Woodie Woodie Project:

Detailed Vertebrate Fauna Survey 2020 - 2021

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Executive Summary

Introduction

Consolidated Minerals Limited (CML) currently operate the Woodie Woodie Project in the Pilbara region of Western Australia. To provide baseline data for the environmental approvals process, CML commissioned Western Wildlife to carry out a two-season detailed vertebrate fauna survey of the Woodie Woodie Project. The key objectives of the fauna survey were to:

- Identify and describe the fauna habitats present.
- List the vertebrate fauna that were recorded in the study area and/or have the potential to occur.
- Identify species of conservation significance, or habitats of particular importance for fauna, that may occur in the study area.

This report includes the findings of the fauna survey conducted in October 2020 and April 2021.

Methods

The fauna survey was undertaken in accordance with the Technical Guidance: terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020) and relevant State and Federal Guidelines on surveying conservation significant fauna. A two-phase field survey was carried out between the 19 September - 1 October 2020 and 22 April – 1 May 2021. The survey included:

- Identification of fauna habitats.
- Trapping at 12 sites, for seven nights in each phase, each with ten pitfall traps, ten funnel traps, 12 Elliott traps and two cage traps to give a total of 1,680 pitfall trap-nights (1,008 bucket and 672 pipe), 1,680 funnel trap-nights, 2,016 Elliott trap-nights and 336 cage trap-nights.
- Bird surveys at the 12 trapping sites and opportunistically.
- Bat survey with acoustic detectors at 38 sites.
- Camera trap survey at 36 sites.
- Spot-lighting.
- Targeted transects and searches for evidence of conservation significant species, such as burrows, tracks and scats.
- Keeping opportunistic records of fauna.

Species of conservation significance were classified as: **Threatened** if listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and/or *Biodiversity Conservation Act 2016* (BC Act); **Migratory** if listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened; **Specially Protected** if listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act; **Priority** if listed as Priority by DBCA and **Locally Significant** if considered by the author to potentially be of local significance.

Fauna Habitats

Five fauna habitats were identified in the study area:

- Rocky outcrops and breakaways
- Spinifex stony hills
- Spinifex plains
- Major creeklines
- Minor creeklines

In addition, two important habitat features were identified:

- Permanent and semi-permanent waterholes
- Small caves

Of the habitats in the study area, the rocky outcrop and breakaway habitat is considered the most important as it provides habitat for several Threatened and Priority fauna species and is limited in extent in the region compared with habitats such as plains. This habitat provides caves, cracks and crevices for shelter, breeding and roosting sites for a range of native fauna, including the Threatened Northern Quoll (*Dasyurus hallucatus*).

The major creekline habitat is also important, as though it is widespread in the region, it is likely to support greater abundance and diversity of fauna than surrounding habitats and may provide an ecological linkage for fauna movement. Permanent and semi-permanent waterholes provide water for fauna in an otherwise relatively dry landscape and provide habitat for the Threatened Pilbara Olive Python (*Liasis olivaceous barroni*).

Faunal Assemblage

Based on the literature review, the predicted faunal assemblage includes up to 7 frogs, 84 reptiles, 130 birds, 36 native mammals, six introduced mammals and eight freshwater fish. The observed assemblage on this survey comprised three frogs, 55 reptiles, 80 birds, 24 native mammals, three introduced mammals and one freshwater fish. The observed faunal assemblage collated across this and previous surveys at Woodie Woodie between 2006 and 2021 includes five frogs, 70 reptiles, 114 birds, 24 native mammals, six introduced mammals and one freshwater fish. This equates to 71.4% of frogs, 83.3% of reptiles, 87.7% of birds, 69.4% of native mammals and 83.3% of the introduced mammals predicted to occur. The faunal assemblage is likely to be relatively intact and typical of the region. Many of the species that occur have wide distributions through the Pilbara and the arid zone.

Conservation Significant Fauna

Based on the literature review, there are 19 vertebrate fauna of conservation significance that potentially occur in the study area: eight Threatened, five Migratory, one Specially Protected and five Priority species.

Six **Threatened** species potentially occur in the study area:

- Northern Quoll (*Dasyurus hallucatus*) – EBPC Act (Endangered), BC Act (Endangered)
- Pilbara Olive Python (*Liasis olivaceous barroni*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Grey Falcon (*Falco hypoleucos*) – EBPC Act (Vulnerable), BC Act (Vulnerable)
- Princess Parrot (*Polytelis alexandrae*) – EBPC Act (Vulnerable), Priority 4
- Night Parrot (*Pezoporus occidentalis*) – EBPC Act (Endangered), BC Act (Critically Endangered)
- Bilby (*Macrotis lagotis*) – EBPC Act (Vulnerable), BC Act (Vulnerable)

Of these, the Northern Quoll and Pilbara Olive Python are known to occur in the study area, with the rocky outcrops and breakaways providing critical habitat. The Northern Quoll was recorded on camera traps and trapped in rocky habitats and the Pilbara Olive Python was recorded at a waterhole. The status of the Night Parrot in the study area is difficult to assess, as this species is represented by very few records overall, so its patterns of distribution and abundance are not clear. The Night Parrot is very rare and thus has a low likelihood of occurrence at any site, but parts of the spinifex plains habitat have large spinifex clumps that may be potential breeding habitat. The Princess Parrot is irruptive and may occur in some years, but the habitats of the study area are unlikely to be important for this species. The Grey Falcon possibly nests along major creeklines, but as yet has not been recorded at Woodie Woodie. Although known from the nearby sandy deserts, the Bilby is unlikely to occur in the study area due to lack of suitable habitat.

Five **Migratory** species potentially occur in the study area:

- Common Sandpiper (*Triga hypoleucos*) – EPBC Act (Migratory), BC Act, (Migratory)
- Wood Sandpiper (*Tringa glareola*) – EPBC Act (Migratory), BC Act, (Migratory)
- Oriental Plover (*Charadrius veredus*) – EPBC Act (Migratory), BC Act, (Migratory)
- Fork-tailed Swift (*Apus pacificus*) – EPBC Act (Migratory), BC Act, (Migratory)
- Glossy Ibis (*Plegadis falcinellus*) – EPBC Act (Migratory), BC Act, (Migratory)

Of these, the Common Sandpiper and Wood Sandpiper have been recorded at Woodie Woodie on previous surveys. However, although the listed Migratory species may occur in the study area, the habitats present are unlikely to be of particular importance. The study area is not likely to support an ecologically significant proportion of the population of any Migratory species.

A single **Specially Protected** species potentially occurs in the study area:

- Peregrine Falcon (*Falco peregrinus*) – BC Act (other specially protected fauna)

The Peregrine Falcon has been recorded at Woodie Woodie on previous surveys. The study area is unlikely to be important for this species as its population is large and secure.

Five **Priority** species potentially occur in the study areas:

- Pin-striped Finesnout Ctenotus (*Ctenotus nigrilineatus*) – Priority 1
- Long-tailed Dunnart (*Sminthopsis longicaudata*) – Priority 4
- Spectacled Hare-wallaby (*Lagorchestes conspicillatus leichardti*) – Priority 4
- Lakeland Downs Mouse (*Leggadina lakedownensis*) – Priority 4
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4

Of these, only the Western Pebble-mound Mouse has been recorded in the study area and is likely to be a relatively common inhabitant of gently sloping stony hills throughout the region. The Lakeland Downs Mouse is likely to occur as it has been recorded nearby and suitable habitats are present. The remaining three species may possibly occur as suitable habitat is present, but the study area is currently outside the known range of these species and there are no nearby records on databases.

Locally significant species

No locally significant species were specifically identified as a part of this survey. The majority of species are widespread through the Pilbara region, occurring in a variety of habitats.

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1. Introduction

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- Identify species of conservation significance, or habitats of particular importance for fauna, that may occur in the study area.

This report includes the findings of the fauna survey conducted in October 2020 and April 2021.

1.1 Study Area

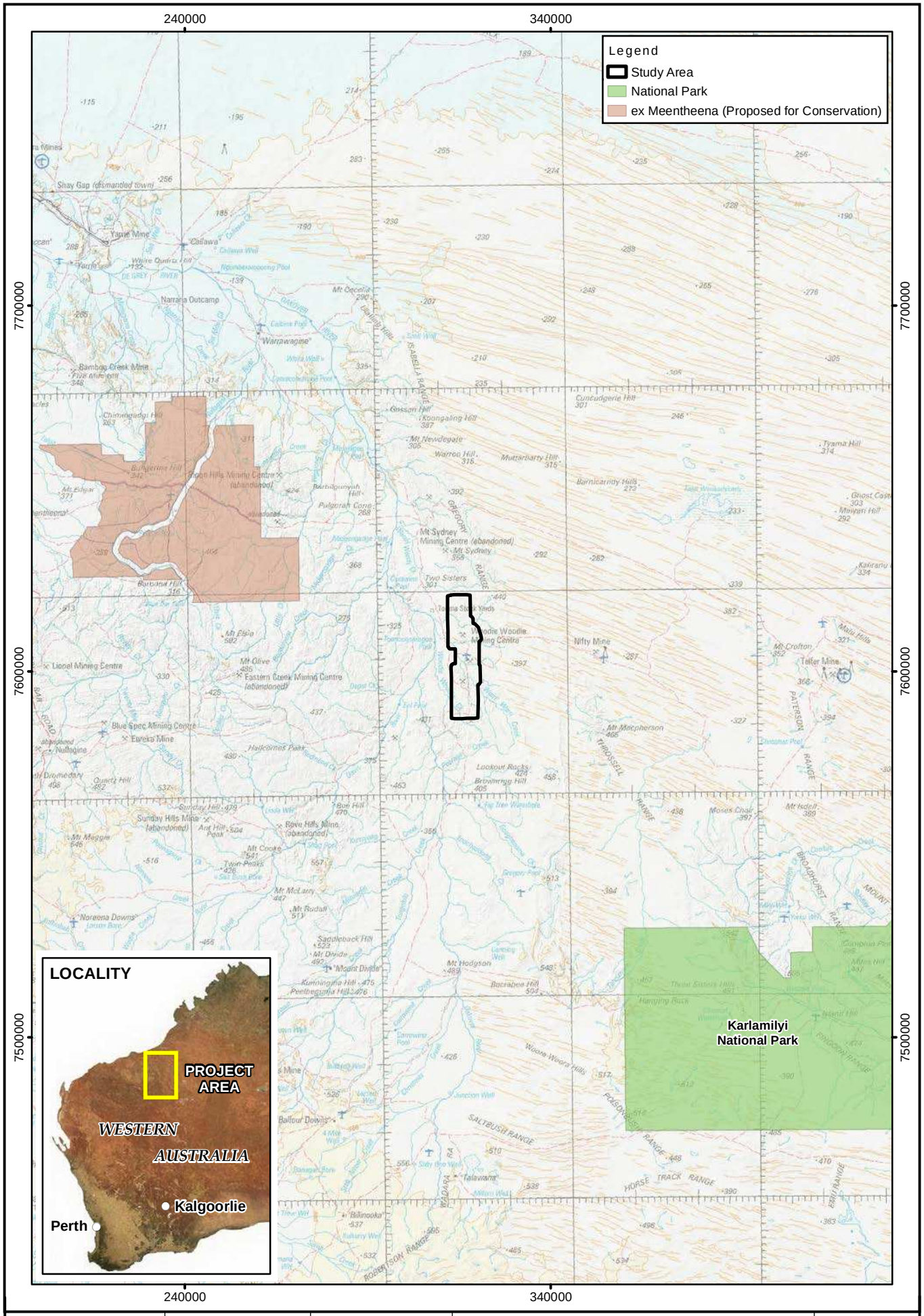
The study area is about 400 km southeast of Port Hedland, 170 km southeast of Marble Bar and 100 km east of Nullagine in the Eastern Pilbara region of Western Australia (Figure 1). The study area totals 24,870ha and the development envelope totals 12,708ha. There is a long history of mining at Woodie Woodie. Contained within the study area are old open pits and waste rock landforms, as well as the current mining operation.

1.2 Regional Context

1.2.1 IBRA Bioregion

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies the land surface of Australia into 89 Bioregions and 419 subregions, each defined by a set of environmental influences that impact the occurrence of flora and fauna and their interaction with the physical environment (DoEE 2018).

The study area falls within the Chichester subregion of the Pilbara Bioregion, which is comprised of undulating plains of Achaean granite and basalt, with basalt ranges (Kendrick and McKenzie 2001). The climate is semi-desert tropical, receiving about 300mm of rain per year (Kendrick and McKenzie 2001). The dominant land-uses are grazing on native pastures, Aboriginal lands and reserves, Unallocated Crown Land and Crown Reserves, Conservation and Mining (Kendrick and McKenzie 2001).



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Date: November 2021 Rev: A	Author: J. Wilcox			

A significant feature in the area surrounding the mine is the Oakover River and its various tributaries. The Oakover River contains permanent water at Running Waters, Yilgalong Pool and Carawine Pool (among others), and is thus important habitat for wetland species in an otherwise dry region. About 15km to the east of the study area is the Little Sandy Desert, which supports a different faunal assemblage. Species that favour rocky habitats are likely to be close to the eastern edge of their range in the region.

1.2.2 Botanical Province

The Botanical Provinces are determined by vegetation mapping (Beard 1980) and broadly correspond to climactic regions; the Southwest (Bassian) Province experiencing warm dry summers and cool wet winters, the Northern Province experiencing warm wet summers and cool dry winters and the Eremaean Province experiencing low, irregular rainfall. The study area is in Eremaean Province.

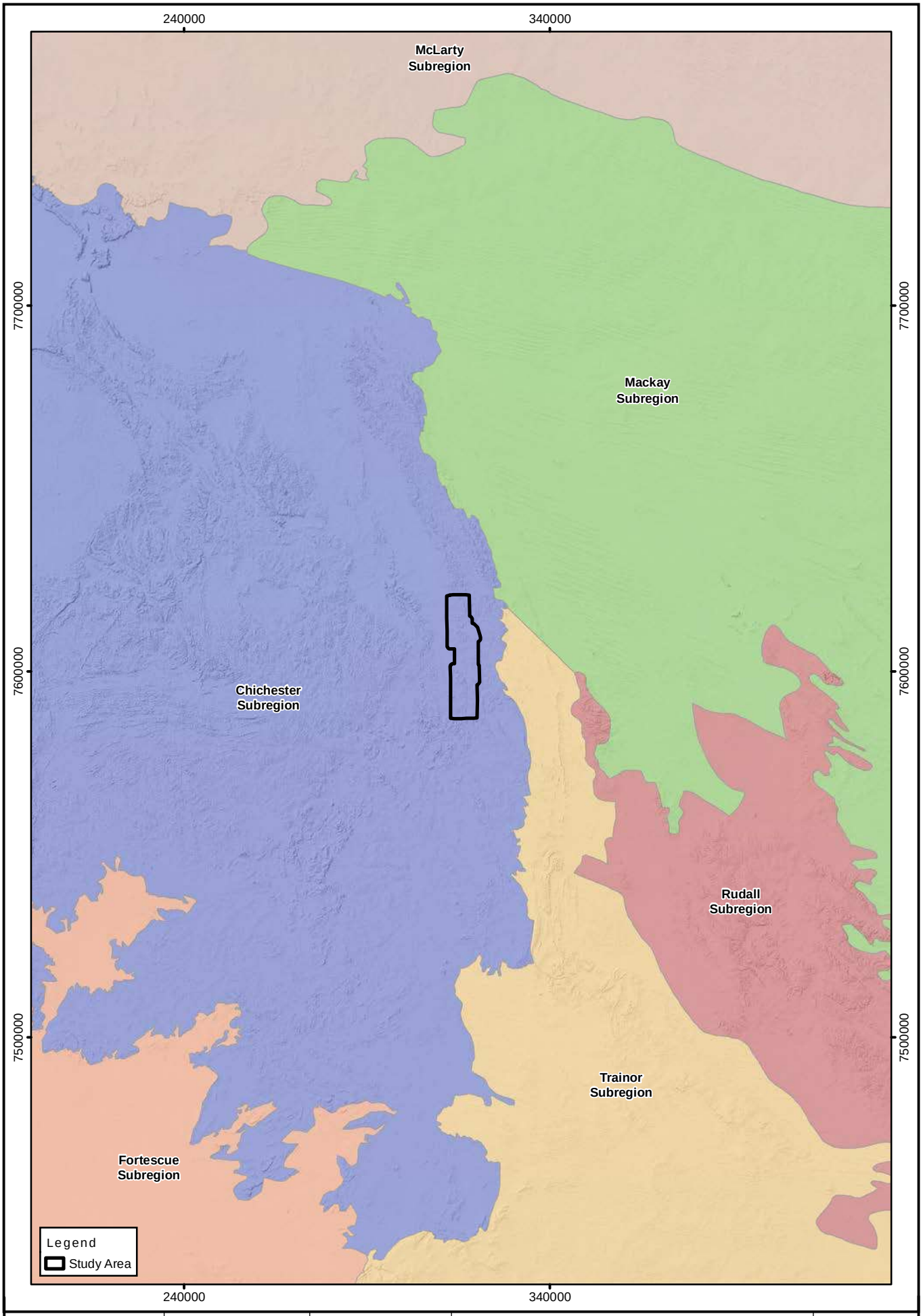
1.2.3 Parks and Reserves

There are no reserves in or immediately adjacent to the study area. The nearest are Meentheena Conservation Park, 40km west of the study area and Karlamilyi National Park, 136km south east of the study area (Figure 1).

1.2.4 Land Systems

Land systems are broad descriptions of landform, geology and soils. The study area intersects six land systems (Figure 3), which are characterised as follows:

- **Coongimah System**: Plateau surfaces, low hills with steep slopes and undulating uplands supporting hard spinifex grasslands.
- **Oakover System**: Breakaways, mesas, plateaux and stony plains of calcrete supporting hard spinifex shrubby grasslands.
- **Paterson System**: Stony and sandy plains with isolated low hills of sandstone or conglomerate supporting hard spinifex (and occasionally soft spinifex) grasslands and minor tussock grasslands.
- **Billygoat System**: Dissected plains and gravelly slopes supporting hard spinifex grasslands.
- **McKay System**: Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.
- **Rocklea System**: Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.



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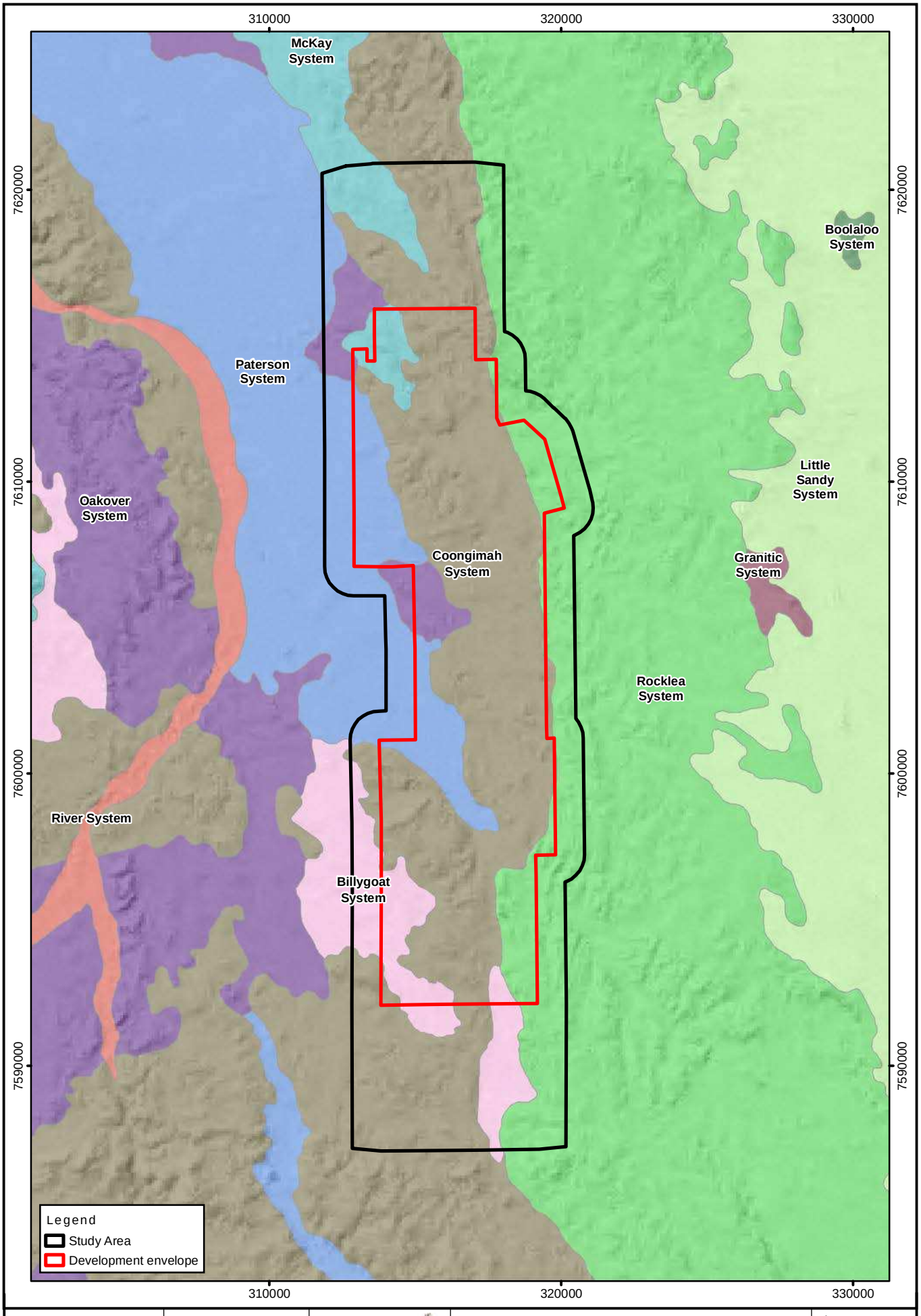

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Western Wildlife

Woodie Woodie Project

Land Systems

Figure: **3**

1.3 Climate and Weather

The climate statistics for Marble Bar (Bureau of Meteorology Site 004106) are presented in Figure 4. The climate is characterised by hot wet summers and cool dry winters. The mean annual rainfall is 376.6mm, based on data collected 2000 – 2021 (BOM 2021). Prior to the survey, annual rainfall was close to average in 2019 (372.6mm) and well above average in 2020 (579.0mm). The weather during each survey period was typically warm and dry (Appendix 1).

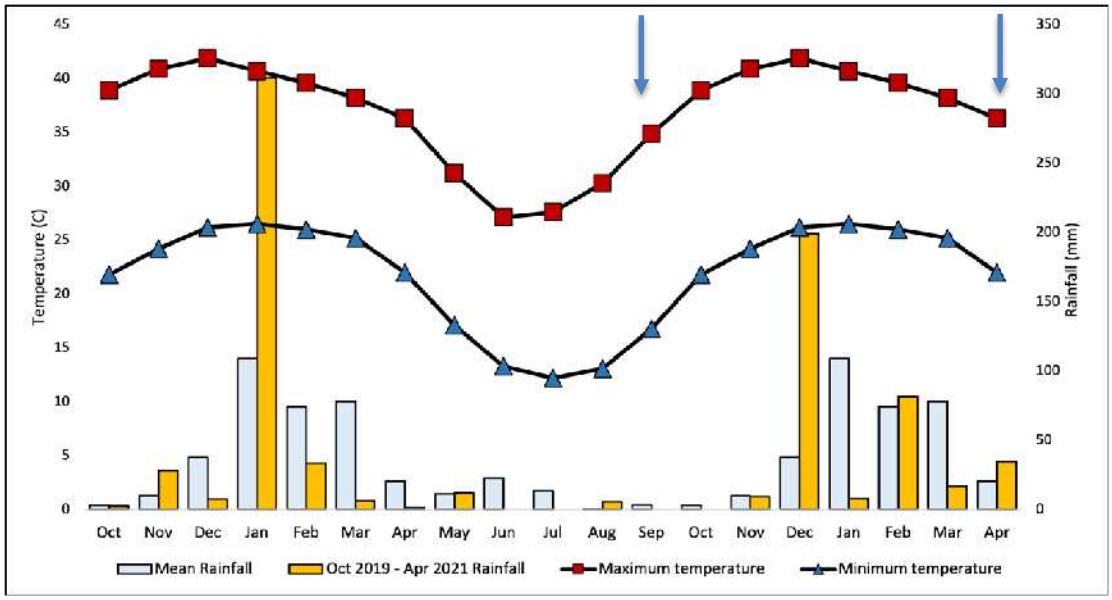


Figure 4. Climate statistics for Marble Bar, arrows showing survey timing (data after BOM 2021).

2. Methods

2.1 Level of Survey

A two-phase detailed vertebrate fauna survey was undertaken in the Woodie Woodie study area in September 2020 and April 2021. The methods are further described in the sections below. The results of the current survey have been supplemented with the results of previous targeted surveys for conservation significant fauna, including the Pilbara Leaf-nosed Bat and Ghost Bat (Western Wildlife 2021), Pilbara Olive Python (Western Wildlife 2020b), Night Parrot (Western Wildlife 2019a) and Northern Quoll (Western Wildlife 2019b, 2020a). Further details of these studies are provided in section 2.5.

2.2 Guidance Documents

The fauna survey was conducted with reference to the following documents:

- Technical guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020)
- Survey Guidelines for Australia's Threatened Mammals (DSEWPaC 2011a)
- Survey Guidelines for Australia's Threatened Bats (DEWHA 2010a)
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010b)
- Survey Guidelines for Australia's Threatened Reptiles (DSEWPaC 2011b)

2.3 Personnel

Four zoologists undertook the fieldwork in September 2020 and six undertook the fieldwork in April 2021, with assistance from the Woodie Woodie environment team. Bat call analysis was provided by Dr Kyle Armstrong of Specialised Zoological. Details of the survey team and their experience are shown in Table 1.

Table 1. Fauna survey personnel.

Name	Role	Qualification	Experience	Phase
[redacted]	Supervising vertebrate zoologist (plan and lead fieldwork, analyse data, prepare report)	BSc. Hons.	21 years	1,2
	Vertebrate zoologist (fieldwork)	BSc.	15 years	1,2
	Vertebrate zoologist (fieldwork)	BSc.	7 years	1,2
	Vertebrate zoologist (fieldwork)	BSc.Hons.	21 years	1,2
	Vertebrate zoologist (fieldwork)	BSc.	10 years	2
	Vertebrate zoologist (fieldwork)	BSc.	10 years	2
	Bat call analysis	PhD.	23 years	1,2

2.4 Taxonomy and Nomenclature

Taxonomy and nomenclature for fauna species used in this report follow the Western Australian Museum checklists. In the text, common names are used where appropriate, and all scientific names are given in species lists. Where a species lacks a common name, it referred to by its scientific name.

2.5 Literature Review

Lists of fauna expected to occur in the study area were produced using information from a number of sources. As far as possible, expected species are those that are likely to utilise the study area. The lists exclude species that have been recorded in the general region as vagrants, or for which suitable habitat is absent within the study area. This is particularly pertinent at Woodie Woodie, as records are returned from the nearby sandy desert, a habitat that is absent from Woodie Woodie.

Various publications provide information on general patterns of distribution of frogs (Tyler *et al*. 2000), reptiles (Wilson and Swan 2017, Storr *et al*. 1983, 1990, 1999 and 2002), birds (Barrett *et al*. 2003; Johnstone and Storr 1998 and 2004) and mammals (Churchill 2008, Menkhorst and Knight 2011; Van Dyck and Strahan 2008). These sources also provide information on habitat preferences and ecology.

The databases listed in Table 2 were searched for fauna records in and around the study area. In all cases the extent of the database search was larger than the extent of the study area in order to pick up records of species in the wider area that may also occur in the study area.

Some species may occur on database results that are not likely to be present in the study areas, usually due to a lack of suitable habitat or the study areas being outside the known range of the species as presented in the literature (i.e. erroneous records). Some records may be historical, with the species known to be locally or regionally extinct. These species are generally not included in lists of expected fauna unless some discussion is thought to be necessary.

Few fauna studies have been undertaken in the region and no relevant surveys could be found within 100km of the Study Area, other than those undertaken at Woodie Woodie. Fauna surveys, including detailed, basic and targeted surveys, have been undertaken at Woodie Woodie between 2006 and 2020 (Table 3).

Table 2. Databases used in the preparation of this report

Database	Type of records held	Area searched
WA Museum Specimen Databases for reptiles, frogs, birds and mammals (NatureMap: DBCA 2007-)	Records of specimens held in the Western Australian Museum. Includes historical records.	40km radius around a point central to the study area (-21.6572°S, 121.2348°E).
Fauna Survey Returns Database (NatureMap: DBCA 2007-)	Records collected from fauna surveys carried out in Western Australia. Includes observational and trapping data.	40km radius around a point central to the study area (-21.6572°S, 121.2348°E).
DBCA's Threatened and Priority Fauna Database (DBCA 2019)	Information and records on Threatened and Priority species in Western Australia.	100km radius around a point central to the study area (-21.6572°S, 121.2348°E).
Birds Australia Atlas Database (NatureMap: DBCA 2007-)	Records of bird observations in Australia, 1998-2009.	40km radius around a point central to the study area (-21.6572°S, 121.2348°E).
Birdata (NatureMap: DBCA 2007-)	Records of bird observations in Australia, 2010-current.	40km radius around a point central to the study area (-21.6572°S, 121.2348°E).
Index of Biological Surveys for Assessment (IBSA) Database	Reports and spatial data from fauna surveys undertaken for environmental impact assessment in Western Australia.	Surveys in the Pilbara Bioregion, within 100km of the study area.
EPBC Act Protected Matters Search Tool	Information and modelled distributions for matters protected under the EPBC Act, including threatened species and ecological communities, migratory species and marine species.	40km radius around a point central to the study area (-21.6572°S, 121.2348°E).

Table 3. Summary of previous fauna surveys at Woodie Woodie, 2006 - 2020.

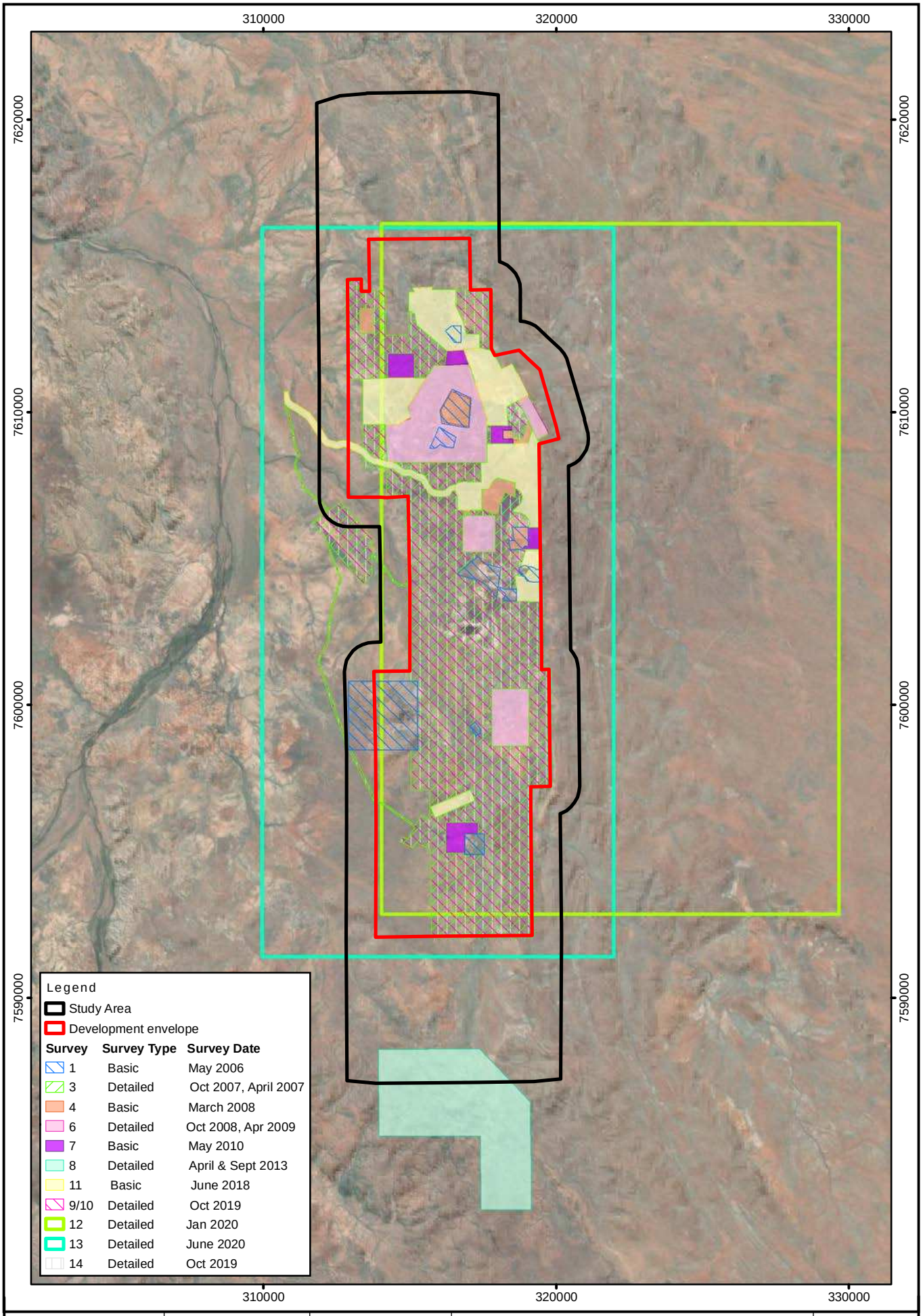
Survey	Date of Survey	Survey Area	Fauna Survey Type	Methods	Vertebrate Fauna Assemblage Recorded	Conservation Significant Fauna Recorded	Reference
1	April 2006	Camp East, Chutney West, Eat, Gulch, Kia, Mac Hill, Paystar, Sat/Nat, Vespa and Scalliwag (see Figure 3)	Basic	Walking transects of the survey areas, opportunistic records of fauna.	• 0 frogs • 2 reptiles • 42 birds • 7 mammals	**Western Pebble-mound Mouse** (inactive mounds)	Western Wildlife (2006a)
2	May 2006	Greensnake and Radio Hill (Radio Hill not accessible)	Targeted (conservation significant fauna)	Walking transects of the survey areas, opportunistic records of fauna.	N/A	**Western Pebble-mound Mouse** (inactive mounds, possible recently active mounds)	Western Wildlife (2006b)
3	October 2006, April 2007	Woodie Woodie Mine corridor (see Figure 3)	Detailed (2-phase)	12 trapping sites, bat detectors, bird surveys, spotlighting and hand-searching for fauna.	• 5 frogs • 59 reptiles • 75 birds • 20 mammals (16 native)	**Pilbara Olive Python** (dead on Nifty Road, outside the Mine corridor). **Wood Sandpiper** (on pond at Rhodes).	Western Wildlife (2007)
4	March 2008	Whiddup, Fault North, Harris, Whodowe, Hunter, Dartmoor, Camp East, Sat/Nat, Chris D, Rhodes, Big Mack (see Figure 3)	Basic	Walking transects of the survey areas, opportunistic records of fauna.	• 0 frogs • 2 reptiles • 41 birds • 1 mammal (1 native)	**Wood Sandpiper** (on pond at Rhodes). **Common Sandpiper** (on pond at Rhodes). **Western Pebble-mound Mouse** (inactive & recently active mounds)	Western Wildlife (2008a)
5	May 2008	Austin	Desktop Assessment	Desktop assessment, no site visit.	N/A	N/A	Western Wildlife (2008b)
6	October 2008, April 2009	Woodie Woodie Mine corridor, including Windy Hill, Whodowe, Hunter, Dartmoor, Big Mack, Greensnake, Chris D, Big Mack West, Fault North and Harris (see Figure 3)	Detailed (2-phase)	10 trapping sites, bat detectors, bird surveys, spotlighting and hand-searching for fauna.	• 2 frogs • 38 reptiles • 62 birds • 16 mammals (13 native)	**Pilbara Leaf-nosed Bat** (calls recorded) **Western Pebble-mound Mouse** (inactive & recently active mounds)	Western Wildlife (2009)

Table 3. (cont.)

Survey	Date of Survey	Survey Area	Fauna Survey Type	Methods	Vertebrate Fauna Assemblage Recorded	Conservation Significant Fauna Recorded	Reference
7	May 2010	Homestead, Parrot, Lucy Mack North, Canyon and Sardine (see Figure 3)	Basic	Walking transects of the survey areas, opportunistic records of fauna.	• 0 frogs • 2 reptiles • 35 birds • 3 mammals	**Western Pebble-mound Mouse** (inactive & recently active mounds)	Western Wildlife (2010)
8	April and Sept 2013	South Woodie and Max (see Figure 3)	Detailed (2-phase)	8 trapping sites, bat detectors, bird surveys, spotlighting, transects for conservation significant fauna and hand-searching for fauna.	• 1 frog • 44 reptiles • 67 birds • 23 mammals (19 native)	**Pilbara Leaf-nosed Bat** (calls recorded) **Western Pebble-mound Mouse** (active & inactive mounds)	Western Wildlife (2014)
9	June 2018	Woodie Woodie Mine corridor	Targeted (Night Parrot)	Passive acoustic detector recordings at 16 sites	N/A	Nil	Western Wildlife (2019a)
10	June 2018	Woodie Woodie Mine corridor	Targeted (Northern Quoll)	Camera trapping at 10 sites	N/A	**Northern Quoll** detected on several cameras across four sites.	Western Wildlife (2019b)
11	June 2018	Access Track, Chris D, Fault North, Hunter, Radio Hill, Rhodes, Vespa (see Figure 3)	Basic	Walking transects of the survey areas, opportunistic records of fauna.	• 0 frogs • 4 reptiles • 57 birds • 6 mammals (3 native)	**Northern Quoll** (recorded within survey areas on camera as part of above survey) **Peregrine Falcon** (overflying Radio Hill) **Western Pebble-mound Mouse** (inactive mounds).	Western Wildlife (2019c)
12	June 2019	Woodie Woodie Mine corridor	Targeted (Northern Quoll)	Trapping for Northern Quoll using large Elliott traps and cage traps in transects at 4 sites.	N/A	**Northern Quoll** captured at 2 sites.	Western Wildlife (2020a)

Table 3. (cont.)

Survey	Date of Survey	Survey Area	Fauna Survey Type	Methods	Vertebrate Fauna Assemblage Recorded	Conservation Significant Fauna Recorded	Reference
13	February 2020	Woodie Woodie Mine corridor	Targeted (Pilbara Olive Python)	Nocturnal walking transects spotlighting for pythons in suitable habitat.	N/A	**Pilbara Olive Python** (1 dead on road, 1 in Muddauthera Creek)	Western Wildlife (2020b)
14	June 2020	Woodie Woodie Mine corridor	Targeted (Ghost Bat and Pilbara Leaf-nosed Bat)	Anabat survey and searches for potential roost caves.	N/A	**Pilbara Leaf-nosed Bat** (calls recorded, no evidence of diurnal roosting)	Western Wildlife (2021)



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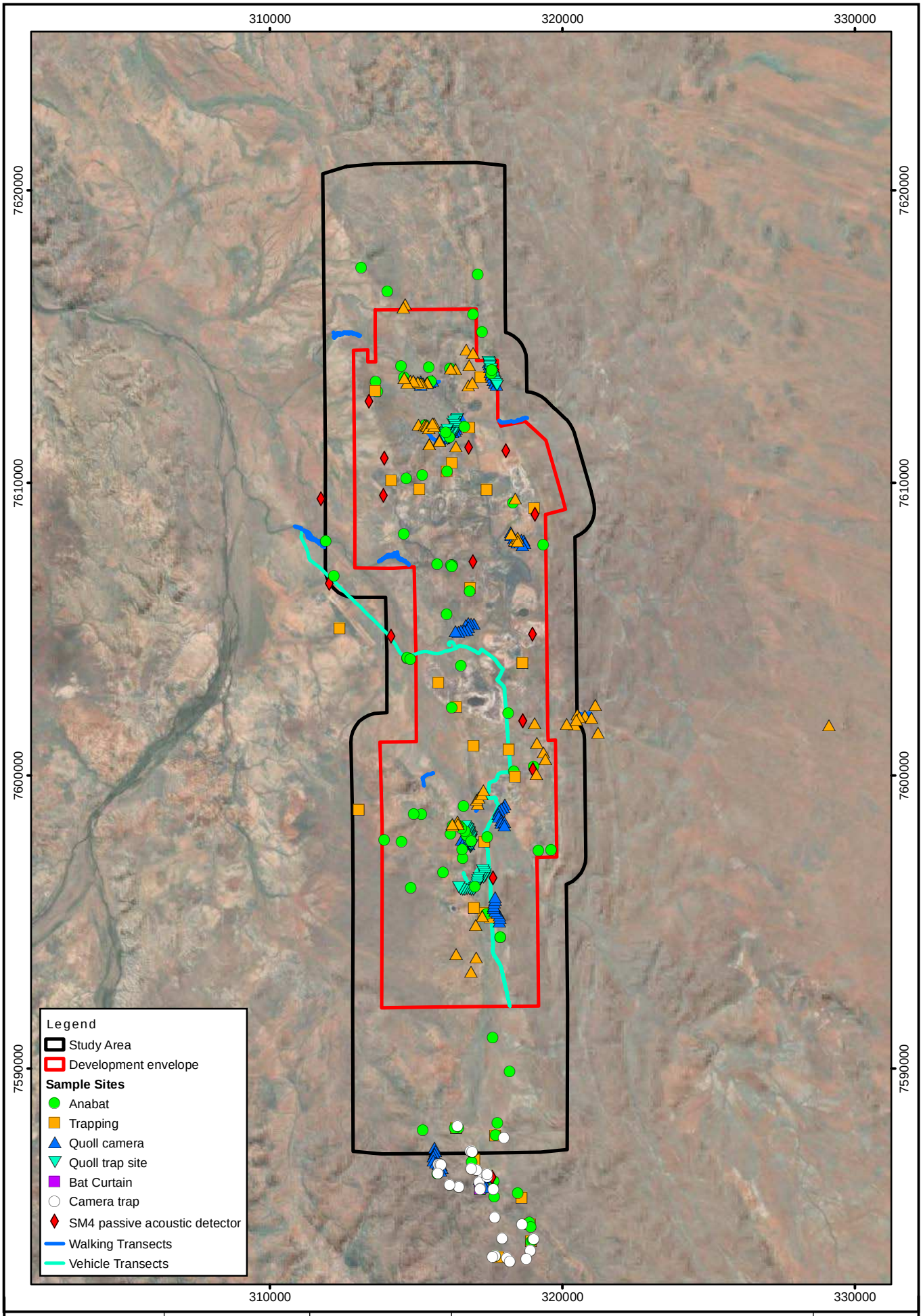
Previous Fauna Survey Coverage

Figure: **5**



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Previous Fauna Survey Sample Sites

Figure: **6**

2.6 Field Survey

2.6.1 Licensing

All fauna works were carried out under Fauna Taking (Biological Assessment) Licence BA27000323 and Authorisation to Take or Disturb Threatened Species TFA 2020-0108 issued by the Department of Biodiversity, Conservation and Attractions (DBCA).

2.6.2 Timing

Trapping in both phases was undertaken during the recommended September – April survey period for reptiles in the Eremaean region (EPA 2020). Bird surveys were concentrated in the April post-wet survey, taking advantage of the increased productivity after summer rain.

2.6.3 Trapping for Terrestrial Fauna

Trapping for terrestrial fauna (frogs, reptiles and small mammals) was undertaken in the throughout the study area, aiming to complement the layout of previous trapping sites. The trapping sites were placed to sample the key habitats present for ground-dwelling fauna, provide geographic spread and in a layout that could be checked in a timely manner. The habitats sampled were Spinifex Plains, Spinifex Stony Hills (including two sites near rocky outcrops) and Major Creeklines. The Minor Creekline habitat was common in the study area, mostly at a scale too small to be mapped, however, sites 6, 7 and 8 all included minor creeks within the trapping grid.

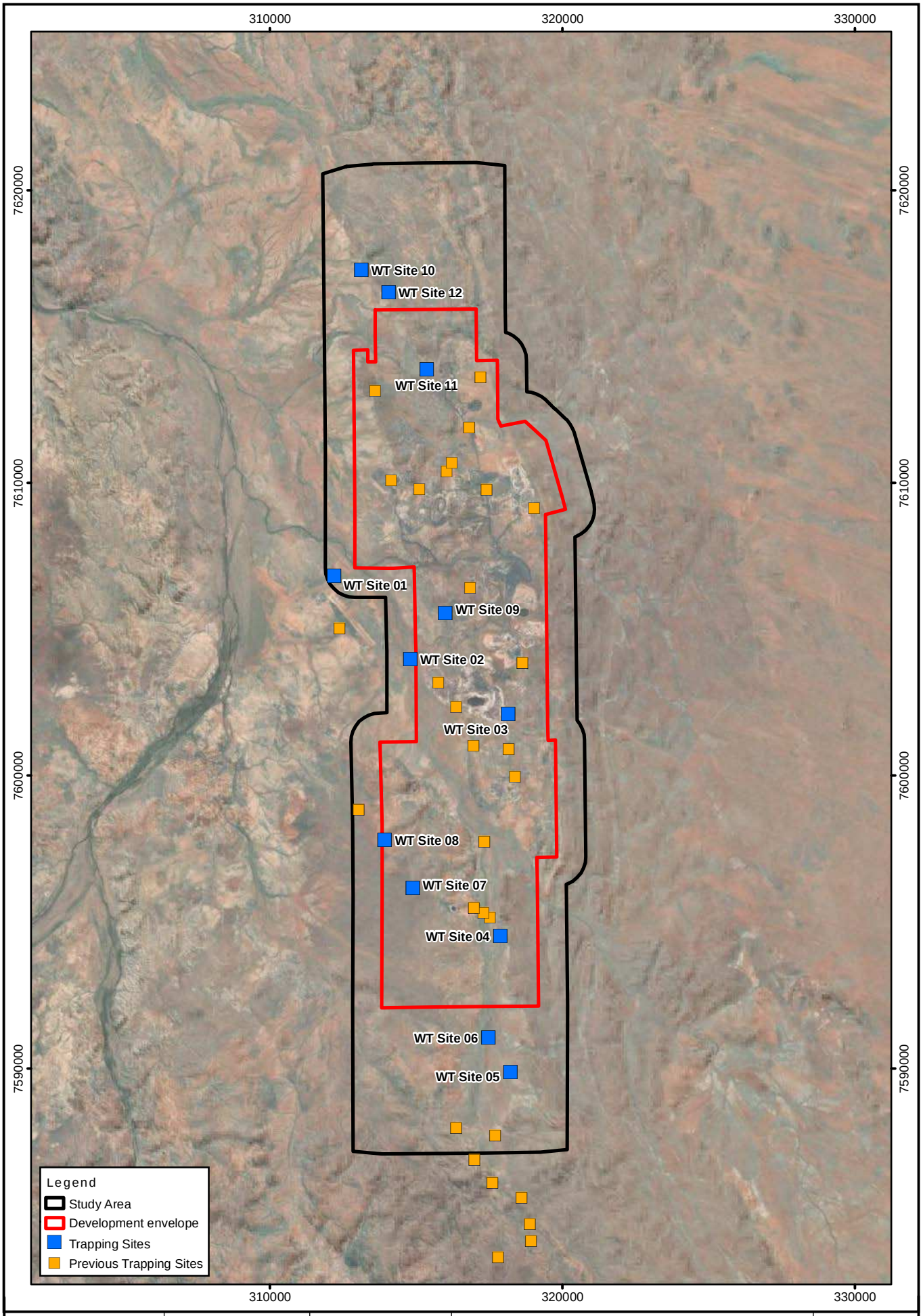
Twelve trapping sites were installed, each consisting of ten pitfall traps, ten funnel traps, 12 Elliott traps and two cage traps open for seven nights in each phase (Table 4). The traps were placed in five transects of two pitfall traps and two funnel traps on a 15m flywire driftfence. Pitfall traps were a combination of six 40cm deep, white 20L buckets and four 60cm deep, 150mm wide PVC pipes. Each bucket had a piece of egg carton and a small amount of dirt to provide shelter for any fauna in the trap. The funnel traps were set with the fence bisecting the funnel entrances. Funnel traps were shaded with a shade-cloth cover, and on exposed sites, shaded with additional layers of hessian or shade-cloth, as well as vegetation (Plate 1).

Elliott traps were placed in a separate transect of 12 traps with the two cage traps at either end. All cage and Elliott traps were placed under vegetation to shade any captured animals and cage traps were covered with a hessian sack. All Elliott and cage traps were baited with a mixture of rolled oats, sardines, peanut butter and vanilla essence.

Each site was open for seven nights in phase, giving a total of 1,680 pitfall trap-nights (1,008 bucket and 672 pipe), 1,680 funnel trap-nights, 2,016 Elliott trap-nights and 336 cage trap-nights across the two survey phases. Photographs of each site are given in Plates 2 - 13. All animals caught were identified and recorded, most released immediately at the site of capture, otherwise temporarily held for identification before release as soon as practicable.

Table 4. Trapping site locations.

Site	Dates open	Location			Habitat
WT Site 01	19 – 26/9/2020 22 – 29/4/2021	51	312195	7606823	Spinifex plain.
WT Site 02	19 – 26/9/2020 22 – 29/4/2021	51	314798	7603973	Major creekline.
WT Site 03	20 – 27/9/2020 23 – 30/4/2021	51	318149	7602104	Spinifex plain.
WT Site 04	20 – 27/9/2020 23 – 30/4/2021	51	317882	7594528	Major creekline.
WT Site 05	20 – 27/9/2020 23 – 30/4/2021	51	318222	7589851	Spinifex plain.
WT Site 06	21 – 28/9/2020 23 – 30/4/2021	51	317476	7591047	Spinifex stony hill near rocky outcrops and with a minor creekline.
WT Site 07	21 – 28/9/2020 23 – 30/4/2021	51	314886	7596156	Spinifex plain with minor creeklines.
WT Site 08	22 – 29/9/2020 24 – 1/5/2021	51	313937	7597795	Spinifex stony hill with minor creeklines.
WT Site 09	22 – 29/9/2020 24 – 1/5/2021	51	316011	7605550	Spinifex stony hill.
WT Site 10	23 – 30/9/2020 24 – 1/5/2021	51	313125	7617279	Spinifex plain.
WT Site 11	23 – 30/9/2020 24 – 1/5/2021	51	315364	7613861	Spinifex stony hill.
WT Site 12	24 – 1/10/2020 24 – 1/5/2021	51	314059	7616507	Spinifex stony hill near rocky outcrops.



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Trapping Sites

Figure: **7**

Plate 1. Examples of trap line set-up.

Plate 2. Site 1 – spinifex plain.

Plate 3. Site 2 – major creekline.

Plate 4. Site 3 – spinifex plain.

Plate 5. Site 4 – major creekline.

Plate 6. Site 5 – spinifex plain.

Plate 7. Site 6 – stony hill near rocky outcrop and minor creekline.

Plate 8. Site 7 – spinifex plain with minor creekline.

Plate 9. Site 8 – footslope of stony hills with minor creekline.

Plate 10. Site 9 – stony hills.

Plate 11. Site 10 – spinifex plain.

Plate 12. Site 11 – stony dolomite hill.

Plate 13. Site 12 – stony hill near rocky outcrops.

2.6.4 Bird Surveys

In September 2020, birds were only recorded opportunistically as conditions were hot and dry and bird activity was minimal. No systematic surveys were undertaken on this phase.

In April 2021, bird surveys were undertaken at each trapping site to give a total of six 20-minute surveys at each site, (24 hours in total across all sites). Surveys were within 300m of the trapping site. Surveys at trapping sites were undertaken concurrently with morning trap checks, between sunrise and approximately 9am. Birds were recorded if seen or heard. Birds were recorded as present only, and a frequency of occurrence calculated for each site in April (sample size = 6).

A total of 36 additional 20-minute birds surveys were undertaken across the study area in 2021 (Figure 8). Birds were also recorded during targeted searches, with some targeted searches aiming to survey habitats that may attract birds, such as creeklines. Birds were also recorded opportunisitically.

2.6.5 Bat Survey

Bat calls were recorded using two Anabat Swift call detector set to record between dusk and dawn. The detectors were deployed overnight at each trap site and then at other sites around the study area, targeting habitats likely to be attractive to bats such as creeklines. This resulted in a total of 20 nights of recordings in September 2020 and 18 nights of recordings in April 2021 (Appendix 2, Figure 8). In general, only a single night of recording was undertaken at each site, as the purpose of the survey was to compile an overall list of the species occurring in the study area. Habitats sampled were almost entirely foraging habitat, and the calls of the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) are easily detected, even on a single night.

The calls were then analysed by Kyle Armstrong of Specialised Zoological, and the bat calls identified to species level where possible. As an indication of activity, the number of 'passes' was counted for the Pilbara Leaf-nosed Bat for each night where this species was recorded.

2.6.6 Targeted Searches

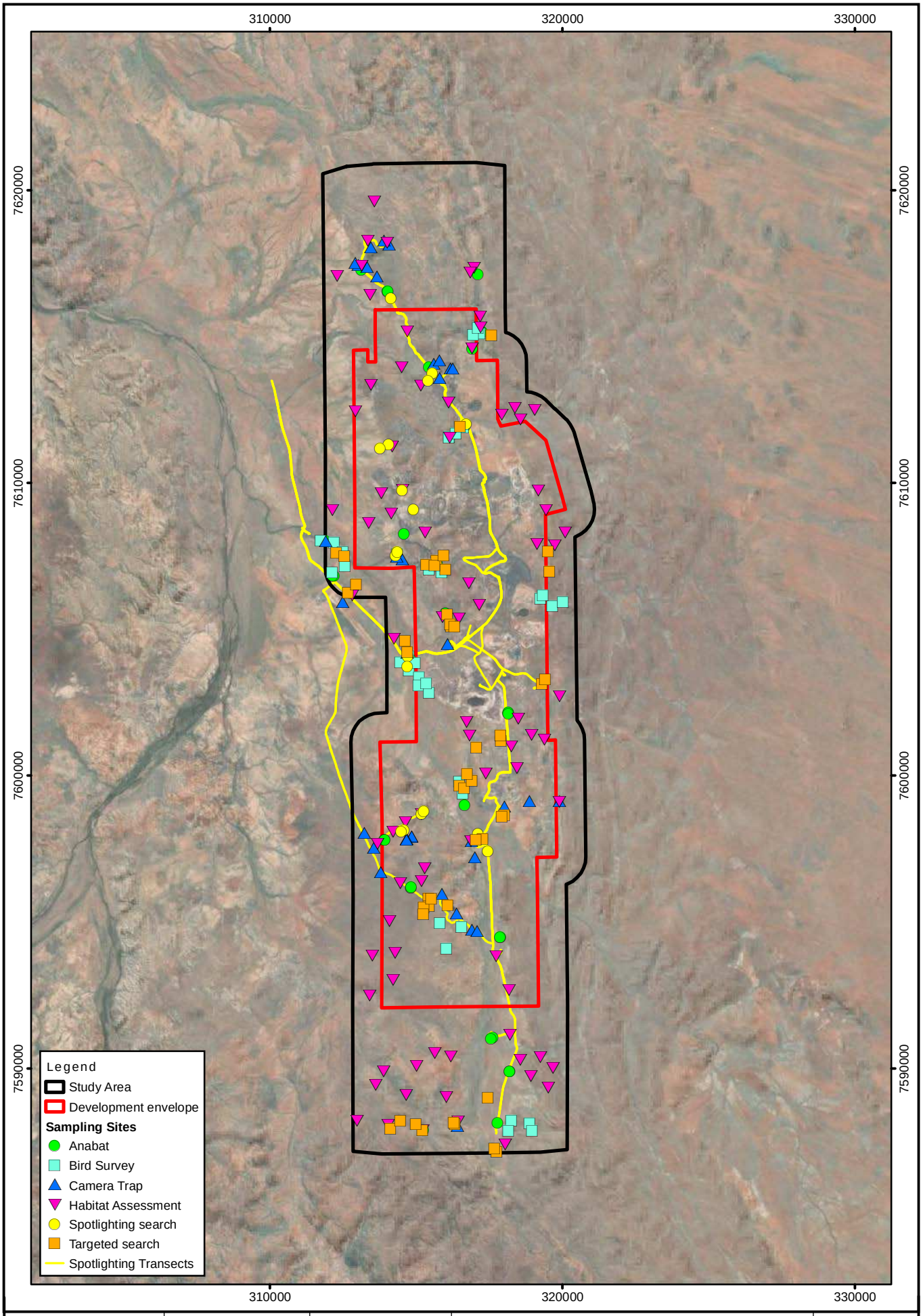
Targeted searches were undertaken throughout the study area (Appendix 3, Figure 8). The purpose of these was to search for species or evidence of species that are not readily trapped, and to search for signs of conservation significant fauna where potential habitat was found. For example, rocky areas were searched for scats of Northern Quoll (*Dasyurus hallucatus*) and stony slopes were searched for the mounds of the Western Pebble Mound Mouse (*Pseudomys chapmani*).

Species such as the Grey Falcon (*Falco hypoleucos*) and Peregrine Falcon (*Falco peregrinus*) were also targeted at search sites. As these species are distinctive diurnal birds, no specific methodology other than vigilance was required.

Reptiles were targeted by hand-searching in suitable habitat. Hand-searching involved raking through leaf litter, peeling bark from dead trees and raking through windrows of dead Spinifex. Any reptiles found were identified and released in situ. Birds were also targeted in searches, with all species seen or heard recorded. All other fauna and secondary signs of fauna encountered while undertaking targeted searches were also recorded.

2.6.7 Spotlighting

Spotlighting was carried out on the 27th, 28th and 29th September 2020, and the 1st and 2nd May 2021, from 6:00pm – 9:30pm. A combination of road-spotting using vehicle headlights and hand-searching using head-torches was used to target nocturnal fauna. Head-torching was used to sample habitats that are otherwise difficult to trap, such as rocky outcrops and waterholes. The routes followed and search sites are shown in Figure 8.



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Other Sampling Sites

Figure: **8**

2.6.8 Camera Traps

Camera traps were deployed at 36 sites across the two phases of the field survey, to give 175 trap-nights. (Appendix 4, Figure 8). Cameras were deployed to target habitat that conservation significant may use, as well as sampling a range of habitats including rocky areas that are difficult to otherwise trap. Cameras were baited with a mixture of rolled oats, peanut butter and sardines.

2.6.9 Opportunistic Records

At all times, observations of fauna were noted when they contributed to the accumulation of information on the fauna of the site. These included casual observations of reptiles, mammals and birds seen while travelling between sites or while undertaking other activities, such as targeted searches. All opportunistic observations were recorded with a GPS location.

2.7 Habitat Assessment and Mapping

2.7.1 Habitat Assessment

Habitat assessments were undertaken at 83 points across the study area (Figure 8, Appendix 5). At each habitat assessment site the following were recorded:

- GPS co-ordinate
- Representative photographs
- Habitat name
- Landform
- Vegetation (brief description of structure and dominant species, if known)
- Fire age
- Disturbance (e.g., weeds, grazing, firewood collection)
- Soil colour and type
- Rock type and presence of any outcropping
- Important habitat elements, including, but not limited to the presence of:
    - Leaf litter accumulations
    - Woody debris and logs
    - Tree hollows or crevices
    - Soils suitable for burrowing
    - Long-unburnt vegetation
    - Water
    - Caves or rock crevices
    - Dense shelter vegetation
    - Important plant species for conservation significant fauna
- Presence of wetlands
- Any fauna

2.7.2 Habitat Mapping

Habitat mapping was undertaken using observations made by fauna personnel in the field, habitat assessments at 83 points across the study area, interpretation of aerial photography and vegetation mapping completed by Umwelt Australia (2021).

2.8 Assessment of Conservation Significance

2.8.1 Legislative Protection for Fauna

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Commonwealth Government's primary piece of environmental legislation. Listed under Part 3 of the EPBC Act are 'Matters of National Environmental Significance' (MNES); these include threatened species, threatened ecological communities and migratory species. Threatened fauna species are assessed against categories based on International Union for Conservation of Nature (IUCN) criteria.

The migratory species listed under the EPBC Act are those recognised under international agreements. These agreements are the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA), or species listed under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) for which Australia is a range state.

Matters of National Environmental Significance (MNES) include the following categories:

- **Extinct in the wild (EW)**: Taxa known to survive only in captivity.
- **Critically Endangered (Cr)**: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En)**: Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu)**: Taxa facing a very high risk of extinction in the wild in the medium-term future.
- **Migratory (Mi):** Taxa listed under international agreements to which Australia is a party.

Reports on the conservation status of most vertebrate fauna species have been produced by the federal Department of Agriculture, Water and the Environment (DAWE) in the form of Action Plans. An Action Plan is a review of the conservation status of a taxonomic group against IUCN categories. Action Plans have been prepared for amphibians (Tyler 1998), reptiles (Cogger *et al*. 1993), lizards and snakes (Chapple *et al*. 2017), birds (Garnett *et al*. 2011) and mammals (Woinarski *et al*. 2014). These publications also use categories similar to those used by the EPBC Act. The information presented in some of the earlier Action Plans may be out of date due to changes since publication.

The *Biodiversity Conservation Act 2016* (BC Act) is State legislation that aims to conserve and protect biodiversity and biodiversity components in Western Australia, including threatened fauna. It is administered by the Department of Biodiversity, Conservation and Attractions (DBCA). In addition to threatened fauna, the BC Act has scope to protect threatened ecological communities and important habitats.

Fauna species are listed under the BC Act as threatened species using IUCN categories, or as specially protected species, as described below.

Threatened Species:

- **Extinct in the wild (EW)**: Taxa known to survive only in captivity.
- **Critically Endangered (Cr)**: Taxa facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered (En)**: Taxa facing a very high risk of extinction in the wild in the near future.
- **Vulnerable (Vu)**: Taxa facing a very high risk of extinction in the wild in the medium-term future.

Specially Protected Species:

- **Migratory (Mi)**: A subset of the migratory fauna that are known to visit Western Australia that are protected under the international agreements or treaties, excluding species that are listed as Threatened species.
- **Conservation dependent fauna (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened
- **Other specially protected species (OS):** fauna in need of special protection to ensure their conservation.

The BC Act supersedes the *Western Australian Wildlife Conservation Act 1950* (WC Act).

Priority species are not listed under State or Commonwealth Acts. In Western Australia, DBCA maintains a list of Priority Fauna made up of species that are possibly Threatened but do not meet adequacy of survey requirements or are otherwise data deficient. There are four levels of Priority as defined by DBCA, as listed below.

- **Priority 1:** Poorly known species (on threatened lands)
- **Priority 2:** Poorly known species in few locations (some on conservation lands)
- **Priority 3:** Poorly known species in several locations (some on conservation lands)
- **Priority 4:** Rare, near threatened and other species in need of monitoring

2.8.2 Levels of Conservation Significance in this report

Five levels of conservation significance are used within this report to indicate the level of significance of fauna species, according to the following criteria:

- **Threatened (T):** Taxa listed as Extinct in the Wild, Critically Endangered, Endangered or Vulnerable under the EPBC Act and/or BC Act. These species are grouped as they are all species considered to be at risk of extinction, are often rare and are likely to be subject to on-going threatening processes.
- **Migratory (Mi):** Taxa listed as Migratory under the EPBC Act and/or BC Act, excluding those species also listed as threatened. These species are grouped as they are not necessarily rare, but may be dependent on specific habitats for a portion of their life-cycle. For these species, loss of important foraging, breeding or stop-over sites may have a disproportionately large impact on populations.
- **Specially Protected (SP):** Taxa listed as Other Specially Protected Species or Conservation Dependent Fauna under the BC Act. These species are not necessarily rare, but may be dependent on on-going conservation to ensure their protection.
- **Priority (P):** Taxa listed as Priority by DBCA. These species are grouped as they are either conservation dependent or data deficient and in need of further survey.
- **Locally Significant (LS):** Locally significant taxa are not listed under State or Commonwealth Acts or in publications on threatened fauna or as Priority species by DBCA, but are considered by the author to potentially be of local significance because they are at the limit of their distribution in the area, they have a very restricted range or they occur in breeding colonies (e.g. some waterbirds). This level of significance has no legislative recognition and is based on interpretation of information on the species patterns of distribution. For example, the Government of Western Australia (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Bush Forever. Recognition of such species is consistent with the aim of preserving regional biodiversity.

2.9 Species Accumulation Curves

A species accumulation curve at its most simple is a graph of the number of detected species against sampling effort. However, the curve is usually derived through sub-sampling the dataset to find a mean curve, otherwise known as a sample-based rarefaction curve.

Species accumulation curves were calculated for reptiles, mammals and birds in each habitat. The species richness was graphed against the number of individuals for reptiles and mammals. For birds, the species richness was graphed against a sampling unit of all species observed in a 20-minute bird survey at a trapping site or on an opportunistic 20-minute bird survey.

The statistical package EstimateS (Colwell 2013) was used to find a non-parametric estimator of species richness; either Chao1 or Chao2. Chao1 uses abundance data to provide an estimation of the lower bound of species richness and is a good estimator of the actual species richness when the sample size is large or the rare species in the sample have similar detection probabilities (Chao and Chiu 2016). Chao2 is similar, but uses incidence (presence only, no abundance) data only. For large sample sizes, if Chao 1 or Chao 2 are equal to the observed number of species, then the accumulation of species is assumed to have reached an asymptote (Colwell 2013).

Jackknife estimators of species richness are not used, as they typically underestimate the true species richness when the sample is small, (as is often the case in detailed surveys) and overestimate when the sample is large. Thus there is only a small window when the Jackknife estimators are close to the true species richness (Chao and Chiu 2016).

2.10 Likelihood of Occurrence

Fauna of conservation significance were assessed and ranked for their likelihood of occurrence in the study area, according to the criteria in Table 5.

Table 5. Criteria for assessing likelihood of occurrence.

Likelihood	Criteria
Unlikely	• The study area is outside the current known distribution of the species as presented in the literature. • No suitable habitat was identified as being present during the field survey. • For some species, individuals may occur occasionally as vagrants, especially if suitable habitat is located nearby, but the study area itself would not support the species. • May include species generally accepted as being locally extinct.
Possible	• The study area is within or just outside the current known distribution of the species, as presented in the literature. • Any habitat present is either limited in extent or of marginal quality at best. • No recent or nearby records of the species on databases. • The species is generally known to be less common in the vicinity of the study area (e.g., for inland sites, where the species usually occurs on the coast).
Potential	• The study area is within the current known distribution of the species, as presented in the literature. • Habitat of reasonable quality was identified as being present during the field survey. • There are some recent and/or nearby records of the species of databases.
Likely	• The study area is well within the current known distribution of the species, as presented in the literature. • Habitat of good quality was identified as being present during the field survey. • Many recent and nearby records of the species on databases.
Known to occur	• The species was positively identified in the study area during this field survey or recorded as occurring in the study area on previous recent field surveys. • Note that for a species 'known to occur', the habitat may still be marginal and therefore the population may be small, or the species may visit the site irregularly.

3. Survey Limitations

Various factors can limit the effectiveness of a fauna survey. Pursuant to EPA Technical Guidance (EPA 2020), these factors have been identified and their potential to impact on the effectiveness of the surveys has been assessed in Table 6 below. All fauna surveys have limitations, and not all fauna species present on the site are likely to be sampled during a survey. Fauna may not be recorded because they are rare, they are difficult to trap or observe, or because they are only present on the site for part of the year.

Table 6. Fauna survey limitations.

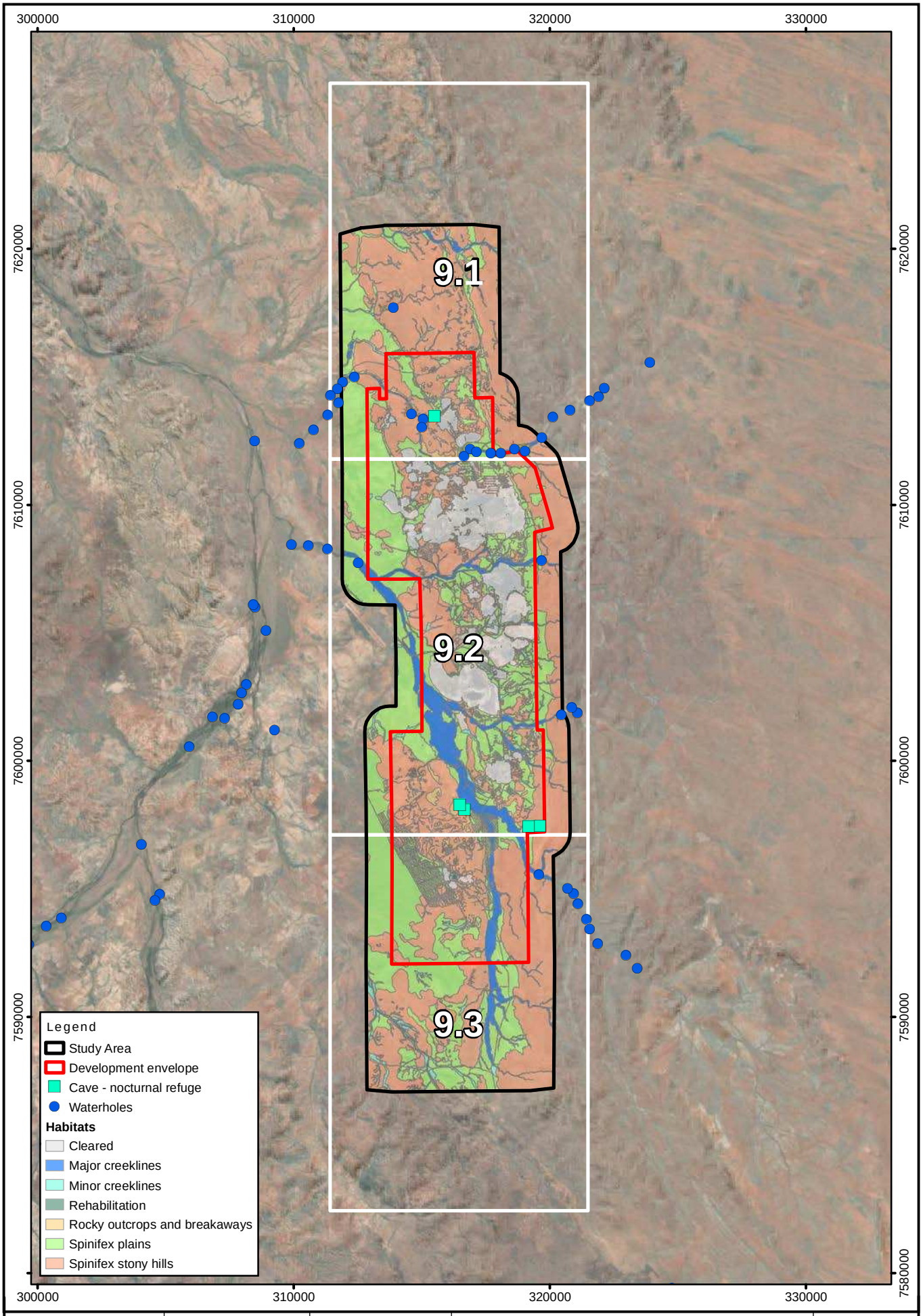
Potential Limitation	Extent of limitation for the fauna survey	
Availability of data and information	Not limiting	Fauna studies have been undertaken at Woodie Woodie since 2006, including trapping surveys and targeted surveys for conservation significant fauna, so there is a relatively large amount of local data available.
Competency /experience of the team carrying out the survey	Not limiting	The lead zoologist has 21 years' experience with fauna surveys in Western Australia. The field team have between seven and 21 years' experience. All survey zoologists have previously undertaken surveys in the Pilbara Bioregion.
Scope of survey (e.g., faunal groups excluded from the survey)	Not limiting	The survey scope was consistent with that for detailed surveys in the Pilbara. The survey methods and timing aimed to sample the birds, reptiles and mammals of the study area, and frogs were sampled in the post-wet survey.
Timing, weather and season	Not limiting	The survey timing was consistent with EPA (2020) guidance for sampling reptiles, birds and mammals. Two seasons were sampled, September 2020 (dry) and April 2021 (post-wet), increasing the chance of recording fauna. The annual rainfall in the two years prior to the survey were average and above-average, so it is likely that faunal populations were not depressed by, e.g., drought conditions.
Disturbance that may have affected the results	Not limiting	Although parts of the study area were recently burnt, unburnt habitat was also available to sample. Likewise, although habitats close to mining areas are likely to experience some disturbance (e.g., noise, light or dust), undisturbed areas were available to sample.
Proportion of fauna identified, recorded and/or collected.	Not limiting	A large proportion of the potentially occurring fauna have been recorded in this and previous surveys at Woodie Woodie.
The adequacy of the survey intensity and proportion of survey achieved (e.g., extent to which the area was surveyed)	Not limiting	Sufficient time was allowed to survey all habitats. A representative proportion of all habitats was able to be accessed and surveyed.
Remoteness and/or access problems	Minor limitation	The majority of the study area was accessible by vehicle or on foot, but some parts in the east are considerable distances from tracks. Although the study area is very large, a representative portion of all habitats was sampled.
Problems with data and analysis, including sampling biases	Not limiting	No complex analyses were undertaken, and no problems were noted.

4. Fauna Habitats of the Study Area

Five fauna habitats were identified in the study area, plus cleared and rehabilitated areas (Table 7, Figure 9). Important habitat features in the study area include small caves (associated with the rocky outcrop and breakaways habitat) and waterholes (associated with the major creekline habitat). The habitats are described in the sections below, with descriptions compiled from those in Umwelt (2021) and observations on this survey.

Table 7. Fauna habitats in the study areas.

Habitat	Key Habitat Elements	Total Area (ha)	
		Study area	Development envelope
Rocky outcrops and Breakaways	• Small caves, cracks and crevices in rocky outcrops provide shelter for reptiles and small mammals. • Caves provide roost sites for common bat species and nocturnal refuge sites for the Pilbara Leaf-nosed Bat. • Provides shelter/denning habitat for the Northern Quoll	416	289
Spinifex stony hills	• Stony lower slopes and flat hilltops provide habitat for the Western Pebble-mound Mouse. • Minor rocky outcrops provide shelter for saxicoline reptiles.	11,488	4,605
Spinifex plains	• Patches of large spinifex in low-lying areas provide shelter for reptiles and mammals.	8,136	3936
Major creeklines	• Mature trees with hollows provide shelter and breeding sites for hollow-using birds, bats and arboreal reptiles. • Sandy flats on creek edges provides habitat for fossorial reptiles. • Woody debris in the creek bed provides habitat for reptiles. • Permanent and semi-permanent waterholes provide water for bathing, drinking and foraging.	1,378	865
Minor creeklines	• Dense vegetation in creeklines provides habitat for breeding and foraging birds.	630	240
Rehabilitation	• Has value as fauna habitat, depending on the age and quality of rehabilitation.	237	230
Cleared	• Little value as fauna habitat, may be used by species that favour open areas for foraging.	2,585	2,543
	Total:	**24,870**	**12,708**



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MGA94 (Zone 51)

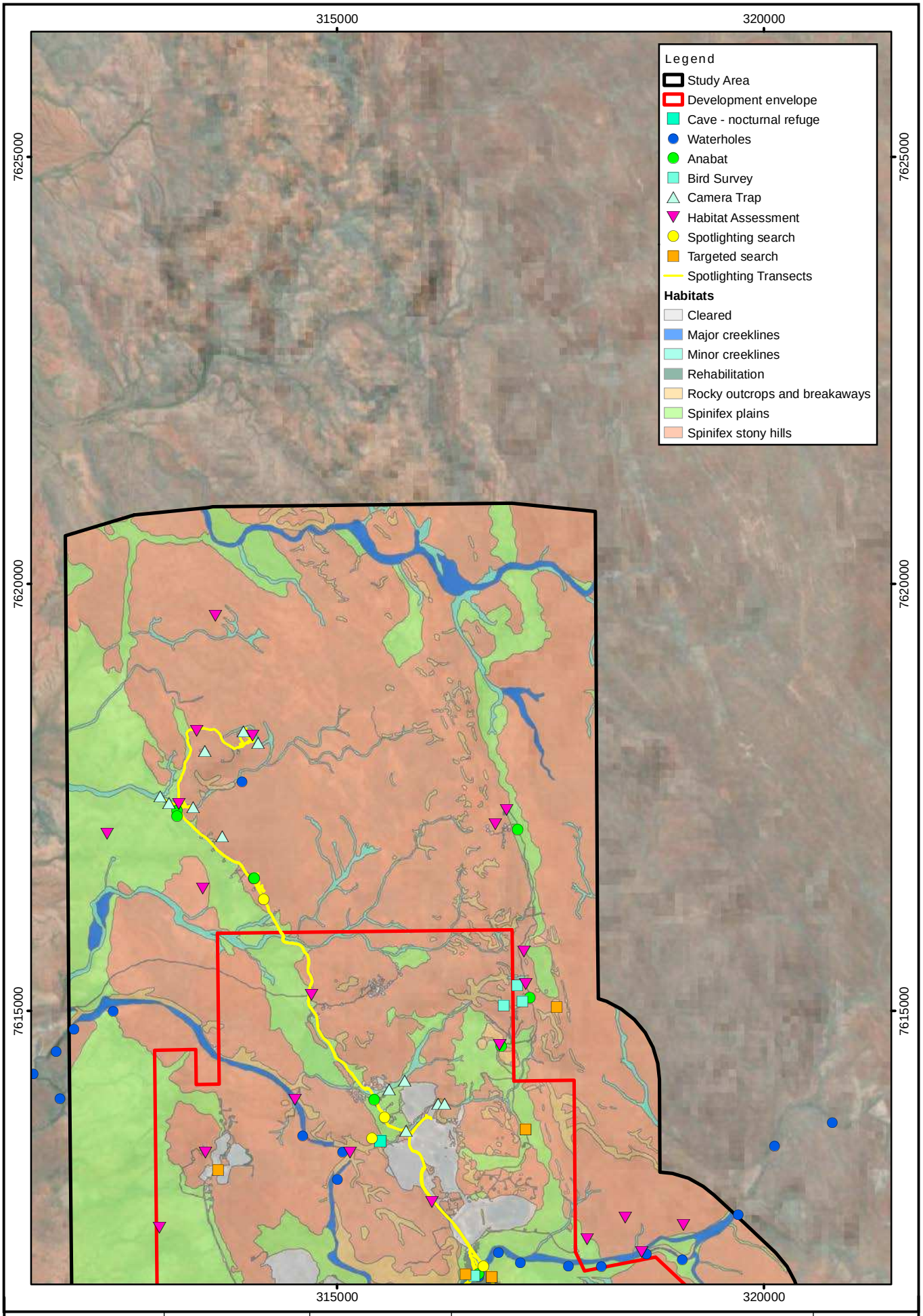
Author: J. Wilcox

Western Wildlife

Woodie Woodie Project

Fauna Habitats

Figure: **9**



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Scale: 1:60,000
MGA94 (Zone 51)

Author: J. Wilcox

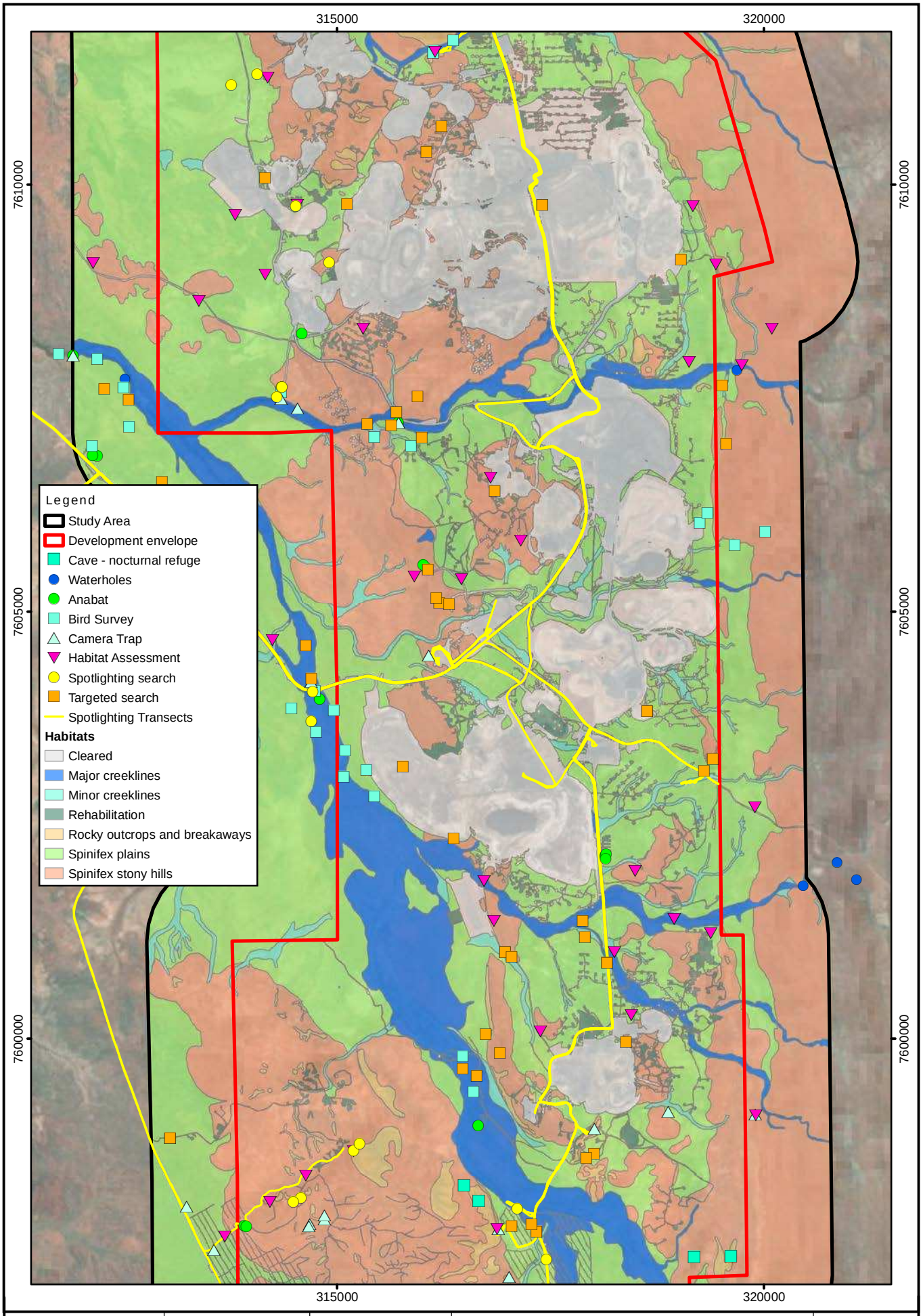
Western Wildlife

Woodie Woodie Project

Fauna Habitats

Figure:

9.1



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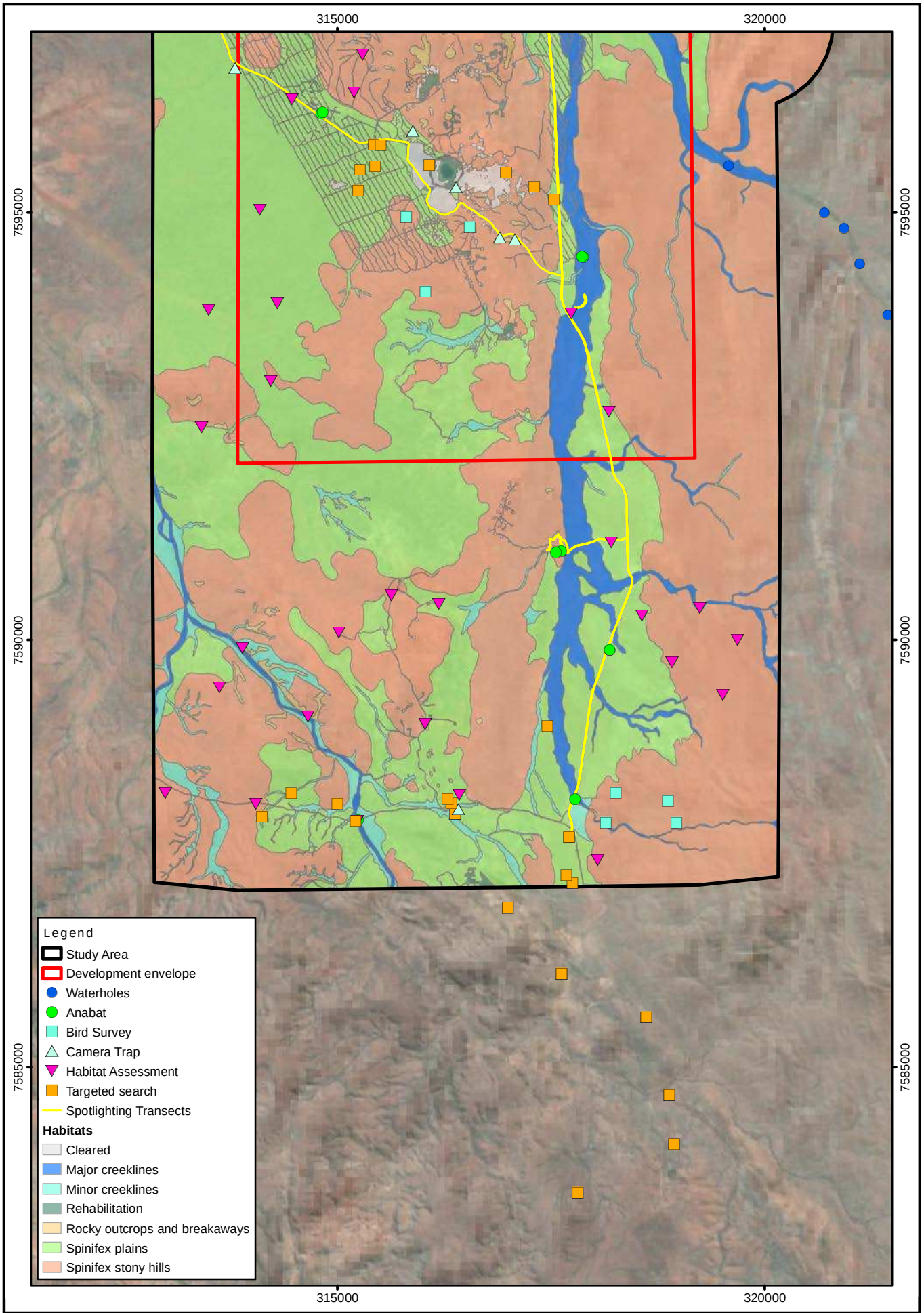
Fauna Habitats

Figure: **9.2**



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Date: December 2021 | Rev: A | Author: J. Wilcox

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Scale: 1:60,000
MGA94 (Zone 51)

Western Wildlife

Woodie Woodie Project

Fauna Habitats

Figure: **9.3**

4.1 Rocky Outcrops and Breakaways

Rocky outcrops and breakaways are generally sparsely vegetated with spinifex (*Triodia* spp.), *Acacia* shrubs and occasional Eucalypts (Plates 14 – 16). The cracks, crevices and caves that occur in this habitat provide shelter for many fauna species. Conservation significant fauna that may be associated with this habitat include the Peregrine Falcon (*Falco peregrinus;* Specially Protected), Northern Quoll (*Dasyurus hallucatus;* Endangered), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia;* Vulnerable) and Ghost Bat (*Macroderma gigas*; Vulnerable).

Plate 14. Rocky breakaways.

Plate 15. Rocky outcrops.

Plate 16. Rocky breakaway.

4.2 Spinifex Stony Hills

Stony hills support spinifex hummock grassland with or without an open shrubland of *Acacia* spp. and/or *Hakea lorea* with occasional *Eucalyptus* sp. (Plates 17 - 20). This habitat lacks the more rugged rocky formations of the Rocky Outcrops and Breakaways habitat but may still have small outcrops that provide shelter habitat for reptiles. Conservation significant fauna associated with this habitat is the Western Pebble-mound Mouse (*Pseudomys chapmani*; Priority 4).

Plate 17. Stony hills.

Plate 18. Stony hills.

Plate 19. Stony hills with minor rocky outcrops.

Plate 20. Recently burnt stony hills.

4.3 Spinifex Plains

Flat to undulating plains, usually with a stony surface, support a spinifex hummock grassland with varying amounts of *Acacia* shrubland (Plates 21 – 23). The soils are generally loams, clay-loams or clays in low-lying parts. In unburnt areas where there is water run-off, the spinifex can be relatively large. Conservation significant fauna possibly associated with this habitat include the Night Parrot (*Pezoporus occidentalis*; Critically Endangered) and the Lakeland Downs Mouse (*Leggadina lakedownensis*; Priority 4).

Plate 21. Spinifex plains.

Plate 22. Spinifex plains.

Plate 23. Spinifex plains.

4.4 Major Creeklines

Major Creeklines are lined with *Eucalyptus camaldulensis* and *Eucalyptus vitrix* over Acacia shrublands and are usually invaded with introduced Buffel Grass (Plates 24 – 26). The sandy soils on the creek margins provide habitat for burrowing reptiles. Conservation significant fauna associated with this habitat include the Pilbara Olive Python (*Liasis olivaceous barroni*; Vulnerable) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; Vulnerable).

Plate 24. Major Creekline.

Plate 25. Major creekline with buffel grass cropped short by cattle in the dry season, September 2020.

Plate 26. Major creekline downstream of the dewatering outfall.

4.5 Minor Creeklines

There are many *Eucalyptus* and/or *Acacia*-lined minor creeklines in the spinifex stony hills and spinifex plains habitats, many of which have not been separately mapped. Minor creeklines provide shelter habitat for birds.

Plate 27. Minor creekline (recently burnt).

Plate 28. Minor creekline.

4.6 Waterholes

Permanent and semi-permanent waterholes are important habitat in a region where surface water is usually scarce (Plates 29 – 31). It is likely that all the waterholes in the study area are semi-permanent, but some may retain water year-round in wetter years. Waterholes support freshwater fish and frogs and provide a water source for birds and mammals to drink from. Conservation significant fauna associated with waterholes include the Pilbara Olive Python (*Liasis olivaceous barroni* Vulnerable) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; Vulnerable).

Plate 29. Waterhole on Muddauthera Creek.

Plate 30. Waterhole.

Plate 31. Waterhole.

4.7 Caves

Caves occur in both the chert breccia and dolomite outcrops and are generally small (Plates 32 – 33). Caves are likely to be used by some bat species for roosting. Conservation significant fauna associated with caves are the Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*; Vulnerable), however, only nocturnal roosts have been identified at Woodie Woodie, and no evidence of diurnal roosting has been found (Western Wildlife 2021). Other conservation significant fauna that use caves include the Pilbara Olive Python (*Liasis olivaceous barroni*; Vulnerable) and Northern Quoll (*Dasyurus hallucatus*; Endangered).

Plate 32. Cave.

Plate 33. Same cave, showing position in landscape under a chert breakaway.

5. Vertebrate Fauna

5.1 Faunal Assemblage

The results of the literature review and field survey were combined to create a list of all the vertebrate fauna potentially occurring in the Study Areas (Appendices 6 - 10). Indicated in the fauna lists are all the species observed during the fauna survey and those recorded in the region as part of the literature review (see Table 2 for search areas). As there has been few surveys in the region immediately surrounding the study area, several species are not represented by records in the surrounding area and their presence has been inferred from their patterns of distribution as presented in the literature.

The potentially occurring faunal assemblage is summarised in Table 8. The overall vertebrate faunal assemblage is likely to be largely intact. Situated in the Eremean region, the faunal assemblage of the study area is primarily comprised of species that occur widely through the arid and semi-arid areas of the Western Australian interior.

Table 8. Summary of vertebrate fauna potentially occurring in the Study Area.

Species Group	Total species	Introduced species	Recorded this survey (all surveys at Woodie)	Conservation significant species				
				Threatened (T)	Migratory (Mi)	Specially Protected (SP)	DBCA Priority (P)	Locally significant (LS)
Amphibians	7	0	3 (5)	-	-	-	-	-
Reptiles	84	0	55 (70)	1	-	-	1	-
Birds	130	0	80 (114)	3	5	1	-	-
Mammals	42	6	27 (30)	4	-	-	4	-
Freshwater Fish	8	0	1 (1)	-	-	-	-	-
Totals:	**271**	**6**	**166 (220)**	**8**	**5**	**1**	**5**	**0**

5.1.1 Amphibians

There are seven species of frog that potentially occur in the study area, of which three species were recorded opportunistically on this survey, *Litoria rubella*, *Cyclorana maini* and *Uperoleia saxatilis* (Appendix 6, Plate 34). A total of five species have been recorded at Woodie Woodie on past surveys.

The frog species of the study area are common and widely distributed in the semi-arid zone. Burrowing species aestivate underground when conditions are dry, so are difficult to sample except immediately after rainfall events. Many species develop from tadpoles into frogs very quickly and can make use of ephemeral pools. Although frogs may occur throughout the study area, they are likely to be most common around major and minor creeklines. Frogs also take advantage of artificial water sources and were observed downstream of the dewatering outfall.

Plate 34. *Cyclorana maini*.

5.1.2 Reptiles

There are 84 species of reptile that have the potential to occur in the study area, of which 55 were recorded during the fauna survey (Table 9, Appendix 7, Plates 35 – 36). A total of 70 species have been recorded on surveys at Woodie Woodie between 2006 and 2021 (Appendix 7). On this survey, between nine and 16 species were recorded at each site and a further nine species were not trapped but were observed opportunistically by other methods (Table 9).

The reptile assemblage of the Pilbara Bioregion is very diverse, including a suite of endemic species associated with rocky surfaces (Doughty *et al*. 2011). As the reptile assemblage is generally informed by the ground surface, the study area is likely to support a reptile assemblage dominated by species that favour rocky or stony surfaces, with species that prefer sandier soils, such as *Lerista bipes*, generally restricted to the margins of major creeklines.

Many reptile species are likely to be widely distributed across both the spinifex stony hills and spinifex plains habitats, including *Ctenotus saxatilis*, the most commonly caught species in this survey, *Heteronotia binoei* and *Ctenophorus caudicinctus* (Table 9). A few species are semi-arboreal, such as *Varanus tristis* and *Gehyra variegata*, and are likely to favour treed habitats across all substrates, particularly major creeklines.

A distinct suite of species is likely to be associated with the rocky outcrops and breakaway habitat, where small caves, crevices and boulders provide shelter. This habitat is generally difficult to trap, but WT Site 06 and WT Site 12 were situated adjacent to rocky outcrops and returned species such as *Heteronotia spelea* and *Gehyra micra*, both rocky habitat specialists. Spotlighting and camera trapping in rocky areas recorded other rocky habitat specialists such as *Gehyra macra*, *Varanus pilbarensis* and *Oedura fimbria* (Plate 35).

Table 9. Reptiles recorded in the study area.

Species	Captures at each site (Sept/Apr)												Opportunistic
	1	2	3	4	5	6	7	8	9	10	11	12	
	Spinifex plain	Major creekline	Spinifex plain	Major creekline	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex plain	Spinifex stony hill	Spinifex stony hill	
Anilios ammodytes Sand-diving Blind Snake		1/-					1/-				-/1		
Anilios grypus Beaked Blind Snake	-/1	-/1		-/1				1/-			2/3	-/2	
Anilios pilbarensis Pilbara Blind Snake		1/-					1/-						
Antaresia perthensis Pygmy Python					-/1								
Antaresia stimsoni Stimson's Python													+
Carlia munda Shaded-litter Rainbow Skink			-/1			-/1	1/1						
Ctenophorus caudicinctus Western Ring-tailed Dragon	-/1	-/1	-/2		2/8	1/1		-/1	-/6	-/7		3/11	
Ctenophorus isolepis Central Military Dragon										1/2			
Ctenophorus nuchalis Central Netted Dragon													+
Ctenotus duricola Eastern Pilbara Lined Ctenotus	-/1		1/3	-/1	1/1		-/2	2/1	-/4	-/2	1/5	-/1	
Ctenotus grandis Grand Ctenotus			-/1				-/1	1/2					
Ctenotus hanloni Nimble Ctenotus	-/4	-/3					-/1						
Ctenotus helenae Clay-soil Ctenotus	5/11		1/1	-/1			-/1			-/4	-/1		
Ctenotus pantherinus Leopard Ctenotus	5/6		2/-		1/-		1/-			2/4			
Ctenotus rubicundus Ruddy Ctenotus												1/-	
Ctenotus saxatilis Rock Ctenotus	2/5	2/14	-/8	7/20	4/15	1/26	6/17	7/17	3/32	7/28	6/16	3/28	
Cyclodomorphus melanops Slender Bluetongue	-/1	1/1	-/2		-/2	-/1		1/-					
Delma butleri Unbanded Delma			-/1										
Delma desmosa Banded Delma		-/1						-/1					
Delma nasuta Sharp-snouted Delma	-/1				-/3				-/1		-/2		
Delma pax Peace Delma	1/-						-/1			1/-			
Delma tincta Excitable Delma								-/1					
Demansia psammophis Yellow-tailed Whipsnake				1/-				-/1					
Demansia rufescens Rufous Whipsnake			1/-										

Table 9. (cont.)

Species	Captures at each site (Sept/Apr)												Opportunistic
	1	2	3	4	5	6	7	8	9	10	11	12	
	Spinifex plain	Major creekline	Spinifex plain	Major creekline	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex plain	Spinifex stony hill	Spinifex stony hill	
Diplodactylus laevis Desert Fat-tailed Gecko										2/3			
Diplodactylus savagei Southern Pilbara Beak-faced Gecko						-/2		2/1	2/2	-/1	4/9	2/5	
Furina ornata Moon Snake							**1/-**				**1/-**	-/1	
Gehyra macra Large Pilbara Rock Gehyra													**+**
Gehyra micra Small Pilbara Rock Gehyra						**1/-**						8/7	
Gehyra punctata Spotted Rock Gehyra						**4/-**						3/-	
Gehyra variegata Variegated Dtella		2/4		1/4						-/1		**1/-**	
Gowidon longirostris Long-nosed Dragon		1/2											
Heteronotia binoei Bynoe's Gecko	1/1	-/3	-/2		-/3	1/1	-/1	-/2	1/2	2/3	3/2		
Heteronotia spelea Pilbara Cave Gecko						2/1							
Lerista bipes Northwestern Sandslider		5/3		5/3						**5/-**			
Lerista jacksoni Jackson's Three-toed Sandslider	2/1	-/1		1/6	-/1	**1/-**			**1/-**		**2/-**		
Lialis burtonis Burton's Legless Lizard						-/1							
Lucasium stenodactylum Sandplain Gecko				-/1			**1/-**	**2/-**		**3/-**			
Menetia greyii Common Dwarf Skink	10/1	-/1	**12/-**	**3/-**						**1/-**	4/1		
Menetia surda Western Dwark Skink			-/1		`								
Morethia ruficauda Lined Fire-tailed Skink					-/1	1/1		**1/-**	-/1			1/1	
Oedura fimbria Western Marbled Velvet Gecko													**+**
Proablepharus reginae Western Soil-crevice Skink						-/1							
Pseudonaja mengdeni Gwardar													**+**
Pygopus nigriceps Hooded Scaley-foot						-/1							
Strophurus elderi Jewelled Gecko										-/1			
Suta punctata Spotted Snake	-/1												

Table 9. (cont.)

Species	Captures at each site (Sept/Apr)												Opportunistic
	1	2	3	4	5	6	7	8	9	10	11	12	
	Spinifex plain	Major creekline	Spinifex plain	Major creekline	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex stony hill	Spinifex plain	Spinifex plain	Spinifex stony hill	Spinifex stony hill	
Tiliqua multifasciata Central Bluetongue	-/1						1/-				1/-		
Varanus acanthurus Spiny-tailed Goanna	-/1	2/1					-/1	3/-	1/1		-/1	-/4	
Varanus brevicauda Short-tailed Pygmy Goanna							1/-			1/-			
Varanus giganteus Perentie													+
Varanus gouldii Sand Goanna													+
Varanus panoptes Spotted Goanna													+
Varanus pilbarensis Northern Pilbara Rock Monitor													+
Varanus tristis Black-tailed Monitor				-/1									
Total number of species:	**16**	**15**	**13**	**11**	**10**	**14**	**16**	**14**	**9**	**16**	**13**	**12**	**9**

Plate 35. *Gehyra macra* and *Gehyra micra* observed in the study area.

Plate 36. ***Antaresia perthensis, Heteronotia spelea and Diplodactylus laevis,*** **captured in the study area.**

5.1.3 Birds

There are 130 species of bird that potentially occur in the study areas, of which 80 species were recorded during the fauna survey (Appendix 8, Table 10). A total of 113 species have been recorded thus far at Woodie Woodie, between 2006 and 2021 (Appendix 8). The terrestrial bird fauna of the Pilbara region is thought to be generally uniform, with a higher species richness where there is riparian vegetation such as tall *Eucalyptus* or *Melaleuca* trees (Burbidge *et al*. 2010). Many of the species present are likely to use a range of habitats across the study area.

Conditions for the September 2020 survey were dry and bird activity was minimal, therefore only opportunistic records were made. Despite these limitations, 51 species were recorded in September. The post-wet conditions in April 2021 were more favorable, and birds were recorded systematically across six surveys at each trapping site, as well as additional targeted and systematic bird surveys across the study area. Between 13 and 25 species were recorded at each trapping site in April 2021 (Table 10). The most species rich sites were WT Site 02 and WT Site 04, both on major creeklines. Sites with lower species richness, such as WT Site 03, WT Site 05 and WT Site 09 are relatively open spinifex plains habitats.

The bird assemblage is likely to include a core suite of species that is resident in the study area, a second group that makes regular movements into and through the study area and a third group of nomads, that may occur in the study area on occasion when conditions are suitable. Resident species include many of the small insectivores such as fairywrens and thornbills. Resident species are present all year, however, their populations are likely to fluctuate in response to rainfall and fire.

Birds that make regular seasonal movements include the Rainbow Bee-eater (*Merops ornatus*), Fairy Martin (*Petrochelidon ariel*), cuckoos and some birds of prey (Plate 37). Honeyeaters are also likely to make seasonal movements to take advantage of flowering events. Although not present all year, these species are likely to use the study area for foraging, breeding or shelter on a seasonal basis or when conditions are suitable.

Wetland dependent bird species, (e.g., ducks, swans, herons, grebes and migratory shorebirds), are highly mobile. Small numbers are likely to occur after significant rainfall events, generally favouring permanent and semi-permanent waterholes on the major creeklines, and artificial waterbodies and dewatering areas associated with the mining areas. Wetland dependent birds are never likely to be present in large numbers and the study area does not contain important breeding habitat.

Plate 37. Fairy Martins seasonally nest under rocky overhangs.

Table 10. Birds recorded in the study area.

Species	Birds at each Site in April 2021 (Frequency of occurrence, n = 6)												Opp.
	1	2	3	4	5	6	7	8	9	10	11	12	
Australian Bustard *Ardeotis australis*				1					1				
Australian Hobby *Falco longipennis*											1		
Australian Kestrel *Falco cenchroides*	2					1	3	2		2	2	3	
Australian Magpie *Gymnorina tibicen*													+
Australian Owlet-nightjar *Aegotheles cristatus*													+
Australian Pipit *Anthus australis*					1				1				
Australian Pratincole *Stiltia isabella*													+
Australian Reed-warbler *Acrocephalus australis*													+
Australian Ringneck *Barnardius zonarius*		1				3							
Bar-shouldered Dove *Geopelia humeralis*													+
Barking Owl *Ninox connivens*													+
Black Kite *Milvus migrans*													+
Black Swan *Cygnus atratus*													+
Black-breasted Buzzard *Hamiostra melanosternon*													+
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	1	3		2		2					1		
Black-faced Woodswallow *Artamus cinereus*					1		3	1	2	1			
Black-fronted Dotterel *Elseyornis melanops*		3											
Blue-winged Kookaburra *Dacelo leachii*		4	1	1									
Brown Falcon *Falco berigora*					2	1	1			1		1	
Brown Honeyeater *Lichmera indistincta*				1						1			
Brown Songlark *Cincloramphus cruralis*													+
Budgerigar *Melopsittacus undulatus*	6	6	4	6	6	6	6	6	6	5	6	4	
Bush Stone-curlew *Burhinus grallarius*													+
Cockatiel *Nymphicus hollandicus*		4		3	1	3	1	2		1	1	1	
Collared Sparrowhawk *Accipiter cirrocephalus*				2		1							
Common Bronzewing *Phaps chalcoptera*													+
Crested Bellbird *Oreoica gutteralis*								1					

Table 10. (cont.)

Species	Birds at each Site in April 2021 (Frequency of occurrence, n = 6)												Opp.
	1	2	3	4	5	6	7	8	9	10	11	12	
Crested Pigeon *Ocyphaps lophotes*		2					2	1	1	3			
Crimson Chat *Epthianura tricolor*													+
Diamond Dove *Geopelia cuneata*	2	3		1			1			2	1		
Fairy Martin *Hirundo ariel*													+
Eurasian Coot *Fulica atra*													+
Galah *Eolophus roseicapilla*	1			5		5				1	2	1	
Grey Butcherbird *Cracticus torquatus*													+
Grey Shrike-thrush *Colluricincla harmonica*													+
Grey Teal *Anas gracilis*													+
Grey-crowned Babbler *Pomatostomus temporalis*		2											
Grey-headed Honeyeater *Ptilotula keartlandi*			3	4		1	2	1		1	1	1	
Horsfield's Bronze-cuckoo *Chalcites basalis*													+
Horsfield's Bushlark *Mirafra javanica*													+
Little Button-quail *Turnis velox*				1	1								
Little Corella *Cacatua sanguinea*	1	6	4			1					1		
Little Crow *Corvus bennetti*							1						
Little Eagle *Heiraaetus morphnoides*									1				
Little Pied Cormorant *Microcarbo melanoleucos*													+
Little Woodswallow *Artamus minor*													+
Magpie-lark *Grallina cyanoleuca*	1	6											
Masked Woodswallow *Artamus personatus*													+
Pacific Black Duck *Anas superciliosus*													+
Painted Finch *Emblema pictum*	4	3	5	2	2	6	6	5	5	6	6	6	
Pallid Cuckoo *Heteroscenes pallidus*				1									
Peaceful Dove *Geopelia striata*	1	1										1	
Pied Butcherbird *Cracticus nigrogularis*		6	3	2	2	4	2	4		3	1	2	
Rainbow Bee-eater *Merops ornatus*		1				1			2				

Table 10. (cont.)

Species	Birds at each Site in April 2021 (Frequency of occurrence, n = 6)												Opp.
	1	2	3	4	5	6	7	8	9	10	11	12	
Red-backed Kingfisher *Todiramphus pyrrhopygius*		2		1						2	1		
Red-browed Pardalote *Pardalotus rubricatus*		1	1	5		2							
Rufous Songlark *Cincloramphus mathewsi*		2											
Rufous Whistler *Pachycephala rufiventris*													+
Sacred Kingfisher *Todiramphus sanctus*		4											
Singing Honeyeater *Gavicalis virescens*	6		2	1	2	2	4	1	2			1	
Southern Boobook *Ninox boobook*													+
Spinifex Pigeon *Geophaps plumifera*			1					1	1	2	2	2	
Spinifexbird *Poodytes carteri*	3									1	1		
Spotted Harrier *Circus assimilis*	1			2									
Spotted Nightjar *Eurostopodus argus*													+
Striated Grasswren *Amytornis striatus*												1	
Torresian Crow *Corvus orru*	1		1	3		3		2	2	1	2		
Variegated Fairy-wren *Malurus lamberti*							2						
Wedge-tailed Eagle *Aquila audax*													+
Weebill *Smicrornis brevirostris*				3									
Western Bowerbird *Ptilonorhynchus maculatus guttatus*													+
Whistling Kite *Haliastur sphenurus*	2	5	1										
White-faced Heron *Egretta novaehollandiae*		1											
White-necked Heron *Ardea pacifica*													+
White-plumed Honeyeater *Ptilotula penicillata*		6		4		1							
White-winged Fairy-wren *Malurus leucopterus*					1								
White-winged Triller *Lalage tricolor*		1		4					1				
Willie Wagtail *Rhipidura leucophrys*				1								1	
Yellow-throated Miner *Manorina flavigula*		3	1			1	1	2		1	1	1	
Zebra Finch *Taeniopygia guttata*		6	4	6	1	3	3	2	3	3	3	3	
Total number of species per site:	**14**	**25**	**13**	**24**	**11**	**19**	**15**	**14**	**13**	**18**	**17**	**15**	**29**

5.1.4 Mammals

There are 42 species of mammal that have the potential to occur in the study areas, of which 36 are native and six introduced (Appendix 9). A total of 27 species were recorded from the study area during this survey, of which 24 are native and three are introduced (Table 11). Across all fauna surveys at Woodie Woodie 2006 to 2021, a total of 25 native and five introduced mammals have been recorded (Appendix 8).

Between zero and four species were recorded in each trapping site, with almost half the mammal species recorded by other methods including camera trapping, bat call records and opportunistic observation (Table 11). The most commonly trapped species were the Little Red Kaluta (*Dasykaluta rosamondae*), Pilbara Ningaui (*Ningaui timeleyi*) and Pilbara Planigale (*Planigale* sp. 1) (Plate 38). These species are likely to be widespread across the plains and stony hills of the study area, favouring minor drainages where water runoff supports the growth of larger spinifex hummocks.

Plate 38. *Dasykaluta rosamondae* and *Ningaui timeleyi* trapped in the study area.

A suite of species favour rocky habitats, including Woolley's False Antechinus (*Pseudantechinus woolleyae*), Long-tailed Dunnart (*Sminthopsis longicaudata*), Common Rock-rat (*Zyzomys argurus*), Rothschild's Rock-wallaby (*Petrogale rothschildi*) and Northern Quoll (*Dasyurus hallucatus*). These species are strongly associated with rocky habitats in the Pilbara region, and the rocky outcrop and breakaway habitat is likely to support these species in the study area.

Bats are likely to forage over the study area at night, by day roosting in either tree hollows or caves. A search for diurnal roosting habitat in June 2020 failed to find diurnal roosts for conservation significant bats (Western Wildlife 2021), but these species are particular in their requirement for deep humid roost sites. It is likely that other species, such as Findlayson's Cave Bat (*Vespadelus findlaysoni*) and Common Sheathtail Bats (*Taphozous georgianus*) roost in small caves in the study area.

Three introduced mammal species were recorded in the study area, Cattle (*Bos taurus*), Feral Cats (*Felis catus*), and House Mouse (*Mus musculus*), though up to six species potentially occur and up to five have been recorded on previous surveys (Table 11, Appendix 9). Although not recorded on surveys, Foxes (*Vulpes vulpes*) have also been reported in the study area by Woodie Woodie environmental personnel.

Table 11. Mammals recorded in the Study Area.

Species	Captures at each site (Sept/Apr)												Other*
	1	2	3	4	5	6	7	8	9	10	11	12	
Bos taurus (Int.) Cow													+
Canis familiaris dingo Dingo													C
Chaerophon jobensis Greater Northern Freetail Bat													A
Chalinolobus gouldii Gould's Wattled Bat													A
Dasykaluta rosamondae Little Red Kaluta	2/1				1/1			1/-	2/-	1/-			
Dasyurus hallucatus (En) Northern Quoll													+
Felis catus (Int.) Cat													C
Macropus rufus Red Kangaroo													+
Mus musculus (Int.) House Mouse	1/-	-/3			1/-								
Ningaui timeleyi Pilbara Ningaui	1/-		1/5		8/-	-/1		-/2				-/1	
Osphranter robustus Euro													+
Ozimops lumsdenae Northern Freetail Bat													A
Petrogale rothschildi Rothschild's Rock-Wallaby													+
Planigale sp.1 Pilbara Planigale	2/1	-/1	2/-			1/-			-/1		1/-		
Pseudomys chapmani (P4) Western Pebble-mound Mouse													+
Pseudomys desertor Desert Mouse			2/		1/-		-/1	3/-					
Pseudomys hermannsburgensis Sandy Inland Mouse							1/1						
Pteropus scapulatus Little Red Flying Fox													+
Rhinonicteris aurantia (Vu) Pilbara Leaf-nosed Bat													A
Saccolaimus flaviventris Yellow-bellied Sheathtail Bat													A
Scotorepens greyii Little Broad-nosed Bat													A
Sminthopsis macroura Stripe-faced Dunnart									-/1				
Sminthopsis youngsoni Lesser Hariy-footed Dunnart							-/1						
Tachyglossus aculeatus Echidna													+
Taphozous georgianus Common Sheathtail Bat													A
Vespadelus findlaysoni Findlayson's Cave Bat													A
Zyzomys argurus Common Rock Rat						-/1							
Total number of species per site:	**4**	**2**	**3**	**0**	**4**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**18**

*A = Anabat record, + = Opportunistic observation, C = camera trap record.

The Feral Cat is known to prey on native fauna species. 'Predation by Feral Cats' and 'Predation by the European Red Fox' are listed as a key threatening processes under the EPBC Act. Foxes prey on 'critical weight range' mammals (i.e. those between 35g and 5.5kg) and ground-nesting birds (Commonwealth of Australia 2008). Feral Cats have contributed to the extinction of many small to medium sized native mammals and ground-nesting birds in the arid zone (Commonwealth of Australia 2015a). Though mammals tend to be the dominant prey (Commonwealth of Australia 2015a), each Feral Cat in natural environments kills on average 225 reptiles per year, with cats in arid areas taking even more, equating to the predation of about 1.8 million reptiles per day (Woinarski *et al*. 2018).

The relationships between feral predators are complex, as they may compete for prey, prey on each other or kill to remove a competitor. The presence of one predator, such as a wild dog or dingo, may affect the behavior or suppress the abundance of smaller species, such as Cats (Commonwealth of Australia 2015b). Also, the presence of feral prey species such as Rabbits (*Oryctolagus cuniculus*) can support Fox populations (Commonwealth of Australia 2008). These complex interactions mean that control of these species is not straightforward, as reducing the population of one species may result in the increase in another.

5.1.5 Freshwater Fish

The freshwater fish fauna of the interior Pilbara region is not diverse. Only eight species are expected to occur in the vicinity of the study areas (Appendix 10), though most of these are likely to be restricted to the larger rivers (i.e. the Oakover River) and any permanent river pools. All species listed in Appendix 5 have been recorded in the De Grey River, of which the Oakover is a tributary, by Morgan and Gill (2004).

Spangled Perch (*Leiopotherapon unicolor*) were recorded in waterholes in the study area. The isolated nature of the pools along creeklines is not conducive to supporting diverse fish populations, and fish are generally likely to be present during times they can invade from permanent pools elsewhere in the river system.

5.2 Vertebrate Fauna of Conservation Significance

There are 19 vertebrate fauna of conservation significance that potentially occur in the study area: eight Threatened, five Migratory, one Specially Protected and five Priority species (Table 12). No locally significant species were identified, as it is considered that most species are widespread in the IBRA subregion. Each species is summarised in Table 12 and discussed in the sections below. The results of the DBCA Threatened and Priority Fauna Database extract are shown on Figures 10 - 12 and the EPBC Protected Matters Search Tool extract is shown in Appendix 11.

Several conservation significant species listed on database searches in the area have been omitted from the list of potential fauna in Appendices 6 – 10 and the discussion below. This includes the following species:

- **Northern Marsupial Mole** (*Notoryctes caurinus* – Priority 4). Suitable sand dune habitat is absent from the study area.
- **Brush-tailed Mulgara** (*Dasycercus blythi* – Priority 4). Suitable sandplain habitat is absent from the study area. DBCA records are from the sandy deserts.
- **Red Knot** (*Calidris canutus* – Migratory). Species is generally coastal, preferring intertidal mudflats and is only likely to occur as a vagrant to the region. DBCA records are from Nifty Mine.
- **Eastern Osprey** (*Pandion cristatus* – Migratory). Species is generally coastal, breeding on coasts and offshore islands. Although it may occur regionally on the larger rivers with large permanent pools, such as Carawine Gorge on the Oakover River, suitable habitat is absent from the study area.
- **Barn Swallow** (*Hirundo rustica* – Migratory). A vagrant to the region and no habitat in the study area is likely to be important for this species.
- **Grey Wagtail** (*Motacilla cinera* – Migratory). A vagrant to the region and no habitat in the study area is likely to be important for this species.
- **Yellow Wagtail** (*Motacilla flava* – Migratory). A vagrant to the region and no habitat in the study area is likely to be important for this species.
- **Pectoral Sandpiper** (*Calidris melanotos* – Migratory). This species occurs in vegetated wetlands and no habitat in the study area is likely to be important for this species.
- **Sharp-tailed Sandpiper** (*Calidris acuminata* – Migratory). This species is more common near the coast and is only likely to occur as a vagrant.
- **Curlew Sandpiper** (*Calidris ferruginea* – Critically Endangered, Migratory). Species is generally coastal, preferring intertidal mudflats and is only likely to occur as a vagrant to the region.
- **Gull-billed Tern** (*Geochelidon nilotica* – Migratory). Species is unlikely to use any habitat in the study area.

Although some of the above species, particularly birds, may occur as vagrants on occasion, the study area does not provide habitat important for maintaining their populations.

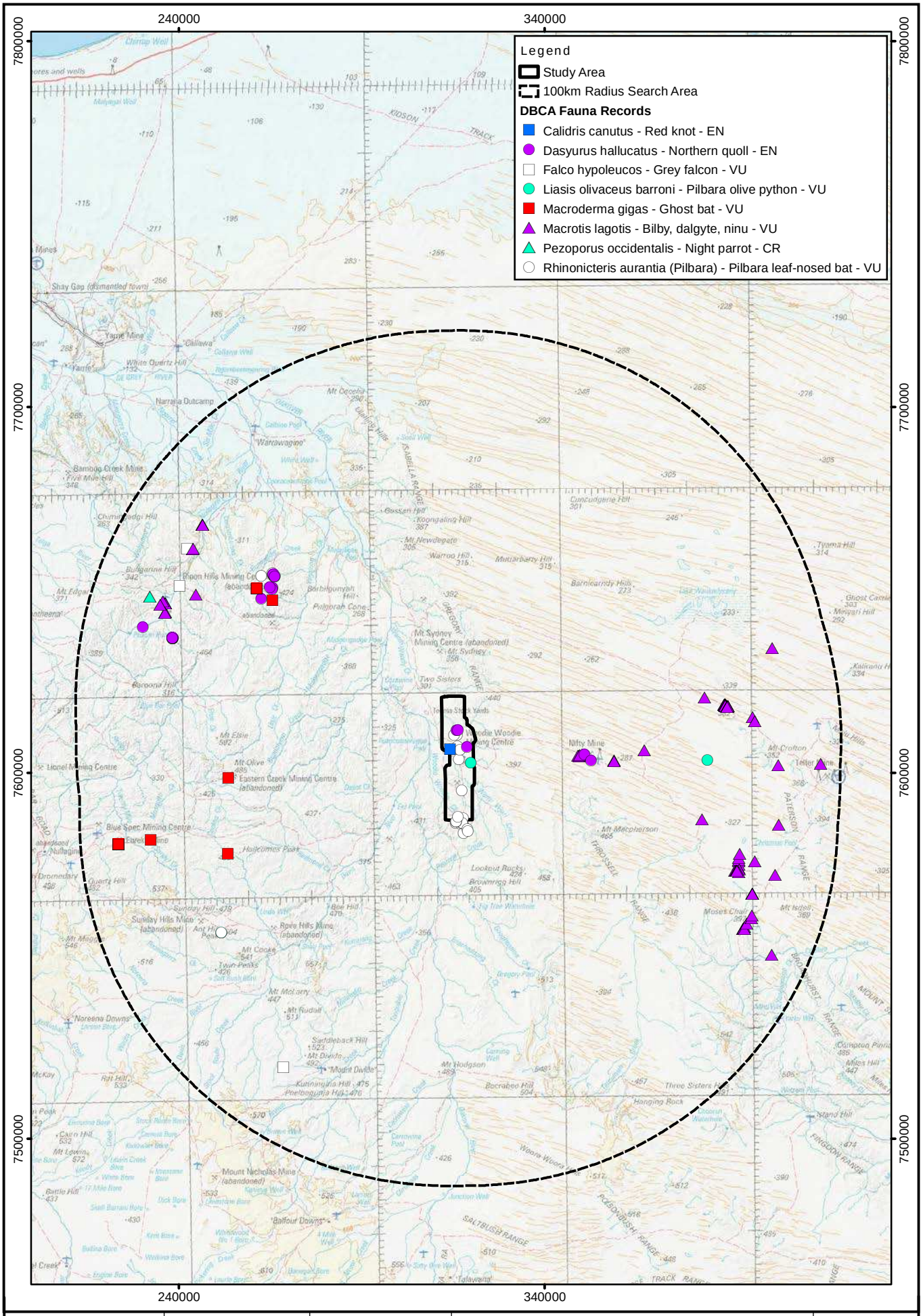
Table 12. Conservation significant fauna potentially occurring at Woodie Woodie.

Key to Status: Cr = Critically Endangered, En = Endangered, Vu = Vulnerable, Mi = Migratory, Cd = Conservation Dependent, Os = Other Specially Protected Fauna, P1 – P4 = Priority 1-4.

Species	Status			Likelihood of occurrence at Woodie Woodie	Explanation
	EPBC Act	BC Act	DBCA Priority		
Threatened					
Pezoporus occidentalis **Night Parrot**	En	Cr	-	Possible	The paucity of data on this species makes it difficult to ascertain its likelihood of occurrence. There is potentially suitable habitat present (though some is recently burnt) but this species is very rarely recorded in WA.
Dasyurus hallucatus **Northern Quoll**	En	En	-	Known to occur	Recorded in the study area and likely to occur where there are rocky hills/outcrops and forage in surrounding habitats.
Macrotis lagotis **Bilby**	Vu	Vu	-	Unlikely	Although this species is highly mobile and is known from nearby Nifty Mine (about 32km east), the study area generally lacks its preferred habitats.
Rhinonicteris aurantia **Pilbara Leaf-nosed Bat**	Vu	Vu	-	Known to occur	This species is likely to forage over all habitats, particularly rocky areas and major creeklines. The roosting location/s for the bats foraging at Woodie Woodie are unknown.
Macroderma gigas **Ghost Bat**	Vu	Vu	-	Likely	Though not recorded, this species is known to occur in rocky hills in the Pilbara.
Liasis olivaceous barroni **Pilbara Olive Python**	Vu	Vu	-	Known to occur	Recorded in the study area. Likely to occur along the larger creeklines and in rocky areas.
Falco hypoleucos **Grey Falcon**	Vu	Vu	-	Potential	Though there are no nearby records of this species, the Grey Falcon is known to occur in the region and potentially suitable habitat is present.
Polytelis alexandrae **Princess Parrot**	Vu	-	P4	Possible	There are no nearby records of this species and the study area is on the edge of its range, however, suitable habitats may be present.
Migratory					
Charadrius veredus **Oriental Plover**	Mi	Mi	-	Potential	Though not recorded nearby, this species is known to occur inland. Although it may occur on flats on occasion, the habitats at Woodie Woodie are unlikely to be important for this species.
Tringa hypoleucos **Common Sandpiper**	Mi	Mi	-	Known to occur	Recorded in the study area. It may occur on creek pools or artificial waters, but the habitat in the study area is not important for this species.

Table 12 (cont.)

Species	Status			Likelihood of occurrence at Woodie Woodie	Explanation
	EPBC Act	BC Act	DBCA Priority		
Tringa glareola **Wood Sandpiper**	Mi	Mi	-	Known to occur	Though known to occur on inland waters, there is little wetland habitat present for this species. It may occur on creek pools or artificial waters, but the habitat at Woodie Woodie is not important for this species.
Apus pacificus **Fork-tailed Swift**	Mi	Mi	-	Likely	This species is largely aerial in Australia and may overfly any of the study areas.
Plegadis falcinellus **Glossy Ibis**	Mi	Mi	-	Potential	Though known to occur on inland waters, there is little wetland habitat present for this species. It may occur on creek pools or artificial waters, but the habitat at Woodie Woodie is not important for this species.
Specially Protected					
Falco peregrinus **Peregrine Falcon**	-	Os	-	Known to occur	This species was recorded at Woodie Woodie in 2019 and suitable nesting and foraging habitat is present.
Priority					
Ctenotus nigrilineatus **Pin-striped Finesnout Ctenotus**	-	-	P1	Possible	Records within 100km. Although study area is outside its known range, this species is rarely recorded and has a patchy distribution.
Sminthopsis longicaudata **Long-tailed Dunnart**	-	-	P4	Possible	No records nearby or in previous surveys at Woodie Woodie, despite camera trapping in rocky habitat. However, this species is often difficult to trap, and potentially suitable habitat is present.
Lagorchestes conspicillatus leichardti **Spectacled Hare-Wallaby (mainland)**	-	-	P4	Possible	Not recorded nearby or in previous surveys at Woodie Woodie. The centre of distribution is generally north-west of Woodie Woodie, and much of the Spinifex plains habitat is too recently burnt.
Leggadina lakedownensis **Lakeland Downs Mouse**	-	-	P4	Likely	Although not recorded previously at Woodie Woodie, this species is known to occur nearby (at Carawine Pool about 20km northwest), and suitable habitats are present.
Pseudomys chapmani **Western Pebble-mound Mouse**	-	-	P4	Known to occur	Inactive and active mounds occur across the stony hills at Woodie Woodie.



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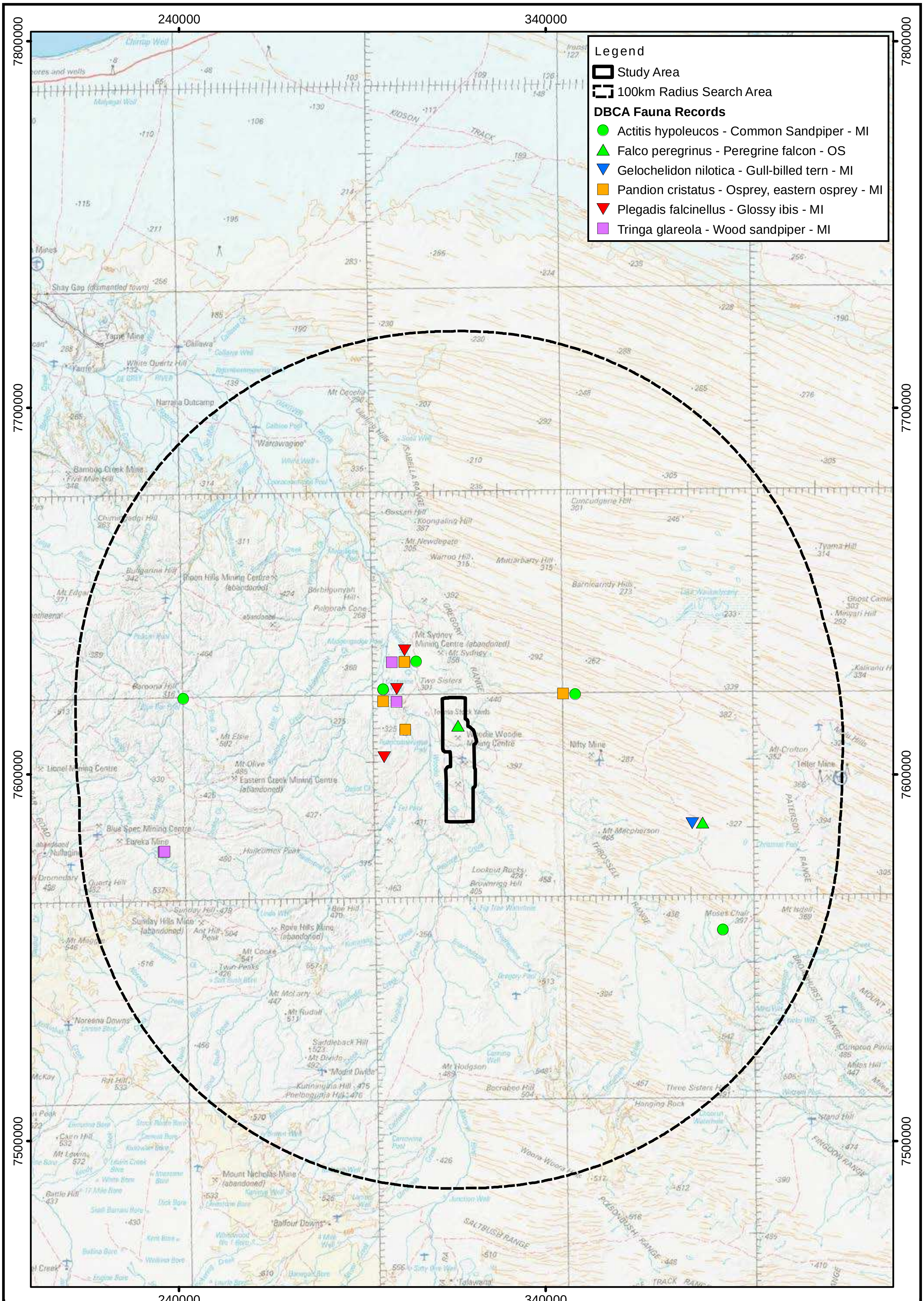
Woodie Woodie Project
DBCA records of Threatened fauna

Figure: **10**



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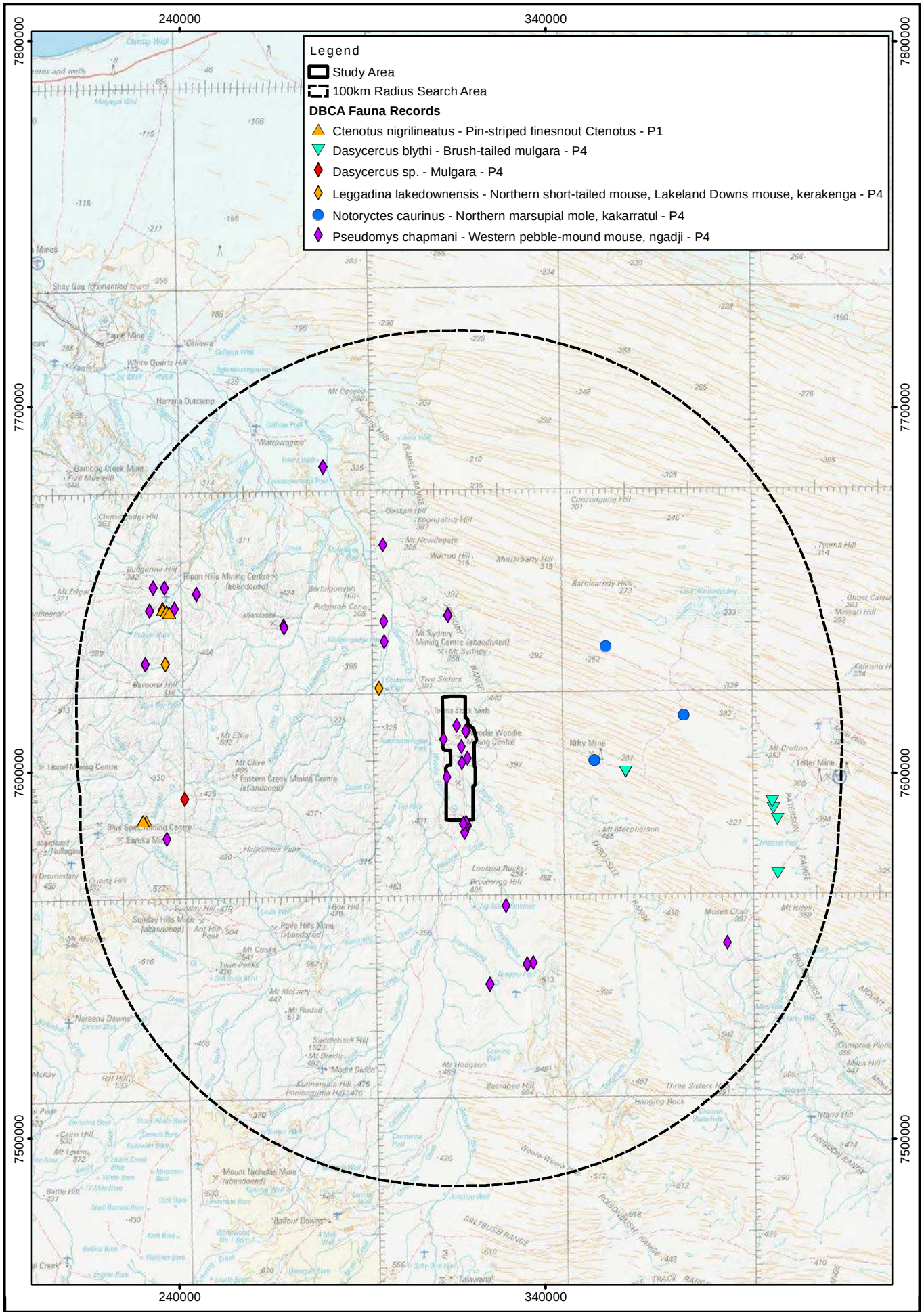
Woodie Woodie Project
DBCA records of Specially Protected and Migratory fauna

Figure: 11



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Woodie Woodie Project
DBCA records of Priority fauna

Figure:
12

5.2.1 Threatened Fauna

There are eight Threatened species that may occur in the study area, three of which have been recorded on this or previous surveys at Woodie Woodie (Table 12). Threatened species are those that are considered in danger of extinction as their populations have declined and/or are still declining, and their total population size is small and/or fragmented or geographically restricted. Sites that support these species may be important for their long-term conservation, particularly if the site supports a resident or breeding population.

Night Parrot – *Pezoporus occidentalis*

The Night Parrot is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act.

Historically, the Night Parrot was recorded across a large range in the arid and semi-arid interior of Australia (Garnett *et al*. 2011). In recent times however, there are very few verified records of the species. Western Australia records are from Lake Gregory, a site near Wiluna and near the Fortescue Marsh in the Pilbara (NPRT 2019, Davis and Metcalf 2008). The key habitats for the Night Parrot are thought to be chenopod shrublands and Spinifex grasslands, with the chenopod shrublands a refuge during dry conditions (Garnett *et al*. 2011). Nesting sites are in mature Spinifex, often large ring-forming clumps, usually in *Triodia longiceps* (DPAW 2017). Foraging habitats are likely to vary across Australia, but include herbs, grasses, grass-like plants, *Sclerolaena spp*. and other chenopods (DPAW 2017).

With the reasons for its decline unknown, potential threats to the species remain unconfirmed (TSSC 2016b). Possible threats include predation by feral cats or foxes, human-induced fire and degradation of soil around watering points (TSSC 2016c).

Knowledge about the current distribution and habitat requirements of the Night Parrot in Western Australia is based on very few records. Therefore, there is considerable uncertainty when assessing the likelihood of occurrence of this species. There is a single record of the Night Parrot within 100km on DBCA's Threatened and Priority Fauna Database (Figure 10), from Marble Bar in 1980 (DBCA 2021).

Most habitats lack the large spinifex clumps required for breeding habitat, but small parts of the spinifex plains habitat support large clumps of *Triodia longiceps*, where water runoff has promoted growth in depressions or at the base of hills. A targeted survey in 2018 deployed passive acoustic detectors at 12 sites but failed to record Night Parrot in the study area (Western Wildlife 2019a), but as potential breeding habitat is present, the species is considered possibly occurring. As Night Parrots forage on Spinifex, much of Woodie Woodie comprises potential foraging habitat. However, this is not unique in a Spinifex-dominated landscape. Other foraging habitats, such as herb-rich alluvial plains or chenopod shrublands, are largely absent.

Northern Quoll – *Dasyurus hallucatus*

The Northern Quoll is listed as Endangered under the EPBC Act and BC Act.

The Northern Quoll occurs across the northern parts of Australia including Western Australia, the Northern Territory, Queensland and some offshore islands (Van Dyck and Strahan 2008). The Northern Quoll has declined, now occurring as several disjunct populations, of which the Pilbara population is one (Braithwaite and Griffiths 1994). The reduction in population size is estimated at 50% over the last decade, with a further 25% reduction expected over the next decade (Woinarski *et al*. 2014). An 'important population' is one that is important to the long-term survival of the Northern Quoll. This may be a population that is high density, a population free of Cane Toads and where Cane Toads are unlikely to gain a foothold, or a population subject to on-going research.

The Northern Quoll is reproductively mature at 11 months, and breed in their first year (Van Dyck and Strahan 2008). Breeding occurs between July and September and is usually synchronised within a population. At about two months old the young are left in a den while the mother forages, and at six months about two or three young are weaned (Van Dyck and Strahan 2008). In general, all adults die after breeding, though some females have been recorded living up to three years in the wild (Van Dyck and Strahan 2008).

The Northern Quoll occurs in a variety of habitats across its range, but favours dissected rocky escarpments in the Pilbara (Hill and Ward 2010, Van Dyck and Strahan 2008). Where shelter habitat occurs within the Northern Quolls predicted range, it is considered 'habitat critical to the survival of the species' (Commonwealth of Australia 2016). In the Pilbara, shelter and denning habitat consists of rocky habitats such as ranges, escarpments, mesas, gorges, breakaways and boulder fields (Commonwealth of Australia 2016). Shelter habitat in the study area is primarily the rocky outcrop and breakaway habitat (Figure 13).

Little is known about Northern Quoll foraging and dispersal habitats, However, the EPBC Act referral guidelines recognise that all native vegetation within 1km of shelter habitat or Northern Quoll records may be considered foraging and dispersal habitat (Commonwealth of Australia 2016). In the Study Area the major creeklines may also be important for foraging and dispersal, as it contains shelter such as tree hollows and is likely to be a higher productivity foraging environment due the seasonal presence of water. Despite the lack of data on usage of dispersal and foraging habitat, it is known that the Northern Quoll is highly mobile and capable of dispersing over long distances.

Cane Toads are considered the main threat to the Northern Quoll in the parts of its range that overlap the Cane Toad distribution (Hill and Ward 2010). As yet the Pilbara is free of Cane Toads, though it is uncertain whether this will be the case in the future. The Northern Quoll was already in decline in parts of its range prior to Cane Toad invasion, so other threatening processes are thought to be at play (Hill and Ward 2010).

Feral Predators, such as the Fox (*Vulpes vulpes*) and Cat (*Felis catus*), are likely to prey on Northern Quolls. Henandez Santin (2018) suggests that in the Pilbara Cats may exclude quolls from open spinifex plains, restricting them to rocky habitats.

Inappropriate fire regimes, such as too-frequent fires, appear to impact Northern Quolls, possibly through decreased cover resulting in increased predation, changes to habitat structure or reduction in food availability. However, these mechanisms are not well understood (Hill and Ward 2010). After a wildfire, a monitored population in the Pilbara showed a reduction in captures from nine before the fire to one after the fire and captures in a second population dropped from 15 to zero (Dunlop 2017).

Habitat degradation caused by livestock is of concern in the northern savannah habitats, and together with inappropriate fire regimes, may be the cause of declines of this species in the Pilbara (Hill and Ward 2010). Habitat destruction occurs through developments such as mining, housing and agriculture, and though it occurs on a smaller scale than habitat degradation, it may still have a significant impact on critical habitat (Hill and Ward 2010).

Frequent fire is one of the potential threats to quolls currently operating at Woodie Woodie. Other potential threats include the presence of feral predators (cats and dingoes) and loss of habitat to current mining operations. Although not currently present, the Cane Toad may potentially invade this area as water is present and seasonally connected to the Oakover River.

There are 27 records of the Northern Quoll within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 10), mainly from Meentheena Conservation Park and Ripon Hills with a few records from Woodie Woodie and Nifty Mine (DBCA 2021). These records are relatively recent, ranging from 2012 – 2018. The Northern Quoll was targeted at Woodie Woodie across a series of surveys including camera trap transects in 2018 (eight transects, each of ten cameras), cage and Elliott trap transects in 2019 (four transects, each of 20 traps) and a regional camera trapping survey using single camera sites across a wider area, on-going from 2019 (Plate 39, Figure 8, Western Wildlife 2020). Northern Quolls were detected at several sites on these previous surveys and were also recorded on a camera trap on this survey in April 2021 (Figure 13). The 2019 trapping survey demonstrated that females were present in the population and that Woodie Woodie supports a breeding population of the species. The rocky outcrop and breakaway habitat is habitat critical for the survival of the species (Plate 40).

Plate 39. Northern Quoll on a camera trap at Woodie Woodie.

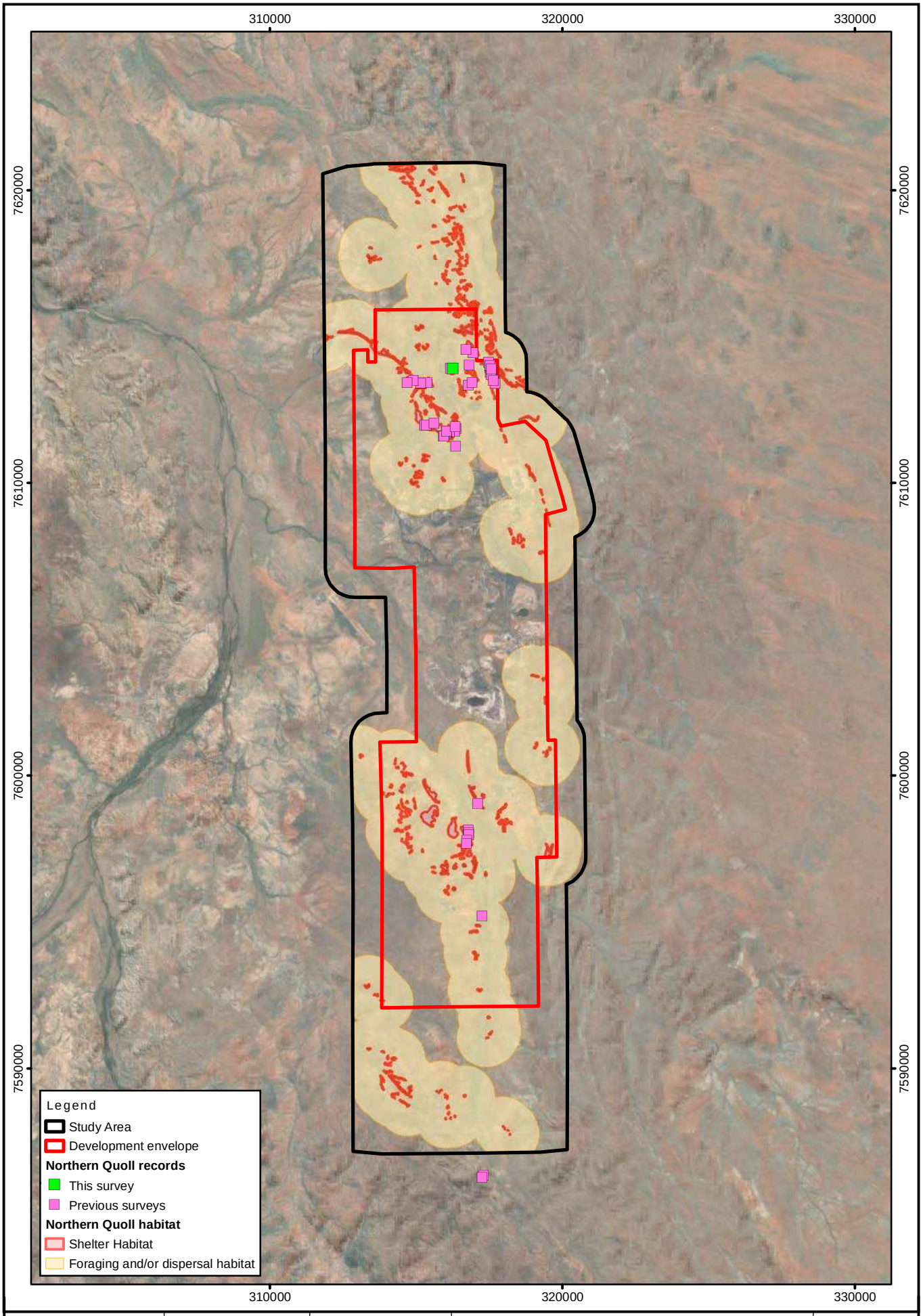
Plate 40. Example of Northern Quoll shelter habitat at Woodie Woodie.

Bilby – *Macrotis lagotis*

The Bilby is listed as Vulnerable under the EPBC Act and BC Act.

The Bilby currently occurs patchily across the Pilbara and inland northern Australia with the total population estimated at less than 10,000 individuals and in decline (Woinarski *et al*. 2014). The Bilby inhabits spinifex on plains and alluvial areas, mulga on ridges and rises and tussock grasslands on uplands and hills (Pavey 2006). Current threats to the Bilby in the northern part of its range include too-frequent fires and introduced herbivores and water-points (TSSC 2016b). Potential threats include predation by Cats and Foxes, land clearing and mining developments (TSSC 2016b). As the Bilby can move its home range in response to the changing availability of food (Van Dyck and Strahan 2008), they may not always be present despite suitable habitat being available.

There are 91 records of the Bilby within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 10). The records are mostly in the vicinity of Telfer and Nifty Mines in the Great Sandy Desert, and along the Oakover River in Meentheena Conservation Park (DBCA 2021). The study area lacks the sandplain habitats favoured by this species, with only narrow tracts of sandy soil along major creeklines. Although the Bilby is highly mobile, it is considered unlikely to occur as the habitats of the study area are generally unsuitable.



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Western Wildlife

Woodie Woodie Project
Northern Quoll habitat and records

Figure:
13

Pilbara Leaf-nosed Bat – *Rhinonicteris aurantia*

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act.

The Pilbara Leaf-nosed Bat requires warm, humid daytime roost sites and forages in gorges, along watercourses and over low Spinifex-covered hills (TSSC 2016d). The local distribution of the Pilbara Leaf-nosed Bat is mostly strongly influenced by the suitability of roost caves (hot and with a high humidity level) rather than habitat type. The species is heavily reliant on warm (28 - 32°C), humid (85 - 100%) sites for roosting, which enables individuals to reduce water loss and energy expenditure (Baudinette *et al*. 2000). Core roost sites are thought to be restricted to caves where at least semi-permanent water is nearby (Armstrong 2001, Churchill 2008), although significant roosts have also become established in man-made structures such as abandoned mines in the Pilbara region (Churchill 1991).

For the Pilbara Leaf-nosed Bat, 'habitat critical to the survival of the species' is defined by TSSC (2016d) as underground diurnal roosts with warm temperatures and high humidity, listed in order of priority for conservation, they are:

- **Permanent Diurnal Roost**:

  "occupied year-round and likely the focus for some part of the 9-month breeding cycle; considered as critical habitat that is essential for the daily survival of the Pilbara leaf-nosed bat."

- **Non-Permanent Breeding Roost**:

  "*evidence of usage during some part of the 9-month breeding cycle (July–March), but not occupied year-round; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat*."

- **Transitory Diurnal Roost:**

  "occupied for part of the year only, outside the breeding season (April–June), and which could facilitate long distance dispersal in the region; considered as critical habitat that is essential for both the daily and long-term survival of the Pilbara leaf-nosed bat."

Habitat important for the persistence of the local population, although not considered to be critical habitat, is:

- **Nocturnal Refuge:**

  "occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Excludes overhangs. Not considered critical habitat but are important for persistence in a local area."

It is difficult to define critical foraging habitat (TSSC 2016d). Foraging habitat appears to be diverse and not a restricting factor, however, suitable foraging habitat located within vicinity of a diurnal roost in order of priority for conservation includes gorges with pools (Priority 1), gullies (Priority 2), rocky outcrops (Priority 3), major watercourses (Priority 4) and open grasslands and woodlands (Priority 5).

The TSSC (2016b) lists nine threats to the conservation status of the Pilbara Leaf-nosed Bat:

- heat and water loss: the species is known for its poor ability to maintain body temperature and water
- mine collapse: resulting in direct mortality
- flooding: resulting in destruction of roost sites and possibly direct mortality
- natural predators
- mine development: may result in the destruction of roost sites
- blasting in adjacent workings: resulting in abandoning of roost sites by bats
- human entry of roosts: resulting in animals abandoning the site
- road kills: direct mortality resulting from increased vehicle activity
- site rehabilitation.

There are records of the Pilbara Leaf-nosed Bat in the surrounding area on DBCA's Threatened and Priority Fauna Database (Figure 10). The records range from 2009 to 2015 and are mainly from previous surveys at Woodie Woodie (Western Wildlife 2007, 2009, 2010, 2014), Ant Hill Mesa and Ripon Hills.

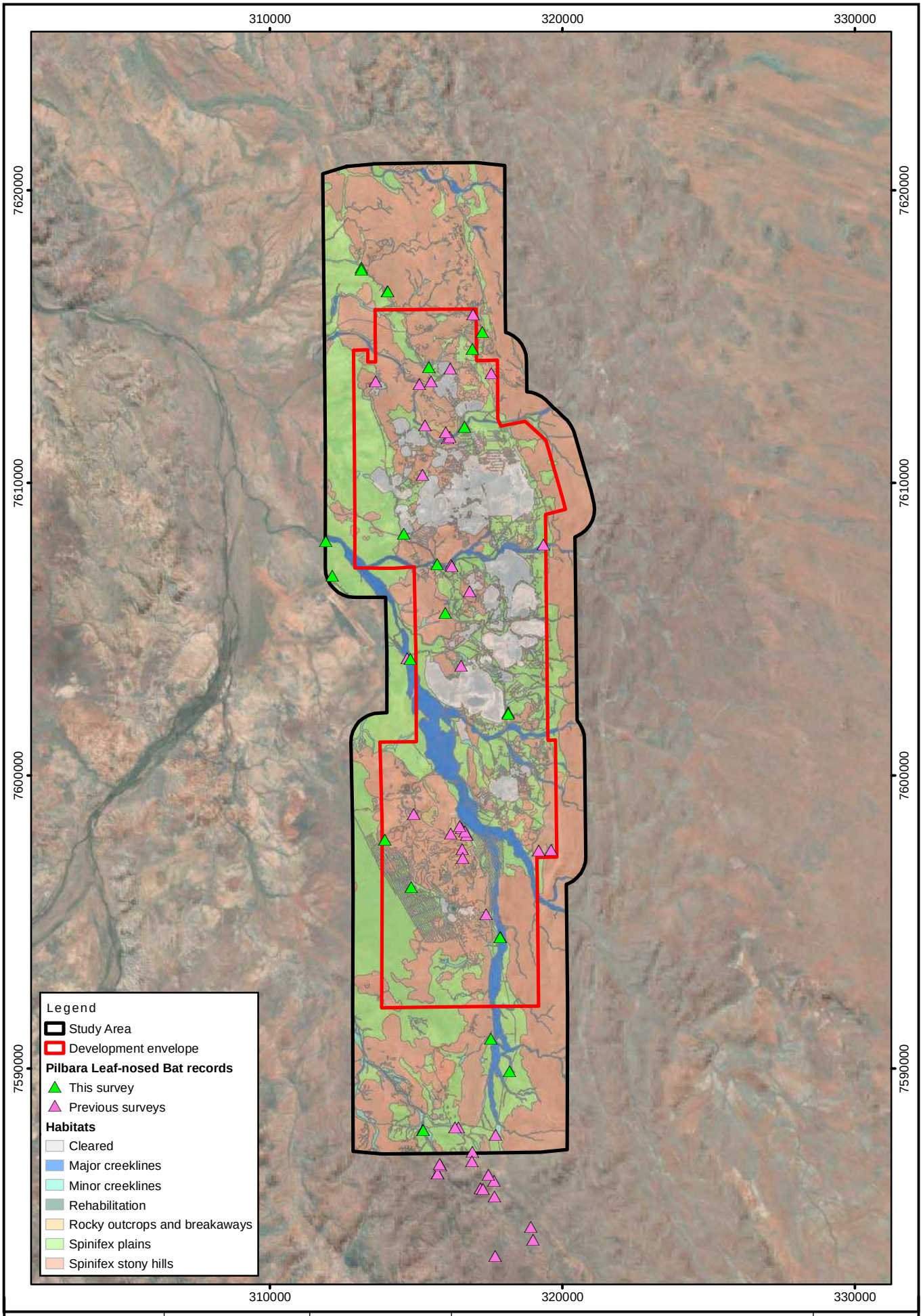
A survey in 2020 failed to find any permanent or transitory diurnal roosts in the study area. (Western Wildlife 2021). Nocturnal refuges are likely to occur in the study area. These are used for feeding at night and are not considered critical habitat. The roosting locations of the bats foraging at Woodie Woodie are currently unknown but there are large areas of potentially suitable rocky habitats in the region. The Pilbara Leaf-nosed Bat is likely to forage throughout the study area, particularly along major creeklines where there are waterholes and rocky habitats.

Ghost Bat – *Macroderma gigas*

The Ghost Bat is listed as Vulnerable under the EPBC Act and BC Act.

The Ghost Bats of the Pilbara region are disjunct and genetically distinct to those that occur in the Kimberley, Northern Territory and Queensland. The Pilbara population is divided between those in the Hamersley Ranges and those in the Chichester Ranges, though the genetic differentiation is low, suggesting bats move between these populations (Ottewell *et al*. 2017). If Ghost Bats are present at Woodie Woodie, they would fall within the Chichester Range subpopulation, which is estimated to be about 1,500 individuals (TSSC 2016a).

In the Chichester region, Ghost Bats are often found in large maternal roosts and these congregations are important for the survival of the species. However, smaller roosts are also likely to be important, allowing bats to occupy and forage through more of the landscape, resulting in dispersal and gene-flow between larger roosts. As the overall Chichester population is so small, all populations are likely to be important.



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Woodie Woodie Project
Pilbara Leaf-nosed Bat records

Figure: **14**

Ghost Bats utilise several diurnal and nocturnal roost caves within an area for feeding, resting, breeding and maternity. In the Pilbara, a number of natural formations are used by the Ghost Bat intermittently as short-term transient roosts and for feeding activity for single or small numbers of individuals, whilst others are used by maternity colonies (Armstrong and Anstee, 2000).

The structure of a roost site is largely indicative of its use. Transient day roosts or feeding sites for Ghost Bats are often shallower with microclimates similar to ambient conditions (Armstrong and Anstee, 2000). Breeding activity for Ghost Bats is associated with roost sites that have a relative humidity of above 80% (Armstrong and Anstee, 2000). Restricted to gorges and escarpments in the Pilbara where access to surface water, particularly where permanent or semi-permanent rock pools are present, is reasonably accessible. Individuals and small groups may shelter in deep rock crevices and abandoned mine pits.

Although the foraging ecology of the Pilbara populations has not been studied, a recent Queensland study has found that male Ghost Bats forage up to 11.8km from the roost, while lactating females forage within 3km (Augusteyn *et al*. 2018). A study in the Northern Territory found that bats foraged on average 1.9km from their diurnal roost (Tidemann *et al*. 1985). Ghost Bats have large wings and are capable of flying considerable distances to forage, but there is uncertainty around the relative importance of close foraging habitats. If bats are forced to fly further to forage, this may impact on breeding success and cause population decline (Augusteyn *et al*. 2018). Therefore, any foraging habitat within 3km of a diurnal roost or potential maternity roost may be considered important foraging habitat.

Threats to the conservation status of the Ghost Bat include:

- direct heat and water loss: the species is known for its poor ability to maintain body temperature and water
- wide fluctuations in cave temperature and humidity due to extrinsic disturbances, especially maternity caves, leading to direct mortality and cave abandonment
- mine/cave collapse: resulting in direct mortality
- flooding: resulting in destruction of roost sites and possibly direct mortality
- mine development: may result in the destruction of roost sites
- blasting in adjacent workings: resulting in abandoning of roost sites by bats
- human entry of roosts: resulting in animals abandoning the site.

There are 40 records of Ghost Bat within 100km of Woodie Woodie on DBCAs Threatened and Priority Fauna Database (Figure 10). All the records are at least 55 – 60km west of the study area, mainly from All Nations Mine, Ripon Hills and around Nullagine (DBCA 2021). Many of the records are historical (1899 – 1967) with only two recent records from near Nullagine in 2006 and 2018 (DBCA 2021). The Ghost Bat has not been recorded at Woodie Woodie on this or previous surveys. Although it potentially occurs, there is limited potential roosting habitat present. No diurnal or other roosts were recorded during a search for potential roost sites in 2020 (Western Wildlife 2021). If present in the region, the Ghost Bat is most likely to occur as a foraging visitor to the study area. While foraging habitat is important, it is also widespread and unlikely to be habitat critical to the survival of the species.

Pilbara Olive Python – *Liasis olivaceous barroni*

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and BC Act.

An iconic species of the Pilbara region, the Pilbara Olive Python is large and mostly nocturnal. Adults are usually around 2.5m long, with individuals reliably measured up to 4.5m long (Pearson 2003). Due to its cryptic habits, there are no reliable estimates of population size (DEWHA 2008), however, it was thought to be uncommon with the initial description of the subspecies in 1981 performed on a mere eight specimens collected over 65 years (Pearson 2003).

Within its range, the Pilbara Olive Python has been found to be widely distributed with many sizable populations (Pearson 2003). It is generally associated with large river systems, such as the Coongan, Shaw, Yule, Harding, Fortescue, Ashburton and Robe Rivers (DSEWPaC 2011). The favoured habitat of the Pilbara Olive Python is generally considered to be deep gorges with waterholes, however, it also occurs in riverine habitats (DSEWPaC 2011) and on the Burrup Peninsula it inhabits large rock piles in spinifex grasslands (Tutt *et al*. 2004). Radio-tracking studies on the Robe and Fortescue Rivers have found that in summer pythons range along rivers, visiting permanent pools, and in winter they shelter in rocky areas away from water, including caves in flat-topped hills (Pearson 2003, DEWHA 2008). Artificial waters, such as sewage ponds and recreational lakes, are also used (Pearson 2003).

Breeding occurs in winter, with males travelling up to three or four kilometres in search of females (Tutt *et al*., 2004, Pearson 2003). Females only breed every 3 – 4 years (DPAW 2013). Nests sites have been observed under large slabs of rock at a considerable distance from water (DPAW 2013, Pearson 2003). In January the eggs hatch, and the young disperse (Pearson 2003). Although only preliminary results are available, on the Burrup Peninsula the Pilbara Olive Python has been found to occupy a large and distinct home-range (Tutt *et al*. 2004). Females have been found to have a highly localised home-range of 89.76 – 365.33 ha (based on three individuals) and males wander widely in search of females and have a home range of 449.26 ha (based on a single individual) (Tutt *et al*. 2004, DPAW 2013).

Threats to the Pilbara Olive Python are listed in the Conservation Advice for the species (DEWHA 2008):

- Direct predation by feral cats (*Felis catus*) and foxes (*Vulpes vulpes*), particularly of juveniles.
- Loss of prey species, such as Northern Quolls (*Dasyurus hallucatus*) and rock-wallabies (*Petrogale spp*.) to predation by foxes.
- Loss of habitat to gas and mining developments, including changes to hydrology and downstream impacts such as sedimentation or pollution.
- Deliberate road-kills.
- Killed due to being mis-identified as a venomous snake species.

There is still a lack of information on the basic ecology of the Pilbara Olive Python. Although radio-tracking studies have been completed in several Pilbara locations, these datasets remain largely unpublished. The cryptic habits of this species make it difficult to systematically survey, as even a large-scale survey may fail to record any individuals.

There are two records of this species within 100km of Woodie Woodie on DBCA's Threatened and Priority Fauna Database (Figure 10). One record is from a previous survey at Woodie Woodie in 2007 and the other is from Ant Hill Mesa in 2013 (DBCA 2021). Although no pythons were recorded on this survey, two (one live and one dead) were recorded on a targeted survey in 2020 and a further record of a dead individual was recorded in 2017 (Figure 14, Western Wildlife 2020).

The Pilbara Olive Python potentially occurs in a variety of habitats when dispersing and looking for mates, however, habitats at Woodie Woodie likely to be habitat critical for survival are Major Creeklines, Waterholes and Rocky Outcrops and Breakaways. Three major creek-line systems occur in the study area, Muddauthera Creek in the north, Brumby Creek in the centre and Warri Creek in the south, all of which drain to the Oakover River in the west. Of these, only Muddauthera Creek has several waterholes inside the study area and is in close proximity to rocky outcrops (Plates 41 and 42). The remaining creeks still provide habitat, particularly when in close proximity to rocky areas, but where they pass through the mine corridor, they lack permanent or semi-permanent waterholes, instead exhibiting a sandy or stony dry creek bed.

The species is likely to be near the eastern edge of its range at Woodie Woodie, as the Great Sandy Desert does not provide suitable habitat. It is difficult to ascertain the size of the Pilbara Olive Python population at Woodie Woodie due to the small number of records, however, the available evidence tends to suggest that it is unlikely to be large.

Plate 41. Rocky outcrops in the hills overlooking Muddauthera Creek.

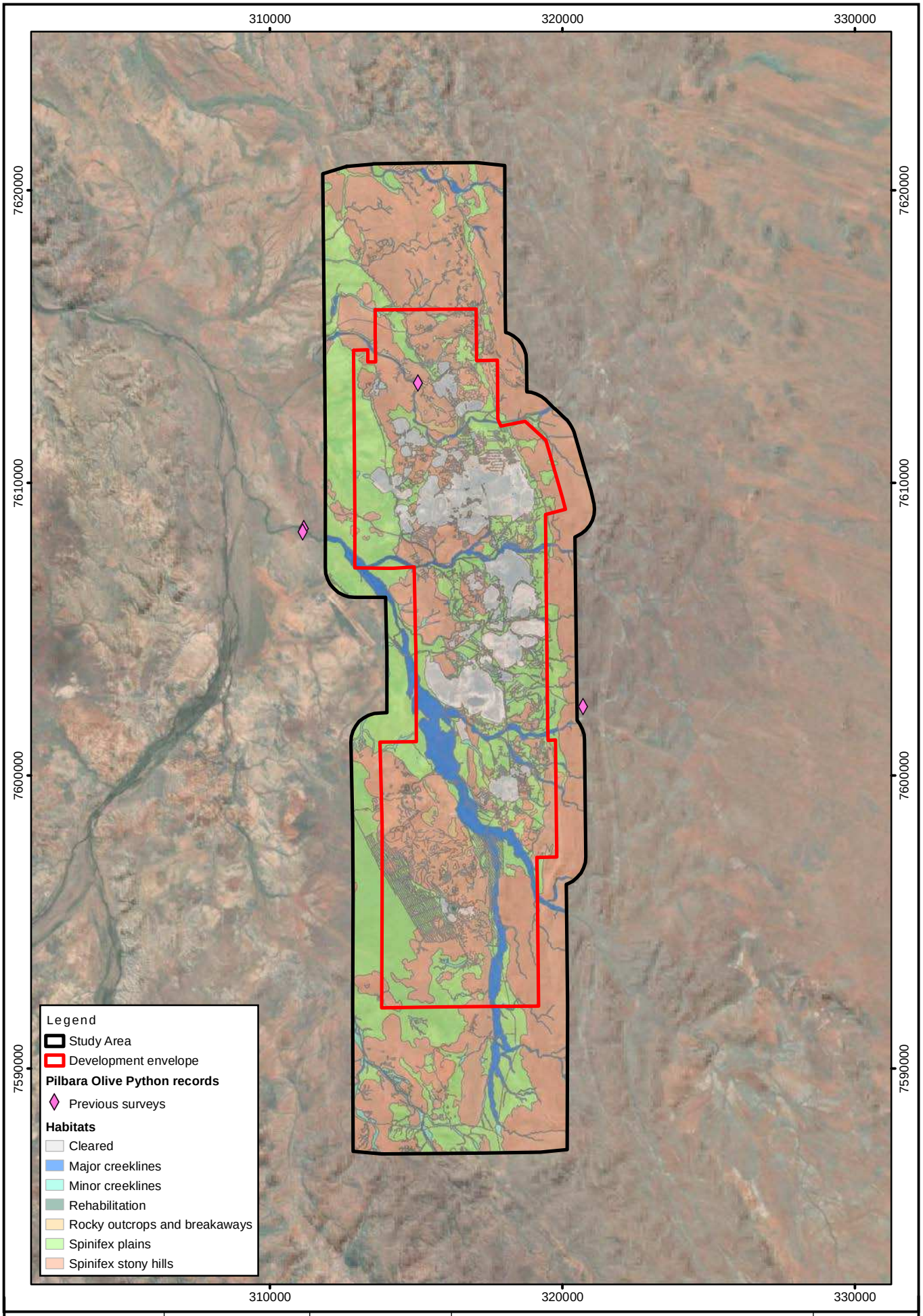
Plate 42. Waterhole on Muddauthera Creek where a python was recorded in 2020.

Grey Falcon – *Falco hypoleucos*

The Grey Falcon is listed as Vulnerable under the EPBC Act and BC Act.

The Grey Falcon may number fewer than 1000 individuals, though it occurs across a large portion of arid and semi-arid Australia with its distribution centered on inland drainages (Garnett *et al*. 2011). It forages over timbered plains, including *Acacia* shrublands, also ranging out onto treeless plains. The Grey Falcon nests in tall trees on watercourses (Garnett *et al*. 2011) and occasionally on man-made structures such as transmission line towers (pers. obs.). Threats to this species are unknown but may include predation by feral cats, increased temperatures due to climate change, stochastic events impacting the small population and habitat degradation due to overgrazing (TSSC 2020).

The Grey Falcon has not been recorded at Woodie Woodie on this or previous surveys since 2006. There are three records in the 100km surrounding the study area on DBCA's Threatened and Priority Fauna Database (Figure 10), the most recent from Tumbinna Pool in 2002 (DBCA 2021). Major creeklines in the study area may possibly provide breeding habitat for this species and the Grey Falcon may forage in the study area during the non-breeding season. Overall, the study area is unlikely to be important habitat for this species unless a pair were found to be breeding.



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Pilbara Olive Python habitat and records

Figure:
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Princess Parrot – *Polytelis alexandrae*

The Princess Parrot is listed as Vulnerable under the EPBC Act and as Priority 4 by DBCA.

The Princess Parrot occurs across inland arid Australia where it inhabits shrublands and open woodlands over Spinifex in the swales between dunes (Garnett *et al*. 2011). There is limited information on population trends, as this species generally occurs in unpopulated areas and can be irruptive (TSSC 2018). The Princess Parrot can congregate in large flocks to breed in response to rainfall events (TSSC 2018). It nests in hollows and has been recorded nesting in River Red Gum (*Eucalyptus camaldulensis*), Marble Gum (*Eucalyptus gongylocarpa*) and Desert Oak (*Allocasuarina decaisneana*) (Garnett *et al*. 2011).

Although no threats are known for the species, it may be adversely affected by altered fire regimes and competition with introduced grazing herbivores (Garnett *et al*. 2011). The conservation priority for the species is to undertake active fire management to protect breeding habitat (TSSC 2018).

There are no records in the 100km surrounding the study area on DBCA's Threatened and Priority Fauna Database (Figure 10) and this species has not been recorded at Woodie Woodie during fauna surveys. The study area is on the western edge of the known range of this species and outside its core range in the sandy deserts, however, it is possible that it occurs in the study area in some years. Tree hollows in *Eucalyptus camaldulensis* in the major creeklines are possible breeding habitat and spinifex plains are possible foraging habitat.

5.2.2 Migratory Fauna

There are five Migratory species that potentially occur in the study area (Table 12). Migratory species are not always present at a site, but a particular site may have significance as a seasonal or ephemeral foraging, breeding or shelter area. Impacts to these sites may then impact the population both within the site and further afield. The study area is only likely to be an internationally significant site for Migratory shorebirds if it supports 20,000 birds or 1% or more of the flyway population of a species, or a nationally significant site if it supports 2,000 birds or 0.1% or more of the flyway population of a species (DoEE 2017).

Oriental Plover – *Charadrius veredus*

The Oriental Plover is listed as Migratory under the BC Act and EPBC Act.

The Oriental Plover favours dry grasslands and open plains, including recently burnt areas (Geering *et al*. 2007). This species is a non-breeding summer visitor to Australia, migrating from northern China and Mongolia through the East Asian-Australasian Flyway (Geering *et al*. 2007). The study area is only likely to be an internationally significant site for this species if it regularly supports 2,300 birds or a nationally significant site if it regularly supports 230 birds (DoEE 2017, Hansen *et al*. 2016).

There are no records of the Oriental Plover within 100km on DBCA's Threatened and Priority Fauna Database (Figure 11). The Oriental Plover potentially occurs in small numbers as a non-breeding visitor to the study area, however, an ecologically important proportion of the population is unlikely to occur. When present, the Oriental Plover is likely to favour open habitats such as recently burnt areas.

Common Sandpiper – *Tringa hypoleucos*

The Common Sandpiper is listed as Migratory under the BC Act and EPBC Act.

The Common Sandpiper may be present at any time of the year, but more likely between September and March (Johnstone and Storr 1998). This species occurs in a range of salt and freshwater habitats, including coasts, river pools, drying swamps and floodwaters (Johnstone and Storr 1998), however, it is most common on the coast (Geering *et al*. 2007). The study area is only likely to be an internationally significant site for this species if it regularly supports 1,900 birds or a nationally significant site if it regularly supports 190 birds (DoEE 2017, Hansen *et al*. 2016).

There are nine records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 11) and this species has previously been recorded at Woodie Woodie (Figure 16). The study area is only likely to support one or two birds on a regular basis and is not likely to provide important habitat for this species. When present, the Common Sandpiper is likely to use habitats such as permanent or semi-permanent pools, or artificial pond habitats.

Wood Sandpiper – *Tringa glareola*

The Wood Sandpiper is listed as Migratory under the BC Act and EPBC Act.

In northern Australia, the Wood Sandpiper inhabits inland freshwater wetlands (Geering *et al*. 2007). The study area is only likely to be an internationally significant site for this species if it regularly supports 1,300 birds or a nationally significant site if it regularly supports 130 birds (DoEE 2017, Hansen *et al*. 2016).

There are four records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 11) and this species has previously been recorded at Woodie Woodie (Figure 16). The study area is only likely to support one or two birds on occasion and is not likely to provide important habitat for this species. When present, the Wood Sandpiper is likely to use habitats such as permanent or semi-permanent pools, or artificial pond habitats.

Fork-tailed Swift – *Apus pacificus*

The Fork-tailed Swift is listed as Migratory under the BC Act and EPBC Act.

The Fork-tailed Swift is a non-breeding visitor to Australia between September and April (Boehm 1962, Johnstone and Storr 1998). While it can be common in the north, it is generally scarce in southwest Australia (Johnstone and Storr 1998). The bird is primarily observed foraging for insects in proximity to cyclonic weather (Boehm 1962). Although a migratory species, the Fork-tailed Swift has a large range and a large population that appears to be stable (BirdLife International 2021).

There are no records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database (DBCA 2021). The Fork-tailed Swift potentially occurs in the study area, but the habitats of the study area are unlikely to be important to this species, as it is largely aerial when visiting Australia.

Glossy Ibis – *Plegadis falcinellus*

The Glossy Ibis is listed as Migratory under the BC Act and EPBC Act.

The Glossy Ibis has an extremely large global range and although its population size is thought to be decreasing, it is not at a rate sufficient to justify listing the species as Vulnerable (Birdlife International 2021). In Western Australia, the Glossy Ibis occurs mainly on well-watered flats in the Kimberley region, favouring freshwater wetlands, and is a vagrant in drier and hillier regions (Johnstone and Storr 1998).

There are five records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 11), from Carawine Pool on the Oakover River and in the vicinity of Marble Bar (DBCA 2021). Although the Glossy Ibis has not been recorded from Woodie Woodie on this or previous fauna surveys, it potentially occurs on permanent or semi-permanent pools, or artificial pond habitats. It is only likely to occur as an occasional foraging visitor and is unlikely to breed in the study area.

5.2.3 Specially Protected Fauna

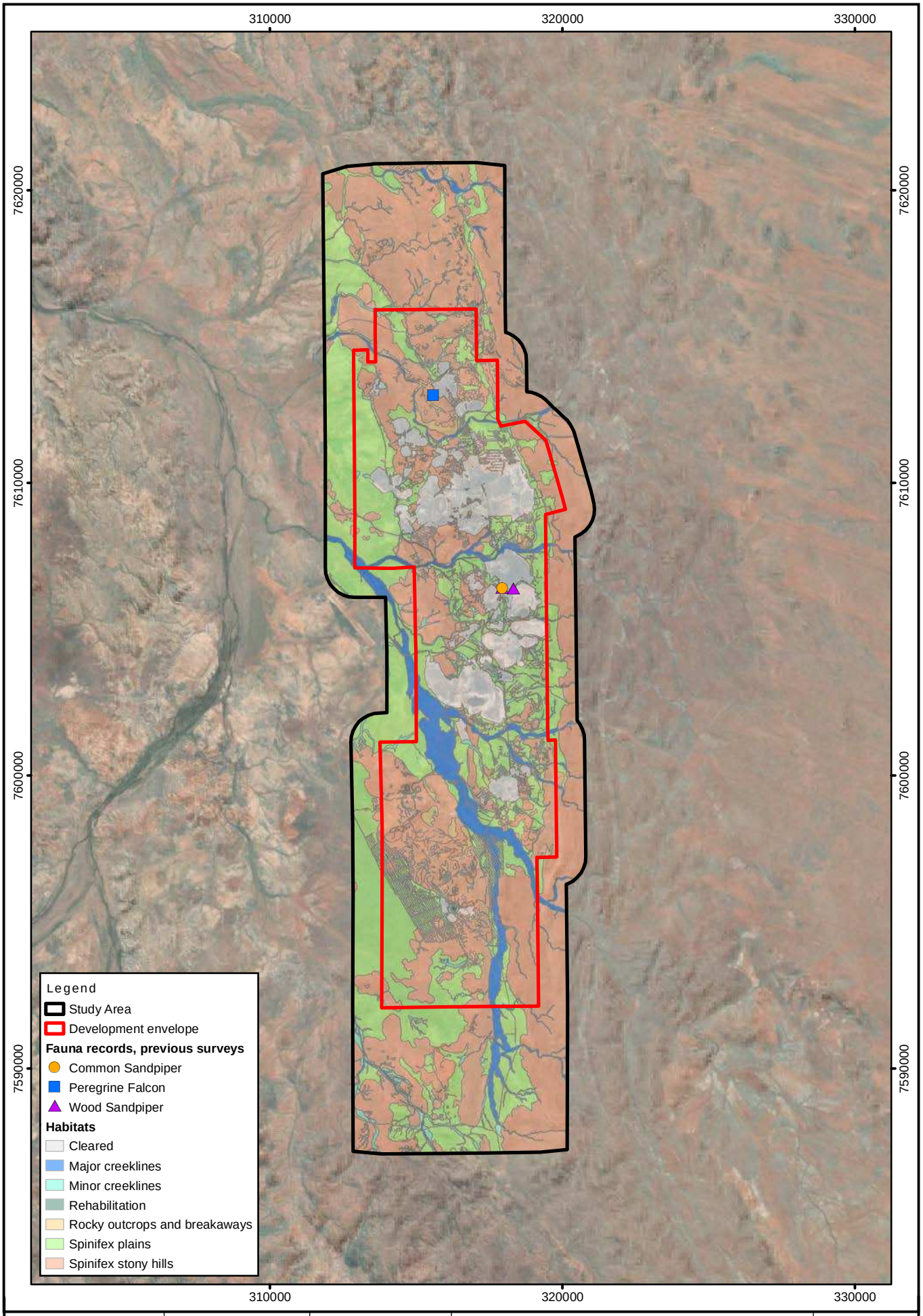
There is one specially protected vertebrate species that potentially occurs in the study area (Table 12). The populations of Specially Protected species are large enough that they are not considered to be Threatened. However, they require on-going conservation intervention (i.e., Conservation Dependent) or be specially protected in order to prevent them from becoming Threatened.

Peregrine Falcon – *Falco peregrinus*

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act.

The Peregrine Falcon is a widespread bird of prey that globally has a very large range and a very large population that appears to be secure (BirdLife International 2021). In Western Australia the population is secure, though this species may experience reductions at a local level due to human disturbance at nesting sites (Debus 1998). The Peregrine Falcon nests mainly on ledges on cliffs or rocky outcrops, and it may also use tall trees (Johnstone and Storr 1998). This species often takes advantage of man-made structures such as abandoned open pits or quarries.

There are two records of the Peregrine Falcon within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 11), of which one is a record from Woodie Woodie in 2018 (Figure 16). The Peregrine Falcon is known to occur at Woodie Woodie and may nest in old open pits or taller rocky outcrops. It is likely to forage over open habitats such as the Spinifex Stony Hills.



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Woodie Woodie Project
Migratory and Specially Protected Fauna Records

Figure: **16**

5.2.4 Priority Fauna

There are five Priority vertebrate fauna species that potentially occur in the study area (Table 12). Priority 1, 2 or 3 species need further survey effort, as insufficient data exist to adequately determine their status. Many Priority 1, 2 and 3 species are known from only a few records in a limited number of locations, thus determining their status in the study area may be problematic. Priority 4 species are considered to require regular monitoring, as although they are adequately known, they are either rare, near threatened or recently removed from the threatened list.

Pin-striped Finesnout Ctenotus – *Ctenotus nigrilineatus*

This species is listed as Priority 1 by DBCA.

The Pin-striped Finesnout Ctenotus is a small lizard that is confined to a small area of the Pilbara interior. It is only known from a few records near Woodstock, Meentheena and Nullagine, and its distribution is thought to be patchy (Chapple *et al*. 2019). Little is known of the species, but those trapped have been from Spinifex plains on granitic soils near watercourses. It is possible that its rarity is natural and there are no known threats to the species (Chapple *et al*. 2019).

There are 26 records of this species within 100km on DBCA's Threatened and Priority Fauna Database (Figure 12), from Meentheena Station in 2000 and 2001 and in vicinity of Nullagine in 2010 (DBCA 2020). The study area is currently outside the known range of this species, but as it is rarely recorded and its distribution is patchy, it possibly occurs. If present, it may occur on the Spinifex Plains or on Major Creeklines.

Long-tailed Dunnart – Sminthopsis longicaudata

The Long-tailed Dunnart is listed as Priority 4 by DBCA.

The Long-tailed Dunnart occurs in the Pilbara, Mid-West and the central deserts of Western Australian and Northern Territory. It is associated with breakaways and scree slopes, but also occurs on gravel or stony plains (Van Dyck and Strahan 2008). It is listed as 'Least Concern' in the Action Plan for Australian Mammals (Woinarski *et al*. 2014). The study area is outside the known range of this species in the Pilbara, but this species is uncommonly recorded so the extent of known records may not be an accurate reflection its distribution.

There are no records of the Long-tailed Dunnart within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 12). This species possibly occurs in the study area, but extensive camera trapping (as part of Northern Quoll surveys) has thus far failed to record the species. If present, the Long-tailed Dunnart is likely to favour the Rocky Outcrops and Breakaways habitat and may also occur in the Spinifex Stony Hills habitat throughout the Study Area.

Spectacled Hare-wallaby – *Lagorchestes conspicillatus leichardti*

The mainland population of the Spectacled Hare-wallaby is listed as Priority 4 by DBCA.

The mainland form of the Spectacled Hare-wallaby is sparsely distributed and generally uncommon (Woinarski *et al.* 2014). It occurs in a range of tropical grassland habitats, sheltering in large spinifex hummocks when in spinifex grasslands (Van Dyck and Strahan 2008). It is listed as 'Near Threatened' in the Action Plan for Australian Mammals, due to past and continuing declines in its population (Woinarski *et al*. 2014). In Western Australia it currently occurs in isolated populations in the Pilbara, Kimberley and north-eastern Great Sandy Desert. Threats to the species include predation by foxes and feral cats and inappropriate fire regimes (Woinarski *et al*. 2014).

There are no records of the Spectacled Hare-wallaby within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 12). The patchy distribution and rarity of records of this species in the Pilbara makes it difficult to ascertain the status of this species in the study area, however, it possibly occurs on spinifex plains.

Lakeland Downs Mouse – *Leggadina lakedownensis*

The Lakeland Downs Mouse is listed as Priority 4 by DBCA.

The Lakeland Downs Mouse (also known as the Short-tailed Mouse) favours cracking and gilgaied clays (Gibson and McKenzie 2009), but it also occurs in a range of other habitats, including Spinifex grasslands and stony ranges (Van Dyck and Strahan 2008). Populations of this species can fluctuate dramatically (Van Dyck and Strahan 2008), so it may be common in one year and virtually absent in another.

There are eight records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 12), from Meentheena Conservation Park in 2000 and near Carawine Gorge on the Oakover River in 1988 (DBCA 2021). Although not recorded during this survey, the Lakeland Downs Mouse potentially occurs in the study area. If present, it may occur in any habitat but is most likely to favour areas in the vicinity of the Major Creekline habitat.

Western Pebble-mound Mouse – *Pseudomys chapmani*

The Western Pebble-mound Mouse is listed as Priority 4 by DBCA.

The Western Pebble-Mound Mouse occurs in the ranges of the central and southern Pilbara, and the smaller ranges of the Little Sandy Desert. It inhabits gentle stony slopes where it constructs its pebble mounds, often situating them near *Acacia*-lined minor drainages (Van Dyck and Strahan 2008). This species has disappeared from parts of its range along the Pilbara coast, Murchison and Gascoyne, possibly due to the fox and introduced herbivores (Van Dyck and Strahan 2008). Despite this, mining is not considered to be a threatening process for this species, as its habitat is relatively widespread (Woinarski *et al*. 2014).

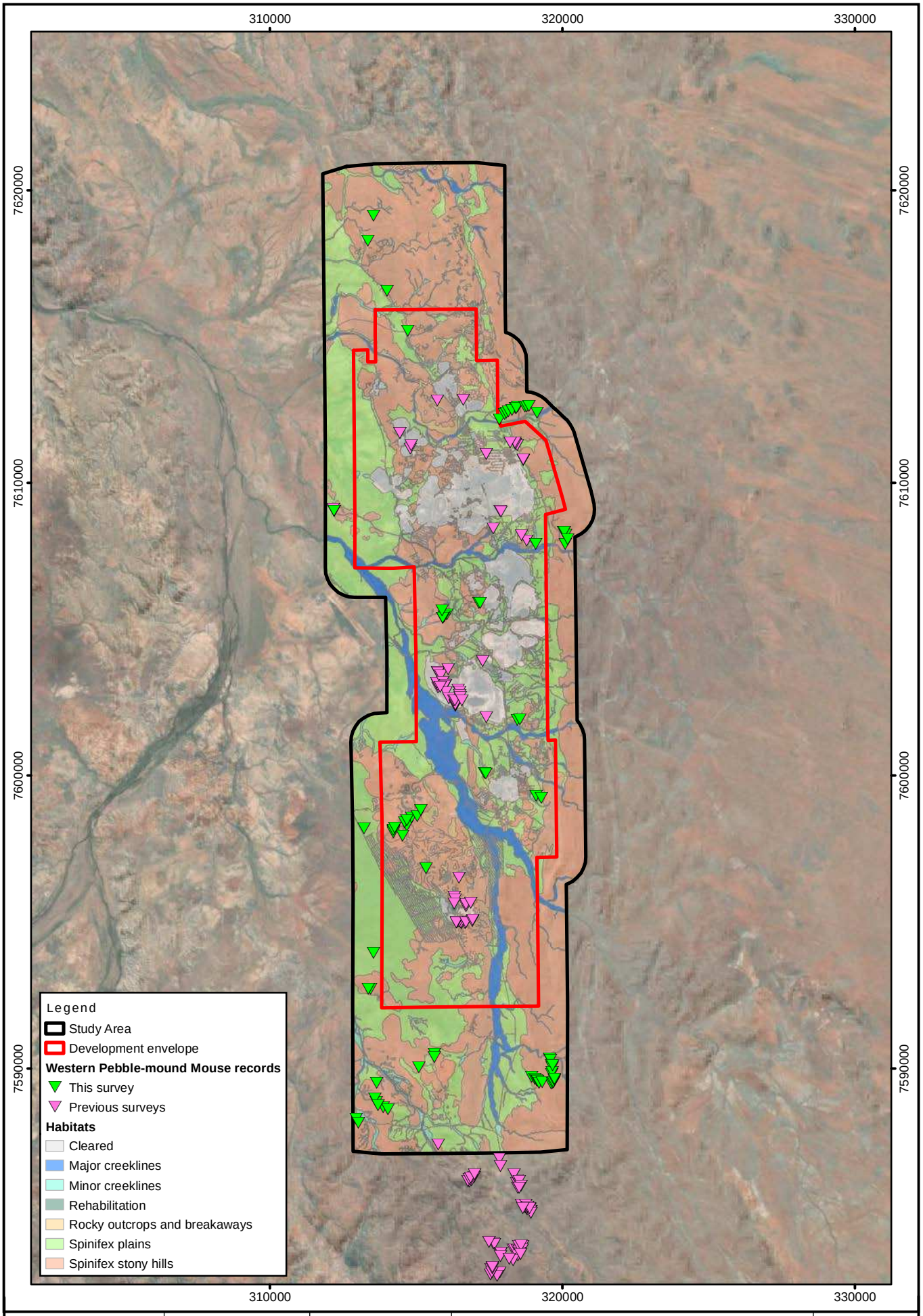
There are many records of this species within 100km of the study area on DBCA's Threatened and Priority Fauna Database (Figure 12). Both active and inactive mounds of this species were found on spinifex stony hills in the study area during this survey, and in previous surveys at Woodie Woodie (Figure 17, Plates 43 - 44). The Western Pebble-mound Mouse is likely to occur throughout the spinifex stony hills of the study area and in the wider region.

Plate 43. Active Western Pebble-mound Mouse mound in the study area.

Plate 44. Active Western Pebble-mound Mouse mound in the study area.

5.2.5 Locally Significant Fauna

No locally significant fauna were identified in this survey. The majority of species are widespread through the Pilbara region, occurring in a variety of habitats. The study area is unlikely to support significant aggregations of any species, such as breeding waterbirds.



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Western Pebble-mound Mouse records

Figure: **17**

6. Survey Adequacy

6.1 Species Accumulation Curves

Species accumulation curves were calculated for reptiles (Figure 18), mammals (Figure 19) and birds (Figure 20) in each habitat, as well as for each group in all habitats combined.

Estimates of species richness for reptiles and mammals are given in Table 13, using the Chao1 estimator for abundance-based trapping data. Species richness estimates for birds in each habitat are given in Table 14, using the Chao2 estimator for incidence-based bird survey data. These are good indicators of the lower bound of the total species richness with small sample sizes. However, the number of singletons in the reptile and bird samples is high, indicating that the sample size was low and the accuracy of these estimates may be poor.

When interpreting species accumulation curves and estimators of species richness in the context of a detailed fauna survey, it is vital to remember that the data collected is influenced by the sampling methods. All sampling methods have inherent biases that favour the detection of some species over others, i.e. some species will be readily trapped, and others may be trapped rarely or not at all. Thus, the species accumulation curves and estimates of species richness are that of the 'trappable' component of the fauna only. Species may not be trappable if they are temporarily absent from the site (e.g. migratory, nomadic or irruptive species), are too large to be targeted by standard trapping techniques (e.g. kangaroos) or are shy of entering traps. Fauna may also be patchy in their distribution within a habitat and only be trapped if the trapping site intersects their home-range. Additionally, the trappable component of the fauna is likely to vary due to the prevailing conditions, e.g. frogs may be trappable after heavy rains, but virtually impossible to sample in dry conditions, drought conditions may reduce some species to undetectable levels, or cool conditions may result in reptiles being inactive.

For reptiles, the species accumulation curves did not reach asymptote in this study, suggesting that if trapping had continued, more species would have been recorded in each habitat (Figure 16, Table 13). However, the overall estimate of species richness for all habitats was 62.58 ± 11.64, and combined surveys at Woodie Woodie have resulted in a similar observed species richness of 70 species.

For mammals, the species accumulation curves were close to asymptote, suggesting that almost all the trappable species were recorded in each habitat (Figure 17, Table 13). The estimated and observed species richness was similar for each habitat and for all habitats combined.

For birds, although the species accumulation curves did not reach asymptote in the separate habitats, the estimated species richness was close to the observed species richness for all habitats combined. (Figure 18, Table 14). The total number of species observed on this survey, including opportunistic records, was 80. Therefore, it is likely that further sampling would have resulted in very few new species records on the current survey.

Although each habitat supports its own faunal assemblage, individual species can occur across more than one habitat. This is particularly the case for habitats with similar substrates such as the stony surface over much of the spinifex plains and the stony surface on the hills, or for birds, habitats with similar vegetation structure. Therefore, even if a species has not been recorded in a particular habitat, it may have been recorded in a similar habitat and still be a part of the overall species inventory for the study area.

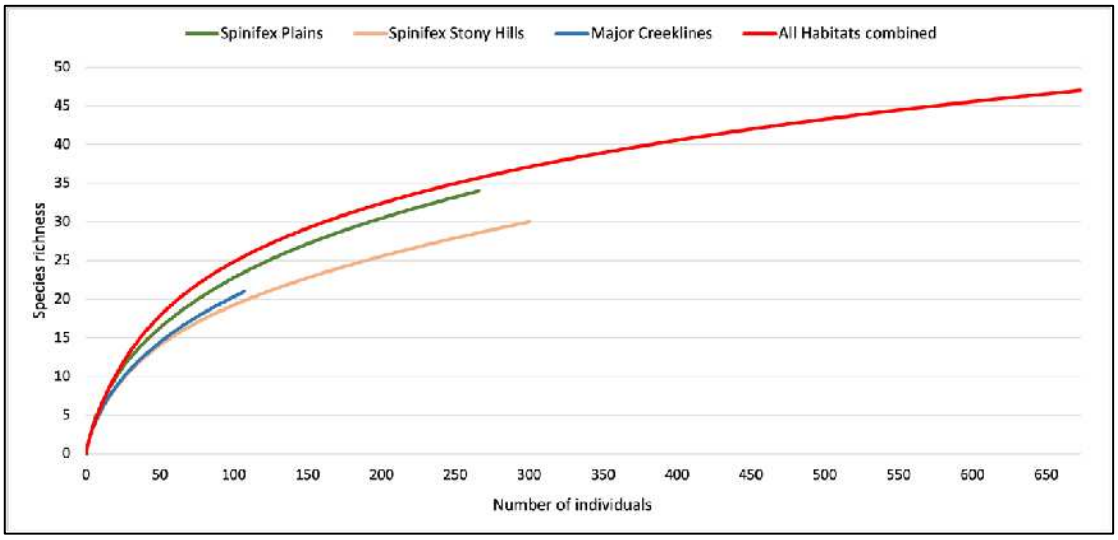

Figure 18. Species accumulation curves for reptiles in each habitat.

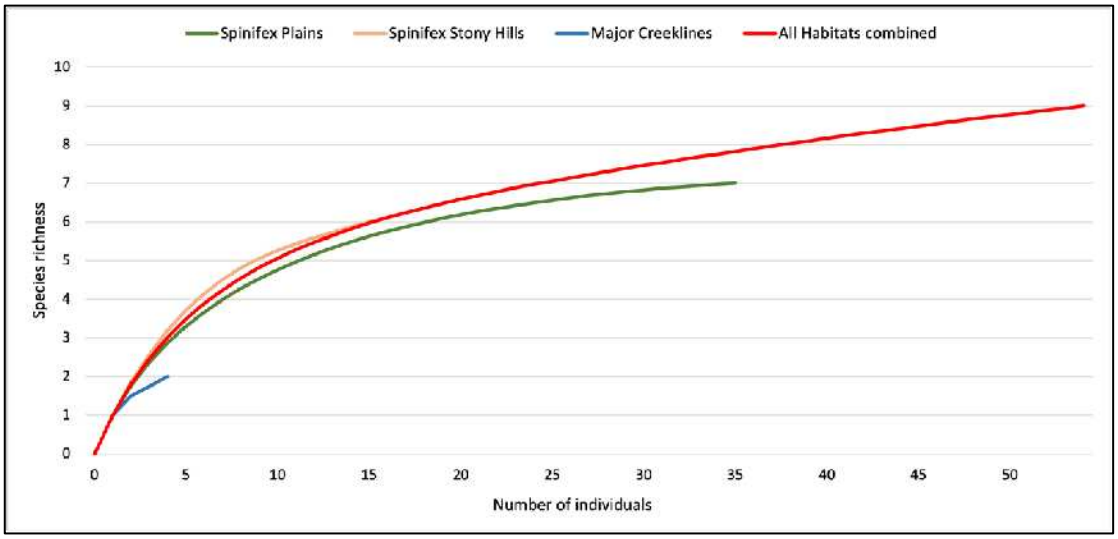

Figure 19. Species accumulation curves for mammals in each habitat.

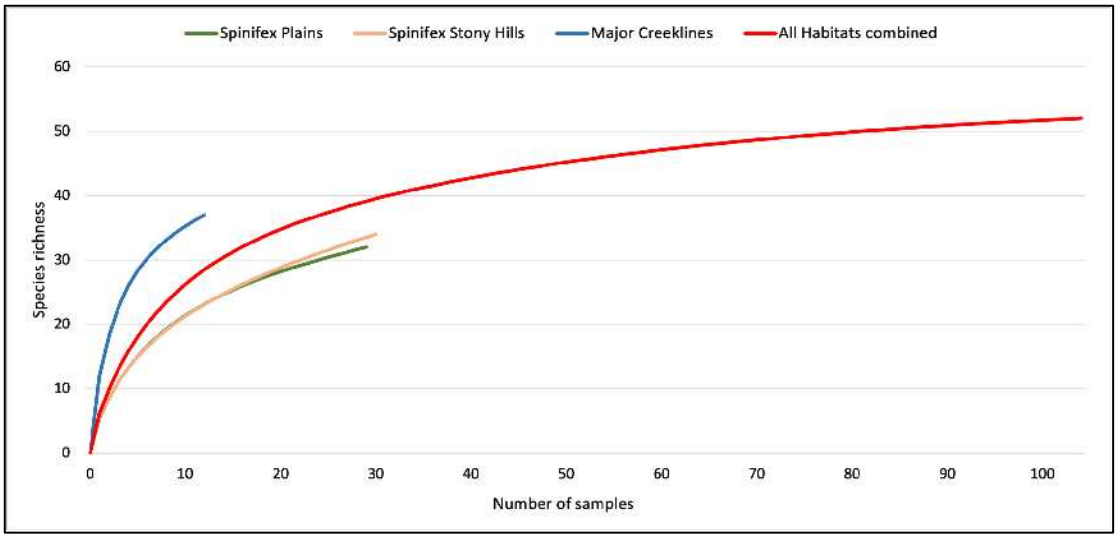

Figure 20. Species accumulation curves for birds in each habitat.

Table 13. Estimated species richness for reptiles and mammals in each habitat.

	Habitat	Observed species richness	Sample size (number of individuals trapped)	Number of singletons in the sample	Chao1 Estimate of species richness (±SD)
Reptiles	Spinifex stony hills	30	300	12	53.92 ± 20.13
	Spinifex plain	34	266	13	49.54 ± 11.61
	Major creekline	21	67	10	45.77 ± 24.02
	All habitats combined	47	673	13	62.58 ± 11.64
Mammals	Spinifex stony hills	6	15	2	6.93 ± 2.09
	Spinifex plain	7	35	1	7.00 ± 0.16
	Major creekline	2	4	1	2.00 ± 0.46
	All habitats combined	9	54	3	10.47 ± 2.56

Table 14. Estimated species richness for birds in each habitat.

	Habitat	Observed species richness	Sample size (number of records)	Number of uniques in the sample	Chao2 Estimate of species richness (±SD)
Birds	Spinifex stony hills	34	30	14	57.68 ± 18.00
	Spinifex plain	32	29	11	45.28 ± 10.82
	Major creekline	37	12	10	43.88 ± 5.87
	All habitats combined	52	104	7	54.31 ± 2.53

6.2 Proportion of the Fauna Identified

Species accumulation curves are not the complete picture, as they are based only on the systematically collected trapping and bird survey data. Many species are observed opportunistically, and these records often add considerably to the total species inventory of a particular site. The total number of species observed can be compared to the number of species potentially occurring on the site.

A total of 7 frogs, 84 reptiles, 130 birds, 36 native mammals and six introduced mammals potentially occur, based on the literature review (Table 8, Appendices 6 - 10). Of these, 42.9% of frogs, 65.5% of reptiles, 61.5% of birds, 66.7% of native mammals and 50.0% of introduced mammals were recorded in the current study. These proportions are similar to those recorded in previous detailed fauna surveys at Woodie Woodie (Figure 21). The observed faunal assemblage at Woodie Woodie across all surveys (including detailed, basic and targeted surveys) represents 71.4% of frogs, 83.3% of reptiles, 87.7% of birds, 69.4% of native mammals and 83.3% of introduced mammals predicted.

As the list of potentially occurring species in Appendices 5 to 8 is relatively conservative, it is quite likely that some of the unrecorded species, although known from the region, do not in fact occur in the study area. Some of the species that remain unrecorded are those that are rare or patchy in their distribution or prefer sandier habitats.

Fauna populations in arid areas are likely to fluctuate in response to local and regional climatic conditions. The large proportion of species recorded at Woodie Woodie can be attributed to several surveys being undertaken in both the dry and post-wet seasons, in several years.

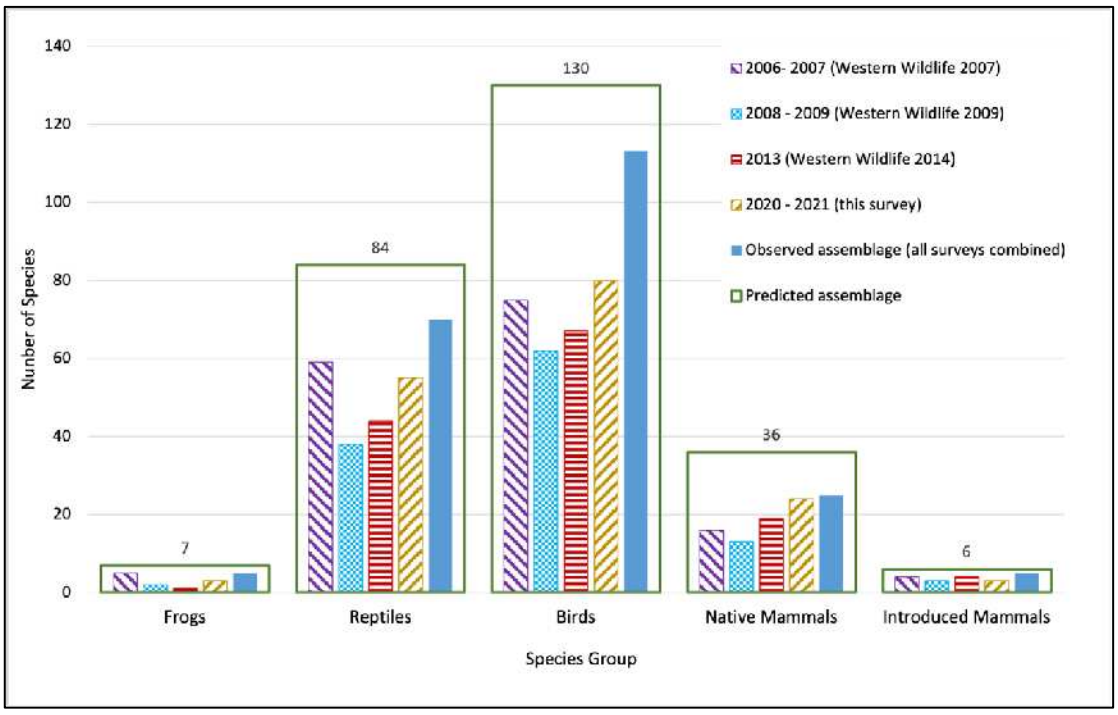

Figure 21. Proportion of the predicted faunal assemblage recorded.

It is likely that further work in the study area will result in more species being recorded. This is the case with all fauna surveys, even detailed ones, as the short survey periods only provide a 'snapshot' of the fauna occurring in the study area. However, the current survey resulted in more than half of the predicted frogs, birds, reptiles and native mammals being recorded, and added to the total number of species confirmed as occurring in the study area. That relatively few species were added to the list of confirmed species indicates that the fauna of Woodie Woodie are relatively well known from previous surveys.

7. Conclusions

7.1 Faunal Assemblage

The predicted faunal assemblage includes up to 7 frogs, 84 reptiles, 130 birds, 36 native mammals, six introduced mammals and eight freshwater fish. The observed assemblage for this survey was three frogs, 55 reptiles, 80 birds, 24 native mammals, three introduced mammals and one freshwater fish. The faunal assemblage is likely to be relatively intact and typical of the region. Many of the species that occur have wide distributions through the Pilbara and the arid zone.

7.2 Conservation Significant Fauna

There are 19 vertebrate fauna of conservation significance that potentially occur in the study area: eight Threatened, five Migratory, one Specially Protected and five Priority species. Of these, seven are known to occur in the study area: the Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*), Pilbara Olive Python (*Liasis olivaceous barroni*), Common Sandpiper (*Tringa hypoleucos*), Wood Sandpiper (*Tringa glareola*), Peregrine Falcon (*Falco peregrinus*) and the Western Pebble-mound Mouse (*Pseudomys chapmani*). Other conservation significant species may occur where suitable habitat is present but remain unrecorded thus far.

The study area provides critical habitat for the Northern Quoll and Pilbara Olive Python. The rocky outcrop and breakaway habitat provides shelter habitat for the Northern Quoll, and the study area supports an important population of this species. Foraging habitat is poorly understood but is considered to include areas within 1km of shelter habitat. Rocky areas also provide shelter habitat for the Pilbara Olive Python, and waterholes on major creeklines provide foraging habitat.

Although the Pilbara Leaf-nosed Bat has been recorded across the study area, no critical habitat (diurnal roosting caves) have been recorded despite extensive searching. The study area is unlikely to be of particular importance to Migratory species such as the Common Sandpiper and Wood Sandpiper, and these species are likely to occur sporadically in small numbers. The Western Pebble-mound Mouse is relatively common in the region, occurring on gentle stony slopes.

7.3 Important Habitats

All habitats have some importance in that they support native fauna, however, habitats may be of particular importance if they:

- support very diverse or unique faunal assemblages
- are restricted or rare in the region (and thus the faunal assemblages are restricted or rare)
- are refugia (e.g. from drought or fire)
- provide ecological linkage
- support conservation significant fauna

Of the habitats in the study area, the rocky outcrop and breakaway habitat is considered the most important as it provides habitat for several Threatened and Priority fauna species and is limited in extent in the region compared with habitats such as plains. This habitat provides caves, cracks and crevices for shelter, breeding and roosting sites for a range of native fauna, including the Threatened Northern Quoll (*Dasyurus hallucatus*).

The major creekline habitat is also important, as although it is widespread in the region, it is likely to support greater abundance and diversity of fauna than surrounding habitats and may provide an ecological linkage for fauna movement. Permanent and semi-permanent waterholes provide water for fauna in an otherwise relatively dry landscape and provide habitat for the Threatened Pilbara Olive Python (*Liasis olivaceous barroni*).

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Appendices.

Appendix 1. Daily weather observations.

Data sourced from Marble Bar (BOM 2021).

Date	Daily Temperature (°C)		Rainfall (mm)	Survey period	Date	Daily Temperature (°C)		Rainfall (mm)	Survey period
	Minimum	Maximum				Minimum	Maximum		
Phase 1					**Phase 2**				
1/9/20	17.8	35.9	0		1/4/21	22.2	36	0	
2/9/20	19.9	33.5	0		2/4/21	19.9	35.9	0	
3/9/20	16.7	33.3	0		3/4/21	21.5	36.4	0	
4/9/20	16.2	34.9	0		4/4/21	21.1	36.9	0	
5/9/20	15.9	35.1	0		5/4/21	20.5	36.9	0	
6/9/20	17	38.2	0		6/4/21	20.2	37	0	
7/9/20	25	38.5	0		7/4/21	20.3	36.9	0	
8/9/20	23.5	37.6	0		8/4/21	20.9	37.5	0	
9/9/20	22.9	39.1	0		9/4/21	26.1	37.5	0	
10/9/20	19	38.8	0		10/4/21	27.1	38	0	
11/9/20	22.7	38.6	0		11/4/21	22.2	37.6	0	
12/9/20	18.6	38.6	0		12/4/21	23.6	37.3	0	
13/9/20	22	37.1	0		13/4/21	23.8	36.5	0	
14/9/20	22.5	38.6	0		14/4/21	22.4	32.8	0	
15/9/20	22.3	37.7	0		15/4/21	19.9	30.1	0	
16/9/20	20.2	37.5	0		16/4/21	18.7	32.1	0	
17/9/20	25.7	31.1	0		17/4/21	20.2	33.2	0	
18/9/20	14.6	29.6	0		18/4/21	17.7	30.9	0	
19/9/20	16.2	35.7	0	+	19/4/21	16.1	30.9	0	
20/9/20	21.3	34	0	+	20/4/21	17	32.5	0	
21/9/20	16.6	29.8	0	+	21/4/21	19.3	32.4	0	
22/9/20	14.6	31	0	+	22/4/21	13.9	32.2	0	+
23/9/20	16.1	33.2	0	+	23/4/21	17.5	32.2	0	+
24/9/20	18.4	34.7	0	+	24/4/21	17.1	32.8	0	+
25/9/20	18.9	36.6	0	+	25/4/21	14.7	31.3	0	+
26/9/20	19.9	37.5	0	+	26/4/21	14.3	31.3	0	+
27/9/20	25	39	0	+	27/4/21	17.6	32.6	0	+
28/9/20	22.6	38	0	+	28/4/21	18.2	33.7	0	+
29/9/20	23.8	37.1	0	+	29/4/21	15.9	33.4	0	+
30/9/20	21.1	36.9	0	+	30/4/21	14.9	34.6	0	+
1/10/20	18.6	38.9	0	+	1/5/21	17.4	34.1	0	+

Appendix 2. Anabat locations.

Anabat	Zone	Easting	Northing	Start date	Stop date	Trap-nights
Bat 449995 19-09-20	51	312195	7606823	19/9/20	20/9/20	1
Bat 449972 19-09-20	51	314798	7603973	19/9/20	20/9/20	1
Bat 449995 21-09-20	51	318146	7602134	21/9/20	22/9/20	1
Bat 449972 21-09-20	51	317882	7594476	21/9/20	22/9/20	1
Bat 449972 22-09-20	51	317623	7591040	22/9/20	23/9/20	1
Bat 449995 22-09-20	51	318189	7589883	22/9/20	23/9/20	1
Bat 449572 23-09-20	51	314814	7596161	23/9/20	24/9/20	1
Bat 449995 23-09-20	51	313916	7597803	23/9/20	24/9/20	1
Bat 449972 24-09-20	51	315435	7613957	24/9/20	25/9/20	1
Bat 449995 24-09-20	51	314025	7616553	24/9/20	25/9/20	1
Bat 449972 25-09-20	51	313128	7617342	25/9/20	26/9/20	1
Bat 449995 25-09-20	51	316043	7605515	25/9/20	26/9/20	1
Bat 449972 26-09-20	51	314588	7608252	26/9/20	27/9/20	1
Bat 449995 26-09-20	51	315719	7607212	26/9/20	27/9/20	1
Bat 449972 27-09-20	51	316662	7611916	27/9/20	28/9/20	1
Bat 449995 27-09-20	51	311909	7607995	27/9/20	29/9/20	2
Bat 449972 28-09-20	51	317786	7588130	28/9/20	29/9/20	1
Bat 449972 29-09-20	51	317259	7615149	29/9/20	30/9/20	1
Bat 449995 29-09-20	51	317118	7617122	29/9/20	30/9/20	1
Bat 450083 23-04-21	51	312135	7606826	23/4/21	24/4/21	1
Bat 450083 24-04-21	51	314032	7616549	24/4/21	25/4/21	1
Bat 450085 23-04-21	51	318153	7602155	23/4/21	25/4/21	2
Bat 450083 25-04-21	51	313125	7617279	25/4/21	27/4/21	2
Bat 450085 25-04-21	51	318149	7602104	25/4/21	26/4/21	1
Bat 450085 26-04-21	51	318189	7589884	26/4/21	27/4/21	1
Bat 450083 27-04-21	51	316011	7605550	27/4/21	28/4/21	1
Bat 450085 27-04-21	51	317562	7591019	27/4/21	28/4/21	1
Bat 450083 28-04-21	51	313937	7597795	28/4/21	29/4/21	1
Bat 450085 28-04-21	51	317864	7594483	28/4/21	29/4/21	1
Bat 450083 29-04-21	51	314827	7596176	29/4/21	30/4/21	1
Bat 450085 29-04-21	51	316654	7598976	29/4/21	30/4/21	1
Bat 450083 30-04-21	51	316926	7614583	30/4/21	1/5/21	1
Bat 450085 30-04-21	51	315243	7587892	30/4/21	1/5/21	1

Appendix 3. Target search locations.

Site name	Zone	Easting	Northing	Survey effort	Date
AGWW04	51	317282	7597819	40 minutes opportunistic searching for fauna and secondary signs	25/4/21
AM WW 01	51	314699	7604210	0.83 km, 20 mins opportunistic searching for fauna and secondary signs	25/4/21
AM WW 02	51	316472	7599644	1.1 km, 20 mins opportunistic searching for fauna and secondary signs	25/4/21
AM WW 03	51	317045	7597800	1.6 km, 20 mins opportunistic searching for fauna and secondary signs	25/4/21
MBW1	51	316511	7611908	2.4km targeted transect	25/4/21
AGWW05	51	315213	7587876	30 minutes opportunistic searching for fauna and secondary signs	26/4/21
AGWW06	51	316336	7588083	20 minutes opportunistic searching for fauna and secondary signs	26/4/21
AGWW08	51	319303	7603129	25 minutes opportunistic searching for fauna and secondary signs	26/4/21
AM WW 04	51	315002	7588079	0.73 km, 20 mins opportunistic searching for fauna and secondary signs	26/4/21
AM WW 05	51	316291	7588136	0.614 km, 20 mins opportunistic searching for fauna and secondary signs	26/4/21
AM WW 06	51	319403	7603273	0.879 km, 20 mins opportunistic searching for fauna and secondary signs	26/4/21
MBW2	51	314633	7604597	2.5km targeted transect	26/4/21
MBW3	51	312275	7607607	2.6km targeted transect	26/4/21
AGWW09	51	316065	7605493	20 minutes opportunistic searching for fauna and secondary signs	27/4/21
AGWW10	51	316197	7605103	40 minutes opportunistic searching for fauna and secondary signs	27/4/21
AGWW11	51	315697	7607334	35 minutes opportunistic searching for fauna and secondary signs	27/4/21
AGWW12	51	315998	7607037	25 minutes opportunistic searching for fauna and secondary signs	27/4/21
AM WW 07	51	316166	7605159	0.602 km, 20 mins opportunistic searching for fauna and secondary signs	27/4/21
AM WW 08	51	316318	7605085	0.44 km, 20 mins opportunistic searching for fauna and secondary signs	27/4/21
AM WW 09	51	315354	7607200	0.83 km, 20 mins opportunistic searching for fauna and secondary signs	27/4/21
AM WW 10	51	315638	7607176	1.1 km, 20 mins opportunistic searching for fauna and secondary signs	27/4/21
MBW4	51	312558	7607482	1.2km targeted transect	27/4/21
MBW5	51	317457	7588991	2.7km targeted transect	27/4/21
MBW6	51	319560	7606963	2.1km targeted transect	27/4/21
MBW7	51	319514	7607648	2.2km targeted transect	27/4/21
AGWW13	51	315428	7595799	25 minutes opportunistic searching for fauna and secondary signs. Some reptile raking	28/4/21
AGWW14	51	315441	7595540	25 minutes opportunistic searching for fauna and secondary signs. Some reptile raking	28/4/21
AGWW15	51	315265	7595497	35 minutes opportunistic searching for fauna and secondary signs	28/4/21
AGWW16	51	312665	7606246	35 minutes opportunistic searching for fauna and secondary signs	28/4/21

Appendix 3. (cont.)

Site name	Zone	Easting	Northing	Survey effort	Date
AGWW17	51	317905	7601185	30 minutes opportunistic searching for fauna and secondary signs	28/4/21
AM WW 11	51	315508	7595788	1.4 km, 20 mins opportunistic searching for fauna and secondary signs	28/4/21
AM WW 12	51	315247	7595257	0.76 km, 20 mins opportunistic searching for fauna and secondary signs	28/4/21
AM WW 13	51	312948	7606517	1.3 km, 20 mins opportunistic searching for fauna and secondary signs	28/4/21
AM WW 14	51	317881	7601371	0.89 km, 20 mins opportunistic searching for fauna and secondary signs	28/4/21
MBW8	51	317574	7615036	1.2km targeted transect	28/4/21
MBW9	51	315945	7607517	3.8km targeted transect	28/4/21
AGWW18	51	317755	7587152	20 minutes opportunistic searching for fauna and secondary signs	29/4/21
AGWW19	51	317049	7600958	20 minutes opportunistic searching for fauna and secondary signs	29/4/21
AGWW20	51	316636	7599562	40 minutes opportunistic searching for fauna and secondary signs	29/4/21
AGWW21	51	318014	7598648	20 minutes opportunistic searching for fauna and secondary signs	29/4/21
AM WW 15	51	317684	7587244	0.72 km, 20 mins opportunistic searching for fauna and secondary signs	29/4/21
AM WW 16	51	316912	7599831	0.91 km, 20 mins opportunistic searching for fauna and secondary signs	29/4/21
AM WW 17	51	316741	7600047	0.72 km, 20 mins opportunistic searching for fauna and secondary signs	29/4/21
AM WW 18	51	317922	7598598	0.70 km, 20 mins opportunistic searching for fauna and secondary signs	29/4/21
MBW10	51	316077	7595557	2.7km targeted transect	29/4/21
AGWW22	51	314116	7587926	20 minutes opportunistic searching for fauna and secondary signs	30/4/21
AM WW 19	51	314465	7588203	0.78 km, 20 mins opportunistic searching for fauna and secondary signs	30/4/21

Appendix 4. Camera trap locations.

Camera	Zone	Easting	Northing	Start date	Stop date	Trap-nights
Cam04	51	315884	7595958	25/9/20	29/9/20	4
Cam18	51	314696	7604175	25/9/20	29/9/20	4
Cam19	51	314076	7618134	25/9/20	30/9/20	5
Cam20	51	313801	7596689	25/9/20	29/9/20	4
Cam23	51	313033	7617430	25/9/20	30/9/20	5
Cam25	51	313657	7617045	25/9/20	30/9/20	5
Cam27	51	315609	7614074	25/9/20	30/9/20	5
Cam28	51	312496	7605923	25/9/20	29/9/20	4
Cam31	51	313239	7598028	25/9/20	29/9/20	4
Cam32	51	313560	7597521	25/9/20	29/9/20	4
Cam40	51	313905	7618266	25/9/20	29/9/20	4
Cam41	51	315806	7613590	25/9/20	30/9/20	5
Cam42	51	316073	7604488	25/9/20	29/9/20	4
Cam44	51	312930	7617504	25/9/20	30/9/20	5
Cam45	51	315795	7614178	25/9/20	30/9/20	5
Cam48	51	316900	7594712	25/9/20	29/9/20	4
Cam50	51	316385	7595297	25/9/20	29/9/20	4
Cam29	51	314537	7607380	26/9/20	30/9/20	4
Cam47	51	314346	7607486	26/9/20	30/9/20	4
Cam49	51	315722	7607210	26/9/20	30/9/20	4
Cam43	51	311909	7607997	27/9/20	30/9/20	3
Cam08b	51	316183	7613909	25/4/21	1/5/21	6
Cam45b	51	313450	7618040	25/4/21	1/5/21	6
Cam48b	51	313316	7617384	25/4/21	1/5/21	6
Cam49b	51	316259	7613907	25/4/21	1/5/21	6
Cam02b	51	317014	7597202	25/4/21	30/4/21	5
Cam21b	51	318879	7599135	25/4/21	1/5/21	6
Cam29b	51	317079	7594686	25/4/21	30/4/21	5
Cam30b	51	318015	7598936	25/4/21	30/4/21	5
Cam35b	51	316888	7597769	25/4/21	30/4/21	5
Cam04b	51	314854	7597882	25/4/21	1/5/21	6
Cam44b	51	316415	7588015	25/4/21	30/4/21	5
Cam47b	51	314855	7597918	25/4/21	1/5/21	6
Cam50b	51	319902	7599109	25/4/21	1/5/21	6
Cam40b	51	314682	7597822	25/4/21	1/5/21	6
Cam06b	51	314671	7597794	25/4/21	1/5/21	6

Appendix 5. Habitat Assessment locations.

Habitat Assesment Point	Representative photograph
Hab001 – Spinifex Plain	
Hab002 – Rocky Outcrops and Breakaways	
Hab003 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab004 – Spinifex Stony Hills	
Hab005 – Major Creekline	
Hab006 – Spinifex Stony Hills	
Hab007 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab008 – Spinifex Stony Hills	
Hab009 – Major Creekline	
Hab010 – Spinifex Plain	
Hab011 – Minor Creekline	

Habitat Assesment Point	Representative photograph
Hab012 – Spinifex Stony Hills	
Hab013 – Minor Creekline	
Hab014 – Spinifex Stony Hills	
Hab015 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab016 – Spinifex Stony Hills	
Hab017 – Spinifex Stony Hills	
Hab018 – Spinifex Plain	
Hab019 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab020 – Spinifex Plain	
Hab021 – Spinifex Stony Hills	
Hab022 – Mjor Creekline	
Hab023 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab024 – Major Creekline	
Hab025 – Spinifex Plain	
Hab026 – Spinifex Stony Hills	
Hab027 – Minor Creekline	

Habitat Assesment Point	Representative photograph
Hab028 – Spinifex Plain	
Hab029 – Spinifex Stony Hills	
Hab030 – Spinifex Stony Hills	
Hab031 – Minor Creekline	

Habitat Assesment Point	Representative photograph
Hab032 – Spinifex Plain	
Hab033 – Minor Creekline	
Hab034 – Spinifex Plain	
Hab035 – Spinifex Stony Hills	

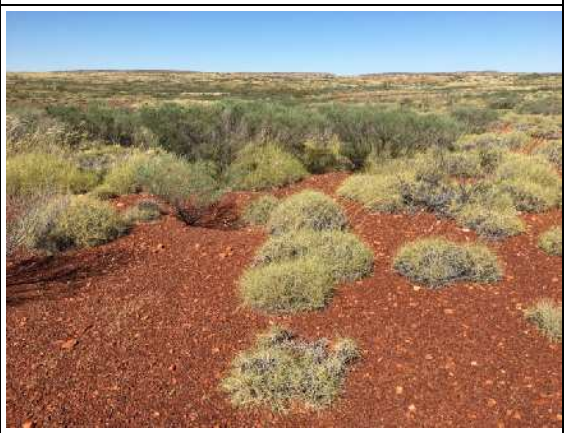
Habitat Assesment Point	Representative photograph
Hab036 – Spinifex Plain	
Hab037 – Spinifex Stony Hills	
Hab038 – Spinifex Stony Hills	
Hab039 – Minor Creekline	

Habitat Assesment Point	Representative photograph
Hab040 – Major Creekline / waterhole	
Hab041 – Spinifex Stony Hills	
Hab042 – Spinifex Stony Hills	
Hab043 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab044 – Spinifex Plain	
Hab045 – Spinifex Stony Hills	
Hab046 – Spinifex Stony Hills	
Hab047 – Spinifex Plain	

Habitat Assesment Point	Representative photograph
Hab048 – Rocky Outcrops and Breakaways	
Hab049 – Spinifex Stony Hills	
Hab050 – Rocky Outcrops and Breakaways	
Hab051 – Rocky Outcrops and Breakaways	

Habitat Assesment Point	Representative photograph
Hab052 – Spinifex Plain	
Hab053 – Spinifex Stony Hills	
Hab054 – Major Creekline / waterhole	
Hab055 – Major Creekline	

Habitat Assesment Point	Representative photograph
Hab056 – Major Creekline	
Hab057 – Spinifex Plain	
Hab058 – Spinifex Plain	
Hab059 – Minor Creekline	

Habitat Assesment Point	Representative photograph
Hab060 – Minor Creekline	
Hab061 – Spinifex Plain	
Hab062 – Major Creekline	
Hab063 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab064 – Spinifex Stony Hills	
Hab065 – Spinifex Stony Hills	
Hab066 – Major Creekline	
Hab067 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab068 – Spinifex Stony Hills	
Hab069 – Spinifex Plain	
Hab070 – Major Creekline / waterhole	
Hab071 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab072 – Rocky Outcrops and Breakaways	
Hab073 – Spinifex Stony Hills	
Hab074 – Minor Creekline	
Hab075 – Spinifex Stony Hills	

Habitat Assesment Point	Representative photograph
Hab076 – Rocky Outcrops and Breakaways	
Hab077 – Spinifex Plain	
Hab078 – Spinifex Plain	
Hab079 – Rocky Outcrops and Breakaways	

Habitat Assesment Point	Representative photograph
Hab080 – Minor Creekline	
Hab081 – Spinifex Stony Hills	
Hab082 – Spinifex Stony Hills	
Hab083 – Spinifex Plains	

Appendix 6. Amphibians potentially occurring in the Study Area.

Key to surveys:
See Table 3.

Key to databases:
WAM = species recorded in the area on the WA Museum specimen Database.
FSDB = species recorded in the area on the Fauna Survey Returns Database.
TF = species recorded in the area on DBCA's Threatened and Priority Fauna Database.
EPBC = species or species habitat in the area on the EPBC Protected Matters Search Tool.

Species	Conservation Status	Records											
		This Survey	Previous Fauna Surveys							Databases			
			13	11	8	7	6	4	3	1	WAM	FSDB	TF	EPBC
Pelodraydidae (tree frogs and water-holding frogs)														
Main's Frog *Cyclorana maini*		x	x				x		x					
Western Water-holding Frog *Cyclorana occidentalis*														
Desert Tree Frog *Litoria rubella*		x	x		x		x		x	x	x	x		
Limnodynastidae (burrowing frogs)														
Centralian Burrowing Frog *Platyplectrum spenceri*									x					
Northern Burrowing Frog *Neobatrachus aquilonius*												x		
Desert Spadefoot *Notaden nichollsi*									x			x		
Myobatrachidae (ground frogs)														
Pilbara Toadlet *Uperoleia saxatilis*		x							x		x	x		
# frog species predicted:		7												

Appendix 7. Reptiles potentially occurring in the Study Area.

Key to surveys:
See Table 3.

Key to databases:
WAM = species recorded in the area on the WA Museum specimen Database.
FSDB = species recorded in the area on the Fauna Survey Returns Database.
TF = species recorded in the area on DBCA's Threatened and Priority Fauna Database.
EPBC = species or species habitat in the area on the EPBC Protected Matters Search Tool.

Species		Conservation Status	Records											
			This Survey	Previous Fauna Surveys							Databases			
				13	11	8	7	6	4	3	1	WAM	FSDB	TF	EPBC
Cheloniidae															
Flat-shelled Turtle	*Chelodina steindachneri*			x								x			
Carphodactylidae (knob-tailed geckoes)															
Smooth Knob-tailed Gecko	*Nephrurus levis*											x			
Diplodactylidae (ground geckoes)															
Clawless Gecko	*Crenadactylus pilbarensis*											x			
Variable Fat-tailed Gecko	*Diplodactylus conspicillatus*												x		
Desert Fat-tailed Gecko	*Diplodactylus laevis*		x			?				?					
Southern Pilbara Beak-faced Gecko	*Diplodactylus savagei*		x	x				x		x		x	x		
Sandplain Gecko	*Lucasium stenodactylum*		x	x		x		x		x		x	x		
Pilbara Ground Gecko	*Lucasium wombeyi*					x		x		x		x	x		
Western Marbled Velvet Gecko	*Oedura fimbria*		x	x		x						x	x		
Beaked Gecko	*Rhynchoedura ornata*					x				x		x	x		
Jewelled Gecko	*Strophurus elderi*		x					x		x			x		
Southern Phasmid Gecko	*Strophurus jeanae*														
Gekkonidae (geckoes)															
Pilbra Dtella	*Gehyra pilbara*														
Spotted Pilbara Rock Gehyra	*Gehyra punctata*		x	?		?		?		?		?	?		
Medium Pilbara Rock Gehyra	*Gehyra media*														
Small Pilbara Rock Gehyra	*Gehyra micra*		x												
Large Pilbara Rock Gehyra	*Gehyra macra*		x												
Central Rock Dtella	*Gehyra montium*														
Variegated Dtella	*Gehyra variegata*		x	x		x		x		x		x	x		
Bynoe's Gecko	*Heteronotia binoei*		x	x		x		x		x			x		
Pilbara Cave Gecko	*Heteronotia spelea*		x	x		x		x		x			x		
Pygopodidae (legless lizards)															
Unbanded Delma	*Delma butleri*		x												
Banded Delma	*Delma desmosa*		x												
Pilbara Delma	*Delma elegans*									x					
Sharp-snouted Delma	*Delma nasuta*		x			x		x		x		x	x		
Peace Delma	*Delma pax*		x			x		x		x			x		
Excitable Delma	*Delma tincta*		x							x					
Burton's Legless Lizard	*Lialis burtonis*		x					x		x					
Hooded Scaly-foot	*Pygopus nigriceps*		x			x		x		x			x		

Appendix 7. (cont.)

Species		Conservation Status	Records											
			This Survey	Previous Fauna Surveys								Databases		
				13	11	8	7	6	4	3	1	WAM	FSDB	TF	EPBC
Agamidae (dragon lizards)															
Western Ring-tailed Dragon	*Ctenophorus caudicinctus*		x		x	x		x	x	x	x	x	x		
Military Dragon	*Ctenophorus isolepis*		x		x			x		x			x		
Central Netted Dragon	*Ctenophorus nuchalis*		x							x		x			
Long-nosed Dragon	*Gowidon longirostris*		x		x	x		x		x		x	x		
Bearded Dragon	*Pogona minor*					x		x		x					
Scincidae (skink lizards)															
Shaded-litter Rainbow Skink	*Carlia munda*		x	x		x		x		x			x		
Buchanan's Snake-eyed Skink	*Cryptoblepharus buchananii*														
Russet Snake-eyed Skink	*Cryptoblepharus ustulatus*														
Eastern Pilbara Lined Ctenotus	*Ctenotus duricola*		x			x		x		x		x	x		
Grand Ctenotus	*Ctenotus grandis*		x			x		x		x		x	x		
Nimble Ctenotus	*Ctenotus hanloni*		x												
Clay-soil Ctentotus	*Ctenotus helenae*		x					x		x		x	x		
Pin-striped Finesnout Ctenotus	*Ctenotus nigrilineatus*	P1												x	
Leopard Ctenotus	*Ctenotus pantherinus*		x			x		x		x			x		
Coarse Sands Ctentotus	*Ctenotus piankai*														
Ruddy Ctentus	*Ctenotus rubicundus*		x			x		x		x		x	x		
Rock Ctenotus	*Ctenotus saxatilis*		x			x		x		x		x	x		
Slender Bluetongue	*Cyclodomorphus melanops*		x			x		x		x		x	x		
Eastern Pilbara Spiny-tailed Skink	*Egernia epsisolus*									x					
Western Narrow-banded Skink	*Eremiascincus pallidus*														
Broad-banded Sand Swimmer	*Eremiascincus richardsonii*									x					
Northwestern Sandslider	*Lerista bipes*		x					x		x			x		
Jackson's Three-toed Slider	*Lerista jacksoni*		x			x		x		x		x	x		
Common Dwarf Skink	*Menetia greyii*		x			x		x		x			x		
Western Dwarf Skink	*Menetia surda*		x							x		x			
Lined Fire-tailed Skink	*Morethia ruficauda*		x			x		x					x		
Ornate Soil-crevice Skink	*Notoscincus ornatus*												x		
Western Soil-crevice Skink	*Proablepharus reginae*		x							x					
Central Bluetongue	*Tiliqua multifasciata*		x			x		x		x		x	x		
Varanidae (goanna or monitor lizards)															
Spiny-tailed Goanna	*Varanus acanthurus*		x	x		x		x		x		x	x		
Short-tailed Pygmy Goanna	*Varanus brevicauda*		x			x				x			x		
Pygmy Desert Goanna	*Varanus eremius*									x			x		
Perentie	*Varanus giganteus*		x		x	x		x	x	x		x	x		
Sand Goanna	*Varanus gouldii*		x										x		
Spotted Goanna	*Varanus panoptes*		x									x			
Northern Pilbara Rock Monitor	*Varanus pilbarensis*		x			x				x		x	x		
Black-tailed Monitor	*Varanus tristis*		x							x					

Appendix 7. (cont.)

Species		Conservation Status	Records											
			This Survey	Previous Fauna Surveys							Databases			
				13	11	8	7	6	4	3	1	WAM	FSDB	TF	EPBC
Typhlopidae (blind snakes)															
Sand-diving Blind Snake	*Anilios ammodytes*		x			x		x		x					
Beaked Blind Snake	*Anilios grypus*		x	x		x		x		x					
Pilbara Blind Snake	*Anilios pilbarensis*		x			x				x					
Boidae (pythons)															
Pygmy Python	*Antaresia perthensis*		x	x		x		x		x			x		
Stimson's Python	*Antaresia stimsoni*		x	x		x				x			x		
Black-headed Python	*Aspidites melanocephalus*			x											
Pilbara Olive Python	*Liasis olivaceus barroni*	Vu		x						x				x	x
Elapidae (front-fanged snakes)															
Pilbara Death Adder	*Acanthophis wellsi*					x				x		x	x		
Northwestern Shovel-nosed Snake	*Brachyurophis approximans*					x		x		x		x	x		
Yellow-faced Whipsnake	*Demansia psammophis*		x			x		x		x			x		
Rufous Whipsnake	*Demansia rufescens*		x			x		x		x			x		
Moon Snake	*Furina ornata*		x	x		x		x		x		x	x		
Mulga Snake	*Pseudechis australis*			x		x				x			x		
Ringed Brown Snake	*Pseudonaja modesta*					x							x		
Gwardar	*Pseudonaja mengdeni*		x			x				x			x		
Rosen's Snake	*Suta fasciata*					x				x			x		
Spotted Snake	*Suta punctata*		x	x						x					
Pilbara Bandy-bandy	*Vermicella snelli*									x					
Number of reptile species predicted:			**84**												

Appendix 8. Birds potentially occurring in the Study Area.

Key to surveys:
See Table 3.

Key to databases:
Birdata = species recorded in the area by Birds Australia 2010 – 2018.
Atlas = species recorded in the area on Birds Australia's Atlas Database 1998 – 2009.
WAM = species recorded in the area on the WA Museum specimen Database.
FSDB = species recorded in the area on the Fauna Survey Returns Database.
TF = species recorded in the area on DBCA's Threatened and Priority Fauna Database.
EPBC = species or species habitat in the area on the EPBC Protected Matters Search Tool.

Species	Conservation Status	Records													
		This Survey	Previous Fauna Surveys							Databases					
			11	8	7	6	4	3	1	Birdata	Atlas	WAM	FSDB	TF	EPBC
Anatidae (ducks & swans)															
Black Swan *Cygnus atratus*		x			x					x	x				
Grey Teal *Anas gracilis*		x	x		x		x	x	x		x				
Pacific Black Duck *Anas superciliosus*		x	x		x	x	x	x		x	x	x	x		
Hardhead *Aythya australis*					x	x				x	x		x		
Phasianidae (quails)															
Brown Quail *Synoicus ypsilophorus*			x					x							
Podicipedidae (grebes)															
Australasian Grebe *Tachybabtus navaehollandiae*					x	x	x			x	x		x		
Ciconiidae (storks)															
Black-necked Stork *Ephippiorhhynchus asiaticus*								x		x	x				
Threskiornithidae (ibis & spoonbills)															
Yellow-billed Spoonbill *Platalea flavipes*							x								
Glossy Ibis *Plegadis falcinellus*	Mi													x	
Ardeidae (herons, egrets, bitterns & night-herons)															
Eastern Great Egret *Ardea modesta*					x	x	x			x	x				
White-faced Heron *Egretta novaehollandiae*		x			x		x	x			x				
White-necked Heron *Ardea pacifica*		x	x			x					x				
Rufous Night-heron *Nycticorax caledonicus*						x		x			x				
Phalacrocoracidae (cormorants)															
Little Black Cormorant *Phalacrocorax sulcirostris*						x				x	x		x		
Little Pied Cormorant *Microcarbo melanoleucos*		x			x	x		x			x				
Anhingidae (darter)															
Australasian Darter *Anhinga novaehollandiae*					x	x		x		x	x				
Accipitridae (osprey, hawks, eagles & harriers)															
Black-shouldered Kite *Elanus axillaris*			x	x			x				x		x		
Square-tailed Kite *Lophoictinia isura*															
Black-breasted Buzzard *Hamirostra melanosternon*		x													
Black Kite *Milvus migrans*		x	x	x							x		x		
Whistling Kite *Haliastur sphenurus*		x		x	x	x		x	x		x		x		
Brown Goshawk *Accipiter fasciatus*			x	x				x		x			x		
Collared Sparrowhawk *Accipiter cirrocephalus*		x			x						x				

Appendix 8. (cont.)

Species	Conservation Status	Records												
		This Survey	Previous Fauna Surveys							Databases				
			11	8	7	6	4	3	1	Birdata	Atlas	WAM	FSDB	TF	EPBC
Accipitridae (cont.)															
Little Eagle *Hieraaetus morphnoides*		x				x	x			x	x				
Wedge-tailed Eagle *Aquila audax*		x	x	x		x	x	x	x		x		x		
Spotted Harrier *Circus assimilis*		x	x	x		x	x	x	x		x		x		
Otididae (bustard)															
Australian Bustard *Ardeotis australis*		x	x			x		x	x		x		x		
Rallidae (crakes, rails and gallinules)															
Eurasian Coot *Fulica atra*		x			x	x				x	x		x		
Purple Swamp Hen *Porphyrio porphyrio*					x	x							x		
Spotless Crake *Porzana tabuensis*						x									
Turnicidae (button-quails)															
Little Button-quail *Turnix velox*		x	x	x		x		x			x		x		
Burhinidae (stone-curlews)															
Bush Stone-curlew *Burhinus grallarius*		x		x							x		x		
Recurvirostridae (stilts & avocets)															
Black-winged Stilt *Himantopus himantopus*					x						x				
Charadriidae (plovers, dotterels & lapwings)															
Black-fronted Dotterel *Elseyornis melanops*		x					x	x		x	x				
Oriental Plover *Charadrius veredus*	Mi														x
Scolopacidae (sandpipers, stinits, tatltlers, godwits & allies)															
Common Sandpiper *Tringa hypoleucos*	Mi						x				x				x
Wood Sandpiper *Tringa glareola*	Mi						x	x							
Glareolidae (pratincoles)															
Australian Pratincole *Stiltia isabella*		x													
Columbidae (pigeons and doves)															
Common Bronzewing *Phaps chalcoptera*		x	x	x						x	x		x		
Crested Pigeon *Ocyphaps lophotes*		x	x	x				x	x		x		x		
Spinifex Pigeon *Geophaps plumifera*		x	x	x	x	x	x	x	x		x		x		
Diamond Dove *Geopelia cuneata*		x	x	x		x	x	x	x		x		x		
Bar-shouldered Dove *Geopelia humeralis*		x													
Peaceful Dove *Geopelia striata*		x						x	x	x	x	x			
Cuculidae (cuckoos)															
Pheasant-coucal *Centropus phasianinus*				x		x							x		
Pallid Cuckoo *Heteroscenes pallidus*		x	x	x							x		x		
Black-eared Cuckoo *Chalcites osculans*				x			x	x					x		
Horsfield's Bronze-cuckoo *Chalcites basalis*		x		x		x		x	x				x		
Tytonidae (barn owls)															
Barn Owl *Tyto alba*				x									x		

Appendix 8. (cont.)

Species	Conservation Status	Records												
		This Survey	Previous Fauna Surveys						Databases					
			11	8	7	6	4	3	1	Birdata	Atlas	WAM	FSDB	TF	EPBC
Strigidae (hawk owls)															
Barking Owl *Ninox connivens*		x				x				x	x	x			
Southern Boobook *Ninox boobook*		x	x	x		x		x							
Podargidae (frogmouths)															
Tawny Frogmouth *Podargus strigoides*								x			x				
Caprimulgidae (nightjars)															
Spotted Nightjar *Eurostopodus argus*		x		x				x			x		x		
Aegothelidae (owlet-nightjars)															
Australian Owlet-Nightjar *Aegotheles cristatus*		x		x		x		x		x	x		x		
Apodidae (swifts)															
Fork-tailed Swift *Apus pacificus*	Mi														x
Alcedinidae (kingfishers)															
Blue-winged Kookaburra *Dacelo leachii*		x	x	x		x		x	x	x	x		x		
Red-backed Kingfisher *Todiramphus pyrrhopygius*		x	x	x	x	x	x	x	x		x		x		
Sacred Kingfisher *Todiramphus sanctus*		x				x		x			x				
Meropidae (bee-eaters)															
Rainbow Bee-eater *Merops ornatus*		x	x	x	x	x	x	x	x	x	x		x		
Falconidae (falcons)															
Brown Falcon *Falco berigora*		x	x	x	x	x	x	x	x		x		x		
Australian Kestrel *Falco cenchroides*		x	x	x	x	x	x	x	x	x	x		x		
Australian Hobby *Falco longipennis*		x		x									x		
Grey Falcon *Falco hypoleucos*	Vu														
Peregrine Falcon *Falco peregrinus*	OS		x												
Black Falcon *Falco subniger*															
Cacatuidae (cockatoos)															
Galah *Eolophus roseicapilla*		x	x	x	x	x		x	x		x	x	x		
Little Corella *Cacatua sanguinea*		x	x	x		x	x	x	x	x	x	x	x		
Cockatiel *Nymphicus hollandicus*		x		x		x		x	x		x		x		
Psittacidae (parrots, lorikeets and rosellas)															
Australian Ringneck *Platycercus zonarius*		x	x	x		x		x	x		x		x		
Budgerigar *Melopsittacus undulatus*		x	x	x		x	x	x	x	x	x		x		
Princess Parrot *Polytelis alexandrae*	Vu														x
Night Parrot *Pezoporus occidentalis*	Cr														x
Ptilonorhynchidae (bowerbirds)															
Western Bowerbird *Ptilonorhynchus maculatus guttatus*		x	x	x				x			x	x	x		
Climacteridae (treecreepers)															
Black-tailed Treecreeper *Climacteris melanura*															

Appendix 8. (cont.)

Species	Conservation Status	Records												
		This Survey	Previous Fauna Surveys							Databases				
			11	8	7	6	4	3	1	Birdata	Atlas	WAM	FSDB	TF	EPBC
Maluridae (fairy-wrens, grasswrens and emu-wrens)															
Striated Grasswren / Pilbara Grasswren *Amytornis whitei*		x		x	x	x	x						x		
Variegated Fairy-wren *Malurus lamberti*		x	x	x			x	x			x		x		
White-winged Fairy-wren *Malurus leucopterus*		x	x	x				x			x		x		
Rufous-crowned Emu-wren *Stipiturus ruficeps*															
Meliphagidae (honeyeaters and chats)															
Brown Honeyeater *Lichmera indistincta*		x	x	x	x	x	x	x	x	x	x		x		
Black Honeyeater *Sugomel niger*			x			x		x	x						
Pied Honeyeater *Certhionyx variegatus*											x				
Singing Honeyeater *Gavicalis virescens*		x	x	x	x	x	x	x	x				x		
Grey-headed Honeyeater *Ptilotula keartlandi*		x	x	x	x	x	x	x				x	x		
White-plumed Honeyeater *Ptilotula penicillata*		x	x	x		x		x	x						
Black-chinned Honeyeater *Melithreptus gularis*										x		x			
White-fronted Honeyeater *Purnella albifrons*				x							x		x		
Yellow-throated Miner *Manorina flavigula*		x	x	x	x	x	x	x	x	x	x		x		
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*			x	x				x			x		x		
Crimson Chat *Epthianura tricolor*		x	x					x			x				
Pardalotidae (pardalotes)															
Red-browed Pardalote *Pardalotus rubricatus*		x		x		x	x	x	x		x		x		
Striated Pardalote *Pardalotus striatus*			x	x				x	x	x	x		x		
Acanthizidae (thornbills, gerygones & allies)															
Weebill *Smicrornis brevirostris*		x	x	x				x		x	x		x		
Western Gerygone *Gerygone fusca*			x					x			x				
Inland Thornbill *Acanthiza apicalis*				x			x						x		
Pomatostomidae (babblers)															
Grey-crowned Babbler *Pomatostomus temporalis*		x								x	x				
Artamidae (woodswallows)															
White-breasted Woodswallow *Artamus leucorynchus*										x	x				
Masked Woodswallow *Artamus personatus*		x		x							x		x		
White-browed Woodswallow *Artamus superciliosus*											x				
Black-faced Woodswallow *Artamus cinereus*		x	x	x	x	x	x	x	x	x	x		x		
Little Woodswallow *Artamus minor*		x	x	x		x		x		x	x		x		
Cracticidae (butcherbirds & magpie)															
Grey Butcherbird *Cracticus torquatus*		x						x							
Pied Butcherbird *Cracticus nigrogularis*		x	x	x	x	x	x	x	x	x	x		x		
Australian Magpie *Cracticus tibicen*		x		x				x					x		
Campephagidae (cuckoo-shrikes and trillers)															
Black-faced Cuckoo-Shrike *Coracina novaehollandiae*		x	x	x	x	x	x	x	x	x	x	x	x		
White-winged Triller *Lalage tricolor*		x	x	x		x	x	x					x		

Appendix 8. (cont.)

Species	Conservation Status	Records												
		This survey	Previous Fauna Surveys						Databases					
			11	8	7	6	4	3	1	Birdata	Atlas	WAM	FSDB	TF	EPBC
Oreoicidae (bellbirds)															
Crested Bellbird *Oreoica gutturalis*		x						x							
Pachycephalidae (shrike-tits, whistlers and allies)															
Rufous Whistler *Pachycephala rufiventris*		x	x	x		x				x	x		x		
Grey Shrike-thrush *Colluricincla harmonica*		x		x				x	x	x	x	x	x		
Rhipiduridae (fantails)															
Grey Fantail *Rhipidura albiscapa*											x				
Willie Wagtail *Rhipidura leucophrys*		x	x	x	x	x	x	x	x	x	x		x		
Monarchidae (flycatchers, monarchs and magpie-lark)															
Magpie-Lark *Grallina cyanoleuca*		x	x	x	x	x		x	x	x	x		x		
Corvidae (ravens and crows)															
Torresian Crow *Corvus orru*		x	x	x	x	x	x	x	x	x	x		x		
Little Crow *Corvus bennetti*		x		x		x		x	x		x		x		
Petroicidae (robins)															
Red-capped Robin *Petroica goodenovii*											x				
Hooded Robin *Melanodryas cucullata*			x												
Alaudidae (larks)															
Horsfield's Bushlark *Mirafra javanica*		x	x					x			x				
Hirundinidae (swallows and martins)															
White-backed Swallow *Cheramoeca leucosterna*			x								x				
Welcome Swallow *Hirundo neoxena*								x	x		x				
Tree Martin *Petrochelidon nigricans*								x		x	x				
Fairy Martin *Petrochelidon ariel*		x		x				x	x	x	x				
Acrocephalidae (reed warblers)															
Australian Reed Warbler *Acrocephalus australis*		x			x	x		x		x	x		x		
Locustellidae (warblers, songlarks and grassbirds)															
Little Grassbird *Poodytes gramineus*						x				x			x		
Spinifexbird *Poodytes carteri*		x	x	x		x	x	x	x		x		x		
Rufous Songlark *Cincloramphus mathewsi*		x	x	x		x	x	x							
Brown Songlark *Cincloramphus cruralis*		x		x											
Dicaeidae (flowerpeckers)															
Mistletoebird *Dicaeum hirundinaceum*				x						x	x		x		
Estrildidae (grassfinches, sparrows and allies)															
Zebra Finch *Taeniopygia guttata*		x	x	x	x	x	x	x	x	x	x		x		
Star Finch *Neochmia ruficauda*						x		x			x				
Painted Finch *Emblema pictum*		x	x	x	x	x	x	x	x	x	x		x		
Motacillidae (pipits and wagtails)															
Australian Pipit *Anthus australis*		x	x	x	x	x	x	x	x				x		
Number of bird species predicted:		**130**													

Appendix 9. Mammals potentially occurring in the Study Area.

Key to surveys:
See Table 3.

Key to databases:
WAM = species recorded in the area on the WA Museum specimen Database.
FSDB = species recorded in the area on the Fauna Survey Returns Database.
TF = species recorded in the area on DBCA's Threatened and Priority Fauna Database.
EPBC = species or species habitat in the area on the EPBC Protected Matters Search Tool.

Species		Conservation Status	Records											
			This Survey	Previous Fauna Surveys							Databases			
				14	11	8	7	6	4	3	1	WAM	FSDB	TF	EBPC
Tachyglossidae (echidnas)															
Echidna	*Tachyglossus aculeatus*		x		x	x		x		x					
Dasyuridae (dasyurid marsupials)															
Little Red Kaluta	*Dasykaluta rosamondae*		x			x		x		x					
Northern Quoll	*Dasyurus hallucatus*	En	x		x									x	x
Woolley's Pseudantechinus	*Pseudantechinus woolleyae*				x							x			
Pilbara Ninguai	*Ningaui timealeyi*		x			x		x		x		x			
Pilbara Planigale	*Planigale sp 1*		x			x				x					
Long-tailed Dunnart	*Sminthopsis longicaudata*	P4													
Stripe-faced Dunnart	*Sminthopsis macroura*		x			x				x					
Lesser Hairy-footed Dunnart	*Sminthopsis youngsoni*		x			x									
Thylacomidae (bilbies)															
Bilby	*Macrotis lagotis*	Vu												x	x
Macropodidae (kangaroos and wallabies)															
Spectacled Hare-Wallaby	*Lagorchestes conspicillatus*	P4													
Euro	*Osphranter robustus*		x		x	x		x		x	x				
Red Kangaroo	*Osphranter rufus*		x							x	x				
Rothschild's Rock-Wallaby	*Petrogale rothschildi*		x		x										
Muridae (rats and mice)															
Lakeland Downs Mouse	*Leggadina lakedownensis*	P4												x	
House Mouse	*Mus musculus*	Int.	x			x		x		x					
Spinifex Hopping Mouse	*Notomys alexis*														
Western Pebble-mound Mouse	*Pseudomys chapmani*	P4	x		x	x				x	x			x	
Desert Mouse	*Pseudomys desertor*		x			x		x		x		x			
Sandy Inland Mouse	*Pseudomys hermannsburgensis*		x			x				x					
Common Rock-Rat	*Zyzomys argurus*		x		x	x									
Pteropodidae (flying foxes)															
Little Red Flying Fox	*Pteropus scapulatus*		x												
Rhinonicteridae (leaf-nosed bats)															
Pilbara Leaf-nosed Bat	*Rhinonicteris aurantia*	Vu	x	x		x		x						x	x
Megadermatidae (ghost bat)															
Ghost Bat	*Macroderma gigas*	Vu												x	x

Appendix 9. (cont.)

Species		Conservation Status	Records											
			This Survey	Previous Fauna Surveys							Databases			
				14	11	8	7	6	4	3	1	WAM	FSDB	TF	EBPC
Emballonuridae (sheathtail bats)															
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*		x			x									
Common Sheathtail Bat	*Taphozous georgianus*		x			x		x		x		x			
Hill's Sheathtail bat	*Taphozous hilli*														
Molossidae (freetail bats)															
Greater Northern Freetail Bat	*Chaerephon jobensis*		x					x		x					
Northern Freetail Bat	*Ozimops lumsdenae*		x			x									
White-striped Freetail Bat	*Austronomus australis*														
Vespertilionidae (ordinary bats)															
Gould's Wattled Bat	*Chalinolobus gouldii*		x			x		x		x					
North-western Long-eared Bat	*Nyctophilus daedelus*														
Lesser Long-eared Bat	*Nyctophilus geoffroyi*							x							
Inland Broad-nosed Bat	*Scotorepens balstoni*														
Little Broad-nosed Bat	*Scotorepens greyii*		x			x		x		x					
Finlayson's Cave Bat	*Vespadelus finlaysoni*		x			x		x		x					
Canidae (dogs and foxes)															
Dingo	*Canis familiaris dingo*		x		x	x		x		x	x				x
Fox	*Vulpes vulpes*	Int.													x
Felidae (cats)															
Feral / House Cat	*Felis catus*	Int.	x		x	x									x
Equidae (horses)															
Donkey	*Equus asinus*	Int.						x		x	x				x
Camelidae (camels)															
Camel	*Camelus dromedarius*	Int.			x	x				x	x				x
Bovidae (horned ruminants)															
Cow	*Bos taurus*	Int.	x		x	x		x		x	x				
Number of mammal species that potentially occur:			**42**												

Appendix 10. Freshwater Fish potentially occurring in the study area.

Key to surveys:
See Table 3.

Key to databases:
WAM = species recorded in the area on the WA Museum specimen Database.
FSDB = species recorded in the area on the Fauna Survey Returns Database.
TF = species recorded in the area on DBCA's Threatened and Priority Fauna Database.
EPBC = species or species habitat in the area on the EPBC Protected Matters Search Tool.

Species	Conservation Status	Records											
		This Survey	Previous Fauna Surveys							Databases			
			11	8	7	6	4	3	1	WAM	FSDB	TF	EBPC
Anguillidae (eels)													
Indian Short-finned Eel *Anguilla bicolor*													
Clupidae (herrings)													
Bony Bream *Nematalosa erebi*													
Ariidae (fork-tailed catfishes)													
Lesser Salmon Catfish *Arius graeffei*													
Plotosidae (eel-tailed catfishes)													
Hyrtl's Tandan *Neosilurus hyrtlii*													
Melanotaeniidae (Rainbowfishes)													
Western Rainbowfish *Melanotaenia australis*											x		
Atherinidae (hardyheads)													
Murchison River Hardyhead *Craterocephalus cuneiceps*													
Terapontidae (grunters)													
Spangled Perch *Leiopotherapon unicolor*		x	x								x		
Eleotridae (gudgeons)													
Empire Gudgeon *Hypseleotris compressus*													
# fish species that potentially occur:		8											

Appendix 11. EPBC Protected Matters Search Tool results.

Species listed for the area 10km in radius from -21.6572°S, 121.2348°E on the EPBC Act Protected Matters Search Tool.

Species	Status	Type of Presence
Curlew Sandpiper *Calidris ferruginea*	Critically Endangered, Migratory	Species or species habitat **may** occur within area
Grey Falcon *Falco hypoleucos*	Vulnerable	Species or species habitat **likely** to occur within area
Night Parrot *Pezoporus occidentalis*	Endangered	Species or species habitat **likely** to occur within area
Princess Parrot *Polytelis alexandrae*	Vulnerable	Species or species habitat **may** occur within area
Australian Painted Snipe *Rostratula australis*	Endangered	Species or species habitat **may** occur within area
Northern Quoll *Dasyurus hallucatus*	Endangered	Species or species habitat **likely** to occur within area
Ghost Bat *Macroderma gigas*	Vulnerable	Species or species habitat **likely** to occur within area
Bilby *Macrotis lagotis*	Vulnerable	Species or species habitat **may** occur within area
Pilbara Leaf-nosed Bat *Rhinonicteris aurantia*	Vulnerable	Species or species habitat **known** to occur within area
Pilbara Olive Python *Liasis olivaceous barroni*	Vulnerable	Species or species habitat **known** to occur within area
Fork-tailed Swift *Apus pacificus*	Migratory (marine)	Species or species habitat **likely** to occur within area
Barn Swallow *Hirundo rustica*	Migratory (terrestrial)	Species or species habitat **may** occur within area
Grey Wagtail *Motacilla cinerea*	Migratory (terrestrial)	Species or species habitat **may** occur within area
Yellow Wagtail *Motacilla flava*	Migratory (terrestrial)	Species or species habitat **may** occur within area
Common Sandpiper *Tringa hypoleucos*	Migratory (wetland)	Species or species habitat **may** occur within area
Sharp-tailed Sandpiper *Calidris acuminata*	Migratory (wetland)	Species or species habitat **may** occur within area
Pectoral Sandpiper *Calidris melanotos*	Migratory (wetland)	Species or species habitat **may** occur within area
Oriental Plover *Charadrius veredus*	Migratory (wetland)	Species or species habitat **may** occur within area
Eastern Osprey *Pandion cristatus*	Migratory (wetland)	Species or species habitat **may** occur within area

Appendix 12. Bat Call Analysis