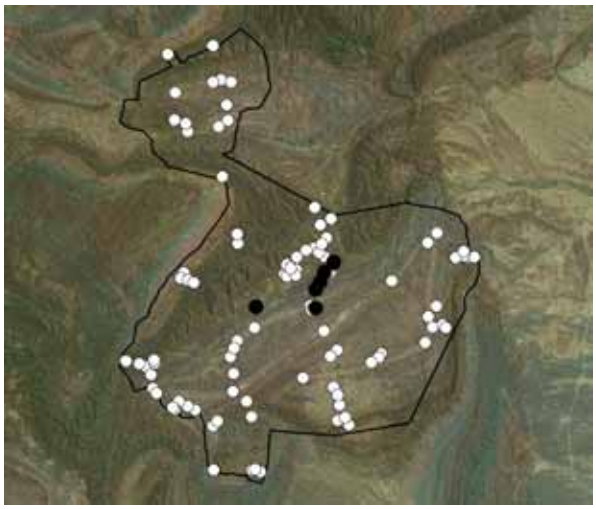
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Sida intricata	Twiggy Sida	8	50.0	4	4			0.06	12	66.7	5	**15**
Sida petrophila	Rock Sida	7	43.8	1	6			0.09	44	15.9	12	1
Abutilon leucopetalum	Desert Lantern-bush	7	43.8	2	5			0.07	28	25.0	8	4
Convolvulus remotus	Grassy Bindweed	7	43.8	7				0.01	29	24.1	11	3
Senna artemisioides ssp. X *artemisioides*	Silver Senna	6	37.5		5		1	0.42	45	13.3	16	**8**
Marsdenia australis	Native Pear	6	37.5	6				0.01	29	20.7	12	2
Rhagodia spinescens	Spiny Saltbush	5	31.3		4		1	0.48	19	26.3	10	**14**
Sclerolaena diacantha/uniflora	Grey Bindyi	5	31.3		3	2		0.46	24	20.8	10	3
Eremophila freelingii	Rock Emubush	5	31.3	3	2			0.05	44	11.4	12	
Boerhavia dominii	Tar-vine	5	31.3	4	1			0.03	13	38.5	6	3
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	13	81.3		8	4	1	0.52	50	26.0	13	
**Centaurea melitensis*	Malta Thistle	10	62.5	2	8			0.08	32	31.3	12	
**Sisymbrium erysimoides*	Smooth Mustard	7	43.8	2	5			0.07	17	41.2	6	

Figure 51. *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) Tall Very Open Shrubland at site IRI00101 on a clay plain south west of Bald Hill (Floristic Vegetation Community 8).

Floristic Group 9 *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) Low Open Shrubland with emergent mixed shrubs

This Low Open Shrubland community occurs on sandy clay loam soil on hill slopes of low hills. It was mainly recorded on the track between the Plaque and Orange Tree Dam but is likely to be more widespread on the undulating plain and low hills between the Uro and Stirrup Iron Ranges. The unifying feature of this group is that it is dominated by the low shrub *Sclerolaena obliquicuspis* (Oblique-spined Bindyi). A number of taller shrubs, including *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna), *Acacia tetragonophylla* (Dead Finish) and *A. aneura* var. (Mulga), as well as *Eucalyptus gillii* (Curly Mallee), regularly occur as very sparse emergents. Associated ground cover species include *Atriplex acutibractea* ssp. (Pointed Saltbush), *Salsola tragus* (Buckbush) and *Austrostipa nodosa* (Tall Spear-grass).

As with the two previous communities this may also be a degraded form of Open Shrubland or Open Mallee communities resulting from historically high grazing pressure by introduced herbivores.



No. of sites in group: 6
Total taxa in group: 55
Annual: 3
Perennial: 52
Exotic: 2
Average no. of taxa per site: 19.0
Range: 13 - 24

Species of conservation significance: nil

Soils: sandy clay loam
Landforms: hill slopes

Sites: 6NEP0943, 6NEP0945, 6NEP0947, 6NEP0949, 6NEP0950, 6NEP0951

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Sclerolaena obliquicuspis	Oblique-spined Bindyi	6	100.0			6		1.00	61	9.8	14	17
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	5	83.3		3	2		0.46	50	10.0	14	4
Acacia tetragonophylla	Dead Finish	5	83.3		4	1		0.28	65	7.7	13	9
Acacia rivalis	Silver Wattle	5	83.3		5			0.10	14	35.7	8	**34**
Atriplex acutibractea ssp.	Pointed Saltbush	4	66.7	1		3		0.75	14	28.6	7	**37**
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	4	66.7		2	2		0.55	35	11.4	12	4
Eucalyptus gillii	Curly Mallee	4	66.7		2	2		0.55	15	26.7	7	4
Salsola tragus	Buckbush	4	66.7	1	2	1		0.30	50	8.0	13	
Acacia victoriae ssp. *victoriae*	Elegant Wattle	4	66.7		4			0.10	61	6.6	15	4
Senna artemisioides ssp.	Desert Senna	3	50.0		1	2		0.70	12	25.0	7	**22**
Austrostipa nodosa	Tall Spear-grass	3	50.0	1		2		0.67	6	50.0	4	**30**
Austrostipa nitida	Balcarra Spear-grass	3	50.0		3			0.10	18	16.7	9	5
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	3	50.0	1	2			0.07	52	5.8	13	3
Sida fibulifera	Pin Sida	3	50.0	2	1			0.04	35	8.6	11	3
Casuarina pauper	Black Oak	2	33.3		2			0.10	41	4.9	11	
Dissocarpus paradoxus	Ball Bindyi	2	33.3		2			0.10	32	6.3	12	1
Eremophila alternifolia	Narrow-leaf Emubush	2	33.3		2			0.10	20	10.0	9	5
Hakea ednieana	Flinders Ranges Corkwood	2	33.3		2			0.10	16	12.5	7	6
Maireana trichoptera	Hairy-fruit Bluebush	2	33.3		2			0.10	7	28.6	3	**16**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	2	33.3		2			0.10	70	2.9	16	1
Amyema maidenii ssp. *maidenii*	Pale-leaf Mistletoe	2	33.3	1	1			0.06	15	13.3	7	**10**
Eremophila scoparia	Broom Emubush	2	33.3	1	1			0.06	11	18.2	8	4
Solanum ellipticum/ *quadriloculatum*		2	33.3	1	1			0.06	62	3.2	15	1
Vittadinia cuneata var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy	2	33.3	1	1			0.06	12	16.7	7	6
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	2	33.3	2				0.01	35	5.7	12	1
Annual taxa occurring at >30% of sites												
**Centaurea melitensis*	Malta Thistle	3	50.0		3			0.10	32	9.4	12	

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
**Acetosa vesicaria*	Rosy Dock	3	50.0	1	2			0.07	23	13.0	10	

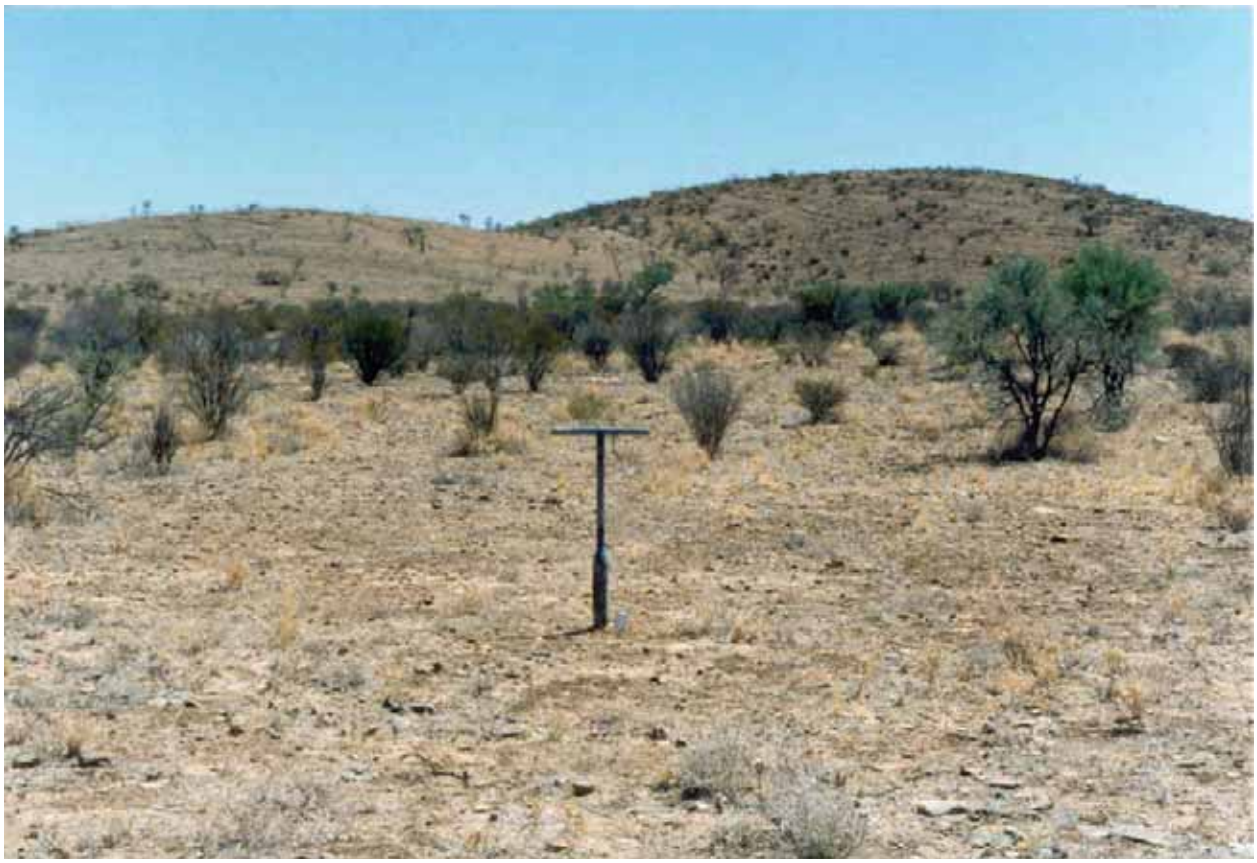
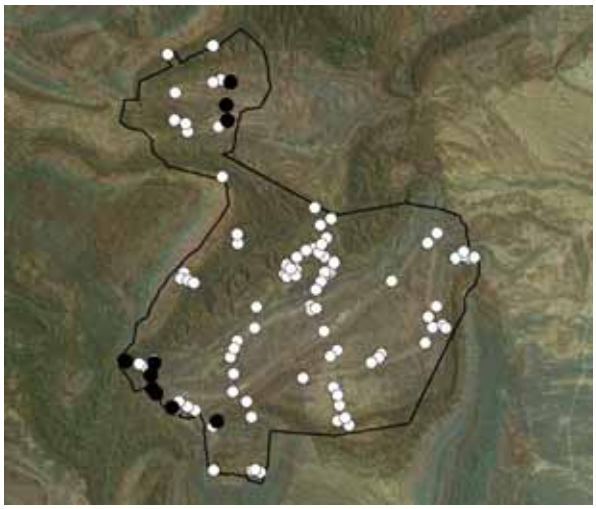


Figure 52. *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna) Very Open Shrubland over *Sclerolaena obliquicuspis* (Oblique-spined Bindyi), *Salsola tragus* (Buckbush) at site NEP0950 on a hill slope between the Plaque and Orange Tree Dam (Floristic Vegetation Community 9).

Floristic Group 10 *Acacia tetragonophylla* (Dead Finish) Very Open Shrubland over *Sida petrophila* (Rock Sida)

This Very Open Shrubland community occurs on rocky slopes and crests of hills, particularly to the north of Nepabunna and between Irish Well and Waukla Woodna Gorge. It is dominated by a very sparse cover of *Acacia tetragonophylla* (Dead Finish) and, very occasionally, *Eremophila alternifolia* (Narrow-leaf Emubush). The understorey is also very sparse with *Sida petrophila* (Rock Sida) being the most common species, along with *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla) and *Solanum ellipticum*/*quadriloculatum*. Other prominent shrubs include *Eremophila freelingii* (Rock Emubush), *Senna artemisioides* ssp. X *artemisioides* (Silver Senna) and *Dodonaea lobulata* (Lobed-leaf Hop-bush). A number of annual herbs are also present, though not consistently. In particular the exotic **Carrichtera annua* (Ward's Weed) was relatively abundant at the few sites where it was recorded in this group.



No. of sites in group: 11
Total taxa in group: 58
Annual: 14
Perennial: 44
Exotic: 6
Average no. of taxa per site: 15.1
Range: 8 - 24

Species of conservation significance: nil

Soils: skeletal, loam and sandy clay loam
Landforms: hill footslopes, hill slopes and hill crests

Sites: 6ANG1693, 6ANG1694, 6ANG1696, 6NAR1990, 6NAR1991, 6NAR1995, 6NAR1996, 6NAR1997, 6NAR1998, 6NAR1999, 6NAR2003

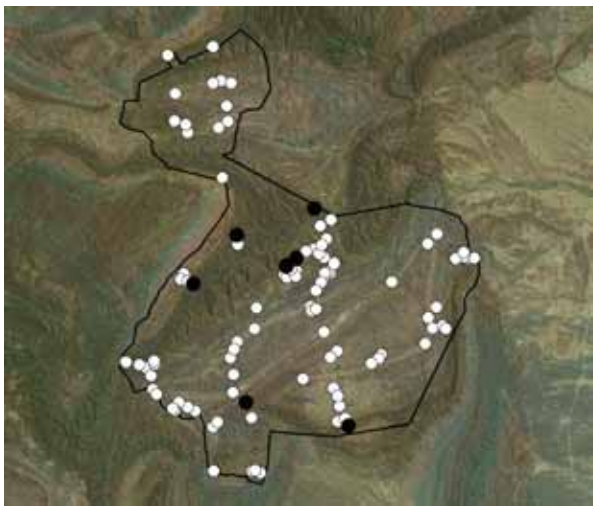
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Acacia tetragonophylla	Dead Finish	11	100.0		10	1		0.18	65	16.9	13	11
Sida petrophila	Rock Sida	10	90.9		6	4		0.46	44	22.7	12	8
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	8	72.7		5	3		0.44	70	11.4	16	4
Solanum ellipticum/ *quadriloculatum*		7	63.6	2	4	1		0.20	62	11.3	15	5
Eremophila alternifolia	Narrow-leaf Emubush	6	54.5		4	2		0.40	20	30.0	9	**17**
Dodonaea lobulata	Lobed-leaf Hop-bush	6	54.5	1	3	2		0.39	30	20.0	12	8
Cheilanthes lasiophylla	Woolly Cloak-fern	6	54.5		6			0.10	24	25.0	9	8
Eremophila freelingii	Rock Emubush	5	45.5	1	1	3		0.62	44	11.4	12	1
Sclerolaena obliquicuspis	Oblique-spined Bindyi	5	45.5	3	2			0.05	61	8.2	14	1
Senna artemisioides ssp. X *artemisioides*	Silver Senna	4	36.4		1	3		0.78	45	8.9	16	3
Zygophyllum aurantiacum ssp.	Shrubby Twinleaf	4	36.4		2	2		0.55	11	36.4	4	**15**
Convolvulus remotus	Grassy Bindweed	4	36.4	3	1			0.03	29	13.8	11	4
Cymbopogon ambiguus	Lemon-grass	4	36.4	3	1			0.03	38	10.5	15	1
Annual taxa occurring at >30% of sites												
Omphalolappula concava	Burr Stickseed	7	63.6	1	6			0.09	10	70.0	4	
**Acetosa vesicaria*	Rosy Dock	5	45.5		5			0.10	23	21.7	10	
**Centaurea melitensis*	Malta Thistle	5	45.5		5			0.10	32	15.6	12	
**Carrichtera annua*	Ward's Weed	4	36.4			2	2	1.50	23	17.4	8	

Figure 53. ***Acacia tetragonophylla*** **(Dead Finish) Very Open Shrubland on a rocky hill crest between Irish Well and Waukla Woodna Gorge (Floristic Vegetation Community 10) (Photo: N. Neagle).**

Floristic Group 11 *Acacia aneura* var. (Mulga) Very Low Woodland

Acacia aneura var. (Mulga) Very Low Woodland is one of the most widespread and distinctive vegetation communities in the IPA. It occurs predominantly on the slopes and crests of the Uro and Stirrup Iron Ranges (though not at the highest elevations). Soil types in these rocky areas vary from clayey sand to sandy clay loam and sandy clay. Two varieties of Mulga - *Acacia aneura* var. *aneura* and *A. aneura* var. *tenuis* - appear to co-dominate over much of its distribution in this area. Tree height is generally less than 5m but may be slightly taller in pockets of better soil. The understorey consists of a very sparse mid-shrub layer featuring *Eremophila freelingii* (Rock Emubush) and, to a lesser extent, *Acacia tetragonophylla* (Dead Finish) and/or *Senna artemisioides* ssp. X *artemisioides* (Silver Senna), plus an equally sparse ground layer of *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla) and *Solanum ellipticum*/*quadriloculatum*.

There are numerous examples, either on the lower hills between the Uro and Stirrup Iron Ranges or on the lower slopes of these ranges, of what may be degraded forms of this community. In these instances the Mulga is predominantly dead and regeneration virtually absent. Emergent trees, generally in poor condition, still exist but these communities are now dominated either by tall shrubs such as *Acacia tetragonophylla* (Dead Finish) and/or *A. victoriae* ssp. *victoriae* (Elegant Wattle) (refer Floristic Groups 7 and 8) or, where this shrub layer is also absent, by *Sclerolaena obliquicuspis* (Oblique-spined Bindyi) (refer Floristic Group 9).



No. of sites in group: 7
Total taxa in group: 111
Annual: 21
Perennial: 90
Exotic: 6
Average no. of taxa per site: 29.0
Range: 13 - 58

Species of conservation significance: *Sclerolaena convexula* (Tall Bindyi) FR:R; *Anacampseros australiana* (Australian Anacampseros) FR:U; *Jasminum didymium* ssp. *lineare* (Native Jasmine) FR:U; *Rhyncharrhena linearis* (Bush Bean) FR:U

Soils: skeletal, clayey sand, sandy clay loam and sandy clay
Landforms: hill slopes and hill crests

Sites: 6ANG1746, 6NEP0955, 6NEP1394, 6WER1176, 636ORA00701, 636PLA00301, 636PLA00401

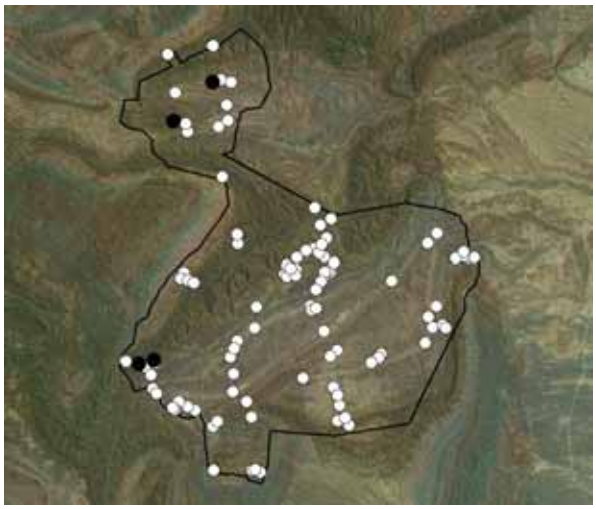
Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Acacia aneura var.	Mulga	7	100.0			1	5	1	2.00	40	17.5	10	**85**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	7	100.0		4	1	2		0.77	70	10.0	16	**40**
Eremophila freelingii	Rock Emubush	6	85.7		3	3			0.55	44	13.6	12	5
Acacia tetragonophylla	Dead Finish	6	85.7	1	5				0.09	65	9.2	13	7
Solanum ellipticum/ quadriloculatum		6	85.7	2	4				0.07	62	9.7	15	7
Senna artemisioides ssp. X *artemisioides*	Silver Senna	5	71.4	2	2	1			0.24	45	11.1	16	6
Cheilanthes lasiophylla	Woolly Cloak-fern	5	71.4	1	4				0.08	24	20.8	9	11
Hakea ednieana	Flinders Ranges Corkwood	5	71.4	1	4				0.08	16	31.3	7	**22**
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	4	57.1		3	1			0.33	9	44.4	5	**19**
Austrostipa scabra ssp.	Rough Spear-grass	4	57.1	1	2	1			0.30	24	16.7	10	11
Eremophila serrulata	Green Emubush	4	57.1	2	1	1			0.28	9	44.4	4	**24**
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	4	57.1	2	2				0.06	52	7.7	13	3
Scaevola spinescens	Spiny Fanflower	3	42.9	1	1	1			0.37	18	16.7	9	7
Casuarina pauper	Black Oak	3	42.9		3				0.10	41	7.3	11	1
Sclerolaena convexula	Tall Bindyi	3	42.9		3				0.10	6	50.0	3	**24**
Sclerolaena obliquicuspis	Oblique-spined Bindyi	3	42.9		3				0.10	61	4.9	14	2
Exocarpos aphyllus	Leafless Cherry	3	42.9	1	2				0.07	37	8.1	11	3
Hibiscus sturtii var. *grandiflorus*	Sturt's Hibiscus	3	42.9	1	2				0.07	11	27.3	8	11
Sclerolaena diacantha/uniflora	Grey Bindyi	3	42.9	1	2				0.07	24	12.5	10	3

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush	3	42.9	2	1				0.04	12	25.0	7	**11**
Convolvulus remotus	Grassy Bindweed	3	42.9	2	1				0.04	29	10.3	11	6
Sauropus rigens	Stiff Spurge	3	42.9	2	1				0.04	11	27.3	6	8
Other significant perennial taxa													
Rhyncharrhena linearis	Bush Bean	2	28.6	1	1				0.06	3	66.7	2	**25**
Annual taxa occurring at >30% of sites													
Anacampseros australiana	Australian Anacampseros	3	42.9	3					0.01	6	50.0	3	

Figure 54. *Acacia aneura* var. *aneura* (Mulga), *Acacia aneura* var. *tenuis* (Mulga) Very Low Woodland at site PLA00301 on a rocky east-facing hill slope of the Uro Range (Floristic Vegetation Community 11).

Floristic Group 12 *Callitris glaucophylla* (White Cypress-pine) Very Low Open Woodland over *Triodia* sp. (Spinifex)

This Very Low Open Woodland community is found in skeletal loamy soils on rocky hill slopes on the fringes of the taller ranges. The overstorey is often less than 5m but can be up to 15m on occasions and is dominated by *Callitris glaucophylla* (White Cypress-pine). Several species may occur as occasional co-dominants, including *Eucalyptus flindersii* (Flinders Grey Mallee) on rocky ridges and *E. camaldulensis* ssp. *minima* (River Red Gum) in gullies and some watercourses. The understorey comprises a sparse shrub layer of *Cassinia laevis* (Curry Bush), *Dodonaea viscosa* ssp. *angustissima* (Narrow-leaf Hop-bush) and *Sida petrophila* (Rock Sida) and a ground layer featuring *Triodia* sp. (Spinifex). The latter may be one of three species (all of which have been recorded in the northern Flinders Ranges) – *T. irritans* (most commonly), *T. scariosa* or *T. bunicola*.



No. of sites in group: 4
Total taxa in group: 45
Annual: 7
Perennial: 38
Exotic: 6
Average no. of taxa per site: 16.0
Range: 10 - 25

Species of conservation significance: nil

Soils: skeletal, loamy sand and loam
Landforms: hill slopes

Sites: 6ANG1695, 6ANG1701, 6NAR1992, 6NAR1994

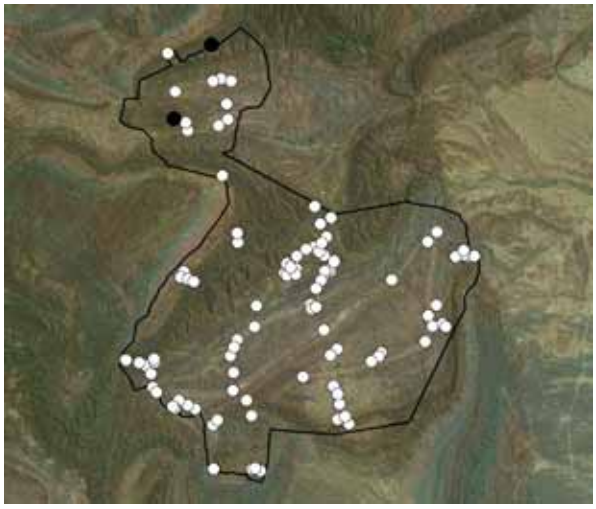
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Callitris glaucophylla	White Cypress-pine	4	100		1	3		0.78	15	26.7	9	**60**
Triodia sp.	Spinifex	3	75		1	2		0.70	8	37.5	5	3
Cassinia laevis	Curry Bush	3	75		2	1		0.40	11	27.3	7	**25**
Austrostipa sp.	Spear-grass	3	75		3			0.10	21	14.3	10	13
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	2	50		1	1		0.55	9	22.2	6	**19**
Paraceterach reynoldsii	Scaly Rock-fern	2	50		1	1		0.55	2	100.0	1	**50**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	2	50		1	1		0.55	70	2.9	16	2
Sida petrophila	Rock Sida	2	50		1	1		0.55	44	4.5	12	3
Cheilanthes lasiophylla	Woolly Cloak-fern	2	50		2			0.10	24	8.3	9	6
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	2	50		2			0.10	9	22.2	5	12
Pleurosorus rutifolius	Blanket Fern	2	50		2			0.10	2	100.0	1	**50**
Chrysocephalum semipapposum	Clustered Everlasting	2	50	1	1			0.06	5	40.0	4	8
Cymbopogon ambiguus	Lemon-grass	2	50	1	1			0.06	38	5.3	15	3
Annual taxa occurring at >30% of sites												
**Acetosa vesicaria*	Rosy Dock	2	50		2			0.10	23	8.7	10	

Figure 55. ***Callitris glaucophylla*** **(White Cypress-pine) Very Low Open Woodland over** ***Triodia irritans*** **(Spinifex) on the eastern slope of the Uro Range (Floristic Vegetation Community 12) (Photo: N. Neagle).**

Floristic Group 13 *Eucalyptus flindersii* (Flinders Grey Mallee), *Melaleuca uncinata* (Broombush) +/- *Eucalyptus intertexta* (Gum-barked Coolibah) Open Low Mallee over *Triodia* sp. (Spinifex)

This Open Low Mallee community is restricted to the higher slopes and crests of the taller hills. Although only recorded at sites north of Nepabunna this community was also observed to be present on the Uro Range during the Nantawarrina IPA Biological Survey. The overstorey is open, generally less than 3m in height and dominated by *Eucalyptus flindersii* (Flinders Grey Mallee), *Melaleuca uncinata* (Broombush) and, occasionally, *E. intertexta* (Gum-barked Coolibah). A variable, and at times diverse, mix of shrubs form an open mid layer with *Spyridium phlebophyllum* (Inland Spyridium), *Calytrix tetragona* (Common Fringe-myrtle) and *Grevillea aspera* (Rough Grevillea) occurring regularly. The most prominent understorey species, though, is the hummock grass *Triodia* sp. (Spinifex), which often forms a mid-dense ground layer. In places, possibly due to fire, the mallee overstorey is absent and the community becomes *M. uncinata* Low Shrubland over *Triodia* sp. As with Floristic Group 12 there are possibly more than one species of *Triodia* present, though *T. irritans* is likely to be the most prevalent.

The elevation at which this community occurs provides a slightly moister micro-climate that supports a number of species not found elsewhere in the IPA. These species are all occurring at, or near, their northern limit in South Australia and many are considered to be of conservation significance in the Flinders Ranges (see below). These include *Grevillea aspera* (Rough Grevillea), *Daviesia genistifolia* (Broom Bitter-pea), *D. stricta* (Flinders Ranges Bitter-pea), *Templetonia aculeata* (Spiny Mallee-pea), *Philotheca angustifolia* ssp. *angustifolia* (Narrow-leaf Wax-flower), *Acacia havilandiorum* (Needle Wattle), *A. continua* (Thorn Wattle), *Astroloma humifusum* (Cranberry Heath) and *Austrostipa pilata* (Prickly Spear-grass).



No. of sites in group: 2
Total taxa in group: 52
Annual: 1
Perennial: 51
Exotic: 0
Average no. of taxa per site: 31.5
Range: 12 - 51

Species of conservation significance: *Austrostipa pilata* (Prickly Spear-grass) SA:V FR:K; *Ozothamnus scaber* (Rough Bush-everlasting) SA:V FR:K; *Daviesia stricta* (Flinders Ranges Bitter-pea) SA:R FR:R; *Philotheca angustifolia* ssp. *angustifolia* (Narrow-leaf Wax-flower) SA:R FR:R; *Eucalyptus polybractea* (Flinders Ranges Box) SA:R FR:U; *Phyllanthus saxosus* (Rock Spurge) FR:U; *Daviesia genistifolia* (Broom Bitter-pea) FR:U; *Templetonia aculeata* (Spiny Mallee-pea) FR:U

Soils: clay loam
Landforms: hill slopes and ridges

Sites: 6ANG1702, 104GAP00601

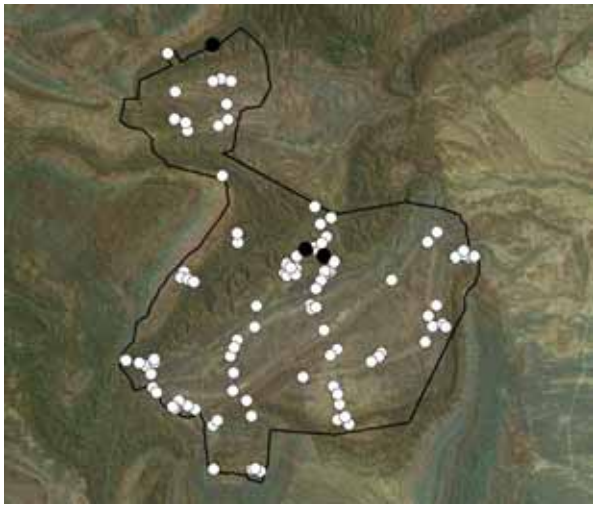
Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Triodia sp.	Spinifex	2	100				1	1	2.50	8	25.0	5	**83**
Melaleuca uncinata	Broombush	2	100			1	1		1.50	3	66.7	2	**94**
Callistemon teretifolius	Needle Bottlebrush	2	100		1	1			0.55	2	100.0	1	**100**
Dianella revoluta var. *revoluta*	Black-anther Flax-lily	2	100		1	1			0.55	4	50.0	3	**72**
Goodenia vernicosa	Wavy Goodenia	2	100		1	1			0.55	7	28.6	6	**61**
Prostanthera striatiflora	Striated Mintbush	2	100	1		1			0.51	10	20.0	8	**54**
Calytrix tetragona	Common Fringe-myrtle	2	100		2				0.10	3	66.7	2	**96**
Cheilanthes lasiophylla	Woolly Cloak-fern	2	100		2				0.10	24	8.3	9	**26**
Eucalyptus flindersii	Flinders Grey Mallee	2	100		2				0.10	3	66.7	2	**67**
Grevillea aspera	Rough Grevillea	2	100		2				0.10	3	66.7	2	**80**
Spyridium phlebophyllum	Inland Spyridium	2	100		2				0.10	4	50.0	3	**63**
Eucalyptus intertexta	Gum-barked Coolibah	1	50				1		2.00	9	11.1	8	**44**
Beyeria lechenaultii	Pale Turpentine Bush	1	50			1			1.00	2	50.0	2	**30**
Cassinia laevis	Curry Bush	1	50			1			1.00	11	9.1	7	17
Chrysocephalum semipapposum	Clustered Everlasting	1	50			1			1.00	5	20.0	4	**25**
Daviesia genistifolia	Broom Bitter-pea	1	50			1			1.00	1	100.0	1	**50**

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Dodonaea baueri	Crinkled Hop-bush	1	50			1			1.00	2	50.0	2	**38**
Eucalyptus polybractea	Flinders Ranges Box	1	50			1			1.00	2	50.0	2	**30**
Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee	1	50			1			1.00	11	9.1	7	2
Lomandra multiflora ssp. *dura*	Hard Mat-rush	1	50			1			1.00	10	10.0	8	**25**
Olearia decurrens	Winged Daisy-bush	1	50			1			1.00	9	11.1	7	**22**
Xanthorrhoea quadrangulata	Rock Grass-tree	1	50			1			1.00	4	25.0	4	**37**
Acacia continua	Thorn Wattle	1	50		1				0.10	1	100.0	1	**50**
Acacia havilandiorum	Needle Wattle	1	50		1				0.10	2	50.0	2	**49**
Astroloma humifusum	Cranberry Heath	1	50		1				0.10	1	100.0	1	**50**
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	1	50		1				0.10	9	11.1	5	12
Daviesia stricta	Flinders Ranges Bitter-pea	1	50		1				0.10	1	100.0	1	**50**
Exocarpos aphyllus	Leafless Cherry	1	50		1				0.10	37	2.7	11	6
Gonocarpus elatus	Hill Raspwort	1	50		1				0.10	1	100.0	1	**50**
Leiocarpa tomentosa	Woolly Plover-daisy	1	50		1				0.10	2	50.0	2	**43**
Marsdenia australis	Native Pear	1	50		1				0.10	29	3.4	12	**15**
Olearia ramulosa	Twiggy Daisy-bush	1	50		1				0.10	1	100.0	1	**50**
Ozothamnus scaber	Rough Bush-everlasting	1	50		1				0.10	2	50.0	2	**21**
Sauropus rigens	Stiff Spurge	1	50		1				0.10	11	9.1	6	**23**
Scaevola spinescens	Spiny Fanflower	1	50		1				0.10	18	5.6	9	9
Senna artemisioides ssp. X *artemisioides*	Silver Senna	1	50		1				0.10	45	2.2	16	3
Solanum petrophilum	Rock Nightshade	1	50		1				0.10	7	14.3	5	**28**
Acacia rivalis	Silver Wattle	1	50	1					0.01	14	7.1	8	2
Amyema miquelii	Box Mistletoe	1	50	1					0.01	10	10.0	7	4
Aristida nitidula	Brush Three-awn	1	50	1					0.01	16	6.3	7	3
Austrodanthonia caespitosa	Common Wallaby-grass	1	50	1					0.01	3	33.3	3	**11**
Austrostipa pilata	Prickly Spear-grass	1	50	1					0.01	1	100.0	1	**50**
Callitris glaucophylla	White Cypress-pine	1	50	1					0.01	15	6.7	9	2
Cymbopogon ambiguus	Lemon-grass	1	50	1					0.01	38	2.6	15	1
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	1	50	1					0.01	9	11.1	6	3
Eremophila oppositifolia ssp. *oppositifolia*	Opposite-leaved Emubush	1	50	1					0.01	8	12.5	6	6
Leiocarpa semicalva ssp. *semicalva*	Scented Button-bush	1	50	1					0.01	10	10.0	6	3
Philotheca angustifolia ssp. *angustifolia*	Narrow-leaf Wax-flower	1	50	1					0.01	1	100.0	1	**50**
Pomax umbellata	Pomax	1	50	1					0.01	1	100.0	1	**50**
Templetonia aculeata	Spiny Mallee-pea	1	50	1					0.01	1	100.0	1	**50**
Themeda triandra	Kangaroo Grass	1	50	1					0.01	8	12.5	5	5
Annual taxa occurring at >30% of sites													
Phyllanthus saxosus	Rock Spurge	1	50		1				0.10	1	100.0	1	

Figure 56. *Eucalyptus intertexta* (Gum-barked Coolibah), *Melaleuca uncinata* (Broombush) Open Low Mallee at site GAP00601 on a high ridge north east of Mt Rowe on the northern boundary of the IPA (Floristic vegetation Community 13).

Floristic Group 14 *Eucalyptus socialis* ssp. *socialis* (Beaked Red Mallee), *Eucalyptus gillii* (Curly Mallee) Open Mallee

This is an Open Mallee community found mainly on calcareous sand or loam soils on the slopes of low hills fringing the south eastern side of the Uro Range. A slightly varied form was also sampled on the crest of the high range near Mount Rowe, north of Nepabunna. The open overstorey is dominated by the two mallees *Eucalyptus socialis* ssp. *socialis* (Beaked Red Mallee) and *E. gillii* (Curly Mallee). Two other mallee species, *Eucalyptus intertexta* (Gum-barked Coolibah) and *E. polybractea* (Flinders Ranges Box) may also be present, but in lower densities. The understorey is of low diversity and often very sparse, but generally includes a mix of *Alectryon oleifolius* ssp. *canescens* (Bullock Bush), *Eremophila scoparia* (Broom Emubush), *Olearia decurrens* (Winged Daisy-bush), *Maireana pentatropis* (Erect Mallee Bluebush), *Dissocarpus paradoxus* (Ball Bindyi) and *Sclerolaena diacantha*/*uniflora* (Grey Bindyi).



No. of sites in group: 3
Total taxa in group: 55
Annual: 3
Perennial: 52
Exotic: 0
Average no. of taxa per site: 23.3
Range: 20 - 29

Species of conservation significance: *Ozothamnus scaber* (Rough Bush-everlasting) SA:V FR:K; *Eucalyptus polybractea* (Flinders Ranges Box) SA:R FR:U

Soils: clayey sand, sandy loam and clay loam
Landforms: hill slopes

Sites: 104GAP00602, 104NAN00401, 636PLA00501

Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites												
Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee	3	100.0				3	2.00	11	27.3	7	**89**
Eucalyptus gillii	Curly Mallee	2	66.7				2	2.00	15	13.3	7	**58**
Dissocarpus paradoxus	Ball Bindyi	2	66.7		1	1		0.55	32	6.3	12	6
Sclerolaena diacantha/uniflora	Grey Bindyi	2	66.7		1	1		0.55	24	8.3	10	13
Amyema miquelii	Box Mistletoe	2	66.7	1		1		0.51	10	20.0	7	**35**
Casuarina pauper	Black Oak	2	66.7	1		1		0.51	41	4.9	11	2
Eremophila scoparia	Broom Emubush	2	66.7	1		1		0.51	11	18.2	8	**28**
Olearia decurrens	Winged Daisy-bush	2	66.7	1		1		0.51	9	22.2	7	22
Alectryon oleifolius ssp. *canescens*	Bullock Bush	2	66.7		2			0.10	42	4.8	13	6
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	2	66.7		2			0.10	35	5.7	12	3
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	2	66.7	1	1			0.06	52	3.8	13	5
Acacia oswaldii	Umbrella Wattle	2	66.7	2				0.01	8	25.0	5	**15**
Acacia tetragonophylla	Dead Finish	2	66.7	2				0.01	65	3.1	13	1
Beyeria lechenaultii	Pale Turpentine Bush	1	33.3			1		1.00	2	50.0	2	13
Chrysocephalum semipapposum	Clustered Everlasting	1	33.3			1		1.00	5	20.0	4	11
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	1	33.3			1		1.00	9	11.1	6	11
Eucalyptus intertexta	Gum-barked Coolibah	1	33.3			1		1.00	9	11.1	8	2
Eucalyptus polybractea	Flinders Ranges Box	1	33.3			1		1.00	2	50.0	2	13
Goodenia vernicosa	Wavy Goodenia	1	33.3			1		1.00	7	14.3	6	9
Maireana pentatropis	Erect Mallee Bluebush	1	33.3			1		1.00	2	50.0	2	**30**
Melaleuca lanceolata	Dryland Tea-tree	1	33.3			1		1.00	1	100.0	1	**33**
Melaleuca uncinata	Broombush	1	33.3			1		1.00	3	33.3	2	2
Ozothamnus scaber	Rough Bush-everlasting	1	33.3			1		1.00	2	50.0	2	19
Sclerolaena obliquicuspis	Oblique-spined Bindyi	1	33.3			1		1.00	61	1.6	14	2
Triodia sp.	Spinifex	1	33.3			1		1.00	8	12.5	5	1
Austrostipa sp.	Spear-grass	1	33.3		1			0.10	21	4.8	10	3

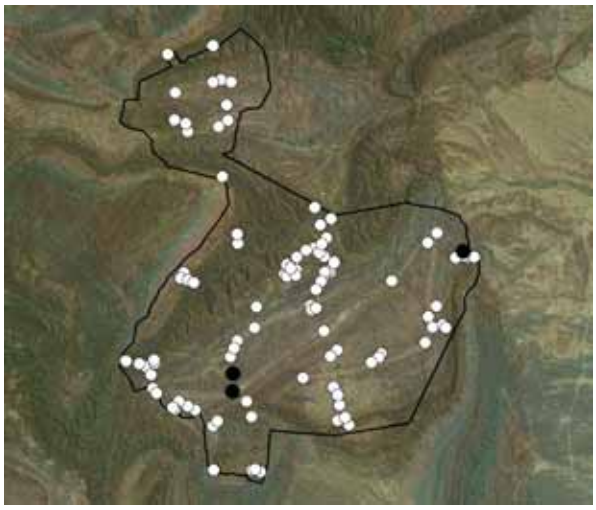
Species Name	Common Name	Freq	% Freq	N	T	1	2	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Brachyscome ciliaris var. *ciliaris*	Variable Daisy	1	33.3		1			0.10	4	25.0	4	**21**
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	1	33.3		1			0.10	9	11.1	5	5
Dianella revoluta var. *revoluta*	Black-anther Flax-lily	1	33.3		1			0.10	4	25.0	3	5
Dodonaea baueri	Crinkled Hop-bush	1	33.3		1			0.10	2	50.0	2	8
Eriochiton sclerolaenoides	Woolly-fruit Bluebush	1	33.3		1			0.10	12	8.3	6	8
Lomandra multiflora ssp. *dura*	Hard Mat-rush	1	33.3		1			0.10	10	10.0	8	6
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	1	33.3		1			0.10	35	2.9	12	5
Prostanthera striatiflora	Striated Mintbush	1	33.3		1			0.10	10	10.0	8	5
Ptilotus exaltatus var.	Pink Mulla Mulla	1	33.3		1			0.10	15	6.7	9	8
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	1	33.3		1			0.10	70	1.4	16	1
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	1	33.3		1			0.10	20	5.0	12	
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	1	33.3		1			0.10	50	2.0	14	
Solanum ellipticum/ *quadriloculatum*		1	33.3		1			0.10	62	1.6	15	2
Spyridium phlebophyllum	Inland Spyridium	1	33.3		1			0.10	4	25.0	3	7
Vittadinia australasica var. *australasica*	Sticky New Holland Daisy	1	33.3		1			0.10	7	14.3	5	11
Acacia victoriae ssp. *victoriae*	Elegant Wattle	1	33.3	1				0.01	61	1.6	15	
Austrostipa nitida	Balcarra Spear-grass	1	33.3	1				0.01	18	5.6	9	
Callitris glaucophylla	White Cypress-pine	1	33.3	1				0.01	15	6.7	9	1
Enneapogon polyphyllus	Leafy Bottle-washers	1	33.3	1				0.01	5	20.0	5	2
Eremophila glabra ssp. *glabra*	Tar Bush	1	33.3	1				0.01	14	7.1	9	3
Exocarpos aphyllus	Leafless Cherry	1	33.3	1				0.01	37	2.7	11	1
Glycine rubiginosa	Twining Glycine	1	33.3	1				0.01	7	14.3	7	3
Marsdenia australis	Native Pear	1	33.3	1				0.01	29	3.4	12	1
Myoporum platycarpum ssp.	False Sandalwood	1	33.3	1				0.01	4	25.0	4	10
Senna artemisioides ssp. X *artemisioides*	Silver Senna	1	33.3	1				0.01	45	2.2	16	
Tribulus eichlerianus	Eichler's Caltrop	1	33.3	1				0.01	3	33.3	3	5
Annual taxa occurring at >30% of sites												
Salsola tragus	Buckbush	2	66.7			1	1	1.50	50	4.0	13	
Dysphania melanocarpa f.	Black-fruit Goosefoot	1	33.3	1				0.01	7	14.3	5	
Zygophyllum prismatothecum	Square-fruit Twinleaf	1	33.3	1				0.01	6	16.7	4	

Figure 57. *Eucalyptus socialis* ssp. *socialis* (Beaked Red Mallee), *E. gillii* (Curly Mallee) Open Mallee at site NAN00401 in low hills south of the Plaque (Floristic Vegetation Community 14) (Photo: N. Neagle).

Floristic Group 15 *Melaleuca glomerata* (Inland Paper-bark) Tall Shrubland with emergent *Eucalyptus camaldulensis* ssp. *minima* (River Red Gum)

This is a widespread Tall Shrubland to Low Open Forest community that occurs as narrow linear strips lining minor watercourses in the low hills and the undulating plain south east of the Uro Range. It is dominated by *Melaleuca glomerata* (Inland Paper-bark) which, in places, can form quite dense thickets. *Eucalyptus camaldulensis* ssp. *minima* (River Red Gum) occurs as an emergent, becoming more abundant where the watercourses broaden and carry water more often. The understorey is open with few shrubs above 50cm in height. Regularly occurring low shrubs include *Abutilon leucopetalum* (Desert Lantern-bush), *Malvastrum americanum* var. *americanum* (Malvastrum), *Pterocaulon sphacelatum* (Apple-bush) and *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla), plus the perennial herb *Wahlenbergia aridicola* (Dryland Bluebell).

The added moisture on the creeklines allows for the presence of numerous annuals not usually occurring in communities of other habitats in the IPA. However, many of these are exotics, particularly the more abundant such as **Carrichtera annua* (Ward's Weed) and **Datura leichhardtii* (Native Thorn-apple). The most common native annual is *Salsola tragus* (Buckbush).



No. of sites in group: 3
Total taxa in group: 94
Annual: 25
Perennial: 69
Exotic: 15
Average no. of taxa per site: 45.0
Range: 21 - 69

Species of conservation significance: *Chenopodium curvispicatum* (Cottony Goosefoot) FR:K; *Wahlenbergia aridicola* (Dryland Bluebell) FR:R; *Schoenoplectus litoralis* (Shore Club-rush) FR:U

Soils: loamy sand and sandy clay loam
Landforms: drainage lines

Sites: 6NEP0979, 636IRI00301, 636IRI00401

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Melaleuca glomerata	Inland Paper-bark	3	100.0				1	2	2.67	10	30.0	4	**88**
Abutilon leucopetalum	Desert Lantern-bush	3	100.0	1	2				0.07	28	10.7	8	21
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	3	100.0	1	2				0.07	70	4.3	16	4
Eucalyptus camaldulensis ssp.	River Red Gum	3	100.0	2	1				0.04	14	21.4	5	2
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	3	100.0	3					0.01	35	8.6	12	9
Dissocarpus paradoxus	Ball Bindyi	2	66.7		1	1			0.55	32	6.3	12	6
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	2	66.7		2				0.10	52	3.8	13	8
Malvastrum americanum var. *americanum*	Malvastrum	2	66.7		2				0.10	25	8.0	9	12
Pterocaulon sphacelatum	Apple-bush	2	66.7		2				0.10	15	13.3	6	23
Sclerolaena obliquicuspis	Oblique-spined Bindyi	2	66.7		2				0.10	61	3.3	14	4
Wahlenbergia aridicola	Dryland Bluebell	2	66.7		2				0.10	6	33.3	3	**50**
Zygophyllum apiculatum	Pointed Twinleaf	2	66.7		2				0.10	9	22.2	5	**31**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	2	66.7	1	1				0.06	61	3.3	15	2
Alectryon oleifolius ssp. *canescens*	Bullock Bush	2	66.7	1	1				0.06	42	4.8	13	4
**Citrullus colocynthis*	Colocynth	2	66.7	1	1				0.06	5	40.0	3	**44**
Convolvulus remotus	Grassy Bindweed	2	66.7	1	1				0.06	29	6.9	11	**18**
Dodonaea lobulata	Lobed-leaf Hop-bush	2	66.7	1	1				0.06	30	6.7	12	6
Euphorbia tannensis ssp. *eremophila*	Desert Spurge	2	66.7	1	1				0.06	3	66.7	2	19
Maireana brevifolia	Short-leaf Bluebush	2	66.7	1	1				0.06	8	25.0	4	24
**Marrubium vulgare*	Horehound	2	66.7	1	1				0.06	9	22.2	5	21
Solanum sturtianum	Sturt's Nightshade	2	66.7	1	1				0.06	22	9.1	10	8
Trichodesma zeylanicum var. *zeylanicum*	Camel Bush	2	66.7	1	1				0.06	5	40.0	2	**60**
Chenopodium desertorum ssp.	Desert Goosefoot	2	66.7	2					0.01	3	66.7	2	**53**
Lotus cruentus	Red-flower Lotus	2	66.7	2					0.01	4	50.0	3	**26**
Oxalis perennans	Native Sorrel	2	66.7	2					0.01	11	18.2	6	8

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Senecio magnificus	Showy Groundsel	2	66.7	2					0.01	33	6.1	11	3
Typha orientalis	Broad-leaf Bulrush	1	33.3					1	3.00	1	100.0	1	**33**
Atriplex acutibractea ssp.	Pointed Saltbush	1	33.3		1				0.10	14	7.1	7	6
Boerhavia dominii	Tar-vine	1	33.3		1				0.10	13	7.7	6	10
Chamaesyce drummondii		1	33.3		1				0.10	6	16.7	4	**15**
Cheilanthes lasiophylla	Woolly Cloak-fern	1	33.3		1				0.10	24	4.2	9	3
Chenopodium curvispicatum	Cottony Goosefoot	1	33.3		1				0.10	2	50.0	2	**32**
Cymbopogon ambiguus	Lemon-grass	1	33.3		1				0.10	38	2.6	15	2
Enneapogon polyphyllus	Leafy Bottle-washers	1	33.3		1				0.10	5	20.0	5	**12**
Eremophila longifolia	Weeping Emubush	1	33.3		1				0.10	8	12.5	6	**13**
Glycine rubiginosa	Twining Glycine	1	33.3		1				0.10	7	14.3	7	**14**
Marsdenia australis	Native Pear	1	33.3		1				0.10	29	3.4	12	7
**Polypogon viridis*	Water Bent	1	33.3		1				0.10	1	100.0	1	**33**
Rhagodia spinescens	Spiny Saltbush	1	33.3		1				0.10	19	5.3	10	3
Scaevola humilis	Inland Fanflower	1	33.3		1				0.10	1	100.0	1	**33**
Schoenoplectus litoralis	Shore Club-rush	1	33.3		1				0.10	1	100.0	1	**33**
Sida filiformis	Fine Sida	1	33.3		1				0.10	1	100.0	1	**33**
Sida intricata	Twiggy Sida	1	33.3		1				0.10	12	8.3	5	11
Sida petrophila	Rock Sida	1	33.3		1				0.10	44	2.3	12	1
Solanum ellipticum/quadriloculatum		1	33.3		1				0.10	62	1.6	15	2
Tribulus eichlerianus	Eichler's Caltrop	1	33.3		1				0.10	3	33.3	3	**24**
Vittadinia gracilis	Woolly New Holland Daisy	1	33.3		1				0.10	11	9.1	8	**9**
Wahlenbergia communis	Tufted Bluebell	1	33.3		1				0.10	4	25.0	4	**27**
Acacia rivalis	Silver Wattle	1	33.3	1					0.01	14	7.1	8	1
Acacia tetragonophylla	Dead Finish	1	33.3	1					0.01	65	1.5	13	
**Asphodelus fistulosus*	Onion Weed	1	33.3	1					0.01	2	50.0	2	**22**
Austrostipa sp.	Spear-grass	1	33.3	1					0.01	21	4.8	10	1
Cyperus gymnocaulos	Spiny Flat-sedge	1	33.3	1					0.01	4	25.0	2	5
Eremophila freelingii	Rock Emubush	1	33.3	1					0.01	44	2.3	12	
Eremophila glabra ssp. *glabra*	Tar Bush	1	33.3	1					0.01	14	7.1	9	3
Eremophila latrobei ssp.	Crimson Emubush	1	33.3	1					0.01	4	25.0	4	8
Eremophila scoparia	Broom Emubush	1	33.3	1					0.01	11	9.1	8	1
Eucalyptus intertexta	Gum-barked Coolibah	1	33.3	1					0.01	9	11.1	8	
Leiocarpa websteri	Narrow Plover-daisy	1	33.3	1					0.01	6	16.7	5	6
Lomandra multiflora ssp. *dura*	Hard Mat-rush	1	33.3	1					0.01	10	10.0	8	1
Melhania oblongifolia	Velvet Hibiscus	1	33.3	1					0.01	2	50.0	2	**15**
Myoporum platycarpum ssp.	False Sandalwood	1	33.3	1					0.01	4	25.0	4	**10**
Petalostylis labicheoides	Butterfly Bush	1	33.3	1					0.01	1	100.0	1	**33**
Pimelea microcephala ssp. *microcephala*	Shrubby Riceflower	1	33.3	1					0.01	4	25.0	3	**20**
Sclerolaena lanicuspis	Spinach Bindyi	1	33.3	1					0.01	11	9.1	6	3
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	1	33.3	1					0.01	20	5.0	12	
Senna artemisioides ssp. *helmsii*	Blunt-leaf Senna	1	33.3	1					0.01	3	33.3	2	10
Senna artemisioides ssp. X *artemisioides*	Silver Senna	1	33.3	1					0.01	45	2.2	16	
Vittadinia australasica var. *australasica*	Sticky New Holland Daisy	1	33.3	1					0.01	7	14.3	5	2
Annual taxa occurring at >30% of sites													
**Carrichtera annua*	Ward's Weed	2	66.7		1	1			0.55	23	8.7	8	
**Datura leichhardtii*	Native Thorn-apple	2	66.7		1	1			0.55	7	28.6	3	
Salsola tragus	Buckbush	2	66.7		1	1			0.55	50	4.0	13	
Dysphania cristata	Crested Goosefoot	2	66.7		2				0.10	6	33.3	4	
Heliotropium europaeum	Common Heliotrope	2	66.7		2				0.10	9	22.2	4	
**Sisymbrium erysimoides*	Smooth Mustard	2	66.7		2				0.10	17	11.8	6	
Amaranthus mitchellii	Boggabri Weed	2	66.7	1	1				0.06	3	66.7	2	
Chamaesyce australis		2	66.7	1	1				0.06	8	25.0	5	
Tetragonia eremaea	Desert Spinach	2	66.7	1	1				0.06	8	25.0	3	
Trianthema triquetra	Red Spinach	2	66.7	1	1				0.06	6	33.3	5	
**Chenopodium murale*	Nettle-leaf Goosefoot	1	33.3		1				0.10	2	50.0	2	
**Dittrichia graveolens*	Stinkweed	1	33.3		1				0.10	3	33.3	2	
Dysphania melanocarpa f.	Black-fruit Goosefoot	1	33.3		1				0.10	7	14.3	5	
**Glaucium corniculatum*	Bristly Horned-poppy	1	33.3		1				0.10	1	100.0	1	
**Hypochaeris glabra*	Smooth Cat's Ear	1	33.3		1				0.10	1	100.0	1	
Nicotiana velutina	Velvet Tobacco	1	33.3		1				0.10	4	25.0	4	
Portulaca oleracea	Common Purslane	1	33.3		1				0.10	2	50.0	2	
Zygophyllum prismatothecum	Square-fruit Twinleaf	1	33.3		1				0.10	6	16.7	4	
**Acetosa vesicaria*	Rosy Dock	1	33.3	1					0.01	23	4.3	10	
**Centaurea melitensis*	Malta Thistle	1	33.3	1					0.01	32	3.1	12	
Chrysocephalum eremaeum	Sand Button-bush	1	33.3	1					0.01	4	25.0	4	
**Onopordum acaulon*	Horse Thistle	1	33.3	1					0.01	1	100.0	1	

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Setaria basiclada		1	33.3	1					0.01	2	50.0	2	
**Sonchus oleraceus*	Common Sow-thistle	1	33.3	1					0.01	6	16.7	6	
Swainsona formosa	Sturt Pea	1	33.3	1					0.01	2	50.0	2	

Figure 58. *Melaleuca glomerata* (Inland Paperbark) Tall Shrubland at site IRI00301 on a minor creekline between Bald Hill and Irish Well (Floristic Vegetation Community 15).

Floristic Group 16 *Eucalyptus camaldulensis* ssp. *minima* (River Red Gum) Woodland

This is perhaps the most distinctive plant community of the Flinders Ranges. In the IPA *Eucalyptus camaldulensis* ssp. *minima* (River Red Gum) Woodland forms impressive tall stands beside the major watercourses. The trees are tall (to 20m) with straight smooth-barked trunks. The understorey is usually open with *Acacia victoriae* ssp. *victoriae* (Elegant Wattle) common in a very sparse mid shrub layer. *Melaleuca glomerata* (Inland Paper-bark) is common in patches where it may form thickets. There are numerous low shrubs regularly present, including *Malvastrum americanum* var. *americanum* (Malvastrum), *Abutilon leucopetalum* (Desert Lantern-bush), *Pterocaulon sphacelatum* (Apple-bush), *Enchylaena tomentosa* var. *tomentosa* (Ruby Saltbush), *Solanum sturtianum* (Sturt's Nightshade), *Maireana brevifolia* (Short-leaf Bluebush), *Senecio magnificus* (Showy Groundsel), *Zygophyllum apiculatum* (Pale Twinleaf), *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla) and *Dissocarpus paradoxus* (Ball Bindyi), as well as the grass *Cymbopogon ambiguus* (Lemon-grass). Numerous annuals are present, though many are exotic, including **Datura leichhardtii* (Native Thorn-apple), *Salsola tragus* (Buckbush) and *Heliotropium europaeum* (Common Heliotrope).

No. of sites in group: 6
Total taxa in group: 130
Annual: 28
Perennial: 102
Exotic: 18
Average no. of taxa per site: 46.5
Range: 14 - 69

Species of conservation significance: *Austrostipa platychaeta* (Flat-awn Spear-grass) FR:R; *Wahlenbergia aridicola* (Dryland Bluebell) FR:R; *Jasminum didymium* ssp. *lineare* (Native Jasmine) FR:U

Soils: loamy sand, clayey sand, sandy loam and silty loam
Landforms: drainage lines

Sites: 6NEP0946, 6WER1172, 104NAN00201, 636ORA00201, 636PLA00101, 636PLA00601

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Eucalyptus camaldulensis ssp.	River Red Gum	6	100.0				4	2	2.33	14	42.9	5	**95**
Malvastrum americanum var. *americanum*	Malvastrum	6	100.0		4	2			0.40	25	24.0	9	**37**
Acacia victoriae ssp. *victoriae*	Elegant Wattle	6	100.0		5	1			0.25	61	9.8	15	9
Abutilon leucopetalum	Desert Lantern-bush	6	100.0	1	4	1			0.24	28	21.4	8	**30**
Pterocaulon sphacelatum	Apple-bush	6	100.0		6				0.10	15	40.0	6	**51**
Melaleuca glomerata	Inland Paper-bark	5	83.3		2	2	1		0.84	10	50.0	4	10
Cymbopogon ambiguus	Lemon-grass	5	83.3		2	3			0.64	38	13.2	15	**20**
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	5	83.3	1	1	3			0.62	52	9.6	13	**18**
Solanum sturtianum	Sturt's Nightshade	5	83.3		5				0.10	22	22.7	10	**22**
Dissocarpus paradoxus	Ball Bindyi	4	66.7		2	1	1		0.80	32	12.5	12	**24**
Senecio magnificus	Showy Groundsel	4	66.7		3	1			0.33	33	12.1	11	**18**
Maireana brevifolia	Short-leaf Bluebush	4	66.7	1	2	1			0.30	8	50.0	4	**41**
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	4	66.7	1	2	1			0.30	70	5.7	16	3
Zygophyllum apiculatum	Pointed Twinleaf	4	66.7	2	1	1			0.28	9	44.4	5	26
Boerhavia dominii	Tar-vine	4	66.7	1	3				0.08	13	30.8	6	**31**
**Marrubium vulgare*	Horehound	4	66.7	1	3				0.08	9	44.4	5	**28**
Ajuga australis f.	Australian Bugle	4	66.7	2	2				0.06	4	100.0	1	**67**
Sclerolaena obliquicuspis	Oblique-spined Bindyi	4	66.7	2	2				0.06	61	6.6	14	2
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	4	66.7	3	1				0.03	35	11.4	12	8
Marsdenia australis	Native Pear	4	66.7	4					0.01	29	13.8	12	5
Senna artemisioides ssp. X *artemisioides*	Silver Senna	3	50.0	1	1	1			0.37	45	6.7	16	3
Oxalis perennans	Native Sorrel	3	50.0		3				0.10	11	27.3	6	**22**
Alectryon oleifolius ssp. *canescens*	Bullock Bush	3	50.0	1	2				0.07	42	7.1	13	2
Cyperus gymnocaulos	Spiny Flat-sedge	3	50.0	1	2				0.07	4	75.0	2	**42**
Dodonaea lobulata	Lobed-leaf Hop-bush	3	50.0	1	2				0.07	30	10.0	12	4

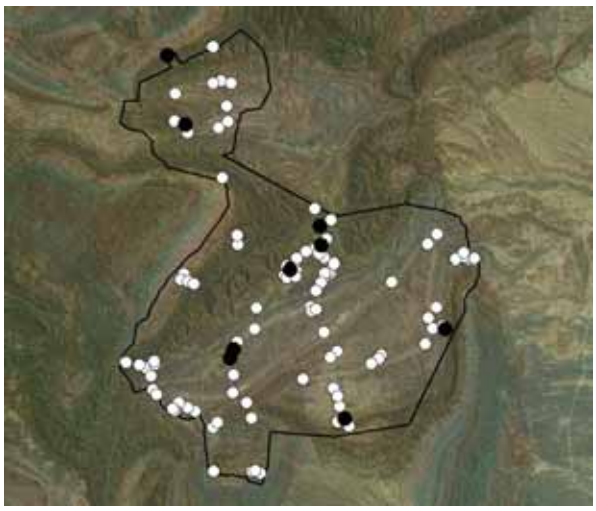
Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Eremophila freelingii	Rock Emubush	3	50.0	1	2				0.07	44	6.8	12	1
Rhagodia parabolica	Mealy Saltbush	3	50.0	1	2				0.07	5	60.0	3	**30**
Sida petrophila	Rock Sida	3	50.0	1	2				0.07	44	6.8	12	1
Eremophila glabra ssp. *glabra*	Tar Bush	3	50.0	2	1				0.04	14	21.4	9	**16**
Eremophila serrulata	Green Emubush	3	50.0	2	1				0.04	9	33.3	4	10
Lomandra multiflora ssp. *dura*	Hard Mat-rush	3	50.0	2	1				0.04	10	30.0	8	6
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	3	50.0	2	1				0.04	50	6.0	14	1
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	3	50.0	3					0.01	9	33.3	6	3
Acacia tetragonophylla	Dead Finish	2	33.3		1	1			0.55	65	3.1	13	2
Sclerolaena patenticuspis	Spear-fruit Bindyi	2	33.3		1	1			0.55	12	16.7	7	9
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	2	33.3		1	1			0.55	20	10.0	12	1
Setaria constricta	Knotty-butt Paspalidium	2	33.3		1	1			0.55	7	28.6	5	**20**
Acacia rivalis	Silver Wattle	2	33.3	1		1			0.51	14	14.3	8	6
Callitris glaucophylla	White Cypress-pine	2	33.3	1		1			0.51	15	13.3	9	4
Solanum ellipticum/ quadriloculatum		2	33.3		2				0.10	62	3.2	15	2
Themeda triandra	Kangaroo Grass	2	33.3		2				0.10	8	25.0	5	**10**
Vittadinia australasica var. *australasica*	Sticky New Holland Daisy	2	33.3		2				0.10	7	28.6	5	**11**
Acacia salicina	Willow Wattle	2	33.3	1	1				0.06	2	100.0	1	**33**
Atriplex acutibractea ssp.	Pointed Saltbush	2	33.3	1	1				0.06	14	14.3	7	4
Austrostipa nitida	Balcarra Spear-grass	2	33.3	1	1				0.06	18	11.1	9	1
Chamaesyce drummondii		2	33.3	1	1				0.06	6	33.3	4	9
**Citrullus colocynthis*	Colocynth	2	33.3	1	1				0.06	5	40.0	3	11
Santalum lanceolatum	Plumbush	2	33.3	1	1				0.06	11	18.2	7	**7**
Solanum petrophilum	Rock Nightshade	2	33.3	1	1				0.06	7	28.6	5	7
Teucrium racemosum	Grey Germander	2	33.3	1	1				0.06	3	66.7	2	**25**
Wahlenbergia aridicola	Dryland Bluebell	2	33.3	1	1				0.06	6	33.3	3	7
Amyema maidenii ssp. *maidenii*	Pale-leaf Mistletoe	2	33.3	2					0.01	15	13.3	7	3
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	2	33.3	2					0.01	35	5.7	12	
Glossocardia bidens	Native Cobbler's-pegs	2	33.3	2					0.01	3	66.7	2	13
Jasminum didymum ssp. *lineare*	Native Jasmine	2	33.3	2					0.01	3	66.7	2	**23**
Malva preissiana	Australian Hollyhock	2	33.3	2					0.01	2	100.0	1	**33**
Pittosporum angustifolium	Native Apricot	2	33.3	2					0.01	11	18.2	6	2
Annual taxa occurring at >30% of sites													
Salsola tragus	Buckbush	5	83.3	2	2	1			0.24	50	10.0	13	
**Datura leichhardtii*	Native Thorn-apple	4	66.7	1	3				0.08	7	57.1	3	
Heliotropium europaeum	Common Heliotrope	4	66.7	1	3				0.08	9	44.4	4	
**Centaurea melitensis*	Malta Thistle	3	50.0		2	1			0.40	32	9.4	12	
**Sisymbrium erysimoides*	Smooth Mustard	3	50.0		2	1			0.40	17	17.6	6	
**Carrichtera annua*	Ward's Weed	3	50.0		3				0.10	23	13.0	8	
Tetragonia eremaea	Desert Spinach	3	50.0	1	2				0.07	8	37.5	3	
Chamaesyce australis		2	33.3		2				0.10	8	25.0	5	
**Cucumis myriocarpus*	Paddy Melon	2	33.3		2				0.10	2	100.0	1	
Dysphania melanocarpa f.	Black-fruit Goosefoot	2	33.3		2				0.10	7	28.6	5	
**Xanthium spinosum*	Bathurst Burr	2	33.3	1	1				0.06	2	100.0	1	
**Carthamus lanatus*	Saffron Thistle	2	33.3	2					0.01	3	66.7	2	
**Dittrichia graveolens*	Stinkweed	2	33.3	2					0.01	3	66.7	2	
Dysphania cristata	Crested Goosefoot	2	33.3	2					0.01	6	33.3	4	

Figure 59. ***Eucalyptus camaldulensis*** **ssp.** ***minima*** **(River Red Gum) Woodland at site NAN00201 in Mt McKinlay Creek just south of the entrance to the IPA (Floristic Vegetation Community 16) (Photo: N. Neagle).**

Figure 60. ***Eucalyptus camaldulensis*** **ssp.** ***minima*** **(River Red Gum) Woodland beside the Alerumba Creek south of the Plaque (Floristic Vegetation Community 16) (Photo: N. Neagle).**

Floristic Group 17 *Casuarina pauper* (Black Oak) Very Low Woodland

This Very Low Woodland community occurs throughout the IPA on mainly loam and clay soils on the rocky footslopes of the taller ranges and slopes of lower hills. The overstorey is mostly less than 5m tall and sparse to mid dense, being dominated by *Casuarina pauper* (Black Oak). The understorey tends to be very sparse with the occasional *Alectryon oleifolius* ssp. *canescens* (Bullock Bush), *Exocarpos aphyllus* (Leafless Cherry), *Senna artemisioides* ssp. X *coriacea* (Broad-leaf Desert Senna), *Enchylaena tomentosa* var. *tomentosa* (Rosy Saltbush), *Ptilotus obovatus* var. *obovatus* (Silver Mulla Mulla) and *Sclerolaena obliquicuspis* (Oblique-spined Bindyi). A relatively high number of annuals have been recorded within this community, though rarely are they abundant. The most common is *Salsola tragus* (Buckbush).



No. of sites in group: 9
Total taxa in group: 96
Annual: 17
Perennial: 79
Exotic: 5
Average no. of taxa per site: 22.9
Range: 7 - 34

Species of conservation significance: *Anacampseros australiana* (Australian Anacampseros) FR:U; *Rhyncharrhena linearis* (Bush Bean) FR:U

Soils: clayey sand, sandy loam, loam, sandy clay loam, light clay and medium clay
Landforms: hill footslopes and hill slopes

Sites: 6ANG1999, 6ANG1734, 6NEP1160, 6WER1175, 104NAN00301, 636IRI00201, 636ORA00601, 636PLA00201, 636PLA00701

Species Name	Common Name	Freq	% Freq	N	T	1	2	3	C/A Ave	Tot Recs	% Recs	Tot Grps	Ind Val
Perennial taxa occurring at >30% of sites													
Casuarina pauper	Black Oak	9	100.0				7	2	2.22	41	22.0	11	**83**
Alectryon oleifolius ssp. *canescens*	Bullock Bush	8	88.9	2	4	1	1		0.43	42	19.0	13	**35**
Exocarpos aphyllus	Leafless Cherry	8	88.9	3	5				0.07	37	21.6	11	14
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	7	77.8	2	2	3			0.46	52	13.5	13	13
Dissocarpus paradoxus	Ball Bindyi	6	66.7		5		1		0.42	32	18.8	12	17
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	6	66.7	1	4		1		0.40	50	12.0	14	8
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	6	66.7	1	5				0.09	70	8.6	16	2
Solanum ellipticum/ quadriloculatum		6	66.7	3	3				0.06	62	9.7	15	4
Acacia tetragonophylla	Dead Finish	6	66.7	4	2				0.04	65	9.2	13	2
Sclerolaena obliquicuspis	Oblique-spined Bindyi	5	55.6	1	3	1			0.26	61	8.2	14	3
Marsdenia australis	Native Pear	5	55.6	5					0.01	29	17.2	12	4
Sclerolaena diacantha/uniflora	Grey Bindyi	4	44.4	2	2				0.06	24	16.7	10	2
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	4	44.4	3	1				0.03	35	11.4	12	4
Ptilotus exaltatus var.	Pink Mulla Mulla	4	44.4	3	1				0.03	15	26.7	9	6
Acacia victoriae ssp. *victoriae*	Elegant Wattle	3	33.3		3				0.10	61	4.9	15	1
Eucalyptus gillii	Curly Mallee	3	33.3		3				0.10	15	20.0	7	1
Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush	3	33.3	1	2				0.07	12	25.0	7	10
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	3	33.3	1	2				0.07	35	8.6	12	1
Senna artemisioides ssp. X *artemisioides*	Silver Senna	3	33.3	1	2				0.07	45	6.7	16	1
Acacia oswaldii	Umbrella Wattle	3	33.3	2	1				0.04	8	37.5	5	9
Senecio magnificus	Showy Groundsel	3	33.3	2	1				0.04	33	9.1	11	2
Annual taxa occurring at >30% of sites													
Salsola tragus	Buckbush	6	66.7	1	4	1			0.24	50	12.0	13	
Zygophyllum prismatothecum	Square-fruit Twinleaf	3	33.3	2	1				0.04	6	50.0	4	

Figure 61. ***Casuarina pauper*** **(Black Oak) Very Low Woodland at site PLA00201 on the eastern footslopes of the Uro Range (Floristic Vegetation Community 17).**

Figure 62. ***Casuarina pauper*** **(Black Oak) Low Woodland at site PLA00701 in low hills north of the Plaque (Floristic Vegetation Community 17).**

MAMMALS

D. Armstrong[1]

Introduction

Based on information from early settlers, Aboriginal knowledge, sub-fossil deposits and SA Museum specimens, as many as 50 native mammal species were known to have occurred within the length of the Flinders Ranges at the beginning of the 19th Century (Smith 1996). Although some were restricted to the southern ranges and others were generally inhabitants of the plains country peripheral to the ranges, many would have occurred within the Nantawarrina IPA. Mainly due to changes in land use with the advent of pastoralism and the introduction of feral species, 24 of the previously known native mammals are extinct or no longer occur in the ranges (Smith 1996).

Where available, Adnyamathanha names have been used in headings of the following sections and are shown in block bracketed bold text. They are taken from Tunbridge (1988 and 1991).

Total Mammal Fauna

Prior to this survey of the Nantawarrina IPA, the limited available records for the reserve provided evidence of occurrence of only 11 mammal species, seven native and four introduced (Appendix 8). This survey obtained a far greater number of additional records, representing 81% of those currently available, and increasing the known mammal species for the IPA to 23, including all those previously recorded. Of these, 15 are native and eight are introduced or feral species.

The native species consist of:-

- one monotreme,
- two species of dasyurid or carnivorous marsupial,
- four species of macropod,
- two species of native rodent,
- five species of insectivorous bats, and
- the dingo

The introduced (feral) mammal species groupings are:-

- four ungulates,
- two carnivores,
- one rodent, and
- one lagomorph.

Species at Survey Sample Sites

Twenty-one standard survey sampling sites providing 128 mammal records were established during this survey. These sites were located in groups based around three separate camp sites, at Orange Tree Dam, Irish Well and Plaque Camp (Figure 63). Almost all of the mammal records available for the IPA prior to this survey were collected in 1999 as a small portion of the sampling effort of the Flinders Ranges Biological Survey. Six were sampled at that time, yielding 36 records, with a further 16 records collected opportunistically within the IPA. Five of the six sites were in the central north of the reserve adjacent to the track into the IPA running south from the Copley - Balcanoona road. The sixth (site GAP00601) was located on a ridgeline on the northern boundary of the IPA, north of Nepabunna (Figure 63). Of the combined 27 sites sampled within the IPA during the two surveys, mammal records were obtained from 26 (Appendices 9 & 10).

Table 21 is a compilation of the mammal records for the Nantawarrina IPA, contained in available databases following this survey. All mammal records which could not be identified to species level were excluded. Two records from the DEH Opportunistic Sightings Database have also been removed from the summary, as they are both sub-fossil records which will be included in a separate section. The effective number of records relating to existing mammals within the IPA is therefore 283, representing 23 species.

Table 21. Nantawarrina IPA mammal records and their sources.

	SA Museum	Flinders Ranges Survey		Nantawarrina IPA Survey		Total
		OP	Sites	OP	Sites	
Records	1	16	36	102	128	283
Species	1	7	7	18	19	23

[1] Science Resource Centre, Information, Science and Technology Directorate, Department for Environment and Heritage, GPO Box 1047, Adelaide SA 5001.

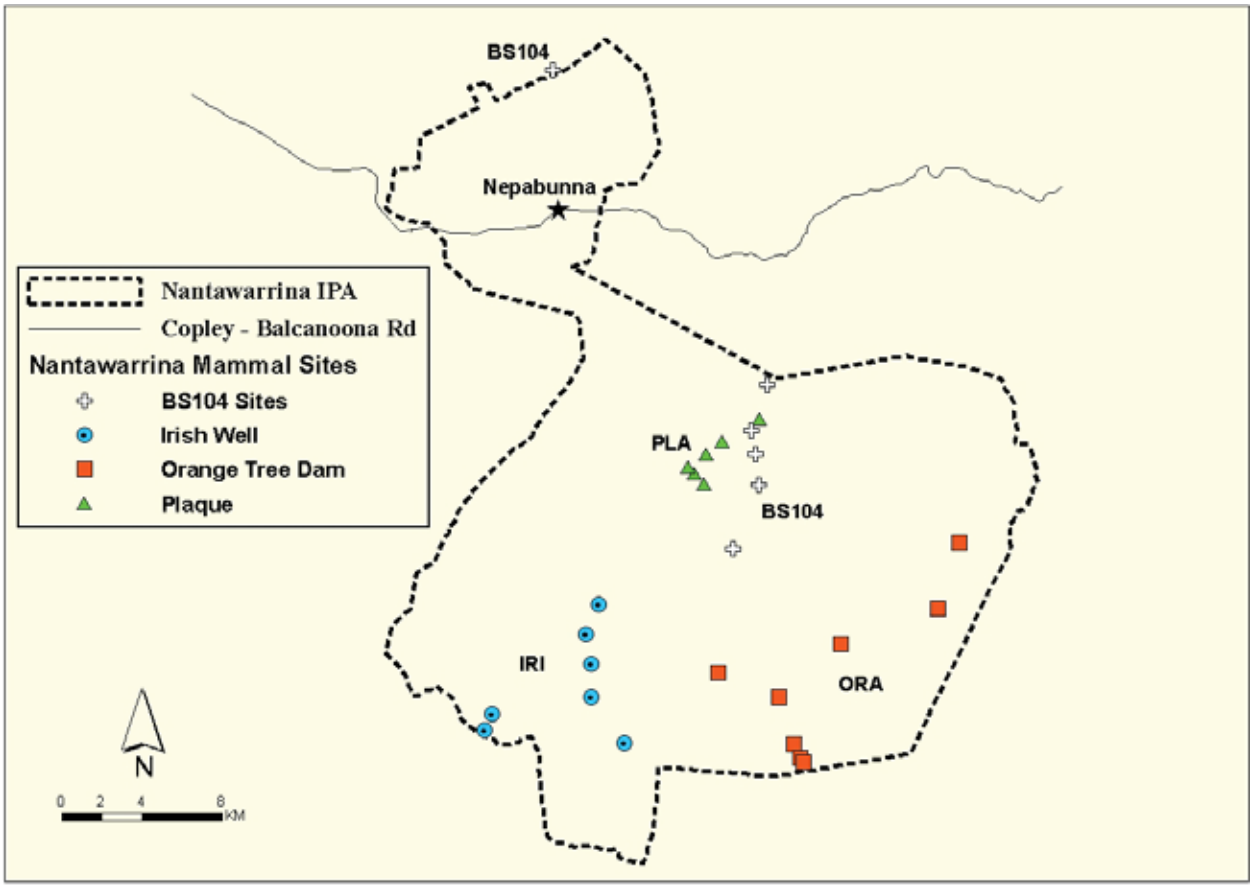


Figure 63. Location of sites where mammals have been sampled in the Nantawarrina IPA (BS104 refers to sites sampled in 1999 as part of the Flinders Ranges Biological Survey).

Species Richness at Sites

The 164 mammal records at sites represent a total of 19 distinct species, 13 native and six introduced. The most frequently recorded species at sites was the Feral Goat (*Capra hircus*) at 13 of 27 sites. Forrest's Mouse (*Leggadina forresti*), the Western Grey Kangaroo (*Macropus fuliginosus*) and the House Mouse (*Mus musculus*) were the least frequently encountered at sites, as each was recorded at only one of the 27 sites.

The average number of mammal species at survey sites was 3.6. The highest number of species at a site was nine at IRI00401, including three bats. As effort to sample bats at each site was not consistent, some sites having no attempt to trap or record bats, statistics related to mammals at sites are most relevant without incorporating bat numbers. In view of this, the highest number of species at sites was six at three separate sites, IRI00401, ORA00601 and PLA00201. The lowest number of species at a site was none at site NAN00401 in Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee (*E. gillii*) Open Mallee on low rocky undulating hills. There were also four sites where only one species was recorded.

The highest number of mammal records at a site was 24 at GAP00601, but 19 of these were of one species, the Feral Goat (*Capra hircus*). The next highest was 18, but 12 of these were of three bat species. With bats removed from calculations and the herd of goats at GAP00601 excluded, the highest number of mammal records at a site was only nine, at ORA00601, an area of Black Oak (*Casuarina pauper*) Very Low Open Woodland. The lowest number of records at a site was none at NAN00401 (as described above). The next lowest site record totals were a single Euro (*Macropus robustus*) at NAN00201 and one Fat-tailed Dunnart (*Sminthopsis crassicaudata*) at ORA00201. Both these sites were in River Red Gum (*Eucalyptus camaldulensis*) Woodland along drainage lines. The average number of records at sites (bats excluded) was 5.1.

Significance of Opportunistic Records

Four of the 23 mammal species currently known to inhabit the Nantawarrina IPA were not found at standard sample sites, but were recorded opportunistically. Two of these were native species, the Yellow-footed Rock-wallaby (*Petrogale xanthopus*) and Gould's Wattled Bat (*Chalinolobus gouldii*), and two introduced species, the Feral Cat (*Felis catus*) and Sheep (*Ovis aries*). Nineteen mammal species were recorded opportunistically, which conversely means that four species were recorded at survey sample sites only (Table 22).

During the two DEH surveys within the IPA a total of 118 of the 283 (42%) valid records of mammals for the IPA were opportunistic sightings. Of these, 102 were from the 2009 survey and the remaining 16 were collected in 1999. Given the relatively low number of mammal records obtained at standard sampling sites

when compared to reptile and bird groups, this is a significant and valuable source of data during most surveys, which often accounts for the majority of records of the larger more mobile species, particularly macropods and ungulates. Opportunistic searching is also important in obtaining records of species which occupy specific habitats which may occur in only small portions of the landscape or be difficult to access, such as the Yellow-footed Rock-wallaby.

The species recorded most frequently opportunistically was the Euro, with 30 records. The least frequent opportunistic records were single records of the Fox (*Vulpes vulpes*), Sheep (*Ovis aries*), Fat-tailed Dunnart (*Sminthopsis crassicaudata*) and Bolam's Mouse (*Pseudomys bolami*).

Table 22. Summary of mammal records obtained during DEH Surveys, with species record frequency in descending order.

Species	Number of Sites Recorded at	Site Records	Opportunistic Records	Total Records
Capra hircus Goat (Feral Goat) *	13	35	11	46
Macropus robustus Euro	8	12	30	42
Oryctolagus cuniculus Rabbit (European Rabbit) *	11	15	12	27
Macropus rufus Red Kangaroo	4	6	17	23
Tachyglossus aculeatus Short-beaked Echidna	8	11	7	18
Sminthopsis macroura Stripe-faced Dunnart	7	14	-	14
Chalinolobus morio Chocolate Wattled Bat	4	11	2	13
Pseudomys bolami Bolam's Mouse	5	11	1	12
Equus caballus Horse (Brumby) *	6	9	3	12
Vespadelus baverstocki Inland Forest Bat	5	8	4	12
Equus asinus Donkey (Feral Donkey) *	4	4	7	11
Sminthopsis crassicaudata Fat-tailed Dunnart	6	9	1	10
Tadarida australis White-striped Freetail-bat	2	2	6	8
Canis lupus dingo Dingo	5	5	2	7
Nyctophilus geoffroyi Lesser Long-eared Bat	3	6	-	6
Petrogale xanthopus Yellow-footed Rock-wallaby	-	-	6	6
Chalinolobus gouldii Gould's Wattled Bat	-	-	3	3
Macropus fuliginosus Western Grey Kangaroo	1	2	2	4
Vulpes vulpes Fox (Red Fox) *	2	2	1	3
Felis catus Cat (Feral Cat) *	-	-	2	2
Leggadina forresti Forrest's Mouse	1	1	-	1
Mus musculus House Mouse *	1	1	-	1
Ovis aries Sheep (Feral Sheep) *	-	-	1	1
TOTAL		**164**	**118**	**282**

* = Introduced species.

Species of Conservation Significance

***Petrogale xanthopus* (Yellow-footed Rock-wallaby) [Andu] Aus:VU, SA:V**

The Yellow-footed Rock-wallaby is the only native mammal species recorded within the Nantawarrina IPA with a threat or conservation rating. It is classed as Vulnerable under both the South Australian *National Parks and Wildlife* (NPWS) *Act 1972* and the national *Environmental Protection and Biodiversity Conservation* (EPBC) *Act 1999*. The Yellow-footed Rock-wallaby still occurs over most of its former range within South Australia, in the Flinders and Gawler Ranges and the Olary Hills. However, there has been a major decline in numbers since European settlement, including local population extinctions within this range (Copley 1982).

Environmental degradation resulting from agricultural and pastoral practices, shooting for sport and skins, competition with introduced herbivores and predation by foxes have been suggested as major factors in this decline (Copley 1981). Within its range in SA it is most numerous and secure within the northern Flinders Ranges. Aerial surveys, as part of the DEH Operation Bounceback, indicate that the population appears stable.

Figure 64. Yellow-footed Rock-wallabies [Andu] (*Petrogale xanthopus*) were sighted in Moro and Waukla Woodna Gorges during the Nantawarrina IPA Survey (Photo: A. Robinson).

Despite recent drought conditions, its continued presence at two sites within the IPA, at Moro Gorge and Waukla Woodna Gorge, was confirmed during this survey. Additional information from other sources indicates that it almost certainly still exists in other less accessible locations within the reserve (see below).

Species Groups

Monotremes

Tachyglossus aculeatus **(Short-beaked Echidna) [Vakirri]**

As is often the case, no actual sightings of Echidnas were made during the survey. However, signs of their activity, usually their untidy and characteristic diggings and occasionally their scats or droppings were commonly encountered. Echidna were the equal most frequently recorded native species at survey sites, at eight of 27 (11 records), plus a further seven opportunistic records. Most were found on rocky slopes or ridges, but two records were in River Red Gum creek beds. Both habitat types provide opportunities for shelter, in caves, deep rock crevices, large fallen trees or large dense shrubs.

Figure 65. Echidna [Vakirri] (*Tachyglossus aculeatus*) diggings and scats were commonly seen during this survey (Photo: P. Canty).

Echidna activity is generally temperature dependent, causing them to be largely nocturnal, particularly in arid climates (Augee 2008). So, despite being regarded as widespread and generally common, they are infrequently seen over much of their range.

Macropods

Macropus fuliginosus **(Western Grey Kangaroo) [Wawu/Yudunandu etc.]**

Recorded only twice during this survey, in Black Oak (*Casuarina pauper*) Very Low Open Woodland at IRI00201 north of Irish Well in the south of the reserve, and about 3 km south-west of Plaque camp in *Acacia* shrubland adjacent to Alerumba Creek.

Its scarcity compared to the other two large kangaroo species is not unexpected as it is not as well adapted to arid conditions. The Western Grey Kangaroo is not capable of embryonic diapause or delayed implantation, a reproductive strategy which is an advantage in population survival in unreliable, particularly arid, climatic conditions. Unlike the desert kangaroos, the Western Grey Kangaroo is a seasonal breeder. Most females give birth in early summer, with young emerging from the pouch in the following spring following predictable rainfall and plant growth (Tyndale-Biscoe 2005). As the northern Flinders Ranges protrude into the arid zone the climate is unreliable and disadvantageous to this sort of seasonal breeding cycle. It is generally regarded as an inhabitant of woodland and shrubland on the lower slopes and plains on either side of the ranges, and appears to have extended its range north and occasionally into the ranges in recent decades. Aitken (1980) stated that it extended as far north as Mt Chambers, to the south of the IPA, and was uncommon in the ranges. However, during the 1980s, there were sightings of Western Grey Kangaroos to the north, on the plains country of the Vulkathunha-Gammon Ranges National Park and in the Mt McTaggart area (Tunbridge 1991). Its recent arrival in the northern Flinders Ranges is evident from the names used for it by Adnyamathanha people, all of which are borrowed from other aboriginal language groups (Tunbridge 1991).

Macropus robustus **(Euro) [Mandya]**

The Euro was the most commonly recorded species away from survey sites, accounting for 25% of opportunistic records. It was also the equal most frequently recorded native mammal species at survey sites, recorded at eight of 27, confirming it to be a common and widespread species within the IPA. Although preferring rocky hills and slopes, it was also observed along creek lines and most other habitat types.

Most caves inspected throughout the reserve during this survey contained carcasses of one or more Euros, all at the same stage of decomposition. It appears that even these hardy animals had suffered badly from the recent drought years and an extreme hot period during the previous late summer. Water alone does not seem to have been the problem, as several carcasses were located within a short distance of the permanent spring at Moro Gorge.

Figure 66. The Euro [Mandya] (*Macropus robustus*) was one of the most commonly observed native mammals during the survey (Photo: H. Stewart).

Macropus rufus **(Red Kangaroo) [Urdlu]**

The number of overall records and sites at which the Red Kangaroo was recorded was about half that of the Euro. This bias is a reflection of the habitat types

within the reserve, which are mostly rocky mountain ridges and rolling hills. The Euro is better adapted to these environments, whilst the Red Kangaroo is generally a plains dweller. Outside the ranges, on the adjacent plains, it is by far the most abundant macropod species.

***Petrogale xanthopus* (Yellow-footed Rock-wallaby) [Andu]**

This species was recorded at both Moro and Waukla Woodna Gorges during this survey. One or two animals were seen on two occasions at both locations. Data compiled for DEH's Operation Bounceback includes records of earlier sightings in the Waukla Woodna Gorge area and sightings or signs at four other locations within the IPA.

- Whilst researching the South Australian distribution of Yellow-footed Rock-wallabies in 1980 Peter Copley observed them on the Campbell Bald Hill Range a short distance south-west of Nepabunna. He also sighted wallabies at three locations around Waukla Woodna Gorge, at the Waukla Woodna Spring and nearby on the southern end of the Uro Range.
- Another site on the Campbell Bald Hill Range, approximately 3kms west of where Copley saw wallabies in 1980, was used to take tourists to see wallabies, presumably at the time this information was compiled in 2001, and possibly after.
- In 2001, old droppings and bones of Yellow-footed Rock-wallabies were located in caves near a creek junction a few kilometres south-west of Camel Yard Springs.
- In 2001 Mark Lethbridge observed two wallabies in the north-eastern section of the Uro Range, approximately 2km west of Alerumba Creek, towards the highest peak in this section of the range.

Both Copley in 1980 and Lethbridge in 2001 sighted wallabies in and around Arrowie (Little Moro) Gorge, just outside the IPA and about 4 kilometres south-south-east of Moro Gorge, but neither appear to have investigated Moro Gorge itself. The DEH Operation Bounceback aerial survey flight pattern was slightly altered in 2008 to incorporate Waukla Woodna Gorge for the first time. Four wallabies were recorded on each of two passes on consecutive days in late June. Wallach *et al.* (2009) reported surveying five Yellow-footed Rock-wallaby colonies within the Nantawarrina IPA between July 2007 and February 2008, as part of research into the interactions between rock-wallabies and dingoes. These were at Moro and Waukla Woodna Springs, Nantawarrina Spring and approximately 2 kilometres east and 5 kilometres south of Nantawarrina Springs (A. Wallach, pers comm, 2009).

The most concerning observation relating to rock-wallabies was the level of goat activity and degradation of vegetation on the ridges and slopes around Moro Gorge. Although the permanent water in the gorge is a benefit to the rock-wallabies, and the vegetation around the lower gorge does not appear badly degraded, the water must also attract apparently large numbers of goats, which are having a devastating effect on the vegetation and therefore the available food for rock-wallabies. As there is some evidence that high goat numbers immediately after drought can suppress rock-wallaby population recovery (Lim *et al.* 1987), the ongoing security of the rock-wallabies in the Moro Gorge area is of some concern.

Small Mammals

Rodents

***Leggadina forresti* (Forrest's Mouse)**

A single specimen was collected at site ORA00601, in Black Oak (*Casuarina pauper*) Low Open Woodland on light clay. This native rodent species occurs in tussock grassland, low chenopod shrublands or sparsely vegetated plains on clay, loam or stony soils (Reid 2008) throughout arid central Australia. It is close to the southern edge of its range within the IPA. During the DEH Flinders Ranges Biological Survey (Brandle 2001) it was recorded at only seven of 121 sample sites, all in the northern ranges.

Figure 67. Forrest's Mouse (*Leggadina forresti*) was only recorded at site ORA00601 during the Nantawarrina IPA Survey (Photo: P. Canty).

As its preferred habitat suggests, it is largely an open plains species. Its occurrence within the IPA was on the edge of a pocket of suitable plains habitat in the south-east of the reserve, within a few kilometres of the eastern edge of the ranges.

***Pseudomys bolami* (Bolam's Mouse)**

Bolam's Mouse occurs across southern arid SA and WA, most commonly in chenopod shrubland plains and low *Acacia* and *Eucalyptus* woodlands with loamy, clay or calcareous soils (Moseby and Read 2008). During the Flinders Ranges Biological Survey (Brandle 2001) it was recorded at nine of 121 (7%) sample sites. Its occurrence at five of 27 (19%) sample sites within the IPA is therefore relatively significant. The five sites were a variety of different woodland and shrubland habitats. These were Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland and Gum-barked Coolibah (*Eucalyptus intertexta*) Mallee along drainage lines, Desert Senna (*Senna artemisioides* ssp.) and Spiny Saltbush (*Rhagodia spinescens*) Shrublands under dead Mulga (*Acacia aneura*) on a rocky slope, and Black Oak (*Casuarina*

pauper) Low Open Woodland, on a variety of soils from sandy clay loam to light clay.

Figure 68. Bolam's Mouse (*Pseudomys bolami*) was recorded from a variety of habitats during this survey (Photo: A. Robinson).

Dasyurids

***Sminthopsis crassicaudata* (Fat-tailed Dunnart) [Yurndu]**

This, the smaller of the two dunnart species recorded in the IPA was trapped at six of the 27 survey sites. Brandle (2001) recorded it in most vegetation associations, with the exceptions of Spinifex (*Triodia* spp.) Hummock Grassland and mallee habitats. It often forages on bare open areas. This was evident within the IPA, as three of the 10 records (nine at sites and one opportunistic) were from survey site ORA00501 where it was the only small mammal species trapped. This was on an open flat loamy clay plain, between Orange Tree Dam and Deep Bore, with sparse very low vegetation providing little cover.

Figure 69. Fat-tailed Dunnart [Yurndu] (*Sminthopsis crassicaudata*) was the only small mammal recorded on the cracking clay plain at site ORA00501 (Photo: I. Williams).

***Sminthopsis macroura* (Stripe-faced Dunnart) [Yurndu]**

Brandle (2001) reported that the Stripe-faced Dunnart was the most commonly recorded small mammal species in a wide variety of habitats in the northern Flinders Ranges. This was also true for the IPA, where 14 were trapped across seven survey sites, including four on the 2009 survey.

The Stripe-faced Dunnart also has a fat tail, but it is longer than that of the former species, being longer rather than shorter than the length of its head and body. It is also slightly larger than the Fat-tailed Dunnart, with a weight range of 15-25g compared to 10-20g.

Figure 70. The Stripe-faced Dunnart [Yurndu] (*Sminthopsis macroura*) was recorded at four sites during this survey (Photo: P. Canty).

Bats

***Chalinolobus gouldii* (Gould's Wattled Bat) [Wadnimikanha]**
***Chalinolobus morio* (Chocolate Wattled Bat) [Wadnimikanha]**
***Mormopterus* sp3/sp4 (Free-tailed Bat) [Wadnimikanha]**
***Nyctophilus geoffroyi* (Lesser Long-eared Bat) [Wadnimikanha]**
***Tadarida australis* (White-striped Freetail-bat) [Ngarlamikanha]**
***Vespadelus baverstocki* (Inland Forest Bat) [Wadnimikanha]**

Trapping for bats at survey sample sites is generally not possible in a standardised manner, comparable between sites. Specific locations are targeted at which the chances of catching bats are maximised. These may be flowering *Eucalyptus* trees (which attract the insects upon which the bats feed), small bodies of water in creeks or dams, flyways through denser vegetation, or trees with multiple hollows in which bats may shelter. Not all survey sites have these, so such features are often targeted when encountered away from sites.

During this survey, 27 bats were trapped (or heard, in the case of *Tadarida australis*) at survey sites and 14 were trapped or recorded opportunistically at other locations (Table 23). The total of 41 records represented five species of insectivorous bats which all have extensive distributions and generally roost in trees or buildings. All five of these, and a sixth species, *Mormopterus* sp3/sp4 (Freetail-bat) were recorded calling at sites (see below).

Biochemical study of *Mormopterus* by Adams *et al*. (1988) revealed several as yet not fully described species. The calls of several are difficult to

Table 23. Bat species records obtained by trapping and observations during the 2009 Nantawarrina IPA Biological Survey.

Species Name	Common Name	No. of Sites Recorded at	Site Recs	OP Recs	Total Recs
Chalinolobus gouldii	Gould's Wattled Bat	-	-	2	2
Chalinolobus morio	Chocolate Wattled Bat	4	11	2	13
Nyctophilus geoffroyi	Lesser Long-eared Bat	3	6	-	6
Tadarida australis	White-striped Freetail-bat	2	2	6	8
Vespadelus baverstocki	Inland Forest Bat	5	8	4	12
Total		**8 ***	**27**	**14**	**41**

* = Bat records were obtained at eight of the twenty-two 2009 survey sites. (Note: this does not include data collected using Anabat recorders.)

Figure 71. Lesser Long-eared Bat [Wadnimikanha] (*Nyctophilus geoffroyi*) was captured at three sites on this survey, but their calls were recorded at 12 (Photo: P. Canty).

differentiate and the two species possibilities for the IPA are *Mormopterus* sp3 (South-eastern Freetail-bat) and *Mormopterus* sp4 (Inland Freetail-bat), which can only be further identified by comparing the penis size of male specimens. The taxonomy of the Australian species of *Mormopterus* is currently under review. Work to complete this process is currently nearing completion (T. Reardon, pers comm, 2009). This additional bat species has not been included in any other statistics within this report due to its currently unclear taxonomic status and the inability of identification to exact species level resulting from the similarity in call of the two species which could be encountered within the area.

The White-striped Freetail-bat is less frequently caught than most other bat species, as they do not manoeuvre very well and so tend to forage in open areas and high above the canopy (Churchill 1998) where they are out of reach of both harp traps and mist nets. However, they are one of the few bats which make an audible and distinctive sound in flight, so are most frequently recorded as "heard". They can often be located with a spotlight once the sound is identified. It is also considerably larger than most other insectivorous bats and has distinctive white markings on the underside. All records for this species included in Table 23 were collected in this manner.

The other four bats are relatively small species which roost in tree hollows, under larger sheets of loose bark or in buildings. The Chocolate Wattled Bat is known to roost in caves on the Nullarbor and in the south-west of WA, but where its range extends into arid areas its distribution tends to follow watercourses which provide River Red Gum (*Eucalyptus camaldulensis*) roost sites (Churchill 1998). Gould's Wattled Bat is also known to frequently use Red Gum roosts. It and the Lesser Long-eared Bat are found over most of the continent (including Tasmania) with the exception of wetter parts of coastal and far north Queensland respectively. The Inland Forest Bat inhabits the arid and semi-arid parts of inland Australia, whilst the Chocolate Wattled Bat has a more restricted range, across southern and eastern Australia.

Figure 72. Free-tailed Bat [Wadnimikanha] (*Mormopterus* sp3/sp4) was only recorded via calls (Photo: A. Robinson).

Anabat bat detectors (Titley Electronics) were used to record high frequency bat calls at 18 of the 22 survey sites and opportunistically at Orange Tree Dam during this survey (Appendix 11). Three sites (ORA00201, ORA00301 and ORA00401) were sampled in this manner on two nights, whilst four others (ORA00101, ORA00501, ORA00601 and ORA00701) had no

recording effort. The remaining 15 sites at which recorders were used (plus the opportunistic location at Orange Tree Dam) were sampled for one night each. Consequently the results are not comparable between sites. However, across the 19 locations sampled, a total of 4,302 calls were recorded. Of these 1,684 (39.1%) were adequately identifiable to be allocated to a particular bat species, or in one case to a choice of two similar species of the same genus (Appendix 11).

The average number of identified calls at sites was 76, but varied from none on one of two nights at ORA00301 to 546 at ORA00201. The average number of identified calls for the six bat species was 281 per species, but varied from 26 between four sites for Gould's Wattled Bat (*Chalinolobus gouldii*) to 706 for White-striped Freetail-bat (*Tadarida australis*), which was recorded at all but one of the 19 locations.

The Anabat recordings confirmed the presence of an additional species, Freetail-bat (*Mormopterus* sp3/sp4). Although it was recorded at 14 sites and accounted for over a third (37.5%) of all identified calls, it was not caught in traps. This could be due to the feeding habits of the two possible species, which may mean they are commonly out of reach of traditional trapping equipment. Churchill (1998) reported that *Mormopterus* sp3 tends to forage in open unobstructed areas, while *Mormopterus* sp4 forages in spaces between trees, the outer edge of remnant vegetation, above the forest canopy and even on the ground. However, Brandle (2001) reported captures of 68 *Mormopterus* spp. during the Flinders Ranges Biological Survey. Of these, three were captured while foraging, 27 were caught in harp traps and 38 in mist nets. Many of these were caught in traps which were set over water (R. Brandle, pers comm, 2009).

Dingo

***Canis lupis dingo* (Dingo) [Urdninyi]**

The Dingo was recorded at five of the 21 sample sites and on two other occasions as opportunistic records at other locations within the IPA during the 2009 survey. These records were centred on three areas:- (1) around the Plaque Camp (2) 10-15 kilometres to the south-west between Bald Hill Bore and Irish Well, and (3) at Waukla Woodna Spring. Four records were of tracks and three were of Dingos heard howling. By comparison, during the more extensive Flinders Ranges Biological Survey (Brandle 2001) there was only one opportunistic record of the Dingo and none at any of the 121 sample sites. Breaches in the dingo fence along the north and eastern edge of the ranges are common, and it is likely that Dingos are always present in the denser (more rugged) parts of the ranges (Brandle 2001).

Sub-fossils – Evidence of Extinct Mammal Fauna

Most of the sub-fossil remains recorded for the Nantawarrina IPA are from caves in Moro Gorge. These in turn are mostly from the regurgitated pellets of owls which roosted in the caves. These pellets contain the undigested bones and fur of animals that the owls have consumed.

Some of the species included in Table 24 may not have inhabited the reserve, or at best only occupied small pockets of suitable habitat, as they are plains dwellers. As Moro Gorge opens to the plains extending away

Table 24. Mammal species identified from Moro Gorge caves by Graham Medlin of the SA Museum. Information contained in the table is mostly reproduced from Tunbridge (1991).

Species	Status	Additional Comments
Dasyurus geoffroii Western Quoll	Locally extinct	
Dasycercus blythi Mulgara	Locally extinct	Also in DEH Opportunistic records, 1987.
Phascogale calura Red-tailed Phascogale	Locally extinct	
Sminthopsis macroura Stripe-faced Dunnart	Currently present	
Antechinomys laniger Kultarr	Currently present	
Isoodon auratus Golden Bandicoot	(E)	
Macrotis lagotis Greater Bilby	Locally extinct	
Onychogalea lunata Crescent Nailtail Wallaby	(E)	
Macroderma gigas Ghost Bat	Locally extinct	
Pseudomys australis Plains Rat	Locally extinct	Recent records from Strzelecki Desert.
Pseudomys gouldii Gould's Mouse	(E)	
Pseudomys desertor Desert Mouse	Locally extinct	
Pseudomys hermansburgensis Sandy Inland Mouse	Currently present	
Leporillus conditor Greater Stick-nest Rat	Locally extinct	Also *Leporillus* sp. in DEH Opportunistic records - nest in cave at Moro Gorge.
Leporillus apicalis Lesser Stick-nest Rat	(E)	Also *Leporillus* sp. in DEH Opportunistic records - nest in cave at Moro Gorge.
Notomys fuscus Dusky Hopping Mouse	Locally extinct	
Notomys longicaudatus Long-tailed Hopping-mouse	(E)	
Notomys amplus Short-tailed Hopping-mouse	(E)	
Rattus villosissimus Long-haired Rat	Visitor to region	May have been present prior to pastoralism.
Mus musculus House Mouse *	Currently present	Introduced species

* = Introduced species. (E) = extinct

from the ranges to the east, it is a short flight for an owl to prey on these plains' species. In addition to those identified from Moro Gorge several other locally or totally extinct mammal species have been identified in similar deposits throughout the northern Flinders Ranges (Tunbridge 1991). The most significant of these is at Chambers Gorge to the south-east of the IPA (Medlin 1993).

These sub-fossil remains provide evidence of the past existence of 19 species of native and one introduced mammal species within or at least adjacent to the Nantawarrina IPA. Six of the native species (one wallaby, one bandicoot and four rodents) are totally extinct. Another nine species are extinct within the region, but still occur in a reduced range somewhere in the wild in other parts of Australia. One species, the Long-haired Rat, is now only an occasional visitor to the region. Following exceptionally wet seasons it can expand from its refuge areas in the channel country to the north-east, and may occasionally reach as far south as the northern Flinders Ranges. Three other small native mammals and the introduced House Mouse still exist within the region. However, two of the native species, the Kultarr, which in South Australia is most common on stony clay plains (R. Brandle, pers comm, 2009), and the Sandy Inland Mouse, which inhabits sandy plains, were not recorded within the reserve. Both occur in habitats which are sparse within the ranges and do not occur within the Nantawarrina IPA.

Whilst all the extinct or locally extinct species are of some interest, the Crescent Nailtail Wallaby [**Urnda**] has particular cultural significance and practical importance to Adnyamathanha people (Tunbridge 1991). It seems to have disappeared from the Flinders Ranges around the 1890s and become extinct at some time in the 1950s (Burbidge 2008). Urnda was known to be a totem animal to one clan, and was mentioned in several "Dreaming" stories. It was also hunted for food and its skins used for clothing and as a carry-bag (Tunbridge 1991).

The Mulgara (*Dasycercus blythi*) record from the DEH Opportunistic Sightings database appears to have been from a separate location to Moro Gorge. What type of material was collected is not specified, but as the collector was a known sub-fossil expert from W.A. its validity is assured.

At least some of the other now locally or totally extinct mammal species known to have occurred within the northern Flinders Ranges would have been present within the IPA, as is suggested by the existence of their Adnyamathanha names (Tunbridge 1991), but as yet no physical remains of these additional species have been located within the reserve. Detailed information on these species can be found in Tunbridge (1991).

Introduced Species

Records of the eight introduced species accounted for more than one third (36.5%) of total mammal records collected (Table 22).

***Capra hircus* (Feral Goat) [Nanikuta/Naniguta]**

The original Feral Goats within the northern Flinders Ranges are believed to have been deliberately released at a time in the late 1800s when the price of angora wool was low, and that these were later joined by other goats of various breeds which strayed from stations within the ranges. They appear to have increased slowly, as it was not until 1940 that the first goats were reported on Balcanoona Station. But, by the late 1970s there were tens of thousands reported on Arkaroola, Balcanoona and in the Gammon Ranges National Park (Copley 1981).

Despite considerable effort in broad scale Feral Goat control over many years, particularly through the DEH Operation Bounceback, goats continue to be an ongoing problem in the northern Flinders Ranges. The Nantawarrina IPA is no exception to this generalisation, as Feral Goats represented a substantial amount of the total mammal records, 46 of 283 (16%). They were clearly the most frequently recorded mammal species at survey sites, recorded at 13 (or almost half) of the 27 sites.

***Equus asinus* (Feral Donkey)**

Both Aitken (1980) and Smith (1996) reported that Feral Donkeys occurred in the foothills of the Gammon Ranges. Brandle (2001) recorded them at nine of 121 sites, all in the northern half of the ranges, plus opportunistic sightings within the Nantawarrina IPA in 1999. The 2009 survey recorded Donkeys, mostly by the presence of tracks, droppings or (presumably shot) carcasses at four survey sites and a further five opportunistic locations. Small groups of three and four Donkeys were seen on two occasions, once about three kilometres east of Orange Tree Dam and one about four kilometres north-east of Irish Well.

Figure 73. Groups of Feral Donkeys (*Equus asinus*) were observed twice during the survey (Photo: D. Armstrong).

***Equus caballus* (Horse/Brumby) [Nandu/Nandhu]**

One opportunistic record of a sighting of a Horse within the IPA was collected in 1999 during the DEH Flinders Ranges Biological Survey. Most records from the 2009 survey were of tracks or droppings, but they were seen on two occasions. Three were seen just south of Orange Tree Dam and probably the same three again a few days later about five kilometres to the southwest. Judging from their behaviour, in that

they stood off a few hundred metres observing human activities for about half an hour on one occasion, it appears these horses were not feral but are presumably station animals.

***Felis catus* (Feral Cat) [Vusikata]**
Only two opportunistic records were made of the Feral Cat. One was seen while spotlighting near Irish Well and a set of tracks was located in the same general area a few kilometres away. As Feral Cats are generally regarded as common within the Flinders Ranges this low number of records is surprising. It is possibly the result of prolonged drought conditions or simply their generally shy and secretive nature. However, as with the Fox, Feral Cat numbers may be suppressed by the presence of Dingos in the IPA.

***Mus musculus* (House Mouse) [Mausa]**
Only a single record of House Mouse (*Mus musculus*) was collected within the IPA, from site IRI00401 in Inland Paper-bark (*Melaleuca glomerata*) Tall Shrubland on a dry creekline near Irish Well. Brandle (2001) reported that within the study area, covering the entire Flinders Ranges, the House Mouse was the most common small mammal, and that it occurred in a variety of habitats throughout the ranges, occurring at 36% (44 of 121) of sites. However, it appeared to become slightly scarcer in the drier north of the ranges where the Stripe-faced Dunnart took this title from the House Mouse.

Figure 74. House Mice [Mausa] (*Mus musculus*) were noticeably scarce during the survey (Photo: A. Robinson).

Several far more extensive DEH Regional Biological Surveys within arid South Australia have recorded far greater numbers of House Mice. The Anangu Pitjantjatjara Lands Survey (Robinson *et al.* 2003) recorded them at 44% of sites and the Stony Deserts Survey (Brandle 1998) at 12% of sites. This lowest possible recording level of the House Mouse within the IPA is most likely the result of lack of food resources due to prolonged drought conditions.

***Oryctolagus cuniculus* (European Rabbit) [Rabbit-a]**
Although Rabbits were the second most frequently recorded species at survey sites, at 11 of 27, and third highest in overall records, many records were of disused warrens or buck heaps, indicating past rather than current presence of animals. Very few records were of actual sightings of Rabbits. Even spotlighting produced very few observations, with only two Rabbits seen in an hour of spotlighting on one occasion.

Most warrens inspected had few or no active burrows. This was particularly evident on the western slopes of the Uro Range, adjacent to the western boundary of the IPA and south-west of Cable Creek Bore. In this area at least, it is clear that rabbit numbers have been much higher in the past. It appears that the Rabbit Haemorrhagic Disease (RHD), which is known to be most effective in dry arid areas, has had a significant effect within the IPA, and it is probable that current drought conditions are continuing to suppress their numbers.

***Ovis aries* (Feral Sheep) [Ivi/Dyambaka]**
As it was previously part of a pastoral property the Nantawarrina IPA has a lengthy history of sheep grazing. Sheep were removed during the late 1990s at the time the reserve was declared and came under the management of the Nepabunna Community. It is likely a few sheep were left in isolated or difficult to access areas at this time, but it is highly unlikely that any of these would have survived within the reserve without active management. The single long unshorn sheep which was recorded during the Nantawarrina IPA Biological Survey was near the southern boundary of the IPA, near Irish Well. Although clearly feral, judging from the length of its fleece and flighty nature, it is more likely a lone stray from an adjacent pastoral property than part of an established feral population within the IPA.

***Vulpes vulpes* (Red Fox)**
Surprisingly, no recent signs of Foxes were found within the IPA during the recent survey. They were recorded by the presence of scats at two survey sites, and a skull was the only opportunistic record. It is usual to see obvious Fox tracks following fresh vehicle tracks along dirt roads, but not one incidence of this common evidence of Fox presence was reported. Drought and the subsequent low numbers of Rabbits and other potential prey species may be a contributing factor. It is also possible that the presence of Dingos may be suppressing Fox numbers.

BIRDS

D. Armstrong[1]

Introduction

Summaries of the bird fauna of the wider Flinders Ranges are provided by Paton (1980) and Reid *et al*. (1996), whilst the most comprehensive information available was found in the report "A Biological Survey of the Flinders Ranges, South Australia 1997-99" (Brandle 2001). This most recent publication is heavily drawn on for comparative information to assist in placing the birds recorded within the Nantawarrina IPA in a regional perspective.

The reserve lies within a relatively interesting area for biodiversity, in that the Flinders/Mt Lofty Ranges provide a corridor and sheltered climatic effect which allows some temperate climate species to extend their range into the arid Eyrean biogeographic region in the northern Flinders Ranges.

The majority of available information on bird species present within the Nantawarrina IPA was collected in late April and early May of 2009 during the Nantawarrina IPA Biological Survey.

Earlier records were obtained from the larger DEH survey of the whole Flinders Ranges in the late 1990s, a handful of visits to the reserve by members of Birds Australia between 1999 and 2001, and smaller numbers of records from the South Australian Museum collection, newsletters of the South Australian Ornithologists Association (SAOA, now Birds SA) and the DEH Opportunistic Sightings Database.

Collectively these sources provided records of the occurrence of 92 bird species within the IPA (refer Table 25 and Appendix 12). None were exotic or introduced species. Adnyamathanha bird names, where known, are shown in block bracketed text and are taken from McEntee (1986). An extended list is provided in Appendix 13.

Table 25. Sources of bird records for the Nantawarrina IPA.

	DEH OP	SAM	Birds Aust	Birds SA	Flinders Ranges Survey		Nantawarrina IPA Survey		Total
					OP	Sites	OP	Sites	
Records	1	4	118	4	44	151	166	495	983
Species	1	3	51	3	27	37	65	59	92

Species at Survey Sites

Bird records were collected systematically at a total of 28 standard DEH biological survey sites within the Nantawarrina IPA. Records were obtained at all 22 survey sites established during this survey, plus a further six sites sampled within the IPA during 1999 as part of the Flinders Ranges Survey (Brandle 2001) (Figure 76). Sampling consists of visiting the area for two one hour periods at peak activity times for birds, generally early morning and late afternoon, and recording all bird related activity or signs of activity in the habitat type designated for that site.

Figure 75. The Red-capped Robin [Mali-ita-na] (*Petroica goodenovii*) was one of the most frequently recorded bird species on this survey (Photo: SAOA).

Almost two thirds of the available records (646 of 983, or 65.7%) representing 65 species, were obtained from these sites. The importance of site based data is that it best reflects the relative abundance of species in the survey area. A list of all bird species recorded at sites (and their relative frequency) in the IPA during both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Surveys is provided in Appendices 14 & 15.

Species Richness at Survey Sites

Sixty five of the 92 species recorded within the IPA were recorded at survey sites. The species recorded at the most survey sites and with the most records was the Spiny-checked Honeyeater [Turrana], at 23 of the 28 sites (refer Table 26). Only six species were

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recorded at half (14) or more survey sites. Twenty species were recorded at only one or two sites, 15 of these were at one site (Table 27) and five at two. In fact, 34 of the 65 (52.3%) bird species at survey sites were recorded at five or less of the 28 survey sites. The average number of sites per species was 6.4. The full list of birds by site frequency is provided in Appendix 16.

The average number of bird species recorded at survey sites was 14.9. The highest number of species at a site was 35 at site PLA00101. The second highest was at site ORA00201, with 34 species. Both sites were in River Red Gum (*Eucalyptus camaldulensis*) Woodland on wide, mostly dry creek beds. The lowest was four species at IRI00601, an extremely degraded site of very open Elegant Wattle (*Acacia victoriae* ssp. *victoriae*) and Silver Senna (*Senna artemisioides* ssp. X *artemisioides*) Open Shrubland, near the southern boundary of the IPA between Irish Well and Waukla Woodna Gorge. The frequency of total bird species recorded at all sites sampled in the IPA are shown in Figure 77.

The average number of bird records at survey sites was 23.1. The highest was 68 records of 34 species, at site ORA00201 (described above). This was also the second highest (by one) number of species recorded at a site. The lowest was five records at IRI00601 (described above) and at IRI00701, in Dead Finish (*Acacia tetragonophylla*) Very Open Shrubland in low hills in the same area.

Table 26. Most frequently recorded bird species at survey sites in the Nantawarrina IPA, in descending order.

Species Name	Common Name	Sites	Records
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	23	45
Petroica goodenovii	Red-capped Robin	21	44
Acanthiza apicalis	Inland Thornbill	20	32
Pachycephala rufiventris	Rufous Whistler	17	29
Corvus coronoides	Australian Raven	15	22
Oreoica gutturalis	Crested Bellbird	14	23

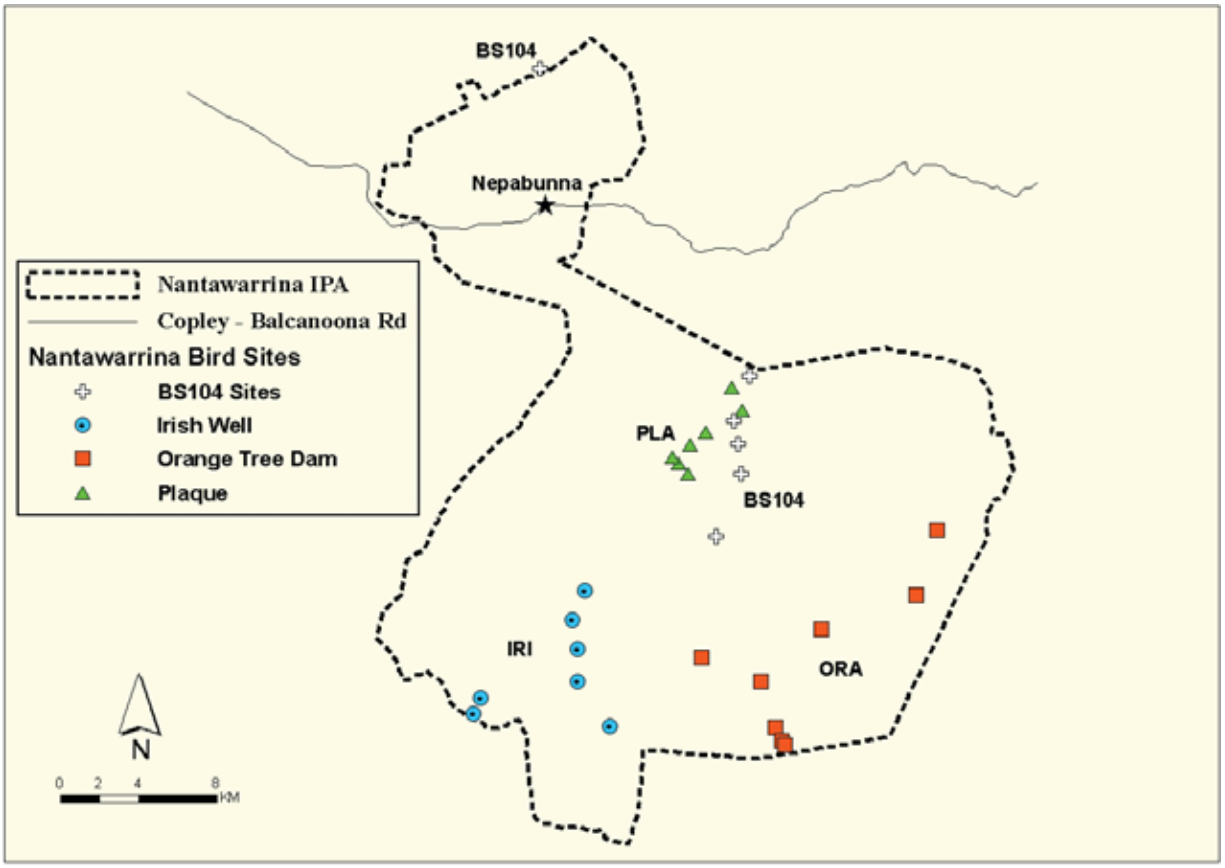

Figure 76. Location of sites where birds have been sampled in the Nantawarrina IPA (BS104 refers to sites sampled in 1999 as part of the Flinders Ranges Biological Survey).

Table 27. Least frequently recorded bird species at survey sites in the Nantawarrina IPA.

Species Name	Common Name	Sites	Records
Acanthiza robustirostris	Slaty-backed Thornbill	1	1
Accipiter cirrocephalus	Collared Sparrowhawk	1	1
Artamus cyanopterus	Dusky Woodswallow	1	2
Cacatua sanguinea	Little Corella	1	2
Daphoenositta chrysoptera #	Varied Sittella	1	1
Eurostopodus argus #	Spotted Nightjar	1	1
Geopelia cuneata	Diamond Dove	1	1
Geopelia striata #	Peaceful Dove	1	2
Gliciphila melanops #	Tawny-crowned Honeyeater	1	1
Lichenostomus ornatus	Yellow-plumed Honeyeater	1	1
Melithreptus brevirostris	Brown-headed Honeyeater	1	1
Neophema elegans	Elegant Parrot	1	1
Petrochelidon ariel #	Fairy Martin	1	1
Psophodes cristatus	Chirruping Wedgebill	1	2
Zosterops lateralis	Silvereye	1	1

= Indicates species recorded at 1999 Flinders Ranges Biological Survey sites only.

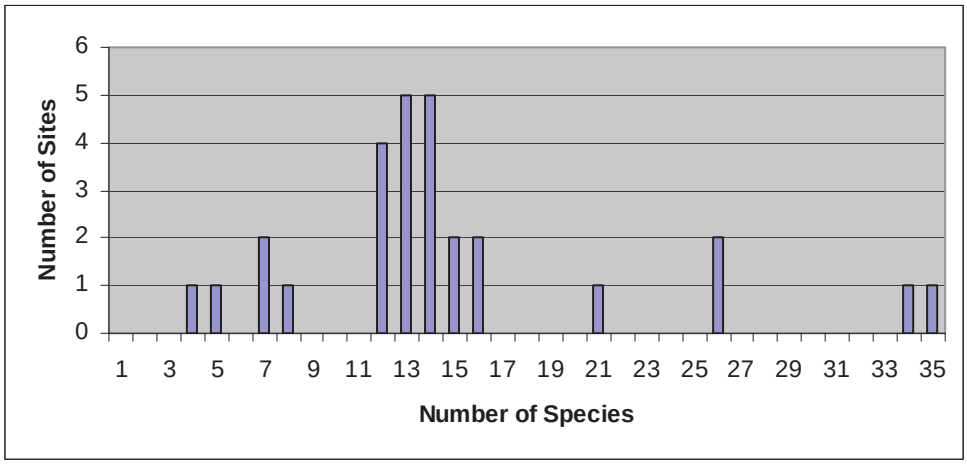

Figure 77. Frequency of number of bird species recorded at sample sites in the Nantawarrina IPA.

Opportunistic Records

In contrast to the systematic collection of bird records at survey sites, opportunistic records are obtained in a more random fashion. Often the majority of such records within a survey area are collected during the survey whilst travelling between formal sampling sites. Others come from independent sources, such as in this case, the records of members of Birds Australia, Birds SA, the SA Museum collection and the DEH Opportunistic Sightings database. An additional 337 bird records were obtained for the Nantawarrina IPA from these sources. Many of these were of the same species recorded at survey sites, but they also included a further 27 species which were not recorded at any of the 28 survey sites (Table 28). This considerable contribution to the bird species total for the IPA correspond to only 36 of the 983 (3.7%) available records, with most represented by single observations.

Only nine of these additional 27 species are sedentary or territorial residents that remain attached to particular locations or even specific habitat types, and are therefore potentially likely to be consistently

Figure 78. The Brown Falcon [Adlana] (*Falco berigora*) was recorded opportunistically four times on this survey (Photo: D. Hopton).

recorded at fixed survey sites. Of these, the three raptors would cover considerable area in search of prey, so are easily missed and dependent mainly on the quantities of other bird species available as their primary prey.

The remaining 18 species are nomadic or seasonal visitors to the area when conditions are favourable. Some of these species are most often observed around water, which is scarce or intermittent within the IPA. Others, such as the Cockatiel, Pied Honeyeater and Crimson Chat are mobile arid species which move and breed in response to irregular rainfall events which stimulate production of their required food, whether it be flowering eucalypts, grass seed or insects.

In light of the series of dry years prior to the 2009 survey and the subsequent poor condition of much of the IPA and other areas of the region, the lack of additional records of these species during the survey is not unexpected.

Table 28. Summary of opportunistic bird species not recorded at survey sites in the Nantawarrina IPA.

Species Name	Common Name	Status	DEH OP	Birds Aust	SAOA	Flinders Ranges Survey OP	Nantawarrina IPA Survey OP
Accipiter fasciatus	Brown Goshawk	R				1	
Acrocephalus australis	Australian Reed Warbler, (Clamorous Reed-Warbler)	N/S		1			
Amytornis merrotsyi	Short-tailed Grasswren	R					1
Anas superciliosa	Pacific Black Duck	N		1			
Ardeotis australis	Australian Bustard	N	1				
Artamus minor	Little Woodswallow	S			1		
Cacomantis pallidus	Pallid Cuckoo	N					1
Certhionyx variegatus	Pied Honeyeater	N					1
Chalcites lucidus	Shining Bronze-Cuckoo	S			2		
Cincloramphus cruralis	Brown Songlark	N/S					1
Cinclosoma cinnamomeum	Cinnamon Quail-thrush	R					2
Coracina maxima	Ground Cuckoo-shrike	N					1
Egretta novaehollandiae	White-faced Heron	R/N		1			
Elseyornis melanops	Black-fronted Dotterel	N		1			
Epthianura tricolor	Crimson Chat	N					2
Falco berigora	Brown Falcon	R				2	4
Falco longipennis	Australian Hobby	R					1
Grallina cyanoleuca	Magpie-lark	R		1			
Merops ornatus	Rainbow Bee-eater	S		1			
Neophema chrysostoma	Blue-winged Parrot	W					1
Nymphicus hollandicus	Cockatiel	N/S					1
Pardalotus rubricatus	Red-browed Pardalote	R		1			
Podargus strigoides	Tawny Frogmouth	R					1
Pomatostomus ruficeps	Chestnut-crowned Babbler	R					1
Todiramphus pyrrhopygius	Red-backed Kingfisher	N/S		1			1
Todiramphus sanctus	Sacred Kingfisher	S		1			
Vanelus tricolor	Banded Lapwing	N/R					1
	Total Records = 36		**1**	**9**	**3**	**3**	**20**
	Total Species = 27		**1**	**9**	**2**	**2**	**15**

Status: The status classifications used in the table above are taken directly from Reid *et al.* (1996) and indicate the likely residential status of birds in the region. They are defined as **N** = nomadic; **R** = resident; **W** = winter (non-breeding) migrant or visitor; **S** = spring-summer (breeding) migrant or visitor. Further information on the status of bird species within the IPA is included in a later section of this report and in Appendix 12.

Significance of 2009 Survey

The total of 661 bird records (495 at survey sites and 166 opportunistic) collected within the Nantawarrina IPA during this survey represents slightly over two thirds (67.2%) of the available records. This data not only provided the quantity of broadscale information necessary to clarify the relative abundance of bird species within the IPA, but also added 28 new species to the list of birds which have been recorded in the reserve. Amongst these were the first records of Blue-winged and Elegant Parrots (which are two of five conservation rated species known for the IPA), two species with significant range extensions, Spotted Pardalote and Slaty-backed Thornbill, and confirmation of the occurrence within the reserve of Short-tailed Grasswren, a species endemic to the Flinders and Gawler Ranges.

Conservation Rated Species

Five of the 92 bird species recorded within the Nantawarrina IPA are classified under the SA *National Parks and Wildlife Act 1972* schedules as being under threat. None are classified under the highest threat category as Endangered (E). Two are considered Vulnerable (V) to extinction in SA, whilst three others are listed in the lowest threat category as Rare (R). None are classified under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* as under any level of threat nationally.

***Ardeotis australis* (Australian Bustard) [Wala] SA:V**

The only bird record in the DEH General Opportunistic Sightings database which came from the IPA was also the only record of the Australian

Bustard. In November 2003 a single bird was seen beside the Copley Road about 2 kilometres east of Nepabunna on the boundary of the Vulkathunha-Gammon Ranges National Park. Although it is still generally common in the central and northern parts of the continent, it is now virtually extinct in the settled districts of the south-west and south-east, where wandering individuals are occasionally seen. It is rated Vulnerable in SA due to the estimated low number of individuals within the state.

Figure 79. The Australian Bustard [Wala] (*Ardeotis australis*) has been sighted on the road east of Nepabunna (Photo: L. Pedler).

***Neophema chrysostoma* (Blue-winged Parrot) SA:V**
The only record of the Blue-winged Parrot within the IPA was collected at Orange Tree Dam during the 2009 survey. This is one of only a handful of records of this species for the northern Flinders Ranges (Brandle 2001). It was recorded at only three of 137 survey sites included in the Flinders Ranges Biological Survey (Brandle 2001). It is a non-breeding, mostly winter visitor to the northern parts of SA. The origin of these birds is unknown, but they breed in the lower south-east of SA, Victoria and Tasmania (G. Carpenter, pers comm, 2009). They are considered Vulnerable in SA due to their generally low numbers and continued decline.

***Climacteris affinis* (White-browed Treecreeper) SA:R**
There are very few records of the White-browed Treecreeper from the Flinders Ranges overall. During the 1997-99 DEH Flinders Ranges Biological Survey, this species was recorded at only four of 137 sites at which bird records were collected. Prior to the 2009 survey the only records of this species for the Nantawarrina IPA were two SA Museum specimens collected close to the Nepabunna Community in 1979. During this survey White-browed Treecreepers were recorded from four of the 28 survey sites. These were ORA00701 in Mulga (*Acacia aneura*) Very Low Open Woodland, ORA00801 in Gum-barked Coolibah (*Eucalyptus intertexta*) Mallee, and IRI00201 and PLA00201 both in Black Oak (*Casuarina pauper*) Very Low Open Woodland.

It may be found in the same general area as the larger Brown Treecreeper, as is the case within the IPA, but generally avoids conflict through using different habitats. In arid areas, the Brown Treecreeper prefers eucalypt dominated woodlands, particularly River Red Gum (*E. camaldulensis*) creeklines, whilst the White-browed Treecreeper uses a variety of other arid woodland types, as is evident from the habitats in which they were recorded in the IPA. This species is rated Rare in SA due to a decline in abundance over a large portion of its range and it is suspected that this decline is continuing.

***Neophema elegans* (Elegant Parrot) [Malka-vadlaru] SA:R**
The first records of this species for the IPA were obtained during the 2009 survey. These were in Mulga (*Acacia aneura*) Low Open Woodland at site ORA00701, and opportunistically on two other occasions, in the wide River Red Gum (*Eucalyptus camaldulensis*) Woodland along Alerumba Creek and at Orange Tree Dam. This last site was also where the single observation of the more highly rated (Vulnerable) Blue-winged Parrot (above) was seen, cautioning care in ensuring positive identification of any future sightings of these similar species within the IPA. The Elegant Parrot appears to be the more common of the two species, at least within the Flinders Ranges. During the Flinders Ranges Biological Survey (Brandle 2001) it was recorded at 10 of 137 sites, compared to three for the Blue-winged Parrot. These sites were scattered throughout the length of the ranges, but in the northern Flinders Ranges it is at the northern extremity of the distribution of the SA population.

It is rated as Rare under the criteria developed for South Australia by the 'Threatened Species Schedule Subcommittee' in February 2002, on the basis that its population within the state is estimated to be fewer than 3,000 mature individuals. It has a disjunct distribution, as it also occurs in south-west Western Australia, where its range appears to have increased.

***Pachycephela inornata* (Gilbert's Whistler) SA:R**
This species was recorded at only four of 137 sites during the Flinders Ranges Biological Survey (Brandle 2001), with only one of these in the northern Flinders Ranges where it is at the northern extremity of its range. It is therefore quite significant that it was recorded at three of 22 survey sites, and opportunistically at Moro Gorge, during the 2009 survey. The three sites were River Red Gum (*Eucalyptus camaldulensis*) Woodland at ORA00201, Mulga (*Acacia aneura*) Very Low Open Woodland at ORA00701 and Gum-barked Coolibah (*Eucalyptus intertexta*) Mallee at ORA00801. Prior to this there had only been a single Birds Australia record of this species within the IPA, from near Nepabunna in 2001.

The distribution of Gilbert's Whistler shadows that of the southern mallee belt. Although generally regarded as a mallee species it may also be found in other woodland types within this area. It is rated Rare in SA

due to a decline in abundance over a large portion of its range and it is suspected that this decline is continuing.

Other Significant Species

***Gliciphila melanops* (Tawny-crowned Honeyeater)**

The Flinders Ranges Biological Survey (Brandle 2001) collected one specimen of the Tawny-crowned Honeyeater at survey site GAP00601. This site is just inside the Nantawarrina IPA, at an elevation of 700m, east of Mt Rowe and approximately 6 kilometres to the north of Nepabunna. This was one of two closely located sites at which this species was recorded, and was a significant northerly range extension for it. Presumably the cooler microclimate effect created by the altitude of these sites in the northern Flinders Ranges enables this southern species to extend its range. The previous most northerly records were 60 kilometres and 120 kilometres further south at Moolooloo and Wilpena (Brandle 2001).

Figure 80. A Tawny-crowned Honeyeater (*Gliciphila melanops*) specimen was collected in 1999 at site GAP00601 on the high ridge near Mount Rowe, north of Nepabunna (Photo: SAOA).

***Amytornis merrotsyi* (Short-tailed Grasswren),**

This species has a fragmented distribution, and is endemic to South Australia, where it is restricted to the Flinders and Gawler Ranges inhabiting rocky hills dominated by Spinifex (*Triodia* spp.) (Carpenter & Bellchambers 2003). The Flinders Ranges records occur in four clusters, two in the southern ranges around Dutchman's Stern and The Bluff, one in the central ranges in the Flinders Ranges National Park and one in the northern ranges around the Gammon Ranges and Arkaroola.

The first sighting of this species within the IPA was made during this survey, when a single bird was observed near the highest point of the north-eastern end of the Uro Range, in Spinifex (*Triodia irritans*) Hummock Grassland. As it is outside the southern boundary of the northern ranges cluster of earlier sightings, this record is possibly evidence of another sub-population within the Nantawarrina IPA (G. Carpenter, pers comm, 2009).

It currently has no threat category rating under the Schedules of the SA *National Parks and Wildlife Act 1972*, but was graded as "Least Concern" by the Action Plan for Australian Birds (Garnett and Crowley 2000). Although patchily distributed (and an isolated sub-population has been discovered recently in the Gawler Ranges) there are too many sub-populations, and the total population is too large, for the species to be given a higher threat status (Garnett and Crowley 2000).

***Acanthiza robustirostrus* (Slaty-backed Thornbill),**

The collection of a specimen of the Slaty-backed Thornbill within the IPA is the first record of the species in the Flinders Ranges. It is also a large extension in range, as the nearest other confirmed records are around 500 kilometres away in the north-west of the state at Tarcoola and Mabel Creek (G. Carpenter, pers comm, 2009). Throughout its range it inhabits dense stands of Mulga (*Acacia aneura*), which is the habitat in which it was recorded during this survey, at survey site ORA00701 near Deep Bore.

***Pardalotus punctatus* (Spotted Pardalote)**

The recording of the Spotted Pardalote, at multiple locations within the IPA during this survey, is a considerable range extension of the sub-species *Pardalotus punctatus punctatus*, as it had not previously been recorded north of the Wirrabara Forest district in the extreme south of the Flinders Ranges. It was seen in a variety of predominantly eucalypt woodland habitats scattered throughout the reserve, at four survey sites and two other locations. These were River Red Gum (*Eucalyptus camaldulensis*) Woodland at site ORA00201 and Moro Gorge, Gum-barked Coolibah (*Eucalyptus intertexta*) Mallee at ORA00801, Black Oak (*Casuarina pauper*) Very Low Open Woodland at PLA00201, Mulga (*Acacia aneura*) Very Low Open Woodland at PLA00401 and Curly Mallee (*Eucalyptus gillii*) Mallee on the western end of the Stirrup Iron Range. Movements of this species are poorly known, but there is some suggestion of winter dispersal (G. Carpenter, pers comm, 2009).

***Pardalotus rubricatus* (Red-browed Pardalote)**

There is a single Birds Australia record for the Red-browed Pardalote within the Nantawarrina IPA, observed during October 2001 from near Nantawarrina Spring on Mount McKinlay Creek. With this earlier observation of the Red-browed Pardalote at the extreme southern edge of its distribution, the presence of the Striated Pardalote and the recent confirmation of the presence of the Spotted Pardalote (above) in mind, it is clear that care in future identification of these three species in the northern Flinders Ranges is essential.

Biogeographical Groupings

Brandle (2001) divided the 241 Flinders Ranges bird species he recorded into four groups, based on variations of the three main Australian biogeographic regions, Bassian (temperate), Eyrean (arid) and Torresian (tropical). The typically Bassian and Eyrean species are clear, but those which overlap these two groups required separating into two further groups – species with Bassian to Bassian/Eyrean affinities that are at the northern or western extreme of their

distribution within the ranges, and the Eyrean/Bassian species which are typically found in the mallee woodlands which extend across the country as a broad boundary zone between the genuine arid and temperate extremes. After excluding species with broad national distributions occurring in all three biogeographic regions, and extracting water birds and vagrant species, 76 of the 241 (31.5%) species remained. Interestingly, when this exclusion process is applied to the bird species recorded in the Nantawarrina IPA, a very similar proportion, 30 of 92 (32.6%) remains.

Figure 81. The Silvereye (*Zosterops lateralis*) is at the northern extreme of its South Australian range in the IPA (Photo: DEH).

The Brandle (2001) analysis clearly showed that the Eyrean (arid) biogeographic region has the greatest influence over the Flinders Ranges bird species, with 35 of the 76 (46%) species classed as principally Eyrean (refer Table 29). As would be expected, due to its location in the northern ranges in closer proximity to the arid centre of the continent, this influence is even more graphic within the Nantawarrina IPA, where 20 of 30 (67%) species were of Eyrean origins (Table 29). These 30 species are listed with their biogeographic regional affinities in Table 30.

The microclimate effect created by altitude enables several species to extend from temperate Bassian locations into the Nantawarrina IPA within the northern ranges. Some of these, such as the Tawny-crowned Honeyeater are probably resident, whilst others, in particular the Shining Bronze Cuckoo, may be less frequent visitors. Many of the Eyrean species

Figure 82. The Dusky Woodswallow [Valpula] (*Artamus cyanopterus*) is typical of drier mallee woodlands (Photo: DEH).

can only penetrate into the IPA along red gum creeklines or exist in pockets of their favoured habitat. In particular this applies to habitat specialist species like the Slaty-backed Thornbill which inhabits Mulga (*Acacia aneura*) woodlands, the Short-tailed Grasswren which requires Spinifex (*Triodia* spp.) on rocky slopes and the Redthroat which is found in chenopod shrublands.

Figure 83. The Chestnut-crowned Babbler [Yunula] (*Pomatostomus ruficeps*) is an Eyrean species associated with drier inland areas (Photo: D. Hopton).

Table 29. Comparison of numbers of species with clear biogeographic regional affiliations, between the surveys of the entire Flinders Ranges (Brandle 2001) and the Nantawarrina IPA.

Survey Area	Biogeographic Regions				
	Bassian	Bassian – Bassian/Eyrean	Eyrean/Bassian	Eyrean	Total Species
Nantawarrina IPA	1	4	5	20	30
Flinders Ranges	19	9	13	35	76

Table 30. Identifiable biogeographic regional affiliations of Nantawarrina IPA bird species.

Bassian	Bassian – Bassian/Eyrean	Eyrean/Bassian	Eyrean
Shining Bronze Cuckoo	Brown-headed Honeyeater	Brown Treecreeper	Australian Bustard
	Silvereye	Dusky Woodswallow	Chestnut-crowned Babbler
	Spotted Pardalote	Elegant Parrot	Chestnut-rumped Thornbill
	Tawny-crowned Honeyeater	Gilbert's Whistler	Chirruping Wedgebill
		Yellow-plumed Honeyeater	Crimson Chat
			Cinnamon Quailthrush
			Diamond Dove
			Grey-fronted Honeyeater
			Ground Cuckoo-shrike
			Little Crow
			Little Woodswallow
			Orange Chat
			Pied Honeyeater
			Red-browed Pardalote
			Redthroat
			Short-tailed Grasswren
			Slaty-backed Thornbill
			Splendid Wren
			White-browed treecreeper
			White-winged Fairy-wren

Residency Status

The residency status of each bird species recorded for the Nantawarrina IPA is included in Appendix 12. There are seven introduced species amongst the 281 species listed by Reid *et al.* (1996) as occurring within the Flinders Ranges and Olary Spur, but none of these are amongst the species so far recorded within the Nantawarrina IPA.

In comparing the residency status of these species there are some disproportionate factors which stand out (Table 31). Although just under one third (92 of 281) of the Flinders Ranges bird species have been recorded within the IPA, none of the 37 species considered vagrant are amongst them. There is also a reduced proportion of the nomadic species amongst the IPA listed species, with just over one sixth (13 of 76) of those of the Flinders Ranges as a whole. Conversely, more than half (60 of 112) of the Flinders Ranges resident species have been recorded for the IPA.

Clearly there is a bias away from transient species towards resident species being recorded within the IPA. This imbalance may be the result minimal sampling within the reserve and difficulty of access during wetter periods, resulting from the relative isolation of the IPA off the main routes travelled throughout the ranges.

However, it must also relate to the majority of records being collected during the April 2009 survey. This survey occurred at the end of three years of comparatively dry or drought conditions (refer Figure 5 in the Introduction), unfavourable for the transient nomadic and vagrant species, which would only be present for relatively short periods when ephemeral food and water are available.

Table 31. Comparison of residency status of bird species recorded within the Nantawarrina IPA and the greater Flinders Ranges.

Status	R	N	V	M	S	W	R/N	N/R	N/S	R/W	S/M	Total
Nantawarrina IPA	60	13	0	2	4	1	2	2	5	2	1	92
Flinders Ranges	112	76	37	9	8	4	13	8	10	3	1	281

Status: The status classifications used in the table above are taken directly from Reid *et al.* (1996) and indicate the likely residential status of birds in the region. They are defined as **R** = resident; **N** = nomadic; **V** = vagrant; **M** = complex status, thought to involve two populations - breeding residents or breeding migrants, and non-breeding visitors; **S** = spring-summer (breeding) migrant or visitor; **W** = winter (non-breeding) migrant or visitor. Several of the minor classifications are combinations of two of the basic groupings. The first letter describes the dominant behaviour of the species whilst the second indicates possible behaviour change in response to changes in habitat condition. For example, a species classified as N/R would normally be nomadic, but under favourable conditions could become resident for prolonged periods.

REPTILES

D. Armstrong[1]

Summary of Records

Prior to this survey of the Nantawarrina IPA, reptile records for the reserve came primarily from a broader regional biological survey of the Flinders Ranges undertaken by DEH from 1997-99 (Brandle 2001). That survey collected 87 reptile records within the IPA, 79 at formal sampling sites and eight opportunistically. A further seven records came from the SA Museum collection, and a single but significant record from the DEH general opportunistic database. Where available, Adnyamathanha names used are shown in block bracketed bold text and are taken from Tunbridge (1988 and 1991).

The 2009 survey undertook intensive fauna sampling at 21 sites within the reserve, although reptile records were only effectively collected at 20 of these. Another six sites sampled during the 1997-99 Flinders Ranges Biological Survey, were within the reserve boundaries (Figure 85). As reptile records were obtained at all six, the total number of intensive survey sites at which reptile records were collected is therefore 26, from a possible 27. In addition to records collected in a systematic nature with consistent effort at these sites, opportunistic records were also collected throughout the survey area during both DEH surveys, particularly targeting mobile species or those that occur in specific habitats which may be difficult to access or have limited occurrence.

When combined these sources provide a total of 315 reptile records and confirm the presence of 33 reptile species within the Nantawarrina IPA (Appendix 17). By obtaining 220 reptile records, 143 at formal sampling sites and 77 opportunistically, the 2009 IPA survey provided 70% of the available records (Table 32).

Table 32. Sources of Nantawarrina IPA reptile records

	DEH OP	Museum	Flinders Ranges Survey		Nantawarrina IPA Survey		Total
			OP	Sites	OP	Sites	
Species	1	7	4	20	18	22	33
Records	1	7	8	79	77	143	315

The 33 reptile species recorded within the Nantawarrina IPA are representatives of six of the seven currently recognised Australian lizard families and one of the six snake families. The lizard families are:-
Agamidae (Dragon Lizards) five species,
Carphodactylidae (Australasian Geckos) one species,
Diplodactylidae (Australian Geckos) three species,
Geckonidae (Typical Geckos) five species,
Pygopodidae (Legless Lizards) two species, and
Scincidae (Skinks) 15 species.

Both snake species are from the family *Elapidae*, most generally described as front-fanged venomous land snakes. The majority of Australian land snakes belong to this family.

New Species Recorded by the 2009 Survey

Twenty four of the 33 species were known from the earlier records. Nine new species were recorded by the 2009 survey (Table 33). These were five skinks, Spotted Ctenotus (*Ctenotus orientalis*), Eastern Desert Ctenotus (*Ctenotus regius*), Sandplain Ctenotus

Figure 84. The two site records of the Broad-banded Swimmer (*Eremiascincus richardsonii*) from near Irish Well are the first records of this species for the IPA (Photo: A. Robinson).

(*Ctenotus schomburgkii*), Broad-banded Sandswimmer (*Eremiascincus richardsonii*) and Sleepy Lizard (*Tiliqua rugosa*) **[Alda]**, two dragons, Nobbi Dragon (*Diporiphora nobbi*) and Central Bearded Dragon (*Pogona vitticeps*) **[Adnu]**, and two geckos, Purple

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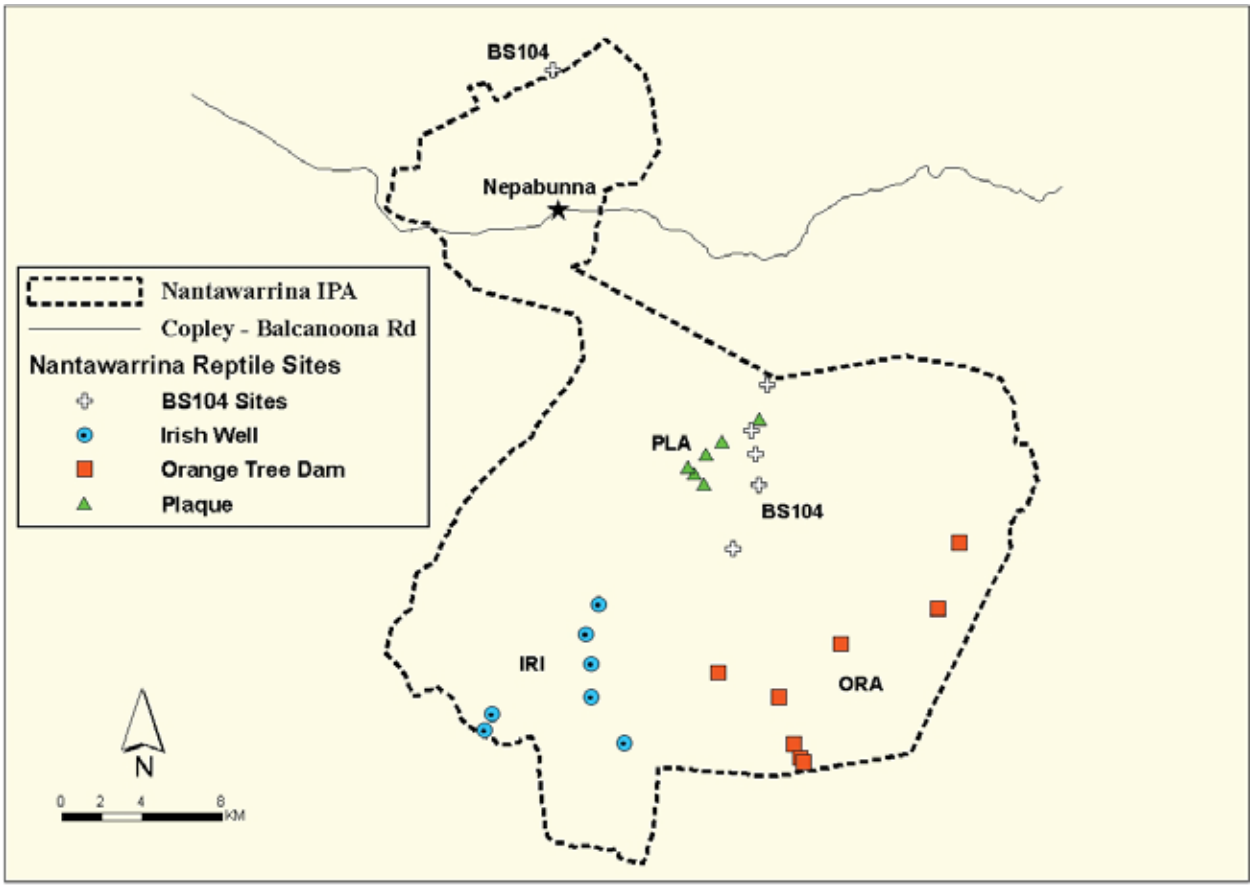

Figure 85. Location of sites where reptiles have been sampled in the Nantawarrina IPA (BS104 refers to sites sampled in 1999 as part of the Flinders Ranges Biological Survey).

Table 33. Summary of reptile species first recorded in the Nantawarrina IPA during the 2009 Nantawarrina IPA survey.

Species Name	Common Name	No. of Sites	Records at Sites	OP Records	Total Records
Ctenotus orientalis	Spotted Ctenotus	3	3	2	5
Ctenotus regius	Eastern Desert Ctenotus	2	2	0	2
Ctenotus schomburgkii	Sandplain Ctenotus	2	4	1	5
Eremiascincus richardsonii	Broad-banded Sandswimmer	2	2	0	2
Tiliqua rugosa	Sleepy Lizard **[Alda]**	2	2	2	4
Diporiphora nobbi	Nobbi Dragon	1	1	0	1
Pogona vitticeps	Central Bearded Dragon **[Adnu]**	2	2	2	4
Gehyra purpurascens	Purple Dtella	2	2	0	2
Rhynchoedura ornata	Beaked Gecko	1	1	0	1

Dtella (*Gehyra purpurascens*) and Beaked Gecko (*Rhynchoedura ornata*).

In general these additional species were recorded as a result of the greater effort and higher number of sites sampled during this survey. However, the accompanying increase in habitat types sampled compared to the 1999 survey is also likely to have been a contributing factor.

With the notable exception of GAP00601 (details below), the 1999 survey sites within the IPA focused on the more easily accessible habitats in the northern areas of the reserve, adjacent to the track south from the Copley road. Of the lower hills and undulating plains country, this area is more heavily vegetated and topographically complex as it lies between two ranges from which it receives shelter and runoff.

This survey sampled additional and more remote areas including the south and west of the IPA, which are more representative of the plains country to the east rather than the ranges. This would be a contributing factor in the recording of at least Eastern Desert Ctenotus (*Ctenotus regius*) and Sandplain Ctenotus (*Ctenotus schomburgkii*), and possibly others.

That two such large species as Sleepy Lizard (*Tiliqua rugosa*) **[Alda]** and Central Bearded Dragon (*Pogona vitticeps*) **[Adnu]** were not recorded in 1999 or by any other means prior to 2009 is unusual. It could be assumed that the area and habitats sampled in 1999 did not favour these species. It is also possible that both

species are uncommon within the IPA, as only four records of both were obtained. In fact, two of Sleepy Lizard (*Tiliqua rugosa*) **[Alda]** records were of decomposed and skeletonised road-killed animals. However, it is difficult to be sure of the reason, as the greatest sampling effort (during this survey), was undertaken in April-May and most of the sampling effort in 1999 was in March, both post midsummer, when many reptiles, particularly the larger species, are generally inactive.

Figure 86. The Central Bearded Dragon [Adnu] (*Pogona vitticeps*) was recorded twice at sites and twice opportunistically during the survey (Photo: N. Neagle).

Species Not Recorded by the 2009 Survey

Six of the 24 species recorded prior to 2009 were not found during the recent survey. These were one skink, Eastern Tree Skink (*Egernia striolata*), one dragon, Tawny Dragon (*Ctenophorus decresii*), two legless lizards, Barred Snake-lizard (*Delma australis*) and Burton's Legless Lizard (*Lialis burtonis*) and two elapid snake species, Common Bandy-Bandy (*Vermicella annulata*) and Mulga Snake (*Pseudechis australis*) **[Udkari]**. All six are represented by less than a handful of records. Five were recorded during the Flinders Ranges Biological Survey (Brandle 2001). In fact one species, Eastern Tree Skink (*Egernia striolata*), was recorded three times between two sample sites in late March. Four others were recorded at only one site - Tawny Dragon (*Ctenophorus decresii*) two records, Barred Snake-lizard (*Delma australis*) one record, Burton's Legless Lizard (*Lialis burtonis*) one record, and Mulga Snake (*Pseudechis australis*) **[Udkari]** one record of a sloughed skin. A single specimen of Common Bandy-Bandy (*Vermicella annulata*) was found in the Nepabunna Community in 2007.

The absence of three of these six species (*Ctenophorus decresii, Delma australis, Lialis burtonis*) from the records obtained in this survey is explained by aspects of the single sample site from the 1999 survey where the only records of them within the IPA have been collected. This site (GAP00601) was visited by helicopter during October (prime time of year for reptile activity), as part of a comprehensive sampling effort of the Mawson Plateau and other higher more inaccessible parts of the ranges. The altitude of this site at 700 metres, compared with other IPA sample sites of between 300-350 metres, and ground cover of 25-50% Spinifex (*Triodia* sp.) hummock grass, are two significant factors which differentiate it from the other sampling sites.

Although both Barred Snake-lizard (*Delma australis*) and Burton's Legless Lizard (*Lialis burtonis*) are not exclusive inhabitants of Spinifex, they are more frequently found in association with it than in most other habitat types. Tawny Dragon (*Ctenophorus decresii*) is a rock dragon with a southerly distribution extending north from Kangaroo Island through the Mt Lofty Ranges into the northern Flinders Ranges, where it is confined to the higher and wetter parts (Houston 1980). This provides slightly cooler microclimate locations to which it is better adapted, and allow it to exist without direct competition with Red-barred Dragon (*Ctenophorus vadnappa*), which dominates in lower drier areas.

Figure 87. The only records of the Tawny Dragon (*Ctenophorus decresii*) in the IPA are from the top of the range near Mount Rowe, north of Nepabunna (Photo: A. Robinson).

In addition, four of the seven records of Southern Rock Dtella (*Gehyra lazelli*) from within the IPA were also obtained at this site. This is another southern rock-dwelling species at the extreme northern limit of its range in the northern Flinders Ranges. It appears to be following the same pattern as Tawny Dragon (*Ctenophorus decresii*) in taking advantage of the microclimate available at higher altitudes and possibly avoiding competition with a similar species, in this case the more widespread habitat generalist Tree Dtella (*Gehyra variegata*), which is abundant in rocky habitats on the lower slopes of the ranges.

Relative Abundance at Sites

There was a strong separation into two clusters in the number of sites at which species were recorded. Four small lizard species accounted for 113 of 222 (51%), just over half of all records at sites, and were clearly also the most frequently encountered, as these four were also the only species recorded at 10 or more sites. They were Tree Dtella (*Gehyra variegata*), Bynoe's Gecko (*Heteronotia binoei*), Common Snake-eye

Figure 88. Bynoe's Gecko (*Heteronotia binoei*) was one of the most commonly recorded reptiles on the Nantawarrina IPA Survey (Photo: A. Robinson).

Figure 89. The Common Snake-eye (*Morethia boulengeri*) was found to be widespread in the IPA (Photo: I. Williams).

(*Morethia boulengeri*) and Desert Wall Skink (*Cryptoblepharus australis*) (Table 34). Conversely, the other 25 species recorded at formal sample sites accounted for the remaining 49% of site records, and all occurred at six or less sites and generally had proportionately few records. In fact 16 of the 29 (55%) species at sites were represented by mostly individual records at only one or two of a possible 27 sites at which reptile records were sampled.

This disparity is just as clear when all opportunistic records are included and total records rather than species occurrence at sites is examined. Of the 33 reptile species recorded within the IPA (29 at sites and four opportunistically) 19 are represented by five or less records and of these, 10 species are represented by just one or two records (Appendix 17). Records of all reptile species recorded at sites in the IPA, on both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Surveys are provided in Appendices 18 & 19.

The average number of reptile species recorded at sites was 4.4. The greatest number of species recorded at a site was nine at GAP00601 in 1999. This site was in Gum-barked Coolibah (*Eucalyptus intertexta*), Broombush (*Melaleuca uncinata*) Open Low Mallee over Spinifex (*Triodia* sp.) on a high ridge near Mt. Rowe, to the north of the Nepabunna Community. The lowest was zero at PLA00401 on a rocky ridge in Mulga (*Acacia aneura*) Very Low Woodland in 2009.

The average number of reptile records at a site was

Table 34. Reptile species recorded at survey sites within the Nantawarrina IPA, in descending order of site frequency.

Species Name	Common Name	Total Records	% of Total	Total Sites
Gehyra variegata	Tree Dtella	37	16.7	16
Heteronotia binoei	Bynoe's Gecko	25	11.3	13
Morethia boulengeri	Common Snake-eye	37	16.7	12
Cryptoblepharus australis	Desert Wall Skink	14	6.3	10
Lerista timida	Dwarf Three-toed Slider	14	6.3	6
Ctenophorus vadnappa	Red-barred Dragon	13	5.9	5
Ctenotus olympicus	Saltbush Ctenotus	6	2.7	5
Ctenotus robustus	Eastern Striped Skink	10	4.5	4
Menetia greyii	Dwarf Skink	7	3.1	4
Diplodactylus furcosus	Ranges Stone Gecko	5	2.3	4
Tympanocryptis tetraporophora	Eyrean Earless Dragon	7	3.1	3
Ctenotus orientalis	Spotted Ctenotus	3	1.3	3
Oedura marmorata	Marbled Velvet Gecko	3	1.3	3
Lucasium byrnei	Pink-blotched Gecko	10	4.5	2
Gehyra lazelli	Southern Rock Dtella	6	2.7	2
Ctenotus schomburgkii	Sandplain Ctenotus	4	1.8	2
Egernia striolata	Eastern Tree Skink	3	1.3	2
Ctenotus regius	Eastern Desert Ctenotus	2	0.9	2
Eremiascincus richardsonii	Broad-banded Sandswimmer	2	0.9	2
Gehyra purpurascens	Purple Dtella	2	0.9	2
Pogona vitticeps	Central Bearded Dragon	2	0.9	2
Tiliqua rugosa	Sleepy Lizard	2	0.9	2
Ctenophorus decresii	Tawny Dragon	2	0.9	1
Delma australis	Barred Snake-lizard	1	0.45	1
Diporiphora nobbi	Nobbi Dragon	1	0.45	1
Lialis burtonis	Burton's Legless Lizard	1	0.45	1
Liopholis margaretae	Masked Rock Skink	1	0.45	1
Pseudechis australis	Mulga Snake	1	0.45	1
Rhynchoedura ornata	Beaked Gecko	1	0.45	1
Total No. of Reptiles Observed		**222**	**100**	**27**
Total No. of Reptile Species Observed		**29**		

8.5. The highest number of reptile records at a site was 20, again at GAP00601. The lowest (apart from PLA00401) was two, at two sites on open flat ground near the southern boundary of the IPA. These were Elegant Wattle (*Acacia victoriae* ssp. *victoriae*), Silver Senna (*Senna artemisioides* ssp. X *artemisioides*) Open Shrubland on a series of minor watercourses at IRI00601 near Irish Well, and Long-spine Bindyi (*Sclerolaena longicuspis*), Tangled Bindyi (*S. divaricata*), Curly Mitchell-grass (*Astrebla lappacea*) Low Open Shrubland with emergent Cotton-bush (*Maireana aphylla*) on a cracking clay plain at ORA00501 to the south of Orange Tree Dam. The frequency of total reptile species recorded at all sites sampled for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys is shown in Figure 90.

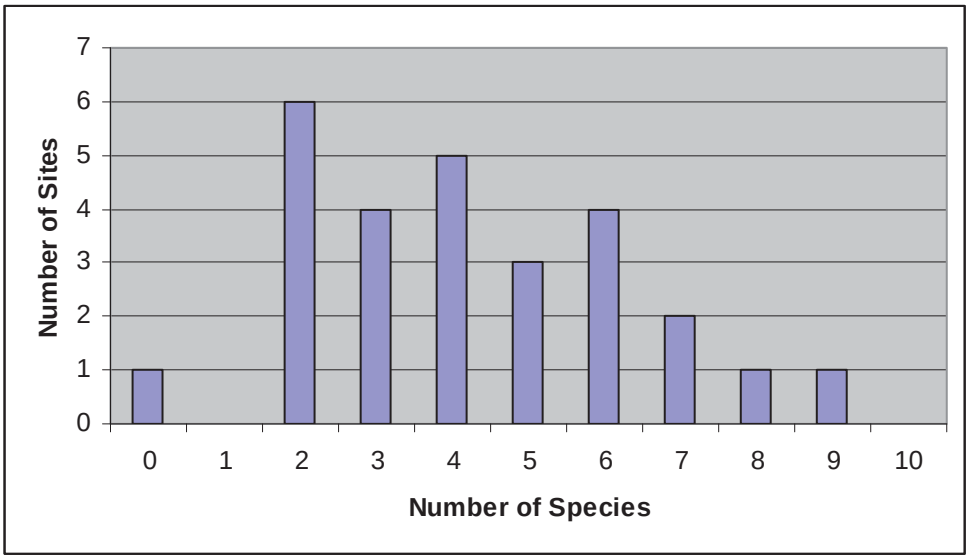

Figure 90. Frequency of number of reptile species recorded at sample sites.

Species of Conservation Significance

Only two of the 33 reptile species recorded within the Nantawarrina IPA are considered of conservation significance in South Australia. None are rated under federal legislation to be of concern nationally. Both the South Australian rated species are at the lowest of three levels of concern (Endangered, Threatened and Rare), as Rare in South Australia under the *National Parks and Wildlife Act 1972*.

Oedura marmorata **(Marbled Velvet Gecko) [Munga] SA: R**

First recorded in SA in 1965 at Mt. McKinlay **[Wayanha]**, just to the north of the Nantawarrina IPA in what is now the Vulkathunha-Gammon Ranges National Park. Although it has a wide distribution in eastern and northern Australia, in SA it is still only known from scattered records from the northern Flinders Ranges east to Danggali Conservation Park.

Within the IPA Marbled Velvet Gecko (*Oedura marmorata*) records were obtained at three sample sites, one during the Flinders Ranges Biological Survey in 1999 and two during this survey, and opportunistically at two other locations during this recent survey. Although it is known to be a crevice dweller in both rock outcrops and trees, all records from within the IPA are from under loose bark or in hollows of, or seen while spotlighting on, Black Oak (*Casuarina pauper*), as are most current records for this species from within SA. Conversations with members of the Nepabunna Community indicate that at least within the northern Flinders Ranges they may also inhabit dead Mulga (*Acacia aneura*).

Figure 91. Four Marbled Velvet Geckos [Munga] (*Oedura marmorata*) were found on Black Oaks [Alku] (*Casuarina pauper*) during the survey (Photo: A. Robinson).

Vermicella annulata **(Common Bandy-Bandy) SA: R**

Despite its name this species does not appear to be common, at least not in SA. There are currently only 11 records of Common Bandy-Bandy (*Vermicella annulata*) for the state, four of these from the northern Flinders Ranges. The available records indicate a restricted distribution in SA, as all are in the Flinders Ranges or to the south-east of the ranges in the Murray

Lands. There is a single record from the Nantawarrina IPA, found caught up in a Red-backed Spider web in the ablutions block of the Nepabunna Community Office in November 2007. The general paucity of records of this species is most likely related to their diet. They feed exclusively on members of a single family of small snakes, the *Typhlopidae* (Blind Snakes). As blind snakes feed predominantly on the larvae, pupae and eggs of various ant species, they spend most of their lives underground in ant nest chambers. In effect Common Bandy-Bandy (*Vermicella annulata*) is a specialist feeder on a specialist feeder. As such they are probably never numerous, spending much of their lives underground searching for their preferred prey and, as they are nocturnal, when they do emerge, they are rarely seen.

Other Significant Species

Ctenophorus vadnappa **(Red-barred Dragon) [Itivadnappa]**

This is a locally endemic species, with its distribution restricted to the northern Flinders Ranges and the adjacent Willouran Ranges. It has significance to Adnyamathanha people whose traditional lands cover a major portion of this area. The species name is a slightly corrupted version of the Adnyamathanha word vardnappa, describing first level initiate young men (Tunbridge 1988). In scientifically describing the species, Houston (1974) stated that the red bars of the male Red-barred Dragon were compared to the red stripes painted on the backs of young men about to be initiated. He also stated that the lizard was known as Itivadnappa - iti meaning lizard and vadnappa meaning boy painted for initiation ceremony.

Figure 92. The Red-barred Dragon [Itivadnappa] (*Ctenophorus vadnappa*) is endemic to the northern Flinders Ranges and adjacent Willouran Ranges (Photo: A. Robinson).

The Red-barred Dragon appears to be relatively common within the IPA. Thirteen observations were made across six of the 27 sample sites at which systematic sampling was undertaken. With an additional 13 opportunistic records the species accounts for 26 of the total 315 (8%) reptile records available for the IPA.

The head and body of this dragon are not quite as depressed as those of other members of the rock or crevice dragon group, Tawny Dragon (*Ctenophorus decresii*) and Peninsula Dragon (*Ctenophorus fionni*) (Houston 1978), possibly indicating that the Red-barred Dragon is not as exclusively tied to high quality rocky terrain as these other closely related species. Observations during the 2009 survey certainly support this. One specimen was found at night, sleeping under the bark of a fallen Black Oak (*Casuarina pauper*). Another was observed retreating into the central hollow of a fallen dead Mulga (*Acacia aneura*). Yet another was seen living around a handful of rock slabs on a windrow edge of a track. All three of these observations were several hundred metres from the nearest substantial rock outcrop.

Liopholis margaretae **(Masked Rock Skink)**

This inhabitant of rock outcrops, scree slopes and gorges is found throughout the Flinders Ranges, where it appears to exist as an isolated population of the sub-species, *Liopholis margaretae personata*. Its nearest relatives are located over 800 kilometres to the north-west in the Musgrave Ranges of the APY Lands (M. Hutchinson, pers comm, 2009). Within the IPA it was recorded several times in 2009 at Moro Gorge and at sample site GAP00601 during the 1999 survey. It is probable that this sample site on Mt. Rowe at around 700 metres and the complex of habitats of Moro Gorge provide a cooler or more sheltered microclimate effect which is preferred by this species.

Biogeographic Species Groups

Houston (1980) stated simply that about five times more (over 80%) of the reptile species found in the Flinders Ranges were of Eyrean origin, with the majority of their range within the arid central parts of the Australian continent, than Bassian species, based in the cooler temperate areas of south-eastern and south-western Australia. This certainly holds true for the reptile species recorded within the Nantawarrina IPA, where 27 of 33 (81%) are Eyrean and six of 33 (19%) are Bassian species.

Bassian Species

There are six species known to occur in the IPA with the majority of their range in southern temperate Australia, extending north away from the coast into parts of the arid interior. Three species, Tawny Dragon (*Ctenophorus decresii*), Ranges Stone Gecko (*Diplodactylus furcosus*) **[Murnga]** and Southern Rock Dtella (*Gehyra lazelli*) are largely or wholly restricted to mountain ranges and have the northern extreme of their distribution in the northern Flinders Ranges. The three other species inhabit more diverse habitats and have a more extensive distribution, expanding as far north as parts of the Lake Eyre Basin. These species are Spotted Ctenotus (*Ctenotus orientalis*), Barking Gecko (*Nephrurus milii*) **[Urnari]** and Sleepy Lizard (*Tiliqua rugosa*) **[Alda]**.

Eyrean Species

The remaining 27 species are considered to be predominantly or entirely Eyrean, in having the majority of their distribution in arid and semi-arid parts of Australia, away from the coast. They can be roughly divided into four groups as follows.

Flinders Ranges near Endemics (2 species)
Only two of the reptile species recorded within the IPA can be considered to be largely endemic to the Flinders Ranges, despite both having populations in other mountain ranges within South Australia. These are Red-barred Dragon (*Ctenophorus vadnappa*) **[Itivadnappa]** and Masked Rock Skink (*Liopholis margaretae personata*). Although the second is currently regarded as an isolated sub-species, it may well eventually receive full species classification due to this extreme isolation. Both have a close association with rocky habitats in ranges, which restricts their potential to disperse away from these areas. They are also discussed in more detail in earlier sections of this report.

Eastern Species (6 species)
These are largely eastern and in some cases also northern Australian species which, although considered to be Eyrean, are not entirely arid adapted. They appear to extend into South Australia through the Murray Darling Basin.

Figure 93. The Spotted Slider (*Lerista punctatovittata*) is one of the Eastern species found in the IPA (Photo: P. Canty).

Four species, Nobbi Dragon (*Diporiphora nobbi*), Spotted Slider (*Lerista punctatovittata*), Marbled Velvet Gecko (*Oedura marmorata*) **[Munga]** and Common Bandy-Bandy (*Vermicella annulata*) reach only as far as the Flinders Ranges. The remaining two, Eastern Striped Skink (*Ctenotus robustus*) and Eastern Tree Skink (*Egernia striolata*) continue onto northern Eyre Peninsula through the Gawler Ranges. Interestingly, the reverse is not true, in that none of a considerable number of reptile species originating in south-west Western Australia and whose range extends onto the Eyre Peninsula actually penetrate into the Flinders Ranges.

Widespread Generalists (4 species)
Although having the greater portion of their distribution within Eyrean arid or semi-arid Australia, largely due to such habitats dominating the greater portion of the continent, these species also extend into Torresian tropical areas of the country. They are found throughout much of the continent in a variety of habitat types, but avoiding the cool wet areas of the south. The members of this small group of widely distributed species are Bynoe's Gecko (*Heteronotia binoei*), Burton's Legless Lizard (*Lialis burtonis*), Dwarf Skink (*Menetia greyi*) and Mulga Snake (*Pseudechis australis*) **[Udkari]**.

Figure 94. Burton's Legless Lizard (*Lialis burtonis*) is an example of a widespread generalist species that occurs in the IPA (Photo: A. Robinson).

Typical Eyrean Species (15 species)
The remaining 15 species of reptiles recorded for the IPA are more typically Eyrean in distribution and habits, in that they live predominantly within the inland desert habitats of arid Australia. These species are:-
Desert Wall Skink (*Cryptoblepharus australis*)
Saltbush Ctenotus (*Ctenotus olympicus*)
Eastern Desert Ctenotus (*Ctenotus regius*)
Sandplain Ctenotus (*Ctenotus schomburgkii*)
Barred Snake-lizard (*Delma australis*)
Gidgee Skink (*Egernia stokesii*) **[Vikarri]**
Broad-banded Sandswimmer (*Eremiascincus richardsonii*)
Purple Dtella (*Gehyra purpurascens*)
Tree Dtella (*Gehyra variegata*)
Dwarf Three-toed Slider (*Lerista timida*)
Pink-blotched Gecko (*Lucasium byrnei*)
Common Snake-eye (*Morethia boulengeri*)
Central Bearded Dragon (*Pogona vitticeps*) **[Adnu]**
Beaked Gecko (*Rhynchoedura ornata*)
Eyrean Earless Dragon (*Tympanocryptis tetraporophora*) **[Murrandyarli]**

Figure 95. Gidgee Skink [Vikarri] (*Egernia stokesii*) is an Eyrean species that inhabits rocky outcrops (Photo: A. Robinson).

FROGS

D. Armstrong[1]

Sampling

As many frog species are either centred on limited areas of permanent water or remain deeply hidden awaiting rain to trigger activity, they are rarely recorded at the systematic survey sampling sites suitable for other vertebrate fauna groups. The records which are obtained usually result from opportunistic searching around water bodies or chance encounters in other locations, usually while targeting other animal groups.

Species Present

Only three of the 27 species of frogs known to occur within South Australia have been recorded in the Nantawarrina IPA. These are currently represented by a total of only 18 sightings. Six are from the specimen collection of the SA Museum, five were recorded during the DEH Flinders Ranges Biological Survey (Brandle 2001), and a further seven are from the 2009 survey (including one observation of an estimated 100 Desert Tree Frogs [*Litoria rubella*] at Moro Gorge).

Two species, Flinders Ranges Froglet (*Crinia riparia*) with four records, and Spotted Marsh Frog (*Limnodynastes tasmaniensis*) five records, are members of the family *Myobatrachidae* (Southern Frogs) which is confined to the Australian region (Cogger 2000). The other species, Desert Tree Frog (*Litoria rubella*) with nine records (109 individuals observed), is the sole member of the more widely distributed family *Hylidae* (Tree Frogs) to be found in the northern Flinders Ranges. A summary of all frog records in the IPA is provided in Table 35.

Table 35. Frog species recorded within the Nantawarrina IPA.

Species Name	Common Name	SAM	Flinders Ranges Survey		Nantawarrina IPA Survey		Total
			OP	SU	OP	SU	
MYOBATRACHIDAE	Southern Frogs						
Crinia riparia	Flinders Ranges Froglet	2	1	-	1	-	4
Limnodynastes tasmaniensis	Spotted Marsh Frog	1	4	-	-	-	5
HYLIDAE	Tree Frogs						
Litoria rubella	Desert Tree Frog	3		-	109	1	113
Total Species		**3**	**2**	-	**2**	**1**	**3**
Total Records		**6**	**5**	-	**110**	**1**	**122**

Note : The single survey site where a frog species (*Litoria rubella*) was recorded is ORA00201, in River Red Gum (*Eucalyptus camaldulensis*) Woodland on a creekline east of Orange Tree Dam.

Figure 96. Approximately 100 Desert Tree Frogs (*Litoria rubella*) were seen at Moro Gorge during the March 2009 survey reconnaissance trip (Photo: I. Williams).

The existing records were mostly collected around permanent water at Nantawarrina Springs and Moro Gorge. Several records of Desert Tree Frog (*Litoria rubella*), which is less dependent on permanent water, were also collected near the Nepabunna Community, at Waukla Woodna Gorge, at the base of a tank at Angas Hut and on a dry creek bed north of Orange

Figure 97. The Flinders Ranges Froglet (*Crinia riparia*) was recorded at Moro Gorge during this survey (Photo: I. Williams).

[1] Science Resource Centre, Information, Science and Technology Directorate, Department for Environment and Heritage, Gpo Box 1047, Adelaide SA 5001.

Tree Dam.

With targeted searching under ideal conditions, during or shortly following rain, all three species would be expected to be found throughout the reserve wherever suitable habitat is found. For the Flinders Ranges Froglet (*Crinia riparia*) this would be around permanent water of wherever water accumulates after rain along sheltered creek beds, such as in narrow gorges and ravines. Spotted Marsh Frog (*Limnodynastes tasmaniensis*) prefers similar, but more swampy, well vegetated locations. Desert Tree Frog (*Litoria rubella*) also occurs in these areas, but would be expected to be encountered along most creeklines, wherever it could shelter in tree hollows or deep rock crevices.

Other Possible Species

Brandle (2001) reported records of nine frog species occurring within the Flinders Ranges study area. Three are Bassian southern species which only extend as far north as the southern Flinders Ranges. Two burrowing species, Trilling Frog (*Neobatrachus centralis*) and Burrowing Frog (*Neobatrachus pictus*), and Brown Toadlet (*Pseudophryne bibroni*) have known distributions which are close to or overlap the IPA. Of the burrowing species, Trilling Frog (*Neobatrachus centralis*) appears the most likely to be found in the IPA, as the nearest records are from the plains just to the east. It is possible that it could occur in the pockets of similar habitat in the south-east of the reserve. Burrowing Frog (*Neobatrachus pictus*) is less likely as it would be at the extreme north of its currently known distribution.

Brown Toadlet (*Pseudophryne bibroni*) is probably the most likely additional species which could be found in the IPA. It is a southern or Bassian species with its most northern occurrence recorded further north, on the Mawson Plateau during the DEH 1997-99 Flinders Ranges Biological Survey, and even earlier, nearby in the Vulkathunha-Gammon Ranges National Park (Brandle 2001). It is therefore possible it may occur in cooler higher locations within the IPA.

Biogeography

Flinders Ranges Froglet (*Crinia riparia*) is, as its common name suggests, a Flinders Ranges endemic species.

Figure 98. The Spotted Marsh Frog (*Limnodynastes tasmaniensis*) is near the western limit of its range in the Flinders Ranges (Photo: A. Robinson).

The common name of Desert Tree Frog (*Litoria rubella*) is strictly only applicable in South Australia, as it is found in a variety of habitats in both the Eyrean (arid) and Torresian (tropical) regions. It is at the southern extreme of its South Australian distribution in the northern Flinders Ranges. The most southerly record is at Brachina Gorge (Brandle 2001), just 75kms south south-west of the Nantawarrina IPA.

Spotted Marsh Frog (*Limnodynastes tasmaniensis*) is an eastern Australian species, also found in a wide variety of habitats, where it shelters along the edge of both permanent and temporary swamps, lagoons and creeks (Cogger 2000).

It is unusual in that, although it is restricted to the eastern side of the continent, it is found in all three Australian biogeographic regions - Torresian (tropical), Eyrean (arid) and Bassian (temperate), and even in Tasmania. It is near the western extreme of its natural range in the Flinders Ranges, but does extend onto lower Eyre Peninsula and further west through the Gawler Ranges.

SUMMARY

N. Neagle[1]

The Nantawarrina IPA Study Area

The Nantawarrina Indigenous Protected Area covers approximately 58,000 hectares in the northern Flinders Ranges of South Australia. Its biodiversity reflects the range of habitats present (high quartzite ridges, steep sided gorges with permanent waterholes, low limestone hills and undulating siltstone flats) and its recent (since European settlement) land use. The average annual rainfall for the area is approximately 211mm, with the three years prior to the autumn 2009 survey being significantly below this average.

The IPA forms part of a larger area of land protected for conservation. Immediately to the north is Vulkathunha-Gammon Ranges National Park (128,000 hectares) with Arkaroola Sanctuary beyond that. To the south west lies Warraweena Private Conservation Park, another former pastoral lease.

The Nantawarrina IPA Biological Survey

The primary aim of the Nantawarrina IPA Biological Survey was to document the vascular plant and vertebrate fauna present in the area by sampling an array of fixed quadrats representing the geographical and biological diversity of the area. Using the data collected on this survey, and with reference to existing data for the IPA, enabled the identification of the range of flora and fauna species present, as well as an analysis of the floristic vegetation communities. This information also enabled the investigation of species richness within different habitats, species distributions and the relative abundance of individual species.

Existing data consisted of 80 vegetation survey sites sampled in 1988 and 1991 as part of the Department for Environment and Heritage's (DEH) Flinders Survey and a further eight sampled in 1999 for the DEH Flinders Ranges Biological Survey. In contrast, vertebrate fauna has been sampled far less extensively. Only six of the 1999 sites and none of the 1988-91 sites had fauna sampling.

This survey established 22 sites. Vegetation and birds were sampled at all of these, and mammals and reptiles at all but one.

Vegetation

The 110 survey sites within the IPA have provided 2811 plant records. A further 733 records have been collected opportunistically, including 433 from the State Herbarium of SA's ADHERB database. From this 505 individual plant taxa were identified, of which 463 are native and 42 are introduced.

This survey alone collected 807 plant records from the 22 sites and an additional 278 opportunistically. This resulted in 270 unique plant taxa, 251 of which were native and 19 introduced. A total of 700 plant specimens were collected during the survey and lodged with the State Herbarium of SA. As this survey was conducted in autumn following three drier than average years relatively few annual species were present. Despite this, an additional 57 plant taxa not previously listed for the IPA were recorded (see below).

The most commonly recorded species were Silver Mulla Mulla (*Ptilotus obovatus* var. *obovatus*) at 21 sites, Ruby Saltbush (*Enchylaena tomentosa* var. *tomentosa*) at 19 sites, Dead Finish (*Acacia tetragonophylla*) and Velvet Potato-bush (*Solanum ellipticum*) at 18 sites each, and Oblique-spined Bindyi (*Sclerolaena obliquicuspis*) at 17 sites. This does not necessarily make these the most abundant species in the IPA, but they are widespread and common to numerous habitats.

By contrast several tree species that tend to characterise the vegetation of the IPA were recorded less frequently, but had comparatively high cover/abundance scores when present. The main examples of these are River Red Gum (*Eucalyptus camaldulensis* ssp. *minima*), both varieties of Mulga (*Acacia aneura* var. *aneura* and *A. aneura* var. *tenuis*), Black Oak (*Casuarina pauper*) and, to a lesser degree, Inland Paper-bark (*Melaleuca glomerata*).

Comparatively few introduced species were recorded during this survey, and those that were were recorded infrequently. The only four to be recorded at more than three sites were Ward's Weed (**Carrichtera annua*) at 9 sites, Thorn-apple (**Datura leichhardtii*) and Smooth Mustard (**Sisymbrium erysimoides*) both at 6 sites, and Colocynth (**Citrullus colocynthis*) at five sites. As the majority of the introduced species recorded in the IPA are annuals, conducting the survey at the end of a very dry summer no doubt had a major influence on their relatively low percentage occurrences.

Fifteen plant species of conservation significance were recorded on the Nantawarrina IPA Biological Survey.

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Two of these are rated at state or national level:-

- Slender Bell-fruit [Alunga] (*Codonocarpus pyramidalis*) is rated Endangered in SA and Vulnerable nationally.
- Leafy Twig-rush (*Cladium procerum*) is rated Rare in SA.

Also of significance is the recent confirmation of the presence in the IPA of Small-leaved Xerothamnella (*Xerothamnella parvifolia*), a species rated as Endangered in SA and Vulnerable nationally.

The other 13 plant species of conservation significance recorded on this survey have regional ratings in the Flinders Ranges Herbarium Region:-

Rare or Threatened species:-
Cottony Goosefoot (*Chenopodium curvispicatum*)

Rare species:-
Flat-awn Spear-grass (*Austrostipa platychaeta*)
Tall Bindyi (*Sclerolaena convexula*)
Cup Velleia (*Velleia connata*)
Dryland Bluebell (*Wahlenbergia aridicola*)

Uncommon species:-
Australian Anacampseros (*Anacampseros australiana*)
Lobe-seed Daisy (*Brachyscome dentata*)
Broom Bitter-pea (*Daviesia genistifolia*)
White Goodenia (*Goodenia albiflora*)
Native Jasmine (*Jasminum didymum* ssp. *lineare*)
Bush Bean (*Rhyncharrhena linearis*)
Caustic Bush (*Sarcostemma viminale* ssp. *australe*)
Spiny Mallee-pea (*Templetonia aculeata*)

In addition, 57 plant taxa not previously listed for the Nantawarrina IPA were recorded on this survey, 49 of which are natives and eight introduced. One of these, Rough Three-awn (*Aristida strigosa*), was the first record for the Flinders Ranges Herbarium Region.

The new native species are:-
Beckler's Rock Wattle (*Acacia beckleri* ssp. *megaspherica*)
Boggabri Weed (*Amaranthus mitchellii*)
Australian Anacampseros (*Anacampseros australiana*)
Arabidella glaucescens
Rough Three-awn (*Aristida strigosa*)
Curly Mitchell-grass [Vawa] (*Astrebla lappacea*)
Small-flower Wallaby-grass (*Austrodanthonia setacea*)
Rusty Spear-grass (*Austrostipa eremophila*)
Flat-awn Spear-grass (*Austrostipa platychaeta*)
Lobe-seed Daisy (*Brachyscome dentata*)
Sticky Cassinia (*Cassinia complanata*)
Annual Rock-fern (*Cheilanthes austrotenuifolia*)
Cottony Goosefoot (*Chenopodium curvispicatum*)
Sand Button-bush (*Chrysocephalum eremaeum*)
Silky Cryptandra (*Cryptandra propinqua*)
Silky-head Lemon-grass (*Cymbopogon obtectus*)
Button-grass [Wala-nurru] (*Dactyloctenium radulans*)
Umbrella Grass (*Enteropogon ramosus*)
Crimson Emubush (*Eremophila latrobei* ssp. *glabra*)
Spotted Emubush [Ilvi] (*Eremophila maculata* ssp.)
White Goodenia (*Goodenia albiflora*)
Streaked Goodenia (*Goodenia calcarata*)
Sturt's Desert Rose [Wilvilvi] (*Gossypium sturtianum var. sturtianum*)
Inland Rush [Vundutu] (*Juncus aridicola*)
Sea Rush [Vundutu] (*Juncus kraussii*)
Cotton-bush [Vunda] (*Maireana aphylla*)
Native Myrtle (*Myoporum montanum*)
Native Millet (*Panicum decompositum* var. *decompositum*)
Phyllanthus maderaspatensis var. *angustifolius*
Common Purslane [Vidlavaka] (*Portulaca oleracea*)
Long-tails (*Ptilotus polystachyus* var. *polystachyus*)
Rhynchosia (*Rhynchosia minima*)
Pink Tongue (*Rostellularia adscendens* ssp. *adscendens* var.)
Spike Centaury (*Schenkia australis*)
Tangled Bindyi (*Sclerolaena cuneata*)
Inland Shrubby Groundsel (*Senecio lanibracteus*)
Desert Senna (*Senna artemisioides* ssp. *alicia*)
Grey Senna [Vunila] (*Senna artemisioides* ssp. X *sturtii*)
Setaria basiclada
Ray Grass (*Sporobolus actinocladus*)
Sturt Pea [Narapana] (*Swainsona formosa*)
Window Mulga-grass (*Thyridolepis mitchelliana*)
Red Spinach (*Trianthema triquetra*)
Eichler's Caltrop [Vutu-ita] (*Tribulus eichlerianus*)
Woolly Yellow-heads (*Trichanthodium skirrophorum*)
Cup Velleia (*Velleia connata*)
Sticky New Holland Daisy (*Vittadinia australasica* var.)
Dryland Bluebell [Wari-wirra] (*Wahlenbergia aridicola*)
Golden Everlasting (*Xerochrysum bracteatum*)

The new introduced species are:-
Nettle-leaf Goosefoot (**Chenopodium murale*)
Colocynth (**Citrullus colocynthis*)
Paddy Melon (**Cucumis myriocarpus*)
Edible Fig (**Ficus carica*)
Bristly Horned-poppy (**Glaucium corniculatum*)
Smooth Heliotrope (**Heliotropium curassavicum*)
Horse Thistle (**Onopordum acaulon*)
Bathurst Burr (**Xanthium spinosum*)

Mammals

A total of 128 individual mammal observations and captures were made at sites during the Nantawarrina IPA Survey, representing 19 confirmed species. A further 102 opportunistic mammal sightings were made, including four species not recorded at sites – Yellow-footed Rock-wallaby [Andu] (*Petrogale xanthopus*), Gould's Wattled Bat [Wadnimikanha] (*Chalinolobus gouldii*), Feral Cat [Vusikata] (**Felis catus*) and Sheep [Ivi/Dyambaka] (**Ovis aries*). An additional bat species was only identified from calls (recorded using Anabat kits) – Free-tailed Bat [Wadnimikanha] (*Mormopterus* sp3/sp4). However, the calls of these two (as yet not fully described) species are difficult to differentiate, hence the exact species could not be determined.

This represents a combined tally of 23 definite species, of which 15 are native and eight introduced. One of these is considered to be of conservation significance – Yellow-footed Rock-wallaby [Andu] (*Petrogale xanthopus*) is rated Vulnerable at both state and national level.

Prior to this survey there was only very limited available data on mammal species' presence in the IPA. As a result eleven new species were confirmed from the 2009 survey, of which seven are native and four introduced. These are:-
Dingo [Urdninyi] (*Canis lupus dingo*)
White-striped Freetail-bat [Ngarlamikanha] (*Tadarida australis*)
Chocolate Wattled Bat [Wadnimikanha] (*Chalinolobus morio*)
Lesser Long-eared Bat [Wadnimikanha] (*Nyctophilus geoffroyi*)
Inland Forest Bat [Wadnimikanha] (*Vespadelus baverstocki*)
Western Grey Kangaroo [Wawu/Yudunandu] (*Macropus fuliginosus*)
Forrest's Mouse (*Leggadina forresti*)
Sheep [Ivi/Dyambaka] (**Ovis aries*)
Red Fox (**Vulpes vulpes*)
Feral Cat [Vusikata] (**Felis catus*)
House Mouse [Mausa] (**Mus musculus*)

This highlights the previous lack of systematic biological survey within the IPA (apart from the six sites of the Flinders Ranges Biological Survey in 1999).

The fifteen native mammal species known to occur in the IPA consist of:-

- One monotreme - Echidna [Vakirri] (*Tachyglossus aculeatus*)
- Two species of dasyurid or carnivorous marsupial - Fat-tailed Dunnart [Yurndu] (*Sminthopsis crassicaudata*) and Stripe-faced Dunnart [Yurndu] (*S. macroura*)
- Four species of macropod - Western Grey Kangaroo [Wawu/Yudunandu] (*Macropus fuliginosus*), Euro [Mandya] (*M. robustus*), Red Kangaroo [Urdlu] (*M. rufus*) and Yellow-footed Rock-wallaby [Andu] (*Petrogale xanthopus*)
- Two species of native rodent – Forrest's Mouse (*Leggadina forresti*) and Bolam's Mouse (*Pseudomys bolami*)
- Five species of insectivorous bats - Chocolate Wattled Bat [Wadnimikanha] (*Chalinolobus morio*), Gould's Wattled Bat [Wadnimikanha] (*Chalinolobus gouldii*), Lesser Long-eared Bat [Wadnimikanha] (*Nyctophilus geoffroyi*), White-striped Freetail-bat [Ngarlamikanha] (*Tadarida australis*) and Inland Forest Bat [Wadnimikanha] (*Vespadelus baverstocki*), and
- The Dingo [Urdninyi] (*Canis lupus dingo*).

The eight introduced mammal species are comprised of:-

- Four ungulates - Feral Goat [Nanikuta/Naniguta] (**Capra hircus*), Sheep [Ivi/Dyambaka] (**Ovis aries*), Feral Donkey (**Equus asinus*) and Horse/Brumby [Nandu] (**E. caballus*)
- Two carnivores - Feral Cat [Vusikata] (**Felis catus*) and Red Fox (**Vulpes vulpes*)
- One rodent - House Mouse [Mausa] (**Mus musculus*), and
- One lagomorph - Rabbit [Rabbit-a] (**Oryctolagus cuniculus*).

The most frequently recorded mammal species at sites from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys were two introduced species – Feral Goats [Nanikuta/Naniguta] (**Capra hircus*) at 13 of 27 sites and Rabbits [Rabbit-a] (**Oryctolagus cuniculus*) at 11 sites. Euro [Mandya] (*Macropus robustus*) and Short-beaked Echidna [Vakirri] (*Tachyglossus aculeatus*) were the most commonly recorded native mammals, at eight of 27 sites each.

The Stripe-faced Dunnart [Yurndu] (*Sminthopsis macroura*) was the most commonly trapped small mammal in the IPA, with 14 individuals caught across seven survey sites. This is consistent with the results from the much broader Flinders Ranges Biological Survey (Brandle 2001), where again it was the most commonly recorded small mammal species, being trapped in a wide variety of habitats in the northern Flinders Ranges. More interestingly, Bolam's Mouse (*Pseudomys bolami*) was trapped at five (of 27) sites within the IPA, but only nine (of 121) across the entire Flinders Ranges (Brandle 2001). The five sites in the IPA were a variety of different woodland and shrubland habitats.

The Dingo [Urdninyi] (*Canis lupus dingo*) was recorded at five of the 21 sites in the IPA during this survey, as well as twice opportunistically. These records were centred on three areas – around the Plaque camp, between Bald Hill and Irish Well, and in Waukla Woodna Gorge. By comparison, there was only one opportunistic record (and none at any of the 121 sites) of a Dingo during the more extensive Flinders Ranges Biological Survey in 1999.

Sub-fossil remains, mostly from regurgitated owl pellets collected from caves in Moro Gorge, provide evidence of the past existence of 19 native and one introduced mammal species within, or at least adjacent to, the Nantawarrina IPA (Tunbridge 1991). Six of the native species are now totally extinct, nine are locally extinct and two others, the Kultarr and Sandy Inland Mouse, have not been recorded within the IPA.

Birds

From existing data and observations made during this survey 92 bird species (all native) have been identified within the IPA. During the 2009 survey 495 bird records were collected at sites as well as 166 opportunistically off-sites. This represented 59 unique

species at sites and 65 observed opportunistically (15 of which were not seen at sites), for a total of 74.

Of these, 28 were species not previously recorded in the IPA. Amongst these were two species of conservation significance (Blue-winged and Elegant Parrots), two species with significant range extensions (Spotted Pardalote and Slaty-backed Thornbill), and confirmation of the occurrence within the reserve of Short-tailed Grasswren, a species endemic to the Flinders and Gawler Ranges.

The new species confirmed on this survey are:-
Australasian Pipit [Yaliwarruna] (*Anthus novaeseelandiae*)
Australian Hobby [Manga] (*Falco longipennis*)
Banded Lapwing [Vildarkari] (*Vanelus tricolor*)
Black-eared Cuckoo (*Chalcites osculans*)
Black-faced Woodswallow [Valpula] (*Artamus cinereus*)
Blue-winged Parrot (*Neophema chrysostoma*)
Brown Songlark [Utilaru] (*Cincloramphus cruralis*)
Brown-headed Honeyeater (*Melithreptus brevirostris*)
Chestnut-crowned Babbler [Yunula] (*Pomatostomus ruficeps*)
Chirruping Wedgebill [Walpundirika] (*Psophodes cristatus*)
Cinnamon Quail-thrush [Vuli] (*Cinclosoma cinnamomeum*)
Cockatiel [Wirupa] (*Nymphicus hollandicus*)
Collared Sparrowhawk [Mura] (*Accipiter cirrocephalus*)
Crimson Chat (*Epthianura tricolor*)
Dusky Woodswallow [Valpula] (*Artamus cyanopterus*)
Elegant Parrot [Malka-vadlaru] (*Neophema elegans*)
Ground Cuckoo-shrike (*Coracina maxima*)
Hooded Robin (*Melanodryas cucullata*)
Orange Chat (*Epthianura aurifrons*)
Pallid Cuckoo [Wilkangani] (*Cacomantis pallidus*)
Pied Honeyeater (*Certhionyx variegatus*)
Short-tailed Grasswren (*Amytornis merrotsyi*)
Slaty-backed Thornbill (*Acanthiza robustirostris*)
Spotted Pardalote (*Pardalotus punctatus*)
Tawny Frogmouth [Muni] (*Podargus strigoides*)
Tree Martin [Wira-yulditi-yulditi] (*Petrochelidon nigricans*)
White-winged Fairy-wren [Yuru yurula] (*Malurus leucopterus*)
Yellow-plumed Honeyeater (*Lichenostomus ornatus*)

Five bird species of conservation significance have been recorded within the IPA, and all but one were observed during the 2009 survey. These are:-

Species Vulnerable in SA:-
Australian Bustard [Wala] (*Ardeotis australis*)
Blue-winged Parrot (*Neophema chrysostoma*)

Species Rare in SA:-
Elegant Parrot [Malka-vadlaru] (*Neophema elegans*)
Gilbert's Whistler (*Pachycephala inornata*)
White-browed Treecreeper (*Climacteris affinis*)

Three other significant species sightings were made during the Nantawarrina IPA Biological Survey. The collection of a specimen of the Slaty-backed Thornbill (*Acanthiza robustirostris*) within the IPA is the first record of the species in the Flinders Ranges. This represents a major extension in range, as the nearest confirmed records are approximately 500km away near Tarcoola and Mabel Creek (G. Carpenter, pers comm, 2009). The Spotted Pardalote records also constitute a considerable range extension of the sub-species *Pardalotus punctatus punctatus*, as it had not previously been recorded north of the Wirrabara Forest district in the southern Flinders Ranges. The sighting of a Short-tailed Grasswren in Spinifex (*Triodia irritans*) Hummock Grassland on the Uro Range confirmed the presence of this species in the IPA, and represents evidence of a new sub-population to the south of a cluster of earlier sightings in the northern Flinders Ranges (G. Carpenter, pers comm, 2009).

The most commonly recorded bird species at sites from both the 1999 and 2009 surveys were the Spiny-cheeked Honeyeater [Turrana] (*Acanthagenys rufogularis*) at 23 of 28 sites, Red-capped Robin [Mali-ita-na] (*Petroica goodenovii*) at 21 sites and Inland Thornbill (*Acanthiza apicalis*) at 20 sites.

The average number of species observed per site was 15. The most diverse sites, with 34 and 35 species respectively, were both in River Red Gum [Wira] (*Eucalyptus camaldulensis* ssp. *minima*) Woodlands on watercourses. At the other extreme, the least diverse site with only four species was in Elegant Wattle [Minga] (*Acacia victoriae* ssp. *victoriae*), Silver Senna [Murku] (*Senna artemisioides* ssp. X *artemisioides*) Open Shrubland not far to the west of Irish Well.

In addition to opportunistic records collected on this and the 1999 Flinders Ranges Biological Survey data was also sourced from the SA Museum collections, Birds Australia Bird Atlas and Birds SA records. All opportunistic records accounted for 27 species not recorded at sites during either survey. Of these, 18 are nomadic or seasonal visitors to the IPA when conditions are favourable. Relatively few of these mobile species were recorded on this survey owing to it being conducted during a succession of drier than average years.

Reptiles

During the Nantawarrina IPA Survey 143 individual reptile observations and captures (representing 22 species) were made at the 21 sites sampled. A further 77 records came from opportunistic sightings and captures, including five extra species not recorded at sites – Barking Gecko (*Nephrurus milii*), Southern Rock Dtella (*Gehyra lazelli*), Gidgee Skink (*Egernia stokesii*), Spotted Slider (*Lerista punctatovittata*) and Masked Rock Skink (*Liopholis margaretae*).

Six other species previously recorded in the IPA were not seen on this survey. These comprise one skink, Eastern Tree Skink (*Egernia striolata*), two dragons,

Tawny Dragon (*Ctenophorus decresii*), two legless lizards, Barred Snake-lizard (*Delma australis*) and Burton's Legless Lizard (*Lialis burtonis*), and two elapid snakes, Common Bandy-Bandy (*Vermicella annulata*) and Mulga Snake [Udkari] (*Pseudechis australis*).

The 33 reptile species recorded within the IPA include representatives of six of Australia's seven currently recognised lizard families (Agamidae, Carphodactylidae, Diplodactylidae, Geckonidae, Pygopodidae and Scincidae) and one of the six Australian snake families (Elapidae). Two species of conservation significance are known to occur in the IPA – Marbled Velvet Gecko [Munga] (*Oedura marmorata*) and Common Bandy-Bandy (*Vermicella annulata*) are both rated as Rare in South Australia.

Two other significant reptile species were recorded on this survey. The Red-barred Dragon [Itivadnappa] (*Ctenophorus vadnappa*) is a locally endemic species, with its distribution restricted to the northern Flinders Ranges and the adjacent Willouran Ranges. It appears to be relatively common in the IPA as it was recorded at six of the 27 sites plus 13 opportunistic sightings on the 2009 survey. The Masked Rock Skink (*Liopholis margaretae*) is a common inhabitant of rocky areas throughout the Flinders Ranges, where it appears to exist as an isolated population of the subspecies *Liopholis margaretae personata*. Its nearest relatives are over 800km away in the Musgrave Ranges. Several individuals were seen at Moro Gorge during this survey.

The 1999 Flinders Ranges Biological Survey sampled reptiles at six sites in the IPA. The most commonly recorded reptile species from these sites and the current survey combined (a total of 27 sites) were Tree Dtella (*Gehyra variegata*) at 16 sites, Bynoe's Gecko (*Heteronotia binoei*) at 13 sites, Common Snake-eye (*Morethia boulengeri*) at 12 sites and Desert Wall Skink (*Cryptoblepharus australis*) at 10 sites. These four small lizards were the only species recorded at ten or more sites and accounted for 113 of the total 222 (51%) reptile site records. Of the 29 species recorded at sites 16 were only seen at one or two sites.

The average number of reptile species per site was 4.4. The most diverse site, with nine species, was GAP00601. Surveyed in 1999, this site was in Gum-barked Coolibah [Yundu] (*Eucalyptus intertexta*), Broombush [Alaru] (*Melaleuca uncinata*) Open Low Mallee over Spinifex [Vakirri] (*Triodia* sp.) at an altitude of 700m on a ridge near Mt. Rowe, to the north of the Nepabunna Community. The least diverse site was PLA00401, where no reptiles were recorded. This site was in Mulga [Malka] (*Acacia aneura*) Very Low Woodland on a rocky ridge in the Uro Range.

Nine of the 27 species recorded on this survey were not previously known to occur in the IPA. As they are known from the general area of the northern Flinders Ranges their absence from the known reptile fauna of the IPA is likely due to the previous lack of systematic survey of major habitats within Nantawarrina.

The newly recorded species are:
Beaked Gecko (*Rhynchoedura ornata*)
Broad-banded Sandswimmer (*Eremiascincus richardsonii*)
Central Bearded Dragon [Adnu] (*Pogona vitticeps*)
Eastern Desert Ctenotus (*Ctenotus regius*)
Nobbi Dragon (*Diporiphora nobbi*)
Purple Dtella (*Gehyra purpurascens*)
Sandplain Ctenotus (*Ctenotus schomburgkii*)
Sleepy Lizard [Alda] (*Tiliqua rugosa*)
Spotted Ctenotus (*Ctenotus orientalis*)

Frogs

Three species of frog have been recorded within the IPA – Desert Tree Frog (*Litoria rubella*), Flinders Ranges Froglet (*Crinia riparia*) and Spotted Marsh Frog (*Limnodynastes tasmaniensis*). Of these, only the Desert Tree Frog and Flinders Ranges Froglet were recorded on the 2009 survey.

Sightings have only been made at a few locations in the IPA – around permanent water at Moro Gorge and Nantawarrina Spring, as well as in Waukla Woodna Gorge, at the base of a tank at Angas Hut Well, site ORA00201 in the dry bed of Rainwater Creek, and in the bed of Mount McKinlay Creek just south of the entrance to the IPA.

Plant Communities

Perennial vegetation data from 107 sites sampled in the Nantawarrina IPA were examined using PC-ORD hierarchical cluster analysis software. Seventeen Floristic Vegetation Communities were chosen that best represent the range of communities present in the IPA, as follows:-

Woodlands/Tall Shrublands:-

- River Red Gum [Wira] (*Eucalyptus camaldulensis* ssp. *minima*) Woodland
- Black Oak [Alku] (*Casuarina pauper*) Very Low Woodland
- Black Oak [Alku] (*Casuarina pauper*) +/- Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*) Very Low Open Woodland
- Mulga [Malka] (*Acacia aneura* var.) Very Low Woodland
- White Cypress-pine [Vinba] (*Callitris glaucophylla*) Very Low Open Woodland over Spinifex [Vakirri] (*Triodia* sp.)
- Inland Paper-bark [Alaru] (*Melaleuca glomerata*) Tall Shrubland with emergent River Red Gum [Wira] (*Eucalyptus camaldulensis* ssp. *minima*).

Mallee Communities:-

- Beaked Red Mallee (*Eucalyptus socialis* ssp. *socialis*), Curly Mallee [Manduwarra] (*Eucalyptus gillii*) Open Mallee
- Flinders Grey Mallee (*Eucalyptus flindersii*), Broombush [Alaru] (*Melaleuca uncinata*) +/- Gum-barked Coolibah [Yundu] (*Eucalyptus*

intertexta) Open Low Mallee over Spinifex [Vakirri] (*Triodia* sp.).

Shrublands:-

- Elegant Wattle [Minga] (*Acacia victoriae* ssp. *victoriae*) +/- Dead Finish [Vara] (*Acacia tetragonophylla*) Very Open Shrubland with emergent Mulga [Malka] (*Acacia aneura*)
- Dead Finish [Vara] (*Acacia tetragonophylla*), Rock Emubush [Alda] (*Eremophila freelingii*) Very Open Shrubland with emergent Mulga [Malka] (*Acacia aneura*)
- Dead Finish [Vara] (*Acacia tetragonophylla*) Very Open Shrubland over Rock Sida [Vudari] (*Sida petrophila*)
- Elegant Wattle [Minga] (*Acacia victoriae* ssp. *victoriae*) Very Open Shrubland over Spear-grass (*Austrostipa* spp.)
- Rock Emubush [Alda] (*Eremophila freelingii*) Open Shrubland over Rock Sida [Vudari] (*Sida petrophila*)
- Fine-leaf Desert Senna [Murku] (*Senna artemisioides* ssp. *filifolia*), Broad-leaf Desert Senna [Murku] (*Senna artemisioides* ssp. X *coriacea*), Brilliant Hop-bush (*Dodonaea microzyga* var. *microzyga*) Open Shrubland.

Low Shrublands:-

- Low Bluebush (*Maireana astrotricha*) Low Open Shrubland with emergent Harlequin Emubush (*Eremophila duttonii*)
- Long-spine Bindyi [Yalkirri-ita] (*Sclerolaena longicuspis*) Low Open Shrubland
- Oblique-spined Bindyi [Wabma-ita] (*Sclerolaena obliquicuspis*) Low Open Shrubland with emergent mixed shrubs.

Biogeographic Significance

The location of the Nantawarrina IPA in the northern Flinders Ranges marks it at a crossover point for a number of arid adapted (Eyrean) and temperate (Bassian) species. The elevation of the ranges has a major influence on climate, and in particular rainfall, effectively extending southern climatic patterns north into the arid interior of Australia. Many species with eastern affinities are at or near the extreme western limit of their distribution in the Flinders Ranges. The Flinders also serve as a refuge for species that are adapted to arid rocky ranges and their occurrence may be shared with the Gawler Ranges, Barrier Ranges and/or Central Australian Ranges (Brandle 2001).

The climatic effect of altitude and rainfall is evident in the variation in vegetation communities on the dry lower hills and undulating plains, where open shrublands dominated by *Acacia* and *Senna* species are common, compared to the Mallee, Broombush and Spinifex communities in the cooler and moister conditions at higher altitudes (up to 700m) on the ranges.

Bird species found in the IPA may be divided into four distinguishable biogeographic groupings - Bassian; Bassian to Bassian/Eyrean (species at the extreme northern or western limit of their range); Eyrean/Bassian (species typically found in the mallee woodlands that extend across the country as a broad boundary zone between the genuine arid and temperate extremes); and Eyrean (Brandle 2001). The exclusion of species with broad national distributions, as well as water birds and vagrants, from the avifauna of the IPA leaves a total of 30 species. Their biogeographical affinities are as follows.

(1) Bassian species:-
Shining Bronze-Cuckoo (*Chalcites lucidus*)

(2) Bassian to Bassian/Eyrean species:-
Brown-headed Honeyeater (*Melithreptus brevirostris*)
Silvereye (*Zosterops lateralis*)
Spotted Pardalote (*Pardalotus punctatus*)
Tawny-crowned Honeyeater (*Gliciphila melanops*)

(3) Eyrean/Bassian species:-
Brown Treecreeper (*Climacteris picumnus*)
Dusky Woodswallow [Valpula] (*Artamus cyanopterus*)
Elegant Parrot [Malka-vadlaru] (*Neophema elegans*)
Gilbert's Whistler (*Pachycephala inornata*)
Yellow-plumed Honeyeater (*Lichenostomus ornatus*)

(4) Eyrean species:-
Australian Bustard [Wala] (*Ardeotis australis*)
Chestnut-crowned Babbler [Yunula] (*Pomatostomus ruficeps*)
Chestnut-rumped Thornbill (*Acanthiza uropygialis*)
Chirruping Wedgebill [Walpundirika] (*Psophodes cristatus*)
Crimson Chat (*Epthianura tricolor*)
Cinnamon Quail-thrush [Vuli] (*Cinclosoma cinnamomeum*)
Diamond Dove (*Geopelia cuneata*)
Grey-fronted Honeyeater (*Lichenostomus plumulus*)
Ground Cuckoo-shrike (*Coracina maxima*)
Little Crow [Vanda] (*Corvus bennetti*)
Little Woodswallow [Valpula] (*Artamus minor*)
Orange Chat (*Epthianura aurifrons*)
Pied Honeyeater (*Certhionyx variegatus*)
Red-browed Pardalote (*Pardalotus rubricatus*)
Redthroat (*Pyrrholaemus brunneus*)
Short-tailed Grasswren (*Amytornis merrotsyi*)
Slaty-backed Thornbill (*Acanthiza robustirostris*)
Splendid Fairy-wren (*Malurus splendens*)
White-browed Treecreeper (*Climacteris affinis*)
White-winged Fairy-wren [Yuru yurula] (*Malurus leucopterus*)

The microclimate effect created by altitude enables several species to extend from temperate Bassian locations into the Nantawarrina IPA within the northern ranges. Some of these, such as the Tawny-crowned Honeyeater are probably resident, whilst others, in particular the Shining Bronze Cuckoo, may be less frequent visitors. Many of the Eyrean species can only exist in pockets of their favoured habitat. In particular this applies to habitat specialists like the Slaty-backed Thornbill which inhabits Mulga [Malka]

(*Acacia aneura*) woodlands, the Short-tailed Grasswren which requires Spinifex [Vakirri] (*Triodia* spp.) on rocky slopes, and the Redthroat which is found in chenopod shrublands.

The reptile fauna of the IPA and of the Flinders Ranges more generally has about five times as many species of Eyrean origin as compared to Bassian (Houston 1980). Of the 33 reptile species recorded in the IPA six have Bassian affinities and 27 Eyrean.

Three of the Bassian species - Tawny Dragon (*Ctenophorus decresii*), Ranges Stone Gecko (*Diplodactylus furcosus*) and Southern Rock Dtella [Murnga] (*Gehyra lazelli*) - are largely restricted to the ranges and are at the northern extreme of their distribution in the northern Flinders Ranges. The other three - Spotted Ctenotus (*Ctenotus orientalis*), Barking Gecko [Urnari] (*Nephrurus milii*) and Sleepy Lizard [Alda] (*Tiliqua rugosa*) - occupy more diverse habitats and have more extensive distributions.

The 27 Eyrean species may be divided into four biogeographic sub-groups:-

(1) Flinders Ranges near Endemics
The Red-barred Dragon [Itivadnappa] (*Ctenophorus vadnappa*) and Masked Rock Skink (*Liopholis margaretae*) are considered to be largely endemic to the Flinders Ranges despite both having populations in other ranges within South Australia, the former in the Willouran Ranges and the latter in the Musgrave Ranges.

(2) Eastern Species
These are largely eastern Australian species that extend into SA through the Murray Darling Basin. Although not entirely arid adapted they are still regarded as Eyrean. Four species - Nobbi Dragon (*Diporiphora nobbi*), Spotted Slider (*Lerista punctatovittata*), Marbled Velvet Gecko [Munga] (*Oedura marmorata*) and Common Bandy-Bandy (*Vermicella annulata*) - reach only as far as the Flinders Ranges. The remaining two - Eastern Striped Skink (*Ctenotus robustus*) and Eastern Tree Skink (*Egernia striolata*) - continue onto northern Eyre Peninsula and the Gawler Ranges.

(3) Widespread Generalists
These species - Bynoe's Gecko (*Heteronotia binoei*), Burton's Legless Lizard (*Lialis burtonis*), Dwarf Skink (*Menetia greyi*) and Mulga Snake [Udkari] (*Pseudechis australis*) - are found in a variety of habitats throughout much of the continent, but avoid the cool wet areas in the south.

(4) Typical Eyrean Species
These 15 species occur predominantly within the inland desert habitats of Australia:-
Barred Snake-lizard (*Delma australis*)
Beaked Gecko (*Rhynchoedura ornata*)
Broad-banded Sandswimmer (*Eremiascincus richardsonii*)
Central Bearded Dragon [Adnu] (*Pogona vitticeps*)
Common Snake-eye (*Morethia boulengeri*)
Desert Wall Skink (*Cryptoblepharus australis*)
Dwarf Three-toed Slider (*Lerista timida*)
Eastern Desert Ctenotus (*Ctenotus regius*)
Eyrean Earless Dragon [Murrandyarli] (*Tympanocryptis tetraporophora*)
Gidgee Skink [Vikarri] (*Egernia stokesii*)
Pink-blotched Gecko (*Lucasium byrnei*)
Purple Dtella (*Gehyra purpurascens*)
Saltbush Ctenotus (*Ctenotus olympicus*)
Sandplain Ctenotus (*Ctenotus schomburgkii*)
Tree Dtella (*Gehyra variegata*)

Of the three frog species recorded in the Nantawarrina IPA the Flinders Ranges Froglet (*Crinia riparia*) is endemic to the region, the Desert Tree Frog (*Litoria rubella*) is occurring at the southern limit of its range in SA, and the Spotted Marsh Frog (*Limnodynastes tasmaniensis*) (an eastern Australian species) is near the western limit of its range in the Flinders Ranges (though it does extend to Eyre Peninsula and the Gawler Ranges).

Further Research

The Nantawarrina IPA Biological Survey has provided an inventory of the vascular plants and vertebrate fauna currently extant in the area. As it was limited to 22 sites across the entire 58,000ha of the IPA it could only adequately sample the major accessible habitats. Hence rare species, vegetation communities of limited extent and difficult to access areas could not be specifically targeted.

Areas Requiring Further Survey
Some areas of the Nantawarrina IPA have been inadequately sampled. This is particularly the case for the high ranges, with very few sites located within the Uro and Campbell Bald Hill Ranges. Obviously accessibility is the key constraint to sampling in these areas, and this presents a significant logistical challenge. A number of sites were sampled on the Gammon and Mawson Plateaux in 1999 during the Flinders Ranges Biological Survey (including site GAP00601 on the northern boundary of the IPA). In that instance a helicopter was used for access.

Site GAP00601 was at an altitude of 700m and is significant because:-

- it had the highest reptile diversity of any site in the IPA,
- it had three reptile species not recorded elsewhere in the IPA,
- it had one bird species not recorded elsewhere in the IPA,
- it had seven plant species not recorded elsewhere in the IPA,
- it is one of only two sites that comprise Floristic Vegetation Community 13 - Flinders Grey Mallee (*Eucalyptus flindersii*), Broombush [Alaru] (*Melaleuca uncinata*) +/- Gum-barked Coolibah [Yundu] (*Eucalyptus intertexta*) Open Low Mallee over Spinifex [Vakirri] (*Triodia* sp.). From limited on ground investigation this community appears to

be relatively prominent on the upper slopes and crests of the higher ranges.

Further sampling of sites in the ranges, particularly above an altitude of 500m, would not only help determine the distribution of these species in the IPA and better define this floristic community, but also enable a more complete analysis of the diversity, distribution and extent of flora and fauna communities in these areas.

Seasonal Surveys

The 2009 survey was conducted in autumn following three drier than average years. There is no doubt this will have influenced the range and abundance of species recorded. The dry conditions resulted in fewer annual plants species present and reduced resources available to support fauna populations. As this survey has provided the majority of flora and fauna records for the IPA further sampling in spring and following notable rainfall events is likely to result in additional species being recorded.

Plant Community Requiring Further Study

There are numerous examples in the IPA, particularly on the lower hills and undulating plain between the Uro and Stirrup Iron Ranges, of degraded areas of Mulga [Malka] (*Acacia aneura* var. *aneura*) Very Low Woodland. In these instances the Mulga is predominantly dead and regeneration appears to be virtually absent. Emergent trees, generally in poor condition, still exist but these communities are now dominated either by tall shrubs such as *Acacia tetragonophylla* [Vara] (Dead Finish) and/or *A. victoriae* ssp. *victoriae* [Minga] (Elegant Wattle) or, where this shrub layer is also absent, by *Sclerolaena obliquicuspis* [Wabma-ita] (Oblique-spined Bindyi).

Figure 99. Degraded Mulga [Malka] (*Acacia aneura* var. *aneura*) Very Low Woodland between Orange Tree Dam and Irish Well (Photo: N. Neagle).

It is possible that Mulga recruitment has been suppressed for many years by the combined grazing effects of introduced herbivores, particularly rabbits and sheep. Investigation is required to determine if any seedling recruitment is occurring or has occurred since the area was destocked and since the Rabbit Haemorrhagic Disease (RHD) first arrived.

Unconfirmed Plant Records

The discussion of plants of conservation significance (Vegetation chapter) included seven species whose presence within the IPA could not be confirmed and four that have not been recorded as present since the mid 1970s.

Those requiring confirmation are:-

Sandalwood (*Santalum spicatum*) SA:V FR:V

Purple Loosestrife (*Lythrum salicaria*) SA:R FR:X

Velleia cycnopotamica SA:R FR:unrated

Western Golden-tip (*Goodia medicaginea*) FR:R

Yakka Grass (*Sporobolus caroli*) FR:R

Hakea-leaf Hibiscus (*Alyogyne hakeifolia*) FR:U

Woolly Darling Pea (*Swainsona burkittii*) FR:Q

Those not recorded since the 1970s are:-

Lee's Swainson-pea (*Swainsona leeana*) SA:R FR:K

Swainsona oliveri FR:K

Australian Hound's-tongue (*Cynoglossum australe*) FR:R

Coil-pod Wattle (*Acacia pravifolia*) FR:U

In addition, Swamp Twig-rush (*Baumea arthrophylla*) was recorded at Moro Gorge in 1990, but as this is the only record for this species from the northern Flinders Ranges during the last 40 years its continued presence warrants investigation.

Examination of all these species may require re-determination of original specimens, checking location details on specimens, and searching at original collection locations and elsewhere in potential habitats within the IPA.

Rare Plants

Eight plant species of state or national conservation significance are known to occur in the IPA. Work is required to determine their extent of occurrence and what, if any, are their main threats. This could be the basis of ongoing monitoring of populations, particularly to determine if regular recruitment and survival of seedlings is occurring.

The confirmed rated species are:-

Slender Bell-fruit (*Codonocarpus pyramidalis*) Aus:V SA:E FR:E

Small-leaved Xerothamnella (*Xerothamnella parvifolia*) Aus:V SA:E FR:E – re-monitoring of existing populations near Moro Gorge and targeted searching for new occurrences conducted by Kieran Brewer in 2009 and 2010.

Prickly Spear-grass (*Austrostipa pilata*) SA:V FR:K – may be found to be more widespread with further sampling at altitude in the ranges.

Rough Bush-everlasting (*Ozothamnus scaber*) SA:R FR:K – may be found to be more widespread with further sampling at altitude in the ranges.

Leafy Twig-rush (*Cladium procerum*) SA:R FR:K – further searching needed in Moro Gorge and at other sites of permanent or semi-permanent water.

Flinders Ranges Bitter-pea (*Daviesia stricta*) SA:R FR:R – may be found to be more widespread with further sampling at altitude in the ranges.

Narrow-leaf Wax-flower (*Philotheca angustifolia* var. *angustifolia*) SA:R FR:R – may be found to be more widespread with further sampling at altitude in the ranges.

Flinders Ranges Box (*Eucalyptus polybractea*) SA:R FR:U – requires further taxonomic study to determine relationship with populations of this species in the eastern states.

Mammal Species Requiring Further Study

The capture of one small native rodent on the 2009 survey was of particular interest. A Forrest's Mouse (*Leggadina forresti*) was recorded south of Orange Tree Dam near the base of the Stirrup Iron Range at site ORA00601 in Black Oak (*Casuarina pauper*) Low Open Woodland on light clay. This is the only record for this species in the IPA and one of the few for the Flinders Ranges (Brandle 2001). It generally occurs in tussock grassland, low chenopod shrublands or sparsely vegetated plains on clay, loam or stony soils (Reid 2008). Site ORA00601 is on the edge of such habitat near the southern boundary of the IPA. Further trapping in the area, particularly in good seasons, would help to determine the extent and size of the population.

Bird Species Requiring Further Study

Three bird species of significant interest were recorded for the first time in the IPA during the 2009 survey. Each requires follow up study to determine the extent of the population.

The Slaty-backed Thornbill (*Acanthiza robustirostris*) had not previously been recorded in the Flinders Ranges and the nearest records are as far away as Tarcoola and Mabel Creek. In keeping with its preferred habitat throughout its range it was observed in a Mulga [Malka] (*Acacia aneura*) Very Low Woodland in the IPA. This was site ORA00701 on the Stirrup Iron Range near Deep Bore. Further searching in the extensive Mulga Low Woodlands in this area, and elsewhere, in the IPA is therefore required to establish the size, extent, residency and potential threats of the population.

The Short-tailed Grasswren (*Amytornis merrotsyi*) has a fragmented distribution in SA, being restricted to rocky hills dominated by Spinifex [Vakirri] (*Triodia* spp.) in the Flinders and Gawler Ranges. The nearest known occurrences to the IPA are in the Gammon Ranges and Arkaroola. As this habitat appears to be widespread on the higher ranges in the IPA targeted searching is required in these areas to determine the extent of this population.

The Spotted Pardalote (*Pardalotus punctatus punctatus*) was observed at several locations in the IPA in 2009. This represents a major range extension for this subspecies, with the previous nearest recordings being from the Wirrabara Forest area. In addition, there is also a Birds Australia record of a Red-browed Pardalote (*Pardalotus rubricatus*) from near Nantawarrina Spring in 2001. The northern Flinders Ranges constitutes the southern limit of this species' distribution. The presence of these two species, plus the more widespread Striated Pardalote (*Pardalotus striatus*), means the IPA is an overlap area for three Pardalote species. Further work is needed to establish the extent of the Spotted Pardalote range in the northern Flinders, while care is required in future identification of the three species in the area.

Further bird sampling is required in the poorly sampled higher parts of the ranges in the IPA. Site GAP00601 located on the northern boundary at an altitude of 700m is the only location where the Tawny-crowned Honeyeater (*Gliciphila melanops*) has been recorded in the IPA. It is possible the cooler microclimate effect created by the altitude of the ranges has allowed this species to extend its range from milder southern latitudes.

Reptile Species Requiring Further Study

Additional sampling of reptiles on the upper slopes and crests of the higher ranges, particularly in Spinifex [Vakirri] (*Triodia* spp.), is also required in the IPA. Again the results of sampling at site GAP00601 indicate there is a suite of species that tend to utilise the cooler microclimate associated with altitude that occur less frequently or not at all on the lower hills and undulating plains. In particular, Tawny Dragon (*Ctenophorus decresii*), Barred Snake-lizard (*Delma australis*) and Burton's Legless Lizard (*Lialis burtonis*) were only seen at this site.

Conservation Management Issues

Management for biodiversity conservation greatly improved in Nantawarrina with its declaration as an Indigenous Protected Area and the consequent removal of domestic stock and ongoing program of feral animal control. There are, however, still some significant conservation issues to address.

Weeds

Much of the vegetation of the Nantawarrina IPA is relatively weed free, as shown by 88% of the 110 sites sampled for all surveys having three or fewer introduced species. However, more sampling in spring and following good rains may show a different picture. In any case there are several species of existing or potential concern. These are:-

- Ward's Weed (**Carrichtera annua*) is one of the more widespread and abundant weed species present in the IPA. It is recognised as a common weed of degraded pastures in semi-arid areas.
- Thorn-apple (**Datura leichhardtii*) has been recorded at numerous sites in creeklines in the IPA. It is known to respond well to spring and early summer rain by forming dense stands in watercourses. However, it was still prominent at all creekline sites during the 2009 survey, even though this survey followed three drier than average years.
- Horehound (**Marrubium vulgare*) is a widespread weed that is particularly prevalent in disturbed areas such as rabbit warrens. Once established, plants are extremely hardy and difficult to remove.

It has been recorded nine times in the IPA, including at three sites in the 2009 survey, mostly in watercourses.

- Bathurst Burr (**Xanthium spinosum*) is one of the most common and economically serious weeds in Australia. The burrs catch easily in wool or fur and are thus readily transferred. It was first recorded in the IPA during the 2009 survey, when it was recorded at four locations, all in watercourses.

Several of these most serious weed species were mainly recorded in watercourses during this survey. As such, in addition to animals and/or the wind acting as an agent of dispersal, water flow may also transport seeds and fruits downstream.

It may be necessary to establish a formal monitoring program (based on existing survey sites) to track the success and spread of some weed species, and the efficacy of control measures, in areas where they are prevalent.

Feral Animals

Feral Goats [Nanikuta/Naniguta] (**Capra hircus*) were the most frequently recorded mammal species at the 27 sites sampled in the IPA during both the 1999 and 2009 surveys, with a total of 35 observed at 13 sites plus 11 more opportunistic sightings. The Department for Environment and Heritage and the South Australian Arid Lands Natural Resource Management Board have both funded goat control programs in the Flinders Ranges in recent years in an effort to reduce overall numbers and enhance opportunity for native species recovery. In particular, DEH's Operation Bounceback has been a long term initiative involving ongoing Feral Goat control.

Feral Goats are particularly hardy animals that are well adapted to the rugged range country of Nantawarrina. They are generalist grazers and browsers, eating almost any plant species, highly mobile, notoriously disrespectful of fences, thrive in rugged terrain and have a high reproductive rate (Neagle 2003).

Figure 100. Goat trap near One Tree Bore (Photo: N. Neagle).

Goat traps at water points have been established in the Nantawarrina IPA. These consist of fenced off yards around troughs with access via a constructed one way ramp. The theory of operation is the gate into the yard is left open for a period of time to allow the Feral Goats to become accustomed to accessing the trough for water. The gate is then shut forcing the goats to enter the yard via the one way ramp. Once inside they are unable to escape and can be loaded onto a truck for removal.

Feral Donkeys (**Equus asinus*) were recorded by the presence of tracks, droppings or (presumably shot) carcasses at four survey sites and a further five opportunistic locations on the 2009 survey. Only small numbers were seen during the survey, suggesting control measures are in place and have reduced numbers to minimal levels.

Feral Horses/Brumbies [Nandu/Nandhu] (**Equus caballus*) were twice observed south of Orange Tree Dam during the 2009 survey. Their calm behaviour suggested they were station animals rather than feral, but this has not been confirmed.

Feral Cat [Vusikata] (**Felis catus*) distribution is uncertain in the IPA as the only records during this survey were of one seen while spotlighting near Irish Well and a set of tracks in the same general area. The lack of records may be the result of prolonged drought conditions, their secretive nature or their numbers may be suppressed by the presence of Dingos [Urdninyi] (*Canis lupus dingo*).

Cats are extremely predatory animals with body form, musculature and sense highly specialised for stalking and capturing prey (Biodiversity Group Environment Australia 1999). Their nutrition and metabolism are such that they require large amounts of fresh animal protein (Biodiversity Group Environment Australia 1999), yet do not appear to need fresh water (Newsome 1991).

Foxes (**Vulpes vulpes*) were not recorded in the IPA during the 2009 survey. Drought and the subsequent low numbers of Rabbits [Rabbit-a] (**Oryctolagus cuniculus*) and other prey species may be a contributing factor. It is also possible that the presence of Dingos may be suppressing Fox numbers.

Rabbits [Rabbit-a] (**Oryctolagus cuniculus*) were the second most common species recorded at sites in 2009, yet many of the records were of disused warrens or buck heaps indicating past rather than current presence. Few were observed even while spotlighting. Many warrens were observed on the western side of the Uro Range, south of Cable Creek Bore, indicating rabbit numbers have been high in the past. It appears the Rabbit Haemorrhagic Disease (RHD) has had a significant effect in the past, and it is probable that the drier than average years preceding the 2009 survey had suppressed their numbers.

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APPENDIX 1. LIST OF BIOLOGICAL SURVEY SITES WITHIN THE NANTAWARRINA IPA

SU Survey Number (6 = Flinders; 104 = Flinders Ranges; 636 = Nantawarrina IPA)
SITE ID Site identification code.
Veg Grp Floristic Group Number (refer Table 20 in the Vegetation chapter)
Vegetation
Overstorey dominant vegetation species in the overstorey layer (numbers and letters in brackets following each species relate to the cover-abundance estimates :– N = not many, 1-10 plants, cover <5%; T = sparsely present, cover small, <5%; 1 = plentiful, but of small cover, <5%; 2 = cover 5-25%; 3 = cover 25-50%).
N.B. A blank for any of the physical parameters indicates it was not recorded at the time of the survey.

SU	SiteID	Date	Zone	Easting	Northing	General Location	Landform Pattern	Landform Element	Soil	Veg Grp	Overstorey	Structural Formation
6	ANG1606	30/08/1990	54	307223	6615179	1.0 km ENE of Nepabunna	Plain	plain (incl undulating plain)	loamy sand		Maireana pyramidata (1), Maireana astrotricha (1)	Low Open Shrubland
6	ANG1692	3/05/1991	54	306623	6614479	0.6 km SSE of Nepabunna	Low hills	hill slope	skeletal	1	Senna artemisioides ssp. X coriacea (1), Acacia victoriae ssp. victoriae (T), Dodonaea lobulata (T)	Open Shrubland
6	ANG1693	3/05/1991	54	307423	6615079	1.2 km ENE of Nepabunna	Low hills	hill crest	loam	10	Acacia tetragonophylla (T), Eremophila alternifolia (T)	Very Open Shrubland
6	ANG1694	3/05/1991	54	307223	6616479	1.8 km NNE of Nepabunna	Hills	hill slope	skeletal	10	Acacia tetragonophylla (1), Eremophila alternifolia (1)	Open Shrubland
6	ANG1695	3/05/1991	54	305873	6618479	3.6 km NNW of Nepabunna	Drainage line	flat	loamy sand	12	Callitris glaucophylla (1), Eucalyptus camaldulensis var. camaldulensis (NC) (1)	Woodland
6	ANG1696	3/05/1991	54	307523	6618579	3.9 km NNE of Nepabunna	Low hills	hill crest		10	Acacia tetragonophylla (T), Eremophila alternifolia (T)	Very Open Shrubland
6	ANG1697	3/05/1991	54	306623	6618779	3.9 km NNE of Nepabunna	Low hills	hill footslope	clay loam	2	Casuarina pauper (1)	Very Low Open Woodland
6	ANG1698	4/05/1991	54	303823	6613879	2.6 km WSW of Nepabunna	Low hills	hill crest	skeletal	2	Acacia tetragonophylla (1), Senna artemisioides ssp. filifolia (T), Senna artemisioides ssp. X coriacea (T)	Open Shrubland
6	ANG1699	4/05/1991	54	303623	6614629	2.6 km WSW of Nepabunna	Rises	hill crest	sandy loam	17	Casuarina pauper (2)	Low Woodland
6	ANG1700	4/05/1991	54	303873	6615979	2.6 km WNW of Nepabunna	Rises	hill slope	clay loam		Eucalyptus dumosa (1)	Very Open Mallee
6	ANG1701	4/05/1991	54	302523	6614779	3.7 km WNW of Nepabunna	Hills	hill slope	loam	12	Callitris glaucophylla (1), Eucalyptus flindersii (1)	Very Low Woodland
6	ANG1702	4/05/1991	54	302573	6614879	3.7 km WNW of Nepabunna	Hills	hill slope		13	Eucalyptus flindersii (T)	Very Low Open Woodland
6	ANG1703	3/05/1991	54	302523	6617379	4.5 km WNW of Nepabunna	Peneplain	flat	sandy loam	1	*Carrichtera annua (2)	Open Herbland
6	ANG1734	5/05/1991	54	301623	6620779	2.3 km WNW of Mount Rowe	Hills	hill footslope	loam	17	Casuarina pauper (2)	Very Low Woodland
6	ANG1745	9/05/1991	54	304173	6601129	17.5 km WSW of The John Crossing	Low hills	hill footslope	sandy loam	1	Acacia victoriae ssp. victoriae (1)	Very Open Shrubland
6	ANG1746	9/05/1991	54	305123	6600279	17.4 km WSW of The John Crossing	Hills	hill slope	skeletal	11	Acacia aneura (NC) (2)	Very Low Woodland
6	ANG1747	9/05/1991	54	304623	6600479	17.6 km WSW of The John Crossing	Hills	hill slope	skeletal	2	Casuarina pauper (1)	Very Low Open Woodland
6	ANG1748	9/05/1991	54	303923	6600579	18.0 km WSW of The John Crossing	Low hills	hill slope	skeletal	1	Senna artemisioides ssp. filifolia (1), Senna artemisioides ssp. petiolaris (NC) (1), Dodonaea lobulata (1)	Open Shrubland
6	ANG1758	29/05/1991	54	307223	6609929	5.1 km SSE of Nepabunna	Hills	hill footslope	clay loam, sandy	2	Casuarina pauper (1), Eucalyptus socialis (NC) (1)	Very Low Woodland
6	NAR1185	5/03/1988	54	307873	6583329	2.0 km SSW of Mount Roebuck	Mountains	hill slope	lt. sandy clay loam	7	Eremophila freelingii (1), Olearia decurrens (1), Dodonaea viscosa ssp. angustissima (1)	Open Shrubland
6	NAR1990	26/08/1991	54	299273	6592829	8.6 km WNW of Irish Well	Hills	hill slope	skeletal	10	Acacia aneura (NC) (1)	Very Low Open Woodland
6	NAR1991	26/08/1991	54	299423	6592779	8.4 km WNW of Irish Well	Hills	hill slope	skeletal	10	Acacia aneura (NC) (1), Hakea ednieana (T)	Very Low Open Woodland
6	NAR1992	27/08/1991	54	300623	6592629	7.3 km WNW of Irish Well	Hills	hill slope	skeletal	12	Hakea ednieana (T), Callitris glaucophylla (T)	Very Low Open Woodland

SU	SiteID	Date	Zone	Easting	Northing	General Location	Landform Pattern	Landform Element	Soil	Veg Grp	Overstorey	Structural Formation
6	NAR1993	27/08/1991	54	301223	6592379	6.7 km WNW of Irish Well	Hills	hill slope	skeletal	2	Eucalyptus socialis (NC) (1), Casuarina pauper (1)	Very Open Mallee
6	NAR1994	27/08/1991	54	301923	6593029	6.6 km NNW of Irish Well	Hills	hill slope	skeletal	12	Callitris glaucophylla (1)	Very Low Open Woodland
6	NAR1995	27/08/1991	54	302023	6592779	6.4 km NNW of Irish Well	Hills	hill slope	skeletal	10	Eremophila freelingii (1)	Very Open Shrubland
6	NAR1996	27/08/1991	54	301723	6591679	5.9 km WNW of Irish Well	Hills	hill slope	skeletal	10	Senna artemisioides ssp. X artemisioides (1), Dodonaea lobulata (1)	Open Shrubland
6	NAR1997	27/08/1991	54	301973	6590429	5.1 km WNW of Irish Well	Hills	hill slope	skeletal	10	Sida petrophila (1), Zygophyllum aurantiacum (NC) (1)	Open Shrubland
6	NAR1998	27/08/1991	54	302323	6590029	4.6 km WNW of Irish Well	Hills	hill slope	skeletal	10	Dodonaea lobulata (1), Senna artemisioides ssp. X artemisioides (1)	Open Shrubland
6	NAR1999	27/08/1991	54	303873	6588829	2.7 km WNW of Irish Well	Hills	hill slope	sandy clay loam	10	Senna artemisioides ssp. X artemisioides (1), Sida petrophila (1)	Open Shrubland
6	NAR2000	27/08/1991	54	304423	6589379	2.4 km WNW of Irish Well	Peneplain	flat	sandy clay loam	1	Acacia victoriae ssp. victoriae (T)	Tall Very Open Shrubland
6	NAR2001	28/08/1991	54	305873	6588679	0.8 km WNW of Irish Well	Hills	hill footslope	sandy clay loam	1	Zygophyllum aurantiacum (NC) (1)	Low Very Open Shrubland
6	NAR2002	28/08/1991	54	305223	6588979	1.5 km WNW of Irish Well	Low hills	flat	sandy clay loam	1	Acacia victoriae ssp. victoriae (T)	Tall Very Open Shrubland
6	NAR2003	28/08/1991	54	307973	6587779	1.5 km ESE of Irish Well	Hills	hill footslope	clay loam, sandy	10	Acacia aneura (NC) (1)	Very Low Open Woodland
6	NAR2004	28/08/1991	54	307573	6587329	1.4 km SSE of Irish Well	Hills	hill slope	silty loam	4	Acacia victoriae ssp. victoriae (T)	Tall Very Open Shrubland
6	NEP0942	3/03/1988	54	315823	6603879	9.2 km SSW of The John Crossing	Low hills	hill slope	sandy clay loam	8	Casuarina pauper (1), Eucalyptus gillii (1)	Very Low Open Woodland
6	NEP0943	3/03/1988	54	317723	6602779	10.2 km SSE of The John Crossing	Hills	hill crest	fine sandy clay loam	9	Acacia tetragonophylla (1), Acacia aneura (NC) (1)	Very Low Open Woodland
6	NEP0944	3/03/1988	54	317223	6601979	11.0 km SSW of The John Crossing	Rises	hill slope	fine sandy clay loam	8	Acacia victoriae ssp. victoriae (1)	Very Open Shrubland
6	NEP0945	3/03/1988	54	316923	6601879	11.1 km SSW of The John Crossing	Low hills	hill slope	lt. sandy clay loam	9	Eucalyptus gillii (1)	Very Open Mallee
6	NEP0946	3/03/1988	54	316323	6603529	9.5 km SSW of The John Crossing	Drainage line	open depression	clayey sand	16	Eucalyptus camaldulensis var. (2)	Woodland
6	NEP0947	3/03/1988	54	316623	6600979	12.0 km SSW of The John Crossing	Rises	hill slope	fine sandy clay loam	9	Eucalyptus gillii (1)	Very Open Mallee
6	NEP0948	4/03/1988	54	317423	6601879	11.1 km SSW of The John Crossing	Hills	hill crest	sandy clay loam	7	Acacia tetragonophylla (1)	Very Open Shrubland
6	NEP0949	4/03/1988	54	316223	6600279	12.7 km SSW of The John Crossing	Peneplain	hill slope	sandy clay loam	9	Atriplex acutibractea ssp. (1)	Low Very Open Shrubland
6	NEP0950	4/03/1988	54	316323	6598579	14.4 km SSW of The John Crossing	Peneplain	hill slope	fine sandy clay loam	9	Senna artemisioides ssp. X coriacea (1)	Very Open Shrubland
6	NEP0951	4/03/1988	54	310923	6598379	15.8 km SSW of The John Crossing	Low hills	hill slope	fine sandy clay loam	9	Senna artemisioides ssp. filifolia (1)	Very Open Shrubland
6	NEP0952	4/03/1988	54	313523	6601279	12.2 km SSW of The John Crossing	Peneplain	hill slope	fine sandy clay loam	3	Sclerolaena longicuspis (2)	Low Open Shrubland
6	NEP0953	4/03/1988	54	313323	6601479	12.1 km SSW of The John Crossing	Low hills	hill slope	sandy clay loam	2	Frankenia foliosa (2)	Low Open Shrubland
6	NEP0955	5/03/1988	54	315723	6607629	5.5 km SSW of The John Crossing	Mountains	hill crest	sandy clay	11	Acacia aneura (NC) (2)	Very Low Woodland
6	NEP0973	9/03/1988	54	323023	6601429	13.0 km SSE of The John Crossing	Peneplain	hill slope	sandy clay loam	8	Acacia aneura (NC) (1)	Very Low Open Woodland
6	NEP0974	9/03/1988	54	326923	6605929	12.1 km ESE of The John Crossing	Low hills	hill slope	fine sandy clay loam	8	Acacia tetragonophylla (1), Senna artemisioides ssp. filifolia (1)	Very Open Shrubland
6	NEP0975	10/03/1988	54	329923	6603879	15.8 km ESE of The John Crossing	Low hills	hill slope	sandy clay loam	7	Acacia aneura (NC) (1)	Very Low Open Woodland
6	NEP0976	10/03/1988	54	330423	6603879	16.2 km ESE of The John Crossing	Rises	hill slope	sandy clay loam	7	Dodonaea microzyga var. microzyga (1), Senna artemisioides ssp. X coriacea (1)	Very Open Shrubland

SU	SiteID	Date	Zone	Easting	Northing	General Location	Landform Pattern	Landform Element	Soil	Veg Grp	Overstorey	Structural Formation
6	NEP0977	10/03/1988	54	329423	6603979	15.3 km ESE of The John Crossing	Hills	hill crest	sandy clay loam	7	Eremophila freelingii (1)	Very Open Shrubland
6	NEP0978	10/03/1988	54	328723	6603779	14.9 km ESE of The John Crossing	Hills	hill slope	sandy clay loam	7	Acacia tetragonophylla (1)	Very Open Shrubland
6	NEP0979	10/03/1988	54	329423	6604379	15.1 km ESE of The John Crossing	Drainage line	open depression		15	Melaleuca glomerata (2)	Very Low Woodland
6	NEP0980	10/03/1988	54	326123	6604979	12.1 km SSE of The John Crossing	Low hills	hill slope	sandy clay	7	Dodonaea microzyga var. microzyga (1)	Very Open Shrubland
6	NEP1158	29/02/1988	54	327773	6597629	9.4 km NNE of Rivers Bluff	Rises	hill slope	loam fine sandy	5	Maireana astrotricha (2)	Low Open Shrubland
6	NEP1159	29/02/1988	54	327873	6597679	9.5 km NNE of Rivers Bluff	Drainage line	open depression	sand	8	Eucalyptus camaldulensis var. (1)	Open Woodland
6	NEP1160	29/02/1988	54	328173	6597429	9.3 km NNE of Rivers Bluff	Rises	hill slope	sandy clay loam	17	Casuarina pauper (2)	Very Low Woodland
6	NEP1163	1/03/1988	54	326523	6598329	9.9 km NNE of Rivers Bluff	Peneplain	hill slope	fine sandy clay loam	8	Sclerolaena obliquicuspis (1)	Low Very Open Shrubland
6	NEP1164	1/03/1988	54	326973	6597379	9.0 km NNE of Rivers Bluff	Low hills	hill slope	lt. sandy clay loam	7	Acacia aneura (NC) (T)	Very Low Open Woodland
6	NEP1173	3/03/1988	54	314323	6601929	11.4 km SSW of The John Crossing	Alluvial plain	flat	sandy loam	8	Eucalyptus camaldulensis var. (T)	Open Woodland
6	NEP1393	27/05/1988	54	308923	6603979	12.1 km SW of The John Crossing	Hills	hill slope	clay loam	4	Casuarina pauper (1), Callitris glaucophylla (T)	Very Low Open Woodland
6	NEP1394	27/05/1988	54	308823	6604779	11.6 km WSW of The John Crossing	Hills	hill slope	fine sandy clay loam	11	Acacia aneura (NC) (2), Callitris glaucophylla (T), Casuarina pauper (T)	Very Low Woodland
6	WER1161	29/02/1988	54	322273	6594379	6.7 km NNW of Rivers Bluff	Peneplain	hill slope	lt. sandy clay loam	8	Acacia aneura (NC) (1)	Very Low Open Woodland
6	WER1162	29/02/1988	54	322473	6594729	6.9 km NNW of Rivers Bluff	Low hills	hill slope	loam fine sandy	7	Austrostipa nitida (2)	Open (Tussock) Grassland
6	WER1165	1/03/1988	54	318323	6591479	8.5 km NNW of Mulga View	Rises	closed depression	clay loam	8	Sclerolaena brachyptera (1), Sclerolaena obliquicuspis (T)	Low Very Open Shrubland
6	WER1166	1/03/1988	54	318723	6590729	7.7 km NNW of Mulga View	Plain	flat	clay loam	8	Sclerolaena divaricata (1), Sclerolaena longicuspis (T)	Low Very Open Shrubland
6	WER1167	2/03/1988	54	319473	6588629	5.5 km NNW of Mulga View	Rises	hill slope	loam fine sandy	2	Maireana sedifolia (2)	Low Open Shrubland
6	WER1168	2/03/1988	54	318873	6588479	5.6 km NNW of Mulga View	Rises	hill slope	loam fine sandy	2	Casuarina pauper (1)	Very Low Open Woodland
6	WER1169	2/03/1988	54	318973	6589879	6.8 km NNW of Mulga View	Plain	hill slope	loam fine sandy	7	Maireana sedifolia (T), Dodonaea microzyga var. microzyga (T)	Low Very Open Shrubland
6	WER1170	2/03/1988	54	317873	6594279	11.3 km NNW of Mulga View	Rises	hill slope	fine sandy loam	7	Sclerolaena obliquicuspis (1)	Low Very Open Shrubland
6	WER1171	2/03/1988	54	318448	6594829	11.7 km NNW of Mulga View	Plain	flat	fine sandy clay loam	5	Maireana astrotricha (2)	Low Open Shrubland
6	WER1172	2/03/1988	54	317173	6596504	16.5 km SSW of The John Crossing	Drainage line	open depression	clayey sand	16	Eucalyptus camaldulensis var. (2), Melaleuca glomerata (2)	Low Woodland
6	WER1174	3/03/1988	54	310873	6596479	9.2 km NNE of Irish Well	Peneplain	hill slope	loam fine sandy	8	Acacia victoriae ssp. victoriae (T)	Very Open Shrubland
6	WER1175	3/03/1988	54	309123	6594529	6.7 km NNE of Irish Well	Peneplain	flat	sandy clay loam	17	Casuarina pauper (2)	Low Woodland
6	WER1176	3/03/1988	54	310523	6589729	4.2 km ENE of Irish Well	Hills	hill slope	clayey sand	11	Acacia aneura (NC) (1)	Very Low Open Woodland
6	WER1181	5/03/1988	54	312073	6583379	3.2 km ESE of Mount Roebuck	Hills	hill slope	sandy loam	7	Acacia victoriae ssp. victoriae (1), Eremophila freelingii (1)	Open Shrubland
6	WER1182	5/03/1988	54	311623	6583629	2.7 km ESE of Mount Roebuck	Peneplain	hill slope	sandy loam	7	Dissocarpus paradoxus (1), Sclerolaena divaricata (T), Sclerolaena obliquicuspis (T)	Low Very Open Shrubland
6	WER1184	5/03/1988	54	311363	6583529	2.6 km SE of Mount Roebuck	Low hills	hill slope	loam	4	Eremophila freelingii (2), Senna artemisioides ssp. X coriacea (T), Senna artemisioides ssp. X artemisioides (T)	Open Shrubland

SU	SiteID	Date	Zone	Easting	Northing	General Location	Landform Pattern	Landform Element	Soil	Veg Grp	Overstorey	Structural Formation
104	GAP00601	22/10/1999	54	305605	6621822	2.3 km ENE of Mount Rowe	Mountains	ridge	clay loam	13	Eucalyptus intertexta (2), Melaleuca uncinata (NC) (2)	Open Low Mallee
104	GAP00602	22/10/1999	54	305708	6621821	2.3 km ENE of Mount Rowe	Mountains	hill slope	clay loam	14	Eucalyptus socialis (NC) (2)	Mallee
104	NAN00201	17/03/1999	54	317223	6606659	6.3 km SSW of The John Crossing	Hills	stream channel	loamy sand	16	Eucalyptus camaldulensis var. obtusa (NC) (2)	Woodland
104	NAN00301	17/03/1999	54	316543	6604319	8.7 km SSW of The John Crossing	Hills	hill slope	clayey sand	17	Casuarina pauper (3)	Low Woodland
104	NAN00401	18/03/1999	54	316813	6603209	9.8 km SSW of The John Crossing	Low hills	hill slope	clayey sand	14	Eucalyptus socialis (NC) (2), Eucalyptus gillii (2)	Open Mallee
104	NAN00501	18/03/1999	54	317053	6601649	11.3 km SSW of The John Crossing	Low hills	hill slope	sandy clay loam	6	Senna artemisioides ssp. X coriacea (2), Senna artemisioides ssp. filifolia (2)	Open Shrubland
104	NAN00601	18/03/1999	54	315933	6598379	14.6 km SSW of The John Crossing	Low hills	hill slope	sandy clay loam	6	Senna artemisioides ssp. filifolia (2), Dodonaea microzyga var. microzyga (2)	Low Open Shrubland
104	NAN00602	18/03/1999	54	315823	6598759	14.3 km SSW of The John Crossing	Low hills	hill crest	sandy clay loam	4	Eremophila freelingii (2)	Low Open Shrubland
636	IRI00101	30/04/2009	54	309375	6595227	7.5 km NNE of Irish Well	Low hills	stony plain	medium clay	8	Acacia victoriae ssp. victoriae (2)	Tall Very Open Shrubland
636	IRI00201	30/04/2009	54	308837	6593718	5.9 km NNE of Irish Well	Low hills	hill slope	medium clay	17	Casuarina pauper (3)	Low Woodland
636	IRI00301	30/04/2009	54	309168	6592207	4.7 km NNE of Irish Well	Low hills	stream channel	clay loam, sandy	15	Melaleuca glomerata (3)	Tall Shrubland
636	IRI00401	1/05/2009	54	309246	6590548	3.5 km ENE of Irish Well	Low hills	stream channel	loamy sand	15	Melaleuca glomerata (3)	Tall Shrubland
636	IRI00501	2/05/2009	54	311036	6588358	4.5 km ESE of Irish Well	Low hills	hill footslope	light clay	8	Rhagodia spinescens (2)	Open Shrubland
636	IRI00601	1/05/2009	54	304366	6589421	2.5 km WNW of Irish Well	Low hills	hill footslope	light clay	8	Acacia victoriae ssp. victoriae (2), Senna artemisioides ssp. X artemisioides (2)	Very Open Shrubland
636	IRI00701	1/05/2009	54	304021	6588639	2.6 km WNW of Irish Well	Low hills	hill crest	light clay	8	Acacia tetragonophylla (2)	Very Open Shrubland
636	ORA00101	30/04/2009	54	315520	6592132	9.7 km ENE of Irish Well	Alluvial plain	plain (incl undulating plain)	silty loam	5	Maireana astrotricha (3)	Low Shrubland
636	ORA00201	29/04/2009	54	321627	6593907	6.6 km NNW of Rivers Bluff	Low hills	stream channel	sandy loam	16	Eucalyptus camaldulensis ssp. minima (3)	Woodland
636	ORA00301	2/05/2009	54	326365	6595970	7.5 km NNE of Rivers Bluff	Rises	hill footslope	clay loam, sandy	8	Acacia aneura var. aneura (1)	Low Open Woodland
636	ORA00401	2/05/2009	54	327245	6599316	11.0 km NNE of Rivers Bluff	Low hills	hill crest	sandy clay loam	4	Eremophila freelingii (2), Senna artemisioides ssp. X coriacea (2)	Low Open Shrubland
636	ORA00501	30/04/2009	54	318628	6591064	8.0 km NNW of Mulga View	Plain	plain (incl undulating plain)	light clay	3	Sclerolaena longicuspis (2), Sclerolaena divaricata (1), Astrebla lappacea (T)	Low Open Shrubland
636	ORA00601	30/04/2009	54	319509	6588747	5.6 km NNW of Mulga View	Low hills	hill slope	light clay	17	Casuarina pauper (2)	Low Open Woodland
636	ORA00701	1/05/2009	54	319867	6588098	4.8 km NNW of Mulga View	Low hills	hill slope	clay loam, sandy	11	Acacia aneura var. tenuis (3)	Tall Shrubland
636	ORA00801	1/05/2009	54	320064	6587881	4.6 km NNW of Mulga View	Plain	stream channel	sandy clay loam		Eucalyptus intertexta (3)	Mallee
636	PLA00101	5/05/2009	54	314314	6601468	11.8 km SSW of The John Crossing	Hills	stream channel	silty loam	16	Eucalyptus camaldulensis ssp. minima (3)	Woodland
636	PLA00201	5/05/2009	54	313824	6602016	11.4 km SSW of The John Crossing	Hills	hill slope	sandy loam	17	Casuarina pauper (2)	Very Low Woodland
636	PLA00301	5/05/2009	54	313474	6602283	11.3 km SSW of The John Crossing	Hills	hill slope	clay loam, sandy	11	Acacia aneura var. aneura (2), Acacia aneura var. tenuis (1)	Very Low Woodland
636	PLA00401	6/05/2009	54	314361	6603019	10.3 km SSW of The John Crossing	Hills	hill slope	clayey sand	11	Acacia aneura var. tenuis (2), Acacia aneura var. aneura (2)	Very Low Woodland
636	PLA00501	6/05/2009	54	315146	6603666	9.5 km SSW of The John Crossing	Low hills	hill slope	sandy loam	14	Eucalyptus gillii (2), Eucalyptus socialis ssp. socialis (2)	Open Mallee
636	PLA00601	6/05/2009	54	316929	6604925	8.1 km SSW of The John Crossing	Low hills	stream channel	sandy loam	16	Eucalyptus camaldulensis ssp. minima (2)	Woodland
636	PLA00701	7/05/2009	54	316313	6606043	7.0 km SSW of The John Crossing	Low hills	hill footslope	clayey sand	17	Casuarina pauper (2)	Low Woodland

APPENDIX 2. PLANT TAXA RECORDED IN THE NANTAWARRINA IPA.

Taxonomy follows Barker *et al*. (2005) as updated by the DEH FLORA Database (as at November 2009).

I Indigenous/alien designation. Naturalised alien taxa are designated with an asterisk (*).

(NC) Appearing after a scientific name designates it as a non-current name in the SA FLORA Database 2009. A non-current name represents a previous taxonomic circumscription corresponding to one or more currently recognised taxa.

Conservation Status:

Aus Australian status under the *Environment Protection and Biodiversity Conservation Act 1999* as at November 2009.

SA South Australian status under the *National Parks and Wildlife Act 1972* (2007 update of schedules 7, 8 and 9).

FR Regional status for the Flinders Ranges Herbarium Region as per the SA FLORA database (November 2009), which provides an update of the original assessments of Lang and Kraehenbuehl (1987).

Status Codes: **X** = extinct; **E** = endangered; **V** = vulnerable; **T** = threatened (either endangered or vulnerable but insufficient data to enable accurate assessment); **R** = rare; **K** = uncertain (either rare or threatened but insufficient data to enable accurate assessment); **U** = uncommon; **Q** = not yet assessed but considered to be of possible significance; **#** = not yet assessed as this is a new record for the region; refer to Notes field.

I	Species Name	Common Name	Aus	SA	FR	Notes
	Abutilon cryptopetalum (NC)	Hill Lantern-bush				= *Abutilon cryptopetalum* ssp. *cryptopetalum*
	Abutilon fraseri (NC)	Dwarf Lantern-bush				= *Abutilon fraseri* ssp. *diplotrichum*
	Abutilon fraseri ssp.	Dwarf Lantern-bush				= *Abutilon fraseri* ssp. *diplotrichum*
	Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush				
	Abutilon halophilum	Plains Lantern-bush				
	Abutilon leucopetalum	Desert Lantern-bush				
	Abutilon sp.	Lantern-bush				
	Acacia aneura (NC)	Mulga				Used in the broad sense according to Jessop and Toelken (1986). Now may refer to either *Acacia aneura* var. *aneura* or *A. aneura* var. *tenuis*.
	Acacia aneura var.	Mulga				Could be either *Acacia aneura* var. *aneura* or *A. aneura* var. *tenuis*.
	Acacia aneura var. *aneura*	Mulga				
	Acacia aneura var. *major*	Mulga				
	Acacia aneura var. *tenuis*	Mulga				
	Acacia ayersiana var. (NC)	Broad-leaf Mulga				Used in the broad sense according to Jessop (1993). Now may refer to either *Acacia ayersiana* or *A. aneura* var. *intermedia*.
	Acacia beckleri ssp. *megaspherica*	Beckler's Rock Wattle				
	Acacia burkittii	Pin-bush Wattle				
	Acacia continua	Thorn Wattle				
	Acacia havilandiorum	Needle Wattle				
	Acacia kempeana	Witchetty Bush				
	Acacia oswaldii	Umbrella Wattle				
	Acacia paradoxa	Kangaroo Thorn				
	Acacia pravifolia	Coil-pod Wattle			U	
	Acacia rivalis	Silver Wattle				
	Acacia salicina	Willow Wattle				
	Acacia sibirica	Bastard Mulga				
	Acacia sp.					.
	Acacia tetragonophylla	Dead Finish				
	Acacia victoriae ssp.	Elegant Wattle				= *Acacia victoriae* ssp. *victoriae*
	Acacia victoriae ssp. *victoriae*	Elegant Wattle				
	Acacia wilhelmiana	Dwarf Nealie				
*	*Acetosa vesicaria*	Rosy Dock				
	Actinobole uliginosum	Flannel Cudweed				
*	*Adonis microcarpa*	Pheasant's Eye				
	Ajuga australis	Australian Bugle				= *Ajuga australis* f.
	Ajuga australis f. A (A.G.Spooner 9058)	Australian Bugle				
	Alectryon oleifolius ssp. *canescens*	Bullock Bush				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Allocasuarina muelleriana ssp. *alticola*	Flinders Ranges Oak-bush				
	Alyogyne hakeifolia	Hakea-leaf Hibiscus			U	
	Amaranthus mitchellii	Boggabri Weed				
	Amyema linophylla ssp. *orientale*	Casuarina Mistletoe			U	
	Amyema maidenii ssp. *maidenii*	Pale-leaf Mistletoe				
	Amyema miquelii	Box Mistletoe				
	Amyema miraculosa ssp. *boormanii*	Fleshy Mistletoe				
	Amyema preissii	Wire-leaf Mistletoe				
	Anacampseros australiana	Australian Anacampseros			U	
*	*Anagallis arvensis*	Pimpernel				
*	*Anagallis minima*	Chaffweed				
	Anemocarpa podolepidium	Rock Everlasting				
	Arabidella glaucescens					
	Arabidella sp.	Native Cress				
	Arabidella trisecta	Shrubby Cress				
	Aristida contorta	Curly Wire-grass				
	Aristida nitidula	Brush Three-awn				
	Aristida sp.	Three-awn/Wire-grass				
	Aristida strigosa	Rough Three-awn			#	New record for FR from 2009 survey.
	Asperula conferta	Common Woodruff				
*	*Asphodelus fistulosus*	Onion Weed				
	Astrebla lappacea	Curly Mitchell-grass				
	Astrebla pectinata	Barley Mitchell-grass				
	Astroloma humifusum	Cranberry Heath				
	Atriplex acutibractea ssp.	Pointed Saltbush				Could be either *Atriplex acutibractea* ssp. *acutibractea* or ssp. *karoniensis*.
	Atriplex acutibractea ssp. *acutibractea*	Pointed Saltbush				
	Atriplex eardleyae	Eardley's Saltbush				
	Atriplex limbata	Spreading Saltbush				
	Atriplex sp.	Saltbush				
	Atriplex stipitata	Bitter Saltbush				
	Atriplex vesicaria ssp.	Bladder Saltbush				
	Austrodanthonia caespitosa	Common Wallaby-grass				
	Austrodanthonia setacea	Small-flower Wallaby-grass				
	Austrostipa elegantissima	Feather Spear-grass				
	Austrostipa eremophila	Rusty Spear-grass				
	Austrostipa nitida	Balcarra Spear-grass				
	Austrostipa nodosa	Tall Spear-grass				
	Austrostipa pilata	Prickly Spear-grass		V	K	
	Austrostipa platychaeta	Flat-awn Spear-grass			R	
	Austrostipa scabra ssp.	Rough Spear-grass				Could be either *Austrostipa scabra* ssp. *falcata* or ssp. *scabra*.
	Austrostipa sp.	Spear-grass				
	Austrostipa trichophylla					
	Baumea arthrophylla	Swamp Twig-rush			R	
	Beyeria lechenaultii	Pale Turpentine Bush				
	Boerhavia dominii	Tar-vine				
	Boerhavia schomburgkiana	Schomburgk's Tar-vine				
	Brachyscome ciliaris var.	Variable Daisy				Could be any 1 of 4 subspecies.
	Brachyscome ciliaris var. *ciliaris*	Variable Daisy				
	Brachyscome ciliaris var. *lanuginosa*	Woolly Variable Daisy				
	Brachyscome dentata	Lobe-seed Daisy			U	
	Brachyscome lineariloba	Hard-head Daisy				
*	*Bromus rubens*	Red Brome				
	Bromus sp.	Brome				
	Bulbine alata	Winged Bulbine-lily				
	Bursaria spinosa ssp.	Bursaria				
	Bursaria spinosa ssp. *lasiophylla*	Downy Bursaria				
	Bursaria spinosa ssp. *spinosa*	Sweet Bursaria				
	Calandrinia ptychosperma	Creeping Parakeelya				
	Callistemon teretifolius	Needle Bottlebrush				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Callitris glaucophylla	White Cypress-pine				
	Calotis hispidula	Hairy Burr-daisy				
	Calotis latiuscula	Leafy Burr-daisy				
	Calotis plumulifera	Woolly-headed Burr-daisy				
	Calytrix tetragona	Common Fringe-myrtle				
	Capparis mitchellii	Native Orange				
	Carpobrotus sp.	Pigface				Only species of this genus known to occur in FR is *Carpobrotus rossii*.
*	*Carrichtera annua*	Ward's Weed				
*	*Carthamus lanatus*	Saffron Thistle				
	Caryophyllaceae sp.	Pink Family				
	Cassinia complanata	Sticky Cassinia				
	Cassinia laevis	Curry Bush				
	Cassytha flindersii	Flinders Ranges Dodder-laurel				
	Casuarina pauper	Black Oak				
*	*Centaurea melitensis*	Malta Thistle				
	Chamaesyce australis					
	Chamaesyce centralis					
	Chamaesyce drummondii					
	Chamaesyce drummondii (NC)	Caustic Weed				Used in the broad sense according to Jessop (1993, *Chamaesyce = Euphorbia*). Now may be either *Chamaesyce drummondii* or *C*. sp. Papillose plants (D.E.Symon 14628).
	Chamaesyce sp.	Spurge				
	Cheilanthes austrotenuifolia	Annual Rock-fern				
	Cheilanthes lasiophylla	Woolly Cloak-fern				
	Cheilanthes sieberi ssp.	Narrow Rock-fern				= *Cheilanthes sieberi* ssp. *sieberi*
	Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern				
	Cheilanthes sp.	Rock-fern				
	Chenopodiaceae sp.	Goosefoot Family				
	Chenopodium curvispicatum	Cottony Goosefoot			K	
	Chenopodium desertorum ssp.	Desert Goosefoot				Could be any 1 of 3 subspecies – ssp. *anidiophyllum*, ssp. *desertorum* or ssp. *microphyllum*.
	Chenopodium desertorum ssp. *desertorum*	Frosted Goosefoot				
*	*Chenopodium murale*	Nettle-leaf Goosefoot				
	Chrysocephalum eremaeum	Sand Button-bush				Recently recognised as occurring in the region.
	Chrysocephalum semipapposum	Clustered Everlasting				
*	*Citrullus colocynthis*	Colocynth				
*	*Citrullus lanatus*	Bitter Melon				
	Cladium procerum	Leafy Twig-rush		R	K	
	Codonocarpus pyramidalis	Slender Bell-fruit	VU	E	E	
	Commicarpus australis	Pink Gum-fruit				
	Convolvulus remotus	Grassy Bindweed				
	Crassula colorata var. *colorata*	Dense Crassula				
	Crassula tetramera	Australian Stonecrop				
	Cruciferae sp.	Cress Family				
	Cryptandra propinqua	Silky Cryptandra				
*	*Cucumis myriocarpus*	Paddy Melon				
	Cymbopogon ambiguus	Lemon-grass				
	Cymbopogon obtectus	Silky-head Lemon-grass				
	Cynanchum floribundum	Desert Cynanchum				
	Cynoglossum australe	Australian Hound's-tongue			R	
	Cyperus alterniflorus	Umbrella Flat-sedge				
	Cyperus gymnocaulos	Spiny Flat-sedge				
	Cyperus vaginatus	Stiff Flat-sedge				
	Dactyloctenium radulans	Button-grass				
	Danthonia sp. (NC)	Wallaby-grass				= *Austrodanthonia* sp.
*	*Datura leichhardtii*	Native Thorn-apple				
	Daucus glochidiatus	Native Carrot				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Daviesia genistifolia	Broom Bitter-pea			U	
	Daviesia stricta	Flinders Ranges Bitter-pea		R	R	
	Dianella revoluta (NC)					= *Dianella revoluta* var. *revoluta*
	Dianella revoluta var.					= *Dianella revoluta* var. *revoluta*
	Dianella revoluta var. *revoluta*	Black-anther Flax-lily				
	Dichanthium sericeum ssp. *humilius*	Annual Silky Blue-grass				
	Digitaria brownii	Cotton Panic-grass				
	Dissocarpus biflorus var. *biflorus*	Two-horn Saltbush				
	Dissocarpus paradoxus	Ball Bindyi				
*	*Dittrichia graveolens*	Stinkweed				
	Dodonaea baueri	Crinkled Hop-bush				
	Dodonaea lobulata	Lobed-leaf Hop-bush				
	Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush				
	Dodonaea sp.	Hop-bush				
	Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush				
	Dodonaea viscosa ssp. *spatulata*	Sticky Hop-bush				
	Dysphania cristata	Crested Goosefoot				
	Dysphania melanocarpa f.	Black-fruit Goosefoot				= *Dysphania melanocarpa* f. *melanocarpa*
*	*Echium plantagineum*	Salvation Jane				
	Einadia nutans ssp.	Climbing Saltbush				= *Einadia nutans* ssp. *nutans*
	Einadia nutans ssp. *nutans*	Climbing Saltbush				
	Enchylaena tomentosa var.	Ruby Saltbush				= *Enchylaena tomentosa* var. *tomentosa*
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush				
	Enneapogon avenaceus	Common Bottle-washers				
	Enneapogon caerulescens var. *caerulescens*	Blue Bottle-washers				
	Enneapogon cylindricus	Jointed Bottle-washers				
	Enneapogon lindleyanus	Purple-head Nineawn				Presumed to be mis-identified as this species is not known to occur in FR.
	Enneapogon polyphyllus	Leafy Bottle-washers				
	Enneapogon sp.	Bottle-washers/Nineawn				
	Enteropogon ramosus	Umbrella Grass				
*	*Eragrostis barrelieri*	Pitted Love-grass				
	Eragrostis dielsii var. *dielsii*	Mulka				
	Eragrostis xerophila	Knotty-butt Neverfail				
	Eremophila alternifolia	Narrow-leaf Emubush				
	Eremophila duttonii	Harlequin Emubush				
	Eremophila freelingii	Rock Emubush				
	Eremophila glabra (NC)	Tar Bush				= *Eremophila glabra* ssp. *glabra*
	Eremophila glabra ssp.	Tar Bush				= *Eremophila glabra* ssp. *glabra*
	Eremophila glabra ssp. *glabra*	Tar Bush				
	Eremophila latrobei ssp.	Crimson Emubush				Could be either *Eremophila latrobei* ssp. *glabra* or ssp. *latrobei*.
	Eremophila latrobei ssp. *glabra*	Crimson Emubush				
	Eremophila longifolia	Weeping Emubush				
	Eremophila maculata ssp.	Spotted Emubush				= *Eremophila maculata* ssp. *maculata*
	Eremophila oppositifolia ssp.	Opposite-leaved Emubush				= *Eremophila oppositifolia* ssp. *oppositifolia*
	Eremophila oppositifolia ssp. *oppositifolia*	Opposite-leaved Emubush				
	Eremophila scoparia	Broom Emubush				
	Eremophila serrulata	Green Emubush				
	Eremophila sp.	Emubush/Turkey-bush				
	Eremophila sturtii	Turpentine Bush				
	Eriachne mucronata	Mountain Wanderrie				
	Eriochiton sclerolaenoides	Woolly-fruit Bluebush				
*	*Erodium aureum*					
	Erodium carolinianum	Clammy Heron's-bill				
*	*Erodium cicutarium*	Cut-leaf Heron's-bill				
	Erodium crinitum	Blue Heron's-bill				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Erodium cygnorum ssp. *glandulosum* (NC)	Clammy Heron's-bill				Used in the broad sense according to Jessop (1993). Now may be either *Erodium carolinianum* or *E. janszii*.
	Erodium sp.	Heron's-bill/Crowfoot				
	Eucalyptus camaldulensis ssp. *minima*	River Red Gum				
	Eucalyptus camaldulensis var. (NC)	River Red Gum				Most likely *Eucalyptus camaldulensis* ssp. *minima* but possibly ssp. *arida*.
	Eucalyptus camaldulensis var. *camaldulensis* (NC)	River Red Gum				= *Eucalyptus camaldulensis* ssp. *minima*
	Eucalyptus camaldulensis var. *obtusa* (NC)	River Red Gum				Most likely *Eucalyptus camaldulensis* ssp. *minima* but possibly ssp. *arida*.
	Eucalyptus dumosa	White Mallee				
	Eucalyptus flindersii	Flinders Grey Mallee				
	Eucalyptus gillii	Curly Mallee				
	Eucalyptus intertexta	Gum-barked Coolibah				
	Eucalyptus polybractea	Flinders Ranges Box		R	U	Formerly *Eucalyptus* sp. Flinders Ranges (D.Nicolle 562).
	Eucalyptus porosa	Mallee Box				
	Eucalyptus socialis (NC)	Beaked Red Mallee				= *Eucalyptus socialis* ssp. *socialis*
	Eucalyptus socialis ssp.	Beaked Red Mallee				= *Eucalyptus socialis* ssp. *socialis*
	Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee				
	Euchiton sphaericus	Annual Cudweed				
	Euphorbia australis (NC)	Hairy Caustic Weed				Used in the broad sense according to Jessop (1993). Now may be either *Chamaesyce australis* or *C. centralis*.
	Euphorbia tannensis ssp. *eremophila*	Desert Spurge				
	Exocarpos aphyllus	Leafless Cherry				
*	*Ficus carica*	Edible Fig				
	Frankenia crispa	Hoary Sea-heath				
	Frankenia foliosa	Leafy Sea-heath				
	Frankenia serpyllifolia	Thyme Sea-heath				
	Frankenia subteres			R	K	
*	*Galium murale*	Small Bedstraw				
	Geococcus pusillus	Earth Cress				
	Geranium sp.	Geranium				
*	*Glaucium corniculatum*	Bristly Horned-poppy				
	Glossocardia bidens	Native Cobbler's-pegs				
	Glycine canescens	Silky Glycine				
	Glycine clandestina var. (NC)	Twining Glycine				= *Glycine rubiginosa*
	Glycine rubiginosa	Twining Glycine				
	Gnephosis arachnoidea	Spidery Button-flower				
	Gonocarpus elatus	Hill Raspwort				
	Goodenia albiflora	White Goodenia			U	
	Goodenia calcarata	Streaked Goodenia				
	Goodenia fascicularis	Silky Goodenia				
	Goodenia vernicosa	Wavy Goodenia				
	Goodia medicaginea	Western Golden-tip			R	
	Gossypium sturtianum var. *sturtianum*	Sturt's Desert Rose				
	Gramineae sp.	Grass Family				
	Grevillea aspera	Rough Grevillea				
	Hakea ednieana	Flinders Ranges Corkwood				
	Hakea leucoptera ssp. *leucoptera*	Silver Needlewood				
	Haloragis aspera	Rough Raspwort				
	Heliotropium asperrimum	Rough Heliotrope				
*	*Heliotropium curassavicum*	Smooth Heliotrope				
	Heliotropium europaeum	Common Heliotrope				
	Hibiscus sturtii var.	Sturt's Hibiscus				= *Hibiscus sturtii* var. *grandiflorus*
	Hibiscus sturtii var. *grandiflorus*	Sturt's Hibiscus				
	Hyalosperma semisterile	Orange Sunray				
*	*Hypochaeris glabra*	Smooth Cat's Ear				
	Indigofera leucotricha	Silver Indigo				
	Ixiochlamys cuneifolia	Silverton Daisy				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Ixodia flindersica	Flinders Ranges Ixodia				
	Jasminum didymum ssp. *lineare*	Native Jasmine			U	
	Juncus aridicola	Inland Rush				
	Juncus kraussii	Sea Rush				
	Korthalsella japonica f. *japonica*	Jointed Mistletoe				
*	*Lamarckia aurea*	Toothbrush Grass				
	Lawrencia glomerata	Clustered Lawrencia				
	Leiocarpa semicalva ssp.	Hill Button-bush				= *Leiocarpa semicalva* ssp. *semicalva*
	Leiocarpa semicalva ssp. *semicalva*	Scented Button-bush				
	Leiocarpa sp.	Plover-daisy				
	Leiocarpa tomentosa	Woolly Plover-daisy				
	Leiocarpa websteri	Narrow Plover-daisy				
	Lepidium leptopetalum	Shrubby Peppercress				
	Lepidium oxytrichum	Green Peppercress				
	Lepidium papillosum	Warty Peppercress				
	Lepidium phlebopetalum	Veined Peppercress				
	Lepidium sp.	Peppercress				
	Lomandra multiflora ssp. *dura*	Hard Mat-rush				
	Lomandra sp.	Mat-rush				
	Lotus cruentus	Red-flower Lotus				
	Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe				
	Lythrum paradoxum				K	
	Lythrum salicaria	Purple Loosestrife		R	X	
	Maireana aphylla	Cotton-bush				
	Maireana astrotricha	Low Bluebush				
	Maireana brevifolia	Short-leaf Bluebush				
	Maireana campanulata	Bell-fruit Bluebush				
	Maireana georgei	Satiny Bluebush				
	Maireana lobiflora	Lobed Bluebush				
	Maireana pentatropis	Erect Mallee Bluebush				
	Maireana pyramidata	Black Bluebush				
	Maireana sedifolia	Bluebush				
	Maireana sp.	Bluebush/Fissure-plant				
	Maireana tomentosa ssp. *urceolata*					
	Maireana trichoptera	Hairy-fruit Bluebush				
	Maireana turbinata	Top-fruit Bluebush				
	Malva preissiana	Australian Hollyhock				
	Malvaceae sp.					
	Malvastrum americanum var. *americanum*	Malvastrum				
*	*Marrubium vulgare*	Horehound				
	Marsdenia australis	Native Pear				
	Melaleuca dissitiflora					
	Melaleuca glomerata	Inland Paper-bark				
	Melaleuca lanceolata	Dryland Tea-tree				
	Melaleuca lanceolata ssp. *lanceolata* (NC)	Dryland Tea-tree				= *Melaleuca lanceolata*
	Melaleuca uncinata	Broombush				
	Melaleuca uncinata (NC)	Broombush				Used in the broad sense according to Jessop (1993). Now may be either *Melaleuca uncinata* or *M. interioris.*
	Melhania oblongifolia	Velvet Hibiscus				
	Mentha australis	River Mint				
	Minuria cunninghamii	Bush Minuria				
	Minuria integerrima	Smooth Minuria				
	Myoporum montanum	Native Myrtle				
	Myoporum platycarpum (NC)	False Sandalwood				Used in the broad sense according to Jessop and Toelken (1986). Now may be either *Myoporum platycarpum* ssp. *platycarpum* or *M. platycarpum* ssp. *perbellum.*
	Myoporum platycarpum ssp.	False Sandalwood				Could be either *Myoporum platycarpum* ssp. *platycarpum* or ssp. *perbellum.*

I	Species Name	Common Name	Aus	SA	FR	Notes
	Myoporum platycarpum ssp. *platycarpum*	False Sandalwood				
	Neurachne alopecuroidea	Fox-tail Mulga-grass				
*	*Nicotiana glauca*	Tree Tobacco				
	Nicotiana simulans	Native Tobacco				
	Nicotiana sp.	Tobacco				
	Nicotiana velutina	Velvet Tobacco				
	Nitraria billardierei	Nitre-bush				
	Olearia decurrens	Winged Daisy-bush				
	Olearia muelleri	Mueller's Daisy-bush				
	Olearia ramulosa	Twiggy Daisy-bush				
	Omphalolappula concava	Burr Stickseed				
*	*Onopordum acaulon*	Horse Thistle				
	Oxalis perennans	Native Sorrel				
	Oxalis perennans (NC)	Native Sorrel				= *Oxalis perennans*
	Ozothamnus scaber	Rough Bush-everlasting		V	K	
	Panicum decompositum var. *decompositum*	Native Millet				
*	*Papaver somniferum* ssp. *setigerum* (NC)	Small-flower Opium Poppy				= **Papaver somniferum*
	Paraceterach reynoldsii	Scaly Rock-fern				
	Parietaria cardiostegia/debilis	Smooth-nettle				Broader taxonomic entity used, when specimen not collected, due to difficulties recognised in identification in the field.
	Petalostylis labicheoides	Butterfly Bush				
	Philotheca angustifolia ssp. *angustifolia*	Narrow-leaf Wax-flower		R	R	
	Phlegmatospermum cochlearinum	Downy Cress				
	Phyllanthus lacunarius (NC)	Lagoon Spurge			U	Used in the broad sense according to Jessop (1993). Now may be either *Phyllanthus lacunarius* (doubtful occurrence in FR) or *P. lacunellus*.
	Phyllanthus maderaspatensis var. *angustifolius*					
	Phyllanthus saxosus	Rock Spurge			U	
	Pimelea microcephala ssp.	Shrubby Riceflower				= *Pimelea microcephala* ssp. *microcephala*
	Pimelea microcephala ssp. *microcephala*	Shrubby Riceflower				
	Pimelea simplex ssp. *simplex*	Desert Riceflower				
	Pimelea trichostachya	Spiked Riceflower				
	Pittosporum angustifolium	Native Apricot				
	Plantago drummondii	Dark Plantain				
	Plectranthus intraterraneus	Inland Spur-flower				
	Pleurosorus rutifolius	Blanket Fern				
	Pluchea dentex	Bowl Daisy				
	Pluchea rubelliflora					
*	*Polypogon viridis*	Water Bent				
	Pomax umbellate	Pomax				
	Portulaca oleracea	Common Purslane				
	Prostanthera striatiflora	Striated Mintbush				
	Pseudognaphalium luteoalbum	Jersey Cudweed				
	Pterocaulon sphacelatum	Apple-bush				
	Ptilotus decipiens					
	Ptilotus exaltatus var.	Pink Mulla Mulla				Could be either *Ptilotus exaltatus* var. *exaltatus* or var. *pallidus*.
	Ptilotus exaltatus var. *exaltatus*	Pink Mulla Mulla				
	Ptilotus nobilis var.	Yellow-tails				Most likely *Ptilotus nobilis* var. *nobilis* but possibly var. *angustifolius*.
	Ptilotus nobilis var. *nobilis*	Yellow-tails				
	Ptilotus obovatus (NC)					= *Ptilotus obovatus* var. *obovatus*
	Ptilotus obovatus var.	Silver Mulla Mulla				= *Ptilotus obovatus* var. *obovatus*
	Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla				
	Ptilotus parvifolius var. *laetus* (NC)	Small-leaf Mulla Mulla				= *Ptilotus propinquus*
	Ptilotus polystachyus var. *polystachyus*	Long-tails				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Ptilotus propinquus					
	Pycnosorus pleiocephalus	Soft Billy-buttons				
	Radyera farragei	Desert Rose Mallow			R	
	Ranunculus hamatosetosus	Hill Buttercup				
	Ranunculus sessiliflorus var. *sessiliflorus*	Annual Buttercup				
	Rhagodia parabolica	Mealy Saltbush				
	Rhagodia spinescens	Spiny Saltbush				
	Rhagodia ulicina	Intricate Saltbush				
	Rhodanthe floribunda	White Everlasting				
	Rhodanthe microglossa	Clustered Everlasting				
	Rhodanthe moschata	Musk Daisy				
	Rhodanthe pygmaea	Pigmy Daisy				
	Rhodanthe stricta	Slender Everlasting				
	Rhyncharrhena linearis	Bush Bean			U	
	Rhynchosia minima	Rhynchosia				
*	*Rorippa nasturtium-aquaticum*	Watercress				
	Rostellularia adscendens ssp. *adscendens* var.	Pink Tongue				Could be either either *Rostellularia adscendens* var. *latifolia* or var. *pogonanthera*.
	Rostellularia adscendens var. *pogonanthera*	Pink Tongues				
	Salsola tragus	Buckbush				
	Santalum acuminatum	Quandong				
	Santalum lanceolatum	Plumbush				
	Santalum spicatum	Sandalwood		V	V	
	Sarcostemma viminale ssp. *australe*	Caustic Bush			U	
	Sauropus rigens	Stiff Spurge				
	Scaevola humilis	Inland Fanflower				
	Scaevola spinescens	Spiny Fanflower				
	Schenkia australis	Spike Centaury				
*	*Schismus barbatus*	Arabian Grass				
	Schoenoplectus litoralis	Shore Club-rush			U	
	Scleranthus sp.	Knawel				
	Sclerolaena brachyptera	Short-wing Bindyi				
	Sclerolaena convexula	Tall Bindyi			R	
	Sclerolaena cuneata	Tangled Bindyi				
	Sclerolaena diacantha	Grey Bindyi				
	Sclerolaena diacantha/uniflora	Grey Bindyi				Broader taxonomic entity used, when specimen not collected, due to difficulties recognised in identification in the field.
	Sclerolaena divaricata	Tangled Bindyi				
	Sclerolaena lanicuspis	Spinach Bindyi				
	Sclerolaena limbata	Pearl Bindyi				
	Sclerolaena longicuspis	Long-spine Bindyi				
	Sclerolaena obliquicuspis	Oblique-spined Bindyi				
	Sclerolaena parallelicuspis	Western Bindyi				
	Sclerolaena patenticuspis	Spear-fruit Bindyi				
	Sclerolaena sp.	Bindyi				
	Sclerolaena uniflora	Small-spine Bindyi				
	Sclerolaena ventricosa	Salt Bindyi				
	Senecio glossanthus (NC)	Annual Groundsel				= *Senecio glossanthus*
	Senecio lanibracteus	Inland Shrubby Groundsel				
	Senecio magnificus	Showy Groundsel				
	Senna artemisioides ssp.	Desert Senna				Could be any 1 of 9 subspecies.
	Senna artemisioides ssp. *alicia*	Desert Senna				
	Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna				
	Senna artemisioides ssp. *helmsii*	Blunt-leaf Senna				
	Senna artemisioides ssp. *petiolaris* (NC)	Flat-stalk Senna				Used in the broad sense according to Jessop (1993). Now may be either *Senna artemisioides* ssp. *petiolaris* or *S. phyllodinea*.

I	Species Name	Common Name	Aus	SA	FR	Notes
	Senna artemisioides ssp. X *artemisioides*	Silver Senna				
	Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna				
	Senna artemisioides ssp. X *sturtii*	Grey Senna				
	Setaria basiclada					
	Setaria constricta	Knotty-butt Paspalidium				
*	*Setaria verticillata*	Whorled Pigeon-grass				
	Sida corrugata var.	Corrugated Sida				Could be either *Sida corrugata* var. *angustifolia* (doubtful occurrence in FR) or var. *corrugata*.
	Sida everistiana	Everist's Sida				
	Sida fibulifera	Pin Sida				
	Sida filiformis	Fine Sida				
	Sida intricata	Twiggy Sida				
	Sida petrophila	Rock Sida				
	Sida sp.	Sida				
	Sida spodochroma					
	Sida trichopoda	High Sida				
	Sigesbeckia australiensis	Australian Sigesbeckia				
*	*Silene* sp.	Catchfly				
*	*Sisymbrium erysimoides*	Smooth Mustard				
*	*Sisymbrium orientale*	Indian Hedge Mustard				
*	*Sisymbrium* sp.	Wild Mustard				
	Solanum ellipticum	Velvet Potato-bush				
	Solanum ellipticum/quadriloculatum					Broader taxonomic entity used, when specimen not collected, due to difficulties recognised in identification in the field.
	Solanum petrophilum	Rock Nightshade				
	Solanum quadriloculatum	Plains Nightshade				
	Solanum simile	Kangaroo Apple				
	Solanum sturtianum	Sturt's Nightshade				
*	*Sonchus oleraceus*	Common Sow-thistle				
*	*Sonchus oleraceus* (NC)	Common Sow-thistle				*= *Sonchus oleraceus*
	Sporobolus actinocladus	Ray Grass				
	Sporobolus caroli	Yakka Grass			R	
	Spyridium phlebophyllum	Inland Spyridium				
	Stenopetalum lineare (NC)	Narrow Thread-petal				*= Stenopetalum lineare*
	Streptoglossa liatroides	Wertaloona Daisy				
	Swainsona burkittii	Woolly Darling Pea			Q	
	Swainsona fissimontana	Broken Hill Pea				
	Swainsona formosa	Sturt Pea				
	Swainsona leeana	Lee's Swainson-pea		R	K	
	Swainsona oliveri				K	
	Swainsona sp.	Swainson-pea				
	Swainsona stipularis	Orange Swainson-pea				
	Swainsona tephrotricha	Ashy-haired Swainson-pea			R	
	Tecticornia disarticulata					
	Templetonia aculeata	Spiny Mallee-pea			U	
	Templetonia egena	Broombush Templetonia				
	Tetragonia eremaea	Desert Spinach				
	Tetragonia tetragonioides (NC)	New Zealand Spinach				Used in the broad sense according to Jessop (1993). Now may be either *Tetragonia tetragonioides* or *T. moorei*.
	Teucrium racemosum	Grey Germander				
	Themeda triandra	Kangaroo Grass				
	Thyridolepis mitchelliana	Window Mulga-grass				
	Tragus australianus	Small Burr-grass				
	Trianthema triquetra	Red Spinach				
	Tribulus eichlerianus	Eichler's Caltrop				
	Trichanthodium skirrophorum	Woolly Yellow-heads				
	Trichodesma zeylanicum var. *zeylanicum*	Camel Bush				

I	Species Name	Common Name	Aus	SA	FR	Notes
	Triodia irritans	Spinifex				Used in the broad sense according to Jessop (1993). Now may be 1 of 3 species (*Triodia irritans*, *T. bunicola* or *T. scariosa*).
	Triodia irritans var. (NC)					Used in the broad sense according to Jessop and Toelken (1986). Now may be 1 of 3 species (*Triodia irritans*, *T. bunicola* or *T. scariosa*).
	Triodia scariosa ssp. (NC)	Spinifex				Used in the broad sense according to Jessop (1993). Now may be either *Triodia bunicola* or *T. scariosa*.
	Triraphis mollis	Purple Plume Grass				
	Typha domingensis	Narrow-leaf Bulrush				
	Typha orientalis	Broad-leaf Bulrush				
	Typha sp.	Bulrush				
*	*Vaccaria hispanica*	Cow Soapwort				
	Velleia arguta	Toothed Velleia				
	Velleia connata	Cup Velleia			R	
	Velleia cycnopotamica			R	#	No conservation rating yet applied for FR as only recently recognised as occurring in the region.
*	*Verbena officinalis*	Common Verbena				
	Vittadinia australasica var.	Sticky New Holland Daisy				= *Vittadinia australasica* var. *australasica*
	Vittadinia cuneata var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy				
	Vittadinia eremaea	Desert New Holland Daisy				
	Vittadinia gracilis	Woolly New Holland Daisy				
	Vittadinia pterochaeta	Rough New Holland Daisy				
	Vittadinia sp.	New Holland Daisy				
	Vittadinia sulcata	Furrowed New Holland Daisy				
	Wahlenbergia aridicola	Dryland Bluebell			R	
	Wahlenbergia communis	Tufted Bluebell				
	Wahlenbergia queenslandica					Recently recognised as occurring in the region.
	Westringia rigida	Stiff Westringia				
*	*Xanthium spinosum*	Bathurst Burr				
	Xanthorrhoea quadrangulata	Rock Grass-tree				
	Xerochrysum bracteatum	Golden Everlasting				
	Xerothamnella parvifolia		VU	E	E	
	Zygophyllum "Terete leaves"(D.E.Symon 14690) (NC)					= *Zygophyllum aurantiacum* ssp. (this entity is now *Z. aurantiacum* ssp. *simplicifolium*, however, this is not recognised as occurring in FR).
	Zygophyllum apiculatum	Pointed Twinleaf				
	Zygophyllum aurantiacum (NC)	Shrubby Twinleaf				Used in the broad sense according to Jessop (1993). Now may be 1 of 3 subspecies (*Zygophyllum aurantiacum* ssp. *aurantiacum*, *Z. aurantiacum* ssp. *cuneatum* or *Z. aurantiacum* ssp. *verticillatum*).
	Zygophyllum aurantiacum ssp. *verticillatum*	Shrubby Twinleaf				
	Zygophyllum crenatum	Notched Twinleaf				
	Zygophyllum iodocarpum	Violet Twinleaf				
	Zygophyllum prismatothecum	Square-fruit Twinleaf				
	Zygophyllum prismatothecum (NC)	Square-fruit Twinleaf				= *Zygophyllum prismatothecum*
	Zygophyllum sp.	Twinleaf				

APPENDIX 3. PLANT TAXA RECORDS FROM VARIOUS SOURCES FOR THE NANTAWARRINA IPA.

Taxonomy follows Barker *et al*. (2005) as updated by the DEH FLORA Database (as at November 2009).

I Indigenous/alien designation. Naturalised alien taxa are designated with an asterisk (*).

(NC) Appearing after a scientific name designates it as a non-current name in the SA FLORA Database 2009. A non-current name represents a previous taxonomic circumscription corresponding to one or more currently recognised taxa.

Conservation Status

Aus Australian status under the *Environment Protection and Biodiversity Conservation Act 1999* as at November 2009.

SA South Australian status under the *National Parks and Wildlife Act 1972* (2007 update of schedules 7, 8 and 9).

FR Regional status for the Flinders Ranges Herbarium Region as per the SA FLORA database (November 2009), which provides an update of the original assessments of Lang and Kraehenbuehl (1987).

Status Codes: **X** = extinct; **E** = endangered; **V** = vulnerable; **T** = threatened (either endangered or vulnerable but insufficient data to enable accurate assessment); **R** = rare; **K** = uncertain (either rare or threatened but insufficient data to enable accurate assessment); **U** = uncommon; **Q** = not yet assessed but considered to be of possible significance; **#** = not yet assessed as this is a new record for the region.

BS6 SU Number of site records from the Flinders Survey (1988-1991).

BS104 SU Number of site records from the Flinders Ranges Biological Survey (1999).

BS104 OP Number of opportunistic records from the Flinders Ranges Biological Survey in 1999.

Adel Herb Number of specimens held in the Adelaide Herbarium (includes only records databased as of May 2009).

BS636 SU Number of site records from the Nantawarrina IPA Biological Survey in 2009.

BS636 OP Number of opportunistic records from the Nantawarrina IPA Biological Survey in 2009.

Total Recs Total number of records from all sources.

I	Species Name	Common Name	Aus	SA	FR	BS6 SU	BS104 SU	BS104 OP	Adel Herb	BS636 SU	BS636 OP	Total Recs
	Abutilon cryptopetalum (NC)	Hill Lantern-bush				3						3
	Abutilon fraseri (NC)	Dwarf Lantern-bush				4						4
	Abutilon fraseri ssp.						3			2		5
	Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush							1	3		4
	Abutilon halophilum	Plains Lantern-bush							1			1
	Abutilon leucopetalum	Desert Lantern-bush				19	1		3	8	3	34
	Abutilon sp.	Lantern-bush				1			1			2
	Acacia aneura (NC)	Mulga				32						32
	Acacia aneura var.								2		1	3
	Acacia aneura var. *aneura*	Mulga								9	3	12
	Acacia aneura var. *major*								1			1
	Acacia aneura var. *tenuis*	Mulga								3		3
	Acacia ayersiana var. (NC)	Broad-leaf Mulga					1					1
	Acacia beckleri ssp. *megasphaerica*	Beckler's Rock Wattle									1	1
	Acacia burkittii	Pin-bush Wattle				1						1
	Acacia continua	Thorn Wattle					1		1		1	3
	Acacia havilandiorum	Needle Wattle					1			1	3	5
	Acacia kempeana	Witchetty Bush							2			2
	Acacia oswaldii	Umbrella Wattle				2	2		3	4	3	14
	Acacia paradoxa	Kangaroo Thorn							1			1
	Acacia pravifolia	Coil-pod Wattle			U				1			1
	Acacia rivalis	Silver Wattle				10	1	1	3	4	3	22
	Acacia salicina	Willow Wattle					1		3	1	1	6
	Acacia sibirica	Bastard Mulga				3			6			9
	Acacia sp.					3						3
	Acacia tetragonophylla	Dead Finish				44	4		3	18	2	71
	Acacia victoriae ssp.	Elegant Wattle					5			5		10
	Acacia victoriae ssp. *victoriae*	Elegant Wattle				43			1	9	1	54
	Acacia wilhelmiana	Dwarf Nealie				1						1
*	*Acetosa vesicaria*	Rosy Dock				23						23
	Actinobole uliginosum	Flannel Cudweed				2			1			3
*	*Adonis microcarpa*	Pheasant's Eye							1			1
	Ajuga australis	Australian Bugle					1			2		3

I	Species Name	Common Name	Aus	SA	FR	BS6 SU	BS104 SU	BS104 OP	Adel Herb	BS636 SU	BS636 OP	Total Recs
	Ajuga australis f. A (A.G.Spooner 9058)	Australian Bugle				1			3			4
	Alectryon oleifolius ssp. *canescens*	Bullock Bush				24	4			15	1	44
	Allocasuarina muelleriana ssp. *alticola*	Flinders Ranges Oak-bush							1			1
	Alyogyne hakeifolia	Hakea-leaf Hibiscus			U				2			2
	Amaranthus mitchellii	Boggabri Weed								3		3
	Amyema linophylla ssp. *orientale*	Casuarina Mistletoe			U	2						2
	Amyema maidenii ssp. *maidenii*	Pale-leaf Mistletoe				13			1	2	2	18
	Amyema miquelii	Box Mistletoe				6	3			2		11
	Amyema miraculosa ssp. *boormanii*	Fleshy Mistletoe				1						1
	Amyema preissii	Wire-leaf Mistletoe				1					1	2
	Anacampseros australiana	Australian Anacampseros			U					6	1	7
*	*Anagallis arvensis*	Pimpernel				2			1		1	4
*	*Anagallis minima*	Chaffweed						1				1
	Anemocarpa podolepidium	Rock Everlasting							1			1
	Arabidella glaucescens										1	1
	Arabidella sp.	Native Cress					1					1
	Arabidella trisecta	Shrubby Cress				1			4			5
	Aristida contorta	Curly Wire-grass				2						2
	Aristida nitidula	Brush Three-awn				15	1		2			18
	Aristida sp.	Three-awn/Wire-grass				4						4
	Aristida strigosa	Rough Three-awn			#					4		4
	Asperula conferta	Common Woodruff							1			1
*	*Asphodelus fistulosus*	Onion Weed					1			1		2
	Astrebla lappacea	Curly Mitchell-grass								1		1
	Astrebla pectinata	Barley Mitchell-grass							1			1
	Astroloma humifusum	Cranberry Heath					1					1
	Atriplex acutibractea ssp.	Pointed Saltbush				11				2		13
	Atriplex acutibractea ssp. *acutibractea*	Pointed Saltbush							3	1		4
	Atriplex eardleyae	Eardley's Saltbush							1			1
	Atriplex limbata	Spreading Saltbush							1	1		2
	Atriplex sp.	Saltbush				1	1			2		4
	Atriplex stipitata	Bitter Saltbush				4				4	2	10
	Atriplex vesicaria ssp.	Bladder Saltbush				5				1		6
	Austrodanthonia caespitosa	Common Wallaby-grass				2	1		1			4
	Austrodanthonia setacea	Small-flower Wallaby-grass								1		1
	Austrostipa elegantissima	Feather Spear-grass							1			1
	Austrostipa eremophila	Rusty Spear-grass								1		1
	Austrostipa nitida	Balcarra Spear-grass				13			4	5		22
	Austrostipa nodosa	Tall Spear-grass				6			2			8
	Austrostipa pilata	Prickly Spear-grass		V	K		1					1
	Austrostipa platychaeta	Flat-awn Spear-grass			R					1		1
	Austrostipa scabra ssp.	Rough Spear-grass				21				3		24
	Austrostipa sp.	Spear-grass				17				4		21
	Austrostipa trichophylla					1						1
	Baumea arthrophylla	Swamp Twig-rush			R				1			1
	Beyeria lechenaultii	Pale Turpentine Bush					2	1				3
	Boerhavia dominii	Tar-vine				5	2			6		13
	Boerhavia schomburgkiana	Schomburgk's Tar-vine							2			2
	Brachyscome ciliaris var.	Variable Daisy						1				1
	Brachyscome ciliaris var. *ciliaris*	Variable Daisy				1	1			3	3	8
	Brachyscome ciliaris var. *lanuginosa*	Woolly Variable Daisy				1						1
	Brachyscome dentata	Lobe-seed Daisy			U				1	1		2
	Brachyscome lineariloba	Hard-head Daisy				5						5
*	*Bromus rubens*	Red Brome				4						4
	Bromus sp.	Brome				5						5
	Bulbine alata	Winged Bulbine-lily				1						1
	Bursaria spinosa ssp.	Bursaria									1	1
	Bursaria spinosa ssp. *lasiophylla*	Downy Bursaria							1			1
	Bursaria spinosa ssp. *spinosa*	Sweet Bursaria				1						1
	Calandrinia ptychosperma	Creeping Parakeelya				2						2

I	Species Name	Common Name	Aus	SA	FR	BS6 SU	BS104 SU	BS104 OP	Adel Herb	BS636 SU	BS636 OP	Total Recs
	Callistemon teretifolius	Needle Bottlebrush				1	1					2
	Callitris glaucophylla	White Cypress-pine				10	2		4	3	3	22
	Calotis hispidula	Hairy Burr-daisy				2				1		3
	Calotis latiuscula	Leafy Burr-daisy				1					1	2
	Calotis plumulifera	Woolly-headed Burr-daisy							1			1
	Calytrix tetragona	Common Fringe-myrtle				2	1					3
	Capparis mitchellii	Native Orange				6		1	7	3	5	22
	Carpobrotus sp.	Pigface				1						1
*	*Carrichtera annua*	Ward's Weed				13	1		1	9	1	25
*	*Carthamus lanatus*	Saffron Thistle				1	1			1		3
	Caryophyllaceae sp.	Pink Family				1						1
	Cassinia complanata	Sticky Cassinia								1	5	6
	Cassinia laevis	Curry Bush				9	2		5			16
	Cassytha flindersii	Flinders Ranges Dodder-laurel							1			1
	Casuarina pauper	Black Oak				31	2		5	9		47
*	*Centaurea melitensis*	Malta Thistle				31			2	2		35
	Chamaesyce australis								1	8		9
	Chamaesyce centralis								1			1
	Chamaesyce drummondii									6		6
	Chamaesyce drummondii (NC)	Caustic Weed				1	1					2
	Chamaesyce sp.	Spurge								1		1
	Cheilanthes austrotenuifolia	Annual Rock-fern								1	1	2
	Cheilanthes lasiophylla	Woolly Cloak-fern				19	1		3	4	2	29
	Cheilanthes sieberi ssp.	Narrow Rock-fern					2					2
	Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern				5				2		7
	Cheilanthes sp.	Rock-fern				1						1
	Chenopodiaceae sp.	Goosefoot Family				1						1
	Chenopodium curvispicatum	Cottony Goosefoot			K					2		2
	Chenopodium desertorum ssp.	Desert Goosefoot					1			2		3
	Chenopodium desertorum ssp. *desertorum*	Frosted Goosefoot							1			1
*	*Chenopodium murale*	Nettle-leaf Goosefoot								2	1	3
	Chrysocephalum eremaeum	Sand Button-bush								4	2	6
	Chrysocephalum semipapposum	Clustered Everlasting				3	2					5
*	*Citrullus colocynthis*	Colocynth								5	1	6
*	*Citrullus lanatus*	Bitter Melon				2						2
	Cladium procerum	Leafy Twig-rush		R	K			1			1	2
	Codonocarpus pyramidalis	Slender Bell-fruit	V	E	E			2	3		2	7
	Commicarpus australis	Pink Gum-fruit							3			3
	Convolvulus remotus	Grassy Bindweed				21	1		1	7	1	31
	Crassula colorata var. *colorata*	Dense Crassula							1			1
	Crassula tetramera	Australian Stonecrop							1			1
	Cruciferae sp.	Cress Family				8						8
	Cryptandra propinqua	Silky Cryptandra									2	2
*	*Cucumis myriocarpus*	Paddy Melon								2		2
	Cymbopogon ambiguus	Lemon-grass				28	4		3	6	1	42
	Cymbopogon obtectus	Silky-head Lemon-grass									1	1
	Cynanchum floribundum	Desert Cynanchum							1		2	3
	Cynoglossum australe	Australian Hound's-tongue			R				1			1
	Cyperus alterniflorus	Umbrella Flat-sedge							1			1
	Cyperus gymnocaulos	Spiny Flat-sedge				2	1			1	2	6
	Cyperus vaginatus	Stiff Flat-sedge							1		1	2
	Dactyloctenium radulans	Button-grass								1		1
	Danthonia sp. (NC)	Wallaby-grass					1					1
*	*Datura leichhardtii*	Native Thorn-apple					1			6	1	8
	Daucus glochidiatus	Native Carrot				3						3
	Daviesia genistifolia	Broom Bitter-pea			U		1				2	3
	Daviesia stricta	Flinders Ranges Bitter-pea		R	R		1					1
	Dianella revoluta (NC)					2						2
	Dianella revoluta var.						1					1
	Dianella revoluta var. *revoluta*	Black-anther Flax-lily					1				1	2

I	Species Name	Common Name	Aus	SA	FR	BS6 SU	BS104 SU	BS104 OP	Adel Herb	BS636 SU	BS636 OP	Total Recs
	Dichanthium sericeum ssp. *humilius*	Annual Silky Blue-grass							1			1
	Digitaria brownii	Cotton Panic-grass				16			1	1	2	20
	Dissocarpus biflorus var. *biflorus*	Two-horn Saltbush				1						1
	Dissocarpus paradoxus	Ball Bindyi				20	2		4	11	1	38
*	*Dittrichia graveolens*	Stinkweed				2	1				4	7
	Dodonaea baueri	Crinkled Hop-bush					2				1	3
	Dodonaea lobulata	Lobed-leaf Hop-bush				20	2		6	9	2	39
	Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush				22	6		2	7	4	41
	Dodonaea sp.	Hop-bush								1		1
	Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush				4	3		3	3	1	14
	Dodonaea viscosa ssp. *spatulata*	Sticky Hop-bush							1			1
	Dysphania cristata	Crested Goosefoot				1	1		1	4		7
	Dysphania melanocarpa f.	Black-fruit Goosefoot							1	7		8
*	*Echium plantagineum*	Salvation Jane				1	1					2
	Einadia nutans ssp.	Climbing Saltbush				1	1					2
	Einadia nutans ssp. *nutans*	Climbing Saltbush				2				1	1	4
	Enchylaena tomentosa var.	Ruby Saltbush					3			6		9
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush				33			1	13	1	48
	Enneapogon avenaceus	Common Bottle-washers				4	1		3	3		11
	Enneapogon caerulescens var. *caerulescens*	Blue Bottle-washers							5		2	7
	Enneapogon cylindricus	Jointed Bottle-washers				25			1	2		28
	Enneapogon lindleyanus	Purple-head Nineawn				5						5
	Enneapogon polyphyllus	Leafy Bottle-washers				1			2	4	1	8
	Enneapogon sp.	Bottle-washers/Nineawn				1				2		3
	Enteropogon ramosus	Umbrella Grass								1	2	3
*	*Eragrostis barrelieri*	Pitted Love-grass				3			1			4
	Eragrostis dielsii var. *dielsii*	Mulka				2						2
	Eragrostis xerophila	Knotty-butt Neverfail							1			1
	Eremophila alternifolia	Narrow-leaf Emubush				18	1		6	1	2	28
	Eremophila duttonii	Harlequin Emubush				3	1		1	1		6
	Eremophila freelingii	Rock Emubush				27	1			15	2	45
	Eremophila glabra (NC)	Tar Bush				7						7
	Eremophila glabra ssp.	Tar Bush						1		3		4
	Eremophila glabra ssp. *glabra*	Tar Bush					1		5	5	2	13
	Eremophila latrobei ssp.	Crimson Emubush								3	1	4
	Eremophila latrobei ssp. *glabra*	Crimson Emubush								1		1
	Eremophila longifolia	Weeping Emubush				3			1	5	4	13
	Eremophila maculata ssp.	Spotted Emubush								2		2
	Eremophila oppositifolia ssp.	Opposite-leaved Emubush					1			1	1	3
	Eremophila oppositifolia ssp. *oppositifolia*	Opposite-leaved Emubush				6			1		1	8
	Eremophila scoparia	Broom Emubush				5	3		1	4	1	14
	Eremophila serrulata	Green Emubush				4			3	5	6	18
	Eremophila sp.	Emubush/Turkey-bush				3						3
	Eremophila sturtii	Turpentine Bush				1				3	1	5
	Eriachne mucronata	Mountain Wanderrie							2			2
	Eriochiton sclerolaenoides	Woolly-fruit Bluebush				10			1	2		13
*	*Erodium aureum*								1			1
	Erodium carolinianum	Clammy Heron's-bill							1			1
*	*Erodium cicutarium*	Cut-leaf Heron's-bill				1						1
	Erodium crinitum	Blue Heron's-bill							2			2
	Erodium cygnorum ssp. *glandulosum* (NC)	Clammy Heron's-bill				1						1
	Erodium sp.	Heron's-bill/Crowfoot				1						1
	Eucalyptus camaldulensis ssp. *minima*	River Red Gum								5	1	6
	Eucalyptus camaldulensis var.	River Red Gum				7						7
	Eucalyptus camaldulensis var. *camaldulensis* (NC)	River Red Gum				1						1
	Eucalyptus camaldulensis var. *obtusa*	Northern River Red Gum					1		1			2
	Eucalyptus dumosa	White Mallee				2						2

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	Eucalyptus flindersii	Flinders Grey Mallee				2	1		3			6
	Eucalyptus gillii	Curly Mallee				10	2		3	3	1	19
	Eucalyptus intertexta	Gum-barked Coolibah				4	2		3	4	8	21
	Eucalyptus polybractea	Flinders Ranges Box		R	U		2	1				3
	Eucalyptus porosa	Mallee Box							1			1
	Eucalyptus socialis (NC)	Beaked Red Mallee				6	3					9
	Eucalyptus socialis ssp.	Beaked Red Mallee									1	1
	Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee								2	3	5
	Euchiton sphaericus	Annual Cudweed							1			1
	Euphorbia australis (NC)	Hairy Caustic Weed				3						3
	Euphorbia tannensis ssp. *eremophila*	Desert Spurge							2	3		5
	Exocarpos aphyllus	Leafless Cherry				26	2		3	11	2	44
*	*Ficus carica*	Edible Fig									1	1
	Frankenia crispa	Hoary Sea-heath				2						2
	Frankenia foliosa	Leafy Sea-heath				4						4
	Frankenia serpyllifolia	Thyme Sea-heath							1		1	2
	Frankenia subteres			R	K	1						1
*	*Galium murale*	Small Bedstraw				1						1
	Geococcus pusillus	Earth Cress							1			1
	Geranium sp.	Geranium				1						1
*	*Glaucium corniculatum*	Bristly Horned-poppy								1		1
	Glossocardia bidens	Native Cobbler's-pegs					1			2		3
	Glycine canescens	Silky Glycine							1			1
	Glycine clandestina var. (NC)	Twining Glycine					2					2
	Glycine rubiginosa	Twining Glycine				4			2	1		7
	Gnephosis arachnoidea	Spidery Button-flower				5				1		6
	Gonocarpus elatus	Hill Raspwort					1					1
	Goodenia albiflora	White Goodenia			U						1	1
	Goodenia calcarata	Streaked Goodenia								1		1
	Goodenia fascicularis	Silky Goodenia				2			5			7
	Goodenia vernicosa	Wavy Goodenia				5	2	1	2	1	2	13
	Goodia medicaginea	Western Golden-tip			R				2			2
	Gossypium sturtianum var. *sturtianum*	Sturt's Desert Rose									1	1
	Gramineae sp.	Grass Family				7	1			2		10
	Grevillea aspera	Rough Grevillea				2	1					3
	Hakea ednieana	Flinders Ranges Corkwood				14			2	2	5	23
	Hakea leucoptera ssp. *leucoptera*	Silver Needlewood				1					2	3
	Haloragis aspera	Rough Raspwort							5		1	6
	Heliotropium asperrimum	Rough Heliotrope							2	1		3
*	*Heliotropium curassavicum*	Smooth Heliotrope									1	1
	Heliotropium europaeum	Common Heliotrope					1		2	8	1	12
	Hibiscus sturtii var.	Sturt's Hibiscus								2		2
	Hibiscus sturtii var. *grandiflorus*	Sturt's Hibiscus				6	3		3			12
	Hyalosperma semisterile	Orange Sunray							1			1
*	*Hypochaeris glabra*	Smooth Cat's Ear				1						1
	Indigofera leucotricha	Silver Indigo				2						2
	Ixiochlamys cuneifolia	Silverton Daisy							2	1		3
	Ixodia flindersica	Flinders Ranges Ixodia				1						1
	Jasminum didymum ssp. *lineare*	Native Jasmine			U		1			2		3
	Juncus aridicola	Inland Rush								1		1
	Juncus kraussii	Sea Rush									1	1
	Korthalsella japonica f. *japonica*	Jointed Mistletoe							3			3
*	*Lamarckia aurea*	Toothbrush Grass				2						2
	Lawrencia glomerata	Clustered Lawrencia				1					1	2
	Leiocarpa semicalva ssp.	Hill Button-bush					1					1
	Leiocarpa semicalva ssp. *semicalva*	Scented Button-bush				8			1	1		10
	Leiocarpa sp.	Plover-daisy								1		1
	Leiocarpa tomentosa	Woolly Plover-daisy				2						2
	Leiocarpa websteri	Narrow Plover-daisy				6			1		1	8
	Lepidium leptopetalum	Shrubby Peppercress							1			1
	Lepidium oxytrichum	Green Peppercress				2						2
	Lepidium papillosum	Warty Peppercress				1			1			2

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	Lepidium phlebopetalum	Veined Peppercress				1			2			3
	Lepidium sp.	Peppercress								2		2
	Lomandra multiflora ssp. *dura*	Hard Mat-rush				5	3			2	3	13
	Lomandra sp.	Mat-rush					1					1
	Lotus cruentus	Red-flower Lotus				1			2	3		6
	Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe				18	3			15	6	42
	Lythrum paradoxum				K				3			3
	Lythrum salicaria	Purple Loosestrife		R	X				1			1
	Maireana aphylla	Cotton-bush								1	1	2
	Maireana astrotricha	Low Bluebush				10				4	1	15
	Maireana brevifolia	Short-leaf Bluebush				2				6	1	9
	Maireana campanulata	Bell-fruit Bluebush				1			1			2
	Maireana georgei	Satiny Bluebush				1				5		6
	Maireana lobiflora	Lobed Bluebush							1			1
	Maireana pentatropis	Erect Mallee Bluebush				1	1					2
	Maireana pyramidata	Black Bluebush				3	1			1	2	7
	Maireana sedifolia	Bluebush				8	2			1	3	14
	Maireana sp.	Bluebush/Fissure-plant					1			2		3
	Maireana tomentosa ssp. *urceolata*					1						1
	Maireana trichoptera	Hairy-fruit Bluebush				5			4	2		11
	Maireana turbinata	Top-fruit Bluebush				3						3
	Malva preissiana	Australian Hollyhock				1	1				1	3
	Malvaceae sp.					5						5
	Malvastrum americanum var. *americanum*	Malvastrum				15	2		3	8		28
*	*Marrubium vulgare*	Horehound				5	1			3		9
	Marsdenia australis	Native Pear				13	2		1	14	3	33
	Melaleuca dissitiflora								7			7
	Melaleuca glomerata	Inland Paper-bark				4	1		4	5	6	20
	Melaleuca lanceolata	Dryland Tea-tree							1		3	4
	Melaleuca lanceolata ssp. *lanceolata* (NC)	Dryland Tea-tree				1	1					2
	Melaleuca uncinata	Broombush									5	5
	Melaleuca uncinata (NC)	Broombush				1	2	1				4
	Melhania oblongifolia	Velvet Hibiscus				1				1		2
	Mentha australis	River Mint							1			1
	Minuria cunninghamii	Bush Minuria				4						4
	Minuria integerrima	Smooth Minuria				1						1
	Myoporum montanum	Native Myrtle								1	1	2
	Myoporum platycarpum (NC)	False Sandalwood				1						1
	Myoporum platycarpum ssp.	False Sandalwood								1		1
	Myoporum platycarpum ssp. *platycarpum*	False Sandalwood								2		2
	Neurachne alopecuroidea	Fox-tail Mulga-grass				2						2
*	*Nicotiana glauca*	Tree Tobacco				2		1			2	5
	Nicotiana simulans	Native Tobacco				1	1			1		3
	Nicotiana sp.	Tobacco								4		4
	Nicotiana velutina	Velvet Tobacco				1			9	3	2	15
	Nitraria billardierei	Nitre-bush				1			1		2	4
	Olearia decurrens	Winged Daisy-bush				6	3	1			3	13
	Olearia muelleri	Mueller's Daisy-bush				1			1			2
	Olearia ramulosa	Twiggy Daisy-bush					1					1
	Omphalolappula concava	Burr Stickseed				10			2			12
*	*Onopordum acaulon*	Horse Thistle								1		1
	Oxalis perennans	Native Sorrel								4		4
	Oxalis perennans (NC)	Native Sorrel				6	1					7
	Ozothamnus scaber	Rough Bush-everlasting		V	K		2					2
	Panicum decompositum var. *decompositum*	Native Millet								1		1
*	*Papaver somniferum* ssp. *setigerum* (NC)	Small-flower Opium Poppy							1			1
	Paraceterach reynoldsii	Scaly Rock-fern				2			2		1	5
	Parietaria cardiostegia/debilis	Smooth-nettle				1						1
	Petalostylis labicheoides	Butterfly Bush							1	1	2	4
	Philotheca angustifolia ssp. *angustifolia*	Narrow-leaf Wax-flower		R	R		1					1

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	Phlegmatospermum cochlearinum	Downy Cress							1			1
	Phyllanthus lacunarius (NC)	Lagoon Spurge			U		1					1
	Phyllanthus maderaspatensis var. *angustifolius*									1		1
	Phyllanthus saxosus	Rock Spurge			U		1					1
	Pimelea microcephala ssp.	Shrubby Riceflower									1	1
	Pimelea microcephala ssp. *microcephala*	Shrubby Riceflower				1			5	3		9
	Pimelea simplex ssp. *simplex*	Desert Riceflower				1			4			5
	Pimelea trichostachya	Spiked Riceflower							2			2
	Pittosporum angustifolium	Native Apricot				8	1			2	2	13
	Plantago drummondii	Dark Plantain				3				1		4
	Plectranthus intraterraneus	Inland Spur-flower				2		1	4		2	9
	Pleurosorus rutifolius	Blanket Fern				2			1		1	4
	Pluchea dentex	Bowl Daisy					1					1
	Pluchea rubelliflora								1			1
*	*Polypogon viridis*	Water Bent				1			1			2
	Pomax umbellata	Pomax					1		1			2
	Portulaca oleracea	Common Purslane								2		2
	Prostanthera striatiflora	Striated Mintbush				6	2		1	2		11
	Pseudognaphalium luteoalbum	Jersey Cudweed							1			1
	Pterocaulon sphacelatum	Apple-bush				8	1		1	6	1	17
	Ptilotus decipiens								2			2
	Ptilotus exaltatus var.	Pink Mulla Mulla				8	3					11
	Ptilotus exaltatus var. *exaltatus*	Pink Mulla Mulla							1	4	4	9
	Ptilotus nobilis var.	Yellow-tails								2		2
	Ptilotus nobilis var. *nobilis*	Yellow-tails							3			3
	Ptilotus obovatus (NC)					33						33
	Ptilotus obovatus var.	Silver Mulla Mulla					5			7		12
	Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla				12			1	14		27
	Ptilotus parvifolius var. *laetus* (NC)	Small-leaf Mulla Mulla				3						3
	Ptilotus polystachyus var. *polystachyus*	Long-tails								1		1
	Ptilotus propinquus									2	1	3
	Pycnosorus pleiocephalus	Soft Billy-buttons				1						1
	Radyera farragei	Desert Rose Mallow			R			1				1
	Ranunculus hamatosetosus	Hill Buttercup				1						1
	Ranunculus sessiliflorus var. *sessiliflorus*	Annual Buttercup							1			1
	Rhagodia parabolica	Mealy Saltbush				3			1	2		6
	Rhagodia spinescens	Spiny Saltbush				12	1			7		20
	Rhagodia ulicina	Intricate Saltbush				9				3		12
	Rhodanthe floribunda	White Everlasting							1			1
	Rhodanthe microglossa	Clustered Everlasting							2			2
	Rhodanthe moschata	Musk Daisy				1			1			2
	Rhodanthe pygmaea	Pigmy Daisy				4						4
	Rhodanthe stricta	Slender Everlasting				2			2			4
	Rhyncharrhena linearis	Bush Bean			U		1			2		3
	Rhynchosia minima	Rhynchosia								1		1
*	*Rorippa nasturtium-aquaticum*	Watercress						1				1
	Rostellularia adscendens ssp. *adscendens* var.	Pink Tongue									1	1
	Rostellularia adscendens var. *pogonanthera*	Pink Tongues							1	1		2
	Salsola tragus	Buckbush				28	6		1	16		51
	Santalum acuminatum	Quandong				6	1			1		8
	Santalum lanceolatum	Plumbush				8		1	1	3	3	16
	Santalum spicatum	Sandalwood		V	V				1			1
	Sarcostemma viminale ssp. *australe*	Caustic Bush			U	1					1	2
	Sauropus rigens	Stiff Spurge				8	1			2	1	12
	Scaevola humilis	Inland Fanflower						1	1	1		3
	Scaevola spinescens	Spiny Fanflower				12	2			5	3	22
	Schenkia australis	Spike Centaury									1	1
*	*Schismus barbatus*	Arabian Grass				9			1			10
	Schoenoplectus litoralis	Shore Club-rush			U	1						1
	Scleranthus sp.	Knawel								1		1

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	Sclerolaena brachyptera	Short-wing Bindyi				7			2	4	1	14
	Sclerolaena convexula	Tall Bindyi			R	4				2		6
	Sclerolaena cuneata	Tangled Bindyi								1	2	3
	Sclerolaena diacantha	Grey Bindyi				8	3			8		19
	Sclerolaena diacantha/uniflora	Grey Bindyi				6						6
	Sclerolaena divaricata	Tangled Bindyi				8			3	1		12
	Sclerolaena lanicuspis	Spinach Bindyi				8			1	3		12
	Sclerolaena limbata	Pearl Bindyi				2			1			3
	Sclerolaena longicuspis	Long-spine Bindyi				6			1	2	1	10
	Sclerolaena obliquicuspis	Oblique-spined Bindyi				46			1	17		64
	Sclerolaena parallelicuspis	Western Bindyi				1						1
	Sclerolaena patenticuspis	Spear-fruit Bindyi				9	2		3	1		15
	Sclerolaena sp.	Bindyi				3						3
	Sclerolaena uniflora	Small-spine Bindyi					2		3			5
	Sclerolaena ventricosa	Salt Bindyi				3			1			4
	Senecio glossanthus (NC)	Annual Groundsel							1			1
	Senecio lanibracteus	Inland Shrubby Groundsel									2	2
	Senecio magnificus	Showy Groundsel				26	1		3	6	1	37
	Senna artemisioides ssp.	Desert Senna				4					2	6
	Senna artemisioides ssp. *alicia*	Desert Senna								2		2
	Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna				9	4		1	8	1	23
	Senna artemisioides ssp. *helmsii*	Blunt-leaf Senna				2				1	1	4
	Senna artemisioides ssp. *petiolaris* (NC)	Flat-stalk Senna				9			1			10
	Senna artemisioides ssp. X *artemisioides*	Silver Senna				27	3		3	16	7	56
	Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna				36	3			13	3	55
	Senna artemisioides ssp. X *sturtii*	Grey Senna								1		1
	Setaria basiclada									3		3
	Setaria constricta	Knotty-butt Paspalidium				2	1		1	4		8
*	*Setaria verticillata*	Whorled Pigeon-grass				1						1
	Sida corrugata var.	Corrugated Sida				11						11
	Sida everistiana	Everist's Sida							1			1
	Sida fibulifera	Pin Sida				29	1		3	5	1	39
	Sida filiformis	Fine Sida							2	1		3
	Sida intricata	Twiggy Sida				9	1			2		12
	Sida petrophila	Rock Sida				32	4	1	5	8	1	51
	Sida sp.	Sida				3				5		8
	Sida spodochroma								1			1
	Sida trichopoda	High Sida							3	1	1	5
	Sigesbeckia australiensis	Australian Sigesbeckia					1		5			6
*	*Silene* sp.	Catchfly				3						3
*	*Sisymbrium erysimoides*	Smooth Mustard				11				6		17
*	*Sisymbrium orientale*	Indian Hedge Mustard							1			1
*	*Sisymbrium* sp.	Wild Mustard				1						1
	Solanum ellipticum	Velvet Potato-bush					3		1	18	1	23
	Solanum ellipticum/quadriloculatum					42						42
	Solanum petrophilum	Rock Nightshade				3	2		4	2	1	12
	Solanum quadriloculatum	Plains Nightshade							1			1
	Solanum simile	Kangaroo Apple							1			1
	Solanum sturtianum	Sturt's Nightshade				11	3		9	9	4	36
*	*Sonchus oleraceus*	Common Sow-thistle								1		1
*	*Sonchus oleraceus* (NC)	Common Sow-thistle				5			1			6
	Sporobolus actinocladus	Ray Grass								1	1	2
	Sporobolus caroli	Yakka Grass			R	1			1			2
	Spyridium phlebophyllum	Inland Spyridium				2	2					4
	Stenopetalum lineare (NC)	Narrow Thread-petal							1			1
	Streptoglossa liatroides	Wertaloona Daisy							2			2
	Swainsona burkittii	Woolly Darling Pea			Q				1			1
	Swainsona fissimontana	Broken Hill Pea							4			4
	Swainsona formosa	Sturt Pea								2		2
	Swainsona leeana	Lee's Swainson-pea		R	K				1			1
	Swainsona oliveri				K				1			1

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	Swainsona sp.	Swainson-pea									1	1
	Swainsona stipularis	Orange Swainson-pea							1			1
	Swainsona tephrotricha	Ashy-haired Swainson-pea			R				1			1
	Tecticornia disarticulata					1						1
	Templetonia aculeata	Spiny Mallee-pea			U		1				3	4
	Templetonia egena	Broombush Templetonia							3			3
	Tetragonia eremaea	Desert Spinach				4	1		2	4	2	13
	Tetragonia tetragonioides (NC)	New Zealand Spinach				2						2
	Teucrium racemosum	Grey Germander				1				2		3
	Themeda triandra	Kangaroo Grass				5	1		1	2	2	11
	Thyridolepis mitchelliana	Window Mulga-grass								1		1
	Tragus australianus	Small Burr-grass							1			1
	Trianthema triquetra	Red Spinach								6		6
	Tribulus eichlerianus	Eichler's Caltrop								3		3
	Trichanthodium skirrophorum	Woolly Yellow-heads								1		1
	Trichodesma zeylanicum var. *zeylanicum*	Camel Bush				3			1	2		6
	Triodia irritans	Spinifex				3					5	8
	Triodia irritans var. (NC)					3						3
	Triodia scariosa ssp. (NC)	Spinifex					2					2
	Triraphis mollis	Purple Plume Grass							1			1
	Typha domingensis	Narrow-leaf Bulrush						1			1	2
	Typha orientalis	Broad-leaf Bulrush				1						1
	Typha sp.	Bulrush									1	1
*	*Vaccaria hispanica*	Cow Soapwort							1			1
	Velleia arguta	Toothed Velleia				1	1		1			3
	Velleia connata	Cup Velleia			R						1	1
	Velleia cycnopotamica			R	#				1			1
*	*Verbena officinalis*	Common Verbena					1					1
	Vittadinia australasica var.	Sticky New Holland Daisy								7		7
	Vittadinia cuneata var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy				12						12
	Vittadinia eremaea	Desert New Holland Daisy							2			2
	Vittadinia gracilis	Woolly New Holland Daisy				4				7		11
	Vittadinia pterochaeta	Rough New Holland Daisy							1			1
	Vittadinia sp.	New Holland Daisy				6	1			1		8
	Vittadinia sulcata	Furrowed New Holland Daisy				2						2
	Wahlenbergia aridicola	Dryland Bluebell			R					6	1	7
	Wahlenbergia communis	Tufted Bluebell				3	1		2		1	7
	Wahlenbergia queenslandica							1			1	2
	Westringia rigida	Stiff Westringia				1			1			2
*	*Xanthium spinosum*	Bathurst Burr								2	2	4
	Xanthorrhoea quadrangulata	Rock Grass-tree				2	1			1	2	6
	Xerochrysum bracteatum	Golden Everlasting								1		1
	Xerothamnella parvifolia		V	E	E				1			1
	Zygophyllum "Terete leaves"(D.E.Symon 14690) (NC)					4						4
	Zygophyllum apiculatum	Pointed Twinleaf				4	1		5	4	1	15
	Zygophyllum aurantiacum (NC)	Shrubby Twinleaf				6			2			8
	Zygophyllum aurantiacum ssp. *verticillatum*	Shrubby Twinleaf							1	1		2
	Zygophyllum crenatum	Notched Twinleaf							1			1
	Zygophyllum iodocarpum	Violet Twinleaf							1			1
	Zygophyllum prismatothecum	Square-fruit Twinleaf								4	1	5
	Zygophyllum prismatothecum (NC)	Square-fruit Twinleaf					2		3			5
	Zygophyllum sp.	Twinleaf				2				2		4
		Total Taxa	**2**	**13**	**42**	**261**	**140**	**21**	**222**	**216**	**147**	**505**
		Total Records				1769	235	22	433	807	278	3544

APPENDIX 4. PLANT TAXA RECORDED AT EACH SITE DURING THE NANTAWARRINA IPA SURVEY AND THEIR COVER/ABUNDANCE ESTIMATE.

Total Sites — Total number of sites taxon recorded at (of a total of 22).
Cover/Abundance scores — N = Not many (1-10 plants & <5% cover); T = sparsely present (cover <5%); 1 = plentiful, but of small cover (<5%); 2 = any number of individuals covering 5-25% of area; 3 = any number of individuals covering 25-50% of area.

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Abutilon fraseri ssp.	Dwarf Lantern-bush	2		T																	N			
Abutilon fraseri ssp. *diplotrichum*	Dwarf Lantern-bush	3					T													T				N
Abutilon leucopetalum	Desert Lantern-bush	8	N		T	T		T			1	T						T					T	
Acacia aneura var. *aneura*	Mulga	9	N				N					1	N			N	1			2	2		T	
Acacia aneura var. *tenuis*	Mulga	3														3				1	2			
Acacia havilandiorum	Needle Wattle	1					N																	
Acacia oswaldii	Umbrella Wattle	4								N									N			N		N
Acacia rivalis	Silver Wattle	4				N					1						N	N						
Acacia salicina	Willow Wattle	1																N						
Acacia tetragonophylla	Dead Finish	18	T	N		N	T	T	2	N	1	1	1			T	1		N	T	N	N	T	N
Acacia victoriae ssp.	Elegant Wattle	5								1	1	1	N				N							
Acacia victoriae ssp. *victoriae*	Elegant Wattle	9	2		N	T	T	2	T									T				N	T	
Ajuga australis	Australian Bugle	2																N					N	
Alectryon oleifolius ssp. *canescens*	Bullock Bush	15		T	T	N	N	T		N		T	T		1		N		N	N		T	T	N
Amaranthus mitchellii	Boggabri Weed	3			N	T																	T	
Amyema maidenii ssp. *maidenii*	Pale-leaf Mistletoe	2									N												N	
Amyema miquelii	Box Mistletoe	2																				1		N
Anacampseros australiana	Australian Anacampseros	6												N	N	N			T	N	N			
Aristida strigosa	Rough Three-awn	4	T								T	N					N							
**Asphodelus fistulosus*	Onion Weed	1			N																			
Astrebla lappacea	Curly Mitchell-grass	1												T										
Atriplex acutibractea ssp.	Pointed Saltbush	2			T			N																
Atriplex acutibractea ssp. *acutibractea*	Pointed Saltbush	1																T						
Atriplex limbata	Spreading Saltbush	1									T													
Atriplex sp.	Saltbush	2	N											N										
Atriplex stipitata	Bitter Saltbush	4		T				T									N		N					
Atriplex vesicaria ssp.	Bladder Saltbush	1													N									
Austrodanthonia setacea	Small-flower Wallaby-grass	1								N														
Austrostipa eremophila	Rusty Spear-grass	1	N																					
Austrostipa nitida	Balcarra Spear-grass	5							T		N		T									N	T	
Austrostipa platychaeta	Flat-awn Spear-grass	1																T						
Austrostipa scabra ssp.	Rough Spear-grass	3																	T	T	T			

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Austrostipa sp.	Spear-grass	4			N			T														T		N
Boerhavia dominii	Tar-vine	6				T	T				T							T					T	N
Brachyscome ciliaris var. *ciliaris*	Variable Daisy	3								N				N									N	
Brachyscome dentata	Lobe-seed Daisy	1												N										
Callitris glaucophylla	White Cypress-pine	3																N		N			1	
Calotis hispidula	Hairy Burr-daisy	1												N										
Capparis mitchellii	Native Orange	3											N							N			N	
**Carrichtera annua*	Ward's Weed	9	1	T	T	1	T	T	T									T					T	
**Carthamus lanatus*	Saffron Thistle	1						T																
Cassinia complanata	Sticky Cassinia	1														T								
Casuarina pauper	Black Oak	9		3									N		2		N	N	2	T		N		2
**Centaurea melitensis*	Malta Thistle	2	N															T						
Chamaesyce australis		8			N	T	T				T	N	N					T						N
Chamaesyce drummondii		6	N	T		T	T											N					T	
Chamaesyce sp.	Spurge	1																					T	
Cheilanthes austrotenuifolia	Annual Rock-fern	1														N								
Cheilanthes lasiophylla	Woolly Cloak-fern	4														N				T	T		T	
Cheilanthes sieberi ssp. *sieberi*	Narrow Rock-fern	2																		T	T			
Chenopodium curvispicatum	Cottony Goosefoot	2	N			T																		
Chenopodium desertorum ssp.	Desert Goosefoot	2			N	N																		
**Chenopodium murale*	Nettle-leaf Goosefoot	2				T					T													
Chrysocephalum eremaeum	Sand Button-bush	4			N		T														T		T	
**Citrullus colocynthis*	Colocynth	5	N		N	T												N					T	
Convolvulus remotus	Grassy Bindweed	7	N		N	T	N		N										T		T			
**Cucumis myriocarpus*	Paddy Melon	2									T												T	
Cymbopogon ambiguus	Lemon-grass	6	T					T			1	T						T					T	
Cyperus gymnocaulos	Spiny Flat-sedge	1																N						
Dactyloctenium radulans	Button-grass	1												T										
**Datura leichhardtii*	Native Thorn-apple	6			T	1					T							T	N				T	
Digitaria brownii	Cotton Panic-grass	1														N								
Dissocarpus paradoxus	Ball Bindyi	11	T	T	1	T					2						T	T	T			T	1	T
Dodonaea lobulata	Lobed-leaf Hop-bush	9			N	T		T	T		N	N		N				T					T	
Dodonaea microzyga var. *microzyga*	Brilliant Hop-bush	7								1	N		1	N				N	N					T
Dodonaea sp.	Hop-bush	1																					N	
Dodonaea viscosa ssp. *angustissima*	Narrow-leaf Hop-bush	3									N						N						N	
Dysphania cristata	Crested Goosefoot	4		N	T	T												N						
Dysphania melanocarpa f.	Black-fruit Goosefoot	7			T													T	T	T	T	N	T	
Einadia nutans ssp. *nutans*	Climbing Saltbush	1						N																

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Enchylaena tomentosa var.	Ruby Saltbush	6									1	T	N		1	T	1							
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush	13	T	N	T	T	T	T	N									1	T	T		N	1	N
Enneapogon avenaceus	Common Bottle-washers	3	N										T	T										
Enneapogon cylindricus	Jointed Bottle-washers	2								1			N											
Enneapogon polyphyllus	Leafy Bottle-washers	4				T															T	N	T	
Enneapogon sp.	Bottle-washers/Nineawn	2																T	T					
Enteropogon ramosus	Umbrella Grass	1																					T	
Eremophila alternifolia	Narrow-leaf Emubush	1							T															
Eremophila duttonii	Harlequin Emubush	1								T														
Eremophila freelingii	Rock Emubush	15		N		N	N	T	N	1	N	N	2			1		T	N	1	T		T	
Eremophila glabra ssp.	Tar Bush	3									N	N					N							
Eremophila glabra ssp. *glabra*	Tar Bush	5				N												N	T			N	T	
Eremophila latrobei ssp.	Crimson Emubush	3				N		N															T	
Eremophila latrobei ssp. *glabra*	Crimson Emubush	1											N											
Eremophila longifolia	Weeping Emubush	5	T			T	N																T	N
Eremophila maculata ssp.	Spotted Emubush	2													N	N								
Eremophila oppositifolia ssp.	Opposite-leaved Emubush	1													N									
Eremophila scoparia	Broom Emubush	4				N					T											N		N
Eremophila serrulata	Green Emubush	5									N					N		T		N			N	
Eremophila sturtii	Turpentine Bush	3								N	N						3							
Eriochiton sclerolaenoides	Woolly-fruit Bluebush	2						T														T		
Eucalyptus camaldulensis ssp. *minima*	River Red Gum	5			N	N					3							3					2	
Eucalyptus gillii	Curly Mallee	3											N									2		T
Eucalyptus intertexta	Gum-barked Coolibah	4				N										N	3						N	
Eucalyptus socialis ssp. *socialis*	Beaked Red Mallee	2																				2		N
Euphorbia tannensis ssp. *eremophila*	Desert Spurge	3			N	T								1										
Exocarpos aphyllus	Leafless Cherry	11					N		N	N					N	N	1		N	T		N	N	N
**Glaucium corniculatum*	Bristly Horned-poppy	1				T																		
Glossocardia bidens	Native Cobbler's-pegs	2									N												N	
Glycine rubiginosa	Twining Glycine	1				T																		
Gnephosis arachnoidea	Spidery Button-flower	1					T																	
Goodenia calcarata	Streaked Goodenia	1																	T					
Goodenia vernicosa	Wavy Goodenia	1									N													
Gramineae sp.	Grass Family	2																			N		T	
Hakea ednieana	Flinders Ranges Corkwood	2																		T	N			
Heliotropium asperrimum	Rough Heliotrope	1									N													
Heliotropium europaeum	Common Heliotrope	8	T	T	T	T	T				T							T					T	
Hibiscus sturtii var.	Sturt's Hibiscus	2																	T	T				

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Ixiochlamys cuneifolia	Silverton Daisy	1					T																	
Jasminum didymum ssp. *lineare*	Native Jasmine	2																		N			N	
Juncus aridicola	Inland Rush	1									N													
Leiocarpa semicalva ssp. *semicalva*	Scented Button-bush	1																		N				
Leiocarpa sp.	Plover-daisy	1	N																					
Lepidium sp.	Peppercress	2																		T			T	
Lomandra multiflora ssp. *dura*	Hard Mat-rush	2									N												T	
Lotus cruentus	Red-flower Lotus	3			N	N				N														
Lysiana exocarpi ssp. *exocarpi*	Harlequin Mistletoe	15	T	N	N	N	N	N	N		N	N	N		N		N					T	T	N
Maireana aphylla	Cotton-bush	1												T										
Maireana astrotricha	Low Bluebush	4								3				N	N		N							
Maireana brevifolia	Short-leaf Bluebush	6			T	N	N				N							1					T	
Maireana georgei	Satiny Bluebush	5		N								N	T	N	T									
Maireana pyramidata	Black Bluebush	1													N									
Maireana sedifolia	Bluebush	1							N															
Maireana sp.	Bluebush/Fissure-plant	2																				T	N	
Maireana trichoptera	Hairy-fruit Bluebush	2		T					T															
Malvastrum americanum var. *americanum*	Malvastrum	8	T		T	T					1	T		T				T					T	
**Marrubium vulgare*	Horehound	3			N	T												N						
Marsdenia australis	Native Pear	14	N	N		T	N	N		N		N	N					N	N		N	N	N	N
Melaleuca glomerata	Inland Paper-bark	5			3	3					1							T					T	
Melhania oblongifolia	Velvet Hibiscus	1				N																		
Myoporum montanum	Native Myrtle	1									N													
Myoporum platycarpum ssp.	False Sandalwood	1				N																		
Myoporum platycarpum ssp. *platycarpum*	False Sandalwood	2																				N		N
Nicotiana simulans	Native Tobacco	1		N																				
Nicotiana sp.	Tobacco	4																	T	T	T		T	
Nicotiana velutina	Velvet Tobacco	3				T					N			1										
**Onopordum acaulon*	Horse Thistle	1				N																		
Oxalis perennans	Native Sorrel	4	T		N													T					T	
Panicum decompositum var. *decompositum*	Native Millet	1												T										
Petalostylis labicheoides	Butterfly Bush	1			N																			
Phyllanthus maderaspatensis var. *angustifolius*		1																N						
Pimelea microcephala ssp. *microcephala*	Shrubby Riceflower	3				N		N	N															
Pittosporum angustifolium	Native Apricot	2										N											N	
Plantago drummondii	Dark Plantain	1																		T				

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Portulaca oleracea	Common Purslane	2				T																	T	
Prostanthera striatiflora	Striated Mintbush	2					N				N													
Pterocaulon sphacelatum	Apple-bush	6		T	T	T					T							T					T	
Ptilotus exaltatus var. *exaltatus*	Pink Mulla Mulla	4																	T	T			N	N
Ptilotus nobilis var.	Yellow-tails	2												N		T								
Ptilotus obovatus var.	Silver Mulla Mulla	7								N	1	T	N	T		T	T							
Ptilotus obovatus var. *obovatus*	Silver Mulla Mulla	14	N	T	T	T	1	T	T									T	T	T	T	T	T	T
Ptilotus polystachyus var. *polystachyus*	Long-tails	1														N								
Ptilotus propinquus		2												T					T					
Rhagodia parabolica	Mealy Saltbush	2																T					N	
Rhagodia spinescens	Spiny Saltbush	7	T		T		2	T				T			N		1							
Rhagodia ulicina	Intricate Saltbush	3									N						N			N				
Rhyncharrhena linearis	Bush Bean	2														N				T				
Rhynchosia minima	Rhynchosia	1									N													
Rostellularia adscendens var. *pogonanthera*	Pink Tongues	1																					T	
Salsola tragus	Buckbush	16	2	T	1	T	T	T	T		1	1	N	1	T			T				2	T	T
Santalum acuminatum	Quandong	1						N																
Santalum lanceolatum	Plumbush	3					N			N													N	
Sauropus rigens	Stiff Spurge	2											N							N				
Scaevola humilis	Inland Fanflower	1				T																		
Scaevola spinescens	Spiny Fanflower	5						N		1						N	1			T				
Scleranthus sp.	Knawel	1														T								
Sclerolaena brachyptera	Short-wing Bindyi	4												1	1				N		N			
Sclerolaena convexula	Tall Bindyi	2																		T	T			
Sclerolaena cuneata	Tangled Bindyi	1													1									
Sclerolaena diacantha	Grey Bindyi	8	T	T			1										T		T	T		T		N
Sclerolaena divaricata	Tangled Bindyi	1												1										
Sclerolaena lanicuspis	Spinach Bindyi	3				N	1												N					
Sclerolaena longicuspis	Long-spine Bindyi	2												2	1									
Sclerolaena obliquicuspis	Oblique-spined Bindyi	17	T	T	T	T	T	T	T		N	1	N					T	N	T	T	1	T	T
Sclerolaena patenticuspis	Spear-fruit Bindyi	1									1													
Senecio magnificus	Showy Groundsel	6	T	N	N						1							T	T					
Senna artemisioides ssp. *alicia*	Desert Senna	2								1														T
Senna artemisioides ssp. *filifolia*	Fine-leaf Desert Senna	8	N	N		N		T		T	1						1	T						
Senna artemisioides ssp. *helmsii*	Blunt-leaf Senna	1				N																		
Senna artemisioides ssp. X *artemisioides*	Silver Senna	16				N		2	T	N	N	T	N			1	N	T	T	N	N	N	1	N
Senna artemisioides ssp. X *coriacea*	Broad-leaf Desert Senna	13		T					T	N	N	T	2	N			N	T	N	N			N	2

Species Name	Common Name	Total Sites	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701
Senna artemisioides ssp. X *sturtii*	Grey Senna	1																	T					
Setaria basiclada		3		N	N												N							
Setaria constricta	Knotty-butt Paspalidium	4										N						T	T	N				
Sida fibulifera	Pin Sida	5	T	T			T			N								T						
Sida filiformis	Fine Sida	1				T																		
Sida intricata	Twiggy Sida	2				T		N																
Sida petrophila	Rock Sida	8				T	N	T	T		T	T	N										T	
Sida sp.	Sida	5	T		N			N											T				T	
Sida trichopoda	High Sida	1												T										
**Sisymbrium erysimoides*	Smooth Mustard	6			T	T	T											1		N			T	
Solanum ellipticum	Velvet Potato-bush	18	T	T		T	T	T	T	N	T	T	N	T			N	T	N	N	N	T		N
Solanum petrophilum	Rock Nightshade	2	T															T						
Solanum sturtianum	Sturt's Nightshade	9			N	T		T	T	T	T						N	T					T	
**Sonchus oleraceus*	Common Sow-thistle	1	N																					
Sporobolus actinocladus	Ray Grass	1													N									
Swainsona formosa	Sturt Pea	2				N	N																	
Tetragonia eremaea	Desert Spinach	4			N	T												N					T	
Teucrium racemosum	Grey Germander	2									T							N						
Themeda triandra	Kangaroo Grass	2																T					T	
Thyridolepis mitchelliana	Window Mulga-grass	1																			N			
Trianthema triquetra	Red Spinach	6			N	T	1							N					N				T	
Tribulus eichlerianus	Eichler's Caltrop	3				T	T															N		
Trichanthodium skirrophorum	Woolly Yellow-heads	1																	T					
Trichodesma zeylanicum var. *zeylanicum*	Camel Bush	2			N	T																		
Vittadinia australasica var.	Sticky New Holland Daisy	7				N												T		T	T	T	T	N
Vittadinia gracilis	Woolly New Holland Daisy	7	T	T	T			T	T	N	N													
Vittadinia sp.	New Holland Daisy	1																						N
Wahlenbergia aridicola	Dryland Bluebell	6	N		T	T		N										T					N	
**Xanthium spinosum*	Bathurst Burr	2									T												N	
Xanthorrhoea quadrangulata	Rock Grass-tree	1																					N	
Xerochrysum bracteatum	Golden Everlasting	1																			N			
Zygophyllum apiculatum	Pointed Twinleaf	4			T	T					T												N	
Zygophyllum aurantiacum ssp. *verticillatum*	Shrubby Twinleaf	1						N																
Zygophyllum prismatothecum	Square-fruit Twinleaf	4		N		T		T							N									
Zygophyllum sp.	Twinleaf	2				T											T							
	Taxa Per Site		**38**	**30**	**46**	**70**	**37**	**36**	**23**	**26**	**56**	**26**	**26**	**28**	**19**	**21**	**29**	**57**	**37**	**39**	**26**	**30**	**76**	**31**

APPENDIX 5. ADNYAMATHANHA NAMES OF PLANTS KNOWN TO OCCUR IN THE NANTAWARRINA AREA.

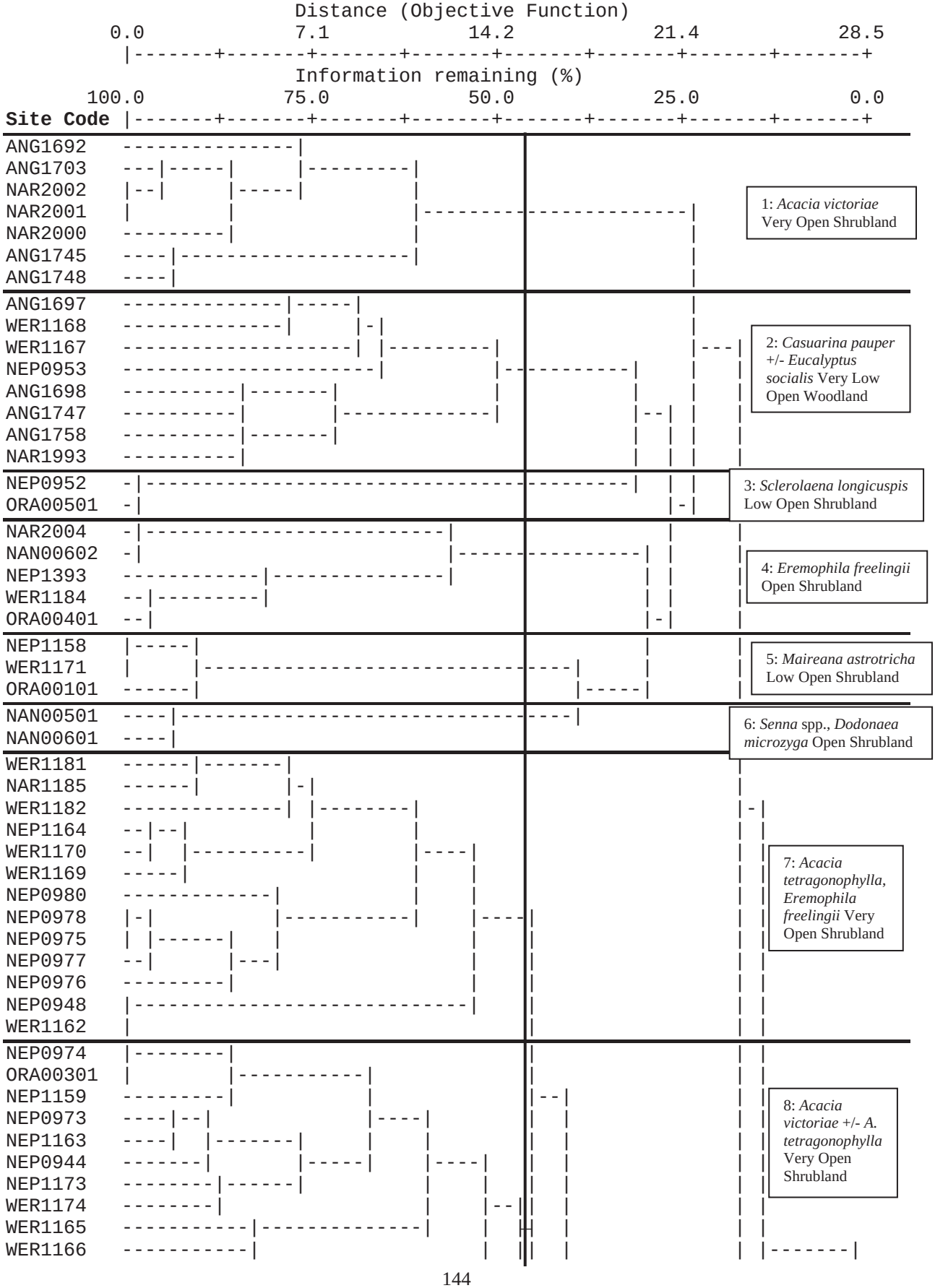
Source: McEntee (1986) unless otherwise stated.

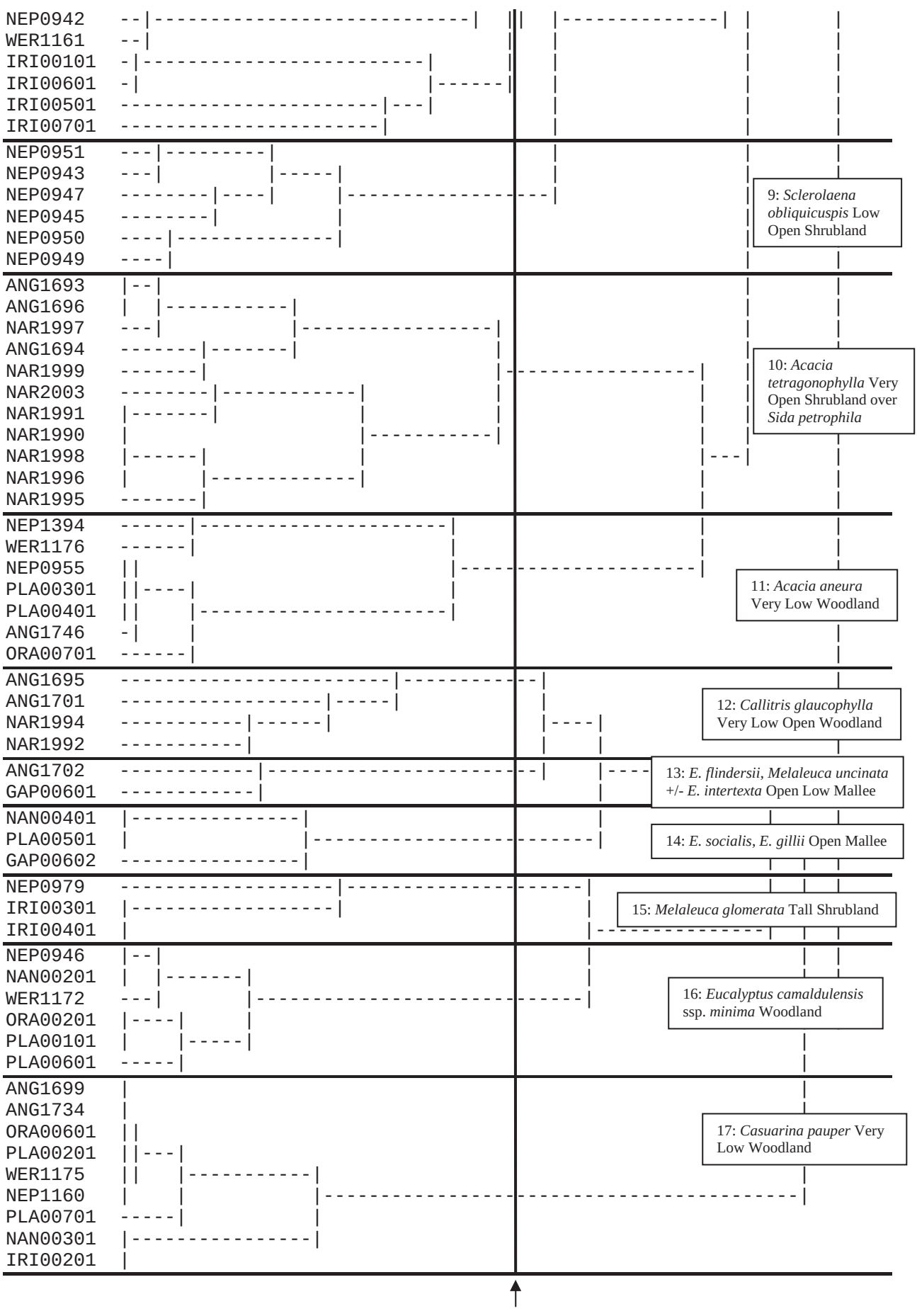
Adnyamathanha Name	Species Name	Common Name	Notes
Ala	*Bulbine* sp.	Bulbine-lily	Native onion - possibly *Bulbine* sp.
Alambu	*Solanum* spp.	Nightshade	mainly applied to inedible species
Alaru	*Melaleuca glomerata*	Inland Paper-bark	possibly same as *M. uncinata*
Alaru	*Melaleuca uncinata*	Broombush	possibly same as *M. glomerata*
Alda	*Eremophila freelingii*	Rock Emubush	
Ali	*Chloris pectinata*	Comb Windmill Grass	
Alkata	*Eremophila oppositifolia* ssp. *oppositifolia*	Opposite-leaved Emubush	
Alku	*Casuarina pauper*	Black Oak	
Alunga	*Codonocarpus pyramidalis*	Slender Bell-fruit	
Analiriliri	*Lotus cruentus*	Red-flower Lotus	as per *Bulbine* sp.
Ardu-mai-i	*Heliotropium europaeum*	Common Heliotrope	Cleland & Johnston (1939)
Arkala	*Carpobrotus rossii*	Native Pigface	
Aru-wirri	*Boerhavia dominii*	Tar-vine	
Ata	*Xanthorrhoea quadrangulata*	Rock Grass-tree	
Atara	*Exocarpos aphyllus*	Leafless Cherry	
Iga	*Capparis mitchellii*	Native Orange	
Ila	*Rhagodia spinescens*	Spiny Saltbush	
Ilka	*Salsola tragus*	Buckbush	
Il-la	*Maireana sedifolia*	Bluebush	Cleland & Johnston (1939)
Ilvi	*Eremophila maculata* ssp. *maculata*	Spotted Emubush	
Kuppinupinya	*Lepidium oxytrichum*	Green Peppercress	Cleland & Johnston (1939)
Malka	*Acacia aneura*	Mulga	
Manawarra	*Santalum lanceolatum*	Plumbush	
Manduwarra	*Eucalyptus gillii*	Curly Mallee	
Mapalu	*Bursaria spinosa* ssp. *spinosa*	Sweet Bursaria	
Matu	*Pittosporum angustifolium*	Native Apricot	
Midi	*Zygophyllum* sp.	Twinleaf	general name for *Zygophyllum* sp.
Minara	*Alectryon oleifolius* ssp. *canescens*	Bullock Bush	
Minga	*Acacia victoriae* ssp. *victoriae*	Elegant Wattle	
Miya-vuta	*Cheilanthes lasiophylla*	Woolly Cloak-fern	
Mulka vatapi	*Amyema maidenii* ssp. *maidenii*	Pale-leaf Mistletoe	
Murku	*Senna artemisioides* ssp.	Desert Senna	covers varieties
Murumba	*Calotis hispidula*	Hairy Burr-daisy	
Namba	*Microseris lanceolata*	Yam Daisy	
Naminamina	*Cassytha flindersii*	Flinders Ranges Dodder-laurel	
Namurku	*Jasminum didymum* ssp. *lineare*	Native Jasmine	
Nandi	*Marsdenia australis*	Native Pear	
Nandu	*Eremophila alternifolia*	Narrow-leaf Emubush	
Narapana	*Swainsona formosa*	Sturt Pea	
Natumi	*Callistemon teretifolius*	Needle Bottlebrush	
Nilpena	*Rhagodia parabolica*	Mealy Saltbush	Cleland & Johnston (1939)
Nulpuru	*Acacia kempeana*	Witchetty Bush	
Numminya-numminya	*Osteocarpum* sp.	Bonefruit	Cleland & Johnston (1939)
Nuna	*Convolvulus remotus*	Grassy Bindweed	
Nuri	*Acacia rivalis*	Silver Wattle	
Nurru	*Gramineae*	Grass - short	any short grass; see also Yutara & Vari yutara
Tapanapanina	*Lepidium papillosum*	Warty Peppercress	
Uli vati	*Eremophila glabra* ssp. *glabra*	Tar Bush	
Ulka	*Acacia oswaldii*	Umbrella Wattle	
Unamburru	*Typha orientalis*	Broad-leaf Bulrush	
Unarru	*Maireana* sp.	Bluebush	general *Maireana* spp.
Unma	*Lavatera plebeia*	Australian Hollyhock	Woolma in Cleland & Johnston (1939)
Urtu	*Dissocarpus paradoxus*	Ball Bindyi	Cleland & Johnston (1939)
Uru-lundula	*Trichodesma zeylanicum* var. *zeylanicum*	Camel Bush	Cleland & Johnston (1939)

Adnyamathanha Name	Species Name	Common Name	Notes
Uta	*Melaleuca lanceolata*	Dryland Tea-tree	
Uti	*Santalum acuminatum*	Quandong	
Vakirri	*Triodia irritans*	Spinifex	
Valkura	*Acacia salicina*	Willow Wattle	
Vana	*Hakea leucoptera* ssp. *leucoptera*	Silver Needlewood	
Vara	*Acacia tetragonophylla*	Dead Finish	
vari oota	*Enneapogon avenaceus*	Common Bottle-washers	Cleland & Johnston (1939)
Vari yutara	*Gramineae*	Grass - long, in creeks	any long grass in creeks; see also Yutara & Nurru
Vatapi	*Lysiana exocarpi* ssp. *exocarpi*	Harlequin Mistletoe	general name for mistletoes
Vativaka	*Eremophila longifolia*	Weeping Emubush	
Vawa	*Astrebla lappacea*	Curly Mitchell-grass	and *A. pectinata*
Vawaru	*Dodonaea viscosa* ssp. *angustissima*	Narrow-leaf Hop-bush	same as *P. striatiflora*
Vawaru	*Prostanthera striatiflora*	Striated Mintbush	same as *D. viscosa* ssp. *angustissima*
Vidalda	*Ptilotus exaltatus*	Pink Mulla Mulla	possibly also *Senecio* spp.
Vidalda	*Senecio magnificus*	Showy Groundsel	possibly other *Senecio* spp. and *P. exaltatus*
Vidlavaka	*Portulaca oleracea*	Common Purslane	
Vilakurru	*Atriplex vesicaria*	Bladder Saltbush	
Vinba	*Callitris glaucophylla*	White Cypress-pine	
Vini	*Templetonia egena*	Broombush Templetonia	
Vudari	*Sida* spp.	Sida	
Vudlura	*Santalum spicatum*	Sandalwood	
Vulami wata	*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush	
Vunda	*Maireana aphylla*	Cotton-bush	
Vundutu	*Juncus* spp.	Rush	
Vunila	*Senna artemisioides* ssp. X *sturtii*	Grey Senna	
Vurpi	*Allocasuarina verticillata*	Drooping Sheoak	
Vuru	*Dianella revoluta* var. *revoluta*	Black-anther Flax-lily	Cleland & Johnston (1939)
Vutu-ita	*Tribulus eichlerianus*	Eichler's Caltrop	ita = general name for prickle
Wabma-ita	*Sclerolaena* spp.	Bindyi	2-spine Bindyis
Wadniri	*Nitraria billardierei*	Nitre-bush	
Wala-nurru	*Dactyloctenium radulans*	Button-grass	
Waridi	*Petalostylis labicheoides*	Butterfly Bush	
Wari-wirra	*Wahlenbergia* spp.	Bluebell	
Warkandu	*Stenopetalum lineare*	Narrow Thread-petal	
Werkundu	*Lepidium phlebopetalum*	Veined Peppercress	Cleland & Johnston (1939)
Widna	*Cyperus vaginatus*	Stiff Flat-sedge	
Wila	*Cynanchum floribundum*	Desert Cynanchum	
Wilvilvi	*Gossypium sturtianum* var. *sturtianum*	Sturt's Desert Rose	
Windari	*Solanum sturtianum*	Sturt's Nightshade	Cleland & Johnston (1939)
Wira	*Eucalyptus camaldulensis*	River Red Gum	
Wirpari	*Pimelea microcephala* ssp. *microcephala*	Shrubby Riceflower	
Wiyuka	*Eremophila scoparia*	Broom Emubush	
Wulpa-werta	*Ajuga australis*	Australian Bugle	
Wuthari	*Malvastrum americanum* var. *americanum*	Malvastrum	Cleland & Johnston (1939)
Yalkirri-ita	*Sclerolaena longicuspis*	Long-spine Bindyi	
Yandana	*Hakea ednieana*	Flinders Ranges Corkwood	
Yara	*Eremophila sturtii*	Turpentine Bush	
Yudli	*Scaevola spinescens*	Spiny Fanflower	
Yulpu	*Cassinia laevis*	Curry Bush	Cleland & Johnston (1939)
Yumburra	*Myoporum platycarpum*	False Sandalwood	
Yumura	*Solanum ellipticum*	Velvet Potato-bush	
Yundu	*Eucalyptus intertexta*	Gum-barked Coolibah	
Yuru-vundulundula	*Nicotiana velutina*	Velvet Tobacco	
Yutara	*Gramineae*	Grass - long	any long grass; see also Vari yutara & Nurru

APPENDIX 6. DENDROGRAM OF THE 107 SITES USED IN THE FLORISTIC VEGETATION ANALYSIS USING PC-ORD.

Site Code The site identification code (refer to Appendix 1 for further details of each site).
Floristic Groups The Floristic Vegetation Group numbers and names are provided on the right side of the dendrogram.





Point at which dendrogram has been cut.

APPENDIX 7. PLANT TAXA RECORDED AT SITES USED IN THE FLORISTIC ANALYSIS AND THEIR SITE FREQUENCY WITHIN EACH FLORISTIC VEGETATION GROUP.

A/P Annual or perennial taxa. Only perennial taxa were used in the floristic analysis.
I Indigenous/alien designation. Naturalised alien taxa are designated with an asterisk (*).
Tot Sites Total number of sites each taxon recorded at out of the total of 107 sites used in the analysis.
Tot Grps Total number of Floristic Vegetation Groups in which each taxon occurs.
1 - 17 Floristic Vegetation Group numbers (refer to Vegetation chapter for descriptions of each group). Figures under each Group refer to the number of sites each taxon occurs at within each Group.

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P		*Abutilon cryptopetalum* ssp. *cryptopetalum*	Hill Lantern-bush			3	2		2									1						
P		*Abutilon fraseri* ssp. *diplotrichum*	Dwarf Lantern-bush			12	7				2			1	1		1	3					1	3
P		*Abutilon leucopetalum*	Desert Lantern-bush			28	8				2	1		7	7	1		1				3	6	
P		*Acacia aneura* var.	Mulga			40	10	1	3		3			10	9	1	3	7					1	2
P		*Acacia burkittii*	Pin-bush Wattle			1	1											1						
P		*Acacia continua*	Thorn Wattle			1	1													1				
P		*Acacia havilandiorum*	Needle Wattle			2	2								1					1				
P		*Acacia oswaldii*	Umbrella Wattle			8	5					1		1		1					2			3
P		*Acacia rivalis*	Silver Wattle			14	8	2	1		1			1		5				1		1	2	
P		*Acacia salicina*	Willow Wattle			2	1																2	
P		*Acacia sibirica*	Bastard Mulga			3	3	1	1								1							
P		*Acacia tetragonophylla*	Dead Finish			65	13		2		5	2	1	13	9	5	11	6			2	1	2	6
P		*Acacia victoriae* ssp. *victoriae*	Elegant Wattle			61	15	7	1	1	4	3	2	9	15	4	2	1			1	2	6	3
P		*Acacia wilhelmiana*	Dwarf Nealie			1	1											1						
A	*	*Acetosa vesicaria*	Rosy Dock			23	10				1			5	3	3	5	1	2			1	1	1
A		*Actinobole uliginosum*	Flannel Cudweed			2	1										2							
P		*Ajuga australis* f.	Australian Bugle			4	1																4	
P		*Alectryon oleifolius* ssp. *canescens*	Bullock Bush			42	13		4	1	3	2	1	5	8	1		2			2	2	3	8
A		*Amaranthus mitchellii*	Boggabri Weed			3	2															2	1	
P		*Amyema linophylla* ssp. *orientale*	Casuarina Mistletoe			2	1		2															
P		*Amyema maidenii* ssp. *maidenii*	Pale-leaf Mistletoe			15	7		1					3	4	2	1	2					2	
P		*Amyema miquelii*	Box Mistletoe			10	7		2	1					1	1				1	2			2
P		*Amyema miraculosa* ssp. *boormanii*	Fleshy Mistletoe			1	1							1										
P		*Amyema preissii*	Wire-leaf Mistletoe			1	1								1									
A		*Anacampseros australiana*	Australian Anacampseros			6	3			1								3						2
A	*	*Anagallis arvensis*	Pimpernel			2	2										1		1					
P		*Arabidella trisecta*	Shrubby Cress			1	1								1									
P		*Aristida contorta*	Curly Wire-grass			2	2				1							1						
P		*Aristida nitidula*	Brush Three-awn			16	7				1	1		7	4			1		1				1
P		*Aristida strigosa*	Rough Three-awn			3	2								2								1	

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P	*	*Asphodelus fistulosus*	Onion Weed			2	2															1	1	
P		*Astrebla lappacea*	Curly Mitchell-grass			1	1			1														
P		*Astroloma humifusum*	Cranberry Heath			1	1													1				
P		*Atriplex acutibractea* ssp.	Pointed Saltbush			14	7		1					2	3	4						1	2	1
P		*Atriplex limbata*	Spreading Saltbush			1	1																1	
P		*Atriplex stipitata*	Bitter Saltbush			7	5					1		2	1	1								2
P		*Atriplex vesicaria* ssp.	Bladder Saltbush			4	3							1	2									1
P		*Austrodanthonia caespitosa*	Common Wallaby-grass			3	3				1							1		1				
P		*Austrodanthonia setacea*	Small-flower Wallaby-grass			1	1					1												
P		*Austrostipa eremophila*	Rusty Spear-grass			1	1								1									
P		*Austrostipa nitida*	Balcarra Spear-grass			18	9			1	1			3	4	3		1			1		2	2
P		*Austrostipa nodosa*	Tall Spear-grass			6	4		1		1				1	3								
P		*Austrostipa pilata*	Prickly Spear-grass		V	1	1													1				
P		*Austrostipa platychaeta*	Flat-awn Spear-grass			1	1																1	
P		*Austrostipa scabra* ssp.	Rough Spear-grass			24	10		2	1	1	1		8	4	1		4					1	1
P		*Austrostipa* sp.	Spear-grass			21	10	7	3		1				1		2	1	3		1	1		1
P		*Austrostipa trichophylla*				1	1								1									
P		*Beyeria lechenaultii*	Pale Turpentine Bush			2	2													1	1			
P		*Boerhavia dominii*	Tar-vine			13	6						1		5			1				1	4	1
P		*Brachyscome ciliaris* var. *ciliaris*	Variable Daisy			4	4			1		1									1		1	
P		*Brachyscome ciliaris* var. *lanuginosa*	Woolly Variable Daisy			1	1									1								
P		*Brachyscome dentata*	Lobe-seed Daisy			1	1			1														
A		*Brachyscome lineariloba*	Hard-head Daisy			5	3				1				3			1						
A	*	*Bromus rubens*	Red Brome			4	3	1	1					2										
A		*Bulbine alata*	Winged Bulbine-lily			1	1											1						
P		*Bursaria spinosa* ssp. *spinosa*	Sweet Bursaria			1	1												1					
A		*Calandrinia ptychosperma*	Creeping Parakeelya			2	2				1							1						
P		*Callistemon teretifolius*	Needle Bottlebrush			2	1													2				
P		*Callitris glaucophylla*	White Cypress-pine			15	9				1			1	1		2	2	4	1	1		2	
A		*Calotis hispidula*	Hairy Burr-daisy			3	3			1	1							1						
P		*Calotis latiuscula*	Leafy Burr-daisy			1	1		1															
P		*Calytrix tetragona*	Common Fringe-myrtle			3	2				1									2				
P		*Capparis mitchellii*	Native Orange			9	7		1		2			1	1			2					1	1
A	*	*Carrichtera annua*	Ward's Weed			23	8	4	3						4		4		1			2	3	2
A	*	*Carthamus lanatus*	Saffron Thistle			3	2								1								2	
P		*Cassinia complanata*	Sticky Cassinia			1	1											1						
P		*Cassinia laevis*	Curry Bush			11	7	1			1			2				2	3	1			1	
P		*Casuarina pauper*	Black Oak			41	11		8		3	1		7	3	2	2	3			2		1	9
A	*	*Centaurea melitensis*	Malta Thistle			32	12	4		1	1	1			10	3	5	1	1			1	3	1
A		*Chamaesyce australis*				8	5				1				2							2	2	1

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P		*Chamaesyce drummondii*				6	4								2							1	2	1
P		*Cheilanthes austrotenuifolia*	Annual Rock-fern			1	1											1						
P		*Cheilanthes lasiophylla*	Woolly Cloak-fern			24	9				2			4	1		6	5	2	2		1	1	
P		*Cheilanthes sieberi* ssp. *sieberi*	Narrow Rock-fern			9	5							1				4	2	1	1			
P		*Chenopodium curvispicatum*	Cottony Goosefoot			2	2								1							1		
P		*Chenopodium desertorum* ssp.	Desert Goosefoot			3	2															2	1	
A	*	*Chenopodium murale*	Nettle-leaf Goosefoot			2	2															1	1	
A		*Chrysocephalum eremaeum*	Sand Button-bush			4	4								1			1				1	1	
P		*Chrysocephalum semipapposum*	Clustered Everlasting			5	4		1										2	1	1			
P	*	*Citrullus colocynthis*	Colocynth			5	3								1							2	2	
A	*	*Citrullus lanatus*	Bitter Melon			2	2							1									1	
P		*Convolvulus remotus*	Grassy Bindweed			29	11	1	4		2			2	7		4	3	1			2	1	2
A	*	*Cucumis myriocarpus*	Paddy Melon			2	1																2	
P		*Cymbopogon ambiguus*	Lemon-grass			38	15	2	1	1	2	1	2	4	10	1	4		2	1		1	5	1
P		*Cyperus gymnocaulos*	Spiny Flat-sedge			4	2															1	3	
A		*Dactyloctenium radulans*	Button-grass			1	1			1														
A	*	*Datura leichhardtii*	Native Thorn-apple			7	3															2	4	1
A		*Daucus glochidiatus*	Native Carrot			3	3				1			1				1						
P		*Daviesia genistifolia*	Broom Bitter-pea			1	1													1				
P		*Daviesia stricta*	Flinders Ranges Bitter-pea		R	1	1													1				
P		*Dianella revoluta* var. *revoluta*	Black-anther Flax-lily			4	3												1	2	1			
P		*Digitaria brownii*	Cotton Panic-grass			17	6		1		1			9	4			1					1	
P		*Dissocarpus paradoxus*	Ball Bindyi			32	12		4	1		1		4	4	2	1	1			2	2	4	6
A	*	*Dittrichia graveolens*	Stinkweed			3	2															1	2	
P		*Dodonaea baueri*	Crinkled Hop-bush			2	2													1	1			
P		*Dodonaea lobulata*	Lobed-leaf Hop-bush			30	12	2	4	1			2	2	3	1	6	2				2	3	2
P		*Dodonaea microzyga* var. *microzyga*	Brilliant Hop-bush			35	12		1	1	3	2	2	10	4	4		1			2		2	3
P		*Dodonaea viscosa* ssp. *angustissima*	Narrow-leaf Hop-bush			9	6				1			1					2	1	1		3	
A		*Dysphania cristata*	Crested Goosefoot			6	4										1					2	2	1
A		*Dysphania melanocarpa* f.	Black-fruit Goosefoot			7	5											2			1	1	2	1
A	*	*Echium plantagineum*	Salvation Jane			2	2												1				1	
P		*Einadia nutans* ssp. *nutans*	Climbing Saltbush			5	5				1				1			1	1				1	
P		*Enchylaena tomentosa* var. *tomentosa*	Ruby Saltbush			52	13		2	1	2	1		9	12	3	2	4			2	2	5	7
P		*Enneapogon avenaceus*	Common Bottle-washers			7	6	1	1	1	2				1	1								
P		*Enneapogon cylindricus*	Jointed Bottle-washers			27	8			1	2	3		7	10	1		1						2
P		*Enneapogon polyphyllus*	Leafy Bottle-washers			5	5				1							1			1	1	1	
P		*Enteropogon ramosus*	Umbrella Grass			1	1																1	
A	*	*Eragrostis barrelieri*	Pitted Love-grass			3	2		2	1														
P		*Eragrostis dielsii* var. *dielsii*	Mulka			2	1								2									
P		*Eremophila alternifolia*	Narrow-leaf Emubush			20	9		1		2		1	3	3	2	6	1						1

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P		*Eremophila duttonii*	Harlequin Emubush			5	3					3	1	1										
P		*Eremophila freelingii*	Rock Emubush			44	12		3		5	1	1	11	5		5	6	1			1	3	2
P		*Eremophila glabra* ssp. *glabra*	Tar Bush			14	9		2					1	3	1	1				1	1	3	1
P		*Eremophila latrobei* ssp.	Crimson Emubush			4	4				1				1							1	1	
P		*Eremophila longifolia*	Weeping Emubush			8	6							1	3		1					1	1	1
P		*Eremophila maculata* ssp. *maculata*	Spotted Emubush			2	2											1						1
P		*Eremophila oppositifolia* ssp. *oppositifolia*	Opposite-leaved Emubush			8	6		3					1	1				1	1				1
P		*Eremophila scoparia*	Broom Emubush			11	8						1	1	1	2					2	1	1	2
P		*Eremophila serrulata*	Green Emubush			9	4				1							4	1				3	
P		*Eremophila sturtii*	Turpentine Bush			3	3					1		1									1	
P		*Eriochiton sclerolaenoides*	Woolly-fruit Bluebush			12	6		2					6	1	1					1			1
A	*	*Erodium cicutarium*	Cut-leaf Heron's-bill			1	1										1							
P		*Eucalyptus camaldulensis* ssp.	River Red Gum			14	5								3			1	1			3	6	
P		*Eucalyptus dumosa*	White Mallee			1	1							1										
P		*Eucalyptus flindersii*	Flinders Grey Mallee			3	2												1	2				
P		*Eucalyptus gillii*	Curly Mallee			15	7				1	1		2	2	4					2			3
P		*Eucalyptus intertexta*	Gum-barked Coolibah			9	8				1			1	1			2		1	1	1	1	
P		*Eucalyptus polybractea*	Flinders Ranges Box		R	2	2													1	1			
P		*Eucalyptus socialis* ssp. *socialis*	Beaked Red Mallee			11	7		3	1					1			1		1	3			1
P		*Euphorbia tannensis* ssp. *eremophila*	Desert Spurge			3	2			1												2		
P		*Exocarpos aphyllus*	Leafless Cherry			37	11		8		2	2		6	2		3	3		1	1		1	8
P		*Frankenia crispa*	Hoary Sea-heath			2	2		1						1									
P		*Frankenia foliosa*	Leafy Sea-heath			4	4		1	1				1	1									
A	*	*Galium murale*	Small Bedstraw			1	1											1						
A	*	*Glaucium corniculatum*	Bristly Horned-poppy			1	1															1		
P		*Glossocardia bidens*	Native Cobbler's-pegs			3	2						1										2	
P		*Glycine rubiginosa*	Twining Glycine			7	7				1						1	1	1		1	1	1	
A		*Gnephosis arachnoidea*	Spidery Button-flower			6	4	2	2						1		1							
P		*Gonocarpus elatus*	Hill Raspwort			1	1													1				
A		*Goodenia calcarata*	Streaked Goodenia			1	1																	1
P		*Goodenia fascicularis*	Silky Goodenia			2	2				1							1						
P		*Goodenia vernicosa*	Wavy Goodenia			7	6		1		1								1	2	1		1	
P		*Grevillea aspera*	Rough Grevillea			3	2												1	2				
P		*Hakea ednieana*	Flinders Ranges Corkwood			16	7				1			4	1	2	2	5	1					
P		*Hakea leucoptera* ssp. *leucoptera*	Silver Needlewood			1	1								1									
P		*Heliotropium asperrimum*	Rough Heliotrope			1	1																1	
A		*Heliotropium europaeum*	Common Heliotrope			9	4								2							2	4	1
P		*Hibiscus sturtii* var. *grandiflorus*	Sturt's Hibiscus			11	8				1		1	1	1		1	3					1	2
A	*	*Hypochaeris glabra*	Smooth Cat's Ear			1	1															1		
P		*Indigofera leucotricha*	Silver Indigo			2	2										1		1					

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P		*Ixiochlamys cuneifolia*	Silverton Daisy			1	1								1									
P		*Ixodia flindersica*	Flinders Ranges Ixodia			1	1												1					
P		*Jasminum didymum* ssp. *lineare*	Native Jasmine			3	2											1					2	
P		*Juncus aridicola*	Inland Rush			1	1																1	
A	*	*Lamarckia aurea*	Toothbrush Grass			2	1										2							
P		*Lawrencia glomerata*	Clustered Lawrencia			1	1								1									
P		*Leiocarpa semicalva* ssp. *semicalva*	Scented Button-bush			10	6				1			2			3	2	1	1				
P		*Leiocarpa tomentosa*	Woolly Plover-daisy			2	2							1						1				
P		*Leiocarpa websteri*	Narrow Plover-daisy			6	5	1	1						2	1						1		
A		*Lepidium oxytrichum*	Green Peppercress			2	2				1							1						
A		*Lepidium papillosum*	Warty Peppercress			1	1												1					
A		*Lepidium phlebopetalum*	Veined Peppercress			1	1		1															
P		*Lomandra multiflora* ssp. *dura*	Hard Mat-rush			10	8				1			1				1	1	1	1	1	3	
P		*Lotus cruentus*	Red-flower Lotus			4	3					1						1				2		
P		*Lysiana exocarpi* ssp. *exocarpi*	Harlequin Mistletoe			35	12	1			1	1	1	4	12	2		1			1	3	4	4
P		*Maireana aphylla*	Cotton-bush			1	1			1														
P		*Maireana astrotricha*	Low Bluebush			12	7		1	1	1	3		4	1									1
P		*Maireana brevifolia*	Short-leaf Bluebush			8	4							1	1							2	4	
P		*Maireana campanulata*	Bell-fruit Bluebush			1	1		1															
P		*Maireana georgei*	Satiny Bluebush			6	5			1	1			1	1									2
P		*Maireana pentatropis*	Erect Mallee Bluebush			2	2								1						1			
P		*Maireana pyramidata*	Black Bluebush			4	4						1	1	1									1
P		*Maireana sedifolia*	Bluebush			11	5		3				2	3	2	1								
P		*Maireana tomentosa* ssp. *urceolata*				1	1		1															
P		*Maireana trichoptera*	Hairy-fruit Bluebush			7	3								3	2								2
P		*Maireana turbinata*	Top-fruit Bluebush			3	2							1	2									
P		*Malva preissiana*	Australian Hollyhock			2	1																2	
P		*Malvastrum americanum* var. *americanum*	Malvastrum			25	9			1		1		1	11	1		1				2	6	1
P	*	*Marrubium vulgare*	Horehound			9	5	1							1				1			2	4	
P		*Marsdenia australis*	Native Pear			29	12		1		2	2		3	6		1	2		1	1	1	4	5
P		*Melaleuca glomerata*	Inland Paper-bark			10	4								1			1				3	5	
P		*Melaleuca lanceolata*	Dryland Tea-tree			1	1														1			
P		*Melaleuca uncinata*	Broombush			3	2													2	1			
P		*Melhania oblongifolia*	Velvet Hibiscus			2	2							1								1		
P		*Minuria cunninghamii*	Bush Minuria			4	4			1	1			1				1						
P		*Myoporum montanum*	Native Myrtle			1	1																1	
P		*Myoporum platycarpum* ssp.	False Sandalwood			4	4							1							1	1		1
P		*Neurachne alopecuroidea*	Fox-tail Mulga-grass			2	1										2							
P	*	*Nicotiana glauca*	Tree Tobacco			2	2							1	1									
A		*Nicotiana simulans*	Native Tobacco			3	3							1									1	1

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A		*Nicotiana velutina*	Velvet Tobacco			4	4			1							1					1	1	
P		*Nitraria billardierei*	Nitre-bush			1	1									1								
P		*Olearia decurrens*	Winged Daisy-bush			9	7		1		1			2				1	1	1	2			
P		*Olearia ramulosa*	Twiggy Daisy-bush			1	1													1				
A		*Omphalolappula concava*	Burr Stickseed			10	4	1	1								7	1						
A	*	*Onopordum acaulon*	Horse Thistle			1	1															1		
P		*Oxalis perennans*	Native Sorrel			11	6				1				1		3	1				2	3	
P		*Ozothamnus scaber*	Rough Bush-everlasting		V	2	2													1	1			
P		*Panicum decompositum* var. *decompositum*	Native Millet			1	1			1														
P		*Paraceterach reynoldsii*	Scaly Rock-fern			2	1												2					
P		*Petalostylis labicheoides*	Butterfly Bush			1	1															1		
P		*Philotheca angustifolia* ssp. *angustifolia*	Narrow-leaf Wax-flower		R	1	1													1				
A		*Phyllanthus maderaspatensis* var. *angustifolius*				1	1																1	
A		*Phyllanthus saxosus*	Rock Spurge			1	1													1				
P		*Pimelea microcephala* ssp. *microcephala*	Shrubby Riceflower			4	3								2		1					1		
A		*Pimelea simplex* ssp. *simplex*	Desert Riceflower			1	1							1										
P		*Pittosporum angustifolium*	Native Apricot			11	6				1			1	4	1	2						2	
A		*Plantago drummondii*	Dark Plantain			4	3	2	1									1						
P		*Plectranthus intraterraneus*	Inland Spur-flower			2	2							1									1	
P		*Pleurosorus rutifolius*	Blanket Fern			2	1												2					
P		*Pluchea dentex*	Bowl Daisy			1	1																1	
P	*	*Polypogon viridis*	Water Bent			1	1															1		
P		*Pomax umbellata*	Pomax			1	1													1				
A		*Portulaca oleracea*	Common Purslane			2	2															1	1	
P		*Prostanthera striatiflora*	Striated Mintbush			10	8							2	1		1		1	2	1		1	1
P		*Pterocaulon sphacelatum*	Apple-bush			15	6							2	2		2					2	6	1
P		*Ptilotus exaltatus* var.	Pink Mulla Mulla			15	9		2		1		1	3	1			1			1		1	4
P		*Ptilotus nobilis* var.	Yellow-tails			2	2			1								1						
P		*Ptilotus obovatus* var. *obovatus*	Silver Mulla Mulla			70	16	2	5	1	5	2	2	11	9	2	8	7	2		1	3	4	6
P		*Ptilotus polystachyus* var. *polystachyus*	Long-tails			1	1											1						
P		*Ptilotus propinquus*	Small-leaf Mulla Mulla			5	3		3	1														1
A		*Ranunculus hamatosetosus*	Hill Buttercup			1	1											1						
P		*Rhagodia parabolica*	Mealy Saltbush			5	3		1														3	1
P		*Rhagodia spinescens*	Spiny Saltbush			19	10		2			1	1	3	5		2	1				1	1	2
P		*Rhagodia ulicina*	Intricate Saltbush			11	6		3		1	1		3				2					1	
A		*Rhodanthe pygmaea*	Pigmy Daisy			4	4		1		1						1	1						
A		*Rhodanthe stricta*	Slender Everlasting			2	2										1		1					
P		*Rhyncharrhena linearis*	Bush Bean			3	2											2						1
P		*Rhynchosia minima*	Rhynchosia			1	1																1	

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
P		*Rostellularia adscendens* var. *pogonanthera*	Pink Tongues			1	1																1	
A		*Salsola tragus*	Buckbush			50	13	1	1	2	3	1	2	8	13	4					2	2	5	6
P		*Santalum acuminatum*	Quandong			8	6	1	1				1	1	3	1								
P		*Santalum lanceolatum*	Plumbush			11	7				1	1		3	2	1							2	1
P		*Sarcostemma viminale* ssp. *australe*	Caustic Bush			1	1							1										
P		*Sauropus rigens*	Stiff Spurge			11	6				2			3			1	3	1	1				
P		*Scaevola humilis*	Inland Fanflower			1	1															1		
P		*Scaevola spinescens*	Spiny Fanflower			18	9				1	2	1	7	1		1	3		1				1
A	*	*Schismus barbatus*	Arabian Grass			9	5				1			4	2			1					1	
P		*Schoenoplectus litoralis*	Shore Club-rush			1	1															1		
P		*Sclerolaena brachyptera*	Short-wing Bindyi			10	7	1	2	1		1			2			1						2
P		*Sclerolaena convexula*	Tall Bindyi			6	3				1			2				3						
P		*Sclerolaena cuneata*	Tangled Bindyi			1	1																	1
P		*Sclerolaena diacantha/uniflora*	Grey Bindyi			24	10		2		2	2	1	2	5	1		3			2			4
P		*Sclerolaena divaricata*	Tangled Bindyi			8	5		2	1				2	2			1						
P		*Sclerolaena lanicuspis*	Spinach Bindyi			11	6		1					3	4			1				1		1
P		*Sclerolaena limbata*	Pearl Bindyi			1	1							1										
P		*Sclerolaena longicuspis*	Long-spine Bindyi			8	4		3	2					2									1
P		*Sclerolaena obliquicuspis*	Oblique-spined Bindyi			61	14	2	2	1	2	2		10	16	6	5	3			1	2	4	5
P		*Sclerolaena patenticuspis*	Spear-fruit Bindyi			12	7						1	4	2	1		1					2	1
P		*Sclerolaena ventricosa*	Salt Bindyi			2	1								2									
P		*Senecio magnificus*	Showy Groundsel			33	11	4		1	2	1		4	9	1	2					2	4	3
P		*Senna artemisioides* ssp.	Desert Senna			12	7	1	1					3	1	3		1						2
P		*Senna artemisioides* ssp. *alicia*	Desert Senna			2	2					1												1
P		*Senna artemisioides* ssp. *filifolia*	Fine-leaf Desert Senna			20	12	1	2			1	2		4	1	2	1			1	1	2	2
P		*Senna artemisioides* ssp. *helmsii*	Blunt-leaf Senna			3	2							2								1		
P		*Senna artemisioides* ssp. X *artemisioides*	Silver Senna			45	16	2	3		4	1	1	8	6	1	4	5	1	1	1	1	3	3
P		*Senna artemisioides* ssp. X *coriacea*	Broad-leaf Desert Senna			50	14	1	6	1	2	3	2	9	8	5	1	2			1		3	6
P		*Senna artemisioides* ssp. X *sturtii*	Grey Senna			1	1																	1
A		*Setaria basiclada*				2	2															1		1
P		*Setaria constricta*	Knotty-butt Paspalidium			7	5				1				1			2					2	1
A	*	*Setaria verticillata*	Whorled Pigeon-grass			1	1																	1
P		*Sida corrugata* var.	Corrugated Sida			11	6				1	1		3	2			2						2
P		*Sida fibulifera*	Pin Sida			35	11		2	1	2	3	1	9	11	3		1					1	1
P		*Sida filiformis*	Fine Sida			1	1															1		
P		*Sida intricata*	Twiggy Sida			12	5	1							8				1			1	1	
P		*Sida petrophila*	Rock Sida			44	12	1			5	1	2	9	7		10	2	2			1	3	1
P		*Sida trichopoda*	High Sida			1	1			1														
A		*Sigesbeckia australiensis*	Australian Sigesbeckia			1	1																1	

A/P	I	Species Name	Common Name	Aus	SA	Tot Sites	Tot Grps	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	*	*Sisymbrium erysimoides*	Smooth Mustard			17	6				2			1	7			2				2	3	
P		*Solanum ellipticum/quadriloculatum*	Velvet Potato-bush			62	15	2	3	2	4	2	1	12	11	2	7	6			1	1	2	6
P		*Solanum petrophilum*	Rock Nightshade			7	5				1				2			1		1			2	
P		*Solanum sturtianum*	Sturt's Nightshade			22	10	3	2			1	1	3	3	1						2	5	1
A	*	*Sonchus oleraceus*	Common Sow-thistle			6	6		1		1				1			1				1	1	
P		*Sporobolus actinocladus*	Ray Grass			1	1																	1
P		*Sporobolus caroli*	Yakka Grass			1	1			1														
P		*Spyridium phlebophyllum*	Inland Spyridium			4	3												1	2	1			
A		*Swainsona formosa*	Sturt Pea			2	2								1							1		
P		*Templetonia aculeata*	Spiny Mallee-pea			1	1													1				
A		*Tetragonia eremaea*	Desert Spinach			8	3										3					2	3	
A		*Tetragonia tetragonioides/moorei*	New Zealand Spinach			2	2				1							1						
P		*Teucrium racemosum*	Grey Germander			3	2								1								2	
P		*Themeda triandra*	Kangaroo Grass			8	5				1			3				1		1			2	
P		*Thyridolepis mitchelliana*	Window Mulga-grass			1	1											1						
A		*Trianthema triquetra*	Red Spinach			6	5			1					1							2	1	1
P		*Tribulus eichlerianus*	Eichler's Caltrop			3	3								1						1	1		
A		*Trichanthodium skirrophorum*	Woolly Yellow-heads			1	1																	1
P		*Trichodesma zeylanicum* var. *zeylanicum*	Camel Bush			5	2							3								2		
P		*Triodia* sp.	Spinifex			8	5				1							1	3	2	1			
P		*Typha orientalis*	Broad-leaf Bulrush			1	1															1		
P		*Velleia arguta*	Toothed Velleia			2	2		1														1	
P	*	*Verbena officinalis*	Common Verbena			1	1																1	
P		*Vittadinia australasica* var. *australasica*	Sticky New Holland Daisy			7	5											2			1	1	2	1
P		*Vittadinia cuneata* var. *cuneata* f. *cuneata*	Fuzzy New Holland Daisy			12	7		1			1		4	2	2		1						1
P		*Vittadinia gracilis*	Woolly New Holland Daisy			11	8				1	1		1	3			2				1	1	1
A		*Vittadinia sulcata*	Furrowed New Holland Daisy			2	2				1			1										
P		*Wahlenbergia aridicola*	Dryland Bluebell			6	3								2							2	2	
P		*Wahlenbergia communis*	Tufted Bluebell			4	4							1				1				1	1	
A	*	*Xanthium spinosum*	Bathurst Burr			2	1																2	
P		*Xanthorrhoea quadrangulata*	Rock Grass-tree			4	4							1					1	1			1	
A		*Xerochrysum bracteatum*	Golden Everlasting			1	1											1						
P		*Zygophyllum apiculatum*	Pointed Twinleaf			9	5		1			1		1								2	4	
P		*Zygophyllum aurantiacum* ssp.	Shrubby Twinleaf			11	4	3	2						2		4							
A		*Zygophyllum prismatothecum*	Square-fruit Twinleaf			6	4								1						1	1		3
			Total No. of Annuals (65)					**7**	**10**	**8**	**15**	**2**	**1**	**10**	**16**	**3**	**14**	**21**	**7**	**1**	**3**	**25**	**28**	**17**
			Total No. of Perennials (238)					**27**	**67**	**37**	**73**	**47**	**30**	**101**	**114**	**51**	**44**	**90**	**38**	**51**	**52**	**69**	**102**	**79**
			Total No. of Taxa (303)					**34**	**77**	**45**	**88**	**49**	**31**	**111**	**130**	**54**	**58**	**111**	**45**	**52**	**55**	**94**	**130**	**96**

APPENDIX 8. MAMMAL SPECIES RECORDED IN THE NANTAWARRINA IPA.

***** Introduced or feral species are designated with an asterisk (*).
SA Museum Number of specimens of each species in the South Australian Museum collection from the Nantawarrina IPA (excludes those collected on the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys).
OP Records Number of records collected opportunistically (i.e. away from sites) during surveys.
Site Records Number of records from survey sites.
Status The only species of conservation significance is *Petrogale xanthopus*, which is rated VU (nationally vulnerable) and V (vulnerable in SA).

Order	Family	Species Name	Common Name	SA Museum	Flinders Ranges Survey		Nantawarrina IPA Survey		Total Records
					OP Records	Site Records	OP Records	Site Records	
ARTIODACTYLA	BOVIDAE	*Capra hircus* *	Goat (Feral Goat)		1	20	10	15	46
ARTIODACTYLA	BOVIDAE	*Ovis aries* *	Sheep (Feral Sheep)				1		1
CARNIVORA	CANIDAE	*Canis lupus dingo*	Dingo				2	5	7
CARNIVORA	CANIDAE	*Vulpes vulpes* *	Fox (Red Fox)				1	2	3
CARNIVORA	FELIDAE	*Felis catus* *	Cat (Feral Cat)				2		2
CHIROPTERA	MOLOSSIDAE	*Tadarida australis*	White-striped Freetail-bat				6	2	8
CHIROPTERA	VESPERTILIONIDAE	*Chalinolobus gouldii*	Gould's Wattled Bat		1		2		3
CHIROPTERA	VESPERTILIONIDAE	*Chalinolobus morio*	Chocolate Wattled Bat				2	11	13
CHIROPTERA	VESPERTILIONIDAE	*Nyctophilus geoffroyi*	Lesser Long-eared Bat					6	6
CHIROPTERA	VESPERTILIONIDAE	*Vespadelus baverstocki*	Inland Forest Bat				4	8	12
DASYUROMORPHIA	DASYURIDAE	*Sminthopsis crassicaudata*	Fat-tailed Dunnart			3	1	6	10
DASYUROMORPHIA	DASYURIDAE	*Sminthopsis macroura*	Stripe-faced Dunnart	1		5		9	15
DIPROTODONTIA	MACROPODIDAE	*Macropus fuliginosus*	Western Grey Kangaroo				2	2	4
DIPROTODONTIA	MACROPODIDAE	*Macropus robustus*	Euro		6	3	24	9	42
DIPROTODONTIA	MACROPODIDAE	*Macropus rufus*	Red Kangaroo		4		13	6	23
DIPROTODONTIA	MACROPODIDAE	*Petrogale xanthopus* VU V	Yellow-footed Rock-wallaby				6		6
LAGOMORPHA	LEPORIDAE	*Oryctolagus cuniculus* *	Rabbit (European Rabbit)			1	12	14	27
MONOTREMATA	ORNITHORHYNCHIDAE	*Tachyglossus aculeatus*	Short-beaked Echidna			1	7	10	18
PERISSODACTYLA	EQUIDAE	*Equus asinus* *	Donkey (Feral Donkey)		2		5	4	11
PERISSODACTYLA	EQUIDAE	*Equus caballus* *	Horse (Brumby)		1		2	9	12
RODENTIA	MURIDAE	*Leggadina forresti*	Forrest's Mouse					1	1
RODENTIA	MURIDAE	*Mus musculus* *	House Mouse					1	1
RODENTIA	MURIDAE	*Pseudomys bolami*	Bolam's Mouse		1	3		8	12
			Total Records Per Source	**1**	**16**	**36**	**102**	**128**	**283**
			Total Species Per Source	**1**	**7**	**7**	**18**	**19**	**23**

APPENDIX 9. MAMMAL SPECIES RECORDED AT EACH SITE ON THE 2009 NANTAWARRINA IPA BIOLOGICAL SURVEY.

***** Introduced or feral species are designated with an asterisk (*).
BS636 Recs Number of records from the 2009 Nantawarrina IPA Biological Survey.
BS636 Sites Number of sites each species recorded at during the 2009 Nantawarrina IPA Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Note Record tallies for bats exclude data collected by Anabat call recorders.

Species Name	Common Name	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	BS636 Recs	BS636 Sites	Total Recs	Total Sites
Canis lupus dingo	Dingo	1			1												1				1	1	**5**	**5**	5	5
Capra hircus *	Goat (Feral Goat)			2		2	1	1			1	2		1	1			2		1		1	**15**	**11**	35	13
Chalinolobus morio	Chocolate Wattled bat		1	2	4						4												**11**	**4**	11	4
Equus asinus *	Donkey (Feral Donkey)		1	1	1		1																**4**	**4**	4	4
Equus caballus *	Horse (Brumby)				1	1			4					1		1	1						**9**	**6**	9	6
Leggadina forresti	Forrest's Mouse													1									**1**	**1**	1	1
Macropus fuliginosus	Western Grey Kangaroo		2																				**2**	**1**	2	1
Macropus robustus	Euro											1					1	2	2		1	2	**9**	**6**	12	8
Macropus rufus	Red Kangaroo			2			2										1					1	**6**	**4**	6	4
Mus musculus *	House Mouse				1																		**1**	**1**	1	1
Nyctophilus geoffroyi	Lesser Long-eared Bat		1	1	4																		**6**	**3**	6	3
Oryctolagus cuniculus *	Rabbit (European Rabbit)	1	2	1	1			2			2	2	1	1			1						**14**	**10**	15	11
Pseudomys bolami	Bolam's Mouse				1	1										6							**8**	**3**	11	5
Sminthopsis crassicaudata	Fat-tailed Dunnart		1							1	1		3										**6**	**4**	9	6
Sminthopsis macroura	Stripe-faced Dunnart					1					1			4	3								**9**	**4**	14	7
Tachyglossus aculeatus	Echidna										1	2		1	1		1	2				2	**10**	**7**	11	8
Tadarida australis	White-striped Freetail-bat									1							1						**2**	**2**	2	2
Vespadelus baverstocki	Inland Forest Bat			1	4											1	1			1			**8**	**5**	8	5
Vulpes vulpes *	Fox (Red Fox)		1																	1			**2**	**2**	2	2
Total Mammal Records		**2**	**9**	**10**	**18**	**5**	**4**	**3**	**4**	**2**	**10**	**7**	**4**	**9**	**5**	**8**	**8**	**6**	**2**	**3**	**2**	**7**	**128**	**21**	**164**	**27**
Total Mammal Species		**2**	**7**	**7**	**9**	**4**	**3**	**2**	**1**	**2**	**6**	**4**	**2**	**6**	**3**	**3**	**8**	**3**	**1**	**3**	**2**	**5**	**19**		**19**	

APPENDIX 10. MAMMAL SPECIES RECORDED AT FLINDERS RANGES BIOLOGICAL SURVEY SITES WITHIN THE NANTAWARRINA IPA.

***** Introduced or feral species are designated with an asterisk (*).
BS104 Recs Number of records from the 1999 Flinders Ranges Biological Survey.
BS104 Sites Number of sites each species recorded at during the 1999 Flinders Ranges Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.

Species Name	Common Name	GAP00601	NAN00201	NAN00301	NAN00401	NAN00501	NAN00601	BS104 Recs	BS104 Sites	Total Recs	Total Sites
Canis lupus dingo	Dingo									5	5
Capra hircus *	Goat (Feral Goat)	19				1		20	2	35	13
Chalinolobus morio	Chocolate Wattled bat									11	4
Equus asinus *	Donkey (Feral Donkey)									4	4
Equus caballus *	Horse (Brumby)									9	6
Leggadina forresti	Forrest's Mouse									1	1
Macropus fuliginosus	Western Grey Kangaroo									2	1
Macropus robustus	Euro	2	1					3	2	12	8
Macropus rufus	Red Kangaroo									6	4
Mus musculus *	House Mouse									1	1
Nyctophilus geoffroyi	Lesser Long-eared Bat									6	3
Oryctolagus cuniculus *	Rabbit (European Rabbit)					1		1	1	15	11
Pseudomys bolami	Bolam's Mouse			2		1		3	2	11	5
Sminthopsis crassicaudata	Fat-tailed Dunnart					1	2	3	2	9	6
Sminthopsis macroura	Stripe-faced Dunnart	2				2	1	5	3	14	7
Tachyglossus aculeatus	Echidna	1						1	1	11	8
Tadarida australis	White-striped Freetail-bat									2	2
Vespadelus baverstocki	Inland Forest Bat									8	5
Vulpes vulpes *	Fox (Red Fox)									2	2
Total Mammal Records		**24**	**1**	**2**	**0**	**6**	**3**	**36**	**6**	**164**	**27**
Total Mammal Species		**4**	**1**	**1**	**0**	**5**	**2**	**7**		**19**	

APPENDIX 11. BAT DATA COMPILED FROM ANABAT RECORDINGS.

Location Sites where Anabats used. (OP OTDam refers to an opportunistic location at Orange Tree Dam.)
Nights Number of nights an Anabat was used at each location.
Note The numbers of calls recorded does not necessarily indicate the number of individual bats at a location. One bat may call many times or many bats may call only once.

Location	Nights	*Chalinolobus gouldii*	*Chalinolobus morio*	*Nyctophilus geoffroyi*	*Vespadelus baverstocki*	*Mormopterus* sp3/sp4	*Tadarida australis*	Number of Calls Identified	Total Number of Calls
ORA00201	2	17	2	107	3	426	126	681	1728
ORA00301	2		18	1		7	1	27	52
ORA00401	2			1		13	24	38	190
ORA00801	1			13	7	130	265	415	788
IRI00101	1		1	3	3	1	6	14	23
IRI00201	1		2	1		1	10	14	46
IRI00301	1					2	1	3	9
IRI00401	1			10	59	34	87	190	545
IRI00501	1			1			1	2	8
IRI00601	1				5	1		6	17
IRI00701	1		3		1	1	1	6	15
PLA00101	1			30			19	49	98
PLA00201	1						4	4	204
PLA00301	1					4	6	10	24
PLA00401	1		1	1		6	51	59	247
PLA00501	1	1	8	1			15	25	50
PLA00601	1	4		8		3	8	23	106
PLA00701	1		6		3	2	47	58	68
OP OTDam	1	4		21	1		34	60	84
Total calls		**26**	**41**	**198**	**82**	**631**	**706**	**1684**	**4302**
Total Sites		**3**	**7**	**12**	**7**	**14**	**17**	**18**	
Total Locations		**4**	**8**	**13**	**8**	**14**	**18**	**19**	

APPENDIX 12. BIRD SPECIES RECORDED IN THE NANTAWARRINA IPA.

SA Conservation status in South Australia under the *National Parks and Wildlife Act 1972* (2007 update of Schedules 7, 8 and 9).
Res Stat Residency status classifications are taken directly from Reid *et al.* (1996) and indicate the likely residential status of birds in the region.
N = nomadic; **R** = resident; **W** = winter (non-breeding) migrant or visitor; **S** = spring-summer (breeding) migrant or visitor.
Gen OP Number of opportunistic records of each species (from minor sources) recorded in the Nantawarrina IPA prior to 2009.
Birds Aust Birds Australia Bird Atlas database (to July 2006) records within the Nantawarrina IPA.
SAM Species held in the SA Museum collected within the Nantawarrina IPA prior to 2009.
SAOA Birds SA (formerly South Australian Ornithilogical Association) species records from the Nantawarrina IPA.
Surveys 1999 Flinders Ranges Biological Survey opportunistic sightings (OP) and site (SU) records from within the Nantawarrina IPA.
2009 Nantawarrina IPA Biological Survey opportunistic sightings (OP) and site (SU) records from within the Nantawarrina IPA.
Total Recs Total number of records for each species from within the Nantawarrina IPA.

Order	Family	Species Name	Common Name	SA	Res Stat	Gen OP	Birds Aust	SAM	SAOA	Flinders Ranges Survey		Nantawarrina IPA Survey		Total Recs
										OP	SU	SU	OP	
Accipitriformes	Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk		R							1	1	2
Accipitriformes	Accipitridae	*Accipiter fasciatus*	Brown Goshawk		R					1				1
Accipitriformes	Accipitridae	*Aquila audax*	Wedge-tailed Eagle		R		2			2	3	7	6	20
Anseriformes	Anatidae	*Anas superciliosa*	Pacific Black Duck		N		1							1
Apodiformes	Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar		R					1		6	1	8
Caprimulgiformes	Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar		N/R		1				1			2
Caprimulgiformes	Podargidae	*Podargus strigoides*	Tawny Frogmouth		R								1	1
Casuariiformes	Casuariidae	*Dromaius novaehollandiae*	Emu		M		2				1	10	3	16
Charadriiformes	Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel		N		1							1
Charadriiformes	Charadriidae	*Vanelus tricolor*	Banded Lapwing		N/R								1	1
Ciconiiformes	Ardeidae	*Egretta novaehollandiae*	White-faced Heron		R/N		1							1
Columbiformes	Columbidae	*Geopelia cuneata*	Diamond Dove		N				1			1		2
Columbiformes	Columbidae	*Geopelia striata*	Peaceful Dove		R		1				2			3
Columbiformes	Columbidae	*Ocyphaps lophotes*	Crested Pigeon		R		2			2	2	4	2	12
Columbiformes	Columbidae	*Phaps chalcoptera*	Common Bronzewing		R		1			1	2	7	3	14
Coraciiformes	Halcyonidae	*Todiramphus pyrrhopygius*	Red-backed Kingfisher		N/S		1						1	2
Coraciiformes	Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher		S		1							1
Coraciiformes	Meropidae	*Merops ornatus*	Rainbow Bee-eater		S		1							1
Cuculiformes	Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo		N								1	1
Cuculiformes	Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo		S				2					2
Cuculiformes	Cuculidae	*Chalcites osculans*	Black-eared Cuckoo		N/S							6		6
Falconiiformes	Falconidae	*Falco berigora*	Brown Falcon		R					2			4	6
Falconiiformes	Falconidae	*Falco cenchroides*	Nankeen Kestrel		R		1			1		5	2	9

Order	Family	Species Name	Common Name	SA	Res Stat	Gen OP	Birds Aust	SAM	SAOA	Flinders Ranges Survey		Nantawarrina IPA Survey		Total Recs
										OP	SU	SU	OP	
Falconiiformes	Falconidae	*Falco longipennis*	Australian Hobby		R								1	1
Gruiformes	Otididae	*Ardeotis australis*	Australian Bustard	V	N	1								1
Passeriformes	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill		R		6				9	23	4	42
Passeriformes	Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill		R		2			1	2	6	2	13
Passeriformes	Acanthizidae	*Acanthiza robustirostris*	Slaty-backed Thornbill		R							1		1
Passeriformes	Acanthizidae	*Acanthiza uropygialis*	Chestnut-rumped Thornbill		R		1					15	1	17
Passeriformes	Acanthizidae	*Aphelocephala leucopsis*	Southern Whiteface		R		4				4	4	3	15
Passeriformes	Acanthizidae	*Pyrrholaemus brunneus*	Redthroat		R		2				4	9	2	17
Passeriformes	Acanthizidae	*Smicrornis brevirostris*	Weebill		R		3				4	16	2	25
Passeriformes	Acrocephalidae	*Acrocephalus australis*	Australian Reed Warbler		N/S		1							1
Passeriformes	Artamidae	*Artamus cinereus*	Black-faced Woodswallow		R							3	4	7
Passeriformes	Artamidae	*Artamus cyanopterus*	Dusky Woodswallow		R							2	2	4
Passeriformes	Artamidae	*Artamus minor*	Little Woodswallow		S				1					1
Passeriformes	Artamidae	*Cracticus tibicen*	Australian Magpie		R		3			3	3	14	3	26
Passeriformes	Artamidae	*Cracticus torquatus*	Grey Butcherbird		R		3			4	1	10	1	19
Passeriformes	Campephagidae	*Coracina maxima*	Ground Cuckoo-shrike		N								1	1
Passeriformes	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		N		2			2	2	8	4	18
Passeriformes	Climacteridae	*Climacteris affinis*	White-browed Treecreeper	R	R			2				4		6
Passeriformes	Climacteridae	*Climacteris picumnus*	Brown Treecreeper		R		6				15	4	2	27
Passeriformes	Corvidae	*Corvus bennetti*	Little Crow		N		3				3			6
Passeriformes	Corvidae	*Corvus coronoides*	Australian Raven		R		1				1	21	2	25
Passeriformes	Estrildidae	*Taeniopygia guttata*	Zebra Finch		R/N					1		2	3	6
Passeriformes	Hirundinidae	*Petrochelidon ariel*	Fairy Martin		S/M		1				1			2
Passeriformes	Hirundinidae	*Petrochelidon nigricans*	Tree Martin		M							7	4	11
Passeriformes	Maluridae	*Amytornis merrotsyi*	Short-tailed Grasswren		R								1	1
Passeriformes	Maluridae	*Malurus lamberti*	Variegated Fairy-wren		R		4			1	4	8	3	20
Passeriformes	Maluridae	*Malurus leucopterus*	White-winged Fairy-wren		R							5	2	7
Passeriformes	Maluridae	*Malurus splendens*	Splendid Fairy-wren		R		1	1			1	6	4	13
Passeriformes	Megaluridae	*Cincloramphus cruralis*	Brown Songlark		N/S								1	1
Passeriformes	Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater		R		7	1		3	9	36	5	61
Passeriformes	Meliphagidae	*Certhionyx variegatus*	Pied Honeyeater		N								1	1
Passeriformes	Meliphagidae	*Epthianura aurifrons*	Orange Chat		N							2		2
Passeriformes	Meliphagidae	*Epthianura tricolor*	Crimson Chat		N								2	2
Passeriformes	Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater		R						1			1

Order	Family	Species Name	Common Name	SA	Res Stat	Gen OP	Birds Aust	SAM	SAOA	Flinders Ranges Survey		Nantawarrina IPA Survey		Total Recs
										OP	SU	SU	OP	
Passeriformes	Meliphagidae	*Lichenostomus ornatus*	Yellow-plumed Honeyeater		R							1		1
Passeriformes	Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater		R		2				15	4	5	26
Passeriformes	Meliphagidae	*Lichenostomus plumulus*	Grey-fronted Honeyeater		R		4			1	3	8	3	19
Passeriformes	Meliphagidae	*Lichenostomus virescens*	Singing Honeyeater		R		1					15	3	19
Passeriformes	Meliphagidae	*Manorina flavigula*	Yellow-throated Miner		R					1		4	1	6
Passeriformes	Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater		R							1		1
Passeriformes	Meliphagidae	*Purnella albifrons*	White-fronted Honeyeater		N						2	8	2	12
Passeriformes	Monarchidae	*Grallina cyanoleuca*	Magpie-lark		R		1							1
Passeriformes	Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit		R							3	4	7
Passeriformes	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird		N		3			1	3	12	6	25
Passeriformes	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella		R		1				1			2
Passeriformes	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush		R		4			2	7	11	5	29
Passeriformes	Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird		R					2	2	21	3	28
Passeriformes	Pachycephalidae	*Pachycephala inornata*	Gilbert's Whistler	R	R		1					3	1	5
Passeriformes	Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler		R		4			1	3	26	3	37
Passeriformes	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote		R							7	3	10
Passeriformes	Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote		R		1							1
Passeriformes	Pardalotidae	*Pardalotus striatus*	Striated Pardalote		R		1			1	8	13	8	31
Passeriformes	Petroicidae	*Melanodryas cucullata*	Hooded Robin		R							4	1	5
Passeriformes	Petroicidae	*Petroica goodenovii*	Red-capped Robin		R/W		8			1	11	33	5	58
Passeriformes	Pomatostomidae	*Pomatostomus ruficeps*	Chestnut-crowned Babbler		R								1	1
Passeriformes	Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler		R		7				7	12	6	32
Passeriformes	Psophodidae	*Cinclosoma cinnamomeum*	Cinnamon Quail-thrush		R								2	2
Passeriformes	Psophodidae	*Psophodes cristatus*	Chirruping Wedgebill		R							2	1	3
Passeriformes	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail		R/W		1					7	1	9
Passeriformes	Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail		R		4			1	9	14	3	31
Passeriformes	Timaliidae	*Zosterops lateralis*	Silvereye		R		1					1		2
Psittaciformes	Cacatuidae	*Cacatua sanguinea*	Little Corella		R		1					2		3
Psittaciformes	Cacatuidae	*Eolophus roseicapillus*	Galah		R		2			3	1	6	2	14
Psittaciformes	Cacatuidae	*Nymphicus hollandicus*	Cockatiel		N/S								1	1
Psittaciformes	Psittacidae	*Barnardius zonarius*	Australian Ringneck		R		2			1	1	11	4	19
Psittaciformes	Psittacidae	*Neophema chrysostoma*	Blue-winged Parrot	V	W								1	1
Psittaciformes	Psittacidae	*Neophema elegans*	Elegant Parrot	R	R							1	2	3
Psittaciformes	Psittacidae	*Psephotus varius*	Mulga Parrot		R		2			2	3	10	1	18

Order	Family	Species Name	Common Name	SA	Res Stat	Gen OP	Birds Aust	SAM	SAOA	Flinders Ranges Survey		Nantawarrina IPA Survey		Total Recs
										OP	SU	SU	OP	
Strigiformes	Strigidae	*Ninox novaeseelandiae*	Southern Boobook		R		1			2		2	2	7
		Total No. of Species = 92	**Total Species Per Source**	**5**		**1**	**51**	**3**	**3**	**27**	**37**	**59**	**65**	
			Total Records per Source			**1**	**118**	**4**	**4**	**44**	**151**	**495**	**166**	**983**

APPENDIX 13. ADNYAMATHANHA NAMES OF BIRDS KNOWN TO OCCUR IN THE NANTAWARRINA IPA.

Source: McEntee (1986).

Species Name	Common Name	Adnyamathanha Names	Notes
Anthus novaeseelandiae	Australasian Pipit	Yaliwarruna	
Ardeotis australis	Australian Bustard	Wala	
Falco longipennis	Australian Hobby	Manga	applies to several species of Falcon
Cracticus tibicen	Australian Magpie	Urrakuli	
Aegotheles cristatus	Australian Owlet-nightjar	Nani-vadnapa	
Corvus coronoides	Australian Raven	Wakala	
Barnardius zonarius	Australian Ringneck	Watuli	
Vanelus tricolor	Banded Lapwing	Vildarkari	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	Vilikuta	
Artamus cinereus	Black-faced Woodswallow	Valpula	any species of Woodswallow
Falco berigora	Brown Falcon	Adlana	
Accipiter fasciatus	Brown Goshawk	Mura	name also applied to Collared Sparrowhawk
Cincloramphus cruralis	Brown Songlark	Utilaru	
Pomatostomus ruficeps	Chestnut-crowned Babbler	Yunula	name also applied to White-browed Babbler
Psophodes cristatus	Chirruping Wedgebill	Walpundirika	
Cinclosoma cinnamomeum	Cinnamon Quail-thrush	Vuli	
Nymphicus hollandicus	Cockatiel	Wirupa	
Accipiter cirrocephalus	Collared Sparrowhawk	Mura	name also applied to Brown Goshawk
Phaps chalcoptera	Common Bronzewing	Manbi	
Oreoica gutturalis	Crested Bellbird	Vaku-vaku	
Ocyphaps lophotes	Crested Pigeon	Mulambara	
Artamus cyanopterus	Dusky Woodswallow	Valpula	any species of Woodswallow
Neophema elegans	Elegant Parrot	Malka-vadlaru	
Dromaius novaehollandiae	Emu	Warrati	
Eolophus roseicapillus	Galah	Kilangila	
Cracticus torquatus	Grey Butcherbird	Awudipi	
Colluricincla harmonica	Grey Shrike-thrush	Anda-anda	name also recorded for the Singing Honeyeater
Cacatua sanguinea	Little Corella	Warrandu	may also apply to Galah
Corvus bennetti	Little Crow	Vanda	
Artamus minor	Little Woodswallow	Valpula	any species of Woodswallow
Grallina cyanoleuca	Magpie-lark	Madi-malpayi	
Dicaeum hirundinaceum	Mistletoebird	Awi-ita-na	name also applied to Rufous Whistler
Psephotus varius	Mulga Parrot	Vadlaru	
Falco cenchroides	Nankeen Kestrel	Naluka	
Anas superciliosa	Pacific Black Duck	Mararra	also applies to Grey Teal & Australian Shoveler
Cacomantis pallidus	Pallid Cuckoo	Wilkangani	
Geopelia striata	Peaceful Dove	Kayadaka/Kurukuku	
Merops ornatus	Rainbow Bee-eater	Yunulu-virru-virru	
Todiramphus pyrrhopygius	Red-backed Kingfisher	Yulu	
Petroica goodenovii	Red-capped Robin	Mali-ita-na	
Pachycephala rufiventris	Rufous Whistler	Awi-ita-na	same name as Mistletoebird
Lichenostomus virescens	Singing Honeyeater	Anda-anda	name also recorded for the Grey Shrike-thrush
Ninox novaeseelandiae	Southern Boobook	Urku/Mupuka	latter derived from English "Mopoke"
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	Turrana	
Eurostopodus argus	Spotted Nightjar	Kuta-kuta	
Pardalotus striatus	Striated Pardalote	Walda-angati	
Podargus strigoides	Tawny Frogmouth	Muni	
Petrochelidon nigricans	Tree Martin	Wira-yulditi-yulditi	
Malurus lamberti	Variegated Fairy-wren	Yuru yurula	name also applied to White-winged Fairy-wren
Aquila audax	Wedge-tailed Eagle	Wildu	
Pomatostomus superciliosus	White-browed Babbler	Yunula	name also applied to Chestnut-crowned Babbler
Egretta novaehollandiae	White-faced Heron	Winurinura	
Malurus leucopterus	White-winged Fairy-wren	Yuru yurula	name also applied to Variegated Fairy-wren
Rhipidura leucophrys	Willie Wagtail	Indarindari	
Manorina flavigula	Yellow-throated Miner	Wilpu	
Taeniopygia guttata	Zebra Finch	Idi	

APPENDIX 14. BIRD SPECIES RECORDED AT EACH SITE ON THE 2009 NANTAWARRINA IPA BIOLOGICAL SURVEY.

***** Introduced or feral species are designated with an asterisk (*).
BS636 Recs Number of records from the 2009 Nantawarrina IPA Biological Survey.
BS636 Sites Number of sites each species recorded at during the 2009 Nantawarrina IPA Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.

Species Name	Common Name	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701	BS636 Recs	BS636 Sites	Total Recs	Total Sites
Anthus novaeseelandiae	Australasian Pipit										2		1											3	2	3	2
Cracticus tibicen	Australian Magpie	1					1			3		1		1		1	2		1	1		1	1	14	11	17	13
Aegotheles cristatus	Australian Owlet-nightjar				1					2					1		2							6	4	6	4
Corvus coronoides	Australian Raven		2		2				1	2	1			2	2	1	2		1	1	1	2	1	21	14	22	15
Barnardius zonarius	Australian Ringneck	1				1				3				1		1	2				1	1		11	8	12	9
Chalcites osculans	Black-eared Cuckoo													1	1	1	1		1		1			6	6	6	6
Coracina novaehollandiae	Black-faced Cuckoo-shrike	1	1	2	1					2							1							8	6	10	7
Artamus cinereus	Black-faced Woodswallow										2	1												3	2	3	2
Climacteris picumnus	Brown Treecreeper																2				2			4	2	19	5
Melithreptus brevirostris	Brown-headed Honeyeater															1								1	1	1	1
Acanthiza uropygialis	Chestnut-rumped Thornbill	1	1							2	1	2		1	3	1	1	1					1	15	11	15	11
Psophodes cristatus	Chirruping Wedgebill										2													2	1	2	1
Accipiter cirrocephalus	Collared Sparrowhawk																				1			1	1	1	1
Phaps chalcoptera	Common Bronzewing				1						1	2			1		1	1						7	6	9	8
Oreoica gutturalis	Crested Bellbird		1			2			1	1	2	2		1	4	2		1	1	2			1	21	13	23	14
Ocyphaps lophotes	Crested Pigeon	1								1		1					1							4	4	6	6
Geopelia cuneata	Diamond Dove															1								1	1	1	1
Artamus cyanopterus	Dusky Woodswallow																				2			2	1	2	1
Neophema elegans	Elegant Parrot														1									1	1	1	1
Dromaius novaehollandiae	Emu								1	1	1	1	1	1	1	2	1							10	9	11	10
Petrochelidon ariel	Fairy Martin																									1	1
Eolophus roseicapillus	Galah									3					2								1	6	3	7	4
Pachycephala inornata	Gilbert's Whistler									1					1	1								3	3	3	3
Cracticus torquatus	Grey Butcherbird				1					3		1					2			1		2		10	6	11	7
Rhipidura albiscapa	Grey Fantail			1	1					2					1		1	1						7	6	7	6

Species Name	Common Name	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701	BS636 Recs	BS636 Sites	Total Recs	Total Sites
Colluricincla harmonica	Grey Shrike-thrush		1	1	3					1				1	1	1	1			1				11	9	18	12
Lichenostomus plumulus	Grey-fronted Honeyeater					1											1				4	1	1	8	5	11	7
Melanodryas cucullata	Hooded Robin					1			1		1			1										4	4	4	4
Acanthiza apicalis	Inland Thornbill	1	2	2	1				1	2		2		2	3	1	1	2	1	1		1		23	15	32	20
Cacatua sanguinea	Little Corella																2							2	1	2	1
Corvus bennetti	Little Crow																									3	3
Dicaeum hirundinaceum	Mistletoebird	1						1	1	1		3		1	1			1	1		1			12	10	15	13
Psephotus varius	Mulga Parrot			1		2		1			1	1					2				2			10	7	13	9
Falco cenchroides	Nankeen Kestrel					1				1			1				1					1		5	5	5	5
Epthianura aurifrons	Orange Chat								1				1											2	2	2	2
Geopelia striata	Peaceful Dove																									2	1
Petroica goodenovii	Red-capped Robin	3	2	1	2	3	1		1	3		2		1	4	1	2	2		3		2		33	16	44	21
Pyrrholaemus brunneus	Redthroat								2			3		1	1	1		1						9	6	13	8
Pachycephala rufiventris	Rufous Whistler		1	2	2	1				2				3	4	1	2	2	1	3	1		1	26	14	29	17
Zosterops lateralis	Silvereye	1																						1	1	1	1
Lichenostomus virescens	Singing Honeyeater	1	1			2	1	1	1	1	1	2	1			3								15	11	15	11
Acanthiza robustirostris	Slaty-backed Thornbill														1									1	1	1	1
Ninox novaeseelandiae	Southern Boobook									1							1							2	2	2	2
Aphelocephala leucopsis	Southern Whiteface					1				1		1						1						4	4	8	7
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	2	3	2		2	2	1	2	3	2	2	1	3	3	2	1			1	2	2		36	18	45	23
Malurus splendens	Splendid Fairy-wren											3			2		1							6	3	7	4
Eurostopodus argus	Spotted Nightjar																									1	1
Pardalotus punctatus	Spotted Pardalote									3						2	1			1				7	4	7	4
Pardalotus striatus	Striated Pardalote			1						3					1	1	2			1	2	1	1	13	9	21	11
Gliciphila melanops	Tawny-crowned Honeyeater																									1	1
Petrochelidon nigricans	Tree Martin									3		2					1				1			7	4	7	4
Daphoenositta chrysoptera	Varied Sittella																									1	1
Malurus lamberti	Variegated Fairy-wren									3		1				2	1	1						8	5	12	7
Aquila audax	Wedge-tailed Eagle		1	1						1	1						2			1				7	6	10	8
Smicrornis brevirostris	Weebill			1	1					4					1	2	1	1		1	1	3		16	10	20	13
Pomatostomus superciliosus	White-browed Babbler			1						2	1			1	1		1	2		1	2			12	9	19	13
Climacteris affinis	White-browed Treecreeper		1												1	1		1						4	4	4	4

Species Name	Common Name	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	PLA00701	BS636 Recs	BS636 Sites	Total Recs	Total Sites
Purnella albifrons	White-fronted Honeyeater	2									1	1			2	2								8	5	10	6
Lichenostomus penicillatus	White-plumed Honeyeater								1	1						1	1							4	4	19	5
Malurus leucopterus	White-winged Fairy-wren				1	1		1	1				1											5	5	5	5
Rhipidura leucophrys	Willie Wagtail		1	2	1	3			1	2					1	2	1							14	9	23	12
Lichenostomus ornatus	Yellow-plumed Honeyeater																					1		1	1	1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				1					3		1					1							6	4	8	6
Manorina flavigula	Yellow-throated Miner									1						1	2							4	3	4	3
Taeniopygia guttata	Zebra Finch										1									1				2	2	2	2
Total Bird Records		**16**	**18**	**18**	**19**	**21**	**5**	**5**	**16**	**68**	**21**	**35**	**7**	**22**	**45**	**36**	**48**	**18**	**7**	**20**	**24**	**18**	**8**	**495**	**22**	**646**	**28**
Total Bird Species		**12**	**13**	**13**	**14**	**13**	**4**	**5**	**14**	**34**	**16**	**21**	**7**	**16**	**26**	**26**	**35**	**14**	**7**	**15**	**15**	**12**	**8**	**59**		**65**	

APPENDIX 15. BIRD SPECIES RECORDED AT FLINDERS RANGES BIOLOGICAL SURVEY SITES WITHIN THE NANTAWARRINA IPA.

BS104 Recs Number of records from the 1999 Flinders Ranges Biological Survey.
BS104 Sites Number of sites each species recorded at during the 1999 Flinders Ranges Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.

Species Name	Common Name	GAP00601	NAN00201	NAN00301	NAN00401	NAN00501	NAN00601	BS104 Recs	BS104 Sites	Total Recs	Total Sites
Anthus novaeseelandiae	Australasian Pipit									3	2
Cracticus tibicen	Australian Magpie					1	2	3	2	17	13
Aegotheles cristatus	Australian Owlet-nightjar									6	4
Corvus coronoides	Australian Raven	1						1	1	22	15
Barnardius zonarius	Australian Ringneck		1					1	1	12	9
Chalcites osculans	Black-eared Cuckoo									6	6
Coracina novaehollandiae	Black-faced Cuckoo-shrike		2					2	1	10	7
Artamus cinereus	Black-faced Woodswallow									3	2
Climacteris picumnus	Brown Treecreeper		10	4	1			15	3	19	5
Melithreptus brevirostris	Brown-headed Honeyeater									1	1
Acanthiza uropygialis	Chestnut-rumped Thornbill									15	11
Psophodes cristatus	Chirruping Wedgebill									2	1
Accipiter cirrocephalus	Collared Sparrowhawk									1	1
Phaps chalcoptera	Common Bronzewing	1					1	2	2	9	8
Oreoica gutturalis	Crested Bellbird	2						2	1	23	14
Ocyphaps lophotes	Crested Pigeon					1	1	2	2	6	6
Geopelia cuneata	Diamond Dove									1	1
Artamus cyanopterus	Dusky Woodswallow									2	1
Neophema elegans	Elegant Parrot									1	1
Dromaius novaehollandiae	Emu						1	1	1	11	10
Petrochelidon ariel	Fairy Martin					1		1	1	1	1
Eolophus roseicapillus	Galah			1				1	1	7	4
Pachycephala inornata	Gilbert's Whistler									3	3
Cracticus torquatus	Grey Butcherbird						1	1	1	11	7
Rhipidura albiscapa	Grey Fantail									7	6
Colluricincla harmonica	Grey Shrike-thrush	2	4		1			7	3	18	12
Lichenostomus plumulus	Grey-fronted Honeyeater	1			2			3	2	11	7
Melanodryas cucullata	Hooded Robin									4	4
Acanthiza apicalis	Inland Thornbill	2		3	1	2	1	9	5	32	20

Species Name	Common Name	GAP00601	NAN00201	NAN00301	NAN00401	NAN00501	NAN00601	BS104 Recs	BS104 Sites	Total Recs	Total Sites
Cacatua sanguinea	Little Corella									2	1
Corvus bennetti	Little Crow			1	1	1		3	3	3	3
Dicaeum hirundinaceum	Mistletoebird			1	1	1		3	3	15	13
Psephotus varius	Mulga Parrot		2		1			3	2	13	9
Falco cenchroides	Nankeen Kestrel									5	5
Epthianura aurifrons	Orange Chat									2	2
Geopelia striata	Peaceful Dove		2					2	1	2	1
Petroica goodenovii	Red-capped Robin	2		4	1	2	2	11	5	44	21
Pyrrholaemus brunneus	Redthroat	2					2	4	2	13	8
Pachycephala rufiventris	Rufous Whistler		1	1	1			3	3	29	17
Zosterops lateralis	Silvereye									1	1
Lichenostomus virescens	Singing Honeyeater									15	11
Acanthiza robustirostris	Slaty-backed Thornbill									1	1
Ninox novaeseelandiae	Southern Boobook									2	2
Aphelocephala leucopsis	Southern Whiteface			2		1	1	4	3	8	7
Acanthagenys rufogularis	Spiny-cheeked Honeyeater		3	1	3	1	1	9	5	45	23
Malurus splendens	Splendid Fairy-wren						1	1	1	7	4
Eurostopodus argus	Spotted Nightjar						1	1	1	1	1
Pardalotus punctatus	Spotted Pardalote									7	4
Pardalotus striatus	Striated Pardalote	1	7					8	2	21	11
Gliciphila melanops	Tawny-crowned Honeyeater	1						1	1	1	1
Petrochelidon nigricans	Tree Martin									7	4
Daphoenositta chrysoptera	Varied Sittella			1				1	1	1	1
Malurus lamberti	Variegated Fairy-wren			2			2	4	2	12	7
Aquila audax	Wedge-tailed Eagle	2			1			3	2	10	8
Smicrornis brevirostris	Weebill	1	1		2			4	3	20	13
Pomatostomus superciliosus	White-browed Babbler			1	1	3	2	7	4	19	13
Climacteris affinis	White-browed Treecreeper									4	4
Purnella albifrons	White-fronted Honeyeater	2						2	1	10	6
Lichenostomus penicillatus	White-plumed Honeyeater		15					15	1	19	5
Malurus leucopterus	White-winged Fairy-wren									5	5
Rhipidura leucophrys	Willie Wagtail		7	1		1		9	3	23	12
Lichenostomus ornatus	Yellow-plumed Honeyeater									1	1
Acanthiza chrysorrhoa	Yellow-rumped Thornbill				1	1		2	2	8	6

Species Name	Common Name	GAP00601	NAN00201	NAN00301	NAN00401	NAN00501	NAN00601	BS104 Recs	BS104 Sites	Total Recs	Total Sites
Manorina flavigula	Yellow-throated Miner									4	3
Taeniopygia guttata	Zebra Finch									2	2
Total Bird Records		**20**	**55**	**23**	**18**	**16**	**19**	**151**	**6**	**646**	**28**
Total Bird Species		**13**	**12**	**13**	**14**	**12**	**14**	**37**		**65**	

APPENDIX 16. FREQUENCY OF BIRD SPECIES RECORDED AT ALL SITES WITHIN THE NANTAWARRINA IPA.

Note Total number of sites where birds sampled is 28 (6 in 1999 and 22 in 2009).

Species Name	Common Name	Total Records	Total Sites
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	45	23
Petroica goodenovii	Red-capped Robin	44	21
Acanthiza apicalis	Inland Thornbill	32	20
Pachycephala rufiventris	Rufous Whistler	29	17
Corvus coronoides	Australian Raven	22	15
Oreoica gutturalis	Crested Bellbird	23	14
Cracticus tibicen	Australian Magpie	17	13
Dicaeum hirundinaceum	Mistletoebird	15	13
Pomatostomus superciliosus	White-browed Babbler	19	13
Smicrornis brevirostris	Weebill	20	13
Colluricincla harmonica	Grey Shrike-thrush	18	12
Rhipidura leucophrys	Willie Wagtail	23	12
Acanthiza uropygialis	Chestnut-rumped Thornbill	15	11
Lichenostomus virescens	Singing Honeyeater	15	11
Pardalotus striatus	Striated Pardalote	21	11
Dromaius novaehollandiae	Emu	11	10
Barnardius zonarius	Australian Ringneck	12	9
Psephotus varius	Mulga Parrot	13	9
Aquila audax	Wedge-tailed Eagle	10	8
Phaps chalcoptera	Common Bronzewing	9	8
Pyrrholaemus brunneus	Redthroat	13	8
Aphelocephala leucopsis	Southern Whiteface	8	7
Coracina novaehollandiae	Black-faced Cuckoo-shrike	10	7
Cracticus torquatus	Grey Butcherbird	11	7
Lichenostomus plumulus	Grey-fronted Honeyeater	11	7
Malurus lamberti	Variegated Fairy-wren	12	7
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	8	6
Chalcites osculans	Black-eared Cuckoo	6	6
Ocyphaps lophotes	Crested Pigeon	6	6
Purnella albifrons	White-fronted Honeyeater	10	6
Rhipidura albiscapa	Grey Fantail	7	6
Climacteris picumnus	Brown Treecreeper	19	5
Falco cenchroides	Nankeen Kestrel	5	5
Lichenostomus penicillatus	White-plumed Honeyeater	19	5
Malurus leucopterus	White-winged Fairy-wren	5	5
Aegotheles cristatus	Australian Owlet-nightjar	6	4
Climacteris affinis	White-browed Treecreeper	4	4
Eolophus roseicapillus	Galah	7	4
Malurus splendens	Splendid Fairy-wren	7	4
Melanodryas cucullata	Hooded Robin	4	4
Pardalotus punctatus	Spotted Pardalote	7	4
Petrochelidon nigricans	Tree Martin	7	4
Corvus bennetti	Little Crow	3	3
Manorina flavigula	Yellow-throated Miner	4	3
Pachycephala inornata	Gilbert's Whistler	3	3
Anthus novaeseelandiae	Australasian Pipit	3	2
Artamus cinereus	Black-faced Woodswallow	3	2
Epthianura aurifrons	Orange Chat	2	2
Ninox novaeseelandiae	Southern Boobook	2	2
Taeniopygia guttata	Zebra Finch	2	2
Acanthiza robustirostris	Slaty-backed Thornbill	1	1
Accipiter cirrocephalus	Collared Sparrowhawk	1	1
Artamus cyanopterus	Dusky Woodswallow	2	1
Cacatua sanguinea	Little Corella	2	1
Daphoenositta chrysoptera	Varied Sittella	1	1
Eurostopodus argus	Spotted Nightjar	1	1
Geopelia cuneata	Diamond Dove	1	1
Geopelia striata	Peaceful Dove	2	1
Gliciphila melanops	Tawny-crowned Honeyeater	1	1
Lichenostomus ornatus	Yellow-plumed Honeyeater	1	1
Melithreptus brevirostris	Brown-headed Honeyeater	1	1
Neophema elegans	Elegant Parrot	1	1
Petrochelidon ariel	Fairy Martin	1	1
Psophodes cristatus	Chirruping Wedgebill	2	1
Zosterops lateralis	Silvereye	1	1

APPENDIX 17. REPTILE SPECIES RECORDED IN THE NANTAWARRINA IPA.

SA Conservation status in South Australia under the *National Parks and Wildlife Act 1972* (2007 update of Schedules 7, 8 and 9).
Gen OP Number of opportunistic records of each species recorded in the Nantawarrina IPA prior to 2009.
SAM Species held in the SA Museum collected within the Nantawarrina IPA prior to 2009.
Surveys Opportunistic sightings (OP) and site (SU) records from the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys within the Nantawarrina IPA.
Total Recs Total number of records for each species from within the Nantawarrina IPA.

Species Name	Common Name	SA	Gen OP	SAM	Flinders Ranges		Nantawarrina IPA		Total Recs
					OP	SU	OP	SU	
Lizards									
AGAMIDAE	**Dragons**								
Ctenophorus decresii	Tawny Dragon					2			2
Ctenophorus vadnappa	Red-barred Dragon			1		8	12	5	26
Diporiphora nobbi	Nobbi Dragon							1	1
Pogona vitticeps	Central Bearded Dragon						2	2	4
Tympanocryptis tetraporophora	Eyrean Earless Dragon					5	1	2	8
CARPHODACTYLIDAE	**Knob-tailed Geckos**								
Nephrurus milii	Barking Gecko			1			2		3
DIPLODACTYLIDAE	**Ground Geckos**								
Diplodactylus furcosus	Ranges Stone Gecko					4		1	5
Lucasium byrnei	Pink-blotched Gecko					9		1	10
Rhynchoedura ornata	Beaked Gecko							1	1
GEKKONIDAE	**Climbing Geckos**								
Gehyra lazelli	Southern Rock Dtella					6	1		7
Gehyra purpurascens	Purple Dtella							2	2
Gehyra variegata	Tree Dtella			1		9	14	28	52
Heteronotia binoei	Bynoe's Gecko			1		8	11	17	37
Oedura marmorata	Marbled Velvet Gecko	R				1	2	2	5
PYGOPODIDAE	**Legless Lizards**								
Delma australis	Barred Snake-lizard					1			1
Lialis burtonis	Burton's Legless Lizard					1			1
SCINCIDAE	**Skinks**								
Cryptoblepharus australis	Desert Wall Skink				1	1	11	13	26
Ctenotus olympicus	Saltbush Ctenotus					1		5	6
Ctenotus orientalis	Spotted Ctenotus						2	3	5
Ctenotus regius	Eastern Desert Ctenotus							2	2
Ctenotus robustus	Eastern Striped Skink				3	7		3	13
Ctenotus schomburgkii	Sandplain Ctenotus						1	4	5
Egernia stokesii	Gidgee Skink			1			5		6
Egernia striolata	Eastern Tree Skink					3			3
Eremiascincus richardsonii	Broad-banded Sandswimmer							2	2
Lerista punctatovittata	Spotted Slider			1			2		3
Lerista timida	Dwarf Three-toed Slider					4	1	10	15
Liopholis margaretae	Masked Rock Skink			1	1	1	2		5
Menetia greyii	Dwarf Skink					4	1	3	8
Morethia boulengeri	Common Snake-eye				3	3	5	34	45
Tiliqua rugosa	Sleepy Lizard						2	2	4
Snakes									
ELAPIDAE	**Elapid Snakes**								
Pseudechis australis	Mulga Snake					1			1
Vermicella annulata	Common Bandy-Bandy	R	1						1
Total No. of Species			**1**	**7**	**4**	**20**	**18**	**22**	**33**
Total No. of Records			**1**	**7**	**8**	**79**	**77**	**143**	**315**

APPENDIX 18. REPTILE SPECIES RECORDED AT EACH SITE ON THE 2009 NANTAWARRINA IPA BIOLOGICAL SURVEY.

BS636 Recs Number of records from the 2009 Nantawarrina IPA Biological Survey.
BS636 Sites Number of sites each species recorded at during the 2009 Nantawarrina IPA Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.

Species Name	Common Name	IRI00101	IRI00201	IRI00301	IRI00401	IRI00501	IRI00601	IRI00701	ORA00101	ORA00201	ORA00301	ORA00401	ORA00501	ORA00601	ORA00701	ORA00801	PLA00101	PLA00201	PLA00301	PLA00401	PLA00501	PLA00601	BS636 Recs	BS636 Sites	Total Recs	Total Sites
Cryptoblepharus australis	Desert Wall Skink	1	1							1		1		1	1		3	2			2		13	9	14	10
Ctenophorus decresii	Tawny Dragon																								2	1
Ctenophorus vadnappa	Red-barred Dragon							2						1				2					5	3	13	6
Ctenotus olympicus	Saltbush Ctenotus	1							2		1	1											5	4	6	5
Ctenotus orientalis	Spotted Ctenotus					1		1											1				3	3	3	3
Ctenotus regius	Eastern Desert Ctenotus													1		1							2	2	2	2
Ctenotus robustus	Eastern Striped Skink					1												2					3	2	10	4
Ctenotus schomburgkii	Sandplain Ctenotus												1			3							4	2	4	2
Delma australis	Barred Snake-lizard																								1	1
Diplodactylus furcosus	Ranges Stone Gecko		1																				1	1	5	4
Diporiphora nobbi	Nobbi Dragon															1							1	1	1	1
Egernia striolata	Eastern Tree Skink																								3	2
Eremiascincus richardsonii	Broad-banded Sandswimmer					1		1															2	2	2	2
Gehyra lazelli	Southern Rock Dtella																								6	2
Gehyra purpurascens	Purple Dtella	1															1						2	2	2	2
Gehyra variegata	Tree Dtella	2	1	1				3		2	1	4		8	1	1		2	2				28	12	37	16
Heteronotia binoei	Bynoe's Gecko	1	1	4	2					3	1			4			1						17	8	25	13
Lerista timida	Dwarf Three-toed Slider		2																1		4	3	10	4	14	6
Lialis burtonis	Burton's Legless Lizard																								1	1
Liopholis margaretae	Masked Rock Skink																								1	1
Lucasium byrnei	Pink-blotched Gecko								1														1	1	10	2
Menetia greyii	Dwarf Skink	1								1						1							3	3	7	4
Morethia boulengeri	Common Snake-eye		1		2					4					1	5	13	4			2	2	34	9	37	12
Oedura marmorata	Marbled Velvet Gecko													1					1				2	2	3	3
Pogona vitticeps	Central Bearded Dragon					1					1												2	2	2	2
Pseudechis australis	Mulga Snake																								1	1
Rhynchoedura ornata	Beaked Gecko	1																					1	1	1	1
Tiliqua rugosa	Sleepy Lizard						1							1									2	2	2	2
Tympanocryptis tetraporophora	Eyrean Earless Dragon						1						1										2	2	7	3
Total Reptile Records		**8**	**7**	**5**	**4**	**4**	**2**	**7**	**3**	**11**	**4**	**6**	**2**	**17**	**3**	**12**	**18**	**12**	**5**	**0**	**8**	**5**	**143**	**21**	**222**	**27**
Total Reptile Species		**7**	**6**	**2**	**2**	**4**	**2**	**4**	**2**	**5**	**4**	**3**	**2**	**7**	**3**	**6**	**4**	**5**	**4**	**0**	**3**	**2**	**22**		**29**	

APPENDIX 19. REPTILE SPECIES RECORDED AT FLINDERS RANGES BIOLOGICAL SURVEY SITES WITHIN THE NANTAWARRINA IPA.

BS104 Recs Number of records from the 1999 Flinders Ranges Biological Survey.
BS104 Sites Number of sites each species recorded at during the 1999 Flinders Ranges Biological Survey.
Tot Recs Total number of records from both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.
Tot Sites Total number of sites each species recorded at for both the 1999 Flinders Ranges and 2009 Nantawarrina IPA Biological Surveys.

Species Name	Common Name	GAP00601	NAN00201	NAN00301	NAN00401	NAN00501	NAN00601	BS104 Recs	BS104 Sites	Total Recs	Total Sites
Cryptoblepharus australis	Desert Wall Skink		1					1	1	14	10
Ctenophorus decresii	Tawny Dragon	2						2	1	2	1
Ctenophorus vadnappa	Red-barred Dragon			1	2	5		8	3	13	6
Ctenotus olympicus	Saltbush Ctenotus					1		1	1	6	5
Ctenotus orientalis	Spotted Ctenotus									3	3
Ctenotus regius	Eastern Desert Ctenotus									2	2
Ctenotus robustus	Eastern Striped Skink	5				2		7	2	10	4
Ctenotus schomburgkii	Sandplain Ctenotus									4	2
Delma australis	Barred Snake-lizard	1						1	1	1	1
Diplodactylus furcosus	Ranges Stone Gecko		2	1		1		4	3	5	4
Diporiphora nobbi	Nobbi Dragon									1	1
Egernia striolata	Eastern Tree Skink		2	1				3	2	3	2
Eremiascincus richardsonii	Broad-banded Sandswimmer									2	2
Gehyra lazelli	Southern Rock Dtella	4			2			6	2	6	2
Gehyra purpurascens	Purple Dtella									2	2
Gehyra variegata	Tree Dtella		2	5	1	1		9	4	37	16
Heteronotia binoei	Bynoe's Gecko	1	3	1		2	1	8	5	25	13
Lerista timida	Dwarf Three-toed Slider				3	1		4	2	14	6
Lialis burtonis	Burton's Legless Lizard	1						1	1	1	1
Liopholis margaretae	Masked Rock Skink	1						1	1	1	1
Lucasium byrnei	Pink-blotched Gecko						9	9	1	10	2
Menetia greyii	Dwarf Skink	4						4	1	7	4
Morethia boulengeri	Common Snake-eye	1			1	1		3	3	37	12
Oedura marmorata	Marbled Velvet Gecko			1				1	1	3	3
Pogona vitticeps	Central Bearded Dragon									2	2
Pseudechis australis	Mulga Snake		1					1	1	1	1
Rhynchoedura ornata	Beaked Gecko									1	1
Tiliqua rugosa	Sleepy Lizard									2	2
Tympanocryptis tetraporophora	Eyrean Earless Dragon						5	5	1	7	3
Total Reptile Records		**20**	**11**	**10**	**9**	**14**	**15**	**79**	**6**	**222**	**27**
Total Reptile Species		**9**	**6**	**6**	**5**	**8**	**3**	**20**		**29**	