Wingellina Nickel Project

Terrestrial Fauna Assessment

April 2009

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EXECUTIVE SUMMARY

Outback Ecology was commissioned by Metals X Limited to conduct a terrestrial fauna assessment of the Wingellina Nickel Project (project area), within exploration tenement E69/535 in Western Australia. The fauna survey was one component of a broader study undertaken concurrently by Outback Ecology, including assessment of vegetation and flora, subterranean fauna, soils and waste materials within the project area.

The project area is approximately 8 km south-west of Surveyor Generals Corner, within the Wingellina Hills, which lie to the north of the Musgrave Ranges in the Ngaanyatjarra Lands Indigenous Protected Area. The project area lies within the Mann-Musgrave subregion of the Central Ranges bioregion.

The objectives of the terrestrial fauna assessment of the Wingellina project were to:

- Develop an inventory of terrestrial vertebrate fauna species, and selected invertebrate fauna considered as potential short-range endemics, identified from the project area, or likely to be present within the project area. This incorporated a desktop review of available information and background information to delineate habitat variables;
- Assess site information in the regional context by comparisons with available data from other localities within the bioregion, and to provide an assessment of current and potential impacts on significant fauna populations and habitats;
- Provide quantitative data that can provide both, a baseline against which future impacts and rehabilitation can be assessed, and the basis of a monitoring program.

This report documents the results of the fauna survey undertaken over a 10 day period from the 8 – 17 April 2008. The report also presents a summary of terrestrial fauna species previously recorded in the project area and surrounds.

The survey involved a variety of sampling techniques, including systematic and opportunistic sampling. Systematic sampling was undertaken over a fixed time period using a standardised sampling effort in each of the broad fauna habitats identified within the project area. Opportunistic sampling included data collected non-systematically within and outside of fixed sampling sites.

Broad habitats identified within the project area include: sparse mulga woodland/grasses; open mulga woodland; open mallee woodland over spinifex; open mallee woodland over dense spinifex, rocky escarpment and open dead mulga woodland.

Fauna survey techniques implemented during the survey included pitfall traps, Elliott traps, funnel traps and cage traps, active searching, soil sieving (invertebrates), spotlighting, Anabat recording of bat echolocation calls and avifauna censussing.

Terrestrial Vertebrate Fauna

A total of 66 terrestrial vertebrate fauna species were recorded during the survey which were comprised of: 17 mammal species (10 native and 6 introduced), 26 reptiles and 23 bird species.

One species of conservation significance was recorded during the survey, the Australian Bustard (*Ardeotis australis*) which is listed as a Priority 4 species under WA Department of Environment and Conservation (DEC) Priority Species List.

Species of conservation significance that were not recorded during the survey that are considered likely to occur over the project area, at least intermittently, include: the Princess Parrot (*Polytelis alexandrae*) which is listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act*, *1999* (EPBC Act); and the Rainbow Bee-eater (*Merops ornatus*) and Fork-tailed Swift (*Apus pacificus*), which are listed as Migratory species under the EPBC Act.

The broad vertebrate fauna habitats identified within the project area are widely represented throughout the region, and the vertebrate fauna assemblage recorded is similar to other regional sites. The development of the project will impact fauna through direct loss of fauna during land clearing, loss of habitat and indirect impacts. The project is unlikely to have a significant impact on any vertebrate fauna species (including any conservation significant fauna species) due to the presence of similar habitat in close proximity to the project area.

Terrestrial Short Range Endemic Invertebrate Fauna

The Short-range Endemic (SRE) invertebrate component of the survey targeted invertebrate groups that have the potential for restricted ranges such as mygalomorph spiders, scorpions, pseudoscorpions and terrestrial snails. Specimens collected in the field were distributed to Western Australian specialists form the University of Western Australia and the Western Australian Museum for identification.

Six previously unknown species with the potential for short range endemism were collected during the survey. These were comprised of five mygalomorph spider species: *Aganippe* sp. nov “Wingellina” sp. 1., *Ananippe* sp. nov “Wingellina” sp. 2, *Kwonkan* sp. 1 sp. nov, *Kwonkan* sp. 2 sp. nov, *Cethegus sp*; and one pseudoscorpion species *Synsphyronus* sp. “Wingellina”.

Rocky escarpments were found to support three of these potential SRE species: the mygalomorph spiders *Ananippe* sp. nov “Wingellina” sp. 2 and *Kwonkan* sp. 2 sp. nov; and the pseudoscorpion *Synsphyronus* sp. “Wingellina”. The rocky escarpments are a limited habitat type in the region and it is likely that these species have a restricted geographic range within this habitat type. Based on the conceptual project layout, it is considered unlikely that the proposed mining footprint will disturb the rocky escarpment habitat.

The mygalomorph *Cethegus* sp was collected within Open sparse Mulga woodland over grasses on clay habitat (MWN05). Vegetation mapping of the project area indicates this habitat exists over a large area in the north east of the project area and also in sections to the south of the project area (Outback Ecology

2009). Main (2008) proposes that the species is likely to have a wider distribution in appropriate habitats although suggests that this habitat type may have a high importance for this species. The proposed Wingellina tailings dam footprint will disturb a large portion of this habitat type within the project area. However, this habitat type is widely represented inside and outside of the project area. Additionally, the habitat type has been degraded by fires and heavy grazing by camels. Control of inappropriate fire regimes and reductions in camel numbers are likely to relieve substantial pressure on this habitat type within and outside the Wingellina project area.

The mygalomorph spider *Kwonkan* sp. 1 sp. nov. was collected within the Open Mallee woodland over Spinifex habitat and is likely to have a restricted distribution (Main 2008). The Open Mallee woodland over Spinifex habitat occurs along the base of the hills that run from north west to south east through the project area. This habitat type is expected to be widely represented within the surrounding landscape and subsequently it is considered likely that this species occurs in areas outside of the proposed disturbance footprints.

The mygalomorph spider species *Aganippe* sp. nov “Wingellina” sp. 1. was collected within three habitat types: Open Mallee Woodland over Spinifex; Open Dead Mulga Woodland over grasses and Mallee over dense Spinifex. As this species was collected in a variety of habitats that occur both within and outside the project area, it is unlikely that the proposed mining footprint will have a substantial impact upon this species.

General management guidelines to minimise potential impacts of the project on the terrestrial fauna occurring within the project area are provided in this report.

Outback Ecology conducted surveys in the project area in a manner that was sensitive to the traditional owners. During the field survey, a traditional elder of the Wingellina community accompanied the field surveyors on several occasions.

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1.0 INTRODUCTION

1.1 Project Background

Outback Ecology was commissioned by Metals X Limited (Metals X) to conduct a terrestrial fauna assessment of the Wingellina Nickel Project (the project area), within exploration tenement E69/535 in Western Australia. The fauna survey was one component of a broader study undertaken concurrently by Outback Ecology, including assessment of vegetation and flora, subterranean fauna, soils and waste materials within the project area.

For the purposes of this fauna assessment, the project area is defined by the E69/535 tenement boundary, located approximately 8 km south-west of Surveyor Generals Corner (**Figure 1**) within the Wingellina Hills, which lie to the north of the Musgrave Ranges in the Ngaanyatjarra Lands Indigenous Protected Area. The project area lies within the Man-Musgrave subregion of Central Ranges bioregion, one of the 85 biogeographic regions of the Interim Biogeographic Regionalisation for Australia (IBRA).

1.2 Scope and Objectives of the Survey

This report documents the results of a terrestrial fauna survey conducted over the project area from 8-17 April 2008.

The fauna survey was planned and implemented as far as practicable in accordance with the Environmental Protection Authority (EPA) Position Statement No 3. “Terrestrial Biological Surveys as an Element of Biodiversity Protection” (EPA, 2002); and Guidance Statement No 56 “Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia” (EPA, 2004).

The overall objectives of the terrestrial fauna assessment of the Wingellina project area were to:

a) Develop an inventory of terrestrial vertebrate fauna species and selected invertebrate fauna identified from the project area, or likely to be present within the project area. This incorporated a desktop review of available information and detailed survey of terrestrial fauna at the locality, incorporating techniques appropriate to the region and scale of impact.
b) Assess site information in the regional context by comparisons with available data from other localities within the bioregion, and to provide an assessment of current and potential impacts on significant fauna populations and habitats.
c) Provide quantitative data that can provide a baseline against which future impacts and rehabilitation can be assessed, and the basis of a monitoring program.

The study included:

- A review of:
    - Vertebrate fauna assemblages and habitats in the bioregion;
    - Fauna species of particular conservation significance potentially present over the project area (including threatened and priority fauna, geographically restricted fauna, and invertebrate short-range endemics);
    - Current impacts to fauna and habitats over the project area; and
    - Potential impacts to terrestrial fauna from the proposed project.
- The identification of :
    - All terrestrial fauna that are present or likely to occur over the project area (incorporating the results of this survey, recent published and unpublished regional records, and an assessment of habitats and likelihood of occurrence);
    - Biologically-significant fauna species at international, national, state, regional and local scales; and
    - Sensitive faunal habitats identified from the project area of particular conservation significance.

1.3 Location of Project Area

The project area is located in the Central Ranges region of Western Australia, approximately 8 km south-west of Surveyors General Corner, the intersection between the Northern Territory, South Australia and Western Australia (**Figure 1**). Metals X currently holds Exploration Licence E69/535 within which the project area is located. **Figure 2** shows the proposed Wingellina project area layout.

The project area is encompasses an area of approximately 100km^2 and is centred around the existing Metals X exploration camp located at: 52 J 495964E, 7117995N (WSG 84).

The project area occurs within the Central Aboriginal Reserve leased by the Ngaanyatjarra Land Council and close to the Wingellina Aboriginal Community (Irrunytiju). Many exclusion zones have been demarcated by the traditional owners and these zones were not surveyed (**Figure 2**).

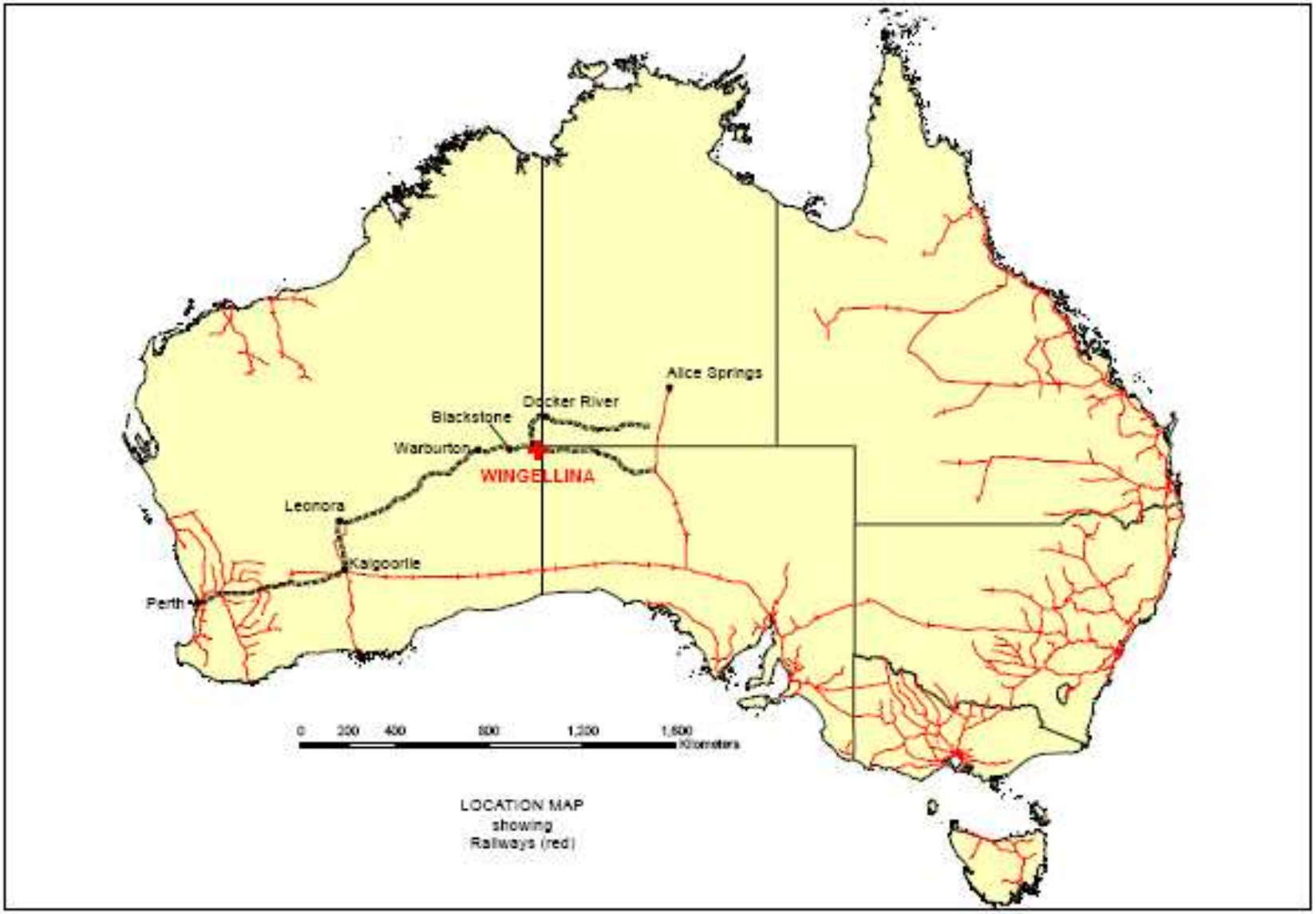

Figure 1 Locality map of the Wingellina project area

1.4 Land Use

1.4.1 Aboriginal Reserve

The majority of the Central Ranges bioregion is Aboriginal freehold land. Only a very small percentage of the area is used for agricultural purposes (Graham and Cowan, 2001).

1.4.2 Mining

The project area was opened for mineral exploration in the 1960's by Inco (HGM, 2002). Metals X purchased the tenement from Acclaim Exploration in 2006. A number of abandoned chrysoprase pits are found throughout the project area (HGM, 2002).

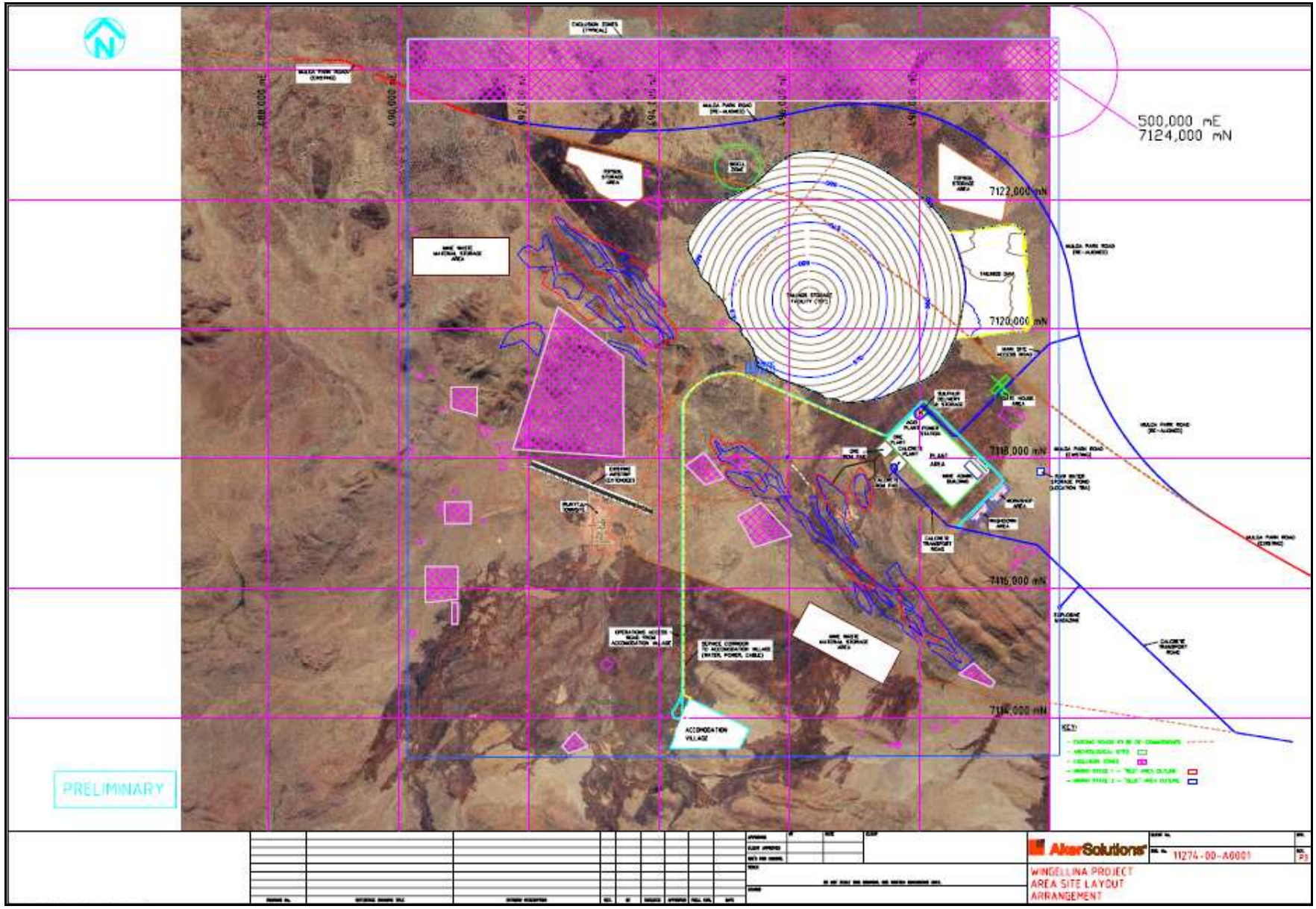

Figure 2 Wingellina project area showing exploration tenement E69/535 boundary and conceptual project layout.

2.0 EXISTING ENVIRONMENT

2.1 Climate

The climate of the Central Ranges is characterised as a true arid desert, with hot summers and mild winters (BOM, 2008). The region is influenced by a northern tropical/summer climatic pattern. Rainfall is variable, however the majority is received during summer, largely due to the movement of low pressure troughs and tropical lows associated with monsoon troughs moving south in the region. Winters are mild and associated with a high pressure subtropical ridge (BOM, 2008).

The Giles weather station is the nearest registered meteorological station, located approximately 130km to the north west of the project area. The weather station was established in 1956 by the Australian Weapons Research Establishment (Defence Science and Technology Organisation) (BOM, 2008). Mean annual rainfall recorded at Giles is 284mm, with the majority received between November and March (**Figure 3**). Mean maximum daily temperature of 37.2 ℃ is re corded during January, with the minimum mean temperature of 6.8 °C recorded during July. (BOM, 2008)

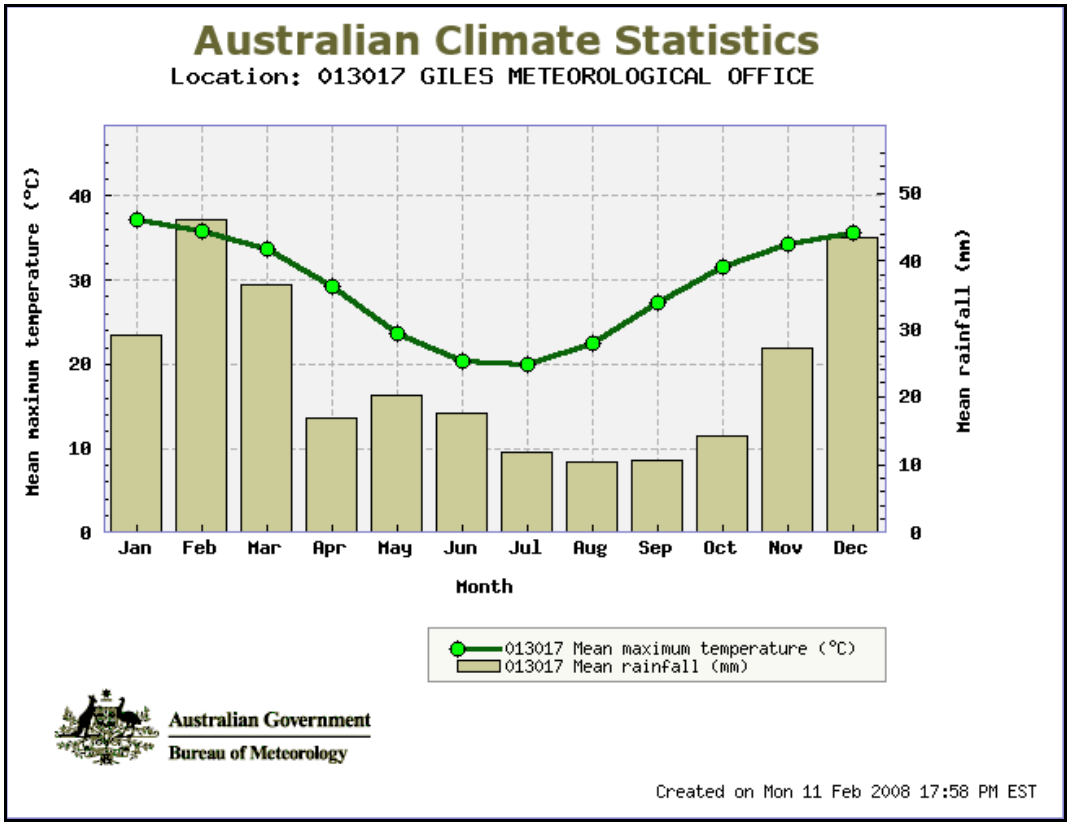

Figure 3 Climate data for Giles Meteorological Station (BOM, 2008).

2.2 Central Ranges Biogeographic Region

The project area is situated in the arid Eyrean Sub-region, one of three very broad sub-regions defined by Heatwole (1987) covering the entire Australian continent, with the others being the tropical Torresian sub-region and the temperate Bassian sub-regions.

Thackway and Cresswell (1995) describe a system of 85 ‘biogeographic regions’ (bioregions) covering the whole of Australia; the result of collaboration between all state conservation agencies with co-ordination by the Australian Government Department of Environment and Heritage (now the Department of Environment and Water Resources). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

Wingellina is located within the Central Ranges Bioregion of the Interim Biogeographic Regionalisation for Australia (or IBRA) (Thackway and Cresswell, 1995). The Central Ranges includes three major components, or sub-regions: Mann-Musgrave (CR1), Wataru (CR2) and Everard (CR3).

The project area lies within the Mann-Musgrave (CR1) sub-region which is characterised by its Proterozoic ranges and derived soil plains with interspersed red Quaternary sandplains (Graham and Cowan, 2001). Vegetation is dominated by open Mulga woodlands and hummock grasslands.

3.0 SURVEY METHODS

3.1 Desktop Review

3.1.1 Database Searches

Database searches were made prior to the field survey. Database search areas were defined by polygons that were centred on the project area and covered at least 250km by 250km (the 'search area') or a point search with a 50km buffer. Database searches of these areas were made using the following databases and internet tools:

- The Western Australian Museum (WAM) FaunaBase database to identify potential vertebrate fauna within the project area (**Appendix A**). The bounding coordinates used were:
    - 24.56°S, 125.65°E; and
    - 27.007°S, 128.97°E.
- The Birds Australia database to identify avifauna potentially occurring over the project area (**Appendix B**).
- Threatened and Priority Fauna Database held by the Department of Environment and Conservation (DEC) to facilitate the identification of species of conservation significance within the project area (**Appendix C**). The bounding coordinates used were:
    - 25.6022°S, 128.427°E; and
    - 26.514°S, 129. 421°E, with a 50km buffer.
- The Australian Natural Resources Atlas of the National Land and Water Resources Audit (NLWRA) to gain information on significant fauna and fauna habitats within the Central Ranges bioregion (**Appendix D**).
- The Environmental Reporting tool of the Australian Government Department of Environment and Water Resources to identify fauna species of national environmental significance (**Appendix E**). The bounding coordinates used were:
    - 24.258°S, 127.010°E; and
    - 27.375°S, 130.530°E.
- The Protected Matters and Environmental Reporting Tools of the Australian Government Department of Environment and Water Resources to identify fauna species of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* potentially occurring within the area (**Appendix F**). The bounding coordinates used were:
    - 24.937°S, 127.230°E; and
    - 27.192°S, 127.230°E.

- The Australian Wetlands Database of the Australian Government Department of Environment and Water Resources to ascertain regionally significant wetland habitats occurring over the project area (**Appendix G**).
- Biological Database held by the Department of Natural Resources, Environment and the Arts (NRETA), Northern Territory. The bounding coordinates used were:
    - 24.66°S, 129.25°E; and
    - 26.20°S, 131.42°E.
- Biological Database of South Australia (BDBSA), Department of Environment and Heritage (DEH). The bounding coordinates used were:
    - 26.12°S, 129.25°E; and
    - 27.29°S, 130.55°E.

3.1.2 Review of Existing Biological Work

Publicly-available literature relevant to the project area, and previous biological survey work undertaken in the bioregion was reviewed.

Key documents reviewed included:

- Halpern Glick Maunsell. (2002) *Acclaim Exploration NL Wingellina Baseline Biological Survey*.
- Robinson, A.C., Copley, P.B., Canty, P.D., Baker, L.M., and Nesbitt, B.J. (2003) *A Biological survey of the Anangu Pitjantjatjara Lands, South Australia 1991-2001*.
- Pearson D., Miller J., Butler M., Butler M., Brennan K., Thompson W. (2006). Learning about country. Landscope Vol. 23 No.2 Summer 2007-08 Naturebase. Department of Environment and Conservation.

Following is a summary of applicable information from each of these key documents, with specific reference to the project area.

HGM Maunsell (2002). Wingellina Baseline Biological Survey

This report includes an inventory of all the flora and fauna recorded during a Level 1 survey of the project area in April 2002. Database searches were undertaken to identify threatened fauna species. Potential species listed under the EPBC Act included the Night Parrot *Pezoporus occidentalis* and Golden Bandicoot *Isoodon auratus* (Endangered nationally), the Princess Parrot *Polytelis alexandrae,* Malleefowl *Leipoa ocellata* and Bilby *Macrotis lagotis* (Vulnerable). Potential species listed under state legislation include ten Scheduled species and seven Priority Fauna. Western Australian Museum database records at the time indicated that 13 bird species, 40 reptiles, one amphibian and nine mammal species had been recorded in the general Warburton region.

No conservation significant fauna species were detected in the project area during this field survey. This preliminary survey yielded 69 terrestrial vertebrate species; namely 54 birds, 10 reptiles and five

mammals (three native and one introduced species). Fire and historical exploration issues were identified as producing the greatest impact on the biological environment within the project area.

A. C. Robinson, P. B. Copley, P. D. Canty, L. M. Baker and B. J. Nesbitt (Eds) (2003). *A Biological Survey of the Anangu Pitjantjatjara Lands, South Australia*.

This report includes an inventory of all the flora and fauna recorded during a survey of the Anangu-Pitjantjatjara (AP) lands in the north-western region of South Australia. It forms part of a comprehensive biological survey of South Australia spanning 10 years. This survey recorded: 41 species of mammals (30 were native species and eleven introduced); 154 species of birds; 97 species of reptiles; and 5 species of frogs.

Two species collected on this survey, the Fat-tailed Dunnart (*Sminthopsis crassicaudata*) and the Narrow-nosed Planigale (*Planigale tenuirostris*), represent additions to the previously known mammal fauna of the AP lands. The survey added eight species to the known bird fauna within the AP lands, with the most notable species being a first record for South Australia of the Spinifex bird (*Eremiornis carteri*). The survey added 33 new reptile species but no new frogs to the previously known fauna. New reptile records included eight new records for South Australia, and the re-discovery of several populations of the Tjakura (*Egernia kintorei*) previously thought to be extinct in South Australia.

Pearson D., Miller J., Butler M., Butler M., Brennan K., Thompson W. (2006). Learning about country. Landscope Vol. 23 No.2 Summer 2007-08 Naturebase, Department of Environment and Conservation

In 2006, a survey of the Ngaanyatjarra lands was performed by the Western Australia Museum (WAM), Department of Environment and Conservation (DEC), South Australian Museum, Department of Environment and Heritage (DEH) (South Australia) and the Ngaanyatjarra people. The survey investigated flora, vertebrate fauna, invertebrates and subterranean fauna. A total of 720 plant specimens were recorded, including 37 species that were either new records or significant range extensions. A new species of Taipan was recorded, (*Oxyuranus temporalis*), and range extensions of several gecko species were documented. One hundred species of spiders identified within this survey are thought to be undescribed.

Information from the database and literature sources outlined above was augmented with additional information relating to species' likelihood of occurrence based upon personal experience and general patterns of distribution and known habitat preferences. Many of the species present on regional lists have specific habitat requirements that may be present in the general area, but not in the specific habitats of the project area. Some species, therefore, will be included in lists but are unlikely to be present in the actual project area. Relevant texts from which information on general patterns of distribution was obtained included:

- Mammals: Churchill (1998); Menkhorst and Knight (2001); Strahan (2002).

- Birds: The Handbook of Australian, New Zealand and Antarctic Birds (Birds Australia, various editors and dates); Barrett *et al*. 2003; Blakers *et al*. (1984); Johnstone and Storr (1998 and 2004);
- Amphibians: Tyler *et al.* (2000).
- Reptiles: Storr *et al*. (1983, 1990, 1999 and 2002); Wilson and Swan (2003).

Comprehensive vegetation mapping over the project area was undertaken by Outback Ecology during a concurrent vegetation and flora study of the project area. Vegetation mapping has been used in this fauna assessment to determine distribution and extent of vertebrate and invertebrate terrestrial fauna habitat.

3.1.3 Targeted Terrestrial Invertebrate Short-range Endemic Groups

Communications with Dr Mark Harvey of the Western Australian Museum (WAM) resulted in the identification of five groups of short-range endemic invertebrates thought most likely to occur over the project area (**Table 1**). The identification of invertebrate species requires the skills of specialists. Internationally-recognised experts from the Western Australian Museum (WAM) and from the University of Western Australia (UWA) were engaged to supervise identifications of any target taxa collected during the survey (**Table 1**).

Table 1 Target SRE groups and associated specialists consulted for formal identifications

Target SRE Group	SRE Specialist and Associated Organisation	
Terrestrial molluscs	Dr. Shirley Slack-Smith	WAM
Scorpions	Dr. Mark Harvey	WAM
Pseudoscorpions	Dr. Mark Harvey	WAM
Myriopods (particularly millipedes)	Dr. Mark Harvey	WAM
Mygalomorph spiders	Prof. Barbara York Main	UWA

3.2 Taxonomy and Nomenclature

Nomenclature and taxonomy of vertebrate species follows that of the WAM provided in the Checklist of the Vertebrates of Western Australia for amphibians, reptiles and mammals (WAM, 2002); and for birds the Birds Australia Draft Working List of Birds of Australia and Australian Territories 2003, based on Christidis and Boles (1994). Invertebrate taxonomy is based on nomenclature provided by the WAM and UWA.

3.3 Survey Timing and Weather

A systematic fauna survey was conducted from the 8 – 17 April, 2008.

Maximum temperatures during the fauna survey ranged between 27.2ºC and 34.7ºC with minima between 11.1ºC and 26.3ºC. Very little rainfall occurred prior to the fauna survey with the highest fall (96.4mm) recorded in December 2007 (BOM, 2008).

3.4 Survey Sampling Methods

The methods adopted for the survey was formulated as far as practicable in context with the Environmental Protection Authority (EPA) Position Statement No 3. "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA, 2002), and Guidance Statement No 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA, 2004).

The inventory of fauna involved a variety of sampling techniques, including systematic and opportunistic sampling. Systematic sampling was that collected over a fixed time period in a discrete vegetation community type, using an equal or standardised sampling effort. Opportunistic sampling includes data collected non-systematically within and outside of fixed sampling sites. Survey design was targeted at the local scale but employed methods that were consistent with regional surveys.

The focus of systematic sampling centred upon the establishment of 14 survey sites of approximately 1.0 ha in size. Where practicable, two representative survey sites were established within each of the broad habitat types identified within the project area. These habitat types included: sparse mulga woodland/grasses; open mulga woodland; open Mallee woodland / spinifex; rocky escarpment; open dead mulga woodland; and mulga woodland / chenopod shrubs (**Table 2**).

3.4.1 Site Selection, Locations and Descriptions

A desktop review of the broad habitat types occurring within the project area was conducted prior to the April 2008 fauna survey. Aerial photography, contour mapping, land systems mapping, and Beard vegetation mapping (1974) were used to determine preliminary site selection, which was based upon the dominant landform and vegetation type.

Sampling sites were chosen as being:

1. Representative of the major fauna habitats present.
2. Representative of areas of environmental impact potentially arising from the proposal.
3. Areas of ecological sensitivity or discrete habitats that may support short-range endemic invertebrates.

A major influence over site selection was the number and frequency of broadscale wildfires over the project area. Examination of Landgate Satellite Remote Sensing Services Fire Scar Mapping (Landgate, 2008) (accurate to 1km) indicated that fires had burnt extensive areas particularly during 1997, 1998 and 2000.

The location and number of sites surveyed is summarised in **Table 2**, with the “Criteria for Selection” referring to those criteria listed above. Fauna survey sites were distributed to encompass a broad cross section of the project area (**Figure 4**). Sites do not cover all differentiated habitats available to the wide range of vertebrates present in the region at a small scale, however they are representative of the major habitats present and provide a useful grouping as a sampling strategy, and within which to discuss species occurrence.

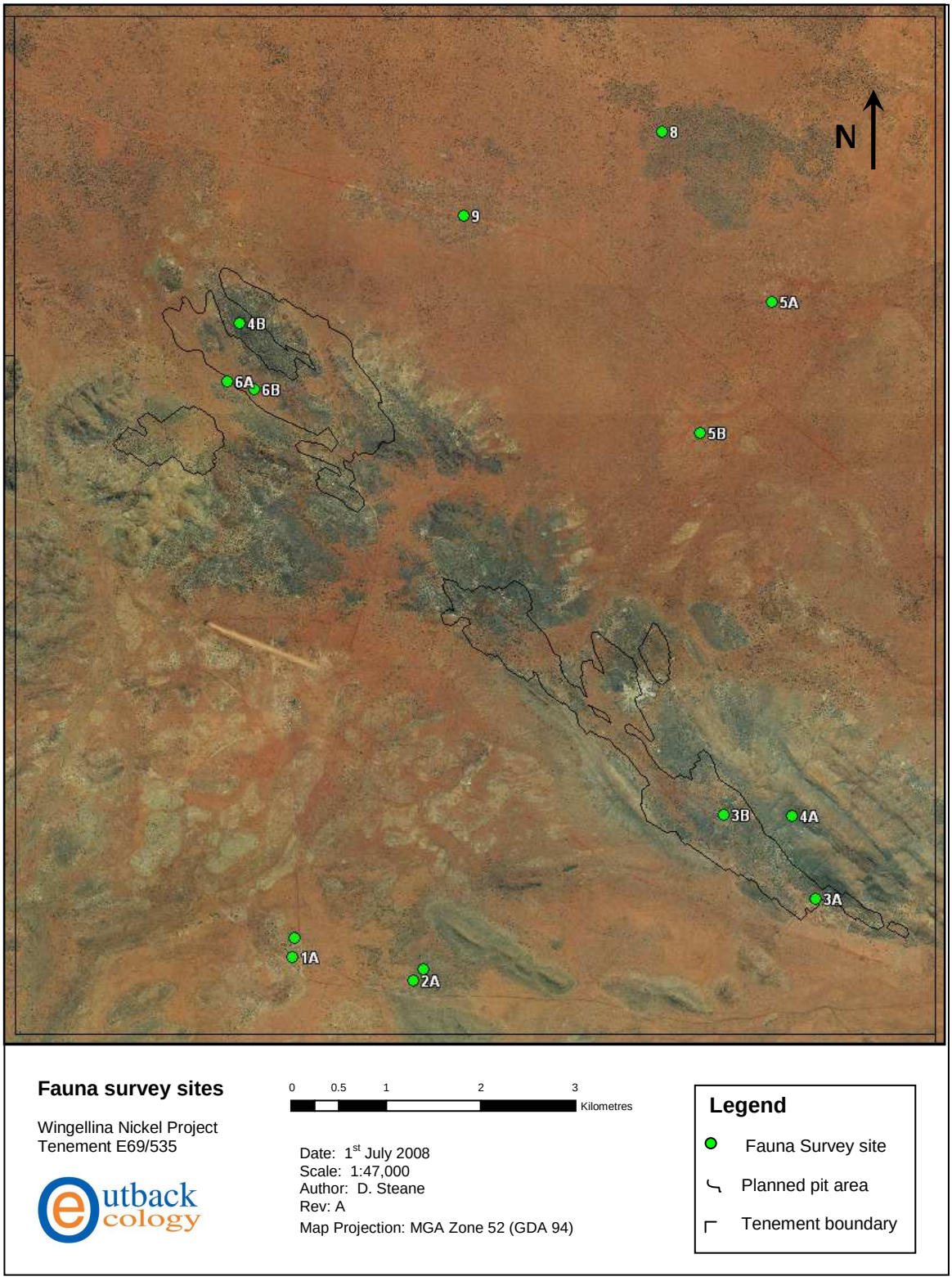

Figure 4 **Locations of terrestrial fauna survey sites established within the Wingellina Project.**

Table 2 Survey site locations within Wingellina project area

Site No	Habitat Type	Criteria for Selection	Location Coordinates (GDA94)
MWN1A	Sparse Mulga woodland/grasses	1	52 J 493144 - 7114240
MWN1B	Sparse Mulga woodland/grasses	1	52 J 493172 - 7114444
MWN2A	Open Mulga woodland	1	52 J 494463 - 7113978
MWN2B	Open Mulga woodland	1	52 J 494571 - 7114103
MWN3A	Open Mallee woodland /spinifex	1, 2, 3	52 J 498834 - 7114873
MWN3B	Open Mallee woodland /spinifex	1, 2, 3	52 J 497833 - 7115784
MWN4A	Rocky escarpment	1, 3	52 J 498574 - 7115773
MWN4B	Rocky escarpment	1, 3	52 J 492573 - 7121128
MWN5A	Sparse Mulga woodland/grasses	1, 2	52 J 498365 - 7121359
MWN5B	Sparse Mulga woodland/grasses	1, 2	52 J 497580 - 7119939
MWN6A	Open dead Mulga woodland	1, 2	52 J 492432 - 7120503
MWN6B	Open dead Mulga woodland	1, 2	52 J 492726 - 7120417
MWN8	Open Mallee woodland/dense spinifex	1, 3	52 J 497164 - 7123220
MWN9	Mulga woodland/chenopod shrubs	1	52 J 495014 - 7122305

Sites MWN1A & B to MWN6A & B were established to sample vertebrate and invertebrate fauna with a combination of trapping, inventory searching, and bird censussing conducted at these sites. Sites MWN8 and MWN9 were sampled by inventory searching only. Survey site descriptions, with photographs, are summarised as follows:

Plate 1 Site MWN1A Sparse Mulga woodland

Plate 2 Site MWN1B Sparse Mulga woodland

Sparse Mulga woodland/grassland site eg. *Acacia aneura, Enteropogon acicularis, Aristida contorta* and *Acacia victoriae* (**Plate 1 & 2**).

Plate 3 Site MWN2A Open Mulga woodland

Plate 4 Site MWN2B Open Mulga woodland

Open Mulga woodland over short grasses and forbes eg. *Acacia aneura, Acacia tenuissima, Acacia kempeana, Enteropogon acicularis, Ptilotus obovatus, Ptilotus sessilfolius* and *Aristida contorta* (**Plate 3 & 4**).

Plate 5 Site MWN3A Mallee over spinifex

Plate 6 Site MWN3B Mallee over spinifex

Mallee over Spinifex loam/clay/gravel substrate eg. *Eucalyptus socialis, Eucalyptus gamophylla, Acacia tenuissima, Triodia scuriousa, Ptilotus obovatus, Eremophila spp* (**Plate 5 & 6**).

Plate 7 Site MWN4A Rocky escarpment

Plate 8 Site MWN4B Rocky escarpment

Rocky Escarpment, Mallee over Spinifex eg. *Eucalyptus socialis, Eucalyptus gamophylla, Acacia* spp, *Aistida contorta, Dodonaea viscosa* ssp *angustissima, Sida* spp, *Senna glutinosa* (**Plate 7 & 8**).

Plate 9 Site MWN5A Open Mulga woodland

Plate 10 Site MWN5B Open Mulga woodland

Open Mulga woodland/ grassland eg. *Acacia aneura, Ptilotus obovatus, Enneapogon* spp, *Digitara coenicola, Aristida contorta, Aristida inaequiglumis, Enteropogon acicularis, Themeda* spp (**Plate 9 & 10**).

Plate 11 Site MWN6A Dead Mulga woodland

Plate 12 Site MWN6B Dead Mulga woodland

Open dead Mulga woodland/grassland eg. *Acacia aneura, Ptilotus obovatus, Enneapogon* spp, *Digitaria coenicola, Arstida contorta, Aristida latifolia, Enteropogon acicularis, Themeda* spp, *Euphorbia drummondii, Euphorbia wheeleri, Cenchrus ciliaris, Sclerolaena cornishiana, Alyogyne pinoniana* (**Plate 11 & 12**).

Plate 13 Site MWN8 Mallee over dense spinifex

Mallee over dense spinifex ground cover, red sandy substrate eg. *Eucalyptus socialis, Triodia* spp, very sparse *Acacia aneura* (**Plate 13**).

Plate 14 Site MWN9 Mulga woodland over chenopod shrubs

Mulga woodland with chenopod shrub understorey eg. *Acacia aneura* (**Plate 14**).

3.4.2 Systematic Censussing

The focus of systematic censussing centred upon the establishment of survey sites of 2.0 ha in size within the major habitats found over the project area. Each survey site was split into two 1.0ha blocks, located in a different area, but within the same habitat type. Within sites MWN1A, MWN1B, MWN2A, MWN2B, MWN3A, MWN3B, MWN5A, MWN5B, MWN6A and MWN6B a standard trapping grid was established that incorporated Pit traps, Elliott box traps, Sheffield cage traps and Funnel traps. Within site MWN4A and MWN4B, Elliott box traps, Sheffield cage traps and Funnel traps were incorporated into the design. Pit traps were not established at MWN4A and MWN4B due to the rocky substrate encountered in this area.

Following is a summary of systematic sampling undertaken at each split survey site:

1. Pitfall traps and drift line: Ten pit traps were positioned in each grid. Two types of pit traps were incorporated into the design: PVC pipe 150mm in diameter and 400mm deep; and standard 20L PVC buckets. Different sized pit traps are used to target particular species. Pit traps were set flush with the surface of the ground, with five traps established in a line, spaced at 7m intervals. Each line of five pits was joined by a single drift line 40cm in height, set into the substrate. Pit traps were checked daily for targeted invertebrates as well as vertebrate fauna.
2. Elliott box traps: One line of ten medium sized Elliott traps (9cm x 9cm x 32cm) were placed within each site in sheltered areas. Traps were baited with a mixture of rolled oats, peanut butter and sardines.
3. Sheffield cage traps: One cage trap was placed within each site in sheltered areas and baited as above.
4. Funnel traps: 2-3 funnel traps measuring 75cm x 18cm x 18cm were placed along the drift line fences at each site.

5. Inventory Searches: Survey sites were hand-searched for cryptic species of vertebrates and targeted invertebrate groups for specific periods of time. Techniques included identification of active animals, raking leaf and bark litter, overturning logs and stones, searching beneath the bark of dead trees, investigating burrows and recording tracks, diggings, scats, and other sign. Bird records were also made during inventory searches. Specific searches were made for the permanent burrows of mygalomorph spiders. Where identified, burrows were excavated and specimens collected. Lids of mygalomorph burrows were also collected for subsequent identification. Searches were made for snail shells at the base of shrubs and hummock grasses.
6. Soil Sieving: Species of terrestrial molluscs may be found within the top 0.2cm to 1.0cm of soil. Samples of this soil layer were collected for inspection in the laboratory. Sieved samples of approximately 0.5L were collected from all sites. Samples were sieved on site, and the < 0.1cm and > 1cm fraction returned to where it was collected. Collected samples were transported from site to the Outback Ecology laboratory in Perth in Eskies.
7. Dry pitfall trapping for invertebrates. Five traps were established at MWN4A and MWN4B. Each trap comprised a 4L plastic container (20cm x 20cm x 10cm), sunk into the ground so that the top of the container is flush with the natural surface profile. A suspended lid was attached to each trap to reduce by-catch and prevent harm (heat exposure, predators etc) to captured specimens. Traps were cleared daily and all specimens preserved.
8. Spotlight Searches: Each survey site was searched at night using spotlights for nocturnal species, such as geckos, snakes, nocturnal birds and invertebrates. Records of species observed when traversing between sites were also made.
9. Avifauna Censussing: Censuses were used to survey the avifauna present within each habitat. The duration of each census was 15 minutes and undertaken during trap clearance. The number of individuals of each species observed and/or heard was recorded. The surveys were carried out in the mornings between 0600hr and 1200hr. To obtain sufficient data bird censussing was un-bounded. That is, observations were not confined to survey site boundaries but all records were made in the vicinity of survey sites and within the habitat represented during the allocated time.

A summary of the trapping components undertaken at each site is given in **Table 3.**

Table 3 Summary of trapping undertaken at each site

Site No	Habitat Description	Pits: 20L bucket	Pipes: 150mm	Elliott Traps	Cage Traps	Funnel Traps	Invertebrate-Pit Traps
MWN1A	Sparse Mulga woodland/grasses	3	2	10	1	3	0
MWN1B	Sparse Mulga woodland/grasses	2	3	10	1	2	0
MWN2A	Open Mulga woodland	3	2	10	1	3	0
MWN2B	Open Mulga woodland	2	3	10	1	2	0
MWN3A	Open Mallee woodland	3	2	10	1	3	0
MWN3B	Open Mallee woodland	2	3	10	1	2	0
MWN4A	Rocky escarpment	0	0	10	1	3	5
MWN4B	Rocky escarpment	0	0	10	1	2	5
MWN5A	Sparse Mulga woodland/grasses	3	2	10	1	3	0
MWN5B	Sparse Mulga woodland/grasses	2	3	10	1	2	0
MWN6A	Open dead Mulga woodland	3	2	10	1	3	0
MWN6B	Open dead Mulga woodland	2	3	10	1	2	0
Total		**25**	**25**	**120**	**12**	**30**	**10**

Systematic Survey Effort

The survey was undertaken by 3 personnel: 2 from Outback Ecology and one from Low Ecological Services. The survey, including trap line establishment, was undertaken over ten days with vertebrate trapping undertaken over a five day period.

Trapping effort displayed as 'trap-nights' is shown in **Table 4**. One trap-night is the equivalent of one trap open for one night. Note that standard pit traps were checked for targeted invertebrates as well as vertebrate fauna. A total of 1180 trap-nights were undertaken over the project area, excluding invertebrate pit traps (**Table 4**).

Table 4 Total systematic trapping effort executed during survey

Site	Habitat Type	Pit Trap-nights	Elliott Trap-nights	Funnel Trap-nights	Cage Trap-nights	Total Trap Nights	Invertebrate Pit Trap-nights
MWN1A	Sparse Mulga woodland/grasses	25	50	30	5	110	0
MWN1B	Sparse Mulga woodland/grasses	25	50	20	5	100	0
MWN2A	Open Mulga woodland	25	50	30	5	110	0
MWN2B	Open Mulga woodland	25	50	20	5	100	0
MWN3A	Open Mallee woodland /spinifex	25	50	30	5	110	0
MWN3B	Open Mallee woodland /spinifex	25	50	20	5	100	0
MWN4A	Rocky escarpment	0	50	30	5	85	25
MWN4B	Rocky escarpment	0	50	20	5	75	25
MWN5A	Sparse Mulga woodland/grasses	25	50	30	5	110	0
MWN5B	Sparse Mulga woodland/grasses	25	50	20	5	100	0
MWN6A	Open dead Mulga woodland	25	50	30	5	110	0
MWN6B	Open dead Mulga woodland	25	50	20	5	100	0
Totals		250	600	300	60	**1180**	50

A total of 4630 minutes was spent undertaking systematic searching during the survey. A breakdown of the various search efforts is provided in **Table 5**. One staff member undertook bird census and two staff members undertook the inventory components. A member of the Wingellina community took part in the majority of the inventory and systematic sampling.

Table 5 Total systematic search effort

Site	Habitat Type	Bird Census (Minutes)	Inventory (Minutes)	Spotlighting (Minutes)	Total (Minutes)
MWN1A	Sparse Mulga woodland/grasses	75	120	60	255
MWN1B	Sparse Mulga woodland/grasses	75	120	60	255
MWN2A	Open Mulga woodland	75	120	60	255
MWN2B	Open Mulga woodland	75	180	60	315
MWN3A	Open Mallee woodland /spinifex	75	160	90	325
MWN3B	Open Mallee woodland /spinifex	75	240	60	375
MWN4A	Rocky escarpment	75	180	180	435
MWN4B	Rocky escarpment	75	210	120	405
MWN5A	Sparse Mulga woodland/grasses	75	120	60	255
MWN5B	Sparse Mulga woodland/grasses	75	120	60	255
MWN6A	Open dead Mulga woodland	75	180	120	375
MWN6B	Open dead Mulga woodland	75	180	180	435
MWN8	Mallee over dense Spinifex	90	180	0	270
MWN9	Live Mulga woodland/chenopod shrubs	60	120	0	180
Total		**1050**	**2530**	**1050**	**4630**

3.4.3 Non-systematic Sampling

To supplement the systematic sampling, the presence of all vertebrate species was recorded wherever and whenever opportunity permitted during surveys.

Non-systematic sampling included:

- Opportunistic sightings: The presence of all vertebrate and invertebrate species encountered was recorded while working and travelling within the project area during the day and night, including during the trap line establishment period. Opportunistic sampling includes data collected non-systematically within and outside fixed sampling quadrats.
- Secondary evidence: Tracks, diggings, scats, burrows and nests were recorded wherever and whenever possible, including invertebrates (particularly mygalomorph burrows).

- Spotlighting (site and nocturnal road surveys): Tracks were traversed in a vehicle at low speeds at night time, with any fauna detected within headlights recorded. Each site was also spotlighted.
- Anecdotal evidence: Observations by members of the Wingellina community and Metals X field staff.

3.4.4 Targeted Searches

Bat Fauna

Bats were sampled primarily via echolocation call detection through electronic detectors. Typical bat habitat such as watercourses, large eucalypts with hollows, or natural surface water was absent over the project area. However, artificial water supplies and rocky outcrops were available (**Plate 15**). The only surface water noted during the survey was located at the exploration camp and at the Wingellina community. Bats often drink at surface water sources after emerging from shelter at dusk and also forage for insects under artificial light. Calls were recorded at the exploration camp and sites MWN3a and MWN4A over four nights (**Table 6**).

Table 6 Bat call detection locations

Date	Site	Technique	Habitat
08/04/2008	Camp No. 1	Anabat onto ZCAIM	Water tank with over spill
09/04/2008	Camp No. 1	Anabat onto Minidisk	Water tank with over spill
10/04/2008	Camp No. 2	Anabat onto Minidisk	Some open water and artificial lighting.
13/04/2007	MWN3A	Anabat onto Minidisk	Mallee over Spinifex
15/04/2008	MWN4A	Anabat onto Minidisk	Rocky Escarpment
16/04/2007	Camp No.3	Anabat onto Minidisk	Artificial lighting around camp
17/04/2007	Camp No.3	Anabat onto Minidisk	Artificial lighting around camp

The echolocation call detection system consisted of an Anabat detector (Titley Electronics, Ballina, NSW) that was used to record ultrasonic bat echolocation calls for analysis. Techniques employed included Anabat detector through ZCAIM (Zero-Crossings Analysis Interface Module), as well as Anabat detector directly onto minidisk (that is, in real time). Interpretation of results were made by Mr Robert Bullen whom has previous experience with bat survey in the area.

Plate 15 Bat call detection site at survey site MWN4A

Other Targeted Searches

From the desktop study and literature review, habitats were identified with the potential to support significant fauna species known from the region. Targeted searches were made for specific or significant terrestrial fauna within specified habitats, with a total of 2530 minutes spent targeted searching during the survey.

Targeted searches included:

1. Mygalomorph spiders and other invertebrates: Litter areas under shrubs (Mallee and Mulga) were searched for mygalomorph (trapdoor spider) burrows as well as the open burrows of the *Teyl* genus.
2. Mulgara: Searches totaling approximately 180 minutes were made for sign or sightings of Mulgara in particular, but also the Greater Bilby, Striated Grasswren and Great Desert Skink. These searches were predominantly conducted over un-burnt sections of dense Spinifex Grasslands at Site MWN8.
3. Black-footed Rock-wallaby and Long-tailed Dunnart: Searches totalling approximately 390 minutes were made for sign or sightings of Black-footed Rock-wallaby and Long-tailed Dunnart at and around the Rocky Escarpments occurring at Site MWN4A and MWN4B.
4. Malleefowl: Searches for the distinctive mounds, or other sign or sightings of Malleefowl were undertaken during the survey period. In addition, specific transect searches were made for the Malleefowl over Sites MWN3A, MWN3B and MWN8. No sign or sighting of Malleefowl was recorded.

3.4.5 Sorting and Identification of Invertebrate Specimens

All invertebrate specimens collected from survey sites were sorted in the field into major taxonomic group. Any specimens of millipedes, scorpions, and pseudoscorpions collected by hand-searching were placed into 70% ethanol immediately upon capture. Spiders were placed in 100% ethanol upon capture due to their softer body parts.

All vials were sealed and labelled before transportation to the Outback Ecology Perth laboratory. Within the laboratory all specimens, including those collected opportunistically, were grouped and labelled into categories suitable for delivery to WAM and UWA. Standard identification keys were used to group specimens (eg. Brunet, 1997; CSIRO, 1970; DEW, 2007; Harvey and Yen, 1989; Raven *et al.* 2002), typically to the level of Order. Spiders were also sorted to differentiate potential mygalomorph species.

Potential mygalomorph spiders were delivered to Professor Barbara York Main of UWA for subsequent identification, and millipede, scorpions and pseudoscorpion specimens were delivered to Dr Mark Harvey of WAM.

The sieved soil samples collected from survey sites were inspected for terrestrial mollusc specimens in the Outback Ecology Laboratory in Perth. A thin layer of soil was placed into a gridded petri dish and inspected under 2.5 X magnification. Mollusc specimens collected were subsequently wrapped in tissue, placed in labelled vials and delivered to Ms Shirley Slack-Smith of WAM.

4.0 VERTEBRATE FAUNA

4.1 Sampling Adequacy

Standard species accumulation curves were produced for the different vertebrate groups recorded during the survey period as a basic aid to assessing sampling adequacy. Data is inclusive of all sampling methods, however in regard to mammals excludes bats, feral animals, and domestic stock, and is presented as the number of species recorded over time.

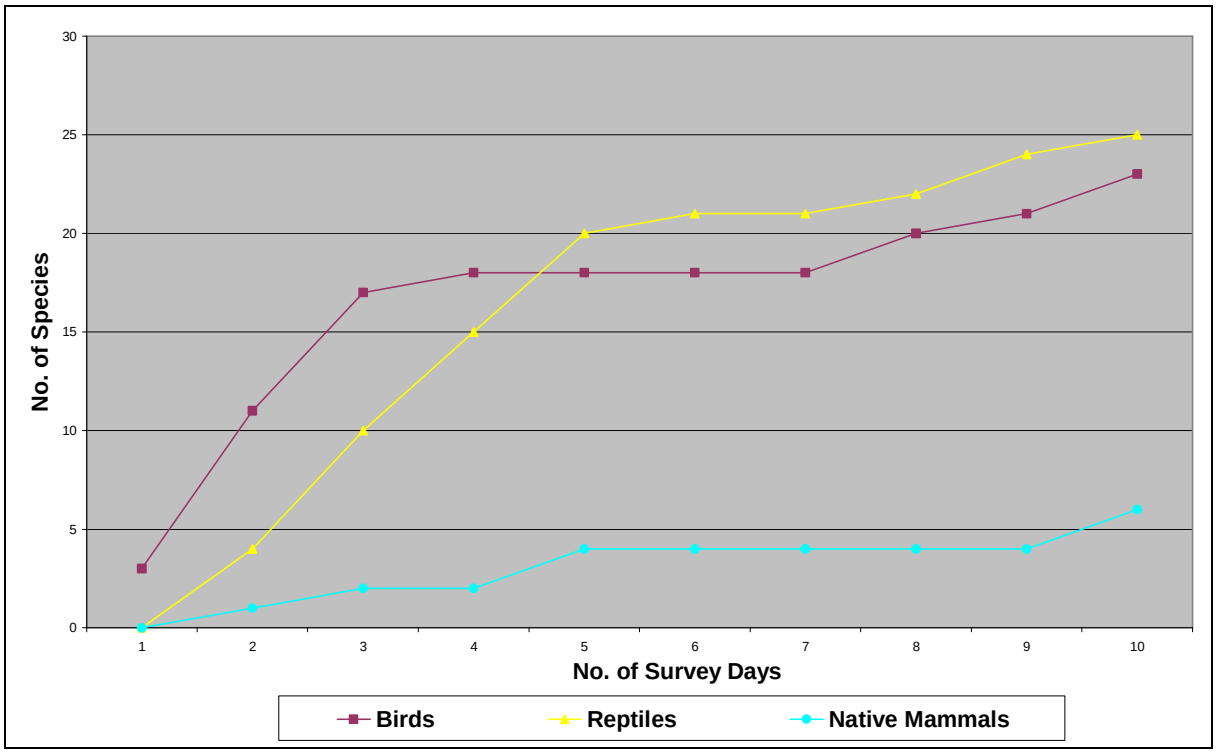

Figure 5 Species accumulation curves for vertebrate fauna recorded in the project area

The number of bird species recorded increased quickly to 18 by day four and increased by a further two species by day 8. However, new birds species were still being recorded at day nine and ten, with 3 additional species recorded over the last two days (**Figure 5**).

The species accumulation curve for native mammals indicates that two mammal species were caught during the first three days before slowly rising to four species caught on day five. However there was a jump as two new species were detected on day ten (all recorded at MWN8 which is dominated by a dense spinifex understorey) (**Figure 5**). The number of mammal species recorded was expected for the bioregion, with the number of small mammal species occurring relatively low compared to birds and reptiles. Small dasyurids in particular, often have wide but patchy distribution with low population densities. With an absence of fixed home ranges they are often considered 'serially nomadic', dispersing widely until favourable conditions are encountered (Gibson and McKenzie, 2005). Two small, and one medium-sized dasyurids were captured during the survey.

The number of new reptile species recorded increased quickly to day 5. Five new species were recorded over day 5 and day 10 **(Figure 5**).

The survey effort is presented in **Table 4** and **Table 5**, with a total of 1180 vertebrate trap nights and 4630 minutes spent on systematic surveys within representative habitats and on targeted searches. More than 330 records were made during the trapping component of the surveys, and evidence of 17 mammals, 26 reptiles and 23 bird species recorded.

Data suggests that sampling was adequate for the particular season sampled. However, sampling a month earlier would likely have increased numbers of all groups recorded within the project area, particularly reptiles. Sampling after a major rain event tends to increase the number of bird species recorded. Due to the prevailing weather conditions experienced during sampling events no amphibians were recorded over the project area.

4.2 Vertebrate Fauna Habitats

The six sites selected for systematic surveying represented fauna habitats that are: characteristic of the project area; are part of the impact area; and are generally consistent with classifications used elsewhere in biodiversity assessments.

Fauna habitats where systematic surveying was undertaken were classified as:

- Sparse Mulga woodland/grasses (Sites MWN1A and MWN1B)
- Open Mulga woodland (Sites MWN2a and MWN2B)
- Open Mallee woodland /Spinifex (Sites MWN3A and MWN3B)
- Rocky escarpment (Sites MWN4A and MWN4B)
- Sparse Mulga woodland/grasses (Sites MWN5A and MWN5B)
- Open dead Mulga woodland (Sites MWN6A and MWN6B)

Spinifex and shrubland habitats over the project area are significantly impacted by frequent fire, by camel grazing and weed invasion. Selection of survey sites was heavily biased towards areas of unburnt vegetation.

Table 7 Abundances recorded at survey sites

Group	Sites														
	MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Mammals (excluding bats and exotics)	1	0	0	1	1	0	9	4	1	1	0	0	1	0	7
Birds	11	6	9	9	7	3	5	3	6	10	10	8	0	1	6
Reptiles	5	20	11	8	8	10	0	3	13	1	9	10	6	0	16
Total	**17**	**26**	**20**	**18**	**16**	**13**	**14**	**10**	**20**	**12**	**19**	**18**	**7**	**1**	**29**

Table 8 Species richness - Number of species recorded at survey sites

Group	Sites														
	MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Mammals (excluding bats and exotics)	1	0	0	1	1	0	2	2	1	1	0	0	1	0	2
Birds	10	4	5	5	5	1	3	3	1	4	6	4	0	1	6
Reptiles	1	7	6	5	8	7	0	3	2	1	6	4	2	0	6
Total	**12**	**11**	**11**	**11**	**14**	**8**	**5**	**8**	**4**	**6**	**12**	**8**	**3**	**1**	**14**

Sites MWN1A, MWN1B, MWN2A, MWN2B, MWN3A, MWN3B, MWN6A and MWN6B recorded greater species richness for birds and reptiles than did other sites (**Table 8**). Moreover, abundances also reflected this trend for reptiles (**Table 7**) and birds (excluding Sites MWN3A and MWN3B). Reptile species richness was lower at sites MWN4A, MWN4B, MWN5A and MWN5B. These sites lacked sandy substrates which are important to a wide-range of burrowing and fossorial ground fauna. Bird diversity was likely to be influenced by the structural complexity of woodland habitats.

Sites that recorded lower overall species richness tended to support species that were absent at other, more productive sites. For example, the Fat-tailed False Antechinus, *Pseudantechinus macdonnellensis*, were recorded exclusively at site MWN4A and MWN4B.

4.3 Vertebrate Fauna Recorded within the Project Area

Results of database searches are presented in **Appendices A** to **G**. Species lists have been prepared for the project area based on: a search of the available literature; information obtained from the WA Museum fauna database; published and unpublished information relevant to the area; and records of the survey over the project area combined with knowledge of habitat preferences and the habitats that actually occur over the project area. Records of species identified from the project area during the survey are detailed below.

4.3.1 Mammals

Seventeen species of mammals were recorded over the project area. Of these, ten were native species: three dasyurids (carnivorous marsupials), one native rodent, one macropod and five bats (**Table 9** and **Table 10**). Three native mammals and one introduced were recorded by HGM (2002) during the 2002 survey of the project area.

There are 41 mammal species known from the entire Central Ranges bioregion (NLWA, 2002), and WAM searches list 25 mammal species recorded in the general vicinity of the project area (**Appendix A**).

Furthermore, NLWA (2002) considers that some mammal species no longer occur in the bioregion, and a number of species are now extinct (e.g. Burrowing Bettong, Lesser Stick-nest Rat, Pig-footed Bandicoot, Crescent Nailtail Wallaby, Long-tailed Hopping-mouse and Short-tailed Hopping-mouse). Apart from the Hopping-mice, all these species are of the critical weight range (CWR) mammals (weights between 35g and 5,500g) that have been most affected by environmental changes following European settlement, predominantly due to fox and cat predation (Burbidge and McKenzie, 1998). The bioregion, therefore, has very high ‘faunal attrition’ and ‘faunal contraction’ indices at 0.45 and 0.44 respectively (NLWA, 2002).

All native mammals were either trapped, or recorded through inventory, spotlight searches and ANABAT recordings. Evidence of all mammals, other than bats, wild dogs and feral cats, were

recorded within survey sites. The red fox was not recorded during the survey. Large numbers of wild dogs and dingos may be suppressing this species.

Mr. S. Mervin, a traditional elder from Wingellina community, remembered seeing Burrowing Bettongs (*Bettongia lesueur*) up to 50 years ago within the project area and surrounds. This species is now considered regionally extinct. **Plate 16** shows an aerial view of some of the project area. The distinctive white blotch was an old warren system excavated by Burrowing Bettongs. The old warren gained the distinctive colouration from calcrete being brought to the surface. Many of these warren systems now contain rabbits.

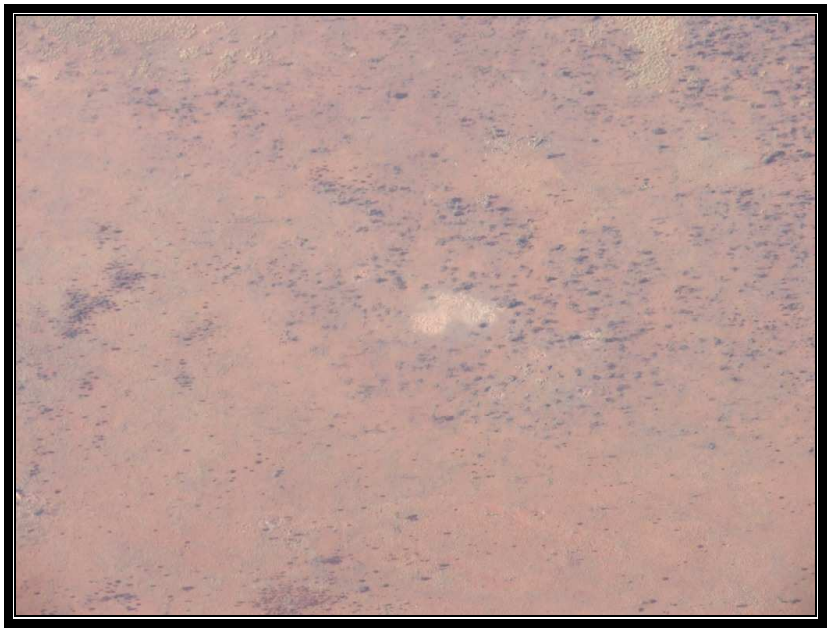

Plate 15 Aerial view of a redundant Burrowing Bettong warren system

Five bat species were recorded during the survey (**Table 9**). Given the habitats present, the identification of five species during the survey is considered a satisfactory result. *Taphozous hilli* and *Vespadelus finlaysoni* roost in crevices and caves, however only *Vespadelus finlaysoni* was recorded at the rocky escarpment survey site (MWN4). Interestingly, both species were recorded at the camp site. The other three species are known to use hollows in trees as roost sites and are therefore may roost over the project area in woodland habitats. HGM (2002) recorded the White-striped Mastiff-bat *Tadarida Australia* near the exploration camp. This species was not recorded during the survey. None of the bat species recorded are of conservation significance.

Table 9 Bat species recorded within the Wingellina project area

Species		SITE				
Common Name	***Scientific Name***	**Camp No. 1**	**Camp No. 2**	**Camp No. 3**	**MWN3A**	**MWN4A**
Gould's Wattled Bat	*Chalinolobus gouldii*	X	X	X	X	
Finlayson's Cave Bat	*Vespadelus finlaysoni*	X	X		X	X
Lesser long-eared Bat	*Nyctophilus geoffroyi*		X	X	X	
Inland Broad-nosed Bat	*Scotorepens balstoni*		X		X	
Hill's Sheathtail Bat	*Taphozous hilli*	X	X			

Table 10 Mammals (excluding bats) recorded within the Wingellina project area during the survey

Species		Sites														
Common Name	***Scientific Name***	MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Striped -faced Dunnart	*Sminthopsis macroura*	X														
Fat-tailed Dunnart	*Sminthopsis crassicaudata*				X											
Fat-tailed False Antechinus	*Pseudantechinus macdonnellensis*							X	X							
Euro	*Macropus robustus erubescens*					X		X	X	X						
Spinifex Hopping-mouse	*Notomys alexis*													X		
*House Mouse	*Mus Musculus*	X	X	X	X		X			X	X	X	X			
*Dingo	*Canis lupus dingo*										X					
*Wild Dog	*Canis familiaris*															X
*Feral Cat	*Felis catus*															X
*European Rabbit	*Oryctolagus cuniculus*	X	X	X	X	X	X			X	X	X	X			
*One-humped Camel	*Camelus dromedarius*	X	X	X	X	X	X	X	X	X	X	X	X	X		

* Introduced species

4.3.2 Birds

Twenty three bird species were observed during the survey (**Table 11**). This compares with 54 recorded by HGM (2002) over the project area in 2002; the 33 species listed by the WAM FaunaBase database as occurring over the project area; and 151 species listed by Birds Australia as occurring in the Central Ranges Bioregion (**Appendix B**) (Blakers *et al*. 1984; Barrett, *et al.* 2003). Differences in numbers are due to differences in survey scale, survey intensity and weather conditions. Scale refers to the size of area surveyed and variability of habitats covered. Survey intensity includes the length of the survey period as well as timing of surveys. For example, Birds Australia data was accumulated over many years over the entire bioregion within numerous habitats.

4.3.3 Reptiles

Twenty six reptile species were recorded during the survey, including seven geckos, six dragons, two legless lizards, two monitors and nine skinks (**Table 12**). Nine reptile species were recorded by HGM during the 2002 biological survey of the project area.

The Central Ranges Bioregion is rich in reptiles and over 76 species are listed for the region within the WAM FaunaBase database (**Appendix A**). However, due to the lack of suitable reptile habitats over the project area that are represented elsewhere in the bioregion, the number is likely to be significantly lower.

Although habitat preferences for reptiles are not completely understood, dunefields, granite tors and riverine habitats are all habitats that are not represented over the project area that support a large number of species.

Anecdotal records exist for the Black-collared Dragon *(Ctenophorus clayi)* and Pebble Dragon (*Tympanocryptis cephalus*) from the Wingellina project area (Mr. S. Mervin, pers comm., 2008).

Table 11 Bird species recorded within the Wingellina project area during the survey

Species		Sites														
		MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Bourke's Parrot	*Neopsephotus bourkii*														X	
Budgie	*Melopsittacus undulatus*	X		X												
Brown Falcon	*Falco berigora*	X	X	X	X	X		X	X			X	X			
Crested Bellbird	*Oreoica gutturalis*	X				X										
Magpie	*Gymnorhina tibicen*	X	X													X
Pied Butcher Bird	*Cracticus nigrogularis*	X										X				X
Torresian Crow	*Corvus orru*	X	X	X	X	X	X	X	X	X	X	X	X			
Richard's Pipit	*Anthus novaeseelandiae*	X		X	X						X					
Pallid Cuckoo	*Cacomantis pallidus*	X														
Zebra Finch	*Taeniopygia guttata*	X									X	X				X
Australian Bustard	*Ardeotis australis*				X											
Spiny Cheeked Honeyeater	*Acanthagenys rufogularis*				X				X							
Grey Headed Honeyeater	*Lichenostomus keartlandi*					X										
Grey Shrike Thrush	*Colluricincla harmonica*					X		X								
Black-faced Wood Swallow	*Artamus cinereus*	X			X				X			X	X			

Species		Sites														
		MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Willy Wagtail	*Rhipidura leucophrys*											X				
Southern Whiteface	*Aphelocephala leucopsis*												X			
Spotted Nightjar	*Eurostopodus argus*															X
Jacky Winter	*Microeca fascinans*				X											
Yellow Throated Miner	*Manorina flavigula*															X
Wedge-tailed Eagle	*Aquila audax*															X
Singing Honeyeater	*Lichenostomus virescens*															X
Black Kite	*Milvus migrans*															X

Table 12 Reptile species recorded within the Wingellina project area during the survey

Species		Sites														
		MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Long-nosed Dragon	*Amphibolurus longirostris*					X										
Black-collared Dragon	*Ctenophorus clayi*															X
Central-netted Dragon	*Ctenophorus nuchalis*				X		X					X				
Central Military Dragon	*Ctenophorus isolepis*													X		
Centralian Earless Dragon	*Tympanocryptis centralis*			X									X			
Pebble Dragon	*Tympanocryptis cephalus*															X
Fat-tailed Gecko	*Diplodactylus conspicillatus*		X	X	X					X				X		
Sandplain Gecko	*Diplodactylus stenodactylus*		X	X	X	X						X				
	Gehyra purpurascens															X
Variegated Gecko	*Gehyra variegata*		X	X					X			X		X		X
Bynoe's Gecko	*Heteronotia binoei*		X		X											
Smooth Knob-tailed Gecko	*Nephurus levis levis*											X				
Northern Spiny-tailed Gecko	*Strophurus ciliaris*		X													
Jewelled Gecko	*Strophurus elderi*					X	X									
	Delma nasuta					X										
Burton's Legless lizard	*Lialis burtonis*					X										

Species		Sites														
		MWN1A	MWN1B	MWN2A	MWN2B	MWN3A	MNW3B	MWN4A	MWN4B	MWN5A	MWN5B	MWN6A	MWN6B	MWN8	MWN9	Other
Fence Skink	*Cryptoblepharus plagiocephalus*								X							
	Ctenotus leonhardii	X	X	X	X	X	X			X	X	X	X			X
Leopard Ctenotus	*Ctenotus pantherinus*						X									
Spinifex Slender Blue-tongue	*Cyclodomorphus melanops*						X									
Broad-banded Sand-swimmer	*Eremiascincus richardsonii*		X													X
	Lerista bipes					X							X			
	Lerista muelleri					X	X		X							
	Lerista spp.											X				
	Proablepharus tenuis						X									
Pygmy Mulga Monitor	*Varanus gilleni*			X	X											
Sand Monitor	*Varanus gouldii*	X	X	X	X				X	X	X	X				

4.3.4 Amphibians

No amphibians were recorded over the project area during the survey. However, WAM lists 4 species that could potentially occur in the region, mostly burrowing species that spend the majority of their life underground. *Pseudophryne occidentalis* was listed on the WAM FaunaBase database as possibly occurring in the project area (**Appendix A**). However, this species requires at least semi-permanent regions of water, which were not found in the project area. HGM (2002) recorded no amphibians from the project area.

4.3.5 Introduced Mammal Species

Introduced mammal species that occur in the Central Ranges bioregion are listed in **Table 13**. Apart from species recorded during the survey, the Red Fox and European Cattle are also likely to be present over the project area at certain times. The One-humped Camel was recorded at high densities, including one herd of greater than 40 in number.

Table 13 Introduced exotic species possibly occurring over the project area

Group	Common Name	Scientific Name
Mammals	*House Mouse	*Mus musculus*
	*Dingo	*Canis lupus dingo*
	*Wild Dog	*Canis familiaris*
	*Cat	*Felix catus*
	*European Rabbit	*Oryctolagus cuniculus*
	*One humped Camel	*Camelus dromedarius*
	European Cattle	*Bos taurus*
	Red Fox	*Vulpes vulpes*

* Recorded during the 2008 survey

5.0 SHORT-RANGE ENDEMIC INVERTEBRATES

A number of invertebrate specimens were collected during the survey from groups that have potential for short range endemism. These specimens were delivered to appropriate experts at the WA Museum and UWA (**Table 14**, **Appendix H**). The specimens included mygalomorph spiders, scorpions, pseudoscorpions and terrestrial snails.

Table 14 Number of invertebrate specimens collected during the April 2008 survey

Site	Mygalomorph Spiders	Scorpions	Pseudoscorpions	Shells of Terrestrial Snails
MWN01	4	0	1	0
MWN02	2	1	2	0
MWN03	4	5	1	92
MWN04	2	0	6	42
MWN05	5	0	0	0
MWN06	2	0	1	0
MWN07	1	0	0	0
MWN08	2	0	0	0
Total	22	6	11	134

5.1 Mygalomorph Spiders

The Mygalomorphae, or trapdoor and funnelweb spiders are represented by 10 families in Australia, eight of which occur in Western Australia. The family Migidae are confined to the moist forested and topographically elevated areas of the south-west (Main 2005) and are unlikely to occur within the Wingellina project area. The remaining seven families including the Actinopodidae, Barychelidae, Ctenizidae, Dipluridae, Idiopidae, Nemesiidae and Theraphosidae (Raven *et al*. 2002) potentially occur within the project area.

A number of mygalomorph spiders, or evidence in the form of burrows and trapdoor lids, were collected during the survey (**Table 15**, **Appendix H**). These were sorted at the Outback Ecology laboratory and delivered to Professor Barbara York Main of UWA on the 2nd of May 2008. In total there were four families, six genera and eight species of mygalomorph spiders collected from the Wingellina project area.

Table 15 Mygalomorph spiders collected within the Wingellina project area

Site Number	Specimen Co-ordinates Datum: GDA 94	Family	Genus	Species	Notes
MWN01A	52 J 493144 - 7114240	Nemesiidae	*Aname*	2	3 Juveniles
MWN01A	52 J 493144 - 7114240	Theraphosidae	*Selenocosmia*	(?) *stirlingi* Hogg	Female/immature
MWN02A	52 J 494463 - 7113978	Idiopidae	*Blakistonia*	sp. nov "Wingellina sp."	Door only
MWN02A	52 J 494463 - 7113978	Theraphosidae	*Selenocosmia*	(?) *stirlingi* Hogg	Female/immature
MWN02B	52 J 494571 - 7114103	Idiopidae	*Blakistonia*	sp. nov "Wingellina sp."	Female
MWN03B	52 J 497833 - 7115784	Idiopidae	*Aganippe*	sp. nov "Wingellina" sp. 1	Female
MWN03B	52 J 497833 - 7115784	Nemesiidae	*Kwonkan*	*sp. 1* sp. nov	Female and Juvenile
MWN03B	52 J 497833 - 7115784	Theraphosidae	*Selenocosmia*	(?) *stirlingi* Hogg	Female/immature
MWN04A	52 J 498574 - 7115773	Idiopidae	*Aganippe*	sp. nov "Wingellina" sp. 2	Female
MWN04A	52 J 498574 - 7115773	Nemesiidae	*Kwonkan*	*sp. 2* sp. nov	Female
MWN05A	52 J 498365 - 7121359	Dipluridae	*Cethegus*	*2*	Female
MWN05A	52 J 498365 - 7121359	Idiopidae	*Blakistonia*	sp. nov "Wingellina sp."	2 females
MWN05B	52 J 497580 - 7119939	Idiopidae	*Blakistonia*	sp. nov "Wingellina sp."	Penultimate instar male
MWN05B	52 J 497580 - 7119939	Idiopidae	*Blakistonia*	sp. nov "Wingellina sp."	Female
MWN06A	52 J 492432 - 7120503	Idiopidae	*Aganippe*	sp. nov "Wingellina" sp. 1	Female
MWN06B	52 J 492726 - 7120417	Idiopidae	*Aganippe*	sp. nov "Wingellina" sp. 1	Female
MWN08A	52 J 497164 - 7123220	Idiopidae	*Aganippe*	sp. nov "Wingellina" sp. 1	Female
MWN08A	52 J 497164 - 7123220	Nemesiidae	*Aname*	*mainae* (?) Raven	Immature

*1 Specimen unable to be identified/determined to species level due to lack of taxonomic knowledge.

*2 Specimens not suitable for accurate identification.

Family Dipluridae

Cethegus sp.

One female specimen from the genus *Cethegus* was collected from MWN05A: Sparse Mulga woodland over grasses (**Plate 17**). This species has affinities with the species *C. ischnotheloides* Raven, however the specimen collected in this study was female and a male would be required for confirmation. The genus *Cethegus* is a web weaving spider with a shallow burrow set against shrubs, logs or amongst rocks where water is harvested (mimicking a wetter former (geohistorical) habitat) (Main 1997; Main 2008; **Appendix I**). Main (2008) proposes that the species is likely to have a wider distribution in appropriate habitats, although the habitat it has been found in at

Wingellina may be regarded as having a high conservation value for this species and require selective protection. However, vegetation mapping of the project area indicates the sparse Mulga woodland over grasses habitat type is extensive within the project area particularly to the north east and within the southern sections of the project area (Outback Ecology 2009).

Plate 16: Burrow of *Cethegus* sp. (possibly *ischnotheloides*) (left) and adult female spider (right)

Family Idiopidae

***Aganippe* sp. nov "Wingellina" sp. 1**

***Aganippe* sp. nov "Wingellina" sp. 2**

Two new species of *Aganippe* were collected during the survey. The genus *Aganippe* is widely distributed throughout southern Australia in sclerophyll forest, woodland, *Acacia* woodlands and shrublands with many (mostly undescribed) species with restricted geographic distributions (Main 2008; **Appendix I**). From this Main (2008) predicts that the two species collected during this survey are likely to have a limited geographic range.

Aganippe sp. nov "Wingellina" sp. 1 (**Plate 18**) was found in three habitats: Open Mallee Woodland over Spinifex (MWN03), Open Dead Mulga Woodland over grasses (MWN06:) and Mallee over dense Spinifex (sandy substrate) (MWN08). Since this species occurs in three habitats that do not appear restricted in the landscape, it is likely that this species has a range in similar habitats that extends outside the project area.

Aganippe sp. nov "Wingellina" sp. 2 was found only at site MWN04A within the rocky escarpment habitat site. This habitat type appears to be restricted in the landscape and it is likely that this species has a restricted range.

Plate 17: *Aganippe* sp. nov "Wingellina" sp. 1 burrow (left) and adult female (right)

Family Idiopidae

***Blakistonia* sp. nov. "Wingellina sp."**

Blakistonia sp. nov. "Wingellina sp." was the only species from the genus collected during the survey. The genus *Blakistonia* occurs predominantly in South Australia particularly in the Flinders Ranges belt, extending in to central Australia, south west Queensland, western Victoria, westward though the Eyre Peninsular, Nullarbor and scattered locations in south eastern semi arid Western Australia (Main 2008; **Appendix I**). Only three of the species in the genus have been formally named. It is possible that the species *Blakistonia* sp. nov. "Wingellina sp." has a range that extends into central Australia however a male specimen would be required to compare this species with other species in this region (Main 2008; **Appendix I**). Male specimens are typically required for species identification as they possess the morphological characteristics that allow comparisons between species (Main 1985).

Blakistonia sp. nov. "Wingellina sp." (**Plate 19**) was collected within two habitats: Open Mulga Woodland (MWN02) and Sparse Mulga Woodland over grasses on clays (MWN05). A high proportion (~80%) of the burrows of this species were found empty from sites within the Sparse Mulga Woodland over grasses. Fires and heavy grazing pressure from camels appears to have changed this habitat from a dense mulga woodland into an open grassland with few surviving mulga trees. This in turn, may have had a substantial impact upon the population of this species. Vegetation mapping indicates that the Sparse Mulga Woodland over grasses habitat is extensive within the project area particularly to the north east but also within the southern sections of the project area (Outback Ecology 2009).

Plate 18: *Blakistonia* sp. nov. "Wingellina sp." burrow (left) and adult female (right)

Family Nemesiidae

(?) *Aname mainae* Raven

One species from the genus *Aname* was tentatively identified as the wishbone spider *A. mainae* Raven however male specimens would be required for the identification to be confirmed (Main 2008; **Appendix I**). This species was collected from Mallee over dense Spinifex (sandy substrate) (MWN08) habitat which predominantly occurs in the north east of the project area. Although this habitat is likely to be widespread in surrounding areas, it appears to be restricted within the project area as a result of inappropriate fire regimes. There were also three other juveniles from the genus *Aname* collected at MWN01: Sparse Mulga woodland/grasses, however these specimens could not be identified.

Family Nemesiidae

***Kwonkan* sp. 1 sp. nov**

***Kwonkan* sp. 2 sp. nov**

Two new (undescribed) species from the genus *Kwonkan* were collected during the survey. *Kwonkan* is a genus that is widely (but sparsely) distributed in Western Australia and south western South Australia with few described species (Main 2008; **Appendix I**). Both species are likely to have a restricted distribution (Main 2008; **Appendix I**). *Kwonkan* sp. 1 sp. nov was represented by a single female specimen collected from MWN03: Open Mallee woodland over Spinifex. Vegetation mapping (Outback Ecology 2009) indicates that this vegetation community occurs along the base of the hills which run diagonally through the project area from north west to south east. It would appear unlikely that this species would have a restricted distribution because the vegetation community is relatively common within the project area and similar habitat is likely to be common around the base of hills and ranges in the surrounding landscape.

Kwonkan sp. 2 sp. nov (**Plate 20**) was collected from MWN04: Rocky Escarpment habitat type. This habitat type appears to be restricted in the landscape and it is likely that this species has a restricted range.

Plate 19: *Kwonkan* sp. 2 sp. nov. that was collected from the Rocky escarpment habitat (MWN04)

Family Theraphosidae

***Selenocosmia sp.* (possibly *stirlingi* Hogg)**

Selenocosmia sp. (**Plate 21**) was collected at three sites; MWN01: Sparse Mulga woodland/grasses; MWN02: Open Mulga woodland and MWN03: Open Mallee woodland/spinifex. This species is widely distributed in arid southern Australia; however it may be transferred to another genus after the completion of a taxonomic review by Robert Raven (Queensland Museum) (Main 2008; **Appendix I**).

Plate 20: *Selenocosmia* sp. (possibly *stirlingi* Hogg) that was collected at a number of sites and is believed to be widespread in arid southern Australia

5.2 Scorpions

Specimens of scorpions and pseudoscorpions were submitted for identification to Dr Mark Harvey of the Western Australian Museum on the 8th of May 2008 (**Table 16** and **Table 17**, **Appendix H**).

Table 16 Scorpion specimens collected from the Wingellina study area

Site Number	Specimen Co-ordinates Datum: GDA 94	Family	Genus	Species	Collection Method
MWN02A	52 J 494463 - 7113978	Buthidae	*Lychas*	*	Active searching
MWN03A	52 J 498834 - 7114873	Buthidae	*Lychas*	*	Active searching
MWN03B	52 J 497833 - 7115784	Buthidae	*Lychas*	*	Active searching

* Indicates specimens cannot be identified to species level with current taxonomic knowledge

Scorpions were collected from Sites MWN02A, MWN03A and MWN03B (**Table 16**). All scorpions that were collected during the survey were found to belong to the widespread genus *Lychas*. Although the specimens cannot be identified to species level, Harvey (2008) (**Appendix J**) is confident that they do not belong to a short-range endemic species.

5.3 Pseudoscorpions

Table 17 Pseudoscorpions collected within the Wingellina study area

Site Number	Specimen Co-ordinates Datum: GDA 94	Family	Genus	Species	Collection Method
MWN02A	52 J 494463 - 7113978	Olpiidae	*Indolpium*	*	Berlese funnel
MWN03A	52 J 498834 - 7114873	Olpiidae	*Indolpium*	*	Berlese funnel
MWN04A	52 J 498574 - 7115773	Olpiidae	*Indolpium*	*	Berlese funnel
MWN04A	52 J 498574 - 7115773	Garypidae	*Synsphyronus*	sp. Wingellina	Berlese funnel
MWN04B	52 J 492573 - 7121128	Olpiidae	*Indolpium*	*	Berlese funnel
MWN06A	52 J 492432 - 7120503	Olpiidae	*Indolpium*	*	Berlese funnel

* Indicates that specimens cannot be identified to species level with current taxonomic knowledge

Pseudoscorpions were collected from Sites MWN01A, MWN02A, MWN03A, MWN04A, MWN04B and MWN06A (**Table 17**, **Appendix J**). These specimens were found to belong to a single species which is extremely similar to specimens collected from other regions of Western Australia. This suggests that the species is widespread and is not a short-range endemic (Harvey 2008; **Appendix J**).

The single specimen of the pseudoscorpion *Synsphyronus* 'sp. Wingellina' (Family Garypidae) collected from Site MWN04A (Rocky Ridge habitat) is a species not previously described or represented in the collections of the Western Australian Museum (Harvey 2008; **Appendix J**). Many species of *Synsphyronus* may represent short-range endemic species (Harvey 1987), but based on current taxonomic knowledge, it is difficult to state whether this species is a short-range endemic, although the possibly certainly exists (Harvey 2008; **Appendix J**).

5.4 Terrestrial Snails

Terrestrial snails were submitted for identification to Shirley Slack-Smith and Corey Whisson of the Department of Aquatic Zoology (Mollusc Section) of the Western Australian Museum (**Table 18**). All specimens were dead-taken shells and therefore identifications were based on shell characteristics which, in general vary only slightly between congeneric species.

Table 18: Terrestrial molluscs collected within the Wingellina study area

Site Number	Specimen Co-ordinates Datum: GDA 94	Family	Genus	Species
MWN03A	52 J 498834 - 7114873	Pupillidae	*Pupoides*	*beltianus* (Tate, 1894)
MWN03A	52 J 498834 - 7114873	Pupillidae	*Pupoides*	*ischnus* (Tate, 1894)
MWN03A	52 J 498834 - 7114873	Pupillidae	*Gastrocopta*	*?margaretae* (Cox, 1868)
MWN03A	52 J 498834 - 7114873	Camaenidae	*Basedowena*	*cognate* (Solem, 1993)
MWN03B	52 J 497833 - 7115784	Pupillidae	*Pupoides*	*beltianus* (Tate, 1894)
MWN03B	52 J 497833 - 7115784	Pupillidae	*Gastrocopta*	*?margaretae* (Cox, 1868)
MWN03B	52 J 497833 - 7115784	Camaenidae	*Basedowena*	*cognate* (Solem, 1993)
MWN04A	52 J 498574 - 7115773	Pupillidae	*Pupoides*	*beltianus* (Tate, 1894)
MWN04A	52 J 498574 - 7115773	Camaenidae	*Basedowena*	*cognate* (Solem, 1993)
MWN04B	52 J 492573 - 7121128	Pupillidae	*Pupoides*	*beltianus* (Tate, 1894)
MWN04B	52 J 492573 - 7121128	Pupillidae	*Pupoides*	*ischnus* (Tate, 1894)

Family Pupillidae

***Pupoides beltianus* (Tate, 1894)**

Specimens from sites MWN03A, MWN03B, MWN04A and MWN04B were found to belong to this relatively small (height 3.66 – 5.13 mm) dextral species, which is known to have a distributional range encompassing an area from Reynolds and Jervois Ranges in the Northern Territory; south to the Musgrave and Mann Ranges in South Australia and then west to Barrow Ranges in Western Australia (Solem 1986, Solem 1988, Solem 1991, Slack-Smith and Whisson, 2008). The Barrow Ranges are approximately 170 km from Wingellina.

Pupoides ischnus (Tate, 1894)

Specimens from sites MWN03A, MWN03B and MWN04B were found to belong to a small (height 3.92-4.77mm) slender, rarely-collected sinistral species identified as *Pupoides ischnus*. This species is known to have a distribution in the central Australia, occupying areas in the lower central part of the Northern Territory, such as the Strangeways Range, the bands of the Hugh River and Palm Valley in the Krichauff Range (Solem, 1988, Solem 1991).

The collection of specimens from Wingellina represents a range extension for this species and is also the first record from Western Australia (Slack-Smith and Whisson, 2008; **Appendix K**).

***Gastrocopta ?margaretae* (Cox, 1868)**

Specimens also collected from MWN03A and MWN03B were of a minute (height 3.92 – 4.77mm) slender species that most closely resembles *Gastrocopta margaretae* (Slack-Smith and Whisson, 2008; **Appendix K**). This species has a recorded distribution from the west and south coasts of Western Australia, the southern part of South Australia and the lower central area of the Northern Territory (near Alice Springs). There is also an isolated record from the King Leopold Ranges in the north of Western Australia (Pokryszko 1996).

Family Camaenidae

***Basedowena cognate* (Solem, 1993)**

The genus *Basedowena* is restricted to the centre of Australia and is represented by nine species with mostly allopatric ranges (Solem, 1993). At the time of its description, *B. cognate* (**Plate 22**) was known to have a distributional range that extended from the southeast tip of the Schwerin Mural Crescent to Lassiter's Cave in the Petermann Ranges of the Northern Territory (Slack-Smith and Whisson 2008; **Appendix K**). This species was collected from sites MWN03A, MWN03B and MWN04A. Shells found at MWN03A and MWN03B are likely to be the results of secondary deposition from the ridge site represented by MWN04A.

Plate 22 *Basedowena cognate* Solem, 1993 Holotype WAM S14450 (From Slack-Smith and Whisson 2008)

In conclusion, Slack-Smith and Whisson (2008) have no reason to believe that, at the species level, any of the four taxa collected during the survey exhibit any degree of short-range endemicity, as all are believed to belong to species that occupy geographic ranges extending well beyond the area of interest.

6.0 SURVEY LIMITATIONS AND CONSTRAINTS

The EPA (2004) lists a number of possible limitations and constraints that can impinge on the adequacy of fauna surveys. These are replicated in **Table 19** below with an assessment relating to the April 2008 survey undertaken by Outback Ecology. A number of factors can influence the design and intensity of a fauna survey. All fauna surveys are limited to some degree by time and seasonal factors, and ideally a number of surveys would be undertaken over a number of years and within a number of different seasons. Nevertheless, all the factors identified by the EPA (2004) were considered in the design of the survey.

No specific formal guidance is available for the survey of terrestrial short-range endemic invertebrates at the time of drafting this report. Moreover, prescriptive survey guidelines, including standard methods, have not been established by regulating authorities.

Terrestrial invertebrate sampling of the project area focussed on mesic habitats presumed more likely to support SRE invertebrate taxa, and the survey used a variety of sampling techniques. However, sampling was targeted at very specific invertebrate groups known to support examples of short-range endemism, and it was not possible to complete identifications of the majority of invertebrates collected. Results presented in this report were obtained from a short, single survey only. It is likely that additional invertebrate species would be recorded if sites were revisited at other times of the year, or under different climatic conditions.

In consideration of the target taxa of interest, mygalomorph spiders in particular are typically sedentary with movement from fixed burrows restricted to specific climatic conditions pertaining to humidity and/or temperature (and therefore restricted opportunities for sampling either through pit-trapping). Targeted searches for mygalomorph burrows was undertaken to overcome this constraint.

Table 19 Summary of Potential Fauna Survey Constraints

Aspect	Constraint?	Comment Regarding Current Survey
Competency/experience of consultants	No	All members of the survey team were fauna specialists employed by Outback Ecology and Low Ecological Services, and have many years experience undertaking fauna surveys of this kind in Western Australia. All potential SRE invertebrates were identified by appropriate experts.
Scope	Limited	All terrestrial vertebrate fauna groups were sampled using well-known and standardised techniques. However, at the time of survey little is known of invertebrate SREs and habitats, and standardised methodologies were not available.
Proportion of fauna identified	No	Species area curves suggest further survey intensity during the survey would not have been productive. A good proportion of the total vertebrate fauna was recorded (apart from amphibians).
Information sources (eg historic or recent)	No	Recent work undertaken in the project area and surrounds were obtained and reviewed.
Proportion of task achieved, and further work which might be needed	Limited	Further targeted work in different seasons may be required for potential short-range endemic invertebrates.
Timing / weather / season / cycle	No	Timing, weather, and seasonality of surveys were appropriate for vertebrates. Amphibians and mygalomorph spiders would require targeted surveying after appropriate rainfall events.
Disturbances	No	Inappropriate fire regimes (for biodiversity management), and recent frequent burns in particular have impacted habitats of the site. Grazing of feral camels has also considerably degraded habitat within the project area. However, the survey results are a reflection of current land management practices.
Intensity	No	1180 trap-nights and 4630 mins of census, inventory, and spotlighting searching is adequate intensity for a local baseline survey of this type within this IBRA subregion.
Completeness	No	Survey was complete. All major taxa covered, as well as all major habitats and landforms. The project area was adequately covered geographically.
Resources	No	Resources were adequate to carry out the survey satisfactorily. Survey participants were competent in identification of species present. Target SRE invertebrates were identified by appropriate specialists.
Remoteness / access problems	No	All representative areas to be sampled were accessible by 4WD vehicle.
Availability of contextual information	No	Information is available for the IBRA subregion including WAM Faunabase, DEC lists, National Land and Water Resources Audit, as well as regional fauna surveys.

7.0 CONSERVATION SIGNIFICANCE

7.1 Framework for conservation significance

Fauna species that have been formally recognised as rare, threatened with extinction or as having high conservation value are protected by law under Commonwealth and state legislation. At the national level, fauna are protected under the *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act). Within Western Australia fauna can be listed under various Schedules under the *Western Australian Wildlife Conservation Act, 1950*. Definitions of conservation significance are presented in **Appendix L**.

The International Union for the Conservation of Nature (IUCN) reviews conservation status and lists fauna under various categories (the IUCN Red List). Categories for fauna and their conservation status used under the EPBC Act are those recommended by the IUCN. The *Western Australian Conservation Act, 1950* uses a set of 'Schedules', but the DEC also classifies species using IUCN categories.

International agreements that Australia has entered into include the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA) that cover migratory species of avifauna, particularly trans-equatorial waders, and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals).

The EPBC Act has lists of migratory species that are recognised under these international treaties. Particular species listed in JAMBA are also protected under Schedule 3 of the Western Australian Wildlife conservation Act.

The Department of Environment and Conservation (DEC) also recognises species not listed under the Western Australian Wildlife Conservation Act, but for which there is some concern, and has produced a supplementary list of 'Priority' fauna. These species as well as those listed in various Government endorsed Action Plans (eg. Duncan, *et al*. 1999; Garnett and Crowley, 2000) are also of recognised significance. Other species of conservation significance include endemics, those with restricted or fragmented ranges, or those that are at the extreme limits of their distribution. Short-range endemic fauna are those with naturally restricted distributional ranges.

The conservation significance of terrestrial vertebrate fauna potentially occurring over the project area can be assessed at four spatial scales:

- International - National - Species listed under the EPBC Act, IUCN, and International Treaties
- State - Species listed under the Western Australian Wildlife Conservation Act, 1950
- Regional - DEC listed Priority Species and species listed in Action Plans
- Local - Species not listed under any Acts or relevant publications, but considered of conservation significance due to patterns of distribution.

7.2 Vertebrate species of conservation significance potentially occurring over the project area

7.2.1 *International, National, State and Regional Significance*

The search of the WAM Faunabase database (**Appendix A**) and the DEC Threatened and Priority Fauna Database (**Appendix C**) identified a number of vertebrate species of conservation significance previously recorded from the region. These include:

- Mulgara (*Dasycercus cristicauda)*
- Ghost Bat *(Macroderma gigas)*
- Greater Bilby (*Macrotis lagotis*)
- Long-tailed Dunnart (*Sminthopsis longicaudata*)
- Northern Marsupial Mole (*Notoryctes caurinus*)
- Southern Marsupial Mole (*Notoryctes typhlops*)
- Black-footed Rock-wallaby (MacDonnell Ranges) (*Petrogale lateralis spp*)
- Malleefowl *(Leipoa ocellata)*
- Major Mitchell's Cockatoo *(Cacatua leadbeateri)*
- Australian Bustard *(Ardeotis australis)*
- Striated Grasswren *(Amytornis striatus striatus)*
- Rainbow Bee-eater (*Merops ornatus*)
- Princess Parrot (*Polytelis alexandrae*)
- Peregrine Falcon (*Falco peregrinus*)
- Grey Falcon (*Falco hypoleucos*)
- Fork-tailed Swift (*Apus pacificus*)
- Woma (*Aspidites ramsayi*)
- Giant Desert Skink *(Egernia kintorei)*

Information from the DEC Threatened and Priority Fauna Database (**Appendix C**) was augmented with additional information relating to species' likelihood of occurrence based upon other database searches and texts, as well as personal experience and general patterns of distribution and known habitat preferences. A list of vertebrate fauna species of conservation significance with the potential to occur over the project area is provided in **Table 20**. This list includes several additional species to those identified from the DEC Threatened and Priority Fauna Database. Likelihood of occurrence is then discussed on an individual species basis.

Species considered regionally extinct, outside their range, or restricted to habitats not present at the Project site, have been excluded from **Table 20**. This includes the Lesser Stick-nest Rat, Golden Bandicoot, Long-tailed Hopping-mouse, Crescent Nail-tail Wallaby, Central Hare-wallaby, Lesser Bilby and the Burrowing Bettong. In consideration of the habitats available over the project area, freshwater fish have also been omitted.

In consideration of the DEC Threatened and Priority Fauna Database the Priority 4 Ghost Bat (*Macroderma gigas*) has also been omitted from **Table 20**. The Ghost Bat is known primarily from northern Australia, including the Pilbara and the Kimberley, and is unlikely to occur in the Central Ranges Bioregion (Churchill, 1998). However specimens are occasionally found in the MacDonnell Ranges where the last known recording was a decade ago.

Table 20 Species of conservation significance potentially occurring over the project area

Group	Name		National	State	Regional	Likelihood of occurrence
Mammals	Mulgara	*Dasycercus cristicauda*	VU	S1		P
	Long-tailed Dunnart	*Sminthopsis longicaudata*			P4	P
	Greater Bilby	*Macrotis lagotis*	VU	S1		U
	Southern Marsupial Mole	*Notoryctes typhlops*	VU	S1		U
	Northern Marsupial Mole	*Notoryctes caurinus*	VU	S1		U
	Black-footed Rock-wallaby (MacDonnell Ranges)	*Petrogale lateralis spp*	VU	S1		U
Birds	Malleefowl	*Leipoa ocellata*	VU	S1		U
	Princess Parrot	*Polytelis alexandrae*	VU		P4	L
	Striated Grasswren	*Amytornis striatus striatus*			P4	P
	Australian Bustard	*Ardeotis australis*			P4	R
	Major Mitchell's Cockatoo	*Cacatua leadbeateri*		SP		P
	Peregrine Falcon	*Falco peregrinus*		SP		U
	Grey Falcon	*Falco hypoleucos*			P4	U
	Rainbow Bee-eater	*Merops ornatus*	Mig			L
	Fork-tailed Swift	*Apus pacificus*	Mig			L
	Migratory Waders/Waterbirds	Various	Mig			U
Reptiles	Great Desert Skink	*Egernia kintorei*	VU	S1		U
	Woma	*Aspidites ramsayi*		SP		P

EN Endangered
VU Vulnerable
S1 Schedule 1
R Recorded
L Likely
P Possible
U Unlikely

SP Specially Protected
Mig Migratory Species
P# Priority Fauna

Mammals

Mammal species of conservation significance are known from the bioregion with the potential to occur over the project area. The mammal species listed in **Table 20** are discussed below:

- **Mulgara**

  It is possible that the threatened Mulgara occurs over the project area, specifically at site MWN8. This species inhabits sandplains dominated by *Triodia* spp*,* where it burrows between low sand dunes as well as laterite rises and hills. Site MWN8 has these attributes. The Mulgara is infrequently recorded in part due to boom-bust cycles, contracting to core habitat areas in lean times, and expanding rapidly after favourable conditions prevail (Gibson and McKenzie, 2005). There are previous records of Mulgara for the region, however not within the project area (NLWRA, 2002).

- **Long-tailed Dunnart**

  The Long-tailed Dunnart has been collected intermittently in various locations primarily to the west and north-west of the project area (FaunaBase, 2008). It occurs in rocky habitats (Strahan, 2002) and may be rarely captured due to the difficulties of installing pit traps in these areas. The Long-tailed Dunnart was not recorded in the project area; however it is possible that it occurs.

- **The Greater Bilby**

  The Greater Bilby once occurred over the project area and a Threatened and Priority Fauna database search revealed one record in 1966 (**Appendix C**). However, in WA it is known only to occur in areas of the Gibson and Great Sandy Deserts south to Warburton, the Pilbara and Dampierland bioregions, as well as the Kimberley (Faunabase, 2008; Pavey, 2006). A male specimen was sited near Docker River in 1998 (Bill Low *pers comm.* 2008). It is unlikely that the Bilby still survives over the project area as the last record was documented over 40 years ago.

- **The Southern and Northern Marsupial Moles**

  The Southern and Northern Marsupial Moles were identified by NLWRA (2002) (**Appendix D**) as occurring in the Central Ranges bioregion and the WA Musuem has records for areas south and east of Warburton (WAM, 2008). These species occupy arid areas immediately east and north of the project area, living underground in sand dunes, inter-dunal flats and sandy soils along river flats. The Southern and Northern Marsupial Moles are unlikely to occur over the project area due to the lack of suitable habitat.

- **Black-footed Rock-wallaby**

  The Black-footed Rock-wallaby (MacDonnell Ranges subspecies) once occurred over the project area and a Threatened and Priority Fauna database search revealed two records from 1873 (**Appendix C**). Its distribution extends from west of the project area to central Australia and the species known habitat consists of rocky escarpments with crevices and caves (Pearson, 1992). The rocky escarpments investigated within the project area are not considered to have large enough caves or crevices to provide suitable habitat, and subsequently the Balck-footed Rock Wallaby is unlikely to be found in the project area.

Birds

Birds of conservation significance are known from the bioregion with the potential to occur over the project area. The bird species listed in **Table 20** are discussed below:

- **Malleefowl**

  The Malleefowl is a ground-dwelling bird that builds large and distinctive mounds of soil and litter within which its eggs are incubated (Blakers *et al*. 1984; Barrett, *et al.* 2003). The Malleefowl's distribution incorporates areas west of the project area and north-east in the Northern Territory (FaunaBase, 2008). It is therefore possible that this rare species could still occur in the habitats present, particularly within Mulga communities. However, extensive wildfires have denuded much of the mulga country with the project area and surrounds. Searches for the distinctive mounds, or other sign or sightings of Malleefowl were undertaken during the survey period. In addition, specific transect searches were made for the Malleefowl over Sites MWN3A, MWN3B and MWN8. No sign or sighting of Malleefowl was recorded.

- **Princess Parrot**

  The Princess Parrot is an inhabitant of lightly wooded country of desert areas to the north-west and north-east of the project area; from the Great Sandy Desert, through the Gibson Desert and into the Great Victoria Desert (Blakers *et al*, 1984). An unconfirmed sighting of a small flock of Princess Parrots occurred at Site MWN8 in open mallee over dense spinifex. It is likely that the Princess Parrot overflies the project area.

- **Striated Grasswren**

  The Striated Grasswren occurs in spinifex communities, with or without an overstorey of shrubs, on sandy or loamy plains. The species has been recorded west and north-west of the project area (FaunaBase, 2008). It now occurs as scattered but widespread populations in the Gibson Desert and Little Sandy Desert, as well as the Pilbara (Higgins, *et al*. 2001). As there was suitable habitat, it is possible that it occurs over the project area.

- **Australian Bustard**

  The Australian Bustard has a wide distribution across Australia and there is a WA Museum record west of the project area (FaunaBase, 2008). Five birds were sighted in open mulga woodland during the survey. Introduced predator's impact on recruitment of these ground-nesting birds, changed fire regimes and climatic conditions influence availability of food sources and hunting by traditional owners all have a major influence on the populations of this species in the project area..

- **Major Mitchell Cockatoo**

  The Major Mitchell Cockatoo's distribution is both patchy and disjunct. The project area lies outside the species distribution as identified by Johnstone and Storr, (1998) and WA Museum. It is possible that this species occurs from time-to-time as its preferred habitat of very open woodland occurred over the project area.

- **Peregrine Falcon and Grey Falcon**

  The Peregrine Falcon is widespread in Australia, but requires specific nesting sites. It does not build a nest and requires cliffs, large rocky outcrops, or large tree hollows none of which occur over the project area. Similarly, the Grey Falcon has a very broad but scattered distribution across Australia and prefers larger creeklines supporting River Red Gums and often nests in eucalypts along watercourses; habitat that does not occur over the project area. There are no records for either species over the project area (WAM, 2008). It is considered unlikely that these species would inhabit the project area.

- **Rainbow Bee-eater and Fork-tailed Swift**

  Although not recorded, the Rainbow Bee-eater and the Fork-tailed Swift are federally-listed migratory species likely to occur over the habitats of the project area. The Rainbow Bee-eater occupies numerous habitats including open woodlands with sandy loamy soil, sandridges, sandpits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves and rainforests (Pizzey and Knight, 1998). The Fork-tailed Swift is an aerial species that would overfly the project area without specifically utilising the habitats present.

- **Migratory Birds**

  No records are known of migratory waders and/or waterbirds directly using the project area, and none were made during current survey. Commonwealth database searches (**Appendices E** and **F**) identified the Oriental Plover and Great Egret (listed as either migratory and/or marine under the EPBC Act) may potentially occur over the project area. A number of migratory wading birds and marine waterbirds listed under Commonwealth legislation (JAMBA and CAMBA) are known from the region. However as there are no waterbodies within the project area, it is unlikely they will occur.

Reptiles

Reptiles of conservation significance are known from the bioregion with the potential to occur over the project area. The reptile species listed in **Table 20** are discussed below

- **Great Desert Skink**

  The Great Desert Skink occurs on red sandplains and sand ridges supporting spinifex *(Triodia)* predominantly to the north east and north-west of the project area (Pearson *et al*. 2001). Nationally, current strongholds for the Great Desert Skink appear to be the Tanami Desert, Uluru and an area of the Gibson Desert north of Warburton. Although the precise distribution of this species is likely to remain vague, three main populations appear to occur in WA; at Patjarr (240km northwest of Warburton), the vicinity of Lake MacKay, and Rudall River National Park. Evidence of this species was not obtained during the survey, including during targeted searches in preferred habitat. The project area is outside of the species current core distribution and it is unlikely that the Great Desert Skink occurs.

- **Woma**

  The Woma occurs throughout arid zones of Australia with a disjunct south west population in Western Australia that is now very rare (and may be taxonomically differentiated from the desert 'form'). In the more arid zones the Woma favours open myrtaceous heath on sandplains, and dunefields dominated by spinifex. In the south west it also appears to favour sandplain habitats (Storr *et al.* 2002), though few records exist. The WA Museum lists a specimen recorded 8km from the project area. The Woma may possibly occur over the project area.

7.3 Terrestrial Short-range Endemic Invertebrates

Endemism refers to the restriction of a species to a particular area, whether it is at the continental, national or local scale (Allen *et al.* 2002). Factors affecting endemism by influencing distribution, speciation, and differentiation, appear to be the taxon's life history, physiology, habitat requirements, habitat availability, biotic and abiotic interactions and historic environmental conditions (Allen *et al.* 2002; EPA, 2004; Ponder and Colgan, 2002; Harvey, 2002).

'Short-range endemism' refers to taxa with naturally restricted distributional ranges. The definition of what constitutes 'restricted ranges' varies from species to species, however the definition proposed by Harvey (2002) is of an area less than 10,000km². These taxa are also characterised by poor dispersal, reliance on discontinuous habitats, low growth rates, often seasonally influenced activity in wetter months, and often exhibit low fecundity (Harvey, 2002). The restriction of a taxon's distribution to a specific area is often most influenced by a prominent physical barrier preventing migration between adjacent populations.

Short-range endemic (SRE) fauna in Australia are dominated by invertebrate species, which have undergone little investigation to date, due to their diverse nature. However, terrestrial invertebrate groups that possess attributes associated with short-range endemism include terrestrial molluscs mygalomorph spiders, myriopods, scorpions and pseudoscorpions.

While species habitat preference varies, there are several common habitat factors favoured by the targeted groups. Primarily, more mesic areas are preferred as they offer protection from heat, desiccation and predators, and provide a source of moisture. Examples of such habitats at a broad scale include gorges, rocky ranges and ridges (particularly those that face south or southeast and/or near water supplies), and rivers and creeklines. Such areas are more likely to provide the habitat attributes required for these species. Gorges, rocky ranges and ridges were targeted for searching and trapping of invertebrate SRE species over the project area.

Potential SRE species collected during the survey are discussed below.

Mygalomorph Spiders

Five potential mygalomorph spiders collected during the survey are considered to be potentially SRE species.

***Cethegus* sp.**

This female specimen was collected within Open Sparse Mulga woodland over grasses on clay habitat (MWN05). Vegetation mapping of the project area indicates this habitat exists over a large area in the north east of the project area and also in sections to the south of the project area (Outback Ecology 2009). Main (2008) proposes that the species is likely to have a wider distribution in appropriate habitats but these habitats need to be regarded as having a high conservation value and require selective protection. This habitat appears to be degraded both within and outside the project area as a result of fire and grazing pressure from camels.

***Aganippe* sp. nov "Wingellina" sp 1**

This species is likely to have a limited geographic range (Main 2008) however was collected from three different habitat types during the survey: MWN03: Open Mallee Woodland over Spinifex, MWN06: Open Dead Mulga Woodland over grasses and MWN08: Mallee over dense Spinifex (sandy substrate). As this species occurs in three habitats that do not appear restricted in the landscape, it is likely that this species has a range that extends in similar habitats outside the project area.

***Aganippe* sp. nov "Wingellina" sp 2**

This species is likely to have a limited geographic range (Main 2008) and is represented by a single specimen from MWN04A: Rocky Escarpments. This habitat type appears to be restricted in the landscape and it is likely that this species has a restricted range.

***Kwonkan* sp. 1 sp. nov**

This species is likely to have a restricted distribution (Main 2008) and was represented by a single female specimen from MWN03 Open Mallee woodland over Spinifex. Vegetation mapping (Outback Ecology 2009) indicates that this vegetation community occurs along the base of the hills which run diagonally through the project area from north west to south east. It would appear unlikely that this species would have a restricted distribution because the vegetation community is relatively common within the project area. Additionally, similar habitat is likely to be common around the base of hills and ranges that occur in the surrounding landscape.

***Kwonkan* sp. 2 sp. nov**

This species is likely to have a restricted distribution (Main 2008) and was represented by a single female from MWN04: Rocky escarpment. The Rocky Escarpment habitat appears to be restricted in the landscape and it is likely that this species has a restricted range.

Pseudoscorpions

***Synsphyronus* 'sp. Wingellina'**

This species of pseudoscorpion collected at MWN04A: Rocky Escarpment represents a species not previously described or represented in the collections of the Western Australian Museum. Many species of *Synsphyronus* may represent short-range endemic species, but based on current taxonomic knowledge, it is difficult to state whether this species is a SRE species. The Rocky Escarpment habitat appears to be restricted in the landscape and it is therefore plausible that this species has a restricted range.

In regard to terrestrial molluscs, Slack-Smith and Whisson (2008) have no reason to believe that, at the species level, any of the four molluscan taxa collected during the survey exhibit any degree of short-range endemicity, as all are believed to belong to species that occupy geographic ranges extending well beyond the area of interest.

7.4 Significant Habitats

7.4.1 State and National Significance

Habitats which are site or type specific and possess high ecological value are of state significance. Habitats which exhibit such a level of significance will contain either specific habitat dependent fauna or high biodiversity and are poorly represented elsewhere. If a habitat is poorly represented in conservation reserves its conservation significance is increased.

Habitat that is considered critical to the survival of a Federally-listed threatened species or threatened ecological community can be entered by the Australian Government Minister for Environment and Water Resources onto a register of critical habitat. Habitat listed in the register in relation to a species or ecological community is critical habitat for the species or ecological community.

No critical habitat is located over the project area, and no World Heritage Properties, Ramsar Wetland Sites or Nationally Important Wetland sites are in the vicinity. The Central Ranges bioregion contains one wetland of National Significance listed on the Directory of Important Wetlands in Australia: The Walter James Range Rock Pools (**Appendix G)**. These wetlands are located 40km south of Lake Hopkins, approximately 150 km north of the project area. The pools are a permanent breeding site for the frog *Cyclorana maini* and a permanent source of water for birds (Graham and Cowan, 2001).

7.4.2 Sensitive Habitats

All broad terrestrial fauna habitat types identified over the project area are represented elsewhere in the bioregion, and none are considered of regional significance.

The landscape within which the project area is situated is subject to frequent burning, and inappropriate fire regimes have been recognised as a major threatening process in the Bioregion (NLWRA, 2002). Habitats that provide refuge against frequent fire are important for the maintenance of biodiversity in such a landscape. For example, short-range endemic species including invertebrates are more likely to be associated with more mesic areas as they offer protection from heat, desiccation and predators, and provide a source of moisture, such as rocky areas and riverine systems.

It is possible that the threatened Mulgara occurs over the project area, specifically at Site MWN8. Spinifex communities of the appropriate structure, and at the appropriate pyric successional sequence, are required to maintain this regionally important population, as well as effective feral predator control. Spinifex communities are prone to inappropriate fire management, and in particular frequent broadscale fire, and although spinifex habitat on sandplain exists, it is not suitable Mulgara habitat in the long term unless managed appropriately. In this sense, dense spinifex habitat can be considered sensitive to inappropriate fire management.

8.0 POTENTIAL IMPACTS TO FAUNA POPULATIONS

8.1 Current Impacts and Habitat Condition

Threatening impacts have been analysed for the Central Ranges Bioregion by the National Land and Water Audit (NLWA, 2002) and a Biodiversity Audit of Western Australia's 53 Biogeographic subregions (Graham and Cowan, 2001). Ecosystems and species at risk are currently subject to a large number of threatening processes, and the trend is not known in many cases. Impacts identified in the bioregion by the audit include changed fire regimes, feral animals, weeds and vegetation clearing. These factors are deemed to be causing a general loss of vegetation cover in the bioregion, with a consequent loss of native species.

Terrestrial vertebrate species at risk within the bioregion have also been identified (**Appendix E**) and specific threats to viability described by the audit (**Table 21**).

Table 21 Vertebrate species considered 'at risk' by DEC (Graham and Cowan, 2001) and NLWA (2002) within the Mann-Musgrave (CR1) subregion

Common name	Scientific Name	Threatening processes
Mulgara	*Dasycercus cristicauda*	Changed fire regimes
		Feral animals – foxes and cats
Long-tailed Dunnart	*Sminthopsis longicaudata*	Feral animals - foxes and cats
Greater Bilby	*Macrotis lagotis*	Feral animals – foxes and cats
Southern Marsupial Mole	*Notoryctes typhlops*	Feral animals – foxes and cats
Northern Marsupial Mole	*Notoryctes caurinus*	Feral animals – foxes and cats
Black-footed Rock-wallaby (MacDonnell Ranges)	*Petrogale lateralis spp*	Feral animals– foxes and dingoes
Malleefowl	*Leipoa ocellata*	Feral animals – foxes and cats
		Changed fire and climatic regimes
Princess Parrot	*Polytelis alexandrae*	Changed fire regimes, grazing livestock
Striated Grasswren	*Amytornis striatus striatus*	Changed fire and climatic regimes
Australian Bustard	*Ardeotis australis*	Changed fire regimes, hunting, intro preds
Major Mitchell's Cockatoo	*Cacatua leadbeateri*	Changed fire regimes
		Increasing fragmentation, loss of remnants and lack of recruitment
Peregrine Falcon	*Falco peregrinus*	Increasing fragmentation, loss of remnants and lack of recruitment
Grey Falcon	*Falco hypoleucos*	Increasing fragmentation, loss of remnants and lack of recruitment
Great Desert Skink	Great Desert Skink *Egernia kintorei*	Changed fire and climatic regimes
		Feral animals– foxes and cats
Woma	*Aspidites ramsayi*	Changed fire regimes
		Feral animals– foxes and cats

Specific threats to terrestrial vertebrates identified in the bioregion (Graham and Cowan, 2001 and NLWA, 2002) include:

- Feral predators (cats and foxes);
- Changed fire regimes; and
- Vegetation fragmentation;

There was significant evidence of feral cats in the project area noted during the survey (scats and tracks); however there was no evidence of foxes. It is feasible that the large dingo and wild dog (and community dogs) populations are restricting the occurrence of foxes.

An inappropriate fire regime for biodiversity outcomes is occurring over the project area, particularly over the dense Spinifex and Mulga Woodland habitats. Extensive impacts to vegetation by past and recent broadscale fire were observed during the fauna and flora surveys, and a study of fire maps from the area indicated that fires had burnt extensive areas over the last ten years, with some areas having been burnt several times (Landgate, 2008).

Inappropriate fire regimes, and frequent broadscale fires in particular, can simplify vegetation communities and lead to reduced heterogeneity of the landscape. Reduced shelter from frequent burns also leads to greater impacts on ground fauna from introduced predators. A number of large fires have affected the project area in the last decade, and this regime is predicted to continue until resources become available regionally for effective fire management and control.

Although vegetation clearing is not significant in the region, vegetation and habitat fragmentation can occur through degradation of habitats.

A threatening process not currently considered in literature by the DEC or NLWA, is the presence of large herds of one-humped camels in the region. One-humped camels were observed stripping the leaves and branches of Mulga (*Acacia aneura*) during the survey (**Plate 22** and **Plate 23**). It is conceivable that over-browsing by one-humped camels may change the vegetation complexity of Mulga woodlands. Mulga woodland communities may change into shrub/grasslands with continued grazing pressure. This will affect fauna composition within the localised area as many species are reliant upon specific habitats.

Plate 23 Degraded Mulga (*Acacia aneura*) as a result of camel grazing pressure

Plate 24 One-humped camels within sparse Mulga woodland

8.2 Potential Impacts of the Project

Development concepts for the Wingellina Nickel Project are in the feasibility stage, with the proposed footprint of the project shown in **Figure 2**.

From the information provided, the potential impacts of the project to terrestrial fauna could be expected to be associated with:

- Loss of fauna and habitat due to vegetation clearing and topsoil removal
- The development and mining of open pits to access the orebody
- Development and operation of waste landforms, ROM pad and topsoil storage areas
- Development and operation of the tailings storage facility (TSF). This represents one of the largest disturbance footprints in terms of habitat loss.
- Processing plant and associated infrastructure
- Mine service infrastructure corridors including pipelines, access roads, power lines
- Mining camp
- Alterations to surface hydrology
- Affects of noise and dust
- Potential to introduce weeds and increase populations of exotic species
- Secondary impacts due to increased traffic and off-road vehicles access
- Increased risk of fire

Vertebrate Fauna

It is considered unlikely that the project will have a significant impact on the four vertebrate species of conservation significance that are considered likely to or have been recorded in the project area, namely the Australian Bustard (*Ardeotis australis*), Princess Parrot (*Polytelis alexandrae*), Rainbow Bee-eater (*Merops ornatus*) and Fork-tailed Swift (*Apus pacificus*).

Vertebrate fauna habitat within the project area is considered to be widely represented throughout the surrounding region. However two habitats within the project area should be given attention where practicable when demarcating the final layout of the project footprint: Rocky Ridges / Escarpments and Mallee woodland/Spinifex.

Rocky escarpments within the project area are located around sites MWN 4A and MWN 4B (**Figure 4**) and a large area of this habitat is also noted to occur to the south east of the project area. It is possible that conservation significant vertebrate fauna species, such as the Long-tailed Dunnart, may be found over these areas. The preliminary site layout of Mining stages 1 and 2 does not directly impact the Rocky escarpment habitat within the project area and it is recommended future disturbance to this habitat is kept to a minimal where practicable (**Figure 2**).

An isolated patch of Mallee woodland / Spinifex (sandy substrate) is located over site MWN 8 in the north of the project area (**Figure 4**). It is possible that conservation significant vertebrate fauna species, such as the Mulgara and Striated Grasswren are found over this area. The preliminary site layout, specifically the location of the TSF does not directly impact this area and care must be taken that this practice is adhered to where possible. However, the re-aligned Mulga Park Road will

bisect the Mallee woodland and thus directly impact the area. Although this habitat is well represented outside the project area, it is suggested that vegetation clearance within this area is minimised where practicable.

Terrestrial SRE Invertebrate Fauna

Six potential invertebrate SRE species were identified during the survey comprised of five mygalomorph spider species: *Aganippe* sp. nov "Wingellina" sp. 1., *Ananippe* sp. nov "Wingellina" sp. 2, *Kwonkan* sp. 1 sp. nov, *Kwonkan* sp. 2 sp. nov, *Cethegus sp*; and one pseudoscorpion species *Synsphyronus* sp. "Wingellina".

Three of these potential SRE species, the mygalomorph spiders *Ananippe* sp. nov "Wingellina" sp. 2 and *Kwonkan* sp. 2 sp. nov; and the pseudoscorpion *Synsphyronus* sp. "Wingellina"; were only identified within the Rocky escarpment habitat type, suggesting these species may be restricted to these areas. Although the Rocky escarpment habitat is represented widely outside the project area, the presence of these potential SRE species in these areas further suggests that this habitat type be left undisturbed where practicable.

The mygalomorph *Cethegus* sp was collected within Open sparse Mulga woodland over grasses on clay habitat (MWN05). Vegetation mapping of the project area indicates this habitat exists over a large area in the north east of the project area and also in sections to the south of the project area (Outback Ecology 2009). Main (2008) proposes that the species is likely to have a wider distribution in appropriate habitats although suggests that this habitat type may have a high importance for this species. The proposed Wingellina tailings dam footprint will disturb a large portion of this habitat type within the project area. However, this habitat type is widely represented inside and outside of the project area. Additionally, the habitat type has been degraded by fires and heavy grazing by camels. Control of inappropriate fire regimes and reductions in camel numbers are likely to relieve substantial pressure on this habitat type within and outside the Wingellina project area.

The mygalomorph spider *Kwonkan* sp. 1 sp. nov. was collected within the Open Mallee woodland over Spinifex habitat and is likely to have a restricted distribution (Main 2008). The Open Mallee woodland over Spinifex habitat occurs along the base of the hills that run from north-west to south-east through the project area. This habitat type is expected to be widely represented within the surrounding landscape and subsequently it is considered likely that this species occurs in areas outside of the proposed disturbance footprints.

The mygalomorph spider species *Aganippe* sp. nov "Wingellina" sp. 1. was collected within three habitat types: Open Mallee Woodland over Spinifex; Open Dead Mulga Woodland over grasses and Mallee over dense Spinifex. As this species was collected in a variety of habitats that occur both

within and outside the project area, it is unlikely that the proposed mining footprint will have a substantial impact upon this species.

8.3 General Management Guidelines

The following general management guidelines below are suggested to minimise potential impacts to the terrestrial fauna of the project area:

- Reduce vegetation clearance to an absolute minimum
- Conserve topsoil and progressively rehabilitate waste dumps, tailings dams and pits to an appropriate standard
- Avoid clearance or disturbance to probable Mulgara habitat within dense Spinifex over sand habitat
- If possible avoid disturbance to Rocky Escarpment habitat within the project area
- Minimise impacts to surface hydrology by avoiding drainage features wherever possible
- Assess the likely impact of dewatering and any groundwater drawdown on vegetation
- Discourage the establishment of artificial water supplies. Assess impacts on artificial water sources on migratory birds and waders and implement management strategies to discourage the attraction of these species.
- Implement standard dust suppression strategies across the project area, during both construction and operation periods, to reduce impacts to surrounding vegetation.
- Systematic culling of camels where practicable to reduce the negative impacts on surviving Mulga woodlands
- Prevent the establishment of new weed species, and the further spread of existing weed species
- Develop strategies to reduce the likelihood of increased populations of feral and pest animals, and dingos by appropriate refuse management and education of mining personnel to prevent feeding feral animals.
- Consider the preparation and implementation of a succinct Fire Management Plan, not only to reduce the risk of unplanned fire emanating from the project area, but also to mitigate against wildfire from off-site ignition sources.

9.0 STUDY TEAM

The Wingellina Fauna Survey was conducted by:

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Mr David Steane	B.Sc. (Hons)	Zoologist (Outback Ecology)
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The Wingellina Fauna Survey (Vertebrates and Invertebrates) was conducted under the following Licence issued by DEC:

- Licence to Take Fauna for Scientific Purposes (Regulation 17) – Licence No: SF006270
  Date of issue: 10/03/2008
  Date of expiry: 30/04/2008
  Valid from: 01/04/2008

The trapping and removal of Fat-tailed Dunnarts and Stripe-faced Dunnarts from the Wingellina project area was conducted under the following Licence issued by DEC:

- Licence to Take Fauna for Scientific Purposes (Regulation 17) – Licence No: SF006070
  Date of issue: 25/09/2007
  Date of expiry: 24/09/2008
  Valid from: 25/09/2007

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Appendix A

Search Results of the Western Australian Museum's Faunabase

WA Museum FaunaBase Search Results for Vertebrate Terrestrial Fauna

Reptiles collected between -24.5612, 125.65 and -27.0071, 128.9754

Agamidae
Caimanops amphiboluroides
Ctenophorus caudicinctus graafi
Ctenophorus clayi
Ctenophorus fordi
Ctenophorus isolepis gularis
Ctenophorus nuchalis
Ctenophorus reticulatus
Ctenophorus rufescens
Ctenophorus scutulatus
Diporiphora winneckei
Lophognathus longirostris
Moloch horridus
Pogona minor minor
Tympanocryptis lineata centralis

Boidae
Antaresia stimsoni stimsoni

Elapidae
Acanthophis pyrrhus
Brachyurophis fasciolata fasciata
Brachyurophis semifasciata
Demansia psammophis psammophis
Furina ornata
Parasuta monachus
Pseudechis australis
Pseudonaja modesta
Pseudonaja nuchalis
Simoselaps anomalus
Suta fasciata

Gekkonidae
Diplodactylus conspicillatus
Diplodactylus damaeus
Diplodactylus pulcher
Diplodactylus stenodactylus
Gehyra montium
Gehyra purpurascens
Gehyra variegata
Heteronotia binoei
Nephrurus laevissimus
Nephrurus levis levis
Nephrurus vertebralis
Rhynchoedura ornata
Strophurus ciliaris aberrans
Strophurus elderi
Strophurus strophurus

Pygopodidae
Delma nasuta
Delma pax
Pygopus nigriceps

Scincidae

Cryptoblepharus plagiocephalus
Ctenotus alacer
Ctenotus ariadnae
Ctenotus brooksi brooksi
Ctenotus dux
Ctenotus helenae
Ctenotus leonhardii
Ctenotus pantherinus ocellifer
Ctenotus quattuordecimlineatus
Ctenotus schomburgkii
Ctenotus septenarius
Cyclodomorphus melanops elongatus
Cyclodomorphus melanops melanops
Egernia depressa
Egernia inornata
Egernia kintorei
Egernia striata
Eremiascincus richardsonii
Lerista bipes
Lerista desertorum
Lerista ips
Lerista labialis
Lerista muelleri
Menetia greyii
Morethia boulengeri
Proablepharus reginae
Tiliqua multifasciata

Typhlopidae

Ramphotyphlops endoterus
Ramphotyphlops waitii

Varanidae

Varanus acanthurus
Varanus eremius
Varanus giganteus
Varanus gilleni
Varanus gouldii
Varanus tristis tristis

Mammals collected between -24.9071, 126.2412 and -27.0318, 128.9507

Canidae
Canis lupus dingo

Dasyuridae
Antechinomys laniger
Dasycercus cristicauda
Ningaui ridei
Pseudantechinus macdonnellensis
Sminthopsis crassicaudata
Sminthopsis hirtipes
Sminthopsis longicaudata
Sminthopsis ooldea

Macropodidae
Lagorchestes hirsutus
Macropus robustus erubescens
Petrogale lateralis lateralis

Molossidae
Tadarida australis

Muridae
Mus musculus
Notomys alexis
Pseudomys desertor
Pseudomys hermannsburgensis

Myrmecobiidae
Myrmecobius fasciatus

Notoryctidae
Notoryctes caurinus
Notoryctes typhlops

Peramelidae
Isoodon auratus auratus

Thylacomyidae
Macrotis lagotis

Vespertilionidae
Chalinolobus gouldii
Nyctophilus geoffroyi
Vespadelus finlaysoni

Birds collected between -24.5612, 126.1673 and -27.0318, 128.9261

Acanthizidae
Acanthiza apicalis
Aphelocephala leucopsis
Aphelocephala nigricincta
Pyrrholaemus brunneus

Cinclosomatidae
Cinclosoma castaneothorax marginatum
Cinclosoma castanotus

Climacteridae
Climacteris rufa

Columbidae
Geophaps plumifera
Geophaps plumifera ferruginea
Ocyphaps lophotes

Corvidae
Corvus orru
Corvus orru cecilae

Cracticidae
Cracticus tibicen tibicen

Cuculidae
Chrysococcyx osculans

Dicruridae
Rhipidura fuliginosa

Maluridae
Amytornis purnelli purnelli
Amytornis striatus striatus
Malurus lamberti assimilis
Malurus splendens musgravi
Stipiturus ruficeps ruficeps

Megapodiidae
Leipoa ocellata

Meliphagidae
Certhionyx variegatus
Lichenostomus keartlandi
Lichenostomus penicillatus
Manorina flavigula

Otididae
Ardeotis australis

Pachycephalidae
Colluricincla harmonica rufiventris

Petroicidae
Microeca fascinans assimilis

Podargidae
Podargus strigoides brachypterus

Pomatostomidae
Pomatostomus superciliosus

Psittacidae

Cacatua roseicapilla

Platycercus zonarius zonarius

Polytelis alexandrae

Amphibia collected between -24.7588, 126.3151 and -27.0812, 128.9507

Hylidae
Cyclorana platycephala

Myobatrachidae
Neobatrachus centralis
Neobatrachus sutor
Pseudophryne occidentalis

Appendix B

Search Results of the Birds Australia Atlas Database - Central Ranges Bioregion

Birds Australia Atlas – Database Search Results

IBRA Region:	**Central Ranges**		**CR**	
Physical characteristics	*Area*	Total area of region:	10,120,033	ha
	Rainfall Index	Comparison with average rainfall:		
		Atlas period 1:	0.21	
		Atlas period 2:	0.62	
		Difference in rainfall index between Atlas periods:	No change	
	Use Index	Use zone:	Extensive	
		Percent cleared:	0.0	
		Continental stress:	Very low	
Number of surveys	*Atlas 1*	10 min surveys:	163	
		60 min surveys:	55	
		10 min surveys used for analysis:	102	
	Atlas 2	2-ha searches:	102	
		500 m area searches:	125	
		5 km area searches:	27	
		Area searches used for analysis:	75	
		Incidental records:	32	

Comments

The birds of the Central Ranges were not well surveyed in either Atlas period, but the composition of the avifauna appears to resemble that of other semi-arid bioregions. One limited range taxon, the Princess Parrot, was seen in the bioregion during the first Atlas period. The only other feature that sets the bioregion apart is the absence of any exotic species. The apparent decline in ground-nesting birds and of ground-feeding insectivores should be investigated at a larger scale.

Status:	Typical semi-arid avifauna.
Rare and threatened:	No major populations.
Increasers:	None indicative of landscape health.
Indicators:	Emu, Australian Bustard, Banded Lapwing, White-browed Treecreeper, Jacky Winter.
Trend:	Possible decline in ground-nesting species.
Scenario:	Probably little change.
Actions	Ensure representative areas have an appropriate fire regime to maintain diversity.

Central Ranges

CR

Area (ha)	10,120,033	26	th largest bioregion	

Class	Value	Rank (1 high-85 low)	IBRA average	IBRA total	Units
All species					
Atlas period 1	141	76	232	698	
Atlas period 2	125	82	226	731	
Both periods	151	81	254	743	
Australian resident species					
No. species	146	75	215	555	
No. genera	105	76	139	248	
Species/genus	1.39	80	1.53	2.24	
Species:area ratio	0.31	81	0.33	0.41	ln(no. species)/ln(bioregion area)
Australian endemic species					
No. endemic species	101	67	124	355	
Endemic/total resident species	0.69	4	0.58	0.64	
Range limitation					
Index of range limitation (frequency)	9.2	82	20.4	100	Sum(100/ no. bioregions)
Index of range limitation (reporting rate)	9.9	78	22.7	100	Sum(100xreporting rate/ no. bioregions)
No. species recorded in 10 or fewer bioregions	1	76	8	154	
Index of importance of bioregion to species recorded in 10 or fewer bioregions	0.1	72	1.2	100	Sum(100/ no. bioregions)
Threatened taxa					
No. Critically Endangered taxa	0		-	15	
No. Endangered taxa	0		-	24	
No. Vulnerable taxa	0		-	35	
Total	0	85	4.0	74	
Introduced species					
Exotic species					
No. species	0	85	6.3	30	
Representation in bioregion	0.0	85	2.6	5.4	No. ESx100/ no. spp. in bioregion
Relative abundance in bioregion	0.0	85	2.6	100	Rep. rate ESx100/ Rep rate spp. in bioregion
Percentage of Australian total	0.0	85	20.9	100	No. ES in regionx100/ no. ES in Australia
Australian translocated species					
No. species	0	85	0.9	16	
Representation in bioregion	0.0	85	0.4	3	No. ATSx100/ no. spp. in bioregion
Relative abundance in bioregion	0.0	85	0.3	100	Rep. rate ATSx100/ Rep rate spp. in bioregion
Percentage of Australian total	0.0	85	5.5	100	No. ATS in regionx100/ no. ATS in Australia

Total introduced species					
No. species	0	85	7.2	36	
Representation in bioregion	0.0	85	2.9	6	No. TISx100/ no. spp. in bioregion
Relative abundance in bioregion	0.0	85	3.0	100	Rep. rate TISx100/ Rep rate spp. in bioregion
Percentage of Australian total	0.0	85	15.5	100	No. TIS in regionx100/ no. TIS in Australia

Central Ranges

Order	Atlas species no	Common name	Scientific name	Proportion of sightings in bioregion
1	1	**Emu**	*Dromaius novaehollandiae*	Medium
2	9	**Stubble Quail**	*Coturnix pectoralis*	Low
3	11	**Brown Quail**	*Coturnix ypsilophora*	Low
4	205	**Plumed Whistling-Duck**	*Dendrocygna eytoni*	Low
5	214	**Freckled Duck**	*Stictonetta naevosa*	Low
6	202	**Australian Wood Duck**	*Chenonetta jubata*	Low
7	208	**Pacific Black Duck**	*Anas superciliosa*	Medium
8	211	**Grey Teal**	*Anas gracilis*	Medium
9	213	**Pink-eared Duck**	*Malacorhynchus membranaceus*	Medium
10	215	**Hardhead**	*Aythya australis*	Low
11	61	**Australasian Grebe**	*Tachybaptus novaehollandiae*	Low
12	62	**Hoary-headed Grebe**	*Poliocephalus poliocephalus*	Low
13	97	**Little Black Cormorant**	*Phalacrocorax sulcirostris*	Low
14	96	**Great Cormorant**	*Phalacrocorax carbo*	Low
15	106	**Australian Pelican**	*Pelecanus conspicillatus*	Low
16	188	**White-faced Heron**	*Egretta novaehollandiae*	Medium
17	189	**White-necked Heron**	*Ardea pacifica*	Low
18	180	**Straw-necked Ibis**	*Threskiornis spinicollis*	Low
19	232	**Black-shouldered Kite**	*Elanus axillaris*	Medium
20	231	**Black-breasted Buzzard**	*Hamirostra melanosternon*	Medium
21	229	**Black Kite**	*Milvus migrans*	Medium
22	228	**Whistling Kite**	*Haliastur sphenurus*	Medium
23	218	**Spotted Harrier**	*Circus assimilis*	Medium
24	221	**Brown Goshawk**	*Accipiter fasciatus*	Medium
25	222	**Collared Sparrowhawk**	*Accipiter cirrhocephalus*	Medium
26	224	**Wedge-tailed Eagle**	*Aquila audax*	**High**
27	225	**Little Eagle**	*Hieraaetus morphnoides*	Medium
28	239	**Brown Falcon**	*Falco berigora*	**High**
29	235	**Australian Hobby**	*Falco longipennis*	Medium
30	236	**Grey Falcon**	*Falco hypoleucos*	Medium
31	238	**Black Falcon**	*Falco subniger*	Medium
32	237	**Peregrine Falcon**	*Falco peregrinus*	Medium
33	240	**Nankeen Kestrel**	*Falco cenchroides*	**High**
34	58	**Purple Swamphen**	*Porphyrio porphyrio*	Low
35	59	**Eurasian Coot**	*Fulica atra*	Low
36	176	**Australian Bustard**	*Ardeotis australis*	Medium
37	18	**Little Button-quail**	*Turnix velox*	Medium
38	158	**Common Greenshank**	*Tringa nebularia*	Low
39	154	**Wood Sandpiper**	*Tringa glareola*	Low
40	167	**Broad-billed Sandpiper**	*Limicola falcinellus*	Low
41	174	**Bush Stone-curlew**	*Burhinus grallarius*	Low
42	148	**Red-necked Avocet**	*Recurvirostra novaehollandiae*	Low

43	143	**Red-capped Plover**	*Charadrius ruficapillus*	Low
44	142	**Oriental Plover**	*Charadrius veredus*	Low
45	145	**Inland Dotterel**	*Peltohyas australis*	Low
46	144	**Black-fronted Dotterel**	*Elseyornis melanops*	Medium
47	132	**Red-kneed Dotterel**	*Erythogonys cinctus*	Low
48	135	**Banded Lapwing**	*Vanellus tricolor*	Low
49	133	**Masked Lapwing**	*Vanellus miles*	Low
50	173	**Australian Pratincole**	*Stiltia isabella*	Low
51	111	**Gull-billed Tern**	*Sterna nilotica*	Low
52	34	**Common Bronzewing**	*Phaps chalcoptera*	Medium
53	43	**Crested Pigeon**	*Ocyphaps lophotes*	**High**
54	42	**Spinifex Pigeon**	*Geophaps plumifera*	Medium
55	31	**Diamond Dove**	*Geopelia cuneata*	Medium
56	264	**Red-tailed Black-Cockatoo**	*Calyptorhynchus banksii*	Low
57	273	**Galah**	*Eolophus roseicapillus*	**High**
58	271	**Little Corella**	*Cacatua sanguinea*	Medium
59	270	**Major Mitchell's Cockatoo**	*Cacatua leadbeateri*	Medium
60	274	**Cockatiel**	*Nymphicus hollandicus*	Medium
61	279	**Princess Parrot**	*Polytelis alexandrae*	Low
62	294	**Australian Ringneck**	*Barnardius zonarius*	**High**
63	296	**Mulga Parrot**	*Psephotus varius*	**High**
64	310	**Budgerigar**	*Melopsittacus undulatus*	**High**
65	304	**Bourke's Parrot**	*Neopsephotus bourkii*	Medium
66	303	**Scarlet-chested Parrot**	*Neophema splendida*	Low
67	337	**Pallid Cuckoo**	*Cuculus pallidus*	Medium
68	341	**Black-eared Cuckoo**	*Chrysococcyx osculans*	Medium
69	342	**Horsfield's Bronze-Cuckoo**	*Chrysococcyx basalis*	Medium
70	242	**Southern Boobook**	*Ninox novaeseelandiae*	Medium
71	249	**Barn Owl**	*Tyto alba*	Medium
72	313	**Tawny Frogmouth**	*Podargus strigoides*	Medium
73	331	**Spotted Nightjar**	*Eurostopodus argus*	Medium
74	317	**Australian Owlet-nightjar**	*Aegotheles cristatus*	Medium
75	325	**Red-backed Kingfisher**	*Todiramphus pyrrhopygia*	Medium
76	326	**Sacred Kingfisher**	*Todiramphus sanctus*	Low
77	329	**Rainbow Bee-eater**	*Merops ornatus*	Medium
78	561	**White-browed Treecreeper**	*Climacteris affinis*	Medium
79	532	**Splendid Fairy-wren**	*Malurus splendens*	Medium
80	536	**Variegated Fairy-wren**	*Malurus lamberti*	**High**
81	535	**White-winged Fairy-wren**	*Malurus leucopterus*	Medium
82	528	**Rufous-crowned Emu-wren**	*Stipiturus ruficeps*	Low
83	513	**Striated Grasswren**	*Amytornis striatus*	Low
84	511	**Dusky Grasswren**	*Amytornis purnelli*	Medium
85	570	**Red-browed Pardalote**	*Pardalotus rubricatus*	Medium
86	976	**Striated Pardalote**	*Pardalotus striatus*	Medium
87	497	**Redthroat**	*Pyrrholaemus brunneus*	Medium
88	465	**Weebill**	*Smicrornis brevirostris*	Medium
89	463	**Western Gerygone**	*Gerygone fusca*	Medium
90	476	**Inland Thornbill**	*Acanthiza apicalis*	Medium
91	481	**Chestnut-rumped Thornbill**	*Acanthiza uropygialis*	Medium
92	480	**Slaty-backed Thornbill**	*Acanthiza robustirostris*	Medium
93	486	**Yellow-rumped Thornbill**	*Acanthiza chrysorrhoa*	**High**
94	466	**Southern Whiteface**	*Aphelocephala leucopsis*	**High**
95	469	**Banded Whiteface**	*Aphelocephala nigricincta*	Medium
96	640	**Spiny-cheeked Honeyeater**	*Acanthagenys rufogularis*	**High**
97	635	**Yellow-throated Miner**	*Manorina flavigula*	**High**
98	608	**Singing Honeyeater**	*Lichenostomus virescens*	**High**
99	621	**Grey-headed Honeyeater**	*Lichenostomus keartlandi*	Medium

100	623	**Grey-fronted Honeyeater**	*Lichenostomus plumulus*	Medium
101	625	**White-plumed Honeyeater**	*Lichenostomus penicillatus*	**High**
102	597	**Brown Honeyeater**	*Lichmera indistincta*	Medium
103	594	**White-fronted Honeyeater**	*Phylidonyris albifrons*	Medium
104	599	**Grey Honeyeater**	*Conopophila whitei*	Low
105	589	**Black Honeyeater**	*Certhionyx niger*	Low
106	602	**Pied Honeyeater**	*Certhionyx variegatus*	Medium
107	449	**Crimson Chat**	*Epthianura tricolor*	**High**
108	450	**Orange Chat**	*Epthianura aurifrons*	Medium
109	448	**White-fronted Chat**	*Epthianura albifrons*	Low
110	377	**Jacky Winter**	*Microeca fascinans*	Medium
111	381	**Red-capped Robin**	*Petroica goodenovii*	**High**
112	385	**Hooded Robin**	*Melanodryas cucullata*	**High**
113	443	**Grey-crowned Babbler**	*Pomatostomus temporalis*	Low
114	445	**White-browed Babbler**	*Pomatostomus superciliosus*	**High**
115	865	**Chiming Wedgebill**	*Psophodes occidentalis*	Medium
116	437	**Chestnut Quail-thrush**	*Cinclosoma castanotus*	Low
117	438	**Chestnut-breasted Quail-thrush**	*Cinclosoma castaneothorax*	Medium
118	549	**Varied Sittella**	*Daphoenositta chrysoptera*	Medium
119	419	**Crested Bellbird**	*Oreoica gutturalis*	**High**
120	401	**Rufous Whistler**	*Pachycephala rufiventris*	**High**
121	408	**Grey Shrike-thrush**	*Colluricincla harmonica*	**High**
122	728	**Restless Flycatcher**	*Myiagra inquieta*	Low
123	415	**Magpie-lark**	*Grallina cyanoleuca*	**High**
124	361	**Grey Fantail**	*Rhipidura fuliginosa*	Low
125	364	**Willie Wagtail**	*Rhipidura leucophrys*	**High**
126	424	**Black-faced Cuckoo-shrike**	*Coracina novaehollandiae*	**High**
127	423	**Ground Cuckoo-shrike**	*Coracina maxima*	Medium
128	430	**White-winged Triller**	*Lalage sueurii*	Medium
129	543	**White-breasted Woodswallow**	*Artamus leucorhynchus*	Medium
130	544	**Masked Woodswallow**	*Artamus personatus*	Medium
131	545	**White-browed Woodswallow**	*Artamus superciliosus*	Low
132	546	**Black-faced Woodswallow**	*Artamus cinereus*	**High**
133	548	**Little Woodswallow**	*Artamus minor*	Medium
134	702	**Grey Butcherbird**	*Cracticus torquatus*	Medium
135	700	**Pied Butcherbird**	*Cracticus nigrogularis*	**High**
136	705	**Australian Magpie**	*Gymnorhina tibicen*	**High**
137	930	**Australian Raven**	*Corvus coronoides*	Low
138	691	**Little Crow**	*Corvus bennetti*	**High**
139	692	**Torresian Crow**	*Corvus orru*	**High**
140	681	**Western Bowerbird**	*Chlamydera guttata*	Medium
141	647	**Australian Pipit**	*Anthus novaeseelandiae*	**High**
142	653	**Zebra Finch**	*Taeniopygia guttata*	**High**
143	654	**Painted Finch**	*Emblema pictum*	Medium
144	564	**Mistletoebird**	*Dicaeum hirundinaceum*	Medium
145	358	**White-backed Swallow**	*Cheramoeca leucosternus*	Medium
146	357	**Welcome Swallow**	*Hirundo neoxena*	Medium
147	359	**Tree Martin**	*Hirundo nigricans*	Medium
148	360	**Fairy Martin**	*Hirundo ariel*	Medium
149	507	**Spinifexbird**	*Eremiornis carteri*	Low
150	509	**Rufous Songlark**	*Cinclorhamphus mathewsi*	Medium
151	508	**Brown Songlark**	*Cinclorhamphus cruralis*	**High**

Appendix C

Search Results of the Department of Environment and Conservation Threatened and Priority Fauna Database

25.6022 °S 128.427 °E / 26.514 °S 129.421 °E Wingellina Nickel Project area (plus~50km buffer)

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Macrotis lagotis **Bilby** *1 records*

This species shelters in burrows and occupies a range of habitats from grassland on clayey and stony soils or sandplains to mulga scrub and woodlands on red earths. It has suffered a large decline and contraction in distribution.

1966	1	3	Ngaanyatjarra-Giles	

Petrogale lateralis ssp. (ANWC CM15314) **McDonnell Range Rock-wallaby** *2 records*

This species thrives in steep, complex rocky habitats providing tunnels, caves and crevices for shelter and protection from predators.

	1	1	Ngaanyatjarra-Giles	
1873	2	0	Ngaanyatjarra-Giles	Day sighting

***** Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

Appendix D

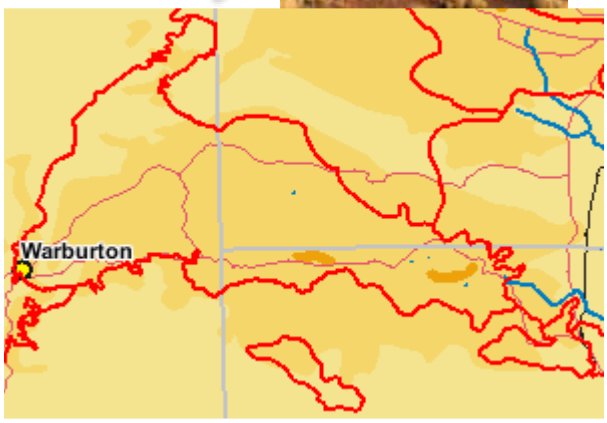
National Lands and Water Resources Audit – Central ranges Bioregion Biodiversity Assessment Report

Biodiversity Assessment - Central Ranges

Specify a region: -- select region --

On this page

Central Ranges



Introduction

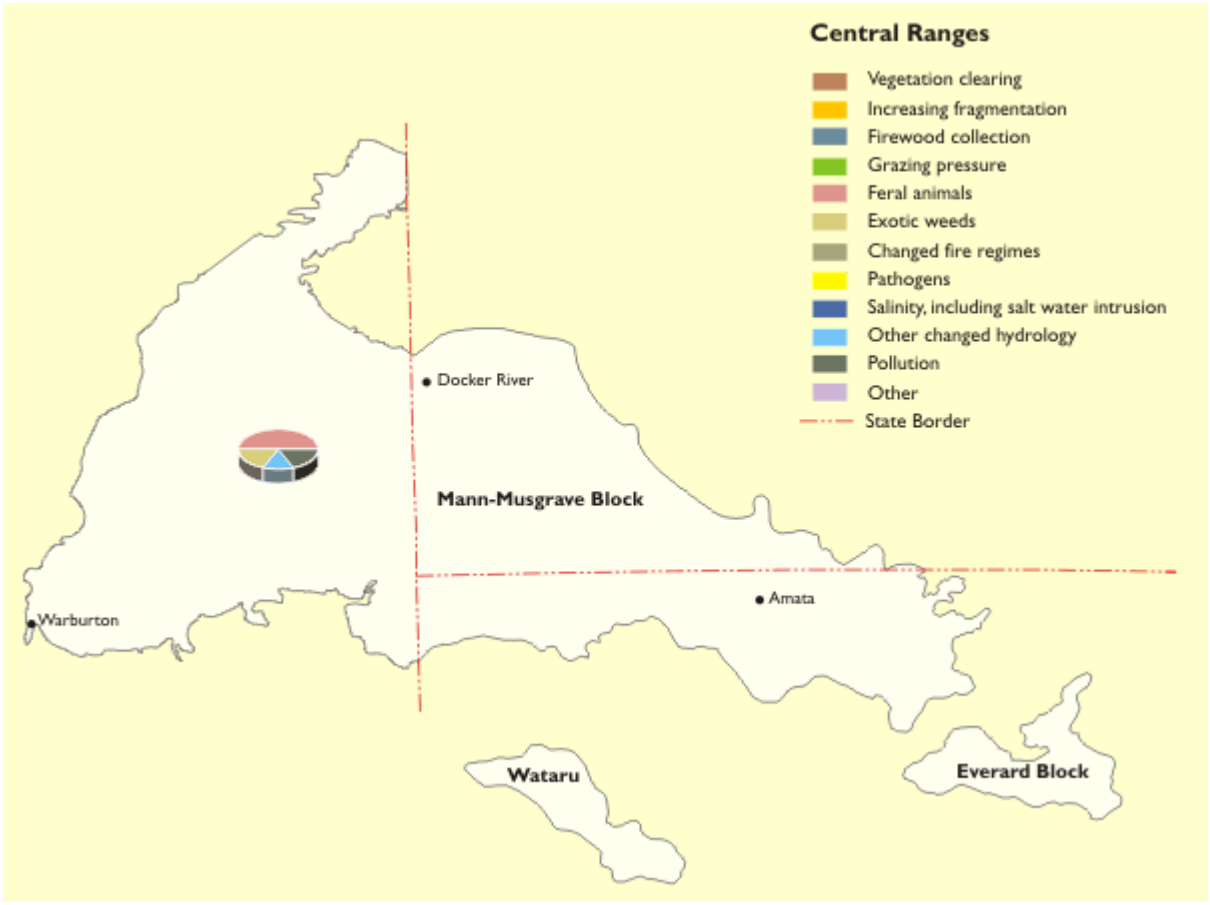
Natural values

Click here to link to a table of natural values within each subregion

Wetlands

Nationally important wetlands

Map: IBRA map showing DIWA locations, towns, subregions, major roads and reserves and most common threatening processes.



Click here to link to a table of Australia's Important Wetlands (Directory of Important Wetlands of Australia): their type, condition, trend and threatening processes within each subregion.

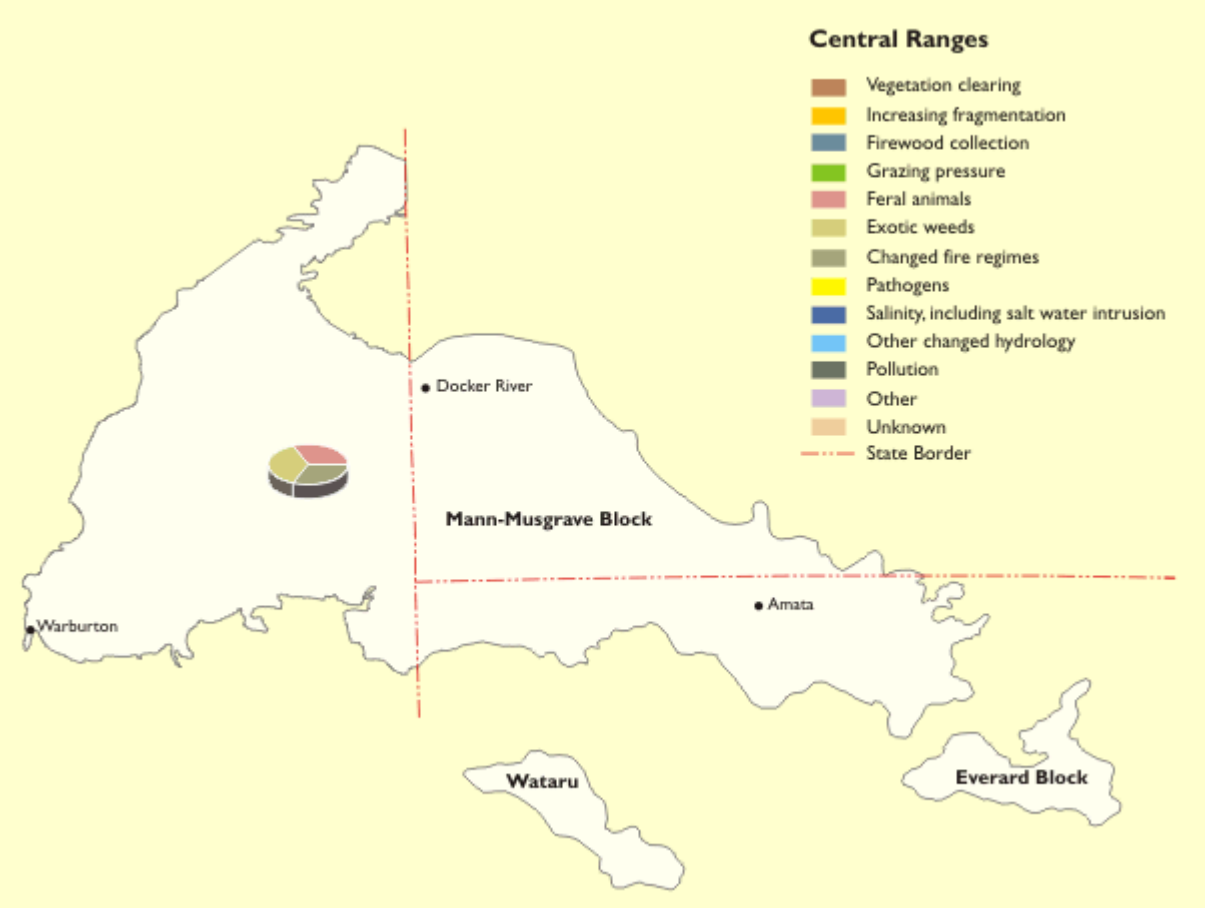
Regionally important wetlands

Click here to link to a table of provisional identification of wetlands of regional significance: their type and special values within each subregion. The reliability of the overall subregional assessment is indicated.

Click here to link to a table of provisional identification of wetlands of regional significance: their condition, trend and threatening processes within each subregion.

Riparian Zones

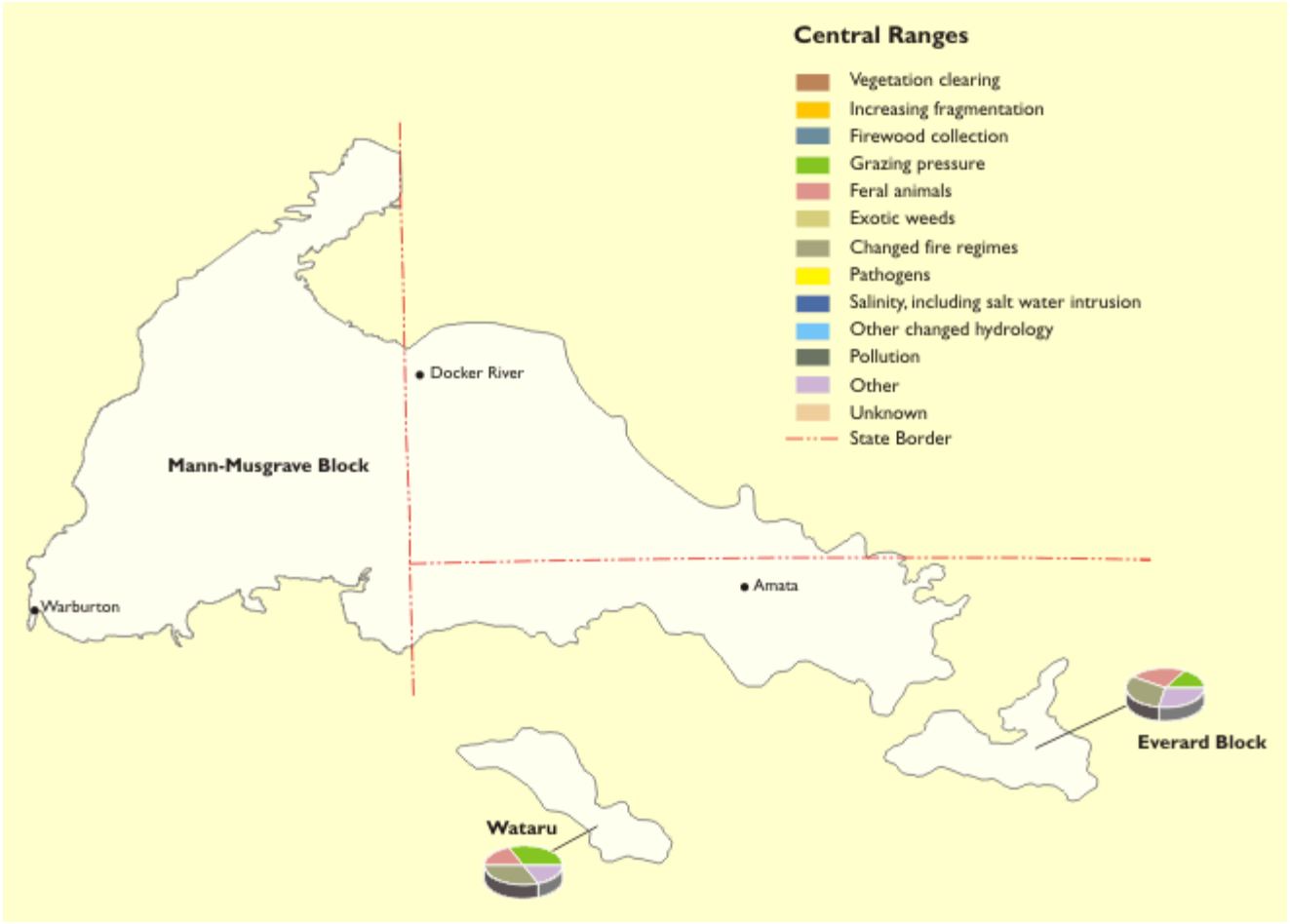
Map: Riparian threatening processes.



Click here to link to a table of riparian zones: their average condition, trend and threatening processes for each subregion. The reliability of this overall assessment is indicated.

Ecosystems at risk

Map: IBRA map showing frequency of threatening processes for ecosystems.



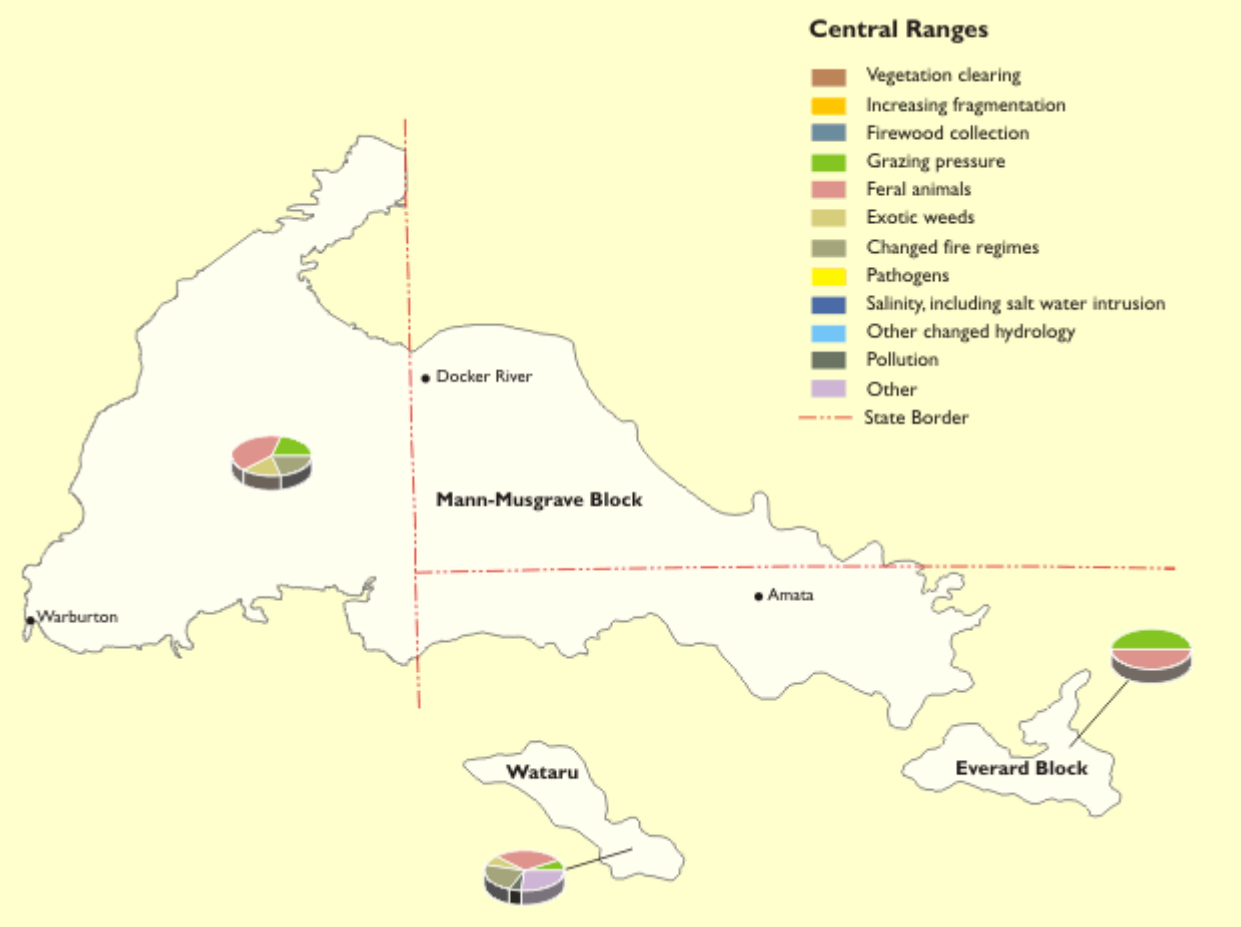
Click here to link to a table of provisional list of threatened ecosystems in Australia: their broad vegetation type (National Vegetation Information System - Major Vegetation Subgroup), recommended status, current legislative protection as a threatened ecosystem, trend and bioregional distribution. These ecosystems are arranged in the bioregion of their principal occurrence. The reliability of the recommended status is indicated.

Click here to link to a table of provisional list of threatened ecosystems in each subregion: their threatening processes.

Click here to link to a table of provisional list of threatened ecosystems in each subregion: their recommended recovery actions

Species at risk

Map: IBRA map showing frequency of threatening processes for species.



Click here to link to a table of species at risk in each subregion: their status, trend and subregional distribution. The reliability of the assessment of trend is indicated and whether recovery plans have been prepared.

Click here to link to a table of species at risk in each subregion: their threatening processes.

Click here to link to a table of species at risk in each subregion: their status recommended recovery actions.

Birds

The birds of the Central Ranges were not well surveyed in either Atlas period, but the composition of the avifauna appears to resemble that of other semi-arid bioregions. One limited range taxon, the Princess Parrot, was seen in the bioregion during the first Atlas period. The only other feature that sets the bioregion apart is the absence of any exotic species. The apparent decline in ground-nesting birds and of ground-feeding insectivores should be investigated at a larger scale.

Status: Typical semi-arid avifauna.

Rare and threatened: No major populations.

Increasers: None indicative of landscape health.

Indicators: Emu, Australian Bustard, Banded Lapwing, White-browed Treecreeper, Jacky Winter.

Trend: Possible decline in ground-nesting species.

Scenario: Probably little change.

Actions: Ensure representative areas have an appropriate fire regime to maintain diversity.

Click hereto download a summary report including the physical characteristics of the bioregion, a species list, and summary statistics [Excel file]. The file may open on your screen. To save it to your system 'Save as' under the File menu.

Mammals

Number of species and status

There are 41 mammal species within this bioregion. (The maximum number of species recorded in a bioregion is 86 and the minimum is 25).

Click here to link to a table of number of species in each status class for this bioregion.

Click here to link to a list of mammal species and their status for this bioregion.

Critical weight range

The critical weight range (35 - 5500 g) of mammals is the size range of Australian mammals that have been most affected by environmental changes following European settlement. In this bioregion, the proportion of mammal fauna within the critical weight range is .585. (The maximum proportion of fauna within the critical weight range recorded in a bioregion is 0.632 and the minimum is 0.222).

Faunal Attrition Index

Faunal attrition is a measure of contraction or loss of species richness with a region. A high index value means many species have declined or are extinct in the bioregion. The index can be used to compare the status of mammal fauna to regional attributes such as changes since European settlement and average annual rainfall. The Faunal Attrition Index for mammals in this bioregion is .45. (The maximum faunal attrition index value recorded in a bioregion is 0.66 and the minimum is 0).

Click here to link to a table of Faunal Attrition Index for groups of mammals shows the contributions of each group to overall patterns of faunal decline.

Faunal Contraction Index

A range contraction index is a measure of the extent to which the range inhabited by a particular species has contracted. A high index value means that many of the species comprising the region's original mammal fauna have contracted from a high proportion of the regions they originally occurred in. The faunal contraction index for the mammal fauna in this bioregion is .44. (The maximum faunal contraction index value recorded in a bioregion is 0.51 and the minimum is 0.07).

Faunal Endemism Index

Endemic species are those restricted to certain regions. Regions containing endemic species are considered to have high biodiversity conservation values because opportunities to conserve those species do not exist elsewhere. A high index value means that the species comprising the original mammal fauna typically occurred in few bioregions. The faunal endemism index value for the mammal fauna in this bioregion is .64. (The maximum faunal endemism index value recorded in a bioregion is 0.79 and the minimum is 0.52).

New Endemism Index

Extant (still surviving) species that have undergone major range contractions can be considered 'new endemics'. Bioregions that contain new endemic species are often important refugia for threatened species. The new endemism index for the mammal fauna in this bioregion is .66. (The maximum new endemism index value recorded in a bioregion is 0.93 and the minimum is 0.5).

Table: Translocated Species

There is no data available for this table within the bioregion.

Exotic Mammals

The number of introduced exotic mammal species that occur within this bioregion is 7. (The maximum number of introduced exotic mammal species in a bioregion is 16 and the minimum is 5).

Click here to link to a list of introduced exotic mammal species for this bioregion.

Extinct mammal species

The number of extinct mammal species that previously occurred within this bioregion is 17. (The maximum number of extinct mammal species in a bioregion is 29 and the minimum is 0).

Click here to link to a list of extinct mammal species for this bioregion.

Management responses

Reserve consolidation

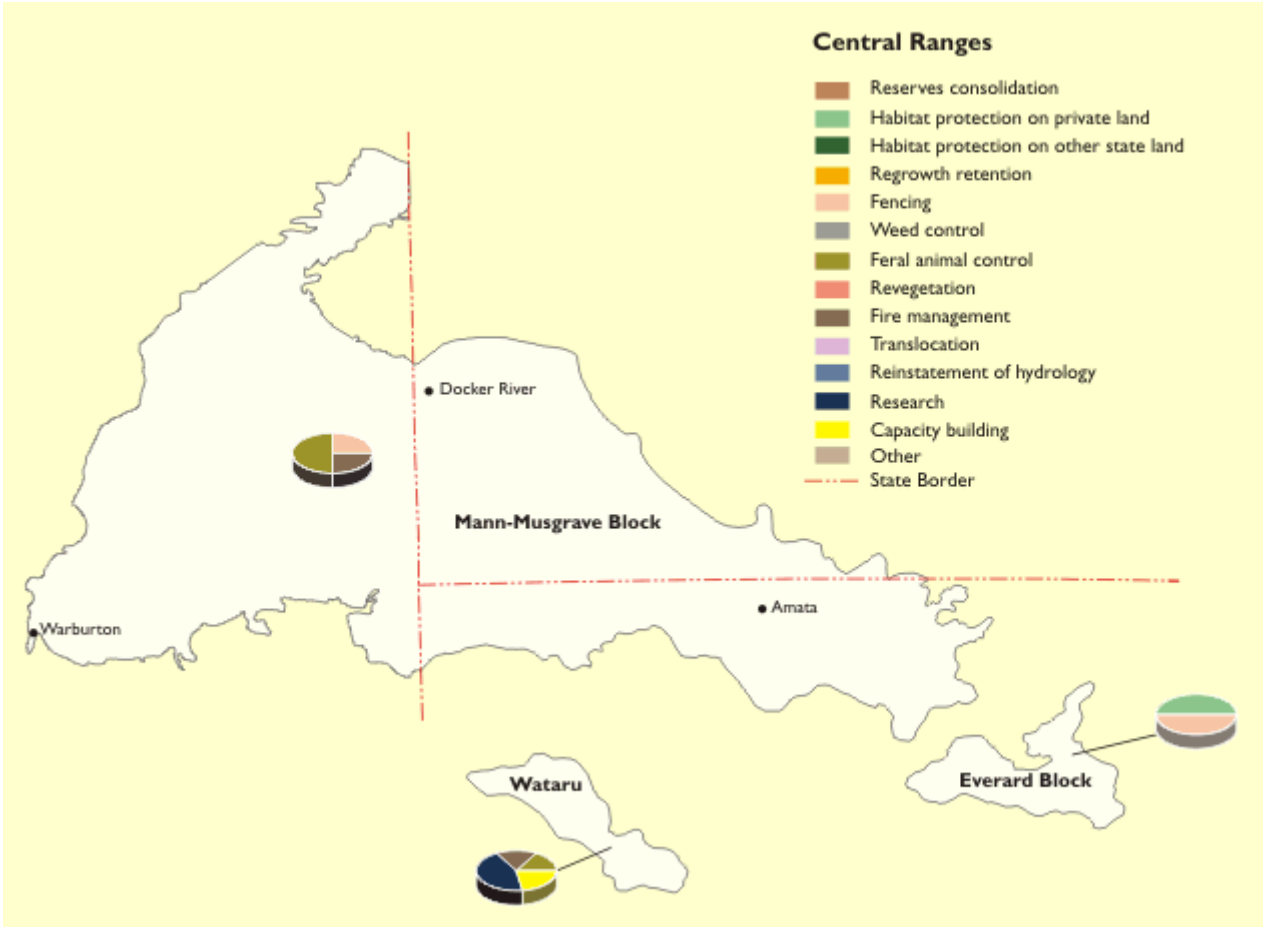
Click here to link to a table of comprehensiveness, adequacy and representativeness (CAR) of the National Reserve System in terms of ecosystems and area sampled and a ranking of reserve management. The bioregional priority for consolidating the National Reserve System is based on this CAR analysis and threat.

Click here to link to a table of bioregional and subregional priorities and ecosystem priorities to consolidate the National Reserve System and associated ecosystem constraints.

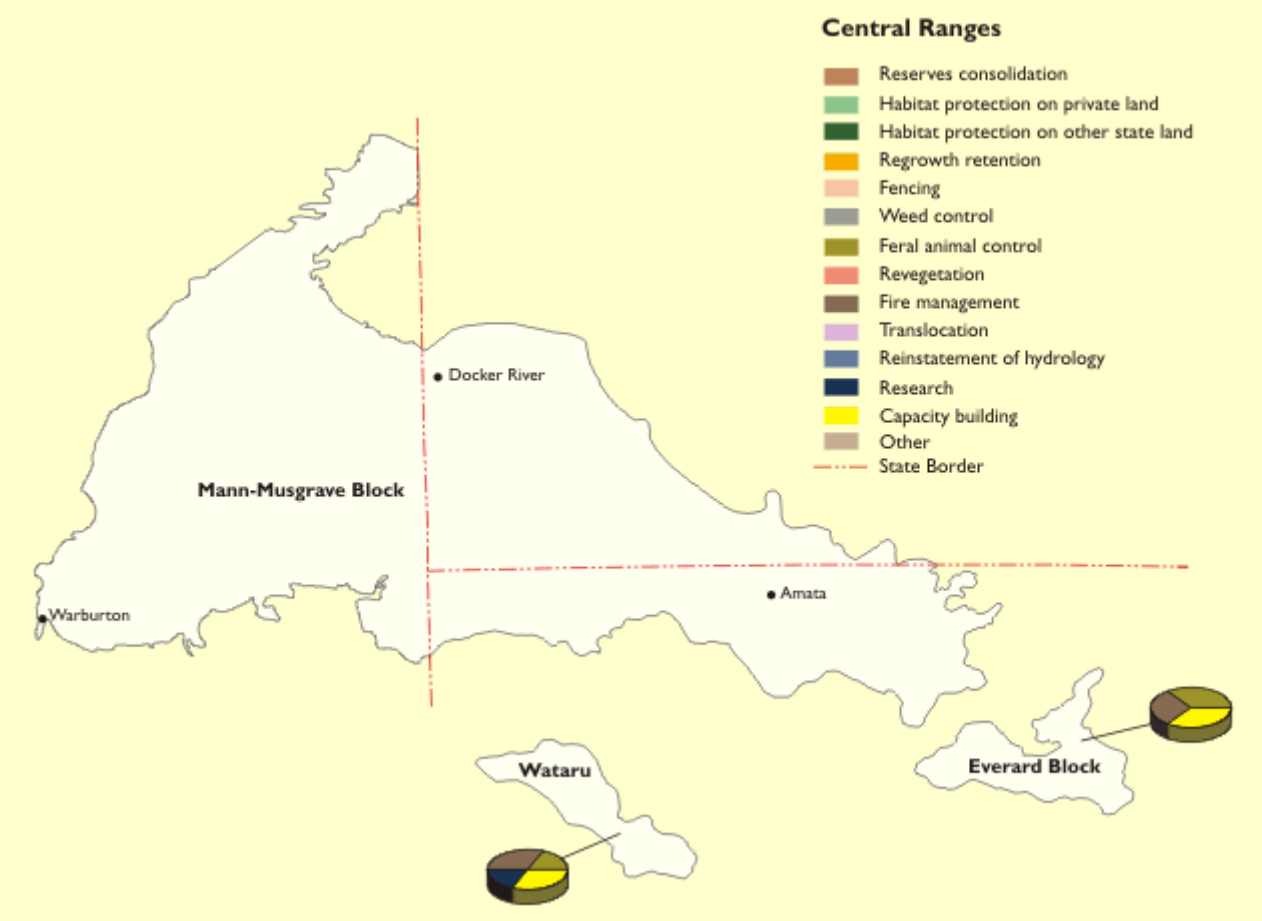
Off-park conservation for species and ecosystem recovery

Integrated NRM

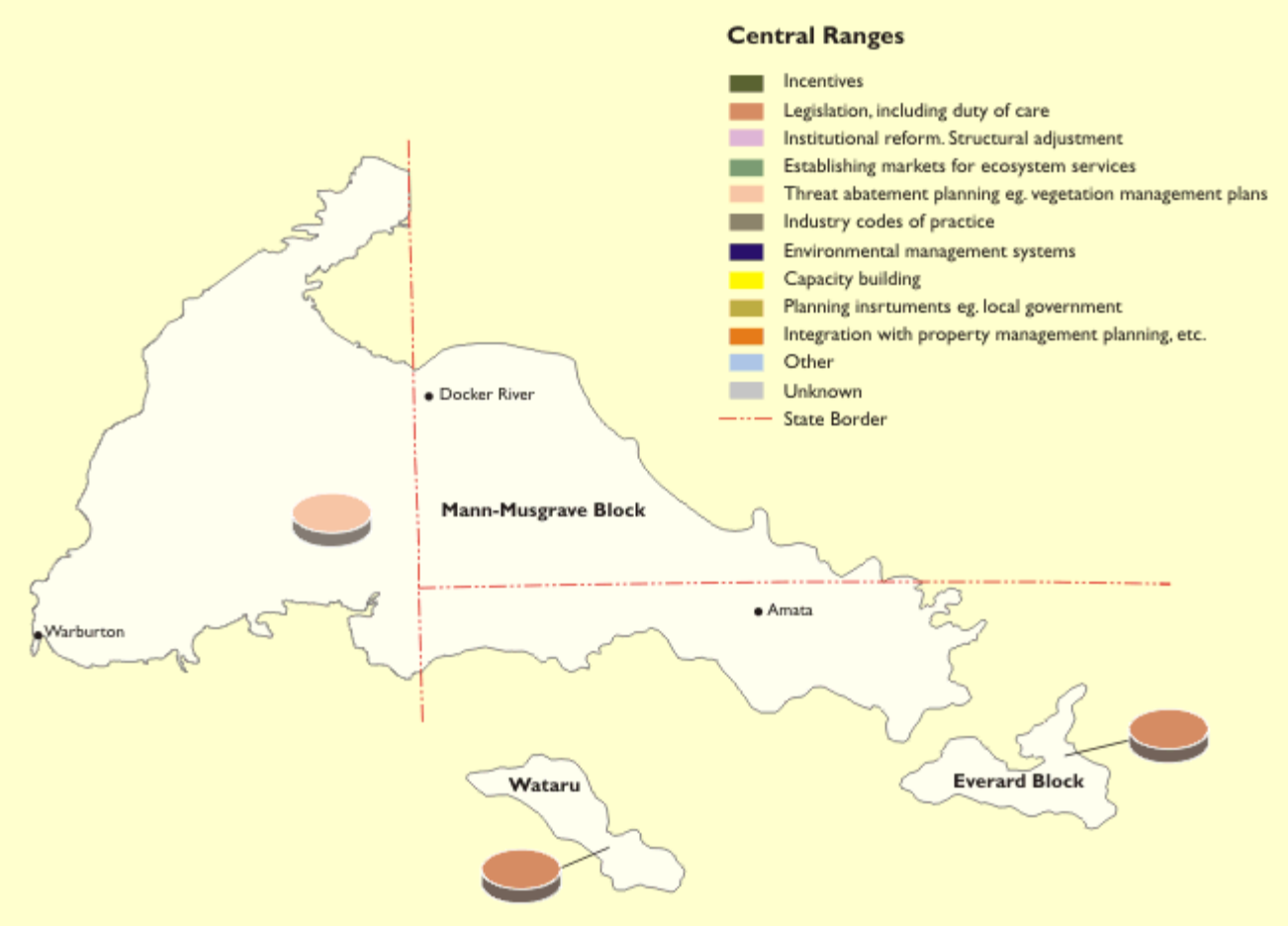
Map: IBRA map showing frequency of recovery actions (species).



Map: IBRA map showing frequency of recovery actions (ecosystems).



Map: IBRA map showing existing projects part of NRM.



Click here to link to a table of contribution of integrated Natural Resource Management to the protection of biodiversity in each subregion: existing measures and effectiveness.

Click here to link to a table of contribution of integrated Natural Resource Management to the protection of biodiversity in each subregion: feasible opportunities and comments.

Further Information & Gaps

Click here to link to a table of some major data gaps in each subregion in terms of protecting biodiversity.

Before you download

Most publications are downloadable as PDF files. Adobe Acrobat Reader is required to view PDF files.

If you are unable to access a publication, please contact us to organise a suitable alternative format.

Key

Links to an another web site
Opens a pop-up window

Australian Natural Resources Atlas
Department of the Environment and Water Resources
GPO Box 787
Canberra ACT 2601 Australia
+61 (0)2 6274 2051 ABN

NLWRA
Australian Government
Environment Portal

Biodiversity Assessment - Central Ranges

Species at risk

Table: Species at risk in each subregion: their status, trend and subregional distribution. The reliability of the assessment of trend is indicated and whether recovery plans have been prepared.

Species Group	Species name	EPBC listing	State listing	Trend	Recommended rank	Existing recovery plans (yes/no)	Subregional occurrence
				CR1			
Birds	Acanthiza iredalei iredalei (Slender-billed Thornbill (western))	Vulnerable	NT (E); SA (V)	Unknown	No data	No	AW1; AW2; COO1; COO2; COO3; CR1; EYB2; EYB3; EYB5; FLB4; FLB5; GAS2; GAS3;

							GAW1; GAW2; GAW4; GAW5; GD1; GS1; GS2; GVD2; GVD5; GVD6; HAM; KAN2; LSD2; MAL1; MAL2; MUR1; MUR2; NCP1; NCP3; NCP4; NUL1; NUL2; NUL3; YAL
Birds	Amytornis textilis modestus (Thick-billed Grasswren (eastern))	Vulnerable	No data	Unknown	No data	No	CAR2; CR1; FIN3; FIN4; FLB4; FLB5; MAC1; MAC2; SSD7; STP1; STP2; STP3; STP4; STP5
Birds	Leipoa ocellata (Malleefowl)	Vulnerable	NSW (E); NT (E); SA (V); VIC (E); WA (V)	Unknown	No data	No	AW1; AW2; BBS23; BBS24; BBS25; CAR2; COO1; COO2; COO3; CP2; CP3; CP4; CP5; CR1;

							DRP10; DRP5; DRP9; ESP1; ESP2; EYB1; EYB3; EYB4; EYB5; GD1; GS1; GS2; GS3; GVD1; GVD2; GVD4; GVD6; HAM; MAL1; MAL2; MDD1; MDD2; MDD3; MDD4; MDD5; MDD6; MUR1; MUR2; NCP1; NCP2; CHC3; CR1; FIN1; FIN2; FIN3; GAS2; GAS3; GD1; GD2; GSD1; GSD2; GSD4; GVD1; GVD3; LSD2; MAC1; MAC2; MAC3; MUR1; NUL1; NUL2;
Birds	Polytelis alexandrae (Princess Parrot, Alexandra's Parrot)	Vulnerable	NT (V)	Unknown	No data	No	

							MII3; PIL1; SEQ1; TAN1
Mammals	Dasycercus cristicauda (Mulgara)	Vulnerable	NSW (X); NT (V); SA (E); WA (V)	Unknown	No data	No	BRT1; BRT2; BRT3; CAR1; CAR2; CHC1; CHC2; COO3; CR1; DMR1; DMR3; GAS2; GAS3; GD1; GD2; GSD1; GSD2; GVD1; GVD2; HAM; LSD1; LSD2; MAC1; MAC3; MUR1; MUR2; NUL1; NUL2; PIL1; SSD1; SSD2; TAN1
Mammals	Dasyurus geoffroii (Chuditch, Western Quoll)	Vulnerable	NT (X); VIC (X); WA (V)	Extinction	No data	No	AW1; AW2; BBS25; CAR2; COO2; COO3; CR1; ESP1; ESP2; GSD2; JF1; JF2; MAL1; MAL2; NUL2; SWA1; SWA2;

							WAR; YAL
Mammals	Lagorchestes asomatus (Central Hare-wallaby)	Extinct	NT (X); WA (X)	Extinction	No data	No	CR1
Mammals	Leporillus apicalis (Lesser Stick-nest Rat)	Extinct	NT (X); VIC (X); WA (X)	Extinction	No data	No	AW1; CAR2; CR1; GAS3; GD1; GS1; GVD1; GVD2; HAM; LSD2; MAL1; MDD2; MUR1; NUL2; PIL3; YAL
Mammals	Macrotis lagotis (Greater Bilby)	Vulnerable	NT (V); QLD (E); SA (E); WA (V)	Unknown	No data	No	AW1; AW2; BBS22; BBS24; BHC1; CAR2; CHC2; CHC3; CHC4; COO2; COO3; CP2; CP3; CR1; DL2; DMR3; DRP8; GAS1; GAS3; GD1; GD2; GSD1; GSD2; JF1; JF2; LSD1; LSD2; MAL2; MDD1; MDD6; MGD4; MGD7; MUR1;

							MUR2; NSS1; NSS2; NUL2; OVP1; OVP2; OVP4; PIL1; PIL2; PIL4; SSD6;
Mammals	Macrotis leucura (Lesser Bilby)	Extinct	NT (X); WA (X)	Extinction	No data	No	CR1; GD1; GSD2
Mammals	Myrmecobius fasciatus (Numbat)	Vulnerable	WA (V)	Extinction	No data	No	AW2; CR1; DRP10; ESP1; JF1; JF2; MAL2; SWA2
Mammals	Notomys longicaudatus (Long-tailed Hopping-mouse)	Extinct	NT (X); WA (X)	Extinction	No data	No	AW2; BHC1; BHC2; CR1; GD1; MUR1; YAL
Mammals	Notoryctes typhlops (Yitjarritjarri, Southern Marsupial Mole)	Endangered	NT (V); SA (E); WA (E)	Unknown	No data	No	COO3; CR1; CR2; FIN1; FIN2; FIN3; GAW2; GD1; GSD2; GSD5; GVD1; GVD2; GVD3; GVD4; LSD2; MAC2; MUR1; NUL1; NUL2; TAN1; TAN2
Mammals	Onychogalea lunata	Extinct	NT (X);	Extinction	No data	No	AW1; COO3;

	(Crescent Nail-tail Wallaby)		WA (X)				CR1; GD1; MAL2; MUR1; NUL2
Mammals	Petrogale lateralis MacDonnell Ranges race (Warru, Black-footed Rock-wallaby (MacDonnell Ranges race))	Vulnerable	SA (E); WA (V)	Unknown	No data	No	BRT1; BRT2; BRT3; BRT4; CHC1; CR1; CR2; DMR2; FIN1; GSD2; GVD2; GVD4; MAC1; MAC2; MAC3; SSD1; STP4
Mammals	Petrogale lateralis lateralis (Black-flanked Rock-wallaby)	Vulnerable	WA (V)	Unknown	No data	No	AW1; AW2; CAR1; CR1; ESP2; GD1; GD2; GS2; LSD2; PIL4
Mammals	Trichosurus vulpecula (Common Brushtail Possum)	No data	NT (E); NT (X)	Rapidly declining	Qualitative	No	BRT2; BRT3; CR1; GSD2; MAC1; MAC3
Reptiles	Egernia kintorei (Great Desert Skink)	Vulnerable	NT (V); SA (E); WA (V)	Unknown	No data	No	BRT1; CR1; DMR1; FIN2; GAS2; GD1; GSD1; GSD2; GSD4; LSD1; MAC1; MAC2; MUR1; TAN1
Vascular	Basedowia	Vulnerable	No	Unknown	No data	No	CR1; CR3

plants	tenerrima		data				
Vascular plants	Prostanthera nudula	Vulnerable	SA (V)	Unknown	No data	No	CR1; CR3
				CR2			
Birds	Amytornis striatus (Striated Grasswren)	No data	NSW (V); SA (V)	Unknown	No data	No	CP2; CP3; CR2; EYB5; FLB4; FLB5; GAW1; GVD4; GVD6; MDD1; MDD6; NCP4; RIV1; STP5
Birds	Ardeotis australis (Australian bustard)	No data	NSW (E); SA (V); VIC (E)	Unknown	No data	No	BBS22; BBS24; BBS25; BHC1; BHC2; BHC4; CHC10; CHC2; CHC6; CHC9; CP2; CP5; CR2; DRP1; DRP2; DRP4; DRP5; DRP6; DRP7; DRP8; EYB5; FIN3; FIN4; FLB4; GVD4; GVD5; GVD6; MDD1; MDD2; MDD4; MDD5; MUL14; MUL16;

							MUL7; NAN1; NCP2; NET12; NSS1; NSS2; RIV1; RIV2; RIV3; COO3; CR1; CR2; FIN1; FIN2; FIN3; GAW2; GD1; GSD2; GSD5; GVD1; GVD2; GVD3; GVD4; LSD2; MAC2; MUR1; NUL1; NUL2; TAN1; TAN2
Mammals	Notoryctes typhlops (Yitjarritjarri, Southern Marsupial Mole)	Endangered	NT (V); SA (E); WA (E)	Unknown	No data	No	BRT1; BRT2; BRT3; BRT4; CHC1; CR1; CR2; DMR2; FIN1; GSD2; GVD2; GVD4; MAC1; MAC2; MAC3; SSD1; STP4
Mammals	Petrogale lateralis MacDonnell Ranges race (Warru, Black-footed Rock-wallaby (MacDonnell Ranges race))	Vulnerable	SA (E); WA (V)	Unknown	No data	No	CR3
Vascular	Basedowia	Vulnerable	No	Unknown	No data	No	CR1; CR3

plants	tenerrima		data				
Vascular plants	Prostanthera nudula	Vulnerable	SA (V)	Unknown	No data	No	CR1; CR3

Biodiversity Assessment - Central Ranges

Species at risk and the Threatening Process

Table: Species at risk in each subregion: their threatening processes.

Species name	Threatening processes	Threatening processes notes
	CR1	
Trichosurus vulpecula (Common Brushtail Possum)	Changed fire regimes	habitat change through increased incidence of hot extensive fires
Trichosurus vulpecula (Common Brushtail Possum)	Exotic weeds	habitat change through broad-scale weed invasion
Trichosurus vulpecula (Common Brushtail Possum)	Feral animals	habitat change through grazing by camels, donkeys, etc.
		predation by foxes, cats
Trichosurus vulpecula (Common Brushtail Possum)	Grazing pressure	habitat change through cattle grazing
	CR2	
Amytornis striatus (Striated Grasswren)	Changed fire regimes	Fire, particularly extensive fires that destroy mature hummock grassland over large areas, and excessive frequent fires. (Garnett, 1992)
Amytornis striatus (Striated Grasswren)	Feral animals	Predation by feral cats and foxes.
Amytornis striatus (Striated Grasswren)	Grazing pressure	Grazing by stock in mallee areas. (Garnett, 1992)
Ardeotis australis (Australian bustard)	Exotic weeds	Invasion of pastoral land by woody weeds.
Ardeotis australis (Australian bustard)	Feral animals	Predation of chicks and eggs by foxes.
Ardeotis australis (Australian bustard)	Other - describe	Agriculture - bustards regularly desert nests in response to disturbance by humans, sheep or cattle.
Ardeotis australis (Australian bustard)	Pollution	Traditional and illegal hunting. Pesticides either directly or indirectly ingested are held responsible for local extinctions.

Notoryctes typhlops (Yitjarritjarri, Southern Marsupial Mole)	Changed fire regimes	Changed fire regimes in the spinifex dominated sandy deserts.
Notoryctes typhlops (Yitjarritjarri, Southern Marsupial Mole)	Feral animals	Predation by foxes and cats.
Notoryctes typhlops (Yitjarritjarri, Southern Marsupial Mole)	Other - describe	Overall lack of knowledge on biology of species and threats
		Predation by dingoes
Petrogale lateralis MacDonnell Ranges race (Warru, Black-footed Rock-wallaby (MacDonnell Ranges race))	Changed fire regimes	Detrimental to preferred habitat.
Petrogale lateralis MacDonnell Ranges race (Warru, Black-footed Rock-wallaby (MacDonnell Ranges race))	Feral animals	Habitat modification by, and competition for food with rabbits
		Predation by foxes and feral cats
	CR3	
Basedowia tenerrima	Grazing pressure	Grazing by stock affects the plant both directly and by habitat degradation resulting in increased run-off
Prostanthera nudula	Grazing pressure	Grazing by stock affects the plant both directly and by habitat degradation resulting in increased run-off

Appendix E

Search Results of the Australian Department of Environment and Water Environmental Reporting Tool

Database Report

11 January 2008 16:41

This report includes places of national environmental significance that are registered in the Department of the Environment and Water Resources' databases, for the selected area. The information presented here has been provided by a range of groups across Australia, and the accuracy and resolution varies.

Search Type:	Area
Buffer:	0 km
Coordinates:	-24.258,127.010, -27.375,127.010, -27.375,130.530, -24.25,130.530

Report Contents: Summary >> Details >> Caveat >> Acknowledgment

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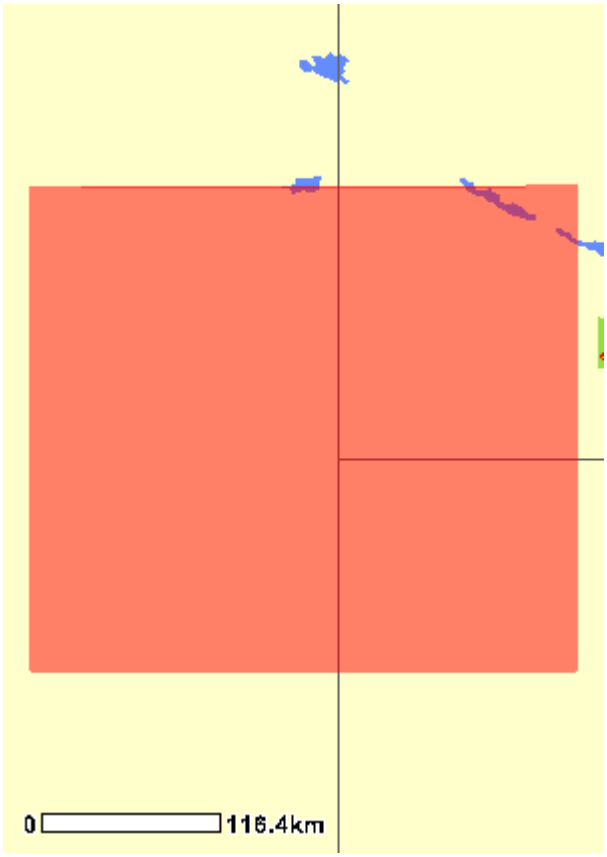

Biodiversity

Threatened Species: 10

Migratory Species:	7
Listed Marine Species:	5
Invasive Species:	4
Whales and Other Cetaceans:	None
Threatened Ecological Communities:	None
Heritage	
World Heritage Properties:	None
Australian Heritage Sites:	1
Wetlands	
Ramsar sites: (Internationally important)	None
Nationally Important Wetlands:	2
National Pollutant Inventory	
Reporting Facilities:	None
Airsheds:	None
Catchments:	None
Protected Areas	
Reserves and Conservation Areas:	2
Regional Forest Agreements:	None

Biodiversity		
Threatened Species [Dataset Information]	Status	Comments
Birds		
Acanthiza iredalei iredalei Slender-billed Thornbill (western)	Vulnerable	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl	Vulnerable	Species or species habitat likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasycercus cristicauda Mulgara	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis	Vulnerable	Species or species habitat may

Greater Bilby		occur within area
Notoryctes caurinus Karkarratul, Northern Marsupial Mole	Endangered	Species or species habitat likely to occur within area
Notoryctes typhlops Yitjarritjarri, Southern Marsupial Mole	Endangered	Species or species habitat likely to occur within area
Petrogale lateralis MacDonnell Ranges race Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)	Vulnerable	Species or species habitat may occur within area
Zyzomys pedunculatus Central Rock-rat	Endangered	Species or species habitat may occur within area
Reptiles		
Egernia kintorei Great Desert Skink, Tjakura, Warrarna, Mulyamiji	Vulnerable	Species or species habitat may occur within area
Migratory Species [Dataset Information]	Status	Comments
Migratory Terrestrial Species		
Birds		
Leipoa ocellata Malleefowl	Migratory	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Migratory	Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Listed Marine Species [Dataset Information]	Status	Comments

Birds

Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Listed - overfly marine area	Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area

Invasive Species [Dataset Information]	Status	Comments
Selected Invasive Species: Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.		

Mammals

Felis catus Cat, House Cat, Domestic Cat	Feral	Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit	Feral	Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox	Feral	Species or species habitat likely to occur within area

Plants

Cenchrus ciliaris Buffel-grass, Black Buffel-grass	Invasive	Species or species habitat may occur within area

Heritage

Australian Heritage Sites [Dataset Information]
Note that not all Indigenous sites may be listed.

Natural

Ranges of the Western Desert WA

Wetlands

Nationally Important Wetland Sites [Dataset Information]

Lake Amadeus, NT

Rock Pools of the Walter James Range, WA

Other

Reserves and Conservation Areas [Dataset Information]

Ngaanyatjarra Lands Indigenous Protected Area, WA

Watarru Indigenous Protected Area, SA

Caveat

The information presented here has been drawn from a range of sources, compiled for a variety of purposes. Details of the coverage of each dataset are included in the metadata [Dataset Information] links above.

Acknowledgment

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra

- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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Appendix F

Search Results of the Federal Government Environment Protection and Biodiversity Conservation Act Protected Matters Database

Wingellina Project : EPBC Act Protected Matters Database Report

Protected Matters Search Tool

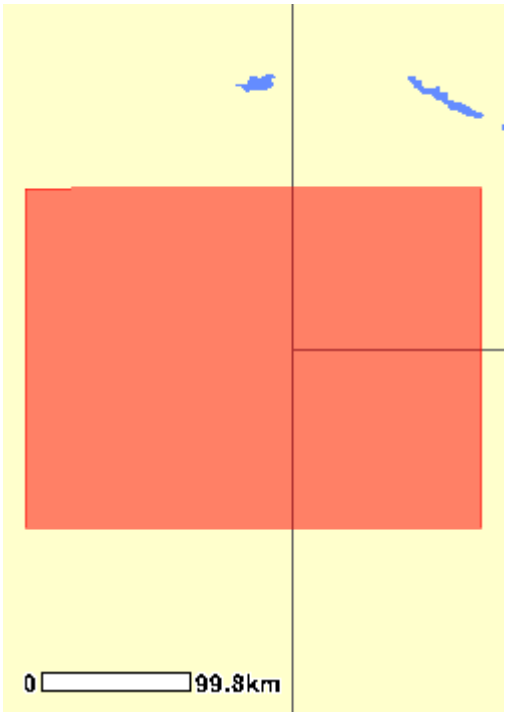
11 January 2008 16:36

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html



Search Type: Area

Buffer: 0 km

Coordinates: -24.937,127.230, -27.192,127.230, -27.192,130.255, -24.93,130.255

Report Contents:

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: (Ramsar Sites)	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	8
Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources

including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Places on the RNE:	1
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Other Commonwealth Reserves:	None
Regional Forest Agreements:	None

Details

Matters of National Environmental Significance

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Leipoa ocellata * Malleefowl	Vulnerable	Species or species habitat likely to occur within area
Polytelis alexandrae * Princess Parrot, Alexandra's Parrot	Vulnerable	Species or species habitat may occur within area

Mammals		
Dasycercus cristicauda * Mulgara	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis * Greater Bilby	Vulnerable	Species or species habitat may occur within area
Notoryctes caurinus * Karkarratul, Northern Marsupial Mole	Endangered	Species or species habitat likely to occur within area
Notoryctes typhlops * Yitjarritjarri, Southern Marsupial Mole	Endangered	Species or species habitat likely to occur within area
*Petrogale lateralis MacDonnell Ranges race** Warru, Black-footed Rock-wallaby (MacDonnell Ranges race)	Vulnerable	Species or species habitat may occur within area
Reptiles		
Egernia kintorei * Great Desert Skink, Tjakura, Warrarna, Mulyamiji	Vulnerable	Species or species habitat may occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		
Birds		
Leipoa ocellata * Malleefowl	Migratory	Species or species habitat likely to occur within area
Merops ornatus * Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Migratory	Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel	Listed - overfly marine area	Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole	Listed - overfly marine area	Species or species habitat may occur within area
Merops ornatus ***** Rainbow Bee-eater	Listed - overfly marine area	Species or species habitat may occur within area
Commonwealth Lands [Dataset Information]		
Defence		
Places on the RNE [Dataset Information] Note that not all Indigenous sites may be listed.		
Natural		
Ranges of the Western Desert WA		

Extra Information

State and Territory Reserves [Dataset Information]
Ngaanyatjarra Lands Indigenous Protected Area, WA
Watarru Indigenous Protected Area, SA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;
- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
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- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Last updated:

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Appendix G

Search Results for the Australian Wetlands Database

Australina Wetlands Database Search Report

[ ]

Inland Waters

A Directory of Important Wetlands in Australia

To save this report to your computer, use File/Save as, and use a .TXT file extension.

Rock Pools of the Walter James Range - WA014

Level of importance: National - Directory

Location: 24 degrees 40' S, 128 degrees 46' E; 62 km north-east of Giles Meteorological Station, 40 km north-west of Docker River (Northern Territory).

Biogeographic region: Central Ranges

Shire: Ngaanyatjarraku.

Area: Each pool is c. 9 m diameter.

Elevation: c. 500 m ASL.

Other listed wetlands in same aggregation: None.

Wetland type: B17

Criteria for inclusion: 1, 3, 6,

Site description: Identified by various names on maps (Bungabiddy Rockhole, Bangalburi Rockhole), the Aboriginal name for the two large rock pools on the eastern side of the Walter James Range is Pungkilpirri. Nearby wetlands: Lake Gruszka (WA039) lies 295 km west south-west.

Physical features: Landform: Two permanent rock pools, c. 9 m in diameter and c. 4 m deep, each at the base of a waterfall. The rock pools lie along a temporary creek which drains the range after rain and they are formed by corrasion of the sandstone at the base of the waterfalls. The lower pool is backed by a 6 m cliff which must be climbed to reach the upper pool. A narrow 50 m stretch of gorge inclines gently to the upper pool which is c. 15 m above the lower. There is a small amount of gravel in the pools which are very turbulent ('tumble pools') when the creek is flowing. Geological setting: Set in the Amadeus Basin, the Walter James Range is a small range of stratified quartzite sandstone surrounded by alluvial and aeolian sandplain broken by other isolated ranges. The steep scree slopes and small cliffs of the gorge rise 200 m above the pools. Climate: Median and mean annual rainfall at nearby Giles Meteorological Station are 245 mm and 259 mm respectively, mostly falling in December-March; average annual evaporation is c. 3400 mm (Forman 1965; P.J. Fuller pers. comm.; D. Pearson pers. comm.).

Hydrological features: Water supply: Surface inflow along a temporary creek. Inundation: Permanent; the high walls of the narrow gorge shade the pools and water loss by evaporation is minimal. Water depth: Maximum, over 5 m deep. Water salinity: Fresh. Water colour: None.

Ecological features: Ecological role: A permanent breeding site for Cyclorana maini; permanent water supply for birds. Plant structural formations: No emergent vegetation; surrounding area open shrubland, creek fringed by trees and sedges.

Significance: A good example of the few permanent rock pools in the Central Ranges bioregion; one of few sources of permanent water.

Notable flora: Threatened species: None. Composition: The rocky pools are bare. Figs Ficus platypoda overhang the lower pool. The creek flowing from the pools has a rocky bed lined with River Red Gums Eucalyptus camaldulensis, sedges and mixed shrubs, and flood-out flats of bloodwood Eucalyptus sp. and mulga Acacia aneura. The steep rocky scree slopes of the gorge support spinifex Triodia (sp.) and a sparse wattle scrub of A. cyperophylla. Callitris columellaris occurs in patches on steeper slopes and in gullies (Beard 1974).

Notable fauna: No information; the narrow gorge and rocky unvegetated surrounds make it unlikely that the pools have any value to waterbirds.

Other Fauna: Threatened species: Black-footed Rock Wallaby Petrogale lateralis (MacDonnell Ranges race) (Nv, Sr) occur in the area, but are not dependent on water from the pools. Composition: Euros Macropus robustus and terrestrial birds, including pigeons, cockatoos, parrots and finches utilise the permanent water supply. Peregrine Falcon Falco peregrinus hunt near the pools. Dusky Grasswren Amytornis purnelli occur on nearby spinifex slopes and Spotted Bowerbird Chlamydera maculata build bowers under nearby fig trees. There are numerous tadpoles of Cyclorana maini in the pools (A. Chapman pers. comm.; P.J. Fuller pers. comm.; D. Pearson pers. comm.).

Social and Cultural values: Cultural: The rockholes are well-known to the Pitjantjatjara, Ngaatjatjarra and Ngaanyatjarra Aboriginal people of the Western Desert as part of an

important songline which extends from Broome WA, through Kings Canyon NT, to Pukara WA and beyond. This songline is a route along which a mythical ancestral being, Pukara a Rainbow Serpent is believed to have travelled. According to Tjukurpa (Aboriginal Law) special events occurred at places along the route and the significance of these sites is preserved in Aboriginal oral tradition. Pungkilpiri is a place of traditional ceremonial importance and was a very important water source, particularly during drought. The lower pool is now used as a swimming hole by people from the Tjukurla community; the upper pool is reserved for drinking water (P.J. Fuller pers. comm.; D. Pearson pers. comm.; L.R. Rive pers. comm.).

Land tenure: Central Australia Aboriginal Reserve for Use and Benefit of Aboriginal Inhabitants (17614). Surrounding area: Central Australia Aboriginal Reserve for Use and Benefit of Aboriginal Inhabitants(17614).

Current land use: Aboriginal usage. Surrounding area: Aboriginal usage and sparse human population.

Disturbance or threat: Past/present: None known.

Potential: Possibly considered as a weekend ""swimming hole"" by Docker River residents and travellers.

Conservation measures taken: Access to Aboriginal land is restricted and permission to enter must be obtained from the Aboriginal Lands Trust.

Management authority and jurisdiction: Managed by the Aboriginal Lands Trust.

References: See Western Australia Reference List

Compiler & date: Romeny J. Lynch, c/- Department of Conservation and Land Management, Busselton. July- October 1995.

Drainage:

Go to basic query form | Go to advanced query form | Go to spatial query tool

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Inland Waters

A Directory of Important Wetlands in Australia

To save this report to your computer, use File/Save as, and use a .TXT file extension.

Lake Amadeus - NT005

Level of importance: National - Directory

Location: 24 degrees 28' - 25 degrees 02' S, 130 degrees 29' - 131 degrees 30' E; 25 km north of Yulara; 275 km west south-west of Alice Springs. Lake Amadeus, to the maximum high water mark; also, some small satellite lakes.

Biogeographic region: Great Sandy Desert.

Shire: Admin Region: Alice Springs.

Area: 103 700 ha.

Elevation: 464 m ASL.

Other listed wetlands in same aggregation: The Karinga Creek Palaeodrainage System (NT004) is 60 km east south-east.

Wetland type: B8

Criteria for inclusion: 1,

Site description:

Physical features: Landform: Megascale irregular-elongate sumpland; also numerous

(adjacent) microscale- macroscale irregular and ovoid sumplands, and numerous (c. 80 mapped at 1: 250 000 scale) microscale-macroscale irregular and ovoid islands within the site. Geological setting: Situated in the Amadeus Basin, in lacustrine evaporites (gypsum, glauberite). Gypsum deflation dunes occur beside the lake. Surrounding land is low-lying. Climate: Median and mean annual rainfall at Ayers Rock (near Yulara) are 310 mm and 331 mm respectively (relatively short recording period), mostly falling in January-March (but variable); annual evaporation is c. 3400 mm.

Hydrological features: Hydrological role: The lake is a major area for discharge of the central Australian groundwater system. Water supply: Direct precipitation, and groundwater seepage around most of the lake. Inundation: Episodic: fills substantially (approx.) only once every ten to 20 years; water from even quite large thunderstorms is rapidly lost to seepage and evaporation. Water depth: When full, probably less than 10-20 cm, or exceptionally c. 50 cm. Water salinity: Brine, poikilohaline (recent surface water probably is hyposaline until lake- bed salt dissolves).

Ecological features: Plant structural formations: Mostly bare; some fringing low open-shrubland (samphire). Surrounding areas support open-woodland over open-hummock grassland and hummock grassland with open- woodland overstorey.

Significance: A good example of a brine lake lacking significant surface inflow; the largest entirely within the NT.

Notable flora: Composition: Fringing samphire is dominated by Halosarcia halocnemoides. Ephemeral tussock grasses (e.g. Eragrostis falcata) and forbs (e.g. Frankenia cordata, Portulaca pilosa) are a significant component of this community, and some Melaleuca glomerata occurs at the margins of the samphire (PWCNT files; Wilson et al. 1990).

Notable fauna: Composition: Seven species were recorded when much of the lake was covered in shallow water in winter 1990. These included Banded Stilt Cladorhynchus leucocephalus, Red-capped Plover Charadrius ruficapillus and Pink-eared Duck Malacorhynchus membranaceus. Breeding: Small islets in the lake are possibly suitable for breeding by Banded Stilt when the lake fills; breeding has occurred at similar wetlands (Percival Lakes, latitude 21 S) in WA. Numbers: Hundreds of ducks were recorded in winter 1990 (PWCNT files).

Other Fauna:

Social and Cultural values: Research: Studies of hydrogeology, sedimentary processes and palaeoclimates at the lake have been conducted since c. 1984 (Chen, Jacobson and others). Economic: Some potential exists for mining of evaporites. Aesthetic: A vast wilderness wetland, exhibiting contrast between bare lake-bed and surrounding (partly vegetated) desert dunes.

Land tenure: In Aboriginal freehold (Petermann Aboriginal Land Trust; Katiti Aboriginal Land Trust).

Current land use: None. Aboriginal usage and very low human population.

Disturbance or threat: Past/present: No information

Potential: Mining of evaporites.

Conservation measures taken: The site has been nominated for inclusion (further information requested) on the Register of the National Estate.

Management authority and jurisdiction: No information.

References: See NT Reference List

Compiler & date: Roger P. Jaensch for the Wildlife Division, Conservation Commission of the Northern Territory, January-February 1993. There has been no further biological survey since the original compilation.

Drainage:

AWRC Division	WESTERN PLATEAU
AWRC Region	SANDY DESERT-MACKAY
AWRC Basin	MACKAY
Catchment	
Sub-catchment	

Department of the Environment, Water, Heritage and the Arts
GPO Box 787 Canberra ACT 2601 Australia
Telephone: (02) 6274 1111

Appendix H

Short-range Endemic Invertebrate Field Summary Sheets

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A) S26 05 27.5 E128 55 53.0 B) S26 05 20.3 E128 55 55.7	**Site:** **Altitude:**	MWN01 685 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Sparse Mulga woodland over shrubs, perennial and annual grasses. Daisy Unid, Enteropogon acicularis, Enteropogon cylindricus, Aristida contorta, Acacia victoriae, Acacia aneura.

	Taxa	Specimen code	Photo #	Comments
19/04/08	Pseudoscorpion	MWN01A5		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A)S26 05 35.9 E128 56 40.6 B)S26 05 32.0 E128 56 44.6	**Site:**	MWN02
		Altitude:	692 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Denser Mulga woodland over short grasses and forbes. Enteropogon cylindricus, Enteropogon acicularis, Ptilotus obovatus, Ptilotus sessilifolius, Aristida contorta, Acacia tenuissima, Acacia kempeana, Acacia aneura

	Taxa	Specimen code	Photo #	Comments
	Scorpion	MWN02A1		Found in spider burrow
19/04/08	Pseudoscorpion	MWN02A5		
19/04/08	Pseudoscorpion	MWN02A6		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A) S26 05 06.3 E128 59 17.5 B) S26 04 37.7 E128 58 41.9	**Site:** **Altitude:**	MWN03 687 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Mallee over Spinifex loam/clay/gravel substrate. Eucalyptus socialis, Triodia scuriousa, Ptilotus obovatus, Eremophila spp, Eucalyptus gamophylla,, Acacia tenuissima.

Date	Taxa	Specimen code	Photo #	Comments
	Scorpion – Type 1	MWN03A1		Found in vertebrate pit trap
	Scorpion – Type 1	MWN03A2		Found in vertebrate pit trap
	2 x Scorpions – Type 2	MWN03B2		Found in vertebrate pit trap
	Scorpion – Type 1	MWN03B3		Found in vertebrate pit trap
19/04/08	Pseudoscorpion	MWN03A5		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A) S26 04 35.3 E128 59 08.5 B) S26 01 43.2 E128 55 32.7	**Site:**	MWN04
		Altitude:	752 m

Site details (location, landscape)**:** Rocky Escarpment

Site profile photo #:

Vegetation description: Rocky Escarpment, Mallee over Spinifex. Eucalyptus socialis, Eucalyptus gamophylla, Acacia spp, Aristida contorta, Dodonaea viscosa ssp. Angustissima, Sida spp, Senna glutinosa.

Date	Taxa	Specimen code	Photo #	Comments
9/04/08	Snail shells	MWN04A1		Shells were common in crevices of the ridges and also where they had been washed down into gullies. No live specimens were found.
13/04/08	Trapdoor + lid	MWN04A2		Found under rocky ridge in accumulated sediment.
14/04/08	Mygalomorph	MWN04A3	MWN04A3(a-b)	Appeared to be an open burrow under a rock. Found in a sheltered gully below ridges.
19/04/08	Pseudoscorpion	MWN04A4		
19/04/08	Snail shell	MWN04A5		
19/04/08	Pseudoscorpion	MWN04B1		
19/04/08	Pseudoscorpion	MWN04B2		

SRE Field Data Sheet

19/4/08	Snail	MWN04A6		
19/04/08	Pseudoscorpion	MWN04B3		
19/04/08	Pseudoscorpion	MWN04A(Gully)		
19/04/08	Pseudoscorpion	MWN04A7		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A) S26 01 36.0 E128 59 01.2 B) S26 02 22.2 E128 58 32.9	**Site:** **Altitude:**	MWN05 650 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Open mulga woodland over grasses. Ptilotus obovatus, Enneapogon cylindricus, Digitaria coenicola, Aristida contorta, Aristida latifolia, Enteropogon acicularis, Themeda spp, Acacia aneura,

Date	Taxa	Specimen code	Photo #	Comments
9/04/08	*Cethegus*	MWN05A1	MWN05A1 (a-b)	Typical curtain spider web
9/04/08	Trapdoor + burrow – Type 1	MWN05A2		Lid lost due to excavation for vert drift line
12/04/08	Trapdoor + Burrow – Type 1	MWN05B1	MWN05B1 (a-b)	High number of burrows present at this site. Many (~80%) did not have spiders present. This is possibly linked to the loss of Mulga in the region due to fire ~30years ago. Additionally, heavy grazing by Camels appears to have impacted upon remaining trees and prevented re-establishment of young Mulga.
12/04/08	Trapdoor + Burrow – Type 1?	MWN05B2	MWN05B2 (a-b)	
15/04/08	Small trapdoor – Type 2?	MWN05A3		No lid found. Possibly Type 2. Little/no silk lining burrow.
19/04/08	Tick/Mite	MWN04B3		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates: **Datum:**	A) S26 02 03.5 E128 55 27.6 B) S26 02 06.9 E128 55 37.9	**Site:** **Altitude:**	MWN06 670 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Open dead mulga woodland over grasses. Sclerolaena johnsonii, Ptilotus obovatus, Enneapogon cylindricus, Digitaria coenicola, Aristida contorta, Aristida latifolia, Enteropogon acicularis, Themeda spp, Euphorbia drummondii, Euphorbia wheeleri, Acacia aneura, Cenchrus ciliaris, Sclerolaena cornishiana, Alyogyne pinoniana,

Date	Taxa	Specimen code	Photo #	Comments
13/04/08	2 x trapdoor lids – Type 2	MWN06A1		
14/4/08	Trapdoor – Type 1	MWN06B1	MWN06B1 (a-b)	Depth of hole ~ 45 cm
14/04/08	Lid of above	MWN06B2		
14/04/08	Trapdoor lid - Type 2	MWN06B3		Flap like door. No silk lining in burrow.
14/04/08	Trapdoor – Type 1	MWN06A2	MWN06A2	Silk lined tube with plug like lid.
14/04/08	Lid of above	MWN06A3	MWN06A3	
19/04/08	Pseudoscorpion	MWN06A4		
19/04/08	Spider	MWN06A5		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates:	A) S26 03 22.7 E128 59 56.2	**Site:**	MWN07
Datum:		**Altitude:**	662

Site details (location, landscape)**:**	**Vegetation description:** Open live Mulga woodland over Spinifex and grasses. Acacia aneura, Triodia spp, Aristida contorta, Aristida latifolia, Themeda spp.
Site profile photo #:	

Date	Taxa	Specimen code	Photo #	Comments
	Trapdoor – Type 1	MWN07A1		

SRE Field Data Sheet

Date:	7/4/08 – 17/4/08	**Client:**	**Metals X** - **Wingellina**
Observers:	Paul Bolton & David Steane	**Job Number:**	MWN-FS-0907 (Samples mislabelled as 0807)
GPS coordinates:	A) S26 00 35.7 E128 58 18.3	**Site:**	MWN08
Datum:		**Altitude:**	654 m

Site details (location, landscape)**:**

Site profile photo #:

Vegetation description: Mallee over dense Spinifex, red sand substrate. Eucalyptus socialis, Triodia spp, some Acacia aneura.

Date	Taxa	Specimen code	Photo #	Comments
	Trapdoor	MWN08A1		Found under Pea Sp1
	Trapdoor	MWN08A2		Y shapped burrow (probably only one entrance). Under Aca sp1
	Trapdoor lid	MWN08A3		Abandoned burrow

Appendix I

Mygalomorph spiders from the Wingellina project area.
Report by Barbara York Main

REPORT TO OUTBACK ON MYGALOMORPH SPIDERS FROM

WINGELLINA

JOB # MWN – FS – 0907 (samples mislabelled 807)

By Barbara York Main
School of Animal Biology MO92
University of Western Australia
Crawley WA 6009

Species list by taxonomic position

Family: DIPLURIDAE

Cethegus sp. possibly ***ischnotheloides*** Raven
Site
MWN 05

Family: IDIOPIDAE

Aganippe sp. nov. "Wingellina" sp. 1
Sites
MWN03 B6, female
MWN06 B1, female
MWN06 A2, female
MWN08 A1, immature specimen

Aganippe sp.nov "Wingellina" sp.2
Site
MWN04 A2, female

Blakistonia sp.nov. "Wingellina sp."
Sites
MWN 02A2 , door only
MWN 02 B1, female
MWN 05A2, female
MWN 05B1, female
MWN 05B2, female & door
MWN 05A3, penultimate instar male
MWN 07 A1, female & door

Family: NEMESIIDAE

Aname sp. unidentifiable, juveniles (dispersants?)
Sites
MWN01 A1

MWN01 A2
MWN01 A3

(?)Aname mainae Raven, immature specimen
Site
MWN08 A2

Kwonkan sp. 1 sp.nov.
Sites
MWN03 B4, female

Possible ***Kwonkan*** , juvenile
Site
MWN03 B5

Kwonkan sp.2, sp.nov
Site
MWN04 A3, female

THERAPHOSIDAE

Selenocosmia sp. (possibly ***stirlingi*** Hogg**)**
Sites
MWN01 A4, possible female or immature;
MWN03B1, female or immature

Comment: Generic status under review (Raven) this genus possibly not recognised now in Australia.
……

SUMMARY& COMMENTS ON DISTRIBUTIONS

Four FAMILIES, six GENERA and EIGHT species of Mygalomorphae represented:

DIPLURIDAE, one genus ***Cethegus***, one species **from one site.**
Cethegus is a web weaving spider with a shallow burrow set against shrubs, logs or amongst rocks where water is harvested (mimicking a wetter former geohistorical habitat (see Main 1997). **The species is likely to have a wider distribution in appropriate habitats which however need to be regarded as of high conservation value and require selective protection.** Affinity with the species *ischnotheloides* Raven is tentative as the species was described from only a male and the specimen noted here is a female.

IDIOPIDAE, two genera:

Aganippe with two new species, one from four sites, and one from a single site (MWN 04A2).

The genus ***Aganippe*** is widely distributed throughout southern Australia (mainly south of the tropic of Capricorn) in sclerophyll forest, woodland , acacia woodlands and shrublands and has many species(mostly undescribed) with notably restricted geographic distributions. **The two species collected in this survey are likely to have a limited geographic range.**

Blakistonia with a single species from six sites plus indication (from doors collected) of occurrence at two additional sites.
Blakistonia occurs predominantly in South Australia particularly in the Flinders Ranges belt, extending into central Australia, south west Queensland, western Victoria, and westward through Eyre Peninsular , thence south of the Nullarbor and in scattered localities into southeastern semi arid Western Australia. Only three species have been formally named. **It is possible that the present species extends into central Australia but without an adult male specimen identity is uncertain.** A penultimate instar male (which generally resembles females in morphology) was collected in April which suggests that males mature in late autumn/early winter (which would be a worthwhile time for pitfall trapping).

NEMESIIDAE
Two genera ***Aname*** and ***Kwonkan***:

Aname with one species tentatively identified as the Black wishbone spider ***A. mainae*** Raven from one site and three unidentifiable juveniles from three sites.

Kwonkan two undescribed (and not seen before) species (female specimens only) each from a single site. A juvenile specimen from another site tentatively identified as *Kwonkan*.
Kwonkan is **widely (but sparsely)** distributed in Western Australia and south western South Australia but few species have been described.. **These species are likely to have a restricted distribution.**

THERAPHOSIDAE

One genus with one species from two sites recorded (a third specimen listed (MWN02A4) but could not be located. Identified here as ***Selenocosmia stirlingi*** Hogg but conceding that the genus is currently under review by Robert Raven and although the species is not in doubt & is widely distributed in arid southern Australia it may be transferred to another genus.

REFERENCES

Main,B.Y. 1997. Tropical rainforest mygalomorph spiders in the Australian desert: the irony of an adaptive legacy. Memoirs of the Museum of Victoria 56(2),339-347.

Appendix J

The Short-Range Endemic invertebrate fauna from Wingellina, Western Australia. Report by Mark Harvey

The Short-Range Endemic Invertebrate Fauna from Wingellina, Western Australia

Report to Outback Ecology

August 2008

Mark S. Harvey

Department of Terrestrial Invertebrates, Western Australian Museum,
Locked Bag 49, Welshpool DC, Western Australia 6986, Australia

Short-Range Endemism

The terrestrial invertebrate fauna of inland Australia contains a plethora of species, and just the arthropods were recently estimated to consist of more than 250,000 species (Yeates *et al.* 2004). The vast majority of these are found within the Insecta and Arachnida, although significant numbers of millipedes are to be expected. For many years, the prospect of including invertebrates in assessments of biological systems subject to alteration proved daunting, and were largely ignored as being too diverse and too difficult to comprehend to satisfy the rapid turn-around needed for environmental surveys.

In a recent publication, the issue of Short-Range Endemism in the Australian invertebrate fauna was examined (Harvey 2002), and series of major groups were nominated as having a very high proportion of individual species that satisfied a certain set of criteria. The main criterion nominated for inclusion as a Short-Range Endemic (SRE) was that the species had a naturally small range of less than 10,000 km^2. Harvey (2002) found that those species possessed a series of ecological and life-history traits, including:

- poor powers of dispersal;
- confinement to discontinuous habitats;
- usually highly seasonal, only active during cooler, wetter periods; and
- low levels of fecundity.

The Western Australian fauna contains a number of SRE taxa, including millipedes, land snails, trap-door spiders, some pseudoscorpions, slaters, and onychophorans. The south coast region is relatively well known compared with other regions of the state but there are many poorly known species and gaps in our understanding of the distributions of many species.

The Wingellina region

The short-range endemic fauna of the region was assessed by examination of pseudoscorpions and scorpions collected by staff from Outback Ecology, preserved in

ethanol and submitted to the Western Australian Museum for identification. The specimens were examined using a Leica dissecting microscope (MZ16) and an Olympus compound microscope (BH-2).

PSEUDOSCORPIONS

The Western Australian pseudoscorpion fauna is fairly diverse with representatives of 17 different families. They are found in a variety of biotopes, but can be most commonly collected from the bark of trees, from the underside of rocks, or from leaf litter habitats. The pseudoscorpion fauna of Wingellina was found to consist of one species of Olpiidae, and one species of Garypidae (Appendix 1).

Family Garypidae

Synsphyronus 'sp. Wingellina'

A single specimen of this species, an adult male, was collected at Wingellina (Appendix 1). It represents a species not previously described or represented in the collections of the Western Australian Museum. Morphologically, it is very distinct from all other species of the genus, with a very different trichobothrial pattern on the chelal fingers.

Many species of *Synsphyronus* may represent short-range endemic species (Harvey 1987), but based on our current levels of knowledge, it is difficult to state whether this species is a short-range endemic, although the possibility certainly exists.

Family Olpiidae

Indolpium sp.

Several specimens of this pseudoscorpion species were collected at a number of sites throughout Wingellina (Appendix 1). The specimens comprise a single species and extremely similar specimens have been collected from other regions of Western Australia, suggesting that only a single species is involved. Based on our current levels of knowledge, it appears that this species is not a short-range endemic species.

SCORPIONS

Family Buthidae

***Lychas* spp.**

The scorpion specimens collected at Wingellina belong to the widespread genus *Lychas*, and although we cannot currently identify the specimens to species level we are confident that it does not represent a short-range endemic species.

REFERENCES

Edward, K.L. and Harvey, M.S. (2008). Short-range endemism in hypogean environments: the pseudoscorpion genera *Tyrannochthonius* and *Lagynochthonius* (Pseudoscorpiones: Chthoniidae) in the semiarid zone of Western Australia. *Invertebrate Systematics* **22**: 259-293.

Harvey, M.S. (1987). A revision of the genus *Synsphyronus* Chamberlin (Garypidae: Pseudoscorpionida: Arachnida). *Australian Journal of Zoology, Supplementary Series* **126**: 1-99.

Harvey, M.S. (2002). Short-range endemism in the Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**: 555-570.

Yeates, D.K., Harvey, M.S. and Austin, A.D. (2004). New estimates for terrestrial arthropod species-richness in Australia. *Records of the South Australian Museum, Monograph Series* **7**: 231-241.

Appendix 1. Location data for pseudoscorpions from Wingellina.

REGNO	FAMILY	GENUS	SPECIES	SITE	REMARKS
T89273	Garypidae	*Synsphyronus*	sp. Wingellina	Wingellina mine site, site MWN04A	Outback Ecology specimen code MWN04A7
T89274	Olpiidae	*Indolpium*		Wingellina mine site, site MWN02	Outback Ecology specimen code MWN02A^6
T89275	Olpiidae	*Indolpium*		Wingellina mine site, site MWN04B	Outback Ecology specimen code MWN04B3
T89276	Olpiidae	*Indolpium*		Wingellina mine site, site MWN04A	Outback Ecology specimen code MWN04A4
T89277	Olpiidae	*Indolpium*		Wingellina mine site, site MWN06	Outback Ecology specimen code MWN06A4
T89278	Olpiidae	*Indolpium*		Wingellina mine site, site MWN04B	Outback Ecology specimen code MWN04B2
T89279	Olpiidae	*Indolpium*		Wingellina mine site, site MWN03	Outback Ecology specimen code MWN03A5
T89280	Olpiidae	*Indolpium*		Wingellina mine site, site MWN04B	Outback Ecology specimen code MWN04B1

Appendix K

Terrestrial Molluscs from Wingellina, Western Australia. Report by Shirley Slack-Smith and Corey Whisson.

The Invertebrate Fauna of the Wingellina area, Western Australia: Land Snail Component.

September 2008

Final Report on the Molluscs taken during a Faunal Survey carried out by *Outback Ecology*

April 7-17, 2008

Shirley Slack-Smith and Corey Whisson

Department of Aquatic Zoology (Molluscs), Western Australian Museum

Locked Bag 49, Welshpool DC, Western Australia 6986

Cover Image: *Basedowena cognata* Solem, 1993 Holotype, WAM S14450

Background

The question of short-range endemicity is regarded as being of great importance when considering the question of the conservation of the biota native to Western Australia. Such a degree of endemicity is best illustrated by organisms that are limited to specific habitats and that cannot easily spread to other appropriate habitats.

Many groups of native land snails are considered to be among the most appropriate organisms in this regard, especially those taxa that are confined to particular habitats that may be patchy in their distribution. In considering such cases, not only the extant landforms and habitats should be considered but also those of the past. Many such habitats are relics of once widespread environments that existed under less rigorous climatic conditions.

Knowledge of the land snail fauna of Western Australia has been and still is limited largely by the paucity of workers in this field. Collecting has been largely limited to areas with easy access and so the fauna of huge areas of the State have not been even superficially collected, let alone surveyed. This has resulted in a lack of information and even of relevant comparative material. Many of the land snail populations currently being encountered during surveys of areas proposed for mining and other development have not previously been recorded.

This survey

Dead-taken specimens of land snails, collected by staff of the environmental consultancy company, *Outback Ecology*, were presented for identification and comment to the Department of Aquatic Zoology (Mollusc Section) of the Western Australian Museum (Accession Form A6012).

The samples had been collected between April 7 and April 17, 2008 at a number of sites during a faunal survey for short range endemic species in the Wingellina area, near to the border of Western Australia where it meets South Australia and the Northern Territory.

Specimen data, including the collecting dates and methods, the site co-ordinates and comments on the habitats, were provided with the specimens (see Table 1). However, the spatial relationship of collecting sites to the boundaries of the leased area was not included.

Procedures

Snail specimens contained were examined and sorted under Leica MZ95 dissecting microscopes and compared with descriptions and figures in relevant publications and with dry and preserved specimens in the Molluscan Collections of the Western Australian Museum. Land snail specimens from the vicinity of Wingellina are not well represented in the Western Australian Museum's collections.

All of this survey material has been registered and lodged in the Western Australian Museum's Mollusc Collection.

Table 1 –Survey Sites for Metals X - Wingellina

Station	Date	Latitude	Longitude	Habitat
MWN03A1	13/04/2008	26°05`06.3"S	128°59`17.5"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03A1	13/04/2008	26°05`06.3"S	128°59`17.5"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03A1	13/04/2008	26°05`06.3"S	128°59`17.5"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03A2	13/04/2008	26°05`06.3"S	128°59`17.5"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03A3	12/04/2008	26°05`06.3"S	128°59`17.5"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03B1	12-13/04/2008	26°04`37.7"S	128°58`41.9"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03B1	12-13/04/2008	26°04`37.7"S	128°58`41.9"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03B1	12-13/04/2008	26°04`37.7"S	128°58`41.9"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03B1	12-13/04/2008	26°04`37.7"S	128°58`41.9"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN03B2	13/04/2008	26°04`37.7"S	128°58`41.9"E	loam, clay, gravel soil; mallee over spinifex - *Eucalyptus, Ptilotus; Eremophila;*
MWN04A1	09/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A1	09/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A1	13/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A1	13/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A2	13/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A5	19/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A Gully	13/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04A Gully	13/04/2008	26°04`35.3"S	128°59`08.5"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04B2	13/04/2008	26°01`43.2"S	128°55`32.7"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.
MWN04B2	13/04/2008	26°01`43.2"S	128°55`32.7"E	Rocky escarpment; mallee over spinifex -*Eucalyptus, Acacia, Aristida*, etc.

Results

The specimens contained in the survey samples belong to the molluscan pulmonate families Camaenidae and Pupillidae (see Table 2). Species identifications of these dead-taken specimens have necessarily been based only on shell characters that, in general, vary only slightly between congeneric species.

All of the species identified from this survey are considered to be part of the indigenous Western Australian fauna

Table 2. Molluscan species identified from samples collected during *Outback Ecology's* SRE Wingellina survey in April, 2008.

Site	WAM Registration. No.	Family	Genus	Species	Author	No. of Specimens
MWN03A1	WAM S41261	Pupillidae	*Pupoides*	*? ischnus*	(Tate, 1894)	1 broken
MWN03A1	WAM S41262	Pupillidae	*Gastrocopta*	*? margaretae*	(Cox, 1868)	1
MWN03A1	WAM S41263	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	18
MWN03A2	WAM S41264	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	26
MWN03A3	WAM S41265	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN03B1	WAM S41266	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN03B1	WAM S41267	Pupillidae	*Gastrocopta*	*? margaretae*	(Cox, 1868)	3
MWN03B1	WAM S41268	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	9
MWN03B1	WAM S41269	Pupillidae	*Pupoides*	*ischnus*	(Tate, 1894)	24
MWN03B2	WAM S41270	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	8
MWN04A1	WAM S41271	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	1
MWN04A1	WAM S41272	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	27
MWN04A1	WAM S41273	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN04A1	WAM S41274	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	2
MWN04A2	WAM S41275	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	3
MWN04A5	WAM S41278	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN04A Gully	WAM S41276	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN04A Gully	WAM S41277	Camaenidae	*Basedowena*	*cognata*	Solem, 1993	1
MWN04B2	WAM S41279	Pupillidae	*Pupoides*	*ischnus*	(Tate, 1894)	1
MWN04B2	WAM S41280	Pupillidae	*Pupoides*	*beltianus*	(Tate, 1894)	4

Family Pupillidae

This family is characterised by the small sized, cylindrical to pupa-shaped shell, with a series of apertural teeth or lamellae or by the possession of a flattened shell with a reflected lip (Smith 1992).

Pupoides beltianus (Tate, 1894)

This relatively small (height 3.66-5.13mm) dextral species has a known distributional range encompassing an area from the Reynolds and Jervois Ranges in the Northern Territory; south to the Musgrave and Mann Ranges in South Australia and then west to the Barrow Ranges in Western Australia, which are near the junction of the borders of Western Australia, South Australia and the Northern Territory (Solem

1986, Solem 1988, Solem 1991). In these three publications, Dr Solem suggested that the distribution of that species in Western Australia might extend as far north-west as the Hamersley Ranges, and as far west as the Shark Bay area. However, because of variation in the shell morphology between the specimens from the western areas of WA and those of central Australia, he listed the former only as *Pupoides* aff. *beltianus*, indicating a doubt as to their conspecificity with the Red Centre species.

Pupoides ischnus (Tate, 1894)

This small (height 3.92-4.77mm), slender, rarely-collected sinistral species has a Red Centre distribution, occupying areas in the lower central part of the Northern Territory, such as the Strangways Range (north-east of Alice Springs), the banks of the Hugh River (just south of the MacDonnell Ranges) and Palm Valley in the Krichauff Range (Solem 1988, Solem 1991).

The specimens collected during this survey extend the known distributional range of *P. ischnus* into Western Australia.

Gastrocopta ?margaretae (Cox, 1868)

These minute (height 1.8-2.59mm), elongate snails are tentatively identified as *Gastrocopta margaretae* (Cox, 1868). The shell characters of the survey specimens most closely resemble those of the species *Gastrocopta tatei* Pilsbry, 1917 from the Red Centre (Solem 1988), which was later placed in the synonymy of *G. margaretae* (Pokryszko 1996).

G. margaretae is recorded as having a geographical distribution from the west and south coasts of Western Australia; the southern part of South Australia and the lower central area of the Northern Territory (near Alice Springs). There is also an isolated record from the King Leopold Ranges in the north of Western Australia (Pokryszko 1996).

Family: Camaenidae

This family is characterised by the mainly medium to large sized, solid, helicoid shells and the absence of a dart apparatus in the reproductive system. (Smith 1992)

Genus: *Basedowena*
Species: *B. cognata* Solem, 1993

The genus *Basedowena* was erected by Iredale in 1937 to accommodate his species *B. cottoni* and two other species previously described by other authors. Six other species, including *B. cognata*, were described and named by Solem in his publication of the camaenid snails of the "Red Centre" in 1993 and placed in that genus.

Solem, in that publication, stated that the genus *Basedowena* is restricted to the Red Centre, with the nine recognised species having "mostly allopatric ranges".

The holotype of *B. cognata* was collected from the Schwerin Mural Crescent, WA. At the time of its original description, the distributional range of this species was known to extend from the SE tip of the Schwerin Mural Crescent to Lassiter's Cave in the Petermann Ranges of the Northern Territory. The type series had been taken during a single collecting expedition in 1983 and comprises the only specimens of this

species then available for study. That type series, with the specimens from this survey, define the known geographic distribution of this species..

Remarks

We have no reason to believe that, at the species level, any of the four taxa collected during the Outback Ecology survey exhibit any degree of short range endemicity, as all are believed to belong to species that occupy geographic ranges extending well beyond the area of interest.

As we did not carry out the field survey ourselves, we have no way of evaluating the relationship of the molluscan taxa to the available habitats. Nor are we able, in the absence of data on the spatial relationship between the collecting sites and the boundaries of the lease, to comment upon the possible effects of industrial interference on the population/populations of molluscan species within the Metals X - Wingellina site.

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Appendix L

Summary Tables Describing Conservation Status

IUCN categories also used under the Commonwealth EPBC Act and by DEC

Status	Code	Description
Extinct	(EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the Wild	(EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range.
Critically Endangered	(CR)	A taxon is Critically Endangered when the best available evidence indicates that it is considered to be facing an extremely high risk of extinction in the wild.
Endangered	(EN)	A taxon is Endangered when the best available evidence indicates that it is considered to be facing a very high risk of extinction in the wild.
Vulnerable	(VU)	A taxon is Vulnerable when the best available evidence indicates that it is considered to be facing a high risk of extinction in the wild.
Lower Risk	(LR)	A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories: o Conservation Dependent (cd). Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years. o Near Threatened (nt). Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable. o Least Concern (lc). Taxa which do not qualify for Conservation Dependent or Near Threatened.
Data Deficient	(DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status.
Not Evaluated	(NE)	A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

Schedules of the Western Australian Wildlife Conservation Act 1950: Wildlife Conservation (Specially Protected Fauna) Notice.

Status	Code	Description
Schedule 1	(S1)	Fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection
Schedule 2	(S2)	Fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection
Schedule 3	(S3)	Birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be faunathat is in need of special protection
Schedule 4	(S4)	Fauna that is in need of special protection, otherwise than for the reasons mentioned above

Priority Fauna Codes used by the Western Australian DEC

Status	Code	Description
Priority One Taxa with few, poorly known populations on threatened lands.	(P1)	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, active mineral leases. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Two Taxa with few, poorly known populations on conservation lands.	(P2)	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Three Taxa with several, poorly known populations, some on conservation lands.	(P3)	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority Four Taxa in need of monitoring.	(P4)	Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
Priority Five Taxa in need of monitoring.	(P5)	Taxa which are not considered threatened but are subject to a specific conservatin program, the cessation of which would result in the species becoming threatened within five years.