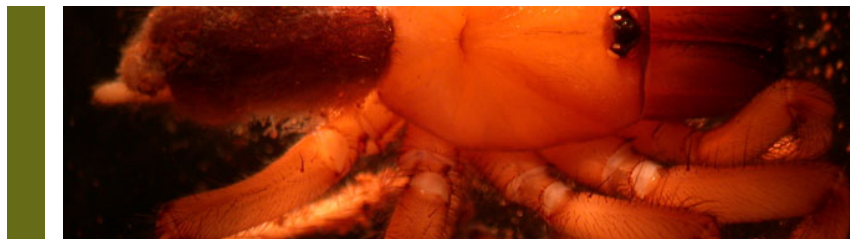
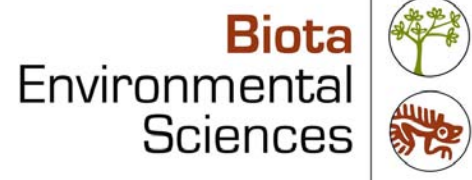




Western Range Two-Phase Fauna Survey





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Western Range Two-Phase Fauna Survey

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1.0 Executive Summary

1.1 Background

Rio Tinto Iron Ore (RTIO) has identified Western Range, located 20 km west of Paraburdoo, as a potential new iron ore mine development.

Biota Environmental Sciences (Biota) was commissioned to complete a Level 2 fauna survey of the area encompassing Western Range (Figure 2.1) during 2009 and 2010.

The scope of the study was to:

- undertake a Level 2 fauna survey of the Western Range study area consistent with relevant Environmental Protection Authority (EPA) Guidance Statements;
- identify and assess the local and regional conservation significance of the fauna assemblage and habitats present in the study area;
- document the vertebrate and potential Short Range Endemic (SRE) terrestrial invertebrate fauna assemblage within the study area using established sampling techniques; and
- identify fauna of particular conservation significance (particularly Schedule and Priority listed species, as well as potential SRE taxa).

1.2 Methodology

The survey was conducted in two main phases: Phase I was conducted from October 20 to 29, 2009 (10 days), and Phase II was conducted from 3rd to 10th May 2010 (8 days). An additional dedicated SRE survey was conducted from June 22 to 25, 2009.

The survey included:

- trapping at 17 locations within defined habitats, comprising 12 pit trapping transects, four Elliott trapping transects and one funnel trapping transect for a total of 2,441 trap nights;
- avifauna censuses at the systematic trapping sites;
- bat sampling using Anabat echolocation call recorders;
- non-systematic survey activities targeting vertebrate fauna such as night spotting, ground foraging and identification of secondary sign; and
- targeted searches for potential SRE invertebrate species.

1.3 Results

1.3.1 Overview

A total of 111 vertebrate species, comprising 40 herpetofauna species, 51 bird species and 20 mammal species (including one introduced species) were recorded.

The recorded herpetofauna comprised one frog (Hylidae), five dragon species (Agamidae), seven gecko species (Diplodactylidae and Gekkonidae), three legless lizard species (Pygopodidae), 11 skink species (Scincidae), four monitor species (Varanidae), two blind snake species (Typhlopidae), two python species (Boidae) and five front-fanged snake species (Elapidae).

The 51 recorded bird species comprised 21 non-passerine species and 30 passerine species from 24 families.

Ten non-volant mammal species (nine native and one introduced) were recorded, comprising three carnivorous marsupial species (Dasyuridae), two kangaroo species (Macropodidae), three rodent species (Muridae), feral cats (Felidae) and dingos (Canidae).

Ten volant mammal species (bats) were present in the study area based on recorded echolocation calls and direct capture records. These comprised the Ghost Bat (Megadermatidae), three species of sheath-tail bat (Emballonuridae), one species of freetail bat (Molossidae), four species of evening bat (Vespertilionidae) and the Pilbara Leaf-nosed Bat (Hipposideridae).

1.3.2 Fauna of Conservation Significance

The Pilbara Olive Python (*Liasis olivaceus barroni*) was the only species of herpetofauna of conservation significance recorded in the study area. It was recorded on one occasion during night spotting in gorge habitat. It is listed as Schedule 1 on the DEC *Wildlife Conservation (Specially Protected Fauna) Notice 2010* under the *Western Australian Wildlife Conservation Act 1950-1979*; and listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*

Avifauna of conservation significance recorded during the survey included the:

- Priority 4 Australian Bustard (*Ardeotis australis*)- two individuals recorded opportunistically within the study area;
- Priority 4 Grey Falcon (*Falco hypoleucos*)- two individuals recorded at one location within the study area; and
- Migratory Rainbow Bee-eater (*Merops ornatus*)- recorded on 10 occasions at four sites within the study area.

Mammals of conservation significance recorded during the survey included the:

- Schedule 1 (Vulnerable under the EPBC Act 1999) Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*)- echolocation calls were recorded at three locations in the study area. Based on call activity it can be inferred that a colony exists in the vicinity of one of the bat monitoring sites (Site WSRbat3).
- Priority 4 Ghost Bat (*Macroderma gigas*)- echolocation calls were recorded at two locations in the study area.
- Priority 4 Western Pebble-Mound Mouse (*Pseudomys chapmani*)- represented by two inactive mounds recorded opportunistically in the study area.

Based on database searches and species distributions, 20 vertebrate species of conservation significance may potentially occur within the study area. However, when habitat requirements and preferences are considered, the number of conservation significant species likely to occur is reduced.

Six potential invertebrate SRE species were recorded (one mygalomorph spider, one araneomorph spider, two pseudoscorpions, one millipede and one pulmonate snail). Of these species, none were recorded outside of the project area during the recent survey. Although, the conservation significance of these species has not been fully established, based on nominal morphospecies recorded during previous studies and in conjunction with known life histories, it appears unlikely that potential SRE taxa are restricted solely to the project area.

1.4 Recommendations

Based on our current appreciation of the likely footprint of the Western Range iron ore mine and associated infrastructure, the following management recommendations apply:

1. Impact to scree slopes, breakaways, escarpments, gorges and caves should be avoided where possible. These landforms offer potential habitat for the Schedule 1 listed Northern Quoll (*Dasyurus hallucatus*), Pilbara Olive Python (*Liasis olivaceus barroni*) and Pilbara Leaf-nosed Bat (*Rhinonictoris aurantius*).
2. In addition, the ephemeral river and spring at the eastern side of the study area (555014 mE, 7433480 mN) should not be disturbed or impacted. Riverine habitat such as this, particularly with the presence of a permanent spring, is utilised by a number of species including the Schedule 1 species listed above.
3. Given the records of species listed as Threatened fauna under EPBC Act 1999, RTIO should consider its obligations to refer the proposed action of mine construction to the Federal Minister for Environment to determine if this represents a Controlled Action under that act. This particularly applies to the Pilbara Leaf-nosed Bat (*Rhinonictoris aurantius*), Pilbara Olive Python (*Liasis olivaceus barroni*), and the Northern Quoll (*Dasyurus hallucatus*).
4. A fire management and response plan should be developed and implemented to prevent unplanned alterations to natural fire regimes.
5. All members of the work force on site should be provided with an environmental induction to ensure they are familiarised with the potential presence of Schedule and Priority fauna. This induction should include driving speed restrictions and ensuring that off-road driving and risk of fire are minimised.

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2.0 Introduction

2.1 Project Background

RTIO has identified Western Range for a potential new iron ore mine development approximately 20 km west of Paraburdoo (Figure 2.1).

The proposed mine is at an early planning stage. However, the nominal infrastructure comprises:

- a series of open-cut pits running approximately 10 km along the length of Western Range;
- an associated haul road to transport the ore to the nearby Paraburdoo mine processing plant, approximately 12 km east of the closest pit; and other associated infrastructure including a waste dump (Figure 2.2)

To assist with the Environmental Impact Assessment (EIA) of the potential mine, Biota was commissioned to undertake a Level 2 fauna survey of an area of 4,831 ha within the Western Range.

2.2 Study Objectives and Scope

2.2.1 Scope

This report documents the methods, results and key findings of the two-phase terrestrial fauna survey within the defined project area and adjacent areas outside the project boundary collectively referred to in this report as the 'study area'.

The scope of this study was to:

- undertake a Level 2 fauna survey of the Western Range study area consistent with relevant EPA Guidance Statements;
- identify and assess the local and regional conservation significance of the fauna assemblage and habitats present in the study area;
- document the vertebrate and potential SRE terrestrial invertebrate fauna assemblage within the study area using established sampling techniques; and
- identify fauna of particular conservation significance (particularly Schedule and Priority listed species, as well as potential SRE taxa).

The survey was planned and implemented in accordance with:

- EPA Position Statement No. 3 "Terrestrial Biological Surveys as an Element of Biodiversity Protection" (EPA 2002);
- EPA Guidance Statement No. 56 "Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia" (EPA 2004);
- EPA Guidance Statement No. 20 "Sampling of Short Range Endemic Invertebrates Fauna for Environmental Impact Assessment in Western Australia" (EPA 2009); and
- EPA/DEC Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA and DEC 2010).

2.2.2 Purpose of this Report

This report documents the methods, results and key findings of a Level 2 terrestrial vertebrate fauna survey and survey of potential SRE invertebrate fauna within the currently identified Western Range study area.

This document reports on the fauna assemblage and species recorded, examines potential conservation issues and presents management recommendations. It is intended for use as a supporting document for the EIA of the project. Both the survey and report are subject to specific limitations that are discussed in more detail in Section 3.3.

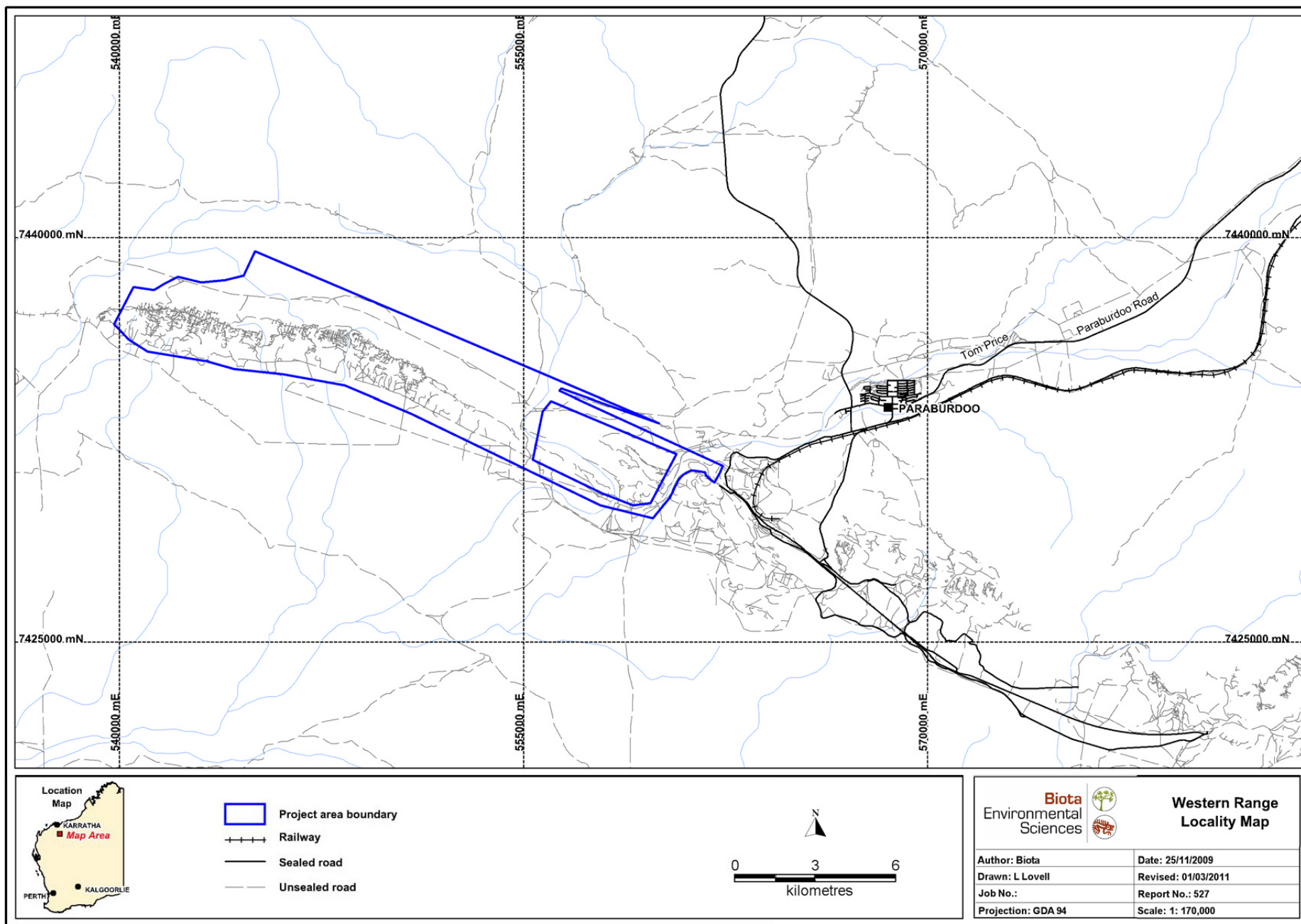


Figure 2.1: Western Range study area location.

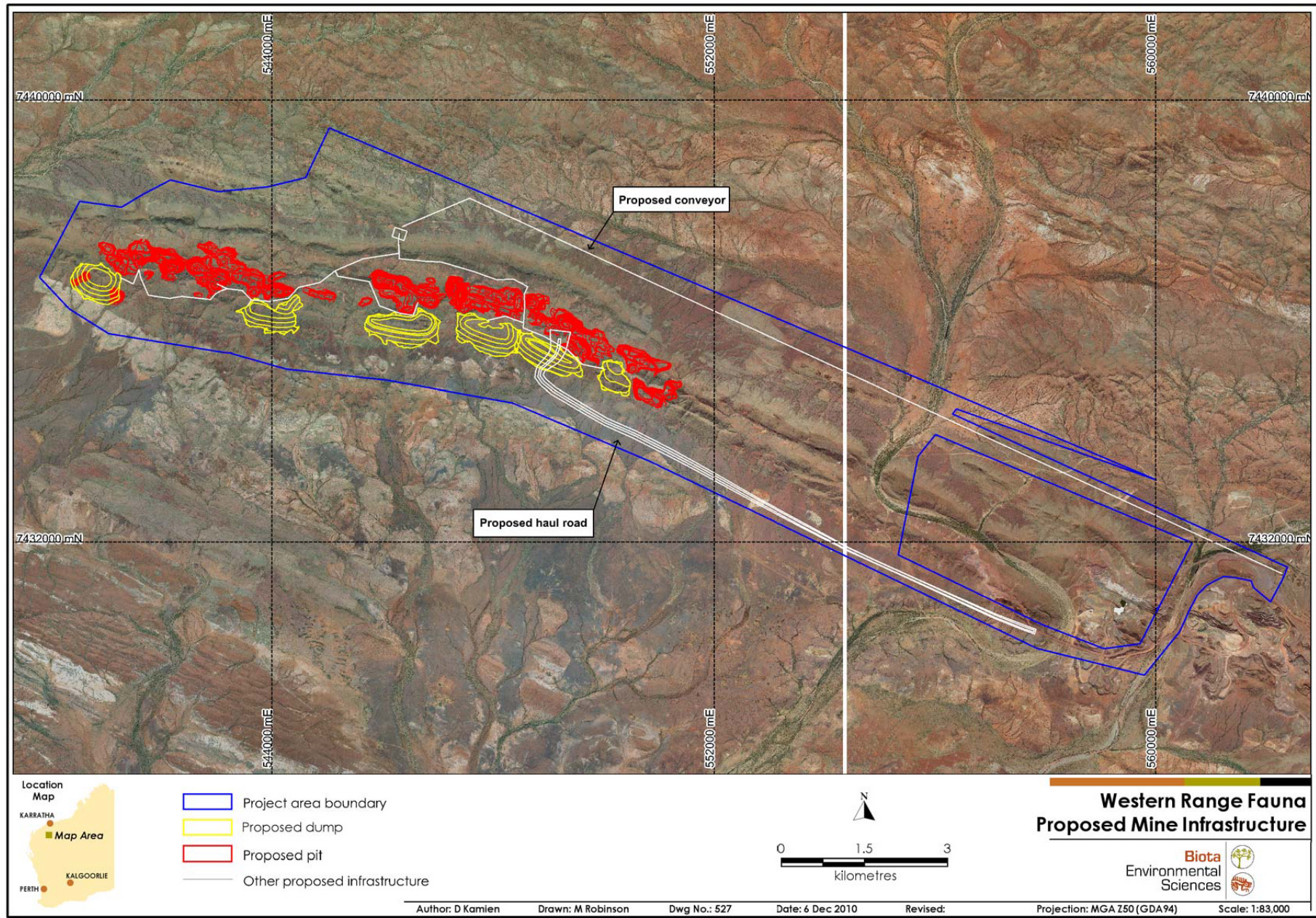


Figure 2.2: Western Range mine, nominal pit and associated infrastructure layout.

3.0 Survey Methodology

3.1 Desktop Review

3.1.1 Database Searches

The following databases were searched to assist in the determining the potential fauna assemblage of the Western Range study area:

1. Department of Environment and Conservation (DEC) Threatened Fauna Database (Appendix 1);
2. NatureMap database (<http://NatureMap.dec.wa.gov.au>; Appendix 2); NatureMap is a joint project of the DEC and the WA Museum, and represents the most comprehensive source of information on the distribution of Western Australia's flora and fauna; and
3. Federal *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters database (Appendix 3).

All database searches requested the return of records from the circle of 40-50 km radius from the central point 23° 10' 59" S, 117° 28' 59" E.

3.1.2 Literature Review

A number of fauna surveys have previously been conducted in the vicinity of the study area. The following studies provide the main contextual fauna data for the current project:

- Marandoo mine two-phase fauna survey (Biota 2008a);
- Tom Price Airport desktop review and SRE fauna survey (Biota 2008b);
- Tom Price Powerline West Detritals two-phase fauna survey (Biota 2009a);
- West Turner Syncline two-phase fauna survey (Biota 2009b);
- West Turner Syncline Section 10 two-phase fauna survey (Biota 2009c); and
- Hamersley Agriculture Project Phase- I Fauna Survey (Biota 2010)

3.1.3 Nomenclature

Species nomenclature for herpetofauna and mammals follows that of the Western Australian Museum fauna taxonomic checklist, which is revised and released by the WA Museum every six months, or as necessary.

Species nomenclature for avifauna follows that of Christidis and Boles (2008).

3.2 Fauna Sampling

3.2.1 Survey Timing and Weather

The Western Range fauna survey was conducted over two phases. The Phase I survey was conducted over a 10-day period from October 20th to October 29th, 2009, and the Phase II survey was conducted over an 8-day period from May 3rd to May 10th, 2010. A dedicated SRE survey was also conducted during a three-day period from June 19th to June 22nd, 2009.

Data from the nearest meteorological station at Paraburdoo indicate that minimum temperatures for Phase I ranged from 18°C to 27.2°C and maximum temperatures ranged from 36.6°C to 39.6°C

(Table 3.1). No rainfall was recorded at Paraburdoo during the survey period, however light rain was observed at the study area on the 26th and 27th October.

A total of 43.6 mm of rain fell in Paraburdoo during the six months leading up to the Phase I survey, compared to an average expected rainfall of 81 mm for this period (based on long term averages at Paraburdoo; Figure 3.1 and Figure 3.2), indicating that the Phase I survey was conducted following a below average rainfall period.

Table 3.1: Daily meteorological observations for Paraburdoo recorded during the Phase I survey, 2009 (data provided by the Bureau of Meteorology).

Date	20 Oct	21 Oct	22 Oct	23 Oct	24 Oct	25 Oct	26 Oct	27 Oct	28 Oct	29 Oct	Mean/Total
Maximum Temp (°C)	37.9	39.5	38.8	na	37.6	38.4	36.6	39.6	38.8	39.5	38.5
Minimum Temp (°C)	na	18.0	18.3	19.4	na	19.5	27.2	20.4	24.1	21.5	21.1
Rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0

na indicates data not available

Phase II minimum temperatures ranged from 13.0°C to 21.6°C and maximum temperatures ranged from 30.3°C to 35.8°C (Table 3.2). No rainfall was recorded in Paraburdoo during the Phase II survey.

A total of 116.6 mm of rain fell in Paraburdoo during the six months leading up the Phase II survey, indicating that it was also conducted following a below average rainfall period based on an expected rainfall of 159.9 mm (based on long term averages at Paraburdoo; Figure 3.1 and Figure 3.2).

Table 3.2: Daily meteorological observations for Paraburdoo recorded during the Phase II survey, 2010 (data provided by the Bureau of Meteorology).

Date	3 May	4 May	5 May	6 May	7 May	8 May	9 May	10 May	Mean/Total
Maximum Temp (°C)	35.7	35.8	34.5	30.3	32.2	31.4	31.2	31.9	32.9
Minimum Temp (°C)	17.6	17.6	19.5	21.6	13.5	15.5	13.0	13.0	16.4
Rainfall (mm)	0	0	0	0	0	0	0	0	0

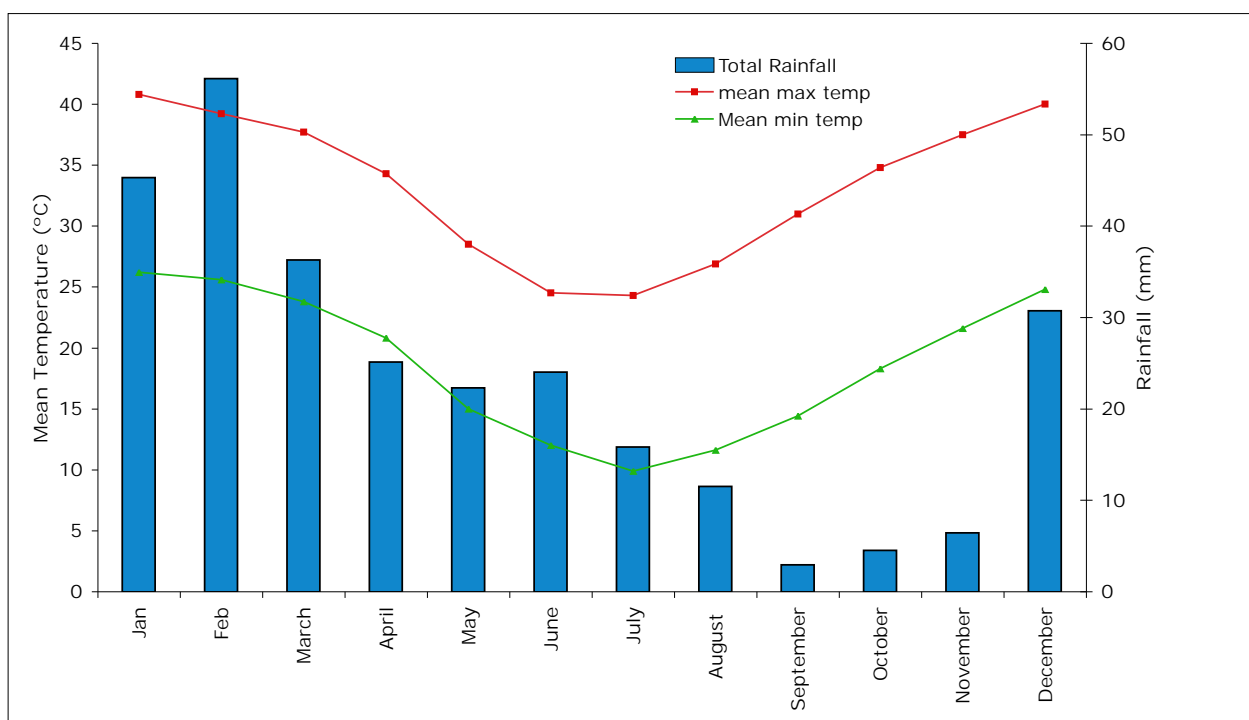


Figure 3.1: Long-term climatological summary for Paraburdoo using data from 1971 to 2010 (data provided by the Bureau of Meteorology).

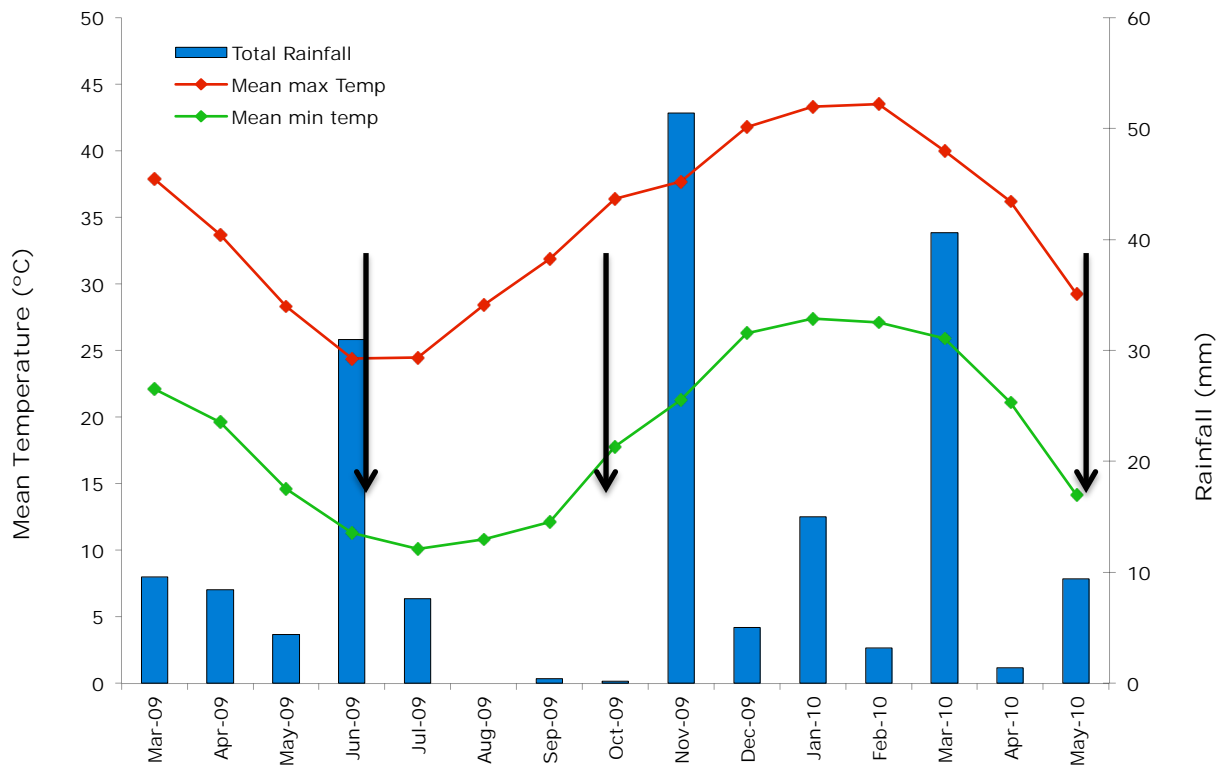


Figure 3.2: Climatological summary for Paraburdoo for survey periods 2009/2010 (data provided by the Bureau of Meteorology; arrows indicate timing of surveys).

3.2.2 Survey Team

The terrestrial fauna sampling for the field survey was conducted under “Licence to Take Fauna for Scientific Purposes” No. SF006934 and No. SF007538 issued to Mr Dan Kamien (Appendix 4).

The survey team comprised Mr Dan Kamien, Ms Jessica Cairnes, Mr Tim Sachse, Mr David Keirle, Mr Michael Greenham, Mr Ashley Johnsen, Mr Christopher Cole, Mr Paul Hoffman and Mr Luke Lovell (all of Biota).

Analysis of bat recordings was completed by Mr Bob Bullen (Bat Call WA). Invertebrate identifications were undertaken by Mr Dan Kamien (Biota), Dr Volker Framenau and Dr Mark Harvey (WA Museum). Geographical Information System (GIS) analyses and maps presented in this report were prepared by Ms Melissa Robinson (Biota).

3.2.3 Fauna Survey

The survey consisted of a combination of systematic sampling and opportunistic searching conducted for vertebrates (Sections 3.2.3.1 to 3.2.3.4), and targeted searches within habitats deemed suitable for potential SRE invertebrate species (Section 3.2.3.5).

3.2.3.1 Terrestrial Vertebrate Fauna Sampling

The systematic census component consisted of 17 trapping transects, each located within a defined habitat (Section 5.1):

- Twelve trapping transects consisted of a single row of 10 pitfall traps. These were arranged as alternating 20 litre buckets and 150 mm diameter x 600 mm high PVC tubes, spaced at approximately 10 m intervals and connected with a 90 m length of 300 mm high flywire fence (Figure 3.3).

- Four trapping transects consisted of 25 medium Elliott box traps spaced at approximately 10 m to 15 m intervals. Elliott traps were baited with a mixture of peanut butter and oats.
- One trapping transect consisted of 12 funnel traps placed in pairs at 10 m intervals adjacent to a 60 m length of 300 mm high flywire fence (Figure 3.4).

A summary of trapping effort is provided in Table 3.3.

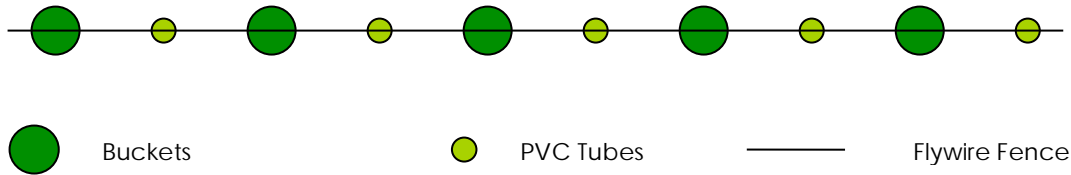


Figure 3.3: Indicative layout of pit trapping sites.

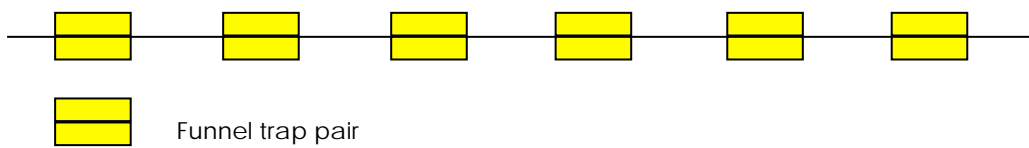


Figure 3.4: Indicative layout of funnel trapping site.

3.2.3.2 Avifauna Sampling

Sampling of avifauna during both survey phases was conducted using a combination of techniques including:

- unbounded area searches conducted at systematic trapping sites; and
- opportunistic observations of birds.

Fifty-eight avifauna censuses were completed across 13 systematic sites, with each site censused a minimum of twice per survey phase (Table 3.4). Individual censuses were confined to discrete habitat types, typically corresponding to vegetation types. Censuses were conducted between 6:00 am and 10:00 am. In total, over 31 hours were dedicated to systematic avifauna censusing over the two survey phases.

Table 3.3: Trapping sites location and effort for Phase I and II.

Site	Easting (mE)	Northing (mN)	Trap Type	Phase I					Phase II					Total Trap Effort	
				Date Opened	Date Closed	Nights Open	No. of Traps	Trap Effort	Date Opened	Date Closed	Nights Open	No. of Traps	Trap Effort		
WSR01	541261	7435940	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR02	543302	7435610	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR03	552761	7432995	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR04	541698	7437959	Pit	22/10/09	29/10/09	7	10	70	4/5/10	10/5/10	6	10	60	130	
WSR05	544696	7437615	Pit	22/10/09	29/10/09	7	10	70	4/5/10	10/5/10	6	10	60	130	
WSR06	550540	7434438	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR07	548294	7437818	Pit	22/10/09	29/10/09	7	10	70	4/5/10	10/5/10	6	10	60	130	
WSR08	548040	7436009	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR09	547590	7435148	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR10	541152	7437161	Pit	22/10/09	29/10/09	7	10	70	4/5/10	10/5/10	6	10	60	130	
WSR11	551534	7436037	Pit	22/10/09	29/10/09	7	10	70	4/5/10	10/5/10	6	10	60	130	
WSR12F	553641	7435134	Funnel	22/10/09	29/10/09	7	12	84	4/5/10	10/5/10	6	12	72	156	
WSR13	555293	7432741	Pit	22/10/09	29/10/09	7	10	70	3/5/10	9/5/10	6	10	60	130	
WSR14E	542327	7436716	Elliott	23/10/09	29/10/09	6	25	150	ns	ns	ns	ns	0	150	
WSR15E	555258	7432617	Elliott	23/10/09	29/10/09	6	25	150	4/5/10	10/5/10	6	25	150	300	
WSR16E	543478	7435777	Elliott	24/10/09	29/10/09	5	25	125	ns	ns	ns	ns	0	125	
WSR17E	544174	7435847	Elliott	ns	ns	ns	ns	0	4/5/10	10/5/10	6	25	150	150	
ns Not Surveyed													Total Pit Trapping Effort		1,560
													Total Elliott Trapping Effort		725
													Total Funnel Trapping Effort		156

Table 3.4: Date and time of systematic avifauna censuses undertaken within the Western Range area during Phases I and II.

	Date	WSR01	WSR02	WSR03	WSR04	WSR05	WSR06	WSR07	WSR08	WSR09	WSR10	WSR11	WSR12F	WSR13
Phase I	23/10/09	-	-	6:46 - 7:26	-	-	7:40 - 8:20	-	-	-	-	6:35 - 7:15	5:45 - 6:25	5:48 - 6:28
	24/10/09	-	-	-	-	-	7:40 - 8:00	7:38 - 8:18	-	8:20 - 8:50	-	6:46 - 7:26	5:47 - 6:27	-
	25/10/09	7:55 - 8:35	7:10 - 7:40	-	7:00 - 7:40	7:50 - 8:20	-	-	-	6:17 - 6:47	6:15 - 6:45	-	-	-
	26/10/09	7:15 - 7:55	8:10 - 8:40	-	6:13 - 6:43	7:50 - 8:30	-	-	6:15 - 6:45	-	7:06 - 7:36	-	-	-
	27/10/09	-	-	-	-	7:45 - 8:25	7:06 - 7:36	6:50 - 7:30	7:44 - 8:14	-	-	5:50 - 6:30	-	5:52 - 6:32
	28/10/09	-	-	7:00 - 7:40	-	-	-	6:59 - 7:29	-	-	-	-	5:55 - 6:25	6:00 - 6:40
Phase II	4/5/10	-	-	8:06 - 8:36	-	-	8:49 - 9:29	-	-	9:40 - 10:10	-	-	-	7:12 - 7:42
	5/5/10	-	-	-	-	9:07 - 9:37	-	8:24 - 8:54	-	-	-	7:41 - 8:11	7:05 - 7:35	-
	6/5/10	9:20 - 9:50	8:39 - 9:09	-	-	-	-	-	7:35 - 7:50	7:57 - 8:27	-	-	-	-
	7/5/10	-	-	-	8:24 - 8:54	7:47 - 8:17	-	7:09 - 7:39	-	-	9:03 - 9:33	-	-	-
	8/5/10	8:40 - 9:10	9:20-9:50	-	7:16 - 7:46	-	-	-	-	-	7:58 - 8:28	-	-	-
	9/5/10	-	-	9:28 - 9:58	-	-	-	-	-	-	-	7:02 - 7:32	7:44 - 8:14	8:35 - 9:05
	10/5/10	-	-	-	-	-	7:20 - 7:50	-	8:00 - 8:30	-	-	-	-	-
Total minutes	140	120	140	130	170	160	160	115	110	120	180	170	180	

3.2.3.3 Bat Sampling

Bat sampling was conducted within the study area by both direct capture methods using harp traps, and recording of echolocation calls (Table 3.5, Figure 4.1, Plate 3.1 to Plate 3.5).

Echolocation calls were recorded using Titley Scientific Anabat SD1 and SD2 bat detector units, which detect and record ultrasonic echolocation calls emitted during bat flight. These units were used in combination with LS-10 Professional PCM Recorders (Olympus, Japan), in order to obtain continuous recordings. Anabat units were positioned at cave, overhang and riverine habitats at four locations within the study area (Figure 4.1; Table 3.5; Plate 3.1 to Plate 3.4).

COOL EDIT 2000 software (Syntrillium) was used to display each continuous call sequence for identification. Details of calls were analysed by Mr Bob Bullen (Bat Call WA) using methods recommended by the Australasian Bat Society (2006) in conjunction with available reference data (Bullen and McKenzie 2002; McKenzie and Bullen 2003 and 2009). Only sequences containing good quality search phase calls were considered for identification.

Table 3.5: Location, method and effort of bat sampling during the survey

Site	Easting (mE)	Northing (mN)	Habitat	Sampling	Date Opened	Date Closed	Nights Sampled
WSRbat01 Phase I	542400	7436608	Cave	Anabat	23/10/09	26/10/09	3
WSRbat01 Phase II	542400	7436608	Cave	ns	ns	ns	0
WSRbat02 Phase I	544025	7435726	Cave	Anabat	27/10/09	28/10/09	1
				Harp Trap 1	23/10/09	25/10/09	2
				Harp Trap 2	23/10/09	28/10/09	5
WSRbat02 Phase II	544025	7435726	Cave	Anabat	5/5/10	7/5/10	2
				Harp Trap	5/5/10	9/5/10	4
WSRbat03 Phase I	555014	7433480	River/water	Anabat	23/10/09	26/10/09	3
				Harp Trap	23/10/09	28/10/09	5
WSRbat03 Phase II	555014	7433480	River/water	Anabat	5/5/10	8/5/10	3
				Harp Trap	5/5/10	9/5/10	4
WSRbat04 Phase I	543478	7435777	Overhang/gorge	Anabat	27/10/09	29/10/09	2
WSRbat04 Phase II	543478	7435777	Overhang/gorge	Anabat	7/5/10	9/5/10	2
ns Not Sampled					Total Anabat Nights		16
					Total Harp Nights		20



Plate 3.1: WSRbat01.



Plate 3.2: WSRbat02.



Plate 3.3: WSRbat03.



Plate 3.4: WSRbat04.

3.2.3.4 Non-Systematic Sampling of Vertebrate Fauna

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

- habitat-specific searches for Schedule and Priority listed fauna species;
- searching of microhabitats for reptile, frog and small mammal species;
- opportunistic sightings and records;
- identification of road kills and other animal remains;
- recording and identification of secondary signs (where possible) including tracks, scats and diggings; and
- night road spotting and head torching.

3.2.3.5 Short Range Endemic Invertebrates

Specific invertebrate groups were targeted using both systematic and non-systematic collection techniques (consistent with EPA 2009). Invertebrate groups targeted during the survey were those considered most likely to potentially support SRE taxa, including but not limited to:

- Mygalomorphae (trapdoor spiders);
- Diplopoda (millipedes);
- Pulmonata (land and aquatic snails); and
- Pseudoscorpiones (pseudoscorpions)

Trapdoor spiders were targeted by searching for and excavating burrows. Collected individuals were preserved in 70% ethanol for morphological description while one leg was removed and placed in 100% ethanol for future molecular studies.

At the time of the survey, Selenopid spiders (Araneomorphae) were considered to be potential SREs and were targeted by searching beneath flat rocks and preserved in the same manner as mygalomorph spiders.

Millipedes were searched for under leaf litter, bark and logs. Aestivating snails were targeted, by digging in drainage gullies and under vegetation. Pseudoscorpions were searched for under rocks and bark.

Sampling for SRE taxa was conducted in the vicinity of all of the systematic survey sites, with additional sampling effort introduced via the pit traps installed for vertebrate fauna. Additionally, unbounded dedicated SRE searches were conducted at locations other than systematic survey sites (Table 3.6).

SRE search sites were selected to provide representative sampling across the range of Land Systems and habitats present, and were targeted at specific locations where SRE species were predicted to more likely occur (for example larger spinifex hummocks, rock piles and drainages).

In total 100 person hours were dedicated to SRE searches, of which over 19 person hours were dedicated to sites outside the project area. Searches were conducted outside the project area with the aim of determining if the distribution of potential SREs extended beyond the proposed impact area.

Table 3.6: Location and duration of SRE searches (Zone 50, WGS84).

Phase	Site	Project area	Easting (mE)	Northing (mN)	People	Search effort (minutes)	Total search effort (person hours)
SRE Targeted	Opp.	inside	554534	7432219	4	20	1.3
SRE Targeted	Opp.	inside	550073	7437362	4	20	1.3
SRE Targeted	Opp.	inside	550088	7437330	4	20	1.3
SRE Targeted	Opp.	inside	550092	7437344	4	20	1.3
SRE Targeted	Opp.	inside	550154	7437346	4	20	1.3
SRE Targeted	Opp.	inside	547137	7435299	4	20	1.3
SRE Targeted	Opp.	inside	545746	7435389	2	30	1.0
SRE Targeted	Opp.	inside	546881	7435983	4	20	1.3
SRE Targeted	Opp.	inside	552899	7433779	4	20	1.3
SRE Targeted	Opp.	inside	554959	7433433	2	60	2.0
SRE Targeted	Opp.	inside	541036	7436101	4	20	1.3
SRE Targeted	Opp.	inside	541087	7436310	4	20	1.3
SRE Targeted	Opp.	inside	541223	7437260	4	20	1.3
SRE Targeted	Opp.	inside	541826	7437787	4	20	1.3
SRE Targeted	Opp.	inside	542798	7438216	4	20	1.3
SRE Targeted	Opp.	inside	544679	7437732	4	20	1.3
SRE Targeted	Opp.	inside	544556	7437448	4	20	1.3
SRE Targeted	Opp.	inside	546450	7437644	4	20	1.3
SRE Targeted	Opp.	inside	548613	7437710	4	20	1.3
SRE Targeted	Opp.	inside	549903	7437236	4	20	1.3
SRE Targeted	Opp.	inside	551309	7436065	4	20	1.3
SRE Targeted	Opp.	inside	553525	7434936	4	20	1.3
SRE Targeted	Opp.	inside	554751	7434324	4	20	1.3
SRE Targeted	Opp.	inside	554894	7433370	4	20	1.3
SRE Targeted	Opp.	inside	555547	7433568	4	20	1.3
SRE Targeted	Opp.	inside	553836	7432427	4	20	1.3
SRE Targeted	Opp.	inside	551609	7433613	4	20	1.3
SRE Targeted	Opp.	inside	548485	7434847	4	20	1.3
SRE Targeted	Opp.	inside	547555	7435085	4	20	1.3
SRE Targeted	Opp.	inside	546506	7435434	4	20	1.3
SRE Targeted	Opp.	inside	543592	7435611	4	20	1.3
SRE Targeted	Opp.	inside	544299	7437017	4	20	1.3
SRE Targeted	Opp.	inside	555074	7431821	4	20	1.3
SRE Targeted	Opp.	inside	554169	7432219	4	20	1.3
SRE Targeted	Opp.	inside	553806	7432394	4	20	1.3
SRE Targeted	Opp.	outside	555004	7431786	4	20	1.3
SRE Targeted	Opp.	outside	552763	7432802	4	20	1.3
SRE Targeted	Opp.	outside	555994	7433621	4	20	1.3
Phase I	Opp.	inside	545746	7435389	1	30	0.5
Phase I	Opp.	inside	557476	7433530	4	40	2.7
Phase I	Opp.	inside	558211	7433272	4	40	2.7
Phase I	Opp.	outside	555692	7430916	2	30	1.0
Phase I	Opp.	outside	555814	7430717	4	40	2.7
Phase I	Opp.	inside	555029	7433328	1	30	0.5
Phase I	WSR01	inside	541261	7435940	1	20	0.3
Phase I	WSR02	inside	543302	7435610	1	20	0.3
Phase I	WSR02	inside	543302	7435610	2	20	0.7

Phase	Site	Project area	Easting (mE)	Northing (mN)	People	Search effort (minutes)	Total search effort (person hours)	
Phase I	WSR03	inside	552761	7432995	4	40	2.7	
Phase I	WSR03	inside	552761	7432995	1	15	0.3	
Phase I	WSR04	inside	541698	7437959	1	30	0.5	
Phase I	WSR05	inside	544696	7437615	2	30	1.0	
Phase I	WSR06	inside	550540	7434438	4	20	1.3	
Phase I	WSR07	inside	548294	7437818	2	30	1.0	
Phase I	WSR07	inside	548294	7437818	2	30	1.0	
Phase I	WSR08	inside	548040	7436009	4	20	1.3	
Phase I	WSR09	inside	547590	7435148	4	20	1.3	
Phase I	WSR10	inside	541152	7437161	4	30	2.0	
Phase I	WSR11	inside	551534	7436037	1	30	0.5	
Phase I	WSR11	inside	551534	7436037	4	30	2.0	
Phase I	WSR12F	inside	553641	7435134	2	30	1.0	
Phase I	WSR13	inside	555293	7432741	2	30	1.0	
Phase I	WSR14E	inside	542327	7436716	2	30	1.0	
Phase I	WSR16E	inside	543468	7435722	2	30	1.0	
Phase I	WSRbat03	inside	555014	7433480	4	30	2.0	
Phase I	WSRbat03	inside	555014	7433480	1	30	0.5	
Phase II	Opp.	outside	540630	7435754	4	40	2.7	
Phase II	Opp.	outside	540415	7435674	4	50	3.3	
Phase II	Opp.	outside	540049	7435853	4	30	2.0	
Phase II	Opp.	outside	556015	7435023	4	60	4.0	
Phase II	WSR03	inside	552761	7432995	4	40	2.7	
Phase II	WSR12F	inside	553641	7435134	4	40	2.7	
Opp. = opportunistic site							Total effort SRE targeted survey	49.8
							Total effort Phase I	32.8
							Total effort Phase II	17.4
							Total effort inside project boundary	80.4
							Total effort outside project boundary	19.6

3.3 Survey Limitations

The following limitations should be recognised:

- Not all sections of the study area were equally ground-truthed or sampled for fauna. Parts of the study area were inaccessible by vehicle and therefore regular checking of fauna traps in these areas would not have been possible. However, systematic fauna sampling (the primary component of the study) was completed on the basis of trapping transect installation in habitats considered to be representative of the range of units present within the project area.
- Terrestrial invertebrate sampling was targeted at a small number of specific groups that are known to potentially harbour SRE taxa (EPA 2009).

4.0 Regional Context of Study Area

4.1 IBRA Bioregions and Subregions

4.1.1 Bioregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 85 bioregions (Environment Australia 2000). The Western Range study area lies at the southern boundary of the Pilbara bioregion, extending slightly south into the adjacent Gascoyne bioregion.

4.1.2 Subregions

The Pilbara bioregion is divided into four subregions; Roebourne Plains, Chichester, Fortescue Plains and Hamersley (ordered from the northern coast to the southern edge). The Western Range study area is located at the southern edge of the 6,215,092 ha Hamersley subregion, which is described as:

“The southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga (*Acacia aneura*) low woodland over bunch grasses on fine textured soils in valley floors, and Snappy Gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on the skeletal soils of the ranges. The climate is Semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into the Ashburton to the south” (Kendrick 2001a).

The Gascoyne bioregion is divided into three subregions; Ashburton, Augustus and Carnegie subregions (ordered from north to south). The southern edge of the Western Range study area falls within the 4,039,387 ha Ashburton subregion, which is described as:

“Mountainous range country divided by broad flat valleys, associated with the Ashburton River Catchment of the Ashburton Basin (shales, sandstones and conglomerates), and the north-western part of the Bangemall Basin (sandstone, shale, carbonates). Mulga/Snake-wood (*Acacia xiphophylla*) low woodlands occur on shallow earthy loams over hardpan on the plains, with mulga scrub and *Eremophila* shrublands on the shallow stony loams of the ranges. Low mixed shrublands on hills with other areas supporting large areas of *Triodia*. Arid (desert) climate with bimodal (winter and summer) rainfall, with tropical monsoon influences” (Kendrick 2001b).

4.2 Land Systems (Range Lands)

Land Systems are comprised of repeating patterns of topography, soils, and vegetation and were mapped by the Western Australian Department of Agriculture. The Pilbara bioregion contains a total of 107 Land Systems (van Vreeswyk et al. 2004; Environment Australia 2000).

Eight Land Systems occur within the project area (Table 4.1 and Figure 4.1), all of which are widespread and well represented through the Hamersley and Gascoyne subregions.

Table 4.1: Land Systems occurring within the project area and their representation within the Hamersley and Gascoyne Subregions

(source: van Vreeswyk et al. 2004)

Land System (Map Code)	Description	Extent within project area (ha)	Extent within Hamersley Subregion (ha)	% of total within Hamersley subregion (ha)	Extent within Gascoyne Subregion (ha)	% of total within Gascoyne subregion (ha)
Boolgeeda (RGEBGO)	Stony plains adjacent to hills, hard spinifex or mulga short grass forb pastures.	337	640061	0.05	37003	0.91
Ethel (RGEETH)	Cobble plains with sparse vegetation; stony short grass forb pastures.	6	2895	0.21	113596	0.01
Marandoo (RGEMDO)	Basalt hills and restricted stony plains supporting grassy mulga shrublands.	166	176745	0.09	NA	NA
Newman (RGENEW)	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	3632	1849356	0.20	6026	60.27
Paraburdoo (RGEPAR)	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex and tussock grasses	111	107239	0.10	14065	0.79
River (RGERIV)	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands	107	73788	0.15	72998	0.15
Rocklea (RGEROC)	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands	302	713000	0.04	7100	4.25
Table (RGETAB)	Low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands.	170	21492	0.79	138946	0.12

Note: 20% of Land Systems in Gascoyne subregion remains unmapped.

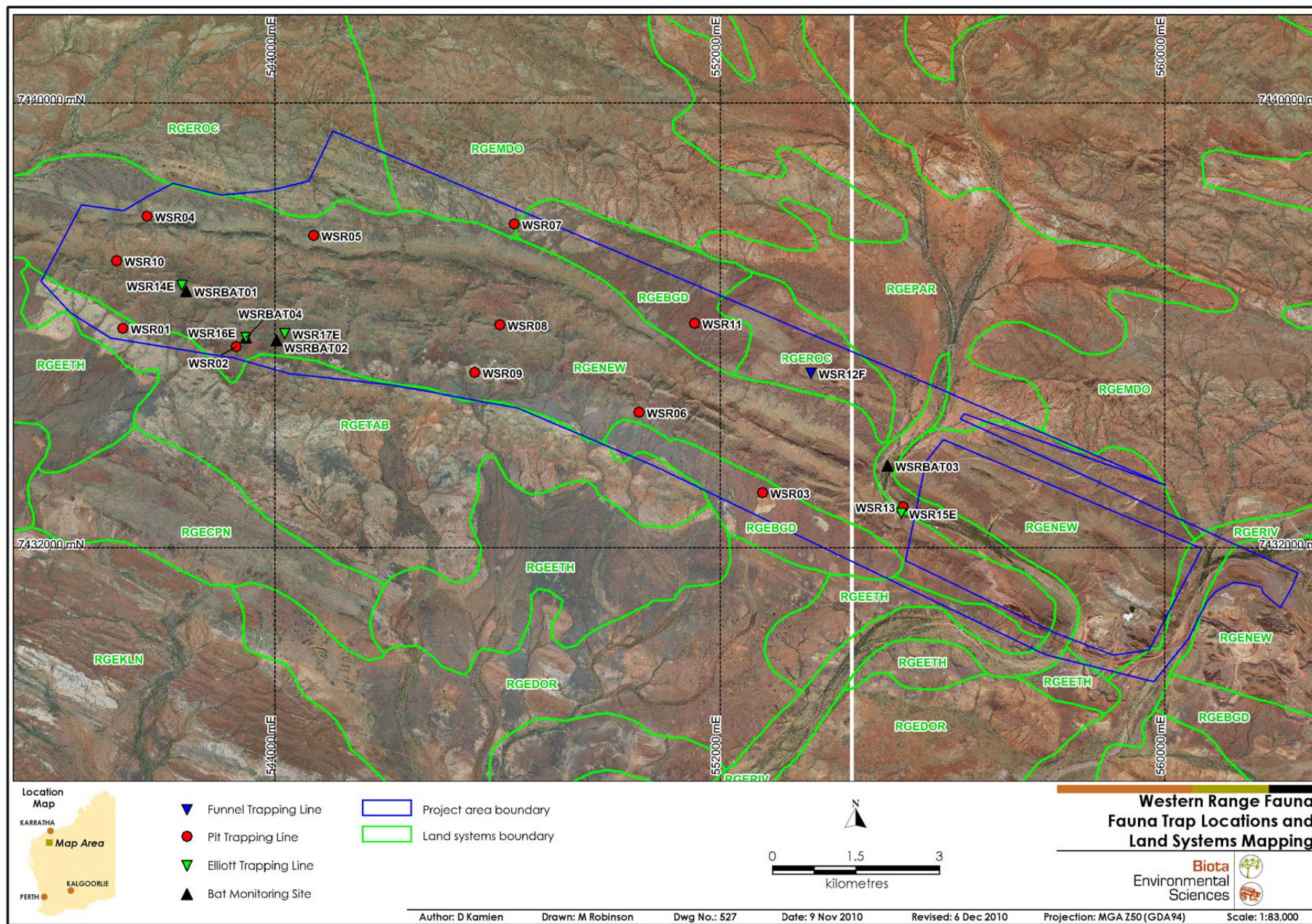


Figure 4.1: Land Systems and fauna trapping sites within the study area.

4.3 Geology

The project area encompasses 15 major geological types (Geological Survey of Western Australia 1984; Table 4.2).

Table 4.2: Geological units within the project boundary

Code	Extent within project boundary (ha)	Unit	Geological description
Czc	2,108	Colluvium	Partly consolidated valley-fill deposits
Czk	100	Calcrete	Sheet carbonate, found along major drainage lines
Fd	303	Metadolerite sills	Metadolerite sills intruded into Fortescue Group; medium- to coarse-grained, massive grey-green rock, usually foliated
Fj	664	Jeerinah Formation	Interbedded mudstone, siltstone and chert with minor felsic tuff, dolomite and sandstone
Fu	45	Bunjina Formation	Metabasaltic pillow lava and breccia; metatuff and minor chert
Hb	1,547	Brockman Iron Formation	Banded iron-formation, chert and minor shale (2490+-20 Ma, U-Pb)
Hd	70	Wittenoom Dolomite	Thin- to medium-bedded metadolomite, dolomitic pelite, and metatuff
Hj	145	Weeli Wolli Formation	Inter-layered banded iron-formation and metadoleritic sills, minor shale
Hm	446	Marra Mamba Iron formation	Chert, banded iron-formation, and pelite
Hs	232	Mt. McRae Shale and Mt. Sylvia Formation	Inter-bedded shale, chert and banded iron-formation
Qa	198	Alluvium	Unconsolidated silt, sand and gravel
Qc	69	Colluvium	Unconsolidated quartz and rock fragments in soil
Wd	60	Duck Creek Dolomite	Thin- to thick-bedded, locally stromatolitic, metadolomite; metadolorudite, and minor chert and pelite
WM	5	Mt. McGrath Formation	Ferruginous metasandstone and metaconglomerate, pelite, and metadolomite
Wq	44	Beasley River Quartzite	Fine - to coarse-grained quartzitic metasandstone, and pelite; minor metadolorite sills

4.4 Vegetation Mapping

Beard (1975) mapped the vegetation of the Pilbara and northern Gascoyne bioregions at a scale of 1:1,000,000. The Western Range study area lies within the Eremaean Botanical Province as defined by Beard (1975), at the boundary between the southern edge of the Fortescue Botanical District and the northern edge of the Ashburton Botanical District. The vegetation of this province is typically open, and frequently dominated by spinifex, wattles and occasional Eucalypts.

The Western Range study area intersects four of Beard's mapping units representing three broad vegetation types:

- the Western Range itself is mapped as "Hamersley 82": scattered low trees of Snappy Gum (*Eucalyptus leucophloia*) over *Triodia wiseana* open hummock grassland;
- areas of plain along the southern boundary and an area along the northern boundary are mapped as "Ashburton Valley 181" and "Hamersley 181", both of which comprise Mulga (*Acacia aneura*) and Snakewood (*A. xiphophylla*) open shrubland; and

- the remainder of the stony undulating plains along the northern edge of the study area is mapped as "Hamersley 567": Mulga and Kanji (*Acacia pyrifolia*) scattered shrubs over *Triodia basedowii*, *T. pungens* open hummock grasslands.

Given the broad nature of Beard's mapping, these four units are only broadly applicable to the vegetation occurring within the Western Range study area. More detailed vegetation mapping was conducted by Biota (2009d).

4.5 Conservation Reserves in the Locality

Karijini National Park is located approximately 40 km to the east of the study area. It is the only formally gazetted conservation reserve in proximity to the Western Range study area.

The Pilbara bioregion is listed as a medium priority for funding of 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 expire.

DEC has lodged a number of submissions, with the intention of adding these areas to the existing conservation estate in order to provide a comprehensive, adequate and representative reserve system. These proposed exclusions are not located in the vicinity of the project area.

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5.0 Survey Results

5.1 Fauna Habitats

Seven main habitat units were identified within the Western Range study area distinguished on the basis of differences in substrate, vegetation, soils and landform (Table 5.1, Plate 5.1 to Plate 5.17).

Table 5.1: Fauna habitats sampled at systematic survey sites within the Western Range study area.

Geology/soils and landform	Vegetation	Site
<i>Acacia</i> sp. over <i>Triodia wiseana</i> hummock grassland on calcrete		
Calcrete spur	<i>Acacia tetragonophylla</i> open shrubland over <i>Triodia wiseana</i> hummock grassland	WSR01
<i>Grevillea</i> sp. and <i>Acacia</i> sp. over <i>Triodia epactia</i> on rocky spur		
Colluvial rocky spur	<i>Grevillea berryana</i> scattered shrubs over <i>Triodia epactia</i> hummock grassland	WSR02
Marra Mamba rocky slope	<i>Acacia ancistrocarpa</i> scattered shrubs over <i>Triodia epactia</i> hummock grassland	WSR04
Colluvial rocky spur	<i>Grevillea berryana</i> scattered shrubs over <i>Triodia epactia</i> hummock grassland	WSR06
Mulga and Snakewood on clay plain		
Colluvial clay broad flood plain	<i>Acacia aneura</i> low open woodland over <i>Acacia xiphophylla</i> tall open shrubland over mixed scattered shrubs	WSR03
Colluvial clay plain	<i>Acacia aneura</i> low open woodland over <i>Acacia xiphophylla</i> tall open shrubland over <i>Triodia wiseana</i> hummock grassland.	WSR05
Clay plain	<i>Acacia aneura</i> low open woodland over <i>Acacia</i> spp. open shrubland over <i>Ptilotus obovatus</i> low open shrubland	WSR07
Stony clay broad floodplain	<i>Acacia aneura</i> low open woodland over <i>Acacia tetragonophylla</i> open shrubland	WSR11
Dolomite and clay plain	<i>Acacia xiphophylla</i> open shrubland over <i>Tecticornia disarticulata</i> low open shrubland	WSR09
Shrubland and <i>Triodia epactia</i> in rocky gorge		
Brockman iron rocky gorge	<i>Corymbia ferritcola</i> low open woodland over <i>Acacia pruinocarpa</i> tall open shrubland over mixed open shrubland over <i>Triodia epactia</i> open hummock grassland	WSR14E
Weeli Wolli rocky gorge	<i>Acacia aneura</i> tall shrubland over mixed open shrubland over <i>Triodia epactia</i> open hummock grassland	WSR16E
Weeli Wolli rocky gorge	<i>Corymbia ferritcola</i> low open woodland over <i>Acacia</i> spp. tall open shrubland over <i>Triodia epactia</i> open hummock grassland	WSR17E
<i>Acacia</i> sp. over buffel grass in ephemeral river		
Sandy ephemeral river bank	<i>Acacia citrinoviridis</i> tall open shrubland over * <i>Cenchrus ciliaris</i> very open tussock grassland	WSR13
Alluvium in ephemeral river	<i>Acacia citrinoviridis</i> tall open scrub over * <i>Cenchrus ciliaris</i> very open tussock grassland	WSR15E
<i>Acacia</i> sp. over <i>Triodia epactia</i> hummock grassland on rocky range		
Brockman iron range	<i>Acacia pruinocarpa</i> tall open shrubland over <i>Triodia epactia</i> hummock grassland	WSR08
Brockman iron range	<i>Acacia pruinocarpa</i> open shrubland over <i>Triodia epactia</i> hummock grassland	WSR10
<i>Acacia</i> and <i>Eremophila</i> spp. over <i>Triodia epactia</i> hummock grassland on rocky outcrop		
Dolerite outcrop	<i>Acacia</i> , <i>Eremophila</i> spp. open shrubland over <i>Triodia epactia</i> hummock grassland	WSR12F



Plate 5.1: Site WSR01



Plate 5.2: Site WSR02



Plate 5.3: Site WSR03



Plate 5.4: Site WSR04



Plate 5.5: Site WSR05



Plate 5.6: Site WSR06



Plate 5.7: Site WSR07



Plate 5.8: Site WSR08



Plate 5.9: Site WSR09



Plate 5.10: Site WSR10



Plate 5.11: Site WSR11



Plate 5.12: Site WSR12F



Plate 5.13: Site WSR13



Plate 5.14: Site WSR14E



Plate 5.15: Site WSR15E



Plate 5.16: Site WSR16E



Plate 5.17: Site WSR17E

5.2 Overview of Vertebrate Fauna of the Study Area

During the Phase I and II surveys a combined total of 111 vertebrate species was recorded, representing 44 families. Table 5.2 provides a summary of the number of species recorded from each major vertebrate group during both survey phases.

Table 5.2: Number of vertebrate species recorded during the Western Range survey.

Fauna Group	Phase I	Phase II	Total
Amphibians	1	1	1
Reptiles	32	21	39
Avifauna	47	32	51
Native Non-volant Mammals	9	4	9
Introduced Mammals	1	0	1
Native Volant Mammals (Bats)	8	9	10
Total	98	67	111

5.3 Herpetofauna

5.3.1 The Assemblage

The Phase I and II surveys yielded a combined total of 40 herpetofauna species (Table 5.2). This represents 43% of all herpetofauna species recorded from the locality (within a 40 km buffer) based on NatureMap database records and recent surveys in the vicinity (Appendix 2).

The assemblage comprised one frog (Hylidae), five dragon species (Agamidae), seven gecko species (Diplodactylidae and Gekkonidae), three legless lizard species (Pygopodidae), 11 skink species (Scincidae), four monitor species (Varanidae), two blind snake species (Typhlopidae), two python species (Boidae) and five front-fanged snake species (Elapidae).

The widespread Pilbara species the Ring-tailed Dragon (*Ctenophorus caudicinctus*) was the most abundant species encountered during the survey with 34 records, representing almost 14% of all herpetofauna individuals recorded during both survey phases. *C. caudicinctus* was recorded predominantly during Phase I of the survey.

As is typical in the Pilbara, the skinks were the most diverse herpetofauna family with 11 species recorded, representing over 27% of all herpetofauna species recorded during the survey.

Site WRS07 exhibited the highest herpetofauna richness within the study area with 16 species recorded, accounting for 40% of herpetofauna species recorded.

5.3.2 Regional Endemism and Restricted Taxa

Of the herpetofauna recorded during the survey, seven species are considered endemic to the Pilbara bioregion (Wilson and Swan 2008).

- *Varanus bushi*;
- *Delma elegans*;
- *Demansia rufescens*;
- *Lerista flamicauda*;
- *Lerista clara*;
- *Liasis olivaceus barroni*; and
- *Lucasium wombeyi*.

In addition, based on database records other Pilbara endemic species that may potentially occur in the study area include *Ctenotus rubicundus*, *Cryptoblepharus ustulatus*, *Delma pax*, *Lerista Jacksoni*, *Lerista rolfei*, *Lerista verhmens*, *Lerista neander*, *Notoscincus butleri* and *Varanus pilbarensis* (Appendix 2).

Although not evident from database records, but based on known distributions, *Lerista muelleri*, *Ramphotyphlops pilbarensis* and *Ramphotyphlops ganei* are additional Pilbara endemic herpetofauna that have potential to occur within the study area.

5.3.3 Herpetofauna of Conservation Significance

A Pilbara Olive Python (*Liasis olivaceus barroni*) was recorded on one occasion from site WRS17E during Phase II.

It is listed as Schedule 1 on the DEC *Wildlife Conservation (Specially Protected Fauna) Notice 2010*, under the Western Australian *Wildlife Conservation Act 1950-1979*; and Vulnerable under the EPBC Act 1999

Family Species Name	WSR01		WSR02		WSR03		WSR04		WSR05		WSR06		WSR07		WSR08		WSR09		WSR10		WSR11		WSR12F		WSR13		WSR14E		WSR15E		WSR16E		WSR17E		WSROPP		Total	
	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2		
<i>Demansia rufescens</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	0	1
<i>Furina ornata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	1	-	-	1	0
<i>Pseudonaja nuchalis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	1	0
<i>Vermicella snelli</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	1	0
Number of Individuals	10	1	4	4	18	6	16	2	21	3	10	6	32	8	9	5	7	1	11	0	8	1	14	0	25	11	1	ns	0	0	2	ns	ns	3	7	0	195	51
Number of Species	5	1	3	4	6	3	9	2	9	3	8	6	14	5	9	5	3	1	7	0	5	1	7	0	9	3	1	ns	0	0	2	ns	ns	2	7	0	33	22
Total Number of Species	5		5		6		10		9		11		16		12		4		7		5		7		11		1		0		2		2		7		40	

^ Schedule fauna

5.4 Avifauna Assemblage

5.4.1 The Assemblage

Fifty-one bird species were recorded from the Western Range study area, comprising 21 non-passerine species and 30 passerine species from 24 families (Table 5.4). This comprised 38% of all avifauna recorded in the area based on recent surveys in the vicinity and NatureMap records.

The Zebra Finch (*Taeniopygia guttata*) was the most abundant species in the study area, with 202 records representing 21% of recorded individuals of avifauna. The most speciose families of birds were the Collumbidae (Pigeons and Doves) and the Meliphagidae (Honeyeaters), each with five recorded species.

5.4.2 Regional Endemism and Restricted Taxa

No avifauna species endemic to the Pilbara bioregion were recorded during the survey and no potential species represent regional endemics or restricted taxa.

5.4.3 Avifauna of Conservation Significance

Three bird species of conservation significance were recorded during the survey:

- Australian Bustard (*Ardeotis australis*) - listed as a Priority 4 species by the DEC.
- Grey Falcon (*Falco hypoleucos*) - listed as a Priority 4 species by the DEC.
- Rainbow Bee-eater (*Merops ornatus*) - listed as Migratory under the EPBC Act 1999.

Family Species Name	Common Name	WSR01		WSR02		WSR03		WSR04		WSR05		WSR06		WSR07		WSR08		WSR09		WSR10		WSR11		WSR12F		WSR13		WSROPP		Total	
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2
Campephagidae																															
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	3	0	
Pachycephalidae																															
<i>Oreoica gutturalis</i>	Crested Bellbird	3	-	3	-	4	-	4	-	6	-	1	-	9	1	2	-	3	-	1	-	5	-	3	-	-	-	-	44	1	
<i>Pachycephala rufiventris</i>	Rufous Whistler	1	-	-	-	-	1	2	1	-	1	-	-	-	-	-	-	2	-	-	-	3	-	-	-	2	-	-	10	3	
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	-	-	2	-	1	-	-	-	4	-	-	-	5	-	1	-	-	-	-	-	1	-	-	-	2	-	-	16	0	
Artamidae																															
<i>Artamus cinereus</i>	Black-faced Woodswallow	4	-	-	-	2	-	-	-	-	-	3	3	3	6	1	-	-	-	-	-	-	-	-	-	-	-	-	13	9	
<i>Artamus minor</i>	Little Woodswallow	-	-	-	-	-	-	-	-	1	-	1	2	-	-	-	3	6	-	-	-	-	-	-	-	-	-	-	8	5	
<i>Cracticus torquatus</i>	Grey Butcherbird	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	0	
<i>Cracticus nigrogularis</i>	Pied Butcherbird	-	-	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	3	-	4	3	
Rhipiduridae																															
<i>Rhipidura albiscapa</i>	Grey Fantail	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	8	0	
<i>Rhipidura leucophrys</i>	Willie Wagtail	1	-	-	1	-	1	3	-	1	-	1	-	8	1	1	-	2	-	2	-	2	2	4	2	1	2	-	26	9	
Corvidae																															
<i>Corvus orru</i>	Torresian Crow	1	2	-	-	-	-	-	2	-	-	1	-	-	1	-	-	-	-	-	1	-	2	-	1	1	3	-	3	12	
<i>Corvus bennetti</i>	Little Crow	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	5	0	
Mornarchidae																															
<i>Grallina cyanoleuca</i>	Magpie-lark	1	-	3	-	-	-	-	-	4	-	-	-	4	1	-	-	1	-	-	-	2	-	1	-	8	3	-	24	4	
Petroicidae																															
<i>Petroica cucullata</i>	Hooded Robin	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	1	2	-	-	-	-	-	3	4	
Megaluridae																															
<i>Eremiornis carteri</i>	Spinifex-bird	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	0	1	
Estrildidae																															
<i>Taeniopygia guttata</i>	Zebra Finch	-	15	9	-	11	8	19	-	7	14	12	1	31	-	5	-	30	1	-	4	6	-	11	-	18	-	-	159	43	
<i>Emblema pictum</i>	Painted Finch	-	-	-	-	-	-	-	-	6	-	2	-	19	-	-	-	-	-	-	16	-	-	10	-	-	-	3	37	19	
	Number of Individuals	16	19	26	31	42	15	42	23	39	21	27	19	105	24	16	9	53	6	9	21	63	12	63	12	134	25	10	8	645	245
	Number of Species	9	4	10	2	10	6	11	6	15	5	9	6	13	9	9	4	9	2	5	3	14	7	13	6	19	11	7	3	47	32
	Total Number of Species	13		12		15		18		19		11		16		11		11		8		20		19		24		12		51	

^ Priority fauna
M Migratory fauna

5.5 Non-Volant Mammals

5.5.1 The Assemblage

Ten non-volant mammal species (nine native and one introduced) were recorded from the study area (Table 5.5). These comprised three carnivorous marsupial species (Dasyuridae), two kangaroo species (Macropodidae), three rodent species (Muridae), feral cats (Felidae) and dingos (Canidae).

The most commonly recorded mammal species was the Pilbara Ningai, which was captured on 11 occasions and comprised 29% of individuals of non-volant mammals recorded during the survey.

5.5.2 Regional Endemism and Restricted Taxa

Under the strict definition *Ningai timealeyi*, *Dasykaluta rosamondae* and *Pseudomys chapmani* are not endemic to the Pilbara as their distributions extend into the Carnarvon Bioregion at Cape Range. However, these species occur predominantly within the Pilbara bioregion.

5.5.3 Non-volant Mammals of Conservation Significance

The Western Pebble-mound Mouse (*Pseudomys chapmani*) is listed as a Priority 4 species by the DEC.

Two inactive *P. chapmani* pebble mounds were recorded at the northern end of the study area (551540 mE, 7435797 mN and 551721 mE, 7435814 mN) in close proximity to site WSR11. Both pebble mounds appeared disused for at least five years.

No other mammals of conservation significance were recorded during the survey.

Table 5.5: Non-volant mammals recorded within the Western Range study area during Phases I and II.

Family Species Name	Common Name	WSR01		WSR02		WSR03		WSR04		WSR05		WSR06		WSR07		WSR08		WSR09		WSR10		WSR11		WSR12F		WSR13		WSR14E		WSR15E		WSR16E		WSR17E		WSROPP		Total			
		P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2	P1	P2				
Dasyuridae																																									
<i>Dasykaluta rosamondae</i>	Little Red Kaluta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	-	0	1		
<i>Ningauai timealeyi</i>	Pilbara Ningauai	-	2	-	1	-	-	1	-	2	-	2	1	-	-	1	-	-	-	1	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	-	7	4		
<i>Planigale ingrami</i>	Long-tailed Planigale	1	-	1	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	ns	-	-	-	ns	ns	-	-	-	-	3	2		
Macropodidae																																									
<i>Macropus robustus</i>	Euro	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	ns	-	-	-	ns	ns	-	-	-	-	2	0		
<i>Macropus rufus</i>	Red Kangaroo	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	3	-	-	4	0		
Muridae																																									
<i>Pseudomys chapmani</i> [^]	Western Pebble-mound Mouse	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	2M	-	-	2	0			
<i>Pseudomys desertor</i>	Desert Mouse	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	-	-	-	1	0		
<i>Zyzomys argurus</i>	Common Rock-rat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	ns	-	-	1	ns	ns	-	-	-	-	5	0		
Canidae																																									
<i>Canis lupus</i>	Dog/Dingo	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	ns	-	-	-	ns	ns	-	-	-	-	2	1	
Felidae																																									
<i>Felis catus</i> [*]	Cat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	ns	-	-	-	ns	ns	-	4	-	-	4	0		
Number of Individuals		2	2	3	1	0	0	2	0	3	0	2	1	1	0	1	2	0	0	1	0	0	0	0	0	0	2	5	ns	0	0	1	ns	ns	0	7	0	30	8		
Number of Species		2	1	2	1	0	0	2	0	2	0	1	1	1	0	1	2	0	0	1	0	0	0	0	0	0	2	2	ns	0	0	1	ns	ns	0	2	0	9	4		
Total Number of Species		3		3		0		2		2		1		1		3		0		1		0		0		2		2		0		1		0		3		10			

^{*} Introduced species

[^] Priority fauna

ns Not surveyed

5.6 Volant Mammals (Bats)

Ten bat species were recorded during the survey (Table 5.6 and Appendix 5). These comprised the Ghost Bat (Megadermatidae), three species of sheath-tail bat (Emballonuridae), one species of freetail bat (Molossidae), four species of evening bat (Vespertilionidae) and one species of leaf-nosed bat (Hipposideridae).

The volant mammals recorded during this survey represent 100% of the bat species potentially occurring in the locality, based on recent surveys and WA Museum records (Appendix 2).

5.6.1 Regional Endemism and Restricted Taxa

The Pilbara population of *Rhinonictis aurantius* (Pilbara Leaf-nosed Bat) is considered separate from the more northern population of Pilbara Leaf-nosed Bat (Armstrong 2001 and 2006). However, formal reclassification of the Pilbara Leaf-nosed Bat has not been conducted due to limited taxonomic specimens.

5.6.2 Bats of Conservation Significance

Bats of conservation significance recorded during the survey include:

- Pilbara Leaf-nosed Bat (*Rhinonictis aurantius*) - listed as Schedule 1 on the DEC *Wildlife Conservation (Specially Protected Fauna) Notice 2010*, under the Western Australian *Wildlife Conservation Act 1950-1979*, and Vulnerable under the EPBC Act 1999.
- Ghost Bat (*Macroderma gigas*) - listed as a Priority 4 species by the DEC.

Table 5.6: Bats recorded within the Western Range study area during Phases I and II.

FAMILY Species Name	Common Name	WSRBAT01		WSRBAT02		WSRBAT03		WSRBAT04	
		P1	P2	P1	P2	P1	P2	P1	P2
MEGADERMATIDAE									
<i>Macroderma gigas</i> ^	Ghost Bat	C	ns	-	C	-	-	-	-
HIPPOSIDERIDAE									
<i>Rhinonicteris aurantius</i> ^	Pilbara Leaf-nosed Bat	-	ns	-	C	-	C	-	C
EMBALLONURIDAE									
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail Bat	C	ns	-	-	-	-	-	-
<i>Taphozous georgianus</i>	Common Sheathtail-bat	C	ns	C+1	C+1	-	-	C	C
<i>Taphozous hilli</i>	Hill's Sheathtail-bat	-	ns	-	-	-	-	-	C
MOLOSSIDAE									
<i>Chaerephon jobensis</i>	Northern Freetail Bat	-	ns	-	-	C	C	-	-
VESPERTILIONIDAE									
<i>Chalinobus gouldii</i>	Gould's Wattled Bat	-	ns	-	C	C+1	C+4	C	C
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	-	ns	-	-	C	C	-	-
<i>Scotorepens greyii</i>	Little Broad-nosed Bat	-	ns	-	C	C	C	C	-
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat	C	ns	C+8	C+10	C+9	C+14	C	C
	Number of Species	4	ns	2	6	5	6	4	5
	Total Number of Species	4		6		6		6	

ns not surveyed

^ schedule or Priority fauna

C echolocation call recording

Numbers indicate capture records