

# Fauna Habitats and Fauna Assemblage of Mesa A and G, near Pannawonica



*Eremiascincus* sp. nov.

Prepared for  
**Robe River Iron Associates**

Prepared by  
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# 1.0 Summary

## 1.1 Background

Robe River Iron Associates (Robe) currently produce pisolite ore from the Mesa J mine site, located approximately 15 km southwest of the town of Pannawonica. Current projections show that the Mesa J deposit will be mined to its maximum extent by the end of this decade. The Mesa A deposit, approximately 43 km west of Pannawonica, has been identified as the next logical deposit for development in the Robe Valley. In addition, exploration drilling is well underway at Mesa G, approximately 20 km southwest of Pannawonica. If sufficient reserves are identified at Mesa G, this area may also be developed in future.

Robe commissioned Biota Environmental Sciences to undertake a survey of the fauna habitats and fauna assemblage present in the Mesa A and G study areas. The study was intended to provide baseline data for use in current and future environmental impact assessment.

## 1.2 Methods

The survey was conducted over an 8-day period between the 12/5/2004 and the 19/5/2004.

The fauna survey team comprised Mr Roy Teale, Ms Zoë Hamilton, Mr Phil Runham (all of Biota) and Mr Greg Harold (consultant). Ms Janine Prosser (Robe River Iron Associates) assisted with site orientation and coordination of logistics. Analysis of bat recordings was completed by Ms Zoë Hamilton and Mr Lee Mould (Biota). Dr Kyle Armstrong was consulted regarding species identifications. Invertebrate identification was undertaken by Mr Dan Kamien (Biota) using the resources of the WA Museum. Dr Volker Fromenau, Dr Mark Harvey, Ms Julianne Waldock and Ms Shirley Slack-Smith (all of the WA Museum) provided assistance with invertebrate identification and information. Mr Brad Maryan and Ms Norah Cooper (both from the WA Museum) assisted with confirmation of herpetofauna and mammal identifications respectively.

The central component of the systematic censusing consisted of 10 trapping sites utilising various combinations of pitfall traps (both PVC tubes and 20 litre buckets), Elliott traps and/or funnel traps.

In addition, sixteen 40-minute avifauna censuses were conducted across ten sites during the survey. Opportunistic records were made of species that were not recorded during censuses or that were uncommon.

Bats were sampled by recording echolocation calls on four nights (14/05/04, 15/05/04, 17/05/04 and 18/05/04) at one site (MEA06). This site was chosen as it supported both trees with hollows and numerous caves, and was therefore deemed the most likely location in the project area to yield the most diverse bat assemblage.

A range of non-systematic fauna survey activities was also undertaken by the survey team to supplement the trapping and investigate additional habitats identified during the course of the survey.

Particular invertebrate groups were also targeted for collection during the survey, including Araneae (Spiders, in particular Trapdoor and Wolf Spiders), Pseudoscorpionida (Pseudoscorpions), Scorpionida (Scorpions), Diplopoda (Millipedes), and Pulmonata (Land Snails). Representative samples of other invertebrates from pit traps were also collected, placed in 70% ethanol and lodged with the WA Museum.

## 1.3 Fauna Habitats

Three primary habitats were identified within the project areas, which were largely based on vegetation structure and landform:

- Stony Hills and Plains (sites MEA01, MEA06, MEA11, MEA21, MEA23, MEG06 and MEG14);
- Sand Dunes and Sand Sheets (site MEA14); and
- Creeklines and Floodplains (sites MEG09, MEA05 and MEG21).

Two fauna habitats are considered to be of high conservation significance:

- The sand dune and sand sheet adjacent to Mesa A is considered likely to be restricted in distribution in both the local area and region, and supports species restricted to the sands of this particular habitat (eg. *Pseudomys delicatulus*, *Notomys alexis*, and burrowing skinks such as *Lerista muelleri* (of the type that occurs on coastal sands)).
- The gorge in Mesa A supports the Priority 4 listed Ghost Bat, which may also occur in other caves along the edges of the mesas. Incidentally, these caves are also important roosts for other cave dwelling bat species. In addition, the gorge supports the as yet undescribed *Eremiascincus* sp. nov., about which little is known.

## 1.4 Fauna Assemblage

The number of vertebrate species recorded by the survey of the Mesa A and Mesa G sites is shown in Table 4.1. The disparity in avifauna species richness between Mesa A and G is attributable to the occurrence of major riverine habitat (the Robe River) in the latter area (sampled by MEG21).

**Table 1.1: Vertebrate species recorded during the Mesa A and G survey.**

Fauna Group	Mesa A	Mesa G	Total
Avifauna	27	46	52
Native Non-volant Mammals	5	6	7
Introduced Mammals	0	0	0
Bats	5	0*	5
Reptiles	26	23	33
Amphibians	0	0	0
<b>Total</b>	<b>63</b>	<b>75</b>	<b>97</b>

\* No bat detectors were used on Mesa G.

### 1.4.1 Birds

The number of bird species recorded by the current survey is comparable to the 57 species recorded during the Brockman 4 survey in October 2004 (Biota 2005b) and the 55 species recorded at Mesa J in 1991 (Ecologia 1991).

No birds of conservation significance were recorded during the Mesa A and G surveys, though three species could potentially occur (see Section 1.4.6). The Striated Grasswren *Amytornis striatus whitei* was the only species recorded that is considered endemic to the Pilbara bioregion, while the Black-tailed Treecreeper *Climacteris melanura wellsii* (not recorded during the current survey) is a regional near endemic.

### 1.4.2 Non-volant Mammals

The seven non-volant mammal species recorded by the current study compares to eight species recorded in the Brockman 4 survey in October 2004 (Biota 2005b) and 13 species recorded at Mesa J (Ecologia 1991).

No non-volant mammals of conservation significance were recorded by the Mesa A and G surveys, though several may occur (see Section 1.4.6). *Ningauai timealeyi* was the only species recorded that is considered a "near endemic" to the Pilbara bioregion. Other regional endemics or near endemics that may occur in the project areas but were not recorded during the current survey include *Dasykaluta rosamondae*, *Planigale* sp. and *Petrogale rothschildi*.

### 1.4.3 Bats

Examination of call frequencies yielded positive identifications of two species of bats (Finlayson's Cave Bat *Vespadelus finlaysoni* and the Northern Free-tail Bat *Chaerephon jobensis*) and tentative identification of a further two species (Gould's Wattled Bat *Chalinolobus gouldii* and the Little Broad-nosed Bat *Scotorepens greyii*).

Additionally, a single Ghost Bat *Macroderma gigas* was observed leaving a cave at site MEA06 within the Mesa A project area. The conservation status of this species is Priority 4.

### 1.4.4 Reptiles

The 33 herpetofauna species recorded from the Mesa A and Mesa G areas during the current survey compares to 51 species recorded during the Brockman 4 survey in October 2004 (Biota 2005b) and 36 species of herpetofauna recorded from Mesa J (Ecologia 1991). The relatively high number of herpetofauna (species richness) recorded for the Brockman 4 project is indicative of summer sampling and a broader range of habitats.

No Schedule or Priority listed herpetofauna species were recorded during the current survey, however three may occur (see Section 1.4.6).

One species recorded during the current survey, the Pilbara Death Adder *Acanthophis wellsi*, is endemic to the Pilbara. A number of other endemic, or nearly endemic, species may occur, including *Delma elegans*, *Diplodactylus savagei*, *Nephrurus wheeleri cinctus*, *Notoscincus butleri*, *Diplodactylus wombeyi*, *Lerista flammicauda* and *Varanus aff gilleni*.

The undescribed skink *Eremiascincus* sp. nov. was recorded from the gorge at site MEA06: this specimen is the first adult individual collected and is likely to become the holotype for the species. In addition, there are a number of unresolved species complexes that do or may occur in the project areas.

### 1.4.5 Invertebrates

No millipedes were collected during the current survey.

Three species of land snails were recorded: *Rhagada convicta*, *R. radleyi*, and a species of Pupillid belonging to the genus *Pupoides*. A further undescribed camaenid, *Rhagada* sp. nov., has been collected nearby and may occur in the study areas.

One individual mygalomorph spider was collected from MEA01: this specimen is awaiting identification from the WA Museum. The survey recorded nine families of Araneomorph spiders and one family of scorpionids: specimens have been identified to morpho-types and are awaiting confirmation at the WA Museum.

### 1.4.6 Rare Fauna

One Priority 4 listed species was recorded from the survey areas, and a further four Schedule and nine Priority listed species have either been recorded or may occur (Table 6.1). The conservation status of these species is unlikely to be affected by the proposal.

Other species of interest recorded during the survey or that are likely to occur within the survey area include those species that have unresolved species complexes, particularly the



undescribed species of *Eremiascincus*. Neither of the camaenid land snails collected from the study areas is considered to be a short-range endemic. The mygalomorph spider collected during the survey is awaiting identification.

**Table 1.2: Species of conservation significance recorded from or potentially occurring within the Mesa A and G survey areas.**

Species	State Level	Federal Level
Northern Quoll <i>Dasyurus hallucatus</i> *†	Not Listed	Endangered
Orange Leaf-nosed Bat <i>Rhinonicteris aurantius</i>	Schedule 1	
Night Parrot <i>Pezoporus occidentalis</i>	Schedule 1	Endangered
Pilbara Olive Python <i>Liasis olivaceus barroni</i>	Schedule 1	Vulnerable
Peregrine Falcon <i>Falco peregrinus</i>	Schedule 4	
Ramphotyphlops ganei <i>Ramphotyphlops ganei</i>	Priority 1	
Pilbara Dragonfly <i>Antipodogomphus hodgkini</i>	Priority 2	
Pilbara Damselfly <i>Nososticta pilbara</i>	Priority 2	
Long-tailed Dunnart <i>Sminthopsis longicaudata</i>	Priority 4	
Ghost Bat <i>Macroderma gigas</i> *	Priority 4	
Lakeland Downs Mouse <i>Leggadina lakedownensis</i>	Priority 4	
Western Pebble-mound Mouse <i>Pseudomys chapmani</i>	Priority 4	
Star Finch (western) <i>Neochmia ruficauda subclarescens</i>	Priority 4	
Fortescue Grunter <i>Leiopotherapon aheneus</i>	Priority 4	
<i>Notoscincus butleri</i>	Priority 4	

\* denotes species recorded during the current survey.

† Recorded from a skull.

## 1.5 Management Recommendations

The following management measures are proposed to minimise or better understand potential impacts to the fauna and fauna habitats of the Mesa A and Mesa G study areas:

- Consideration should be given to commencing a genetic study to assist in defining the status of the *Eremiascincus* sp. nov. collected from the study area.
- Wherever possible, disturbance to surface drainage features should be avoided through sensitive mine planning. Where disturbance is unavoidable, sufficient culverting should be installed to maintain surface water flows.
- Vegetation clearing should be kept to the minimum necessary for safe construction and operation of the project, particularly in areas adjacent to vegetation of higher conservation significance.
- Weed control measures should be developed and implemented to prevent the introduction or spread of weeds in the study area. A Weed Hygiene and Management Plan should be prepared in consultation with CALM prior to construction commencing.
- A Fire Management Plan should be prepared and implemented to minimise the risk of unplanned fires in the study area.
- A Topsoil Management and Rehabilitation Plan should be prepared for all non-permanent cleared areas, in liaison with CALM, the Department of Environment and Department of Industry and Resources prior to the commencement of construction activities. This plan should include use of provenance collected native seed, characterisation and management of topsoil, and the respreading of cleared vegetative material. Recovery monitoring should also be carried out, with any rehabilitation failure subject to additional treatment to a suitable standard.
- Standard dust suppression measures should be implemented across the project area during construction and operation to minimise effects on surrounding vegetation.

## 2.0 Introduction

### 2.1 Background

#### 2.1.1 Background to the Project and Location of the Study Area

Robe River Iron Associates (Robe) currently produce pisolite ore from the Mesa J mine site, located approximately 15 km southwest of the town of Pannawonica. Current projections show that the Mesa J deposit will be mined to its maximum extent by the end of this decade. Production from the Mesa J mine site is predicted to begin to decline in 2007/2008 as the quality of the available ore at Mesa J decreases. The Mesa A deposit has been identified, along with the Warramboos deposit, as the next logical deposit for development in the Robe Valley. Mesa A is located approximately 43 km west of Pannawonica. In addition, exploration drilling is well underway at Mesa G, approximately 20 km southwest of Pannawonica. If sufficient reserves are identified at Mesa G, this area may also be developed in future.

#### 2.1.2 Purpose of this Report

Biota Environmental Sciences (Biota) was commissioned by Robe to undertake a survey of the fauna habitats and fauna assemblage present in the Mesa A and G study areas. This survey was planned and implemented as far as practicable according to 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 purpose of this report is to provide a description of fauna and fauna habitats for use in environmental impact assessment at Mesa A. The report also provides similar information for Mesa G to assist with planning the exploration drilling program. The data for Mesa G may also be used in the future as part of an environmental impact assessment if sufficient ore reserves are identified at Mesa G.

## 2.2 Geological and Physiographic Context of the Study Area

### 2.2.1 Geology

On the Geological Survey of Western Australia 1:250,000 scale mapsheet (Williams, Ryan and Halligan 1964), geological types within the Mesa A study area comprise:

- Tp (Robe Pisolite: pisolitic, oolitic, and massive limonite goethite hematite deposits containing fossil wood fragments; iron ore) on the mesa itself; and
- Qg (colluvium: unconsolidated to loosely consolidated piedmont deposits; scree, talus) associated with the baseplain surrounding the mesa, mainly in the southern section of the study area.

On the Geological Survey of Western Australia 1:500,000 scale mapsheet (Thorne and Trendall 2001), geological types within the Mesa G study area comprise:

- Czp (Robe Pisolite: pisolite limonite deposits; developed along palaeodrainage lines) on the mesa itself;
- PWd (Duck Creek Dolomite) towards the western end of the project area; and
- Qa (alluvium - unconsolidated silt, sand and gravel) and Qx (undivided Quaternary deposits) associated with the Robe River system, mainly on the southern side of the mesa.

## 2.2.2 Major Physiographic Units

Beard (1975) identified four major physiographic units within the Fortescue District. Mesa A and Mesa G lie towards the western end of the Hamersley Plateau (rounded hills and ranges, mainly of jaspilite and dolomite with some shale, siltstone and volcanics).

## 2.2.3 Land Systems (Rangelands)

Land System (Rangelands) mapping covering the project areas has been prepared to a draft stage by the Department of Agriculture Western Australia (2002). These are broad units that each consist of a series of "land units" that occur on characteristic physiographic types within the Land System.

One hundred and seven (107) Land Systems occur in the Pilbara bioregion. [This information was obtained by merging the Ashburton Land System mapping (Payne et al. 1988) and Pilbara Land System mapping (Department of Agriculture 2002) and intersecting this with the Pilbara bioregion (Environment Australia 2000) in ArcView 3.2.]

The Mesa A study area includes sections of the following Land Systems:

1. Robe Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands; dominating the eastern portion of the mesa;
2. Peedamulla Stony and gravelly plains supporting hard spinifex grasslands and snakewood shrublands with patchy spinifex ground layer; dominating the western portion of Mesa A;
3. Capricorn Rugged sandstone hills and ridges; hard spinifex or stony short grass forb pasture; small area fringing the northwestern boundary of the mesa;
4. Nanutarra Low mesas and hills of sedimentary rocks supporting soft and hard spinifex grasslands; small areas fringing the southwestern boundary of the mesa; and
5. Stuart Undulating plains with snakewood; low hills with spinifex; stony chenopod and hard spinifex pastures; small areas fringing the southwestern boundary of the mesa.

The Mesa G study area includes sections of the following Land Systems:

1. Newman Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands; dominating the main mesa;
2. Boolgeeda Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands; small areas along the northeastern boundary of the main mesa;
3. Urandy Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands; a very small area along the northern boundary of the central section of the study area; and
4. Sherlock Stony alluvial plains supporting snakewood shrublands with patchy tussock grasses and spinifex grasslands; a small area along the northwestern boundary of the study area; and
5. River Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands; only along the Robe River, on the southern side of Mesa G.

With the exception of the Sherlock Land System, all of the Land Systems in the project area are relatively extensive in terms of their area within the Pilbara bioregion. The Sherlock Land System ranked 44<sup>th</sup> smallest out of the 107 Land Systems in terms of area, with a total area of 38,638 ha or approximately 0.2% of the Pilbara bioregion. Less than 1% of the total mapped area for the Pilbara bioregion for each Land System lies within the Mesa A and Mesa G study areas (see Figure 2.1 and Table 2.1).



**Table 2.1: Distribution of Land Systems within the Mesa A and Mesa G study areas and wider Pilbara bioregion** (data from Payne et al. 1988 and Department of Agriculture 2002).

Land System	Total Area in the Pilbara Bioregion (Rank†)	Number of Mapping Polygons in the Pilbara Bioregion	General Distribution through the Pilbara Bioregion	Area within Mesa A Study Area		Area within Mesa G Study Area	
				Hectares	% of total in Pilbara bioregion	Hectares	% of total in Pilbara bioregion
Capricorn	698,531 ha (102 <sup>nd</sup> )	252	Widespread through the Hamersley and Chichester subregions; numerous occurrences	5.9	<0.01	-	
Nanutarra	77,384 ha (67 <sup>th</sup> )	52	Restricted to the western section of the Hamersley subregion; few occurrences	13.8	0.02	-	
Peedamulla	59,201 ha (57 <sup>th</sup> )	8	Restricted to a narrow band through the western section of the Hamersley subregion; very few occurrences	334.9	0.57	-	
Robe	128,859 ha (76 <sup>th</sup> )	251	Occurs within the central and western region of the Hamersley subregion, with a few occurrences in the Chichester subregion	704.4	0.55	-	
Stuart	276,685 ha (94 <sup>th</sup> )	53	Restricted to the western section of the Hamersley subregion; few occurrences	27.4	0.01	-	
Boolgeeda	961,634 ha (103 <sup>rd</sup> )	588	Widespread with a large number of occurrences, particularly through the Hamersley subregion	-		161.1	0.02
Newman	1,993,741 ha (106 <sup>th</sup> )	321	Relatively widespread through the Hamersley Range, also occurring as a band along the Chichester Range to the north of the Fortescue Marsh; numerous occurrences	-		1,560.4	0.08
River	482,175 ha (101 <sup>st</sup> )	126	Widespread in major river systems	-		427.5	0.09
Sherlock	38,638 ha (44 <sup>th</sup> )	39	Associated with river systems in the western sections of the Hamersley and Chichester subregions; few occurrences	-		26.8	0.07
Urandy	131,976 ha (78 <sup>th</sup> )	23	Occurs along the boundary of the Hamersley and Fortescue Plains subregions; also in the western section of the Hamersley subregion; few occurrences	-		13.4	0.01
<b>Pilbara Total</b>	<b>17,800,478 ha</b>	<b>5636</b>		<b>1,086.5</b>		<b>2,189.2</b>	

† Ranking of Land System in terms of area out of the 107 Land Systems in the Pilbara bioregion; ranked from least abundant in terms of area (1) to most abundant (107).

## 2.3 Biological Context of the Study Area

### 2.3.1 Pilbara IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (Environment Australia 2000). Mesa A and Mesa G lie within the Pilbara Bioregion, at the western end of the Hamersley Range subregion.

With increasing survey work in the Pilbara, it is becoming apparent that this region is one of the centers of biodiversity in the State. This appears to be related to the diversity of geological, altitudinal and climatic elements in the region, as well as a function of its location. The eastern portion of the Pilbara in particular is located in a transitional zone between the floras of the Eyrean (central desert) and southern Torresian (tropical) bioclimatic regions, and contains elements of both floras (see for example van Leeuwen and Bromilow (2002) for a detailed discussion of the significance of the Hamersley Range). The eastern Pilbara is similarly an area of transition for fauna. In recognition of this high species diversity and the high levels of endemism in the region, the Pilbara has recently been nominated as one of 15 national biodiversity "hotspots" by the Minister for the Environment and Heritage (go to [www.deh.gov.au/minister/env/2003/mr03oct03.html](http://www.deh.gov.au/minister/env/2003/mr03oct03.html)).

The Pilbara Bioregion is listed as a medium priority for funding for land purchase under the National Reserves System Co-operative Program due to the limited representation of the area in conservation reserves. Portions of various pastoral leases in the region have been nominated for exclusion for public purposes in 2015, when the leases come up for renewal. Many of the submissions are from the Department of Conservation and Land Management, with the intention of adding these areas to the existing conservation estate in order to provide a comprehensive, adequate and representative reserve system. None of these proposed exclusions are located in the vicinity of Mesa A or Mesa G.

### 2.3.2 Beard's Vegetation Mapping

Beard (1975) mapped the vegetation of the Pilbara at a scale of 1:1,000,000. The study area lies entirely within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional Eucalypts.

The identity of Beard's mapping unit in the area of Mesa G is difficult to determine, but it appears that both the Mesa A and Mesa G study areas are mapped as:

- *Acacia pyrifolia* and/or *A. bivenosa* sparse shrubs over *Triodia basedowii* and/or *T. wiseana* hummock grasslands.

Given the broad nature of Beard's mapping, this unit is only broadly applicable to the vegetation occurring on site (see Section 3.8).

### 2.3.3 More Detailed Studies in the Region

Fauna surveys in the proximity of the Mesa A and G project areas include:

- the Mesa J survey in 1991 (Ecologia 1991); and
- surveys of Warrambo, Bungaroo Creek and the Mesa J Extension in March 2005 (Biota in prep).

In addition, a survey of the Brockman 4 project near Tom Price (Biota 2005b) has been reviewed for this study. Although some 100 km southeast of Pannawonica, it occurs in the same subregion of the Pilbara bioregion, and shares some habitats, with the current study areas.

As mentioned previously, the Department of Agriculture (2002) has carried out a broadscale survey of parts of the Pilbara. This will result in brief descriptions of the vegetation of various

Land Units within each Land System, however these are not yet available. When completed, descriptions of the Land Units coupled with the Land Systems mapping will be a useful tool for assessing distribution of fauna habitats within the region.

## 3.0 Study Methodology

### 3.1 Database Searches

#### 3.1.1 CALM Threatened Fauna Database

A search of CALM's Threatened Fauna database was requested for the Mesa A and G study areas. The search returned three Schedule 1 species, one Schedule 4 species, one Priority 1 species, two Priority 2 species and six Priority 4 species (Appendix 3, see also Section 6.0).

#### 3.1.2 WA Museum Fauna Database Search

A search of the WA Museum Faunabase returned a number of specimens lodged with the WA Museum from areas surrounding the project area (see Appendix 2).

#### 3.1.3 Biota Database Search

A search was also conducted using the Biota database to determine if any other species have been collected from nearby areas or in different seasons. The Biota database was also utilized to access information on a number of species.

### 3.2 Survey Timing and Weather

The survey was conducted over an 8-day period between the 12/5/2004 and the 19/5/2004.

During this period, maximum temperatures ranged between 26°C and 31°C (Table 3.1) and minimum temperatures ranged between 12.6°C and 19.3°C (Table 3.1)<sup>1</sup>. There was no rainfall during the survey period.

The mean maximum temperature for May 2004 (29.2°C) was slightly below the average in previous years (30.6°C), whilst the mean minimum temperature (17.2°C) was exactly that of previous years (Table 3.2). Total monthly rainfall was very low (0.4mm) compared to previous years (27.3mm) (Table 3.2).

### 3.3 Fauna Survey Team

The vertebrate fauna sampling for this survey was conducted under "Licence to Take Fauna for Scientific Purposes" No. SF004492 issued to RJ Teale. Ethics approval was granted under the Western Australian Museum application to the Department of Conservation and Land Management (CALM) Animal Ethics Committee, which covers Mr Roy Teale as a Research Associate with the WA Museum.

The fauna survey team comprised Mr Roy Teale (Biota Environmental Sciences), Ms Zoë Hamilton (Biota), Mr Phil Runham (Biota) and Mr Greg Harold (consultant). Ms Janine Prosser (Robe River Iron Associates) assisted with site orientation and coordination of logistics.

Analysis of bat recordings was completed by Ms Zoë Hamilton and Mr Lee Mould (Biota). Dr Kyle Armstrong was consulted regarding species identifications.

Invertebrate identification was undertaken by Mr Dan Kamien (Biota) using the resources of the WA Museum. Dr Volker Fromenau, Dr Mark Harvey, Ms Julianne Waldock and Ms Shirley Slack-Smith (all of the WA Museum) provided assistance with invertebrate identification and information.

Also acknowledged are Mr Brad Maryan and Ms Norah Cooper (both from the WA Museum) who assisted with confirmation of herpetofauna and mammal identifications respectively.

<sup>1</sup> Climate data missing over two days.



**Table 3.1: Daily meteorological observations for Pannawonica for 12/5/04 – 19/05/04 (data provided by the Western Australian Bureau of Meteorology).**

Day	Maximum Temperature (°C)	Minimum Temperature (°C)	Rainfall 24 hours to 9am (mm)
12/5/04	30.2	16.6	0
13/5/04	31	19.2	0
14/5/04	31	19	0
15/5/04	27.9	18.7	0
16/5/04	No data available	19.3	0
17/5/04	26	No data available	0
18/5/04	27.4	12.6	0
19/5/04	26.4	13.5	0

**Table 3.2: Climatological summary for Pannawonica using data from 1971 to 2004 (data provided by the Western Australian Bureau of Meteorology).**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Daily Maximum Temperature (°C)	40.8	39.6	38.5	35.7	30.6	27.0	26.7	28.9	32.3	36.0	38.6	40.4	
Mean Daily Minimum Temperature (°C)	25.2	25.2	24.3	21.6	17.2	14.1	12.7	13.7	15.9	18.9	21.5	24.1	
Mean Total Monthly Rainfall (mm)	80.9	95.0	74.7	22.4	27.3	37.0	15.4	9.8	1.5	1.9	6.8	29.2	401.9
Mean Maximum Air Temperature 2004 (°C)	41.2	38.6	38.3	36.1	29.2	29.1	26.3	27.4	31.7	39.5	38.3	41.9	
Mean Minimum Air Temperature 2004 (°C)	26.5	25.6	24.8	22.7	17.2	14.2	15.1	13.1	15.4	22.1	22.5	25.6	
Total Monthly Rainfall 2004 (mm)	91.6	96.8	376.6	19.0	0.4	0.0	20.9	0.0	0.3	2.0	6.2	4.4	618.2

## 3.4 Systematic Censusing of Vertebrate Fauna

### 3.4.1 Location of the Survey Sites

The central component of the systematic censusing consisted of 10 trapping sites (Figures 3.1 and 3.2; Table 3.3) (representative photographs are shown in Plates 2.1 – 2.9). Systematic bird censuses were undertaken at an additional survey site (MEA05), however no traps were established at this location.

Each survey site was located within a defined habitat. In selecting trapping sites, equal weight was also given to accessibility of the sites such that pitfall traps, Elliott traps and funnel traps could be regularly checked.

Systematic fauna sampling, the primary component of the study, was completed on the basis of grid installation in habitats considered to be representative of the range of units apparent within the project area. Not all areas within the project area were ground-truthed or sampled for fauna.

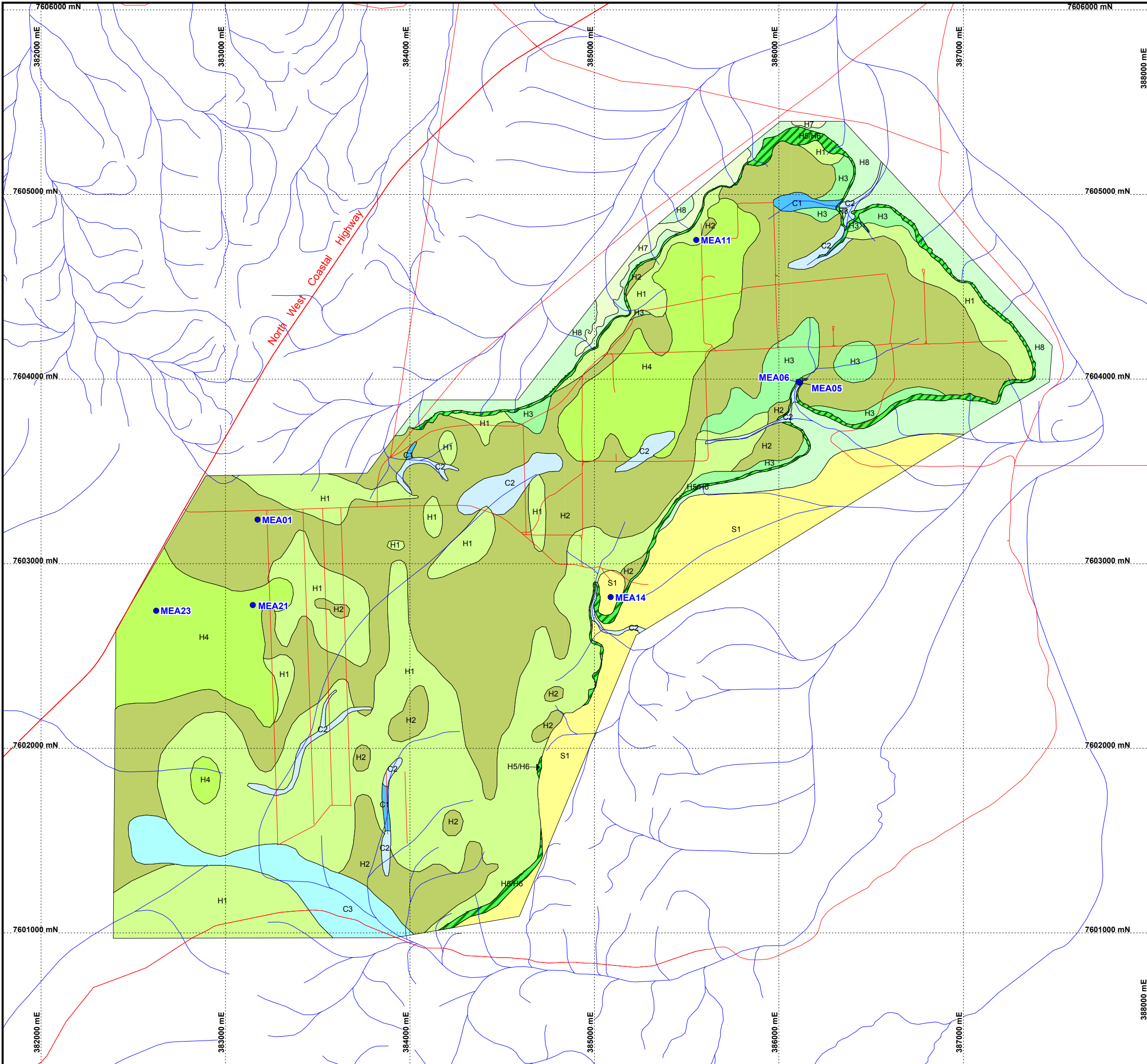
### 3.4.2 Layout of the Trapping Grids

The number of traps at each site is shown in Table 3.3.

Six of the trapping grids (MEA01, MEA14, MEA21, MEG06, MEG14 and MEG21) consisted of one row of ten (or eight in the case of site MEA01) pitfall traps. The pits (alternating 20 litre buckets and PVC tubes) were spaced at approximately 9 m intervals and connected with a single length of 30 cm tall flywire fence. Two grids (MEA06 and MEG27) comprised 25 Elliott traps, spaced at approximately 10 m intervals. Three trapping grids (MEA11, MEA23 and MEG09) consisted of 10 funnel traps. These trapping grids were arranged with four pairs of funnels along the fenceline and one funnel at either end. Funnels were spaced at approximately 10 m intervals and connected with a single length of 30 cm tall, 50 m long flywire fence.

**Table 3.3: Trapping grid location and trap effort (WGS84 datum, Zone 50).**

Site	Location (AMG)	Trap Type	Date Opened	Date Closed	Nights Open	No. of Traps	Total Effort (trap nights)
<b>Mesa A</b>							
MEA01	383174mE, 7603239mN	Pit	14/05/04	19/05/04	5	8	40
MEA05	386115mE, 7603980mN	Bird Census					
MEA06	386106mE, 7603985mN	Elliott	16/05/04	19/05/04	3	25	75
MEA11	385552mE, 7604754mN	Funnel	15/05/04	19/05/04	4	10	40
MEA14	385088mE, 7602819mN	Pit	14/05/04	19/05/04	5	10	50
MEA21	383148mE, 7602776mN	Pit	14/05/04	19/05/04	5	10	50
MEA23	382624mE, 7602745mN	Funnel	15/05/04	19/05/04	4	10	40
<b>Mesa G</b>							
MEG06	407374mE, 7597689mN	Pit	13/05/04	19/05/04	6	10	60
MEG14	404399mE, 7594780mN	Pit	13/05/04	19/05/04	6	10	60
MEG21	406578mE, 7594221mN	Pit	13/05/04	19/05/04	6	10	60
MEG27	412071mE, 7595642mN	Elliott	15/05/04	19/05/04	4	25	100
MEG09	406651mE, 7595377mN	Funnel	13/05/04	19/05/04	6	10	60
<b>Elliott nights</b>							175
<b>Pit nights</b>							320
<b>Funnel nights</b>							140



**LEGEND**

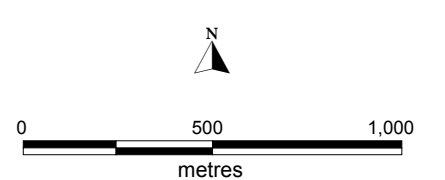
- Major Road
- Roads
- Drainage

**Fauna Sites**

- MEA02 - Fauna Survey Sites

**Vegetation Communities**

- C1 *Eucalyptus leucophloia* scattered low trees over *Acacia pruinocarpa* scattered tall shrubs over *Acacia atkinsiana*, *A. arida* shrubland over *Triodia wiseana* open hummock grassland
- C2 *Acacia tumida* var. *pilbarensis*, *A. pruinocarpa*, *Grevillea wickhamii* tall open shrubland to open scrub over *Acacia atkinsiana*, *A. arida* open shrubland to tall open shrubland over *Triodia wiseana* open hummock grassland and *Eriachne mucronata* scattered tussock grasses
- C3 *Corymbia hamersleyana*, *C. candida* scattered low trees to low open woodland over *Acacia atkinsiana*, *A. ancistrocarpa* scattered tall shrubs over *Triodia epactia* hummock grassland
- H1 *Eucalyptus leucophloia* scattered low trees over *Acacia arida* shrubland to tall shrubland over *Triodia wiseana* mid-dense hummock grassland
- H2 *Eucalyptus leucophloia* scattered low trees over *Acacia atkinsiana* (*A. arida*) open shrubland to tall shrubland over *Triodia wiseana* mid-dense hummock grassland
- H3 *Eucalyptus leucophloia* scattered low trees over *Acacia pruinocarpa*, *A. atkinsiana* tall open shrubland over *Triodia wiseana* open hummock grassland
- H4 *Acacia atkinsiana*, *A. inaequilatera* (*A. arida*) tall open shrubland over *Acacia bivenosa* open shrubland over *Triodia wiseana* hummock grassland
- H5 *Acacia pruinocarpa*, *Eucalyptus leucophloia* scattered low trees to low open woodland over scattered mixed tall shrubs over *Triodia wiseana* hummock grassland
- H6 *Eucalyptus leucophloia* scattered low trees over *Acacia tumida* var. *pilbarensis* tall open shrubland to open scrub over *Triodia wiseana* hummock grassland
- H7 *Acacia xiphophylla* low woodland to tall shrubland over *Triodia wiseana* hummock grassland
- H8 *Acacia ancistrocarpa*, *A. bivenosa* shrubland over *Triodia wiseana* hummock grassland
- S1 *Corymbia zygomphylia* scattered low trees over *Acacia tumida* var. *pilbarensis*, *Grevillea eriostrachya* high shrubland over *Triodia schinzii* hummock grassland



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**Fauna Survey Sites in the Mesa A Study Area**

Author: M Maier	Date: 11/04/05
Drawn: P Sawers	Revised:
Job No.: 232	WS No. WS 01205
Projection: MGA Zone 50	Scale: 1:20,000

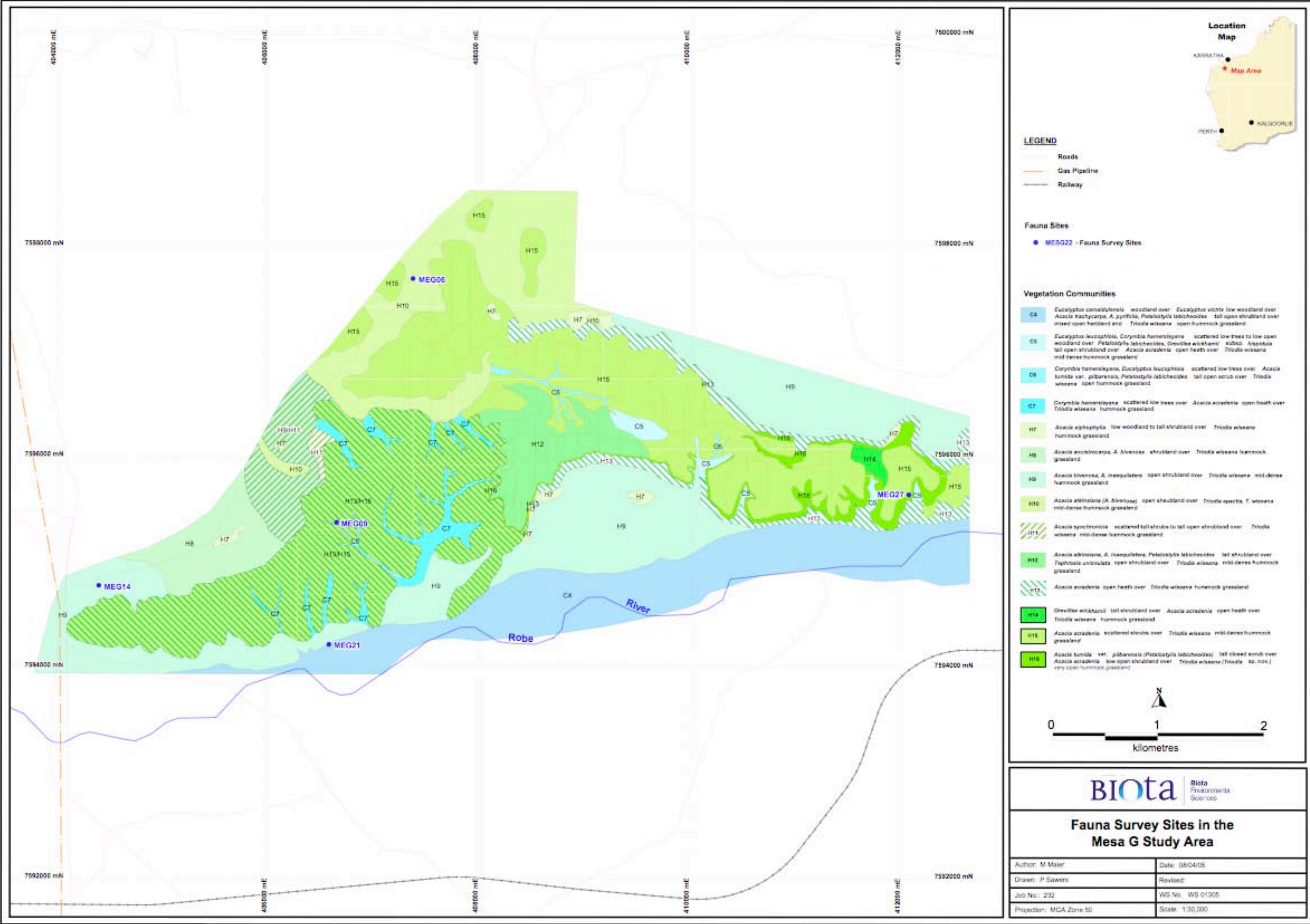


Figure 3.2: Location of fauna survey sites in the Mesa G study area (NB. vegetation mapping from Biota 2005a).

### 3.4.3 Avifauna Sampling

The avifauna of the project area was sampled using a combination of techniques, which included:

- unbounded area searches conducted at most of the systematic sampling grids;
- unbounded area searches conducted at opportunistic locations containing habitats or microhabitats likely to support previously unrecorded species; and
- opportunistic observation of birds while driving around the study area.

Sixteen 40 minute avifauna censuses were conducted across ten sites during the survey (Table 3.4). Individual censuses were confined to discrete habitat types, typically corresponding to vegetation types. In addition, opportunistic records were made of species that were not recorded during censuses or that were uncommon.

**Table 3.4: Systematic avifauna censuses undertaken at each of the fauna sites.**

<b>Mesa A</b>	<b>15/5/04</b>	<b>16/5/04</b>	<b>17/5/04</b>	<b>18/5/04</b>
MEA01		11:20-12:00		08:25-09:05
MEA05		13:15-14:05		
MEA06				09:15-09:55
MEA11				10:30-11:10
MEA14	09:25-10:05			07:40-08:20
MEA23				11:15-11:55
<b>Mesa G</b>	<b>15/5/04</b>	<b>16/5/04</b>	<b>17/5/04</b>	<b>18/5/04</b>
MEG06		06:40-07:20	08:30-09:10	
MEG09		08:53-09:33		
MEG14	07:55-08:35			
MEG21	06:50-07:30	07:55-08:35	10:40-11:20	13:00-13:40

### 3.4.4 Bat Sampling

Bats were sampled by recording echolocation calls. A comprehensive survey of bats, which would include trapping to determine the presence of bats not readily recorded by microphones, was not undertaken during this survey. Echolocation calls were recorded with an Anabat II bat detector, which detects and transforms the ultrasonic echolocation that bats emit whilst foraging.

Sampling was undertaken on four nights (14/05/04, 15/05/04, 17/05/04 and 18/05/04) at one site (MEA06). On all occasions a delay switch was connected to the detector to maximise the time that calls could be collected. The calls were stored on a compact flash card after being processed by an Anabat CF ZCAIM. Site MEA06 was chosen as it supported both trees with hollows and numerous caves, and was therefore deemed the most likely location in the project area to yield the most diverse bat assemblage.

Calls were visualised on Analook 4.3f software. Identifications were made by comparing values of minimum frequency (measured directly from Analook) with those in Fullard et al. (1991), Bullen and McKenzie (2002) and Bullen (2003). Only sequences containing good quality search phase calls were considered for identification. These sequences were reviewed by Dr Kyle Armstrong.

In addition, any opportunistic sightings of bats or roosts within the project area were recorded.

### 3.5 Non-Systematic Sampling of Vertebrate Fauna

A range of non-systematic fauna survey activities was also undertaken by the survey team to supplement the trapping and investigate additional habitats identified during the course of the survey. These included:

- Habitat specific searches for Schedule and Priority listed fauna species;
- Searching (including head-torching) of microhabitats for reptile, frog and small mammal species;
- Opportunistic sightings and records;
- Identification of road kills and other animal remains; and
- Recording and identification of secondary signs (where possible) including tracks, scats and diggings.

### 3.6 Vertebrate Fauna Identification and Data Entry

Individual species were identified in the field using current fauna guide-books, species keys and knowledge of survey team. Representatives of each species from each site, or any individuals that displayed vast morphological variation, were vouchered and lodged with the WA Museum. Herpetofauna identifications were subsequently confirmed or corrected by Mr Brad Maryan of the WA Museum.

All fauna noted in the field were recorded and later entered into the Biota database.

### 3.7 Invertebrate Sampling

Targeted invertebrate groups were sampled through opportunistic and systematic collections during the survey. Prior to field work, WA Museum staff were consulted to confirm invertebrate groups of interest and to identify any specific curation methods (eg. the preservation of Wolf spiders for DNA analyses).

Invertebrate groups targeted during the survey included:

- Araneae (Spiders, in particular Trapdoor and Wolf Spiders);
- Pseudoscorpionida (Pseudoscorpions);
- Scorpionida (Scorpions);
- Diplopoda (Millipedes); and
- Pulmonata (Land Snails).

Spiders were mainly collected from pit traps. Hand foraging was undertaken for pseudoscorpions, involving peeling bark and lifting rocks. The latter technique was also used to search for scorpions, with additional specimens collected from pit traps. The remaining two groups (millipedes and land snails) were searched for whilst raking leaf litter and other debris.

Trapdoor and Wolf Spiders were preserved in 70% ethanol, with one or two legs removed and placed in 100% ethanol for future molecular studies.

Samples of land snails were collected as both live and dead specimens. Live specimens were collected by excavating beneath *Triodia* hummocks and rocks; only dead specimens in good condition were collected. Live specimens were submitted to Dr Mike Johnson (University of Western Australia) for future genetic analysis and to the WA Museum for confirmation of initial field identifications. Dead shells were submitted to the WA Museum and added to the Biota reference collection.

Representative samples of other invertebrates from pit traps were also collected, placed in 70% ethanol and lodged with the WA Museum.

### 3.8 Vegetation Types and Fauna Habitat Classification at each Survey Site

Three primary habitats were identified within the project areas, which were largely based on vegetation structure (Biota 2005a) and landform (Table 3.5).

The broad habitats were as follows:

- Stony Hills and Plains (sites MEA01, MEA06, MEA11, MEA21, MEA23, MEG06 and MEG14);
- Sand Dunes and Sand Sheets (site MEA14); and
- Creeklines and Floodplains (sites MEG09, MEA05 and MEG21).

Photographs of representative habitats are given in Plates 3.1 to 3.9.



Plate 3.1: Site MEA01.



Plate 3.2: Site MEA05.



Plate 3.3: Site MEA06.



Plate 3.4: Site MEA11.



**Plate 3.5: Site MEA21.**



**Plate 3.6: Site MEG06.**



**Plate 3.7: Site MEG14.**



**Plate 3.8: Site MEG21.**



**Plate 3.9: Site MEG09.**

### 3.9 Survey Limitations

The habitats targeted for bat sampling during this survey were watercourses and caves where bats might congregate and be easily encountered. The survey methods were biased towards those species that frequent such habitats and which can be readily identified using the Anabat system. This meant that some species could have been missed.

Sampling of the study area reported in this document comprised a single survey phase. It is likely that additional fauna species would be recorded if the sites were revisited at other times of the year.

Terrestrial invertebrate sampling was targeted at specific groups, and was otherwise largely opportunistic. Given the WA Museum is currently undergoing relocation, it was not possible to



complete identifications of the collected invertebrates in the timeframe for finalising this report.

Given the WA Museum's relocation during the latter half of 2004 and early part of 2005, curatorial staff have indicated that only key specimens will currently be accepted for vouchering. As a consequence, vouchers were not provided for all vertebrate species collected during the survey.

The seasonal timing would not have been optimal for some groups of short-range endemic taxa such as millipedes, while weather conditions during the survey were not conducive to recording mygalomorph spiders and frogs.

Table 3.5: Habitat types and corresponding vegetation descriptions for each of the Mesa A and G fauna survey sites.

Site Code	Habitat Description	Vegetation Code	Vegetation Description
<b>Stony Hills and Plains at Mesa A</b>			
MEA01	<i>Eucalyptus</i> over <i>Acacia</i> over <i>Triodia</i>	H2	<i>Eucalyptus leucophloia</i> scattered low trees over <i>Acacia atkinsiana</i> ( <i>A. arida</i> ) open shrubland to tall shrubland over <i>Triodia wiseana</i> mid-dense hummock grassland
MEA06	<i>Acacia</i> and <i>Eucalyptus</i> over <i>Triodia</i>	H5	<i>Acacia pruinocarpa</i> , <i>Eucalyptus leucophloia</i> scattered low trees to low open woodland over scattered mixed tall shrubs over <i>Triodia wiseana</i> hummock grassland
MEA11	<i>Eucalyptus</i> over <i>Acacia</i> over <i>Triodia</i>	H1	<i>Eucalyptus leucophloia</i> scattered low trees over <i>Acacia arida</i> shrubland to tall shrubland over <i>Triodia wiseana</i> mid-dense hummock grassland
MEA23	<i>Acacia</i> over <i>Triodia</i>	H4	<i>Acacia atkinsiana</i> , <i>A. inaequilatera</i> ( <i>A. arida</i> ) tall open shrubland over <i>Acacia bivenosa</i> open shrubland over <i>Triodia wiseana</i> hummock grassland
MEA21	<i>Acacia</i> over <i>Triodia</i>	H4	<i>Acacia atkinsiana</i> , <i>A. inaequilatera</i> ( <i>A. arida</i> ) tall open shrubland over <i>Acacia bivenosa</i> open shrubland over <i>Triodia wiseana</i> hummock grassland
<b>Stony Hills and Plains at Mesa G</b>			
MEG06	<i>Acacia</i> over <i>Triodia</i>	H10	<i>Acacia atkinsiana</i> ( <i>A. bivenosa</i> ) open shrubland over <i>Triodia epactia</i> , <i>T. wiseana</i> mid-dense hummock grassland
MEG14	<i>Acacia</i> over <i>Triodia</i>	H9	<i>Acacia bivenosa</i> , <i>A. inaequilatera</i> open shrubland over <i>Triodia wiseana</i> mid-dense hummock grassland
<b>Sand Dunes and Sand Sheets</b>			
MEA14	<i>Corymbia</i> over <i>Acacia</i> and <i>Grevillea</i> over <i>Triodia</i>	S1	<i>Corymbia zygomphylla</i> scattered low trees over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Grevillea eriostrachya</i> high shrubland over <i>Triodia schinzii</i> hummock grassland
<b>Creeklines and Floodplains</b>			
MEG09	<i>Corymbia</i> and <i>Eucalyptus</i> over <i>Acacia</i> over <i>Triodia</i>	C6	<i>Corymbia hamersleyana</i> , <i>Eucalyptus leucophloia</i> scattered low trees over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> tall open scrub over <i>Triodia wiseana</i> open hummock grassland
MEG21	<i>Eucalyptus</i> over <i>Acacia</i> over mixed hermland and <i>Triodia</i>	C4	<i>Eucalyptus camaldulensis</i> woodland over <i>Eucalyptus victrix</i> low woodland over <i>Acacia trachycarpa</i> , <i>A. pyrifolia</i> , <i>Petalostylis labicheoides</i> tall open shrubland over mixed open hermland and <i>Triodia wiseana</i> open hummock grassland
MEA05	<i>Acacia</i> and <i>Grevillea</i> over mixed <i>Acacias</i> over <i>Triodia</i> and <i>Eriachne</i>	C2	<i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>A. pruinocarpa</i> , <i>Grevillea wickhamii</i> tall open shrubland to open scrub over <i>Acacia atkinsiana</i> , <i>A. arida</i> open shrubland to tall open shrubland over <i>Triodia wiseana</i> open hummock grassland and <i>Eriachne mucronata</i> scattered tussock grasses

## 4.0 Vertebrate Fauna Inventory Survey

### 4.1 Background

The survey of the Mesa A and Mesa G sites recorded a combined total of 97 vertebrate species. Table 4.1 provides a summary of the number of species recorded from each major vertebrate group during the survey. The disparity in avifauna species richness between Mesa A and G is attributable to the occurrence of major riverine habitat (the Robe River) in the latter area (sampled by MEG21). The Robe River is outside of the area to be directly impacted.

**Table 4.1: Number of species recorded during the Mesa A and G survey**

Fauna Group	Mesa A	Mesa G	Total
Avifauna	27	46	52
Native Non-volant Mammals	5	6	7
Introduced Mammals	0	0	0
Bats	5	0*	5
Reptiles	26	23	33
Amphibians	0	0	0
<b>Total</b>	<b>63</b>	<b>75</b>	<b>97</b>

\* No bat detectors were used on Mesa G.

### 4.2 Birds

#### 4.2.1 The Assemblage

A total of 52 species of birds was recorded during the current survey. This total comprised species from 25 families, including 21 non-passerine and 31 passerine species (Table 4.2).

The most abundant and widespread species was the Painted Finch, with 157 records representing 23.5% of all avifauna records for the survey. The next most abundant species was the Budgerigar, with 112 records representing 16.8% of all records. The most abundant and speciose groups of birds were the Psittacidae, with five species representing 25.3% of all records, and the honeyeaters (Meliphagidae), also with five species representing 12.3% of all records for the survey. The richest habitats were MEG21 (33 species) and MEG06 (21 species). The sites poorest in species were MEG14 and MEA23, both with only 5 species recorded.

#### 4.2.2 Breeding Records

Breeding records were obtained for two species:

- A Mistletoebird was recorded with a nest with chicks; and
- A Painted Finch was recorded on a nest in spinifex with chicks.

#### 4.2.3 Annotated List

Table 4.2 presents data for all bird species recorded from each fauna survey site. Each species is discussed individually in the following annotated list. (For a description of habitat at each site see Table 3.5).

##### CASUARIIDAE

Emu – *Dromaius novaehollandiae*

Recorded from scats and tracks at three sites (MEA11, MEA14 and MEG06).

**ARDEIDAE**

White-faced Heron – *Ardea novaehollandiae*  
A group of three individuals sighted at MEG21.

**ACCIPITRIDAE**

Brown Goshawk – *Accipiter fasciatus didimus*  
Two singles seen at MEA06 and MEA14.

Little Eagle – *Aquila morphnoides morphnoides*  
Two singles seen at MEA01 and MEA23.

**FALCONIDAE**

Brown Falcon – *Falco berigora berigora*  
A single individual observed at MEA05.

Australian Kestrel – *Falco cenchroides cenchroides*  
A single individual observed at MEG06.

**CHARADRIIDAE**

Black-fronted Dotterel – *Charadrius melanops*  
Four individuals seen at MEG21.

**COLUMBIDAE**

Common Bronzewing – *Phaps chalcoptera*  
A single individual observed at MEA14.

Spinifex Pigeon – *Geophaps plumifera*  
Moderately common; observed on 18 occasions at MEA14 (n=2), MEG14 (n=4) and MEG21 (n=12).

Diamond Dove – *Geopelia cuneata*  
Recorded on 15 occasions from both calls and sightings at MEA05 (n=1), MEA06 (n=5), MEA11 (n=3), MEG06 (n=2) and MEG21 (n=4).

Peaceful Dove – *Geopelia striata placida*  
One call recorded from MEG21.

**PSITTACIDAE**

Galah – *Cacatua roseicapilla assimilis*  
Common, with a total of 34 records; most records from MEG21 (n=32), but also recorded from MEA14 (n=2).

Little Corella – *Cacatua sanguinea westralensis*  
A single individual observed at MEG21.

Cockatiel – *Nymphicus hollandicus*  
A total of 14 individuals recorded, in groups of three (MEA14, MEG14) and a group of eight (MEG06).

Australian Ringneck – *Platycercus zonarius zonarius*  
A total of eight individuals observed, in pairs and singles at MEG21.

Budgerigar – *Melopsittacus undulatus*  
The second most commonly recorded species with 112 records throughout the project areas. Both observed and heard, in singles and groups of up to 40 individuals, at all sites except MEA11 and MEG14.

**CUCULIDAE**

Pallid Cuckoo – *Cuculus pallidus*  
Recorded on four occasions, all singles, from MEG09 (n=1) and MEG21 (n=3).

Horsfield's Bronze Cuckoo – *Chrysococcyx basalis*  
Two individuals recorded from calls at MEA11 and MEG21.

#### HALCYONIDAE

Blue-winged Kookaburra – *Dacelo leachii leachii*  
A single individual observed at MEG21.

Red-backed Kingfisher – *Todiramphus pyrrhopygia*  
Three individuals recorded from MEA14 (n=2) and MEG21 (n=1).

Sacred Kingfisher – *Todiramphus sanctus sanctus*  
A single individual observed at MEG21.

#### MEROPIDAE

Rainbow Bee-eater – *Merops ornatus*  
Moderately common with 21 records. Recorded in singles, pairs and a group of seven individuals. Recorded from MEA06 (n=1), MEA14 (n=9), MEG06 (n=1), MEG09 (n=1) and MEG21 (n=9).

#### MALURIDAE

Variiegated Fairy-wren – *Malurus lamberti assimilis*  
Recorded on 21 occasions as singles, pairs, threes and groups of five. Only recorded from Mesa G, from sites MEG06 (n=2), MEG09 (n=2), MEG14 (n=8) and MEG21 (n=9).

Rufous-crowned Emu-wren – *Stipiturus ruficeps ruficeps*  
Recorded on ten occasions, mostly sightings, from MEA01 (n=5), and MEG06 (n=5).

Striated Grasswren – *Amytornis striatus whitei*  
Four sightings; two pairs, one each from MEA14 and MEG09.

#### PARDALOTIDAE

Red-browed Pardalote – *Pardalotus rubricatus*  
Calls were recorded on five occasions from MEA05 (n=1) and MEG21 (n=4).

Striated Pardalote – *Pardalotus striatus murchisoni*  
A single call recorded from MEG21.

#### ACANTHIZIDAE

Weebill – *Smicrornis brevirostris*  
A total of three individuals recorded from MEG21.

Western Gerygone – *Gerygone fusca fusca*  
A single individual observed at MEG21.

#### MELIPHAGIDAE

Brown Honeyeater – *Lichmera indistincta indistincta*  
Recorded on 16 occasions, mostly as calls, from MEA14 (n=10), MEG06 (n=1), MEG09 (n=1) and MEG21 (n=4).

Black Honeyeater – *Certhionyx niger*  
This species was recorded on 15 occasions, mostly as calls, from MEA01 (n=1), MEA05 (n=1), MEA06 (n=3), MEA11 (n=2), MEA14 (n=4) and MEG06 (n=4).

Singing Honeyeater – *Lichenostomus virescens*  
Recorded mostly as calls on 14 occasions from MEA01 (n=7), MEA11 (n=1), MEA14 (n=3), MEA23 (n=2), and MEG06 (n=1).

Grey-Headed Honeyeater – *Lichenostomus keartlandi*  
Recorded as singles, and groups of three, four and five. A total of 28 records from MEA05 (n=8), MEA06 (n=8) and MEA14 (n=12). Not recorded from Mesa G sites.

White-plumed Honeyeater – *Lichenostomus penicillatus*

Recorded as singles and pairs on nine occasions from MEG21. Not recorded from Mesa A sites.

#### POMATOSTOMIDAE

Grey-crowned Babbler – *Pomatostomus temporalis rubeculus*

Recorded on five occasions as singles and a group of three from MEG21. Not recorded from Mesa A sites.

#### PACHYCEPHALIDAE

Crested Bellbird – *Oreoica gutturalis*

Calls of this species were recorded on six occasions from MEA01 (n=2) and MEG06 (n=4).

Rufous Whistler – *Pachycephala rufiventris rufiventris*

Recorded on four occasions, all as singles, from MEA14 (n=1) and MEG21 (n=3).

#### DICRURIDAE

Grey Fantail – *Rhipidura fuliginosa fuliginosa*

A single individual was observed at MEG21.

Willie Wagtail – *Rhipidura leucophrys leucophrys*

This species was recorded on 11 occasions from both calls and sightings at MEA05 (n=2), MEA06 (n=1), MEA14 (n=1), MEG06 (n=1) and MEG21 (n=6).

Magpie-lark – *Grallina cyanoleuca*

Two single individuals observed at MEG21.

#### CAMPEPHAGIDAE

Black-faced Cuckoo-shrike – *Coracina novaehollandiae subpallida*

This species was recorded on seven occasions, mostly as singles but also as a pair from MEA05 (n=1), MEG06 (n=1) and MEG21 (n=5).

White-winged Triller – *Lalage tricolor*

Three individuals observed at MEG21.

#### ARTAMIDAE

Black-faced Woodswallow – *Artamus cinereus melanops*

A group of four individuals was observed at MEG06.

Little Woodswallow – *Artamus minor*

Twelve individuals were recorded during the survey; a group of nine individuals from MEG06 and a group of three from MEG21.

#### CRACTICIDAE

Pied Butcherbird – *Cracticus nigrogularis*

Nine individuals were recorded during the survey from MEA14 (n=1) and MEG06 (n=8).

#### CORVIDAE

Torresian Crow – *Corvus orru ceciliae*

Calls of this species were recorded on three occasions from MEG06 (n=2) and MEG21 (n=1).

#### HIRUNDINIDAE

Fairy Martin – *Hirundo ariel*

Eleven individuals were recorded during the survey; a group of 10 individuals was observed at MEA11, and a single individual was observed at MEA06.

#### SYLVIIDAE

Spinifex-bird – *Eremiornis carteri*

Calls of this species were recorded on five occasions from MEA01 (n=1), MEA23 (n=1) and MEG06 (n=3).

Rufous Songlark – *Cincloramphus mathewsi*

A single individual was observed at MEG21.

#### DICAEIDAE

Mistletoebird – *Dicaeum hirundinaceum hirundinaceum*

A single individual was observed at MEG09.

#### PASSERIDAE

Zebra Finch – *Taeniopygia guttata castanotis*

This species was recorded on 45 occasions from MEA01 (n=4), MEA06 (n=10), MEA11 (n=1), MEA14 (n=7), MEG06 (n=15) and MEG21 (n=8).

Painted Finch – *Emblema pictum*

This was the most commonly recorded species with 157 records during the survey. This species was recorded from every site at both Mesa A and Mesa G.

### 4.2.4 Discussion

The current survey recorded 52 species of birds, which is comparable to the 57 species recorded during the Brockman 4 survey in October 2004 (Biota 2005b) and the 55 species recorded at Mesa J in 1991 (Ecologia 1991). Between these three surveys, a total of 79 species has been recorded, of which only 32 were recorded on all three surveys, while 26 species were recorded on only one of the three surveys.

The variation in species composition recorded by the three surveys listed above is likely to reflect three main factors:

1. variation in the habitats present within the different study areas (eg. extensive watercourses at Mesa J and the presence of mulga at Brockman 4);
2. many birds, especially birds of prey, occur at low densities and so are likely to be missed on any given survey, even if they are present in the study area;
3. many birds respond to the ephemeral appearance of resources in the arid zone by being highly mobile; as a result, their appearance in any study area is highly dependent on the climatic conditions that prevail at the time of the survey.

The creekline site MEG21 had by far the greatest species diversity of the habitats surveyed. While this was probably partly influenced by the greater number of surveys conducted there, creeklines do typically have a greater number of bird species than other habitats due to their greater productivity and greater vertical foliage height diversity. In contrast, *Triodia* flats with little overstorey typically have the lowest species diversity of any habitat, as was found in this survey. It should be noted, however, that spinifex flats do contain a few specialised species that rarely occur in other habitats.

#### Regional Endemism and Restricted Taxa

The Striated Grasswren *Amytornis striatus whitei* was the only species recorded by us that is considered endemic to the Pilbara bioregion. It is widespread and common in the bioregion in suitable habitat, which usually consists of *Triodia* growing on scree slopes, mesa tops and, particularly, the edges of hilltops (Johnstone and Storr 2004). It appears to favour areas where there are some patches of bare, exposed rocks and it occurs primarily on banded ironstone (Dr Mike Craig, Biota, pers. obs.).

The only other regional near endemic that may occur in the project area is the Black-tailed Treecreeper *Climacteris melanura wellsii*, which was not recorded during the current survey. This species typically occurs in eucalypt woodland, either along minor watercourses or in more open woodlands on scree slopes and mesa tops.

#### Species of Conservation Significance

No birds of conservation significance were recorded during the Mesa A and G surveys, though three species could potentially occur in the study area (see Section 6.4).

**Table 4.2: Avifauna records from the Mesa A and G survey areas.**

Common Name	Species Name	Mesa A						Mesa G				Total
		MEA01	MEA05	MEA06	MEA11	MEA14	MEA23	MEG06	MEG09	MEG14	MEG21	
Emu	<i>Dromaius novaehollandiae</i>				1	1		1				3
White-faced Heron	<i>Ardea novaehollandiae</i>										3	3
Brown Goshawk	<i>Accipiter fasciatus didimus</i>			1		1						2
Little Eagle	<i>Aquila morphnoides morphnoides</i>	1					1					2
Brown Falcon	<i>Falco berigora berigora</i>		1									1
Australian Kestrel	<i>Falco cenchroides cenchroides</i>							1				1
Black-fronted Dotterel	<i>Charadrius melanops</i>										4	4
Common Bronzewing	<i>Phaps chalcoptera</i>					1						1
Spinifex Pigeon	<i>Geophaps plumifera</i>					2				4	12	18
Diamond Dove	<i>Geopelia cuneata</i>		1	5	3			2			4	15
Peaceful Dove	<i>Geopelia striata placida</i>										1	1
Galah	<i>Cacatua roseicapilla assimilis</i>					2					32	34
Little Corella	<i>Cacatua sanguinea westralensis</i>										1	1
Cockatiel	<i>Nymphicus hollandicus</i>					3		8		3		14
Australian Ringneck	<i>Platycercus zonarius zonarius</i>										8	8
Budgerigar	<i>Melopsittacus undulatus</i>	11	1	11		30	3	47	4		5	112
Pallid Cuckoo	<i>Cuculus pallidus</i>								1		3	4
Horsfield's Bronze Cuckoo	<i>Chrysococcyx basalis</i>				1						1	2
Blue-winged Kookaburra	<i>Dacelo leachii leachii</i>										1	1
Red-backed Kingfisher	<i>Todiramphus pyrrhopygia</i>					2					1	3
Sacred Kingfisher	<i>Todiramphus sanctus sanctus</i>										1	1
Rainbow Bee-eater	<i>Merops ornatus</i>			1		9		1	1		9	21
Variegated Fairy-wren	<i>Malurus lamberti assimilis</i>							2	2	8	9	21
Rufous-crowned Emu-wren	<i>Stipiturus ruficeps ruficeps</i>	5						5				10
Striated Grasswren	<i>Amytornis striatus whitei</i>					2			2			4
Red-browed Pardalote	<i>Pardalotus rubricatus</i>		1								4	5
Striated Pardalote	<i>Pardalotus striatus murchisoni</i>										1	1
Weebill	<i>Smicronis brevirostris</i>										3	3
Western Gerygone	<i>Gerygone fusca fusca</i>										1	1
Brown Honeyeater	<i>Lichmera indistincta indistincta</i>					10		1	1		4	16
Black Honeyeater	<i>Certhionyx niger</i>	1	1	3	2	4		4				15



Table 4.2: Avifauna records from the Mesa A and G survey areas.

Common Name	Species Name	Mesa A						Mesa G				Total	
		MEA01	MEA05	MEA06	MEA11	MEA14	MEA23	MEG06	MEG09	MEG14	MEG21		
Singing Honeyeater	<i>Lichenostomus virescens</i>	7			1	3	2	1				14	
Grey-headed Honeyeater	<i>Lichenostomus keartlandi</i>		8	8		12						28	
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>										9	9	
Grey-crowned Babbler	<i>Pomatostomus temporalis rubeculus</i>										5	5	
Crested Bellbird	<i>Oreoica gutturalis</i>	2						4				6	
Rufous Whistler	<i>Pachycephala rufiventris rufiventris</i>					1					3	4	
Grey Fantail	<i>Rhipidura fuliginosa fuliginosa</i>										1	1	
Willie Wagtail	<i>Rhipidura leucophrys leucophrys</i>		2	1		1		1			6	11	
Magpie-lark	<i>Grallina cyanoleuca</i>										2	2	
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae subpallida</i>		1					1			5	7	
White-winged Triller	<i>Lalage tricolor</i>										3	3	
Black-faced Woodswallow	<i>Artamus cinereus melanops</i>							4				4	
Little Woodswallow	<i>Artamus minor</i>							9			3	12	
Pied Butcherbird	<i>Cracticus nigrogularis</i>					1		8				9	
Torresian Crow	<i>Corvus orru ceciliae</i>							2		1		3	
Fairy Martin	<i>Hirundo ariel</i>			1	10							11	
Spinifex-bird	<i>Eremiornis carteri</i>	1						1	3			5	
Rufous Songlark	<i>Cincloramphus mathewsi</i>										1	1	
Mistletoebird	<i>Dicaeum hirundinaceum hirundinaceum</i>								1			1	
Zebra Finch	<i>Taeniopygia guttata castanotis</i>	4		10	1	7		15			8	45	
Painted Finch	<i>Emblema pictum</i>	9	11	31	28	2	4	41	5		7	19	157
											<b>No. Species</b>	<b>52</b>	
											<b>No. Individuals</b>	<b>666</b>	

## 4.3 Mammals

### 4.3.1 The Assemblage

The survey recorded seven species of non-volant mammals, comprising one tachyglossid (echidna), two dasyurid (carnivorous marsupial), one macropod (kangaroos and wallabies), two native murids (murid rodents) and one canid (fox/dingo).

The most abundant group encountered was the Macropodidae, with 13 records comprising 29.5% of all the mammal records for the survey. The most common mammal species was the Euro *Macropus robustus erubescens*, with the 13 records previously discussed for the Macropodidae. The most speciose site was MEG21 with records of five species of mammals. The sites poorest in species were MEA05, MEA11, MEG26 and MEG27, with only one species recorded from each (see Table 4.3).

Table 4.3 contains the mammal records from each fauna survey site (for habitat descriptions of each site see Table 3.5). The species are discussed individually in the annotated list below.

Specimens lodged with the WA Museum have been assigned M numbers; these are given below where relevant. A list of vouchered specimens is given in Appendix 4.

### 4.3.2 Annotated List

#### TACHYGLOSSIDAE

Short-beaked Echidna - *Tachyglossus aculeatus*

Evidence of this species in the form of diggings and scats was recorded on five occasions, once each from MEA05, MEA11, MEA23, MEG09 and MEG21.

#### DASYURIDAE

Pilbara Ningai - *Ningai timealeyi*

This species was the most commonly trapped mammal species with 9 records from MEA01 (n=4), MEA23 (n=1), MEG06 (n=1), MEG14 (n=2), MEG 26 (n=1), and one individual observed whilst raking at MEG21. No individuals were vouchered.

Northern Quoll - *Dasyurus hallucatus*

A skull of this species was found at the opening of a cave at MEA06.

#### MACROPODIDAE

Euro - *Macropus robustus erubescens*

This was the most commonly recorded mammal species in the survey area with 13 records. This species was observed at MEA06 (n=2), MEG06 (n=2), MEG09 (n=5), MEG14 (n=1) and MEG21 (n=3). No individuals were vouchered.

#### MURIDAE

Delicate Mouse - *Pseudomys delicatulus*

Two individuals were pit-trapped, one each from sites MEA14 (M55109) and MEG21 (M55110).

Common Rock-rat - *Zyzomys argurus*

A single male captured in an Elliott trap at MEG27 (M55278).

#### CANIDAE

Dingo - *Canis lupus dingo*

Eleven individuals were observed within the survey area at MEA01 (n=1), MEA14 (n=3), MEG06 (n=5) and MEG21 (n=2). No individuals were vouchered.

### 4.3.3 Discussion

The current survey recorded seven species of non-volant mammals (see above). This compares to eight species recorded in the Brockman 4 survey in October 2004 (Biota 2005b)

and 13 species recorded at Mesa J (Ecologia 1991). The current survey recorded one mammal species, the Delicate Mouse *Pseudomys delicatulus*, not recorded at Brockman 4 (Biota 2005b) or Mesa J (Ecologia 1991). The recorded ground mammal assemblage is depauperate and we would expect additional species to occur in the Mesa A and G project areas.

The Brockman 4 survey recorded one species, the House Mouse *Mus musculus*, not recorded in the current survey or the survey of Mesa J (Ecologia 1991).

In addition to the species recorded during the current survey, the survey of Mesa J in 1991 (Ecologia 1991) found secondary signs of the Lesser Stick-nest Rat *Leporillus apicalis* (extinct-old nests only), and the Pebble Mound Mouse *Pseudomys chapmani* (abandoned mounds only). The survey also recorded the Cow *Bos Taurus*, the Fat-tailed Antechinus *Pseudantechinus roryi*<sup>2</sup>, Rothschild's Rock Wallaby *Petrogale rothschildi* and the Little Red Kaluta *Dasykaluta rosamondae*.

A recent survey (March 2005; Biota in prep.) of Warrambo, Bungaroo Creek and the Mesa J Extension recorded only six species of mammals including *Pseudomys hermannsburgensis*, *Ningau timealeyi*, *Dasykaluta rosamondae*, secondary evidence of *Pseudomys chapmani* (inactive mounds only), *Macropus robustus erubescens* and an additional species for the area, *Planigale* sp.

### Regional Endemism and Restricted Taxa

*Ningau timealeyi* was the only species recorded by us that is considered a "near endemic" to the Pilbara bioregion. It is widespread and common across a range of substrate types vegetated with *Triodia* spp. Including *T. angusta*, *T. basedowii*, *T. brizoides*, *T. epactia*, *T. lanigera*, *T. longiceps*, *T. pungens* and *T. wiseana* (source: Biota database).

Other regional endemics or near endemics that may occur in the project areas but were not recorded during the current survey include *Dasykaluta rosamondae*, *Planigale* sp. and *Petrogale rothschildi*. *D. rosamondae* exhibits a distribution that closely mirrors *N. timealeyi* and like this species is found across a wide range of substrates dominated by *Triodia* spp., including *T. basedowii*, *T. brizoides*, *T. epactia*, *T. lanigera*, *T. longiceps* and *T. wiseana* (source: Biota database). *Planigale* spp. are believed to be restricted to the Pilbara bioregion (Ms Norah Cooper, WA Museum, pers. comm. 2005; see below). *Petrogale rothschildi* favours large boulder screes, boulder tors and breakaways with caves and overhangs.

### Unresolved Species Complexes

In Western Australia, the genus *Planigale* has recently undergone a revision and two new species have been recognised in the Pilbara (Ms Norah Cooper, WA Museum, pers. comm. 2004). The two species may separate on the basis of habitat type, with one preferring the self-mulching clays on the Chichester Plateau and the weakly gilgaied soils dominated by *Acacia xiphophylla*, whilst the second species may prefer the scree slopes of the Hamersley Plateau (Roy Teale, Biota, pers. obs.).

There are potentially two taxa within the Pilbara *Pseudomys hermannsburgensis* (Ms Norah Cooper, WA Museum, pers. comm.). One form, nominally called *Pseudomys* sp. "Hamersley", has been recorded from upland habitats at a number of locations including near Mt Brockman and at Mindy Mindy Creek near the Fortescue Marshes.

### Species of Conservation Significance

No non-volant mammals of conservation significance were recorded by the Mesa A and G surveys, though several may occur (see Section 6.4).

<sup>2</sup> This species was originally identified as a *Pseudantechinus macdonnellensis* but without a registration number it is not possible to confirm the identification. The species name has been updated to reflect current taxonomy (see Cooper et al. 2000).



### 4.3.4 Bats

#### Summary of Results

A number of bat call sequences were analysed using the Anlook software version 4.3. Examination of call frequencies yielded positive identifications of two species of bats and the tentative identification of a further two species from call attributes. These calls were recorded using two separate recording units at one location over a period of four evenings.

The taxa identified in the call sequence study are *Vespadelus finlaysoni* (Finlayson's Cave Bat), *Chaerephon jobensis* (Northern Free-tail Bat), *Chalinolobus gouldii* (Gould's Wattled Bat) and *Scotorepens greyii* (Little Broad-nosed Bat). These species represent two families, the Molossidae and the Vespertilionidae. A trace of the echolocation call of each species identified by call characteristics is presented in the following annotated list (see Figure 4.2, Figure 4.1, Figure 4.3 and Figure 4.4 respectively). In each trace, the time between calls has been compressed to allow illustration of a greater number of pulses.

Additionally, a single Ghost Bat (*Macroderma gigas*), representing the Megadermatidae, was seen during the survey.

#### Annotated List

##### MOLOSSIDAE

##### *Chaerephon jobensis*

The Northern Freetail-bat generally roosts in trees and is found in a variety of habitats (Churchill 1998). This species was recorded at 2318 hrs on the 14/05/04 (Figure 4.1).

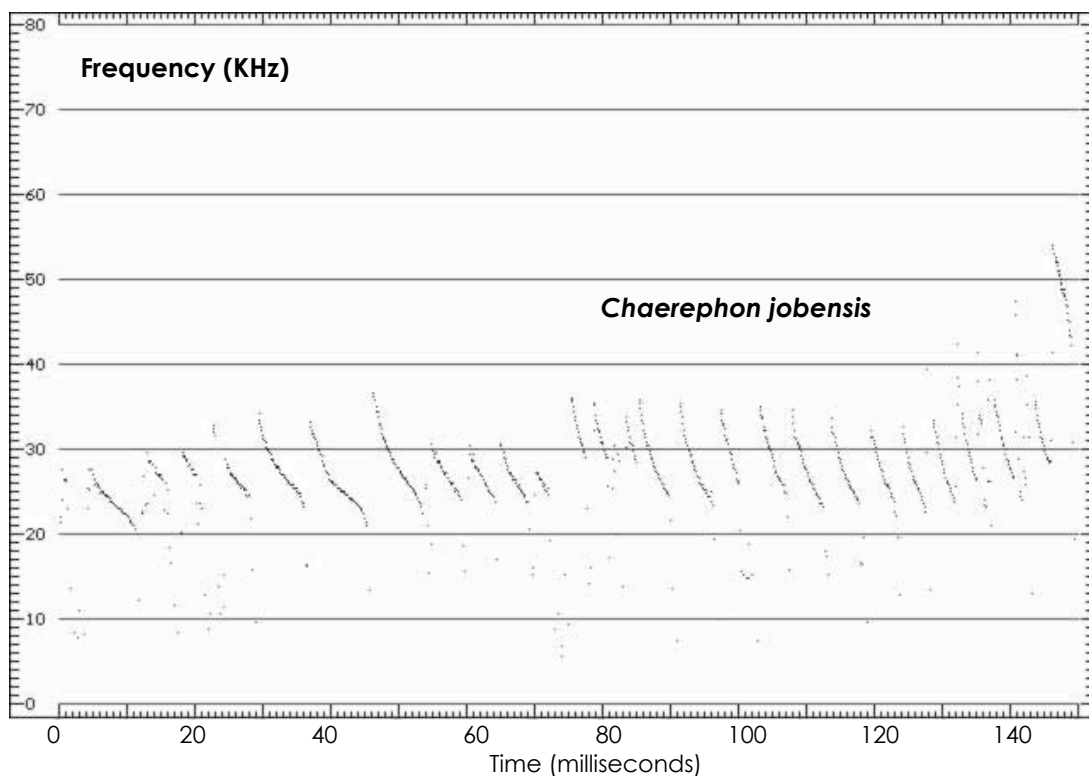
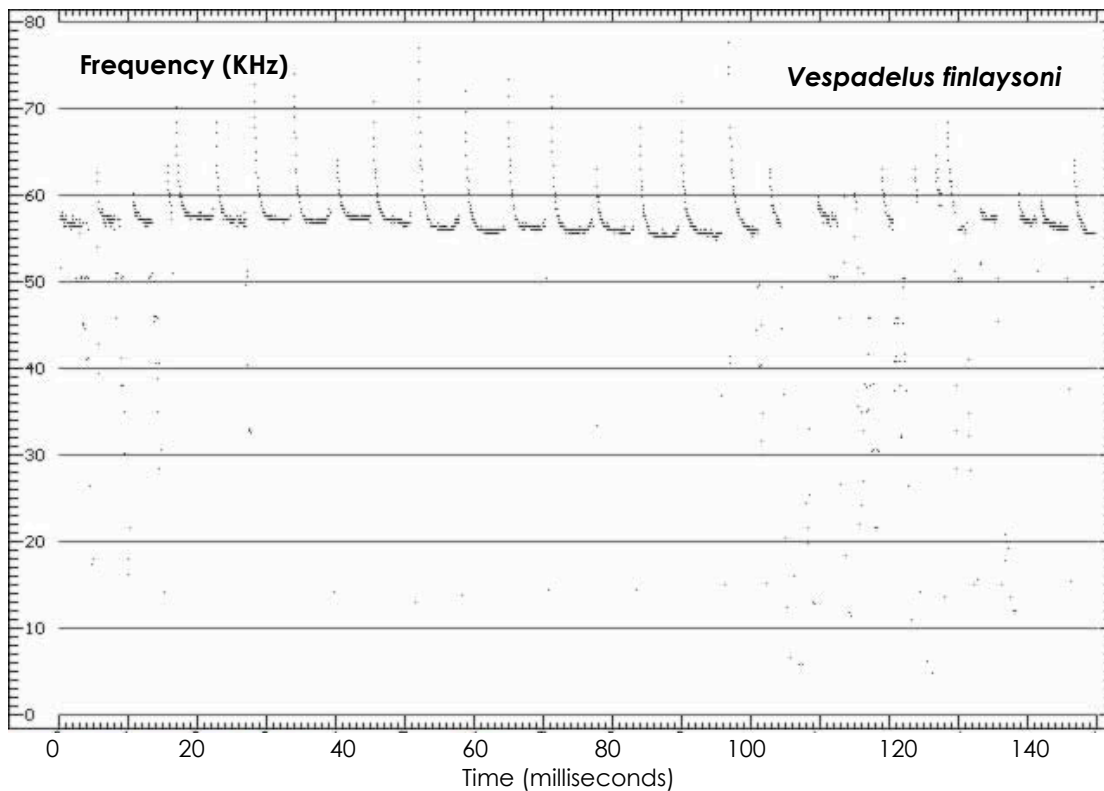


Figure 4.1: Call of *Chaerephon jobensis*.

##### VESPERTILIONIDAE

##### *Vespadelus finlaysoni*

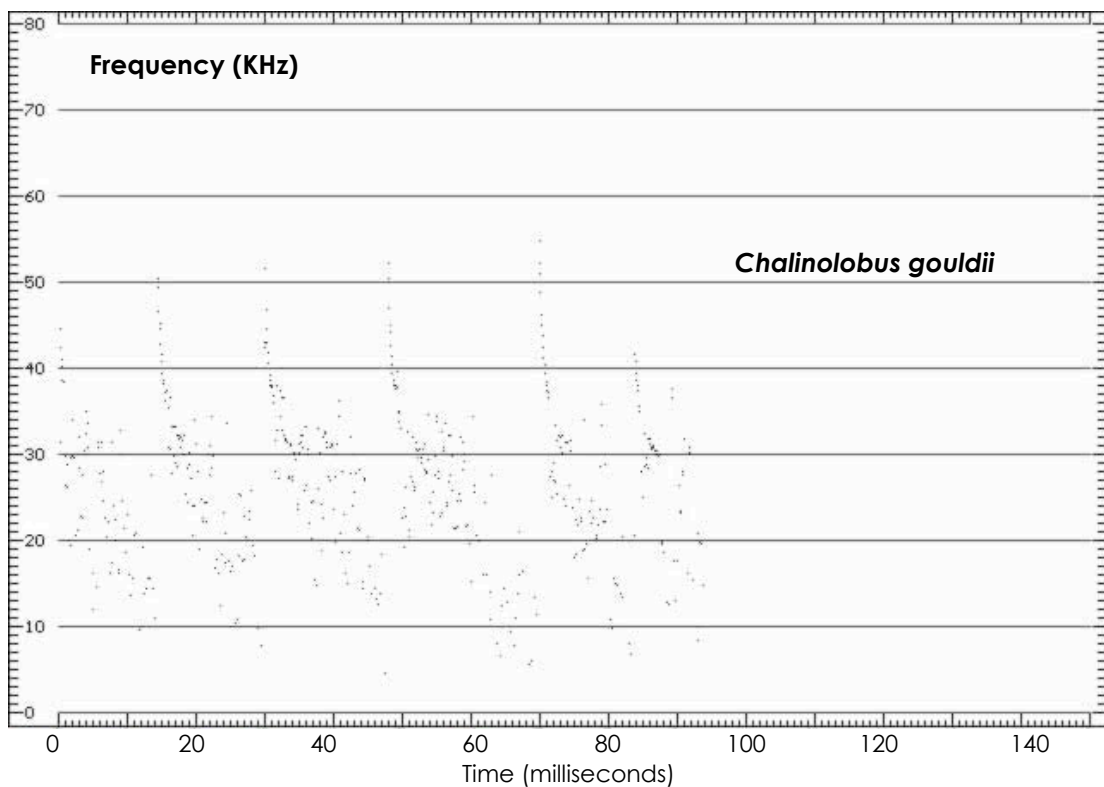
Finlayson's Cave Bat typically roosts in caves and other subterranean structures (Churchill 1998). Figure 4.2 illustrates a call recorded at 0430 hrs on the 15/05/04. The sequence displayed includes several types of calls/pulses that include search and attack.



**Figure 4.2:** Call sequence of *Vespadelus finlaysoni*.

*Chalinolobus gouldii*

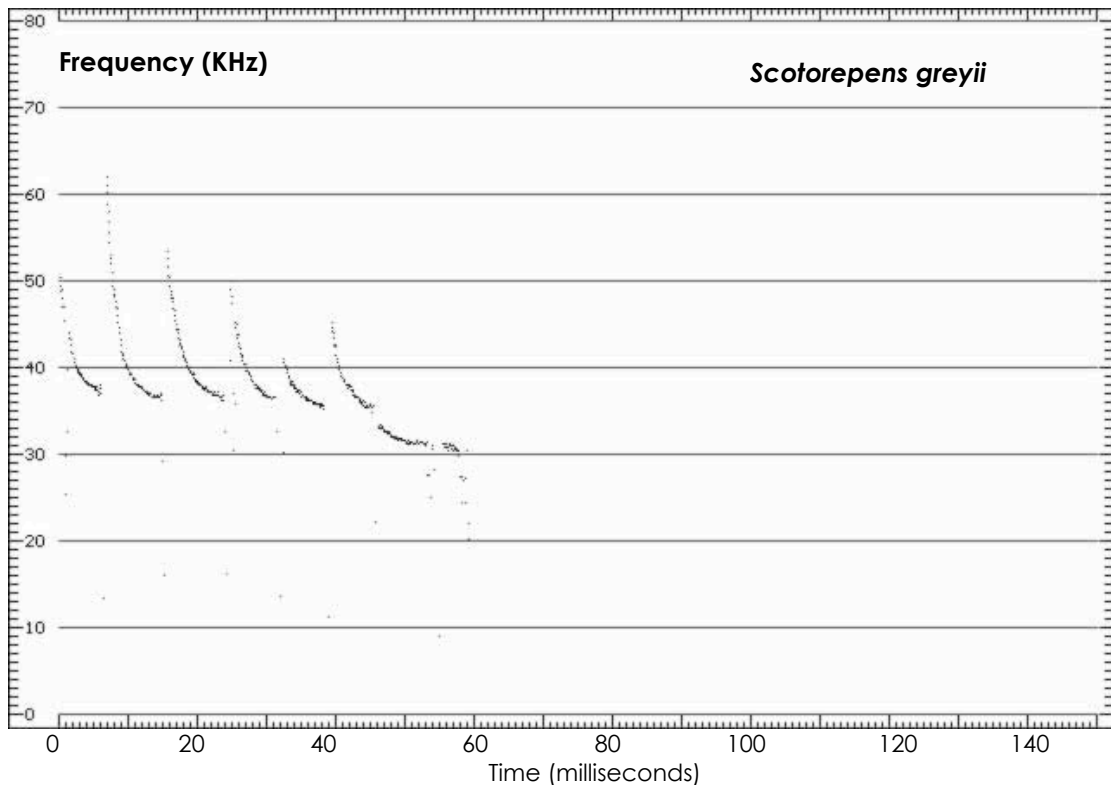
Gould's Wattled Bat generally roosts in trees and is found in a variety of habitats throughout Australia (Churchill 1998). Figure 4.3 illustrates a call of this species recorded at 0809 hrs on the 15/05/04. This was a tentative identification based on call sequence only.



**Figure 4.3:** Call of *Chalinolobus gouldii*.

*Scotorepens greyii*

The Little Broad-nosed Bat generally roosts in trees, utilising a variety of wooded habitats (Churchill 1998) and is commonly found in the Pilbara region. This species was recorded at 2222 hrs on the 14/05/04 (Figure 4.4). This was a tentative identification based on call sequence only.



**Figure 4.4:** Call of *Scotorepens greyii*.

### MEGADERMATIDAE

#### Ghost Bat - *Macroderma gigas*

A single individual was observed in the overhang of a cave at MEA06, indicating the presence of a roost.

#### Species of Conservation Significance

The Ghost Bat, *Macroderma gigas*, was observed leaving a cave at site MEA06 within the Mesa A project area. The conservation status of this species is Priority 4. Unpublished data shows significant genetic structuring within the Pilbara, with differences between populations in the Hamersley Range (colonies southwest of the Fortescue Valley) and eastern Pilbara (those in large mines in the Bamboo, Nullagine and Marble Bar districts) (Biota 2004a; Armstrong 2004; Armstrong and Wilmer 2004; Dr Kyle Armstrong, Kyoto University Museum, pers. comm. 2005).

## 4.4 Herpetofauna

### 4.4.1 Assemblage

Thirty-three reptile species were recorded from the project area during the current survey (Table 4.4). The reptiles comprised six gekkonids (geckos), three pygopodids (legless lizards), four agamids (dragons), 14 scincids (skinks), one varanid (goanna), one boid (python), and four elapids (front-fanged snakes).

The most abundant group encountered were the Scincidae, with 104 records comprising 60.4% of all the herpetofauna records for the survey. The most common species was *Lerista bipes*, with 47 occurrences comprising 27.3% of all records. The most speciose site was MEA14

with 17 species recorded from the one site. The site poorest in species was MEA21 with only one species recorded (see Table 4.4).

Table 4.4 summarises the records of herpetofauna from each site and opportunistic collections. Each species is discussed individually in the following annotated list. Specimens lodged with the WA Museum have been assigned R numbers, and these are given below where relevant. A list of vouchered specimens is given in Appendix 4.

#### 4.4.2 Annotated List

##### GEKKONIDAE

A total of 25 individuals of six species were recorded from this family during the current survey.

Fat-tailed Gecko - *Diplodactylus conspicillatus*

Recorded from a total of six individuals from MEA01 (n=1), MEA06 (n=1) and MEA14 (n=4) (R157533).

Pale-snouted Ground Gecko - *Diplodactylus stenodactylus*

Also recorded from six individuals from sites MEG14 (n=3) (R157573, R157539) and MEA14 (n=3) (R157553, R157579).

Bynoe's Gecko - *Heteronotia binoei*

Recorded from eight individuals from MEA06 (n=1), MEA11 (n=3) (R157581), MEA14 (n=1), MEA23 (n=1) and MEG14 (n=2) (R157586, R157530).

Common Knob-tailed Gecko - *Nephrurus levis pilbarensis*

Two individuals were pit-trapped from MEA14 (n=1) (R157528) and MEG14 (n=1) (R157588).

Marbled Velvet Gecko - *Oedura marmorata*

Recorded from a single observation whilst head-torching at MEA06.

Beaked Gecko - *Rhynchoedura ornata*

Two individuals recorded, both from pit traps, from MEG21 (n=1) (R157541) and MEA14 (n=1) (R157554).

##### PYGOPODIDAE

Six individuals of three species were recorded from this family during the current survey.

Long-nosed Delma - *Delma nasuta*

Recorded from four individuals from MEA06 (n=1) (R157587), MEA14 (n=1) (R157568), MEG27 (n=1), and one individual raked from under leaf litter in an opportunistic location within the project area.

Burton's Legless Lizard - *Lialis burtonis*

Two individuals recorded, both from pit-traps, from MEA21 (n=1) and MEG21 (n=1). No individuals were vouchered.

Hooded Scaly-foot - *Pygopus nigriceps nigriceps*

A single specimen was hand captured from MEA06 (R157575).

##### AGAMIDAE

A total of 29 individuals from four species were recorded from this family during the current survey.

Ring-tailed Rock Dragon - *Ctenophorus caudicinctus caudicinctus*

Recorded from 15 individuals from MEA05 (n=1), MEA06 (n=1), MEA11 (n=3) (R157542), MEA14 (n=4), MEA23 (n=2), MEG14 (n=3) and MEG21 (n=1).



*Military Sand Dragon - Ctenophorus isolepis isolepis*

Recorded from eight individuals from MEA14 (n=1) (R157556), MEG06 (n=2) (R157571) and MEG14 (n=5) (R157526).

*Central Notted Dragon - Ctenophorus nuchalis*

This species was recorded from five individuals, four from pit traps and one hand captured, all from MEA14 (R157555).

*Long-nosed Water Dragon - Lophognathus longirostris*

A single individual recorded from MEG21.

**SCINCIDAE**

A total of 104 individuals of 14 species were recorded from this family during the current survey.

*Carlia munda*

Recorded from five individuals from MEA01 (n=1) (R157592), MEA05 (n=1), MEA14 (n=2) (R157565) and MEG14 (n=1).

*Cryptoblepharus carnabyi*

Recorded from two individuals observed at MEA05. No individuals were vouchered.

*Cryptoblepharus aff. carnabyi*

Two individuals hand captured from MEG27. No individuals were vouchered.

*Ctenotus duricola*

This species was recorded on four occasions from MEA06 (n=1), MEA14 (n=1) (R157566), and MEG06 (n=2).

*Ctenotus grandis titan*

This species was recorded on two occasions; both individuals were males, and both were from the same pit trap at MEA06 (R157594, R157574).

*Ctenotus hanloni*

Recorded on 10 occasions from MEA06 (n=3), MEA14 (n=3) (R157557, R157543, R157531), MEG06 (n=2) (R157576), MEG14 (n=1) (R157583) and MEG21 (n=1) (R157540).

*Ctenotus aff. helenae*

Two individuals were recorded from MEG06 (n=1) and MEG21 (n=1). No individuals were vouchered.

*Leopard Skink - Ctenotus pantherinus ocellifer*

Recorded on six occasions, mostly from funnel traps, from MEA11 (n=2), MEA23 (n=2), MEG14 (n=1) (R157582) and MEG21 (n=1).

*Ctenotus saxatilis*

This species was recorded on 13 occasions from MEA01 (n=2) (R157580), MEA06 (n=1), MEA11 (n=2) (R157567), MEA14 (n=1) (R157532), MEA23 (n=1), MEG06 (n=1) (R157591) and MEG21 (n=5) (R157529).

*Eremiascincus sp. nov.*

Recorded from a single female specimen caught in an Elliott trap at MEA06 (R157584) (see Plate 4.1). This individual was caught at the base of cliffs within the gorge. It represents a new taxon, not yet described, for which there are currently only two other specimens in the WA Museum (R125768 and R129631). This species is discussed in more detail in the discussion below.

*Lerista bipes*

This was the most commonly recorded species with 47 records, all from MEA14 (R157535, R157527, R157538, R157536, R157537).

*Lerista muelleri*

This species was pit-trapped on four occasions, all from MEA14 (R157552, R157558, R157593).

Common Dwarf Skink - *Menetia greyii*

Recorded on five occasions, all from pit-traps, from MEA01 (n=1), MEA14 (n=1) and MEG14 (n=3). No individuals were vouchered.

Fire-tailed Skink - *Morethia ruficauda exquisita*

A single male specimen was pit-trapped from MEG14 (R157577).

**VARANIDAE**

Two individuals from one species were recorded from this family during the current survey.

Desert Pygmy Monitor - *Varanus eremius*

Two individuals were pit-trapped from MEA06 (n=1) (R157569) and MEG14 (n=1) (R157578).

**BOIDAE**

A single individual from one species was recorded from this family during the current survey.

Black-headed Python - *Aspidites melanocephalus*

A single individual was observed crossing a track within the project area at dusk.

**ELAPIDAE**

Four individuals from four species were recorded from this family during the current survey.

Pilbara Death Adder - *Acanthophis wellsi*

Recorded from one specimen caught in a funnel trap at MEA23 (R157563).

Yellow-faced Whipsnake - *Demansia psammophis cupreiceps*

A single individual was pit-trapped at MEG14 (R157564).

Moon Snake - *Furina ornata*

Recorded from a single female pit-trapped at MEA14 (R157585). This individual was greyish in appearance and differs from the typical *Furina ornata* not only in colour, but also by possessing 17 instead of 15 mid-body scale rows, and by only attaining an adult size of only 50cm instead of 65cm. The two forms of this snake are quite distinct and have previously been recognized as separate species (see Bush and Maryan (2004) for more information).

Spotted Snake - *Suta punctata*

A single individual was pit-trapped at MEG06 (R157534).

**4.4.3 Discussion**

Thirty-three herpetofauna species were recorded from the project area during the current survey. This compares to 51 herpetofauna species recorded during the Brockman 4 survey in October 2004 (Biota 2005b) and 36 species of herpetofauna recorded from Mesa J (Ecologia 1991). The relatively high number of herpetofauna (species richness) recorded for the Brockman 4 project is indicative of summer sampling and a broader range of habitats.

Ten species that were recorded during the current survey were not recorded during the Brockman 4 survey. These species comprise *Nephrurus levis pilbarensis*, *Oedura marmorata*, *Ctenophorus nuchalis*, *Cryptoblepharus* aff. *carnabyi*, *Ctenotus hanloni*, *Eremiascincus* sp. nov., *Lerista bipes*, *Aspidites melanocephalus*, *Acanthophis wellsi* and *Suta punctata*.

Species recorded during the Brockman 4 survey that were not recorded during the current survey include: *Cyclorana maini*, *Litoria rubella*, *Diplodactylus savagei*, *D. wombeyi*, *Gehyra punctata*, *G. variegata*, *Strophurus elderi*, *S. wellingtonae*, *Delma pax*, *D. tincta*, *Diporiphora valens*, *Pogona minor*, *Cryptoblepharus plagioccephalus*, *Ctenotus rutilans*, *C. schomburgkii*,

*Cyclodomorphus melanops melanops*, *Egernia formosa*, *Lerista muelleri*, *Menetia surda surda*, *Notoscincus butleri*, *Varanus acanthurus*, *V. panoptes panoptes*, *V. tristis tristis*, *Ramphotyphlops grypus*, *R. pilbarensis*, *Brachyuropis approximans*, *Parasuta monachus* and *Pseudechis australis*.

Seven species recorded in the Mesa J area (Ecologia 1991) were not recorded by us either during the current survey or during the Brockman 4 survey (Biota 2005b). These were *Nephrurus wheeleri*, *Lophognathus gilberti*<sup>3</sup> (this is likely to be a mis-identification as the species only occurs in Mangrove areas on coastal Pilbara), *Lerista flammicauda*, *Glaphyromorphus isolepis*, *Varanus aff. gilleni*, *Antaresia perthensis* and *Uperoleia russelli*.

Many of the species not recorded in the current survey but recorded in the Brockman 4 and Mesa J surveys have since been recorded in a recent survey in March 2005 of Bungaroo Creek, Warramboos and Mesa J (Biota in prep). Such species include *Diplodactylus savagei*, *Gehyra punctata*, *Gehyra variegata*, *Nephrurus wheeleri*, *Strophurus elderi*, *Delma tincta*, *Cryptoblepharus plagiocephalus*, *Cyclodomorphus melanops melanops*, *Glaphyromorphus isolepis*, *Lerista muelleri*, *Notoscincus butleri*, *Varanus acanthurus*, *Varanus aff. gilleni*, *Ramphotyphlops grypus*, *Ramphotyphlops pilbarensis*, *Brachyuropis approximans*, and *Pseudechis australis*. The absence of these species during the current survey is likely to reflect both habitat and seasonal differences, with a number of these species representing lowland species.

The absence of any frog records during the current survey probably reflects the lack of any rain during the survey period.

### Regional Endemism and Restricted Taxa

One species recorded during the current survey, the Pilbara Death Adder *Acanthophis wellsii*, is endemic to the Pilbara. In addition, a number of species endemic, or nearly endemic, to the Pilbara may occur in the project area: *Delma elegans* (recorded from Warramboos in March 2005), *Diplodactylus savagei* (recorded in March 2005 from Warramboos, in October 2004 at Brockman 4, and in 1991 at Mesa J (Ecologia 1991)), *Nephrurus wheeleri cinctus* (recorded in March 2005 from Warramboos), *Notoscincus butleri* (recorded in March 2005 from Bungaroo Creek), *Diplodactylus wombeyi* (recorded in October 2004 at Brockman 4), *Lerista flammicauda* (recorded by Ecologia at Mesa J in 1991) and *Varanus aff. gilleni* (recorded in March 2005 from Bungaroo Creek and in 1991 from Mesa J (Ecologia 1991)).

### Unresolved Species Complexes

The *Diplodactylus stenodactylus* species complex is currently under review, with possibly six new species occurring in the Pilbara bioregion (Mr Laurie Smith, WA Museum, pers. comm. 2004). The conservation status of those specimens recorded by us during the Mesa A and G survey is uncertain.

*Menetia greyii* is known to be a species complex. The taxonomic status of the specimens recorded by us and their conservation significance is again uncertain.

*Ctenotus* aff. *helenae* is well known and has been collected from a wide area of the Pilbara over the past few decades. Dan Robuske, a PhD student from New York, is currently attempting to resolve this species complex. There is a general opinion that there may be different expressions of morphology of a range of species in this genus on different substrates. This is being investigated with the use of molecular markers as an independent evaluation of morphology.

The *Lerista muelleri* complex has been subject to revision by Mr Laurie Smith (WA Museum). The four individuals of *Lerista muelleri* collected from the survey area are a form of this species complex that has previously been recognised. This form is distributed along the Pilbara coast, where it is common.

<sup>3</sup> Scientific names have been updated to reflect current taxonomy.

*Cryptoblepharus carnabyi* is a species complex that is currently being reviewed by Mr Paul Horner of the Northern Territory Museum. The taxonomic status, distribution and conservation status of the specimens collected by us from the project area are unclear.

The *Eremiascincus* sp. nov. (see Plate 4.1) collected during the current survey is one of only three individuals of this species presently in the WA Museum collection. This specimen is the first adult individual collected and is likely to become the holotype for the species (Mr Brad Maryan, WA Museum, pers. comm.). It is recommended that Robe River Mining Associates pursue taxonomic revision of this taxon.



**Plate 4.1:** *Eremiascincus* sp. nov. collected during the current survey (Photo: Greg Harold). Note that the total length of this individual is around 150mm.

*Furina ornata* may represent a species complex, with two distinct morphs currently recognised within the taxon.

*Diplodactylus savagei* also has a range of morphologies within its distribution and may represent a species complex.

The entire genus *Gehyra* is undoubtedly a species complex.

*Oedura marmorata* may represent a species complex, with distinct differences within its distribution including differences in head shape.

*Lerista bipes* is believed to be a species complex.

### Species of Conservation Significance

No Schedule or Priority listed herpetofauna species were recorded during the current survey.

There are three species of conservation significance that may occur in the study areas:

- *Notoscincus butleri* is endemic to Western Australia and restricted to the arid Northwest. This species is currently listed as Priority 4 fauna, taxa in need of monitoring (see section 6.4 for a more detailed description). This species was not recorded during the current survey but has been recorded in March 2005 at Bungaroo Creek (Biota in prep.). It is possible that this species occurs in the project area.
- The Pilbara Olive Python *Liasis olivaceus barroni* is a Schedule 1 species and is also listed as Vulnerable at the Federal level. This species is discussed more extensively in Section 6.4.
- *Ramphotyphlops ganeii* is a Priority 1 species. This blind snake is poorly collected, being represented by only eight specimens in the WA Museum collection. These records are mainly from the area surrounding Pannawonica, together with a record from north of Newman (see section 6.4 for a more detailed discussion).

As noted in the above section, there are several unresolved taxa with uncertain conservation significance. The most significant of these is *Eremiascincus* sp. nov. This individual represents a new taxon, not yet described, for which there are currently only two other specimens in the WA Museum (R125768 and R129631). These specimens are from Dales Gorge in the Hamersley Range (22° 38' 36"S, 118° 33' 47"E) and from a gorge 120 km northwest of Newman (22° 55' 00"S, 118° 53' 00"E) respectively. Both of these specimens are believed to be immature, as they are considerably smaller than the individual collected during the current survey. All three specimens have been found in rocky gorges, a habitat not typical of the two described species, *E. richardsonii* and *E. fasciolatus*, both of which favour sandy areas. Given the apparently wider distribution of this taxon and habitat preference (rocky gorges), it may be undersampled rather than rare.

**Table 4.4: Herpetofauna records from the Mesa A and G project area.**

Species Name	Mesa A							Mesa G				Opportunistic	Total
	MEA01	MEA05	MEA06	MEA11	MEA14	MEA21	MEA23	MEG06	MEG14	MEG21	MEG27		
Gekkonidae													
<i>Diplodactylus conspicillatus</i>	1		1		2				2				6
<i>Diplodactylus stenodactylus</i>					3				3				6
<i>Heteronotia binoei</i>			1	3	1		1		2				8
<i>Nephrurus levis pilbarensis</i>					1				1				2
<i>Oedura marmorata</i>				1									1
<i>Rhynchoedura ornata</i>					1					1			2
Pygopodidae													
<i>Delma nasuta</i>			1		1						1	1	4
<i>Lialis burtonis</i>						1				1			2
<i>Pygopus nigriceps nigriceps</i>			1										1
Agamidae													
<i>Ctenophorus caudicinctus caudicinctus</i>		1	1	3	4		2		3	1			15
<i>Ctenophorus isolepis isolepis</i>					1			2	5				8
<i>Ctenophorus nuchalis</i>					5								5
<i>Lophognathus longirostris</i>										1			1
Scincidae													
<i>Carlia munda</i>	1	1			2				1				5
<i>Cryptoblepharus aff. carnabyi</i>											2		2
<i>Cryptoblepharus carnabyi</i>		2											2
<i>Ctenotus aff. helenae</i>								1		1			2
<i>Ctenotus duricola</i>			1		1			2					4
<i>Ctenotus grandis titan</i>			2										2
<i>Ctenotus hanloni</i>			3		3			2	1	1			10
<i>Ctenotus pantherinus ocellifer</i>				2			2		1	1			6
<i>Ctenotus saxatilis</i>	2		1	2	1		1	1		5			13
<i>Eremiascincus richardsonii</i>			1										1
<i>Lerista bipes</i>					47								47
<i>Lerista muelleri</i>					4								4
<i>Menetia greyii</i>	1				1				3				5
<i>Morethia ruficauda exquisita</i>									1				1

**Table 4.4: Herpetofauna records from the Mesa A and G project area.**

Species Name	Mesa A							Mesa G				Opportunistic	Total
	MEA01	MEA05	MEA06	MEA11	MEA14	MEA21	MEA23	MEG06	MEG14	MEG21	MEG27		
Varanidae													
<i>Varanus eremius</i>			1						1				2
Boidae													
<i>Aspidites melanocephalus</i>												1	1
Elapidae													
<i>Acanthophis wellsi</i>							1						1
<i>Demansia psammophis cupreiceps</i>									1				1
<i>Furina ornata</i>					1								1
<i>Suta punctata</i>								1					1
												<b>No. Species</b>	<b>33</b>
												<b>No Individuals</b>	<b>172</b>

## 5.0 Invertebrate Fauna Inventory Survey

### 5.1 Overview

The survey of the Mesa A and Mesa G study sites recorded a large number of invertebrate taxa, many of which were not identified beyond family level. The only taxa identified to genus or species level were those taxa belonging to groups known to include short-range endemics (ie. mygalomorphs, millipedes and camaenid land snails), that were otherwise of conservation significance (examples would include the Pilbara dragonfly *Antipodogomphus hodgkini* and the Pilbara Damselfly *Nososticta pilbara*), or for which expertise was readily available at the WA Museum (eg. wolf spiders and other spider groups).

### 5.2 Short-Range Endemics

#### 5.2.1 Millipedes

No millipedes were collected during the current survey.

In general, this group is poorly studied taxonomically (Harvey 2002) and poorly collected (Harvey 2002, Hoffman 2003). With the exception of pin-cushion millipedes (Polyxenida), which the authors have collected from a number of localities including Barrow Island, near the Fortescue Marsh, West Angelas, Yandicoogina, and more recently Mesa J and Bungaroo Creek, we rarely observe millipedes in the Pilbara. Examples include a new genus of spirobolid millipede from the Burrup Peninsula (Hoffman 2003), and several individuals from the family Paradoxosomatidae from nearby Mesa J (Biota in prep.) and from Mt Brockman in October 2004 (Biota 2005b) (suggesting that these may also occur in the mesic microhabitats of current project areas).

According to Harvey (2002), the polydesmid millipedes (including the family Paradoxosomatidae) are considered to harbour species that have narrow ranges. Within this order, the genus *Antichiropus* has undergone the largest radiation and displays some of the smallest documented distributions (Dr Mark Harvey, WA Museum, pers. comm. 2004).

#### 5.2.2 Terrestrial Molluscs (Land Snails)

In his review of the conservation status of Australia's non-marine molluscs, Ponder (1997) identifies over 900 described terrestrial land snails from 23 families, with the most speciose families being the Camaenidae (408 taxa), Helicarionidae (60 taxa), Pupillidae (41 taxa), Bulimulidae (31 taxa), Punctidae (23 taxa) and Pupinidae (19 taxa). There are 230 described taxa in Western Australia, with 201 of these restricted to this State (Ponder 1997). Within the Pilbara bioregion the most conspicuous elements of this fauna are the *Rhagada* and *Quistrachia* species (Camaenidae), though several *Bothriembryon* species (Bulimulidae) are known.

The geographic range of the genus *Rhagada* extends from the northern Kimberley to the Carnarvon area. With 29 species currently described, the Western Australian endemic *Rhagada* is the second most diverse genus of the family Camaenidae (Solem 1997), which includes more than half the terrestrial snails of Australia (Ponder 1997). A number of *Rhagada* species inhabit the coast of the Pilbara region and the islands of the Dampier Archipelago. On the mainland, there is a series of eight coastal species between Shark Bay and Cape Leveque. These form a set of non-overlapping geographic replacements (Solem 1997).

Genetic diversification may be expected to be greater amongst land snails than for more vagile insects and vertebrates, however few genetic studies have been completed to investigate this (see Johnson et al. 2004). There is certainly extensive variation in shell morphology for *Rhagada* species from the Dampier Archipelago (including the Burrup Peninsula), with seven species described (Solem 1997) and several additional species awaiting description (Dr Peter Kendrick, CALM, pers. comm. 2004; Ms Shirley Slack-Smith, WA



Museum, pers. comm. 2004). Many of these taxa have very narrow distributions, with some confined to single outcrops (Dr Peter Kendrick, pers. comm. 2004). Shell morphology of mainland *Rhagada* species within the Pilbara bioregion tends to be more conservative by comparison and species tend to have larger non-overlapping distributions (eg. spanning a linear distance in excess of 200 km) (Solem 1997; see also Johnson et al. 2004).

Three species of land snails were recorded during the Mesa A and G survey, two within the genus *Rhagada* and one pupillid.

### **Rhagada**

Two species of *Rhagada* were collected during the current survey (see Table 5.1). Most specimens were represented only by empty shells, but a number of aestivating snails were also collected and lodged with Dr Mike Johnson from the University of Western Australia for genetic investigations (see Section 3.7). Ms Zoë Hamilton (Biota Environmental Sciences) is currently conducting the molecular investigation. Only adult shells were used in identification, as juveniles will not key out (Solem 1997).

**Table 5.1: Number and location of live and dead snail specimens collected from the project areas.**

Species	No. Live Snails Collected	No. Empty Shells Collected	Site	Lat/Long Coordinates
<i>Rhagada convicta</i>	2	16	MEA01	21°40'13"S, 115°52'15"E
<i>Rhagada radleyi</i>	0	2	MEG21	21°40'28"S, 115°52'14"E

- *Rhagada convicta* (Cox 1870)

Based on shell characteristics alone, live snails and empty shells found at MEA01 and on a rocky hillslope at Mesa G key out to this species (see Plate 5.1). It is a large sized *Rhagada* species (mean diameter 20.15 mm) (Solem 1997).

*Rhagada convicta* has the largest range of any *Rhagada* species, with a mainly coastal plains distribution (see Figure 5.1). It ranges from the Minilya River northeast to Dampier and Cossack.



**Plate 5.1: Aestivating individuals of *Rhagada convicta*.**

- *Rhagada radleyi* (Preston 1908)

Shells collected from MEG21 keyed out to *Rhagada radleyi* (Plate 5.2), which is a medium sized species of *Rhagada* (mean diameter 16.64mm) (Solem 1997).

*Rhagada radleyi* is an inland species. Its distribution extends over the hills from Millstream on the Fortescue River south-southwest to the upper Ashburton River drainage (see Figure 5.1).



**Plate 5.2: A comparison of *Rhagada radleyi* (left) from near Pannawonica with *Rhagada* sp. (right) from Brockman No. 4.**

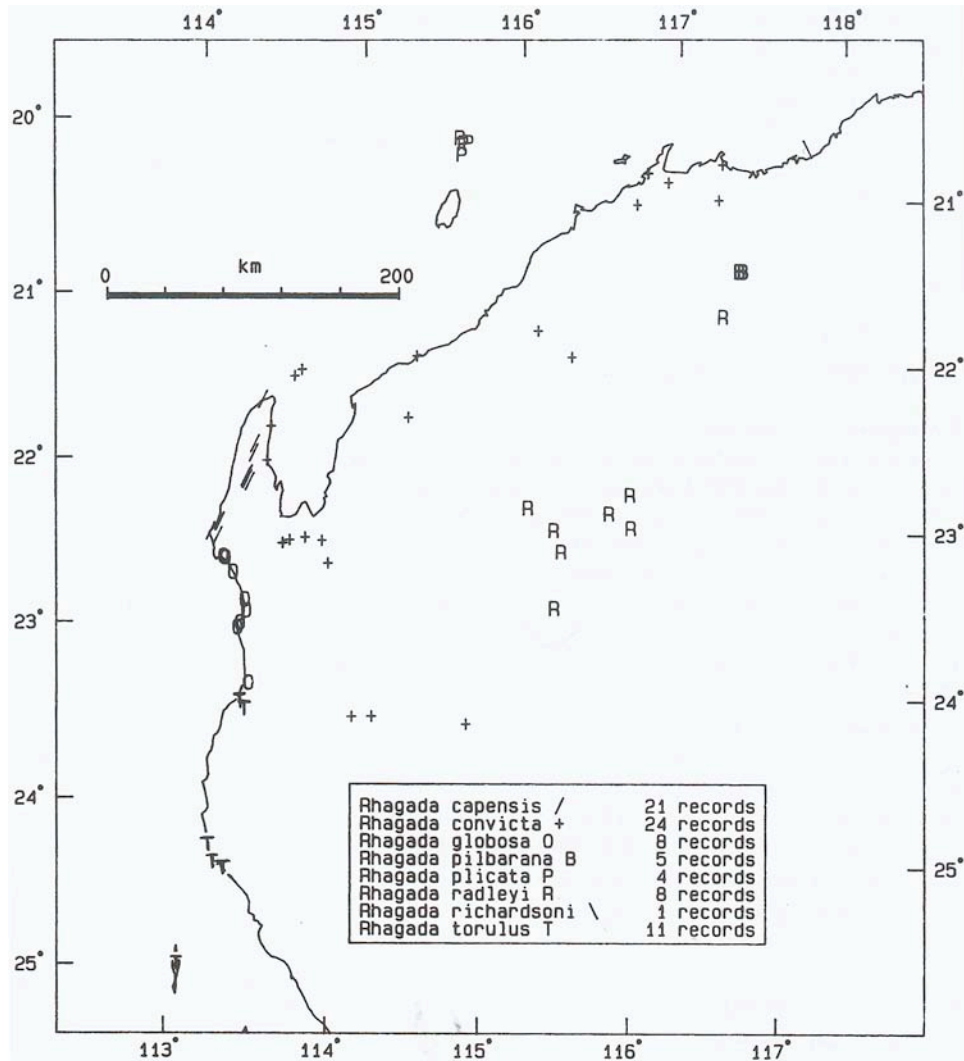


Figure 5.1: Distribution map showing range of *R. convicta* and *R. radleyi* (from Solem 1997).

#### *Rhagada* sp. nov.

In October 2004 a new species of *Rhagada* was collected from Mt Brockman (Plate 5.2) (Biota 2005b). This species has subsequently also been collected from Mesa J and Bungaroo Creek (Biota in prep.). It is possible that this taxon also occurs in the Mesa A and G study areas.

#### **Pupoides**

One Pupillid snail shell was collected from the project area and lodged with the WA Museum.

### 5.2.3 Mygalomorph Spiders

One individual mygalomorph spider was collected from MEA01. This specimen is awaiting identification from the WA Museum.

## 5.3 Other Invertebrate Taxa

### 5.3.1 Other Spiders

The survey recorded nine families of Araneomorph spiders (Table 5.2). Specimens have been identified to morpho-types and are awaiting confirmation at the WA Museum.

**Table 5.2: Spider families recorded from fauna survey sites at Mesa A and G.**

Family*	Mesa A			Mesa G		
	MEA01	MEA14	MEA03	MEG21	MEG14	MEG06
Lycosidae	√	√		√	√	√
Salticidae	√					
Miturgidae	√	√	√		√	
Gnaphosidae	√			√	√	√
Lamponidae	√			√	√	
Trochanteridae	√					
Zodariidae	√				√	
Araneidae		√				
Oxyopidae				√		

\* Classification represents tentative identifications only and is yet to be confirmed by the WA Museum.

### 5.3.2 Scorpionida

A total of 36 scorpionids were collected from MEG14, MEG06, MEA01 and MEA03 (see Table 5.3). These have been sorted to two morpho-species, both belonging to the family Buthidae, and are awaiting identification at the WA Museum.

**Table 5.3: Invertebrates collected from Mesa A and G.**

Location	Biota Specimen Number	Class	Order	No. Specimens
MEA14	MEA14-1	Insecta	Coleoptera	42
	MEA14-2	Insecta	Hymenoptera	8
	MEA14-3	Arachnida	Araneae	8
	MEA14-4	Chilopoda	Scolopendrida	1
	MEA14-5	Insecta	Orthoptera	1
	MEA14-6	Insecta	Thysanura	1
	MEA14-7	Chilopoda	Scutigera	2
MEA01	MEA01-1	Chilopoda	Scolopendrida	6
	MEA01-2	Arachnida	Araneae	6
	MEA01-3	Arachnida	Araneae	23
	MEA01-4	Arachnida	Scorpionida	23
	MEA01-5	Insecta	Orthoptera	10
	MEA01-6	Insecta	Coleoptera	4
	MEA01-7	Insecta	Blattodea	2
	MEA01-8	Insecta	Dermaptera	4
	MEA01-9	Insecta	Hymenoptera	5
	MEA01-10	Arachnida	Araneae	17
MEA03	MEA03-1	Arachnida	Araneae	1
	MEA03-2	Arachnida	Scorpionida	1
	MEA03-3	Chilopoda	Scolopendrida	1
	MEA03-4	Insecta	Coleoptera	1
	MEA03-5	Gastropoda	Diotocardia	1
MEG14	MEG14-1	Chilopoda	Scolopendrida	4
	MEG14-2	Chilopoda	Scolopendrida	3
	MEG14-3	Arachnida	Araneae	25
	MEG14-4	Arachnida	Scorpionida	11
	MEG14-5	Insecta	Hymenoptera	21
	MEG14-6	Insecta	Orthoptera	1
	MEG14-7	Insecta	Coleoptera	2
	MEG14-8	Insecta	Blattodea	3
	MEG14-9	Insecta	Thysanura	2
	MEG14-10	Malacostraca	Isopoda	2
MEG21	MEG21-1	Insecta	Coleoptera	2
	MEG21-2	Insecta	Coleoptera	10
	MEG21-3	Arachnida	Araneae	11
	MEG21-4	Insecta	Orthoptera	3
	MEG21-5	Insecta	Hymenoptera	20
	MEG21-6	Insecta	Thysanura	2

**Table 5.3: Invertebrates collected from Mesa A and G.**

<b>Location</b>	<b>Biota Specimen Number</b>	<b>Class</b>	<b>Order</b>	<b>No. Specimens</b>
MEG06	MEG06-1	Chilopoda	Scolopendrida	3
	MEG06-2	Insecta	Hymenoptera	100
	MEG06-3	Arachnida	Araneae	6
	MEG06-4	Arachnida	Scorpionida	1
	MEG06-5	Insecta	Coleoptera	4
	MEG06-6	Malacostraca	Isopoda	1

## 6.0 Conservation Significance

### 6.1 Approach to the Assessment

The fauna conservation value of the survey area is discussed in general terms in Section 6.2 and specifically for vertebrate and invertebrate fauna of conservation significance in Sections 6.4 and 6.6 respectively. Section 6.5 addresses known species complexes within the vertebrate fauna recorded from the study areas, and for which the conservation status is therefore unresolved. Section 6.3 describes the statutory framework under which species are assigned special protection.

### 6.2 Overall Fauna Conservation Value

The general conservation value of the study area considers the populations of all individual species within it. Species richness tends to vary primarily on the size of an area and the number of habitats present (which may reflect numerous factors including geology, soil type, landform, altitude and aspect). Seasonal timing is also clearly a factor in terms of recording the assemblage.

#### 6.2.1 Vertebrates

The current survey recorded 97 species of terrestrial vertebrate taxa belonging to 40 families from the Mesa A and G study areas (see Section 4.0). The tally comprised 33 reptiles, 52 birds, five bats and seven non-volant mammals.

In comparison:

- the fauna survey of the Mesa J project area (Ecologia 1991) recorded 106 vertebrate species comprising two frogs, 34 reptiles, 55 birds, two bats and 13 non-volant mammals; and
- the survey of the Brockman 4 project area (Biota 2005b) recorded 123 vertebrate taxa comprising two frogs, 49 reptiles, 57 birds, seven bats and eight non-volant mammals.

The difference in tallies across these surveys can be attributed to the differing scales of the projects, varying trapping effort and different seasonal timing of the surveys.

On the basis of the results from a single survey and examining the data at a coarse level, the species list is typical for the Pilbara and the Hamersley Range subregion. The assemblage is comparable to other regional surveys with the exception of *Eremiascincus* sp. nov. collected during the current survey.

The *Eremiascincus* sp. nov. individual collected from a gorge at Mesa A (site MEA06) during the current survey is only the third specimen – and the first adult specimen – of the species collected to date, and is likely to become the holotype. Site MEA06 also supported a Priority 4 listed species, the Ghost Bat *Macroderma gigas*. Given these records alone, this site appears to have significant conservation value and will need to be managed accordingly.

Other than this gorge, the only other site that has particular conservation value is MEA14. No rare species were recorded from this site, however this habitat type (sand dune and sand sheets) has not been encountered by us elsewhere in the western portion of the Hamersley subregion and is likely to be uncommon (see Section 7.0 for more detail). Similar habitats exist further south along the North West Coastal Highway towards Nanutarra at Peedamulla and Cane River (Dr Stephen van Leeuwen, CALM Karratha, pers. comm. 2005). Given that such habitat is apparently uncommon in the Pilbara bioregion, its biota is likely to be significant and of some conservation interest at least at a regional scale (Dr Stephen van Leeuwen, CALM Karratha, pers. comm. 2005).

## 6.2.2 Invertebrates

A comparable list of key invertebrate taxa is not available and could not be compiled for this report due to the ongoing relocation of the WA Museum. It is envisaged that proposed follow-up work will include database searches to access previously lodged invertebrate specimens of potential conservation significance (ie. Short Range Endemic taxa).

To date, the survey has documented two key groups of invertebrate taxa potentially supporting Short Range taxa. These are:

- Pulmonata – three taxa; and
- Mygalomorphae – one taxon.

No regional surveys of invertebrates are available for comparison.

## 6.3 Threatened Fauna Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Western Australian *Wildlife Conservation Act 1950*. In addition, many of these species are listed under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999).

### 6.3.1 EPBC Act 1999

Fauna species of national conservation significance are listed under the EPBC Act 1999, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'conservation dependent' (consistent with IUCN categories (go to <http://www.wcmc.org.uk/species/animals/categories.html> for more information)). Migratory wader species are also protected under the EPBC Act 1999. The national List of Migratory Species consists of those species listed under the following International Conventions:

- *Japan-Australia Migratory Bird Agreement* (JAMBA);
- *China-Australia Migratory Bird Agreement* (CAMBA); and
- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention).

### 6.3.2 Wildlife Conservation Act 1950-1979

Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 2005* recognises four distinct schedules of taxa:

1. Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
2. Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
3. Schedule 3 taxa are birds which 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, which are declared to be fauna in need of special protection; and
4. Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, fauna are also classified under five different Priority codes:

- Priority One Taxa with few, poorly known populations on threatened lands. Taxa which are known from a few specimens or sight records from one or a few localities on lands not managed for conservation. 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, or taxa with several, poorly known populations not on conservation lands. 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. 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. 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. 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. Taxa which are declining significantly but are not yet threatened.
- Priority Five** Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

## 6.4 Threatened Fauna Species from the Mesa A and G Study Area

One Priority 4 listed species was recorded from the survey area. A further four Schedule and nine Priority listed species have either been recorded from or may occur in the Mesa A and G survey areas. The Night Parrot and Northern Quoll are listed as Endangered at the Federal level (although the Northern Quoll is not listed at the State Level), while the Pilbara Olive Python is listed as Vulnerable. These threatened fauna species are listed in Table 6.1 and discussed individually below.

**Table 6.1: Species of conservation significance recorded from or potentially occurring within the Mesa A and G survey areas.**

Species	State Level	Federal Level
Northern Quoll <i>Dasyurus hallucatus</i> <sup>†</sup>	Not Listed	Endangered
Orange Leaf-nosed Bat <i>Rhinonicteris aurantius</i>	Schedule 1	
Night Parrot <i>Pezoporus occidentalis</i>	Schedule 1	Endangered
Pilbara Olive Python <i>Liasis olivaceus barroni</i>	Schedule 1	Vulnerable
Peregrine Falcon <i>Falco peregrinus</i>	Schedule 4	
Ramphotyphlops ganei <i>Ramphotyphlops ganei</i>	Priority 1	
Pilbara Dragonfly <i>Antipodogomphus hodgkini</i>	Priority 2	
Pilbara Damselfly <i>Nososticta pilbara</i>	Priority 2	
Long-tailed Dunnart <i>Sminthopsis longicaudata</i>	Priority 4	
Ghost Bat <i>Macroderma gigas</i> *	Priority 4	
Lakeland Downs Mouse <i>Leggadina lakedownensis</i>	Priority 4	
Western Pebble-mound Mouse <i>Pseudomys chapmani</i>	Priority 4	
Star Finch (western) <i>Neochmia ruficauda subclaescens</i>	Priority 4	
Fortescue Grunter <i>Leiopotherapon aheneus</i>	Priority 4	
<i>Notoscincus butleri</i>	Priority 4	

\* denotes species recorded during the current survey.

† Recorded from a skull

### **Northern Quoll *Dasyurus hallucatus* (Endangered)**

**Distribution:** The northern Quoll was originally recorded across Northern Australia from the North-west Cape, Western Australia to south-east Queensland but has declined in recent years. Its distribution is now restricted to six main areas, being the Hamersley Ranges and

Kimberley in north and north west Western Australia, north and western top end of the Northern Territory, north of Cape York, Atherton Cairns area and the Carnarvon Range-Bowen area of Queensland (Menkhorst 2001).

This historical range extended across northern Australia from the Pilbara to south-eastern Queensland, extending inland in the Northern Territory as far south as Alexandria. There are no historical data available on relative abundance across this range. It was notably absent from the two large islands of Bathurst and Melville, but present on other, smaller offshore islands. This species has since disappeared from coastal lowland areas in north Queensland, including the Burdekin River delta and around Townsville, following agricultural and urban development.

**Ecology:** The Northern Quoll, *Dasyurus hallucatus*, is classed as a medium-sized marsupial, with adult weight ranging from 300 g up to 1,200 g. It is considered a partially arboreal and aggressive carnivore, preying on a varied diet of small invertebrates and vertebrates, including lizards, birds, snakes, small mammals and frogs (Oakwood 1997). It is also known to feed on fleshy fruit. The Northern Quoll is mostly nocturnal although crepuscular (dusk and dawn) activity is common. It is a short-lived mammal with both sexes maturing at 11 months. Females reproduce only once each year, and all males die shortly after reproducing (Dickman and Braithwaite 1992, Oakwood 2000). The discrete male cohorts that arise within populations make quolls vulnerable to extinction. If no juvenile male quolls survive to adulthood, there will be no males for females to mate with the following year, and the local population will rapidly go extinct (Braithwaite and Griffiths 1994, Oakwood 2000). Therefore, any factor that results in significant increases in mortality rates of female and juvenile quolls could cause local extinction of quoll populations.

**Likelihood of occurrence:** A skull from this species was recovered from a small cave at Mesa A (386106mE, 7603985mN; 21°39'49"S, 115°53'57"E). It is likely to occur along the length of the Rob River where there is suitable habitat.

**Potential Impacts:** Loss of suitable habitat and potential nesting areas. With home ranges between 35ha and 1km<sup>2</sup> the likely impact can be calculated once the disturbance area is finalized.

### **Orange Leaf-nosed Bat *Rhinonicteris aurantius* (Schedule 1)**

**Distribution:** The Orange Leaf-nosed Bat is found in the Pilbara region of Western Australia, through the Kimberley and across the Top End into north-western Queensland. This species is an Australian endemic. The Pilbara population is geographically the most isolated population of *R. aurantius*, being separated from the northern Australian populations by nearly 400km of sand ridge desert. It differs from the Northern population in terms of wing-shape indices and echolocation call frequency (Dr Norm McKenzie, CALM Woodvale, unpubl. data.).

**Ecology:** This species is often found in monsoon rainforest, tall open forest, open savanna woodland, black soil grassland and spinifex-covered hills. They are more influenced by the availability of suitable roost caves than habitat types (Churchill 1998). In the Pilbara, they are thought to be restricted to caves where water is nearby (Dr Kyle Armstrong, Kyoto University Museum, pers. comm. 2005). They are opportunistic in their diet, eating primarily moths and beetles throughout the year and flying termites during the wet season.

**Likelihood of occurrence:** It is possible that this species occurs in the project areas, as numerous caves are present. No caves over permanent water bodies exist in the project areas, however the Robe River is relatively close to both Mesa A and Mesa G and would provide a favourable foraging ground. There are no documented roosts or records within or near the project areas (see Armstrong 2001), although it is unclear whether the area has been thoroughly searched.

**Potential Impacts:** This species will abandon roost caves if disturbed unreasonably, which places the colony in great danger (Churchill 1998). Any deep suitable caves that do occur and are subsequently destroyed will clearly result in the loss of potential roosting sites. If these caves are occupied at the time of excavation then there will also be individual mortality.



**Night Parrot *Pezoporus occidentalis* (Schedule 1, 'Endangered')**

Distribution: Night Parrots have been reported from every state on the Australia mainland. Apparently suitable habitat occurs, or has occurred, across most of the inland, covering at least half of the continent. Records are sparsely distributed through this area, however there does appear to be concentrations of records in western Queensland and the eastern Pilbara (Higgins et al. 1999). There is an unconfirmed record from Moojarri Well north of the Fortescue Marsh.

Ecology: This species is listed as Endangered under the *EPBC Act 1999*, and as Schedule 1 under the *Wildlife Conservation Notice 2005*. Night Parrots inhabit areas where there is dense, low vegetation, which provides them shelter during the day. Most records come from hummock grasslands with spinifex (*Triodia*), from areas dominated by samphire or, particularly, where these two habitats are juxtaposed. It has been suggested that birds move into the grasslands when *Triodia* is seeding. They have also been reported in low chenopod shrublands with saltbush and bluebush, and from areas of Mitchell grass *Astrelba* with scattered chenopods. Many records have come from waterholes, and almost all reports from areas of *Triodia* have noted the presence of nearby water. The species is secretive and almost all confirmed sightings of feeding or drinking birds have come after dark. Sightings during the day almost always have been of birds flushed from hiding places by herds of stock, dogs or fire. Birds typically sit very tight, flushing only if the disturbance is very close, actually affecting the clump of vegetation in which they are hiding. Early observers stressed the dependence of the parrot upon dense spinifex or samphire for daytime roosting spots and for nesting.

The Night Parrot is presumably like other arid zone birds in being markedly nomadic. The extent of the movements and the possibility of some seasonality in any part of the range are unknown. Several possible reasons have been proposed for the decline of this species in recent years including: (1) habitat loss through clearing, (2) changes in habitat from burning practices, (3) changes in habitat caused by or competition from stock grazing or rabbits, (4) reduced availability of water holes or surrounding suitable food plants, and (5) predation from feral animals, particularly cats and foxes (cats were mentioned as a major problem by several early observers). The relative importance of each of these factors is unclear.

Likelihood of occurrence: Not recorded during the current survey. A single, moderately certain record of this species from Yarraloola (near Mesa A) in 1967 was yielded by the CALM Rare Fauna database search for area (Appendix 3). This species is unlikely to occur in the project area.

Potential Impacts: As this species is unlikely to occur in the project area, the project is unlikely to impact on its conservation significance.

**Pilbara Olive Python *Liasis olivaceus barroni* (Schedule 1, Vulnerable)**

Distribution: Regarded as a Pilbara endemic, this subspecies has a known distribution that coincides roughly with the Pilbara bioregion (Environment Australia 2000).

Ecology: Shows a preference for rocky habitats near water, particularly rock pools. May shelter in deep rock crevices, with a diet that includes birds, reptiles, and mammals as large as rock wallabies.

Likelihood of occurrence: A single record of this species from 1923 was yielded by the CALM Rare Fauna database search for the area (Appendix 3). Suitable habitat for this species occurs within the project area. A population exists along the Robe River near Pannawonica (Dr David Pearson, CALM Woodvale, pers. comm. 2005). Several individuals have been radio-tracked where the access road to the mine crosses the Robe River. Another individual has been tracked at Pot Pot Creek, on the access road into Pannawonica from the North West Coastal Hwy (Dr David Pearson, CALM Woodvale, pers. comm. 2005, Mr Brad Maryan, pers. comm. 2005). It is highly likely that this species occurs within the project area.

**Potential Impacts:** Some potential habitat loss; possible direct mortality associated with construction of mines and infrastructure. The conservation status and distribution of this species is unlikely to be affected by the proposal.

#### **Peregrine Falcon *Falco peregrinus* (Schedule 4)**

**Distribution:** The Peregrine Falcon has an almost cosmopolitan distribution. The only subspecies in Australia (*macropus*) is widespread throughout Australia and Tasmania (Marchant and Higgins 1993). The Australian population has been estimated at 3,000 to 5,000 pairs (Cade 1982). Whilst its status is difficult to determine in the Pilbara, it is certainly more common than its Priority 4 listed congener *Falco hypoleucos*. We have recorded this species from near Tom Price, as well as within the Nammuldi-Silvergrass project area adjacent to the Brockman mine (Hamersley Iron 1999).

**Ecology:** This species inhabits a wide range of habitats including forest, woodlands, wetlands and open country. The availability of prey is apparently more important than habitat in determining its distribution. Home ranges are probably defended year round and are variable in size, though not typically less than 480 ha (Marchant and Higgins 1993).

This species typically nests on cliffs (81% of nests Australia-wide) but also on stick nests (11%) and in tree hollows (8%). Breeding typically occurs from August to November (Johnstone and Storr 1998). Food is almost exclusively birds such as pigeons, parrots and passerines, which are captured in flight (Johnstone and Storr 1998). Mammals such as possums and rabbits have been recorded as rare prey items (Marchant and Higgins 1993).

**Likelihood of occurrence:** Not recorded during the current survey. This species is likely to be resident in the Mesa A and G survey areas as suitable prey species, such as parrots, are common.

**Potential Impacts:** Loss of potential nesting and foraging habitat. The conservation status of this species is unlikely to be affected by the proposal.

#### **Ramphotyphlops ganei (Priority 1)**

**Distribution:** This blind snake is poorly collected, being represented by just eight specimens in the WA Museum collection. Records of this species exist from:

- Pannawonica (21°39'00"S, 116°19'00"E);
- Mt Whaleback (23°20'57"S, 119°34'00"E);
- Millstream (21°35'00"S, 117°04'00"E);
- the Chichester Range (22°01'02"S, 118°58'57"E and 22°13'49"S, 118°58'55"E);
- Cathedral Gorge, 30 km west of Newman (23°17'30"S, 119°28'00"E);
- an area 89 km west-northwest of Newman (23°04'00"S, 118°56'00"E); and
- the Newman area (23°21'00"S, 119°34'00"E).

**Ecology:** This species is poorly known, but as for most blind snakes, individuals are likely to mostly inhabit the topsoil, termitaria and ant nests. Blind snake diet typically consists of the eggs, larvae and pupae of ants (Storr et al. 2002). A single specimen (R151749) of this species was recorded from a pitfall trap in *Triodia epactia* hummock grassland on a scree slope of the Chichester Range near Redmont Camp (22°01'02"E, 118°58'57"E; Biota database).

**Likelihood of occurrence:** A single record of this species from 1991 from Pannawonica was yielded by the CALM Rare Fauna database search for the area (Appendix 3). It is likely that this species occurs in the project area.

**Potential Impacts:** Some potential habitat loss; possible direct mortality associated with construction of mines and infrastructure. The conservation status of this species is difficult to ascertain from the eight known records. However, the records of the species suggest that it

does not have a restricted distribution, and therefore its conservation status is unlikely to be affected by the proposal.

**Pilbara Dragonfly *Antipodogomphus hodgkini* (Priority 2)**

No published information was readily available for this species.

**Pilbara Damselfly *Nososticta pilbara* (Priority 2)**

No published information was readily available for this species.

**Long-tailed Dunnart *Sminthopsis longicaudata* (Priority 4)**

Distribution: Inhabits rocky, rugged habitat from the Pilbara and adjacent upper Gascoyne region east to the central Northern Territory and South Australia.

Ecology: Records have come from plateaus near breakaways, and scree and rugged boulder strewn scree. Mark Cowan (CALM Kalgoorlie) has recently recorded moderate numbers of this species (in excess of 50) in the Goldfields region from most stony substrates, particularly fractured/weathered mudstone/siltstone but also breakaways (Mr Mark Cowan, CALM Kalgoorlie, pers. comm. 2004). We have only recorded three individuals from the Pilbara; the first from the bank of Caves Creek (near Mt Brockman) adjacent to a rugged scree; the second from calcareous soil on a low hill near Mt Brockman; and the third during the Fortescue Metals Group Stage B survey, from spinifex hummock grassland on a low stony hillslope near Mt Joel (Biota 2005c).

Likelihood of occurrence: Not recorded during the current survey but likely to occur in the study areas.

Potential Impacts: Potential habitat loss. The project is unlikely to alter the distribution or the conservation status of this species should it occur in the project area.

**Ghost Bat *Macroderma gigas* (Priority 4)**

Distribution: The distribution of Ghost Bats is fragmented, with each population showing some genetic differentiation (Dr Kyle Armstrong, pers. comm. 2004).

Ecology: Ghost Bats are efficient predators of small birds, mammals and reptiles, and large insects, and they have highly developed echolocation, visual and hearing systems. Vocalisations audible to humans are used in their complex social interactions. Scat material from *M. gigas* is quite distinctive and can be used to identify temporary roosts or feeding sites. Fairy Martin (*Hirundo ariel*) nests within culverts provide a roosting substrate for *M. gigas* and the culverts may function either as a night or feeding roost or (probably less commonly) as a temporary day roost. This is an example of where man-made habitat has benefited bats (Biota 2002a).

Likelihood of occurrence: This species was sighted leaving a cave in the Mesa A project area at MEA06 (386106mE, 7603985mN; 21°39'49"S, 115°53'57"E) (Mr Roy Teale, Ms Zoë Hamilton, Biota, pers. obs.). The cave was shallow and there was no evidence to suggest that it was a maternity roost.

Potential Impacts: Loss of roosting sites and foraging habitat.

**Notoscincus *butteri* (Priority 4)**

Distribution: *Notoscincus butteri* is endemic to Western Australia and restricted to the arid northwest of the Pilbara bioregion (Storr et al. 1999).

Ecology: This species has been associated with spinifex-dominated areas near creek and river margins (Wilson and Swan 2003; Mr Greg Harold, pers. comm. 2004; Biota unpublished data). This small skink is diurnal and egg laying (Wilson and Knowles 1998).

**Likelihood of occurrence:** This species was not recorded in the present survey, but has been recorded at Bungaroo Creek in March 2005 (Biota in prep.). This species has also been recorded at Brockman 4 in creekline habitat (Biota 2005b), and from the Nammuldi / Silvergrass project areas adjacent to the existing Brockman 2 mine (Hamersley Iron 1999). This species is now known from 36 records in the WA Museum collection. It is quite possible that this species occurs in the Mesa G project area adjacent to the Robe River.

**Potential Impacts:** The conservation status of this species is unlikely to be impacted by the proposed development either at the bioregion or subregion level.

#### **Lakeland Downs Mouse *Leggadina lakedownensis* (Priority 4)**

**Distribution:** Since 1997, the number of records of this species has increased substantially such that it has now been recorded from over 20 locations (Armstrong et al. in prep). A recent taxonomic revision of *Leggadina* (Cooper et al. 2003) found that despite morphological variation, *L. lakedownensis* are genetically similar across their range and the variation is insufficient to warrant subspecific status for any regional populations. In Western Australia the distribution includes the Pilbara and Kimberley regions. We have recorded this species on cracking clay communities from Cape Preston in the west to the northern flanks of the Fortescue Marshes in the east.

**Ecology:** Regional records suggest that the primary mainland habitat comprises areas of cracking clay and adjacent habitats, although this species has also been recorded from hill tops (Dr Peter Kendrick, CALM Karratha, pers. comm. 2003) and sandy coastal areas near Onslow (Biota unpublished data). At Cape Preston, this species was recorded from *Acacia xiphophylla* open shrubland over a mosaic of *Triodia wiseana* and *Eragrostis xerophila* mixed hummock and tussock grassland (Halpern Glick Maunsell and Biota 2000). At the Southern Plains study site (near Tom Price), numerous individuals were recorded from *Acacia xiphophylla* shrubland over *Triodia longiceps* and annual grasses (Biota 2002b). Along the proposed Hope Downs rail alignment, it was recorded from *Astrebla pectinata* tussock grassland. During the Fortescue Metals Group Stage A survey (Biota 2004b), this species was recorded from *Astrebla pectinata*, *Aristida latifolia* tussock grassland on the self-mulching clays within the Chichester Range.

**Likelihood of occurrence:** This species was not recorded during the current survey and core habitat (cracking clay communities) is absent from the project areas. It is unlikely to occur at either Mesa A or Mesa G.

**Potential Impacts:** The proposed projects are not expected to affect the distribution or the conservation status of this species.

#### **Western Pebble-mound Mouse *Pseudomys chapmani* (Priority 4)**

**Distribution:** This species is common to very common in suitable habitat within the Hamersley and Chichester subregions of the Pilbara bioregion.

**Ecology:** Well known for its behaviour of constructing extensive mounds of small stones covering areas from 0.5 to 9.0 square metres (Strahan 1995). This mound formation is most common on spurs and gentle slopes with suitable size class stones.

**Likelihood of occurrence:** No active mounds were recorded during the current surveys.

**Potential Impacts:** The conservation status of this species would not be impacted by the proposed development either at the bioregion or subregion level.

#### **Star Finch *Neochmia ruficauda subclaescens* (Priority 4)**

**Distribution:** This species is endemic to Australia where it is found from the Pilbara to south-eastern Australia. It remains most common in the tropics. Its population has not been estimated but the species is typically patchy and highly variable in abundance.

**Ecology:** This species is typically confined to reedbeds and adjacent vegetation communities along permanent waterways in the Pilbara. It is considered to be resident in most of its range but, as with all finches, the species can wander widely. Its ecology in the Pilbara is not well known but it has been observed feeding on the seed of sedges (*Cyperus* spp.) and Buffel Grass (*Cenchrus ciliaris*) (Dr Mike Craig, Biota, pers. obs.). In other parts of its range it feeds mainly on seeds, but insects are a common part of the diet during the breeding season. It typically nests in March and April, as seeds are maturing after summer cyclones, and its domed nest is usually built in reeds up to several metres from the ground. The clutch is between three and six and the young usually fledge after about 16 days. In captivity, Star Finches may produce as many as three broods per year. The main threat to the species is considered to be overgrazing by stock along waterways, which destroys the riparian vegetation on which they depend (Garnett and Crowley 2000).

**Likelihood of occurrence:** Not recorded during the current assessment. The absence of permanent watercourses suggests that the species is unlikely to be a permanent resident in the area, due to a lack of large areas of suitable habitat. The species may pass through the area when moving from one watercourse to another and, when it does, it is likely to use reed patches along the Robe River and move primarily along watercourses and minor drainage lines.

**Potential Impacts:** Given that the species is unlikely to occur in the study areas permanently, and would probably only use the areas while moving between habitat patches, the proposed developments would be expected to have little impact on the species. Given that the species would utilise the watercourses and minor drainage lines while these hold water preferentially when moving through the areas, it is important to protect creekline vegetation from cattle grazing and too frequent burning, and to ensure that hydrological disruption to these areas is minimised.

#### **Fortescue Grunter *Leiopotherapon aheneus* (Priority 4)**

**Distribution:** Endemic to the Pilbara, and previously thought to be restricted to the Fortescue catchment until specimens were captured recently from the Ashburton and Robe Rivers (Allen et al. 2002; Morgan et al. 2003).

**Ecology:** This species is found in slow to fast flowing streams and pools over sand or rock substrates, sometimes congregating at the base of small waterfalls. The diet typically includes small crustaceans and juvenile fishes. Little else is known about the biology (Allen et al. 2002).

**Likelihood of occurrence:** It is highly unlikely that this species occurs in the project area outside of the Robe River.

**Potential Impacts:** The conservation status of this species would not be impacted by the proposed development at either the bioregion or subregion level.

## **6.5 Other Vertebrate Species of Interest**

Other species of interest recorded during the survey or that are likely to occur within the survey area include those species that have unresolved species complexes, as discussed in Sections 4.2, 4.3 and 4.4. Of particular interest is the undescribed species of *Eremiascincus* collected during the current survey, which is discussed in detail in Section 4.4.

## **6.6 Short-Range Endemics**

Many recent publications have highlighted taxonomic groups of invertebrates with naturally small distributions (less than 10,000 km<sup>2</sup>) (general reference, Harvey 2002; freshwater snails, Ponder and Colgan 2002; land snails, Clark and Richardson 2002; mygal spiders, York Main et al. 2000). These taxa are variously described as narrow range endemics or short-range endemics (see Harvey 2002) and are in part characterised by poor dispersal capabilities, confinement to disjunct habitats and low fecundity (Harvey 2002, Ponder and Colgan 2002).

Given the importance of short-range endemism to the conservation of biodiversity, the assessment of such invertebrate taxa is a potentially important component of impact assessment. Examples of taxonomic groups that show high levels of short-range endemism in this respect include millipedes, mygalomorph spiders, and freshwater and terrestrial molluscs (see Harvey 2002).

Three taxa belonging to groups known to support Short Range Endemics were recorded from the study area: the camaenid land snails *Rhagada convicta* and *R. radleyi*, and a species of Mygalomorph spider.

### **Camaenid Land Snails**

#### *Rhagada convicta*

This species has a broad distribution (see Section 5.2.2) and is not considered to be a short-range endemic species.

#### *Rhagada radleyi*

This species does not appear to be a short-range endemic based on its distribution (see Section 5.2.2).

### **Mygalomorph Spiders**

One individual was collected during the survey and is awaiting identification from the WA Museum.

## 7.0 Fauna Habitat Conservation Significance Assessment

### 7.1 Approach to the Assessment

Fauna habitats may be of conservation significance because they are uncommon, support unique assemblages, support fauna of special conservation significance (those listed in Sections 6.4 – 6.6), or any combination of these three factors. They may also be important because they maintain local ecosystem processes (nitrogen fixation, nutrient turnover etc) important to regional ecosystem function (transfer of energy and matter through the abiotic and biotic components of the ecosystem). Unfortunately, we are some way off being able to resolve the latter.

The following utilizes the vegetation types described for this study area (a classification system using reliable and robust presence / absence data to group sites; see Biota 2005a), the Land System framework (the only regional thematic mapping of suitable resolution; see Section 2.2.3), and knowledge of staff in Biota to extrapolate the distribution of the fauna habitats identified for the study area within the wider region.

In addition, comment is made as to whether the habitats linked with particular vegetation types are known to or are likely to be important to fauna of conservation significance.

### 7.2 Assessment Based on Land Systems

The main vegetation types (see Biota 2005a) identified in the project areas as occurring within each Land System are indicated in Table 7.1.

Biota (2005a) found that the vegetation types identified within the study areas are compatible with the broad descriptions of their associated Land System/s. This study found that the fauna habitats are likewise compatible with these descriptions. The exception, in both cases, is vegetation type S1 corresponding with the sand dune / sand sheet habitat, which does not appear to agree with the descriptions of either the Nanutarra or Stuart Land Systems (see Section 2.2.3). It is possible that this sandplain is an outlier of the Uaroo Land System (broad sandy plains supporting shrubby hard and soft spinifex grasslands), which is broadly distributed along the westernmost edge of the Pilbara bioregion, however without some comparable data it is difficult to be sure. In any case, it appears to be an unusual land unit (and habitat type) within the local area.

**Table 7.1: Association between vegetation types identified at Mesa A and Mesa G, the fauna sites and the Land Systems mapped within the study areas**

Land System	Mesa A Vegetation Types	Mesa G Vegetation Types	Fauna Sites
Capricorn	H8	-	-
Nanutarra	S1	-	-
Peedamulla	H1, H2, H4	-	MEA01, MEA11, MEA23, MEA21.
Robe	H1, H2, H3, H4, H5, H6, H7; C1, C2, C3	-	MEA06, MEA05.
Stuart	S1	-	MEA14.
Boolgeeda	-	H7, H9, H10, H11	MEG06, MEG14.
Newman	-	H10, H11, H12, H13, H14, H15, H16; C5, C6, C7	MEG06, MEG09.
River	-	C4	MEG21.
Sherlock	-	H8, H9	-
Urandy	-	H10	-

## 7.3 Assessment at the Level of the Vegetation Types/Habitat Types

The majority of the vegetation types did not appear to be restricted in distribution (see Biota 2005a), suggesting that the fauna habitats are likewise probably more broadly distributed. The notable exceptions are vegetation type S1 (as discussed above) and vegetation type H16 (which contains an undescribed *Triodia* species that is likely to have a restricted distribution in the region). As noted above, vegetation type S1 corresponds with the sand sheet / sand dune habitat (see Table 3.5). Although this habitat is locally uncommon, it was not found to support any rare or otherwise significant taxa (albeit based on a single sampling event). Vegetation type H16 is encompassed by the Stony Plains and Hills habitat of Mesa G (Table 3.5), and does not represent a distinct fauna habitat.

An additional fauna habitat of importance is the mesa edge and in particular the gorge in Mesa A (MEA06). The edges of the mesas are characterised by the presence of caves and overhangs. Similarly caves and rocky substrates in the gorge of Mesa A yielded the Ghost Bat (Priority 4) and the as yet undescribed and poorly collected skink *Eremiascincus* sp. nov.

The vegetation survey found one vegetation type to be of very high conservation significance, which corresponds with the Sand Dune/Sand Sheet habitat at MEA14. We also consider this habitat to be of high conservation significance to fauna:

- S1 (vegetation of the sand dune and sand sheet adjacent to Mesa A) is considered likely to be restricted in distribution in both the local area and region, and supports species restricted to the sands of this particular habitat (eg. *Pseudomys delicatulus*, *Notomys alexis*, and burrowing skinks such as *Lerista muelleri* (of the type that occurs on coastal sands)).

Also of high conservation significance are the mesa edges, and in particular the gorge at Mesa A:

- The gorge in Mesa A supports the Priority 4 listed Ghost Bat, which may also occur in other caves along the edges of the mesas. Incidentally, these caves are also important roosts for other cave dwelling bat species. In addition, the gorge supports the as yet undescribed *Eremiascincus* sp. nov., about which little is known (although as discussed in Section 4.4, it does appear to have a broad distribution in the Pilbara bioregion).

Of the two vegetation types considered to be of high conservation significance (H16 and C4) (Biota 2005a), the latter is considered to be of moderate conservation value in terms of fauna habitat:

- C4 (riverine vegetation of the Robe River) occurs in the major drainage feature in the local area and supports numerous species restricted to this habitat (eg. *Notoscincus butleri* (Priority 4 and locally restricted), Sacred Kingfishers, Blue-winged Kookaburras, White-plumed Honeyeaters etc). In addition, this habitat type is threatened by ongoing grazing (Kendrick 2001).

The remainder of the habitat types are not considered to be of particular conservation significance (Table 7.2).



**Table 7.2: Probable distribution and representation of vegetation types and encompassing fauna habitats of the Mesa A and Mesa G study areas in the local area and in the broader Pilbara region.**

Vegetation Type	Probable Distribution and Representation	Conservation Significance*
<b>Fauna Habitat: Mesas, Stony Hills and Plains</b>		
H1 – H4, and H8	Common in the Mesa A / Warramboos area	Low
H5 and H6	Likely to occur in suitable habitats (breakaways) in the area; supports species of moderate conservation significance ( <i>Macroderma gigas</i> ) and potentially high conservation significance ( <i>Eremiascincus</i> sp. nov.).	High
H7	Widespread in the Mesa A / Mesa G area	Low
H9 – H15	Common in the Mesa G area	Low
H16	Occurs over various mesas in the Mesa G area, typically restricted to rocky edges; likely to be uncommon in the region but unlikely to support fauna not found in adjacent vegetation types	Low
<b>Fauna Habitat: Sand Dunes and Sand Sheets</b>		
S1	Restricted in the local area; likely to be uncommon in the region	High
<b>Fauna Habitat: Creeklines</b>		
C1 and C2	Likely to be common in the area	Low
C3	Possibly not abundant in the area	Low
C4	Restricted to the Robe River in the local area; similar riverine vegetation occurs in major creeklines in the region; supports a discrete riverine faunal assemblage, taxa of moderate conservation significance (eg. <i>Notoscincus butleri</i> ) and potentially taxa of high conservation significance (eg. <i>Liasis olivaceus barroni</i> ).	Moderate
C5 – C7	Likely to be common in the area, but not abundant in terms of area due to restriction to gully habitats	Low

\* Low conservation significance does not imply that the corresponding habitats are of little or no value, rather that they do not have particular values elevating them above other widespread and common habitats of the Pilbara bioregion.

## 8.0 Recommendations for Management

As the mine planning process has not been finalised (details of pit and infrastructure locations are not yet known), the following recommendations are necessarily largely generic strategies that are typical for projects of similar scale in the Pilbara.

The following management measures are proposed to minimise or better understand potential impacts to the fauna and fauna habitats of the Mesa A and Mesa G study areas:

- Consideration should be given to commencing a genetic study to assist in defining the status of the *Eremiascincus* sp. nov. collected from the study area.
- Wherever possible, disturbance to surface drainage features should be avoided through sensitive mine planning. Where disturbance is unavoidable, sufficient culverting should be installed to maintain surface water flows.
- Vegetation clearing should be kept to the minimum necessary for safe construction and operation of the project, particularly in areas adjacent to vegetation of higher conservation significance.
- Weed control measures should be developed and implemented to prevent the introduction or spread of weeds in the study area. A Weed Hygiene and Management Plan should be prepared in consultation with CALM prior to construction commencing.
- A Fire Management Plan should be prepared and implemented to minimise the risk of unplanned fires in the study area.
- A Topsoil Management and Rehabilitation Plan should be prepared for all non-permanent cleared areas, in liaison with CALM, the Department of Environment and Department of Industry and Resources prior to the commencement of construction activities. This plan should include use of provenance collected native seed, characterisation and management of topsoil, and the respreading of cleared vegetative material. Recovery monitoring should also be carried out, with any rehabilitation failure subject to additional treatment to a suitable standard.
- Standard dust suppression measures should be implemented across the project area during construction and operation to minimise effects on surrounding vegetation.

## 9.0 Acknowledgements

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- Dr Mike Johnson (University of Western Australia) assisted with identification of the terrestrial land snails.
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## 10.0 References

- Allen G.R., S.H. Midgley and M. Allen (2002). Field guide to the freshwater fishes of Western Australia. *Records of the Western Australian Museum*. Supplement No. **63**: pp 51-74.
- Armstrong K.N. (2001). The distribution and roost habitat of the orange leaf-nosed bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. *Wildlife Research*. **28**: 95-104.
- Armstrong K.N. (2004). Landscape-scale influences on spatial and genetic population structure in Pliocene relicts, Pilbara region, Western Australia. Oral presentation at the 13<sup>th</sup> International Bat Research Conference, Mikolajki, Poland, 23-27 August 2004.
- Armstrong K.N. and W.J. Wilmer (2004). The importance of determining genetic population structure for the management of Ghost Bats, *Macroderma gigas*, in the Pilbara region of Western Australia. Oral presentation at the 11<sup>th</sup> Australasian Bat Society Conference, Toowoomba, Queensland, 12-14 April 2004.
- Armstrong K.N., S.D. Anstee, P.A. Landman and R.J. Teale (in prep.). Gilgai soils as core habitat for the mainland Pilbara population of the rodent *Leggadina lakedownensis* (Watts, 1976) (Muridae).
- Beard J.S. (1975). Vegetation Survey of Western Australia. 1:100,000 Vegetation Series Map sheet 5 - Pilbara.
- Biota Environmental Sciences (2002a). Proposed Hope Downs Rail Corridor from Weeli Wolli Siding to Port Hedland - Vertebrate Fauna survey. Unpublished report for Hope Downs Management Services Pty. Ltd.
- Biota Environmental Sciences (2002b). Southern Plains and Southern Detritals Fauna and Vegetation Monitoring 2001. Unpublished report prepared for Hamersley Iron.
- Biota Environmental Sciences (2004a). Genetic Structure of the Ghost Bat in the Pilbara: Alternative Approaches for Determining Roost Importance. Interim Report for Phases 1 and 2. Unpublished report prepared for Robe River Iron Associates and Hamersley Iron.
- Biota Environmental Sciences (2004b). Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage A Rail Corridor. Unpublished report prepared for Fortescue Metals Group Ltd.
- Biota Environmental Sciences (2005a). Vegetation and Flora Survey of Mesa A and G, near Pannawonica. Unpublished report prepared for Robe River Iron Associates.
- Biota Environmental Sciences (2005b). Fauna Habitats and Fauna Assemblage of the Brockman No. 4 Project Area. Unpublished report prepared for Hamersley Iron.
- Biota Environmental Sciences (2005c). Fauna Habitats and Fauna Assemblage of the Proposed FMG Stage B Rail Corridor and Mindy Mindy, Christmas Creek, Mt Lewin and Mt Nicholas Mine Areas. Unpublished report prepared for Fortescue Metals Group Ltd.
- Biota Environmental Sciences (in prep.). Fauna Survey of Bungaroo Creek, Warrambo and the Mesa J Extension, near Pannawonica. Unpublished report being prepared for Robe River Iron Associates.
- Braithwaite, R.W. & Griffiths, A. 1994. Demographic variation and range contraction in the Northern Quoll *Dasyurus hallucatus* (Marsupialia: Dasyuridae). *Wildlife Research* 21:203-17.
- Bullen B. (2003). Three probable range extensions from Western Australia. *Australasian Bat Society Newsletter* 20: 47-48.
- Bullen R.D. and N.L. McKenzie (2002). Differentiating Western Australian *Nyctophilus* (Chiroptera: Vespertilionidae) echolocation calls. *Australian Mammalogy* **23**: 89-93.
- Bush B. and B. Maryan (2004). *Snakes and Snake-like Reptiles of the WA Pilbara and Goldfields*. Snakes Harmful & Harmless, Stoneville, Perth, Western Australia.
- Cade T.J. (1982). *The Falcons of the World*. Collins, London

- Churchill S.K. (1998). *Australian bats*. Reed New Holland: Frenchs Forest, NSW
- Clark, S.A. and B.J. Richardson (2002). Spatial analysis of genetic variation as a rapid assessment tool in conservation management of narrow-range endemics. *Invertebrate Systematics* **16**: 583-587.
- Cooper N.K., K.P. Aplin and M. Adams (2000). A new species of false antechinus (Marsupialia: Dasyuromorphis: Dasyuridae) from the Pilbara region, Western Australia. *Records of the Western Australian Museum*. **20**:115-136.
- Cooper N.K, M. Adams, C. Anthony and L.H. Schmitt (2003). Morphological and genetic variation in *Leggadina* (Thomas, 1910) with special reference to western Australian populations. *Records of the Western Australian Museum* **21**: 333-351
- Department of Agriculture, Western Australia (authors unknown) (2002). Land Systems Mapping of the Pilbara region, WA. Draft mapping.
- Dickman CR & Braithwaite RW. 1992. Postmating mortality of males in the dasyurid marsupials, *Dasyurus* and *Parantechinus*. *Journal of Mammalogy* 73:143–147.
- Environment Australia (2000). Revision of the Interim Biogeographic Regionalisation for Australia (IBRA) and Development of Version 5.1, Summary Report. Environment Australia, November 2000.
- Ecologia Environmental Consultants (1991). Consultative Environmental Review: Fauna Assessment Survey. Mesa j Project.
- Fullard J.H., C. Koehler, A. Surlykke and N.L. McKenzie (1991). Echolocation ecology and flight morphology of insectivorous bats (Chiroptera) in south-western Australia. *Australian Journal of Zoology* **39**: 427-438.
- Garnett S.T. and G.M. Crowley (2000). The Action Plan for Australian Birds 2000. Environment Australia, Canberra.
- Halpern Glick Maunsell and Biota Environmental Sciences (2000). Austeel Biological Survey, Cape Preston. Unpublished report prepared for Austeel, Perth.
- Hamersley Iron Pty Ltd (1999). Nammuldi/Silvergrass Exploration Project. Biological Survey Report November 1998 – May 1999. An unpublished report by Hamersley Iron Pty. Ltd.
- Harvey M.S. (2002). Short-range endemism among Australian fauna: some examples from non-marine environments. *Invertebrate Systematics* **16**: 555-570.
- Higgins P. (ed.) (1999). *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird*. Oxford University Press, Melbourne, Australia.
- Hoffman R.L. (2003). A new genus and species of trigoniuline millipede from Western Australia (Spirobolida: Pachybolidae: Trigoniular). *Rec.. of the West. Aust. Mus.* **22**: 17-22.
- Johnson M.S., Z.R. Hamilton, C.E. Murphy, C.A. MacLeay, B. Roberts and P.G. Kendrick (2004). Evolutionary genetics of island and mainland species of *Rhagada* (Gastropoda: Pulmonata) in the Pilbara Region, Western Australia. *Aust. J. Zool.* **52**: 341-355.
- Johnstone R.E. and G.M. Storr (1998). *Handbook of Western Australian Birds. Volume 1 - Non-passerines (Emu to Dollarbird)*. Western Australian Museum, Perth WA.
- Johnstone R.E. and G.M. Storr (2004). *Handbook of Western Australian Birds. Volume II – Passerines (Blue-winged Pitta to Goldfinch)*. Western Australian Museum.
- Kendrick P. (2001). Pilbara 3 (PIL3 – Hamersley subregion). In May J.E. and N.L. McKenzie (2004). *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002*. Department of Conservation and Land Management, Perth, Western Australia.
- Marchant S. and P.J. Higgins (1993). *Handbook of Australian, New Zealand & Antarctic Birds Volume 2: Raptors to Lapwings*. Oxford University Press, South Melbourne.
- Morgan D., H. Gill, M. Allen and M. Maddern (2003). Distribution and biology of fish in inland waters of the Pilbara (Indian Ocean) drainage division. Centre for Fish and Fisheries Research, Murdoch University, Perth, Western Australia. Natural Heritage Trust Project No. 003026.

- Menkhorst 2001. A field guide to the Mammals of Australia, Oxford University Press, Melbourne, Australia.
- Oakwood, M. 1997. The ecology of the northern quoll, *Dasyurus hallucatus*. PhD thesis, Australian National
- Payne et al. (2002). Land Systems Mapping of the Ashburton region, WA. Mapping prepared by the Western Australian Department of Agriculture.
- Ponder W.F. (1997). Conservation status, threats and habitat requirements of Australian terrestrial and freshwater Mollusca. *Memoirs of the Museum of Victoria* **56**: 421-430.
- Ponder W.F. and D.J. Colgan (2002). What makes a narrow-range taxon? Insights from Australian fresh-water snails. *Invertebrate Systematics* **16**: 571-582.
- Solem A. (1997). Camaenid land snails from Western and Central Australia (Mollusca: Pulmonata: Camaenidae). VII. Taxa from Dampierland through the Nullarbor. *Records of the Western Australian Museum, Supplement* **50**, 1461-1906.
- Storr G.M., L.A. Smith and R.E. Johnstone (1999). *Lizards of Western Australia. I. Skinks*. Western Australian Museum.
- Storr G.M., L.A. Smith and R.E. Johnstone (2002). *Snakes of Western Australia*. Revised edition. Western Australian Museum.
- Strahan R. (1995). *The Mammals of Australia*. Reed Books, Chatswood
- Thorne A.M. and A.F. Trendall (2001). Geology of the Fortescue Group, Pilbara Craton, Western Australia. Geological Survey of Western Australia, Bulletin 144.
- Van Leeuwen S. and B. Bromilow (2002). Botanical Survey of Hamersley Range Uplands. National Reserve System Project N709 Final Report – May 2002. Unpublished report prepared by the Department of Conservation and Land Management, Science Division.
- Wilson S.K. and D.G. Knowles (1998). *Australia's Reptiles: A Photographic Reference to the Terrestrial Reptiles of Australia*. Cornstalk Publishing.
- Wilson S. and G. Swan (2003). *A Complete Guide to Reptiles of Australia*. New Holland Publishers (Australia) Pty Ltd.
- York Main B., A. Sampey and P.L.J. West (2000). Mygalomorph spiders of the southern Carnarvon Basin, Western Australia. *Records of the Western Australian Museum Supplement No.* **61**: 281-293.

**Appendix 1**

CALM Permit



DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

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Telephone: 08 9334 0333  
Facsimile: 08 9334 0242

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Bentley Delivery Centre WA 6983

PAGE 2  
NO. SF004492

**PURPOSE** FAUNA SURVEY OF THE BUNGAROO PROJECT AREA.

232

**DATE OF ISSUE** 10/03/2004  
**DATE OF EXPIRY** 09/03/2005  
**VALID FROM** 10/03/2004

*Opst...*  
LICENSING OFFICER

**LICENSEE:** MR RJ TEALE  
**ADDRESS:** BIOTA ENVIRONMENTAL SERVICES  
2/186 SCARBOROUGH BEACH RD.,  
MT. HAWTHORN  
WA 6016

(ROY JOHN)



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PAGE 1  
 NO. SF004492

RECEIPT NO.      AMOUNT  
    \$0.00

**WILDLIFE CONSERVATION ACT 1950  
 REGULATION 17  
 LICENCE TO TAKE FAUNA FOR SCIENTIFIC PURPOSES**

**THE UNDERMENTIONED PERSON MAY TAKE FAUNA FOR RESEARCH OR OTHER  
 SCIENTIFIC PURPOSES AND WHERE AUTHORISED, KEEP IT IN CAPTIVITY,  
 SUBJECT TO THE FOLLOWING AND ATTACHED CONDITIONS, WHICH MAY BE  
 ADDED TO, SUSPENDED OR OTHERWISE VARIED AS CONSIDERED FIT.**

**EXECUTIVE DIRECTOR**

**CONDITIONS**

- 1 THE LICENSEE SHALL COMPLY WITH THE PROVISIONS OF THE WILDLIFE CONSERVATION ACT AND REGULATIONS AND ANY NOTICES IN FORCE UNDER THIS ACT AND REGULATIONS.
- 2 UNLESS SPECIFICALLY AUTHORISED IN THE CONDITIONS OF THIS LICENCE OR OTHERWISE IN WRITING BY THE EXECUTIVE DIRECTOR, SPECIES OF FAUNA DECLARED AS LIKELY TO BECOME EXTINCT, RARE OR OTHERWISE IN NEED OF SPECIAL PROTECTION SHALL NOT BE CAPTURED OR OTHERWISE TAKEN.
- 3 NO FAUNA SHALL BE TAKEN FROM ANY NATURE RESERVE, WILDLIFE SANCTUARY, NATIONAL PARK, MARINE PARK, TIMBER RESERVE OR STATE FOREST WITHOUT PRIOR WRITTEN APPROVAL OF THE EXECUTIVE DIRECTOR. NO FAUNA SHALL BE TAKEN FROM ANY OTHER PUBLIC LAND WITHOUT THE WRITTEN APPROVAL OF THE GOVERNMENT AUTHORITY MANAGING THAT LAND.
- 4 NO ENTRY OR COLLECTION OF FAUNA TO BE UNDERTAKEN ON ANY PRIVATE PROPERTY OR PASTORAL LEASE WITHOUT THE CONSENT IN WRITING OF THE OWNER OR OCCUPIER, OR FROM ANY ABORIGINAL RESERVE WITHOUT THE WRITTEN APPROVAL OF THE DEPARTMENT OF INDIGENOUS AFFAIRS.
- 5 NO FAUNA OR THEIR PROGENY SHALL BE RELEASED IN ANY AREA WHERE IT DOES NOT NATURALLY OCCUR, NOR HANDED OVER TO ANY OTHER PERSON OR AUTHORITY UNLESS APPROVED BY THE EXECUTIVE DIRECTOR, NOR SHALL THE REMAINS OF SUCH FAUNA BE DISPOSED OF IN SUCH MANNER AS TO CONFUSE THE NATURAL OR PRESENT DAY DISTRIBUTION OF THE SPECIES.
- 6 THIS LICENCE AND THE WRITTEN PERMISSION REFERRED TO AT CONDITIONS 3 & 4 MUST BE CARRIED BY THE LICENSEE OR AUTHORISED AGENT AT ALL TIMES FOR THE PURPOSE OF PROVING THEIR AUTHORITY TO TAKE FAUNA WHEN QUESTIONED AS TO THEIR RIGHT TO DO SO BY A WILDLIFE OFFICER, ANY OTHER STATE OR LOCAL GOVERNMENT EMPLOYEE OR ANY MEMBER OF THE PUBLIC.
- 7 \*\*\*\*\*ANY INTERACTION INVOLVING GAZETTED THREATENED FAUNA THAT MAY BE HARMFUL AND/OR INVASIVE MAY REQUIRE APPROVAL FROM THE COMMONWEALTH GOVERNMENT DEPARTMENT , "ENVIRONMENT AUSTRALIA", PHONE 02 6274 1111. INTERACTION WITH SUCH SPECIES IS CONTROLLED BY THE COMMONWEALTH GOVERNMENT'S "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999" & "ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION REGULATIONS 2000" AS WELL AS CALM'S WILDLIFE CONSERVATION ACT & REGULATIONS.\*\*\*\*\*
- 8 NO BIOPROSPECTING INVOLVING THE REMOVAL OF SAMPLE AQUATIC AND TERRESTRIAL ORGANISMS (BOTH FLORA AND FAUNA) FOR CHEMICAL EXTRACTION AND BIOACTIVITY SCREENING IS PERMITTED TO BE CONDUCTED WITHOUT SPECIFIC WRITTEN APPROVAL BY THE EXECUTIVE DIRECTOR OF C.A.L.M.
- 9 \*\*\*\*\*LICENCE ALSO COVERS MIKE CRAIG, KYLE ARMSTRONG, ZOE HAMILTON, GREG HAROLD AND PHIL RUNHAM.\*\*\*\*\*
- 10 FURTHER CONDITIONS (NUMBERED 1 TO 10) ARE ATTACHED.

**WILDLIFE CONSERVATION ACT 1950**  
**WILDLIFE CONSERVATION REGULATIONS**

**Regulation 17:- Licence to Take Fauna for Scientific Purposes**

FURTHER CONDITIONS (OF LICENCE NUMBER SF 4492.)

1. The licensee shall ensure that all due care is taken in the capture and handling of fauna to prevent injury or mortality resulting from that capture or handling. Where traps or other mechanical means or devices are used to capture fauna these shall be inspected at regular intervals throughout each day of their use. At the conclusion of research all markers etc and signs erected by the licensee and all traps shall be removed, all pitfalls shall be refilled or capped and the study area returned to the condition it was in prior to the research/capture program. During any break in research, cage traps should be removed and pitfalls either removed, capped or filled with sand.
2. No collecting is to be undertaken in areas where it would impinge on pre-existing scientific research programs.
3. Any form of colour marking of birds or bats to be coordinated by the Australian Bird and Bat Banding Schemes.
4. Any inadvertently captured specimens of fauna which is declared as likely to become extinct, rare or otherwise in need of special protection is to be released immediately at the point of capture. Where such a specimen is injured or deceased, the licensee shall contact CALM licensing staff at Kensington (08 9334 0434) for advice on disposal. Records are to be kept of any fauna so captured and details included in the report required under further condition 6 below.
5. Prior to any renewal of this research licence the licensee shall submit a summary report outlining work conducted under this licence and work proposed for the next research period.
6. Within one month of the expiration of this licence (or at such other time or times as the Executive Director may determine) the holder shall furnish to the Executive Director [ATTENTION: WILDLIFE CLERK] a return setting out in full detail the number of each species of fauna taken during the currency of the licence, the localities where the species was/were taken and the method of handling of such fauna and disposal of specimens. A copy of any paper or report resulting from this research should be lodged in due course with the Executive Director. In the case of consultants, a list of the fauna handled, the localities involved and a copy of the interpretive data prepared should be lodged.
7. As a general rule not more than ten specimens of any one protected species shall be permanently taken from any location less than 20km apart. Where exceptional circumstances make it necessary to take large series in order to obtain adequate statistical data the collector will proceed with circumspection and justify their actions to the Executive Director in advance.
8. No fauna, whether dead or alive, may be taken out of Western Australia without the necessary export permit issued under the *Wildlife Conservation Act 1950*. It should be noted that the permit will not be issued unless the State to which the fauna is going has approved that fauna entering that State. In addition to the requirements of the Australian States, the Commonwealth controls exports overseas through Commonwealth legislation administered by the Australian Nature Conservation Agency.
9. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence shall be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected which represents a significant extension of geographic range shall be donated on request to the Western Australian Museum.
10. To prevent any unnecessary collecting in this state, all specimens and material collected under the authority of this license shall, on request, be loaned to the Western Australian Museum. Also, the unused portion or portions of any specimen collected under the authority of this license shall be offered for donation to the Western Australian Museum or made available to other scientific workers if so required.

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## Appendix 2

### Records from WA Museum Database Search

**Reptiles collected between****-21.34, 115.51 and -22.57, 117.26**

## Agamidae

*Ctenophorus caudicinctus*  
*Ctenophorus caudicinctus caudicinctus*  
*Ctenophorus femoralis*  
*Ctenophorus isolepis*  
*Ctenophorus isolepis isolepis*  
*Ctenophorus nuchalis*  
*Ctenophorus reticulatus*  
*Ctenophorus scutulatus*  
*Lophognathus longirostris*  
*Pogona minor minor*  
*Pogona minor mitchelli*  
*Tympanocryptis cephal*

## Boidae

*Antaresia perthensis*  
*Antaresia stimsoni stimsoni*  
*Aspidites melanocephalus*  
*Liasis olivaceus barroni*

## Cheluidae

*Chelodina steindachneri*

## Elapidae

*Acanthophis sp*  
*Acanthophis wellsi*  
*Acanthophis wellsi/pyrrhus*  
*Demansia psammophis cupreiceps*  
*Demansia rufescens*  
*Furina ornata*  
*Parasuta monachus*  
*Pseudechis australis*  
*Pseudonaja modesta*  
*Pseudonaja nuchalis*  
*Suta fasciata*  
*Suta punctata*  
*Vermicella snelli*

## Gekkonidae

*Crenadactylus ocellatus horni*  
*Diplodactylus conspicillatus*  
*Diplodactylus savagei*  
*Diplodactylus stenodactylus*  
*Diplodactylus wombeyi*  
*Gehyra pilbara*  
*Gehyra punctata*  
*Gehyra sp*  
*Gehyra variegata*  
*Heteronotia binoei*  
*Heteronotia spelea*  
*Nephrurus levis occidentalis*  
*Nephrurus levis pilbarensis*  
*Nephrurus wheeleri cinctus*  
*Oedura marmorata*  
*Rhynchoedura ornata*  
*Strophurus elderi*

## Pygopodidae

*Delma elegans*  
*Delma nasuta*  
*Delma pax*  
*Delma tincta*  
*Lialis burtonis*

## Scincidae

*Carlia munda*  
*Cryptoblepharus plagiocephalus*  
*Ctenotus duricola*  
*Ctenotus grandis titan*  
*Ctenotus hanloni*  
*Ctenotus helenae*  
*Ctenotus iapetus*  
*Ctenotus maryani*  
*Ctenotus mimetes*  
*Ctenotus pantherinus ocellifer*  
*Ctenotus robustus*  
*Ctenotus rubicundus*  
*Ctenotus rufescens*  
*Ctenotus rutilans*  
*Ctenotus saxatilis*  
*Ctenotus serventyi*  
*Ctenotus severus*  
*Cyclodomorphus melanops melanops*  
*Egernia depressa*  
*Egernia formosa*  
*Eremiascincus fasciolatus*  
*Eremiascincus richardsonii*  
*Glaphyromorphus isolepis*  
*Lerista bipes*  
*Lerista flammicauda*  
*Lerista muelleri*  
*Menetia greyii*  
*Menetia surda surda*  
*Morethia ruficauda exquisita*  
*Notoscincus butleri*  
*Proablepharus reginae*  
*Tiliqua multifasciata*

## Typhlopidae

*Ramphotyphlops ganei*  
*Ramphotyphlops grypus*  
*Ramphotyphlops pilbarensis*

## Varanidae

*Varanus acanthurus*  
*Varanus brevicauda*  
*Varanus caudolineatus*  
*Varanus giganteus*  
*Varanus gouldii*  
*Varanus panoptes rubidus*  
*Varanus tristis tristis*

**Amphibians collected between  
-21.34, 115.51 and -22.57, 117.26**

## Hylidae

*Cyclorana australis**Cyclorana maini**Litoria rubella*

## Myobatrachidae

*Limnodynastes ornatus**Limnodynastes spenceri**Notaden nichollsi**Uperoleia russelli***Birds collected between  
-21.34, 115.51 and -22.57, 117.26**

## Acanthizidae

*Gerygone fusca fusca**Gerygone fusca mungi**Smicronis brevirostris*

## Accipitridae

*Aquila audax**Haliastur sphenurus*

## Alaudidae

*Mirafrja javanica horsfieldii*

## Anatidae

*Anas superciliosa*

## Anhingidae

*Anhinga melanogaster novaehollandiae*

## Ardeidae

*Ardea pacifica**Ixobrychus flavicollis australis**Nycticorax caledonicus hill*

## Artamidae

*Artamus cinereus melanops**Artamus leucorynchus leucopygialis**Artamus minor*

## Campephagidae

*Coracina novaehollandiae subpallida**Lalage tricolor*

## Caprimulgidae

*Eurostopodus argus*

## Casuariidae

*Dromaius novaehollandiae*

## Centropodidae

*Centropus phasianinus highami*

## Charadriidae

*Charadrius melanops*

## Climacteridae

*Climacteris melanura wellsi*

## Columbidae

*Geopelia cuneata**Geopelia striata placida**Geophaps plumifera**Phaps chalcoptera**Phaps histrionica*

## Corvidae

*Corvus bennetti**Corvus orru**Corvus orru ceciliae*

## Cracticidae

*Cracticus tibicen*

## Cuculidae

*Chrysococcyx basalis**Cuculus pallidus*

## Dicruridae

*Grallina cyanoleuca**Rhipidura fuliginosa preissi**Rhipidura leucophrys leucophrys*

## Falconidae

*Falco berigora berigora**Falco longipennis longipennis*

## Halcyonidae

*Dacelo leachii leachii**Todiramphus pyrrhopygia*

## Hirundinidae

*Hirundo nigricans nigricans*

## Maluridae

*Amytornis striatus whitei**Malurus lamberti assimilis**Malurus leucopterus leuconotus**Stipiturus ruficeps ruficeps*

## Meliphagidae

*Epthianura tricolor**Lichenostomus keartlandi**Lichenostomus penicillatus**Lichenostomus virescens**Lichmera indistincta indistincta**Melithreptus gularis laetior*

## Meropidae

*Merops ornatus*

## Motacillidae

*Anthus australis australis*

Otididae <i>Ardeotis australis</i>	Dasyuridae <i>Dasykaluta rosamondae</i> <i>Dasyurus hallucatus</i> <i>Ningauai</i> sp <i>Ningauai timealeyi</i> <i>Planigale</i> sp <i>Pseudantechinus woolleyae</i> <i>Sminthopsis longicaudata</i> <i>Sminthopsis macroura</i> <i>Sminthopsis youngsoni</i>
Pachycephalidae <i>Colluricincla harmonica rufiventris</i> <i>Pachycephala rufiventris rufiventris</i>	
Pardalotidae <i>Pardalotus rubricatus</i> <i>Pardalotus striatus murchisoni</i>	
Passeridae <i>Emblema pictum</i> <i>Neochmia ruficauda clarescens</i> <i>Taeniopygia guttata castanotis</i>	Emballonuridae <i>Taphozous georgianus</i>
Petroicidae <i>Petroica cucullate</i>	Hipposideridae <i>Rhinonictes aurantius</i>
Phalacrocoracidae <i>Phalacrocorax sulcirostris</i>	Macropodidae <i>Macropus robustus erubescens</i> <i>Macropus rufus</i> <i>Petrogale rothschildi</i>
Pomatostomidae <i>Pomatostomus temporalis rubeculus</i>	Megadermatidae <i>Macroderma gigas</i>
Psittacidae <i>Cacatua roseicapilla assimilis</i> <i>Cacatua sanguinea westralensis</i> <i>Pezoporus occidentalis</i> <i>Platycercus zonarius</i> <i>Platycercus zonarius zonarius</i>	Molossidae <i>Chaerephon jobensis</i> <i>Mormopterus beccarii</i>
Ptilonorhynchidae <i>Ptilonorhynchus maculatus guttatus</i>	Muridae <i>Leggadina lakedownensis</i> <i>Mus musculus</i> <i>Notomys alexis</i> <i>Pseudomys chapmani</i> <i>Pseudomys delicatulus</i> <i>Pseudomys hermannsburgensis</i> <i>Rattus rattus</i> <i>Rattus tunneyi</i> <i>Zyomys argurus</i>
Rallidae <i>Porphyrio porphyrio melanotus</i> <i>Porzana tabuensis</i>	Phalangeridae <i>Trichosurus vulpecula arnhemensis</i>
Strigidae <i>Ninox connivens connivens</i>	Pteropodidae <i>Pteropus alecto</i>
Sylviidae <i>Acrocephalus australis gouldi</i> <i>Cincloramphus mathewsi</i> <i>Cisticola exilis exilis</i> <i>Eremiornis carteri</i>	Vespertilionidae <i>Chalinolobus gouldii</i> <i>Nyctophilus bifax daedalus</i> <i>Scotorepens greyii</i> <i>Vespadelus finlaysoni</i>
Threskiornithidae <i>Threskiornis spinicollis</i>	

**Mammals collected between  
-21.34, 115.51 and -22.57, 117.26**

Canidae  
*Canis lupus dingo*  
*Canis lupus familiaris*  
*Vulpes vulpes*

**Fishes collected between  
-21.34, 115.51 and -22.57, 117.26**

Anguillidae

*Anguilla bicolor*

Ariidae

*Arius bilineatus*

*Arius graeffei*

Clupeidae

*Nematalosa erebi*

*Nematalosa* sp

Eleotrididae

*Hypseleotris compressa*

Elopidae

*Elops hawaiiensis*

Gobiidae

*Glossogobius giuris*

Lethrinidae

*Gymnocranius grandoculis*

Lutjanidae

*Lutjanus carponotatus*

Monacanthidae

*Anacanthus barbatus*

Plotosidae

*Neosilurus hyrtlii*

Pseudomugilidae

*Melanotaenia australis*

Scorpaenidae

*Scorpaena sumptuosa*

Terapontidae

*Amniataba percoids*

*Leiopotherapon aheneus*

*Leiopotherapon unicolour*

*Terapon jarbua*

## Appendix 3

### Records from CALM Rare Fauna Database Search



2001F001096V10  
Christine Freegard

9334 0579  
9334 0278  
christinef@calm.wa.gov.au

Ms Zoe Hamilton  
Biota Environmental Sciences Pty Ltd  
PO Box 176  
NORTH PERTH WA 6906

Dear Ms Hamilton

**REQUEST FOR THREATENED FAUNA INFORMATION**

I refer to your request of 13 December for information on threatened fauna in the vicinity of Mesas A and G.

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as '*Rare or likely to become extinct* (Schedule 1)', '*Birds protected under an international agreement* (Schedule 3)', and '*Other specially protected fauna* (Schedule 4)'. Attached are print outs from these databases where records were found.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for \$150.00 (plus GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact my Senior Zoologist, Dr Peter Mawson on 08 93340421.

Yours sincerely

.....  
for Keiran McNamara  
EXECUTIVE DIRECTOR

12 January, 2005

## Attachment

## DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

THREATENED FAUNA INFORMATION

## Conditions In Respect Of Supply Of Information

- \* All requests for data to be made in writing to the Executive Director, Department of Conservation and Land Management, Attention: Senior Zoologist, Wildlife Branch.
- \* The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided without the prior consent of the Executive Director, Department of Conservation and Land Management.
- \* Specific locality information for Threatened Fauna is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for Threatened Fauna may not be used in reports without the written permission of the Executive Director, Department of Conservation and Land Management. Reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Senior Zoologist is to be contacted for guidance on the presentation of Threatened Fauna information.
- \* Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Conservation and Land Management accepts no responsibility for this.
- \* Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- \* It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened Fauna of the area in question. Its comprehensiveness is dependent of the amount of survey carried out within a specified area. The receiving organisation should employ a biologist/zoologist, if required, to undertake a survey of the area under consideration.
- \* Acknowledgment of the Department of Conservation and Land Management as the source of data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Conservation and Land Management, Attention; Senior Zoologist, Wildlife Branch.

**Threatened and Priority Fauna Database**

Page 1 of 3

21.3347 °S 115.504 °E / 22.5756 °S 117.266 °E

Mesas A and G

*Date	Certainty	Seen	Location Name	Method
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**Schedule 1 - Fauna that is rare or is likely to become extinct**

<b><i>Rhinonicteris aurantius</i></b>			<b>Orange Leaf-nosed Bat</b>		2 records
This species of bat occurs in a few scattered locations in the Pilbara, as well as the Kimberley. It roosts in caves and is sensitive to human disturbance.					
	1	1	Millstream-Chichester NP		
1925	1		Red Hill		
<b><i>Pezoporus occidentalis</i></b>			<b>Night Parrot</b>		1 records
This nocturnal species is known to inhabit treeless or sparsely wooded spinifex ( <i>Triodia</i> spp) near water.					
1967	2		Yarraloola		
<b><i>Liasis olivacea barroni</i></b>			<b>Pilbara Olive Python</b>		1 records
This python occurs in a wide range of habitats but especially in rocky hills and ranges and near water.					
1923	1	1	Millstream Stn	Caught or trapped	

**Schedule 4 - Other specially protected fauna**

<b><i>Falco peregrinus</i></b>			<b>Peregrine Falcon</b>		0 records
This species is uncommon and prefers areas with rocky ledges, cliffs, watercourses, open woodland or margins with cleared land. It may occur in the area in question.					

**Priority One**

<b><i>Ramphotyphlops ganei</i></b>			<b>Ramphotyphlops ganei</b>		1 records
Very little is known about this species of blind snake. It grows to about 30 cm in length and has been recorded from four localities in the Pilbara including Pannawonica and Newman.					
1991	1	1	Pannawonica	Dead	

**Priority Two**

<b><i>Antipodogomphus hodgkini</i></b>			<b>Antipodogomphus hodgkini</b>		1 records
A species of dragonfly known from Millstream Spring and permanent pools of the Fortescue River and Tanberry Creek.					
1958	1	2	Millstream-Chichester NP		
<b><i>Nososticta pilbara</i></b>			<b>Nososticta pilbara</b>		2 records
A species of dragonfly known from Millstream Spring.					
1969	1		Millstream-Chichester NP		
2002	1	4	Millstream-Chichester NP		

**Priority Three**

0 records

Wednesday, 12 January 2005

Department of Conservation and Land Management

**Threatened and Priority Fauna Database**

Page 2 of 3

21.3347 °S 115.504 °E / 22.5756 °S 117.266 °E

Mesas A and G

**\*Date Certainty Seen Location Name****Method****Priority Four*****Sminthopsis longicaudatus*****Long-tailed Dunnart**

0 records

This small marsupial feeds mainly on arthropods and lives in rugged rocky areas. Records in surrounding areas suggest that this species may occur in the area in question.

***Macroderma gigas*****Ghost Bat**

1 records

This species is Australia's only carnivorous bat and has a patchy distribution across northern Australia. It shelters in caves, mine shafts and deep rock fissures and is sensitive to disturbance.

1958	1		Millstream-Chichester NP	Day sighting
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***Leggadina lakedownensis*****Lakeland Downs Mouse (Kerakenga)**

10 records

This secretive species is known to occur in the Pilbara and the Kimberley. Its populations rise and fall dramatically, probably in response to climatic fluctuations and availability of seeds.

1998	1	1		Caught or trapped
1998	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	2		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped
1999	1	1		Caught or trapped

***Pseudomys chapmani*****Western Pebble-mound Mouse (Ngadji)**

6 records

This species is well-known for the characteristic pebble-mounds which it constructs over underground burrow systems. These mounds are most common on spurs and lower slopes of rocky hills.

1992	1	1	Millstream-Chichester NP	Caught or trapped
1994	2	0	Deepdale	
1994	1		Mardie Stn	
1994	1		Parry Range	
1996	2	0	Pannawonica	
1996	2	0	Cane River	

***Neochima ruficauda subclarescens*****Star Finch (western)**

1 records

A nomadic species inhabiting grasslands and eucalypt woodlands near water.

2002	1	5	Yarraloola	Caught or trapped
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***Leiopotherapon aheneus*****Fortescue Grunter**

1 records

A species of freshwater fish restricted to the Prince Regent and Roe River systems of the Kimberley region of Western Australia. Inhabits open rocky pools with minimal aquatic vegetation.

1958	1	12	Millstream-Chichester NP	
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**Priority Five**

0 records

Wednesday, 12 January 2005

Department of Conservation and Land Management

**Threatened and Priority Fauna Database**

Page 3 of 3

21.3347 °S 115.504 °E / 22.5756 °S 117.266 °E

Mesas A and G

<b>*Date</b>	<b>Certainty</b>	<b>Seen</b>	<b>Location Name</b>	<b>Method</b>
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\*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 4

### Specimens Lodged with the WA Museum from the Current Study

## Vouchered Specimens from the Mesa A and G project areas

Site Code	Species	Museum Number
MEA23	<i>Acanthophis wellsi</i>	R157563
MEA01	<i>Carlia munda</i>	R157592
MEA14	<i>Carlia munda</i>	R157565
MEA11	<i>Ctenophorus caudicinctus caudicinctus</i>	R157542
MEA14	<i>Ctenophorus isolepis isolepis</i>	R157556
MEG06	<i>Ctenophorus isolepis isolepis</i>	R157571
MEG14	<i>Ctenophorus isolepis isolepis</i>	R157526
MEA14	<i>Ctenophorus nuchalis</i>	R157555
MEA14	<i>Ctenotus duricola</i>	R157566
MEA06	<i>Ctenotus grandis titan</i>	R157574
MEA06	<i>Ctenotus grandis titan</i>	R157594
MEA14	<i>Ctenotus hanloni</i>	R157531
MEA14	<i>Ctenotus hanloni</i>	R157543
MEA14	<i>Ctenotus hanloni</i>	R157557
MEG06	<i>Ctenotus hanloni</i>	R157576
MEG14	<i>Ctenotus hanloni</i>	R157583
MEG21	<i>Ctenotus hanloni</i>	R157540
MEG14	<i>Ctenotus pantherinus ocellifer</i>	R157582
MEA01	<i>Ctenotus saxatilis</i>	R157580
MEA11	<i>Ctenotus saxatilis</i>	R157567
MEA14	<i>Ctenotus saxatilis</i>	R157532
MEG06	<i>Ctenotus saxatilis</i>	R157591
MEG21	<i>Ctenotus saxatilis</i>	R157529
MEA06	<i>Delma nasuta</i>	R157587
MEA14	<i>Delma nasuta</i>	R157568
MEG14	<i>Demansia psammophis cupreiceps</i>	R157564
MEG14	<i>Diplodactylus conspicillatus</i>	R157533
MEA14	<i>Diplodactylus stenodactylus</i>	R157553
MEA14	<i>Diplodactylus stenodactylus</i>	R157579
MEG14	<i>Diplodactylus stenodactylus</i>	R157539
MEG14	<i>Diplodactylus stenodactylus</i>	R157573
MEA06	<i>Eremiascincus richardsonii</i>	R157584
MEA14	<i>Furina ornata</i>	R157585
MEA11	<i>Heteronotia binoei</i>	R157581
MEG14	<i>Heteronotia binoei</i>	R157530
MEG14	<i>Heteronotia binoei</i>	R157586
MEA14	<i>Lerista bipes</i>	R157527
MEA14	<i>Lerista bipes</i>	R157535
MEA14	<i>Lerista bipes</i>	R157536
MEA14	<i>Lerista bipes</i>	R157537
MEA14	<i>Lerista bipes</i>	R157538
MEA14	<i>Lerista clarus</i>	R157552
MEA14	<i>Lerista clarus</i>	R157558
MEA14	<i>Lerista clarus</i>	R157593
MEG14	<i>Morethia ruficauda exquisita</i>	R157577
MEA14	<i>Nephrurus levis pilbarensis</i>	R157528
MEG14	<i>Nephrurus levis pilbarensis</i>	R157588
MEA06	<i>Pygopus nigriceps nigriceps</i>	R157575
MEA14	<i>Rhynchoedura ornata</i>	R157554
MEG21	<i>Rhynchoedura ornata</i>	R157541
MEG06	<i>Suta punctata</i>	R157534
MEA06	<i>Varanus eremius</i>	R157569
MEG14	<i>Varanus eremius</i>	R157578
MEA14	<i>Pseudomys delicatulus</i>	M55109
MEG21	<i>Pseudomys delicatulus</i>	M55110
MEG27	<i>Zyzomys argurus</i>	M55278