BHP Billiton Iron Ore Pty Ltd

Jimblebar East and Caramulla Fauna Survey

August 2019

Executive summary

Introduction

BHP Western Australian Iron Ore (BHP) engaged GHD to undertake a Level 2 single season vertebrate fauna survey covering the Jimblebar East and Caramulla areas (the survey area). The survey area is positioned directly east of the current Jimblebar mining operation, approximately 60 kilometres (km) east of Newman. The results of the fauna survey will be used to inform future environmental approvals across the area.

This report is subject to, and must be read in conjunction with, the limitations set out in section 1.2.1 and the assumptions and qualifications contained throughout the report.

Survey effort

Field survey consisted a twelve day single season Level 2 assessment from 29 April to 10 May 2019. Habitat assessment was conducted in accordance with the BHP fauna survey guidelines. Trapping for terrestrial vertebrate fauna was undertaken using a series of standardised systematic trapping quadrat sites, remote sensor cameras, acoustic recorders and non-systematic survey methods.

Eight trapping sites were sampled for 7 to 9 consecutive trap-nights and included buckets, pipes, cages, funnels and Elliott traps. Additionally at least 1 night was sampled for bat acoustics (12 nights total), 60 to 120 minutes of night search, 60 to 120 minutes of active search and 60 to 140 minutes of bird assessments undertaken at each site. The total trapping effort consisted of 2520 trap-nights (total trap effort), 820 minutes of bird assessments, 540 minutes of active searches, 510 minutes of night searches, 16 nights of Night Parrot acoustic assessment, 28 nights of Bat detection, 143 camera nights, 1000 minute of additional active search effort and 840 minutes of Bilby plot assessments.

Key results

- Seven broad fauna habitat types (excluding disturbed areas) were recorded during the field survey from the survey area. These habitat types closely align with the different vegetation types and landforms within the survey area. The fauna habitat present include Major Drainage lines, Hillcrest/ Hillslope, Sand Plain, Mulga Woodland, Minor Drainage lines, Stony Plain and Claypan. Some disturbed areas are also present
- The survey area is largely intact, contiguous with cattle grazing, existing exploration areas and fire the main disturbances observed
- The post wet season fauna surveys recorded 144 vertebrate fauna species utilising the survey area, including 28 mammals, 66 birds, 46 reptiles and four amphibians
- Four conservation significant fauna species were recorded within (or close to within) the survey area during the field survey, this included:
  - Ghost Bat (*Macroderma gigas*) – listed Vulnerable (Vulnerable) under the BC Act and Vulnerable under the EPBC Act
  - Peregrine Falcon (*Falco peregrinus*) – listed as Other Special Protection under the BC Act
  - Western Pebble-mound Mouse (*Pseudomys chapmani*) – Listed as Priority 4 under DBCA fauna listings
  - Brush-tailed Mulgara (*Dasycercus blythi*) – Listed as Priority 4 under DBCA fauna listings.

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1. Introduction

1.1 Project background

BHP Western Australian Iron Ore (BHP), part of BHP Billiton Iron Ore Pty Ltd, required a Level 2 single season vertebrate fauna survey covering the Jimblebar East and Caramulla areas (the survey area). The results of the fauna survey will be used to inform future environmental approvals across the area. GHD Pty Ltd (GHD) was commissioned by BHP to undertake the fauna survey.

1.2 Propose of this report

This report details the results of the fauna survey. The purpose of the survey was to identify ecological constraints and values, further add to the biodiversity knowledge within the survey area and support future approvals documentation.

1.2.1 Limitations and assumptions

This report has been prepared by GHD for BHP and may only be used and relied on by BHP for the purpose agreed between GHD and the BHP as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than BHP arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by BHP and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

1.3 Scope of works

The scope of works was to:

- Provide a comprehensive desktop assessment comprising vertebrate fauna database search and literature review for the study area as detailed in BHP guidance document SPR-IEN-EMS-012 v6, to determine the presence, or likely presence, of conservation significant species and communities
- Undertake a single-season Level 2 vertebrate fauna survey within the survey area as detailed in guidance document SPR-IEN-EMS-012 v6
- Provide a technical report detailing the desktop assessment and the fauna survey, prepared in accordance with guidance document SPR-IEN-EMS-012 v6
- Submit fauna survey data in accordance with BHP guidance document SPR-IEN-EMS-015 v9.

1.4 Study area location

1.4.1 Survey area

The survey area includes mining tenements M266SA (portion of) and E52/17764 and is located directly east of the BHP Jimblebar mining operation and approximately 60 kilometres (km) east of Newman. The survey area covers approximately 11,893 hectares (ha) (see Figure 1, Appendix A). For this report, the term study area includes the survey area and an additional 40 km radius buffer around the survey area, which defines the limits of the desktop assessment as described in section 1.3.

1.5 Environment

1.5.1 Regional biogeography

The study area is situated in the Eremaean Botanical Province, within the Pilbara bioregion and the Gascoyne and Fortescue sub-regions as described by the Interim Biogeographic Regionalisation of Australia.

The Pilbara bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses. Tenure comprises Aboriginal land, leasehold (for grazing cattle) and conservation reserves. The bioregion provides the majority of Western Australia (WA)'s exports in petroleum, natural gas and iron ore. Major population centres are Karratha, Port Hedland, Newman and Tom Price.

1.5.2 Geology and soils

Geology

The Australian continent is made up of four continental blocks: the Yilgarn, Pilbara and Gawler Cratons and the Wilyama Block. The survey area is located within the Warakurna and Fortescue Large Igneous Provinces of the Pilbara Craton. The Pilbara Craton is a geological formation formed from Archaean crust (3.6-2.7 billion years ago). The Fortescue Large Igneous province comprises mafic to intermediate and ultramafic layered intrusions and dykes, such as the Black Range Suite. The Warakurna Large Igneous Province consists of dolerite sill complexes, dykes and the Giles layered intrusions in the Musgrave Comples (Glikson et al. 1996; Pirajno & Morris 2005).

The study area appears to intersect the upper and lower Hamersley Group, Fortescue Group sequence 5 and Sylvania Inlier greenstones (GoWA 2019):

- Upper Hamersley Group: Banded iron-formation, chert, mudstone, siltstone, rhyolite, and numerous dolerite sills; metamorphosed
- Lower Hamersley Group: Carbonate sedimentary rocks, shale, siltstone, chert, and banded iron-formation; metamorphosed
- Fortescue Group sequence 5: Siliciclastic sedimentary rocks, mafic volcanic rocks and minor felsic volcanic rocks; local carbonate rocks, chert, and dolerite sills. Includes Jeerinah Formation
- Sylvania Inlier greenstones: Mafic intrusive rock, metamorphosed.

Land systems, landforms and soil

Soils within the study area comprise the following (BRS 2009):

- BE6: Extensive flat and gently sloping plains, which sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops: chief soils are shallow earthy loams (Um5.3), with associated (Gn) soils of units My5O and Mz23 of Sheet 6. As mapped, there are inclusions of units Oc47 and BB9
- Mz25: Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of calcareous earths (Gc) and loams (Um1) on calcrete (kunkar) and some hard red (Dr) soils around creek lines
- Fa13: Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5. 11) soils on the steeper slopes. Associated are (Dr2.33 and Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.

The Pilbara region has been surveyed by the Department of Agriculture and Food, Western Australia (DAFWA) and others for the purposes of land classification, mapping and resource evaluation. One hundred and two land systems have been described for the region, which are distinguished on the basis of topography, geology, soils and vegetation (Vreeswyk et al. 1999). The Sites intersect ten land systems; details of these land systems are presented in Table 1.

Table 1 Land systems within the survey area

Land system	Land type	Description
Newman	Hills and ranges with spinifex grasslands	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands
Jamindie	Wash plains on hardpan with mulga shrublands	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey
Boolgeeda	Stony plains with spinifex grasslands	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands

Sylvania	Stony plains with acacia shrublands	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands
McKay	Hills and ranges with spinifex grasslands	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands
Zebra	Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex	Hardpan plains with large linear gravelly sand banks supporting acacia shrublands with soft and hard spinifex
Washplain	Wash plains on hardpan with mulga shrublands	Hardpan plains supporting groved mulga shrublands
River	River plains with grassy woodlands and tussock grasslands	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands
Cadgie	Wash plains and sandy banks on hardpan, with mulga shrublands and wanderrie grasses or spinifex	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex
Divide	Sandplains and occasional dunes with spinifex grasslands	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands

1.5.3 Hydrology

The study area is intersected by Jimblebar Creek which is classified as a significant stream and Caramulla Creek, a major river. Both of these waterbodies are seasonal and depend largely on cyclonic and monsoonal weather events for the presence of surface water.

At the time of the survey, no surface water was evident in Caramulla Creek and some surface water ponds were observable in Jimblebar Creek although these are presumed to be from mining activities.

1.5.4 Land use

The survey area is located on Sylvania Pastoral Station and is cover by BHP tenement. Additionally the region has a long history of mining with old adits and mine workings scattered though and just outside of the survey area.

Department of Biodiversity Conservation and Attractions (DBCA) managed lands

No DBCA managed lands are located within the survey area or study area. However the Fortescue Marsh, which is listed on the Directory of Important Wetlands of Australia as a wetland of regional and national significance (DBCA 2018) is positioned approximately 45km north of the survey area.

1.5.5 Vegetation

Broad scale (1:1,000,000) pre-European vegetation mapping of the Pilbara region was completed by Beard (1976) at an association level. The mapping indicates there are three vegetation associations present within the survey area including:

- Low tree-steppe: Hummock grassland with scattered bloodwoods & snappy gum, *Triodia* spp., *Corymbia dichromophloia, Eucalyptus leucophloia*
- Low woodland, open low woodland or sparse woodland: Mulga, *Acacia aneura* and associated species
- Shrub-steppe: Hummock grassland with scattered shrubs or mallee, Triodia spp. Acacia spp., Grevillea spp. Eucalyptus spp.

2. Methodology

2.1 BHP requirements

BHP requirements applied to this survey are set out in Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012 v6). This document outlines BHP's expectations for survey components including the level of survey, desktop assessment, survey design and intensity, timing, habitat assessment and reporting requirements. Biological survey spatial data requirements (SPR-IEN-EMS-015 v9) set out all biodiversity data requirements to standard and consistent format. These standards enable analysis of survey data and comparison between surveys spatially and temporally.

2.2 Relevant legislation and background information

In WA all native species and communities are protected under the *Biodiversity Conservation Act 2016*. Species of high conservation status (conservation significant species) are further protected under Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In addition, regulatory authorities also provide a range of guidance and information on expected standards and protocols for environmental surveys. An overview of these key legislation and guidelines, conservation codes and background information relevant to this fauna survey is provided in Appendix B.

2.3 Desktop assessment

Prior to the field survey a desktop assessment was undertaken to collect relevant environmental and ecological information pertaining to the survey area and wider study area and to assist survey design. This included a review of:

- The Department of the Environment and Energy (DEE) Protected Matters Search Tool (PMST) to identify communities and species listed under the EPBC Act potentially occurring within the study area (DEE 2019) (Appendix C)
- Literature review of five previous fauna survey reports provided by BHP that cover portions of the survey area and wider study area
- The DBCA Threatened and Priority Fauna database for the study area
- The DBCA *NatureMap* database for fauna species previously recorded within the study area (DBCA 2007–) (Appendix C). This is an integrated database comprising the following databases:
  - Atlas of Australian birds
  - Pilbara Threatened Fauna
  - Birdata - Birdlife Australia
  - Fauna Survey Returns Database
  - Pilbara Biological Survey - Birds or Pilbara
  - Biological Survey - Pilbara Biological Survey (mammals, birds, reptiles)
  - Waterbirds or Pilbara Threatened Fauna
  - WA Threatened Fauna Database
  - WA Museum (WAM) databases (mammals, birds, reptiles)
- Aerial photography, geology/soils, land systems and hydrology information to provide background information on the variability of the environment and likely vegetation and habitat types present.

Results of the literature review are presented in Table 12 and database search results are presented in Appendix C.

2.4 Field survey

2.4.1 Field survey details and timing

The field survey consisted a twelve day single season Level 2 assessment from 29 April to 10 May 2019. The field survey was led by Glen Gaikhorst and other GHD ecologists Madi Roberts, Kelly Dalton, Craig Grabham, Brad Maryan, Angela Benkovic and Robert Browne-Cooper. The experience of these staff members are presented in Table 2.

Table 2 Personnel experience

Name	Years of experience	Role
Glen Gaikhorst	20	Principle Zoologist and field lead
Craig Grabham	20	Senior Zoologist
Robert Browne-Cooper	20+	Senior Zoologist
Brad Maryan	20+	Senior Zoologist
Kelly Dalton	10	Senior Zoologist
Angela Benkovic	11	Ecologist
Madison Roberts	3	Ecologist

2.4.2 Guiding documents

The survey methodology and data collection that GHD employed was consistent with:

- EPA Technical Guidance –Terrestrial Fauna Surveys, Perth, Environmental Protection Authority (EPA 2016a)
- EPA Technical Guidance – Sampling methods for terrestrial vertebrate fauna, Perth, Environmental Protection Authority (EPA 2016b)
- Interim guideline for preliminary surveys of Night Parrot *(Pezoporus occidentalis)* in Western Australia. (Department of Parks and Wildlife, 2017)
- Survey Guidelines for Australia's Threatened Bats (Department of the Environment, Water, Heritage and the Arts 2010a)
- Survey Guidelines for Australia's Threatened Mammals (Department of the Environment, Water, Heritage and the Arts 2010b)
- Survey Guidelines for Australia's Threatened Reptiles (Department of the Environment, Water, Heritage and the Arts 2010c).

2.4.3 Permits and ethics

A Regulation 17 Licence to Take Fauna for Scientific Purposes was obtained from DBCA prior to undertaking the fauna survey (Licence Number: BA27000031). This permit also allows vouchering a limited number of non-conservation significant specimens for lodgement with the WAM. However in general, only specimens of particular scientific interest or taxonomic significance are collected for the WAM. The fauna survey (specifically trapping and animal handling) was undertaken in accordance with Standard Operating Procedures (SOPs) which were required to be followed under the conditions of GHD's fauna trapping permit. At the time of survey, compliance with these SOPs was accepted by DBCA as evidence of ethical treatment of animals.

2.4.4 Habitat assessment

Habitat assessment was conducted in accordance with the BHP fauna survey guidelines as outlined in section 2.1. Field data was collected via the ArcGis Online platform for all systematic fauna sampling sites (section 2.4.6), at significant species record sites and other locations as required to enable delineation and mapping of major fauna habitat types throughout the survey area. For the purposes of consistency, where appropriate, the habitat type names have been aligned with those of previous reports relevant to the survey area as reviewed as part of the desktop assessment (section 3.1).

Broad habitat types within the survey area were identified, mapped and described based on the following:

- Location within study
- Landscape position
- Geomorphology, topography and substrate
- Photos of representative habitat types
- Vegetation description and dominant structure
- Values to associated fauna including significant species (e.g. refuge, foraging, shelter)
- Ecological processes of importance
- Disturbances (weeds, fire, ground disturbance)
- Wider extent and connectivity of habitat type based on previous mapping
- Comparison between broad habitat types
- Evaluation of the likelihood of occurrence of conservation significant fauna within the environments present (based on presence of suitable habitats and species recorded).

2.4.5 Fauna identification and nomenclature

Species Identification

Fauna were identified in the field using reference books and field guides and electronic guides (Table 3). Where identification was not possible, photographs of specimens were collected to be later identified.

Table 3 Fauna references

Fauna group	Field guide
Mammals	Menkhorst and Knight (2004), Van Dyck and Strahan (2008)
Bats	Churchill (2008), Menkhorst and Knight (2010)
Birds	Morcombe (2004)
Reptiles	Wilson and Swan (2017), Storr et al. (1999), Storr et. al. (2002)
Amphibians	Tyler and Doughty (2009)

Nomenclature

Nomenclature used in this report follows that used by WAM as reported on *NatureMap*. This nomenclature is deemed the most up-to-date species information for WA fauna.

2.4.6 Systematic trapping program

Systematic trapping programs are designed for recording an inventory of general species and significant species in a standardised approach where trapping and other survey effort is equal and quantifiable across all trapping quadrats. This allows comparison of species abundance

and richness between sampling sites and habitat types, and provides a robust and reproducible approach for analysing species accumulation data.

Trapping for terrestrial vertebrate fauna was undertaken using a series of standardised systematic trapping quadrat sites comprising pit-fall traps, Elliott box traps, cage traps and funnel traps. Traps were checked and cleared as per licence condition within specified time each morning, with fauna identified and released in situ. For each quadrat timed bird survey and active searching was also carried out.

A total of eight quadrats were established within the major representative habitat types across the survey area and each quadrat was surveyed (trapped) for seven to nine nights. Checking of traps was carried out in accordance with the DBCA fauna trapping licence stipulating daily requirements for clearing traps. Table 4 presents all systematic trapping methods and survey effort and trapping locations are shown in Figure 2, Appendix A. The trap methods used are described below.

Pit-trap with drift fence

Ten pit-fall traps consisting of alternating buckets and pipes were installed in a linear formation at approximately 20 meter interval within each of the 8 trapping quadrats. Where ground substrate were unable to be penetrated for bucket or pipe establishment additional funnels were a replacement. This gave a total of 76 pit-fall traps across the survey area per night. Buckets were 20 litre plastic buckets (25 cm diameter by 40 cm deep), and pipe traps consisted of 8-9 litre (15 cm diameter by 50 cm length) sections of PVC pipe. Each pit-fall trap was set with a 6-8 meter long flywire drift fence (30 cm high) bisecting the pits to direct fauna into them. Soil, leaf litter and/or egg crate were placed within each pit to provide shade and protection to trapped fauna.

Funnel traps

Two funnel traps were set on each drift fence and positioned with one funnel at each end, giving a total of 20 funnels set at each trapping quadrat. Pits were substituted with funnels at some sites if ground substrates were too difficult to dig. Funnel traps were placed such that animals were directed into them from the drift fence. Funnel traps were covered with insulating and highly reflective materials to maximise shade, and minimise heat and cold exposure to animals.

Elliot box traps

Ten medium sized Elliott box traps were used at each trapping quadrat site. These traps are set primarily for catching small to medium sized rodents such as Rock Rats, and Dasyurud marsupials such as Dunnarts (*Sminthopsis spp*) and Northern Quoll (*Dasyurus hallucatus*). Traps were placed approximately 20 metres apart and approximately 10 metres from each respective pit-fall trap, and baited with universal bait (a mixture of peanut butter, rolled oats and sardines). Elliott traps were located within shady areas or covered with vegetation to minimise exposure to captured animals. A total of 80 Elliot box traps were set per night.

Cage traps

Two cage traps were located at each quadrat site. These traps were placed at each end of the line of Elliott traps. Cage traps were baited with universal bait and each was covered with a hessian sack. A total of 16 cage traps were set per night.

Avifauna

Avifauna surveys were undertaken within each of the trapping quadrat sites. Each survey comprised of a 20 minute census of birds within an unbounded 2 ha area. This approach is the standard method used by Birds Australia for the Bird Atlas project. Birds detected visually (using

binoculars) and/or aurally over a 20 minute period were recorded. Numbers of each species observed were also recorded. All systematic bird surveys were undertaken within four hours of dawn or two hours of dusk, as these are the times of day when birds are most active. In addition to systematic surveys, observations of birds were also made opportunistically.

Active searches

Each trapping quadrat site was actively searched by hand and using cultivator rakes for amphibians, reptiles, and mammals. Searches comprised overturning logs, bark, rocks and leaf litter and low vegetation, and other ground debris to search for inactive fauna. All fauna, both inactive and active including abundance was recorded. Species presence was also determined via secondary evidence, in the form of scats, tracks, feathers, skeletal remains and burrows. A minimum of one hour was spent at each quadrat and the general area around it. Additional active searches were conducted in areas deemed suitable for species richness, to target conservation significant species, and to demonstrate coverage of the site, these additional search areas can be seen in Table 8.

2.4.7 Remote Fauna recording devises

Remote Cameras

Remote sensor cameras (Reconyx-Hyperfire) were deployed for a maximum of 9 nights (minimum of 4). Cameras were used for significant fauna species detection and adding to the general species inventory, recording small to large mammals, birds and reptiles. Cameras were set in areas where significant species are more likely to be recorded e.g. rocky potential forage or den sites, at suspected active burrows, or along potential fauna movement corridors such as vehicle access tracks or rocky ledges. Cameras were baited with sardines and/or universal animal bait to attract fauna species within the survey area, however some cameras targeting fauna burrows, such as mulgara, were not baited. For these cameras the objective was to determine if burrows were occupied. For each camera location the time and date deployed and recovered, and the GPS coordinates were recorded (Table 5).

Data from the cameras were downloaded to a computer and analysed for the presence of fauna following the field survey.

Bat acoustic recorders

Bat Detectors (SM4 Songmeters) were deployed targeting a range of micro bats, but focussing on Ghost Bat and Pilbara Leaf-nosed Bat. Detectors were set for a minimum of one night at each of the systematic trapping sites. Additional recorders were set at selected locations such as Jimblebar Creek or the Adit, where up to six nights were sampled. Bat detectors were positioned in areas where bat species were likely to be present i.e. water bodies, fly-ways such as rocky gullies, and set at potential roost caves. Bat detectors were programmed to record from 25 minutes pre-dusk to 25 minutes post-dawn. For each detector the time and date deployed and recovered, and the GPS coordinates were recorded (Table 4 and Table 6).

Data from the bat detectors were downloaded to a computer and analysed for the presence of animals following the field survey. Data from the detectors was analysed by Craig Grabham and Kyle Armstrong (Specialised Zoological) to determine species using Kaleidoscope ® bat analysis software and a series of graphical reference comparison calls.

Bird acoustic recorders

Bird acoustic recorders were set primarily for detecting the Night Parrot in line with DPaW (2017). Acoustic detectors (SM2 and SM4 Songmeter Acoustic recorders) were deployed in areas where Night Parrot might be recorded i.e. utilising water bodies, Chenopod shrubland

areas or Triodia plain. The detectors were set for a maximum of four nights and programmed to record from 25 minutes pre-dusk to 25 minutes post-dawn. For each detector the time and date deployed and recovered, and the GPS coordinates were recorded (Table 7). Data from the recorders was downloaded to computer and analysed by Nigel Jackett, an ecologist with considerable experience in analysis and identification of night parrot acoustic data.

2.4.8 Non-systematic fauna survey

Non-systematic survey methods are aimed at detecting conservation significant species and boosting inventory species records by augmenting systematic trapping methods. These methods detect fauna by opportunistic observation and selectively searching particular habitat types and landform features in consideration of target species' habitat preferences, optimal seasonal and diurnal timing to record active fauna or opportunistic secondary evidence. Non-systematic methods described below, particularly opportunistic observations, generally account for a high proportion of the total fauna inventory and significant fauna recorded during surveys. Non-systematic survey method locations are shown in Figure 2, Appendix A.

Nocturnal searching

Spot lighting was undertaken to locate nocturnal species such as nocturnal reptiles, mammals and birds that may otherwise remain undetected using other survey techniques. Hand held or head mounted spotlights were used for a minimum of one hour by two personnel in selected areas based on habitat suitability and site access in consideration of HSE requirements.

Opportunistic observations

Opportunistic observations involve the recording of fauna taxa (physical presence and/or signs of presence) spatially throughout the survey area. Opportunistic observations include physical observations (sighting or hearing fauna), and indirect evidence (scats, tracks, diggings, nests, feathers, skeletal remains, pellets) which indicate the current or recent activity of a species. Wherever possible, numbers of individuals, microhabitat use and other relevant information was recorded. Opportunistic observations were recorded outside of the diurnal, nocturnal or general trap site surveys (for example when driving, traversing the survey area, and during habitat assessment).

Walk transect traversing

Walk transects were undertaken for target significant species in selected habitat types including: triodia sand plains targeting Brush-tailed Mulgara and Greater Bilby; stony hill slopes targeting Pebble Mound Mouse; gravel hill slopes targeting Pebble-mound Mouse, and rocky drainage lines targeting Pilbara Olive Python. There are no specific guidelines for transect searching for Brush-tailed Mulgara, Pebble-mound Mouse or Pilbara Olive Python, however the Greater Bilby has a documented sampling technique. The sampling technique endorsed by DEE utilises Southgate's methods of Greater Bilby Plot Assessments (Southgate *et al*. 2018) which involves an assessment of 2 ha plots as a method of sampling a proportion of a given survey area. The approach for the current survey was to extend the Plot Assessment method randomly throughout the survey area to detect Greater Bilby activity and specifically to detect burrows of resident animals if present.

Two ha plots (either 50 m x 400 m or 100 m x 200 m) were traversed on foot for evidence of Greater Bilby activity indicating recent presence. Searching was carried out by a minimum of two personnel. Personnel walked in a line spaced approximately 20 - 30 metres apart providing adequate on-ground coverage to target the Greater Bilby. During the traverses, all evidence of Greater Bilby was recorded including burrows, foot prints, foraging signs, and scats. Signs of

Greater Bilby activity were annotated, photographed, and GPS location recorded. The survey effort and location can be seen below in Table 9.

Cave searches

Caves identified as potentially suitable for Pilbara Leaf-nosed Bat or Ghost Bat were first observed opportunistically while driving through the site, and then further investigated by foot. Outcrops not accessible by vehicle but considered to potentially contain caves were accessed by foot and searched thereafter. Assessment of suitability for Pilbara Leaf-nosed Bat and Ghost Bat included cave dimensions, the presence of guano and evidence of feeding. If possible, Song Meters and/or cameras were set within or at the mouths of caves to collect further evidence of cave use. Where potential roost sites were located a visual inspection for signs of use by Ghost Bat and other microchiropteran bat species was undertaken including:

- Evidence of current or historical occupation (e.g. bat species within the cave; presence, age, type and amount of scat; presence of Ghost Bat feeding)
- Preliminary assessment of cave structure and microclimate characteristics
- Evidence of other species occupying the site.

Adit

A survey of an adit was undertaken using three complementary survey methods:

- Visual inspection – The adit was inspected by Senior Ecologist Craig Grabham on the 2 May 2019 to undertake a preliminary assessment of the roost type and determine the siting of survey equipment. Surveys were not undertaken of the adit structure or microclimate beyond the entrance due to safety concerns
- Acoustic monitoring – A full spectrum Titley Scientific AnaBat Swift bat detector was placed just inside the entrance of the adit for four consecutive nights (2 – 5 May 2019). The detector was placed inside the adit behind a dirt mound to target Ghost Bat and Pilbara Leaf-nosed Bat, increase the likelihood of recording calls from bats occupying the adit and record calls from bats emerging from the adit in the evening and during the re-emergence period early morning (see Appendix E for additional details regarding this method). The survey effort and location can be seen below in Table 6
- Emergence monitoring – Counts of emerging bats from the adit were undertaken over two consecutive nights (5 – 6 May 2019) for at least 40 minutes following sunset using infrared night vision googles or a red filtered torch. The purpose of undertaking the counts was to record the number of bats exiting the roost during the emergence period and attempt to discriminate between the different species using the roost through comparison of different sized bats. A hand held EchoMeter Touch (EMT) bat detector was used to record and actively monitor bat calls during the emergence survey (5 May 2019).

2.5 Survey effort and sampling locations

Survey effort is described as the amount and type of survey that is undertaken during an assessment. Table 4 summarises the type and amount of survey time undertaken during the survey. The effort and location of sampling can be found in the following tables Table 4, Table 5, Table 6, Table 7, Table 8 and Table 9. Figure 2, Appendix A shows the survey effort undertaken for this project.

Each of the eight trapping sites was sampled for 7/9 consecutive trap-nights including bucket, cage, funnel and Elliott traps. Additionally at least 1 night was sampled for bat acoustics (12 nights total), 60 to 120 minutes of night search, 60 to 120 minutes of active search and 60 to 140 minutes of bird assessments undertaken at each site.

The total trapping effort consisted of 2520 trap-nights (total trap effort), 820 minutes of bird assessments, 540 minutes of active searches, 510 minutes of night searches, 16 nights of Night Parrot acoustic assessment, 28 nights of Bat detection, 143 camera nights, 1000 minute of additional active search effort and 840 minutes of Greater Bilby plot assessments.

Table 4 Survey effort and location at systematic trap sites

Fauna Tapping					Pit-fall traps (PVC pipes and buckets)		Elliot traps		Cage Traps		Funnel traps		Bat Detector	Birds search	Noct. search	Active search
Sites	Lats.	Longs.	Habitat	Nights Open	Per site	Trap nights	Per site	Trap nights	Per site	Trap nights	Per site	Trap nights	(nights)	(minutes)		
Trap site 1	-23.3647168	120.393297	Sand Plain	9	10	90	10	90	2	18	20	180	2	60	60	120
Trap site 2	-23.3720133	120.349546	Sand Plain	9	10	90	10	90	2	18	20	180	1	120	60	60
Trap site 3	-23.3860190	120.311648	Major Drainage Line	7	10	70	10	70	2	14	20	140	1	80	60	60
Trap site 4	-23.4045457	120.313091	Mulga Woodland	7	10	70	10	70	2	14	20	140	2	140	-	60
Trap site 5	-23.3765324	120.307659	Mulga Woodland	7	10	70	10	70	2	14	20	140	1	80	60	60
Trap site 6	-23.3753997	120.262022	Hillcrest/ Hillslope	7	8	56	10	70	2	14	22	154	3	60	60	60
Trap site 7	-23.3628874	120.231725	Shallow Gully within Hillcrest/ Hillslope	7	8	56	10	70	2	14	22	154	1	60	90	60
Trap site 8	-23.3854283	120.214608	Major Drainage Line	7	10	70	10	70	2	14	20	140	1	120	120	60
Totals				**-**	**76**	**572**	**80**	**600**	**16**	**120**	**164**	**1228**	**12**	**820**	**510**	**540**

Table 5 Remote camera trap locations

Camera number	Habitat type	Micro-habitat	Location		Nights deployed
			Lats.	Longs.	
Camera 115	Sand Plain	Focused on old Greater Bilby Burrow	-23.371332	120.379345	8
Camera 2	Minor Drainage Line	Amongst Woody debris	-23.355714	120.271998	9
Camera 29	Hillcrest/Hillslope	On ironstone rocky crevice	-23.362824	120.232005	9
Camera 15b	Minor Drainage Line	Amongst Woody debris	-23.354941	120.284379	9
Camera 7	Sand Plain	On plain amongst Triodia	-23.379434	120.324811	8
Camera 19	Sand Plain	On plain amongst Triodia	-23.376236	120.332154	9
Camera 1	Hillcrest/Hillslope	Iron Stone outcropping	-23.357455	120.251727	9
Camera 77	Minor Drainage Line	Amongst Woody debris	-23.355786	120.293580	9
Camera 99	Hillcrest/Hillslope	Breakaway	-23.372147	120.248166	9
Camera A	Hillcrest/Hillslope	Breakaway	-23.371491	120.250342	4
Camera 14	Hillcrest/Hillslope	Breakaway	-23.371828	120.251647	4
Camera 20	Major Drainage line	Carramella Ck - Eucalyptus hollow on ground	-23.364745	120.314311	8
Camera A2	Hillcrest/Hillslope	Iron Stone outcropping	-23.373956	120.249765	9
Camera 25	Hillcrest/Hillslope	On ironstone rocky crevice	-23.362588	120.232928	9
Camera 24	Hillcrest/Hillslope	On ironstone rocky crevice	-23.364684	120.199481	9
Camera 14a	Claypan	On Mulga in Ephemeral Claypan	-23.371416	120.296569	8
Camera 16	Hillcrest/Hillslope	Breakaway	-23.371062	120.249452	9
Camera 13	Hillcrest/Hillslope	Breakaway	-23.380843	120.235727	4
Total nights					**143**

Table 6 Additional bat detector locations

Bat detector sites	Habitat type	Micro-habitat	Location		Nights deployed
			Lats	Longs	
SM4-2	Major Drainage line	Jimblebar Creek	-23.372831	120.194474	5
swift	Hillcrest/Hillslope	Adit	-23.367655	120.193573	5
SM4-6	Hillcrest/Hillslope	Adit	-23.367655	120.193573	6
Total nights					**16**

Table 7 Night Parrot Detector locations

Night Parrot detector number	Habitat type	Location		Nights deployed
		Easting	Northing	
SM4AU4	Sand Plain	-23.3647168	120.3932966	4
SM4AU1	Sand Plain	-23.3720133	120.3495455	4
SM4AU3	Sand Plain	-23.4045457	120.3130912	4
SM4AU2	Sand Plain	-23.3765324	120.3076594	4
Total nights				**16**

Table 8 Additional active search locations

Active Search number	Habitat type	Micro-habitat	Location		Active Search (minutes)
			Lats	Longs	
1	Sand Plain	Under Acacia and Triodia	-23.369898	120.379603	60
2	Hillcrest/Hillslope	In Breakaway	-23.361192	120.235658	120
3	Sand Plain	Under Acacia and Triodia	-23.386953	120.253391	40
4	Claypan	Under Acacia	-23.371416	120.296569	90
5	Sand Plain	Under Acacia and Triodia	-23.364833	120.272391	60
6	Sand Plain	Under Acacia and Triodia	-23.376789	120.285291	60
7	Mulga Woodland	Under Acacia	-23.392360	120.209968	180

8	Hillcrest/Hillslope	Triodia spoil heaps	-23.355957	120.269325	60
9	Sand Plain	Under Acacia and Triodia	-23.363621	120.309959	120
10	Sand Plain	Under Acacia and Triodia	-23.396757	120.419651	90
11	Hillcrest/Hillslope	In iron stone capping	-23.371752	120.268264	60
12	Hillcrest/Hillslope	In iron stone capping	-23.367655	120.193573	60
Total minutes					**1000**

Table 9 Targeted Greater Bilby plots

Plot sites	Habitat type	Comments	Location		Plots (minutes)
			Lats	Longs	
1	Sand Plain	2 ha 50m x 400m	-23.377622	120.380328	60
2	Sand Plain	2 ha 50m x 400m	-23.371332	120.379345	60
3	Sand Plain	2 ha 50m x 400m	-23.398762	120.420158	60
4	Mulga Woodland	2 ha 100m x 200m	-23.384782	120.266694	60
5	Sand Plain	2 ha 50m x 400m	-23.380670	120.374483	60
6	Mulga Woodland	2 ha 50m x 400m	-23.374451	120.289196	60
7	Sand Plain	2 ha 50m x 400m	-23.384798	120.379009	60
8	Sand Plain	2 ha 50m x 400m	-23.381157	120.381460	60
9	Sand Plain	2 ha 50m x 400m	-23.376877	120.373633	60
10	Sand Plain	2 ha 50m x 400m	-23.365000	120.309715	60
11	Mulga Woodland	2 ha 50m x 400m	-23.393318	120.214114	60
12	Mulga Woodland	2 ha 50m x 400m	-23.376356	120.286435	60
13	Sand Plain	2 ha 50m x 400m	-23.396757	120.419651	60
14	Sand Plain	2 ha 50m x 400m	-23.366453	120.379685	60
Total minutes					**840**

2.6 Data analysis

2.6.1 Species accumulation

The number and type of species trapped each day was recorded and a species accumulation curve was created for the survey area using PRIMER v6 (Clarke and Gorley 2006). The species accumulation curve represents the successfulness of the trapping program for its duration. Typically, the longer the trapping program the more complete the representation of species sampled per trapping location or habitat type. Accumulation curves should show "levelling" of the groups species counts prior to the completion of the survey. Many limitations can influence the results of a curve and should be observed as a guide to the project's success. This curve is presented below in Chart 2. Only one curve was created for this survey within the survey area.

The data was run through Primer v6 against 8 existing models, these models are:

- Sobs - Curve of observed species counts
- Chao 1 - Chao's estimator based on number of rare species
- Chao 2 - Chao's estimator using just presence-absence data
- Jacknife 1 - Jacknife estimator based on species that only occur in one sample
- Jacknife 2 - Second order jacknife estimator
- Bootstrap - Bootstrap estimator based on proportion of quadrats containing each species
- MM (Michaelis-Menton) - Curve fitted to observed Sobs curve
- UGE - Calculated species accumulation curve based on (Ugland et al 2003).

In this instance the best fit model was UGE.

2.6.2 Scatter Plots

PRIMER v6 (Clarke and Gorley 2006) was used to examine the similarity between trapping sites using collected data. A matrix was created of all species (based on abundance) recorded at each trap site. The dissimilarity between sites was determined using the Bray-Curtis measure and the Resemblance function in PRIMER. A Cluster analysis (using Agglomerative Hierarchical Clustering technique) based on group average was undertaken using the Bray-Curtis similarity matrix and results presented as a dendrogram. In addition, a nonmetric multi-dimensional scaling analysis (MDS) was undertaken using the Bray-Curtis similarity matrix and results presented as a two dimensional scatter plot. A factor was added to the output to define trap sites by habitat type (Chart 1).

2.7 Seasonal conditions

The survey area is located within the Pilbara region of WA. The climate of this region is arid to tropical with very hot summers and mild winters. Rainfall in the Pilbara is spatially and temporally variable. Rainfall in the eastern Pilbara (containing the site) is most influenced by tropical and monsoonal drivers which are predominantly active in the summer and autumn months (Dec-May) while rainfall in the western Pilbara is also influenced by southern mid-latitude drivers such as frontal systems during autumn and winter (March-Aug) (Sudmeyer 2016).

During summer and early autumn (December-March), average daily temperatures exceed 30°C across the region, with average daily maxima exceeding 35°C from October to March. During the winter months (June to August), average temperatures are around 20°C across the region.

The closest current weather station to the site is in Newman (Station ID: 007176) located approximately 35 km west of the western study area boundary. Climate data from this station indicate:

- Mean maximum temperature ranges from 23.0 °C in June and July to 39.2 °C in December
- Mean minimum temperature ranges from 6.4 °C in July to 25.1 °C in January
- Mean annual rainfall is 329.5 mm with an average of 29.8 rain days per year (BoM 2019).

Rainfall for the previous 6 month lead up to the survey is presented in Table 10 (based on Newman data). The rainfall total for the previous 6 months is 102.8 mm. This is approximately a third of the year's total for this region. Considering the May to September period is considered the dry season, the rainfall to date is well below average for the year.

Table 10 Rainfall 6 months prior to the survey month.

Date	Rainfall (mm)
April 2019	3.8
March 2019	12.2
February 2019	46.2
January 2019	23.8
December 2018	4.0
November 2018	7.0
October 2018	5.8
Total	102.8 mm

The weather over the survey period is presented below in Table 11.

Table 11 Weather during survey period (sourced BoM 2019)

Date	Temperature (°C)		Rainfall (mm)
	Minimum	Maximum	
29 April 2019	NA	NA	NA
30 April 2019	20.4	30.7	0
1 May 2019	11.0	27.0	0
2 May 2019	11.1	30.1	0
3 May 2019	10.6	31.9	0
4 May 2019	11.4	32.2	0
5 May 2019	11.9	32.4	0
6 May 2019	12.0	34.1	0
7 May 2019	17.0	29.4	0
8 May 2019	11.9	27.2	0
9 May 2019	15.3	26.6	0
10 May 2019	12.6	22.8	0

3. Desktop assessment

3.1 Fauna database searches

NatureMap

The *NatureMap* database identified 220 vertebrate fauna taxa previously recorded within 40 km radius of the survey area (DBCA 2007). This total included six amphibians, 102 birds, 32 mammals and 80 reptiles.

Protected Matters Search

The EPBC Act PMST indicated the potential presence of 18 additional fauna taxa within 40 km of the survey area (DEE 2018) (Appendix D). Consisting of 11 birds, four mammals and 1 reptiles. These species are listed threatened or migratory under the EPBC Act. Species solely listed as marine (two) are not included as these are common species.

3.2 Fauna diversity

Based on searches of the EPBC Act PMST (DEE 2018), DBCA Threatened and Priority Fauna database, *NatureMap* database (DBCA 2007) and literature review identified the presence/potential presence of 288 vertebrate fauna taxa previously recorded within 40 km radius of the survey area. This total included 144 birds, 42 mammals, 7 amphibians and 95 reptiles (Appendix D).

3.3 Conservation significant fauna

From the above species diversity 31 conservation significant fauna species were identified to be present/potentially present within the survey area (Appendix D). Species identified by the PMST as marine were excluded from this assessment as no marine habitats were present within or nearby the survey area and these species are not considered to be rare however species identified by the PMST as migratory terrestrial/wetland were considered as part of this assessment.

3.4 Literature review

As part of the desktop assessment fauna survey reports of spatial relevance to the survey area were provided by BHP. Following a review of the reports the findings were collated and are summarised in Table 12.

Table 12 Summary of previous fauna studies

Name of survey	Caramulla Level 1 Vertebrate Fauna Assessment	Caramulla level 1 Flora and Vegetation Survey and Fauna Assessment	Jimblebar Hashimoto Vertebrate Fauna Assessment	Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment	Wheelarra Hill North Fauna Assessment ENV Australia	Jimblebar North Level 1 vertebrate fauna survey report
Consultant	Biologic (2018)	GHD (2009)	Ecologia (2006)	Outback Ecology (2009)	ENV (2012)	Onshore (2019)
Level of experience of consultant	Combined total of 10+ years of fauna survey experience in the Pilbara	Combined total of 6+ years of fauna survey experience	Senior personnel had specific training and had undertaken at least 15 Pilbara surveys	Survey team were fauna specialists with many years' experience undertaking fauna surveys of this kind in WA	The Level Two surveys included practitioners that were regarded as suitably qualified in their respective fields	Single season Level 1
Location of survey in relation to this survey	Adjoins the southern edge of the current survey area	This survey lies approximately 6 km south east of the survey area but incorporates part of the same Hillcrest/ Hillslope habitat that extends from the current survey area	Adjoins the southern edge of the current survey area	Adjoins the southern edge of the current survey area	Incorporates the western portion of the current survey area	Incorporates the northern portion, and adjacent to the northwest portion of the current survey area
Dates of survey	17-21/2/2018	1-8/12/2008	26/8-16/9/2005, 6-15/2/2006	4-15/6/2008, 27/9-3/10/2008	7-18/4/2011 4-13/10/2011	12-17/9/2018
Seasonal conditions during and in the six months prior to the survey	126.8 mm of rainfall recorded at Newman Airport. This was slightly below the long-term annual average rainfall for the same period	60.4 mm of rainfall recorded at Newman Airport http://www.bom.gov.au/climate/data/index.shtml	157.4 mm rainfall recorded at Newman Airport. http://www.bom.gov.au/climate/data/index.shtml	205.6 mm rainfall recorded at Newman Airport http://www.bom.gov.au/climate/data/index.shtml	288.6 mm rainfall recorded at Newman Airport http://www.bom.gov.au/climate/data/index.shtml	68.2 mm rainfall recorded at Newman Airport. This was below average for the period being approximately 120 mm. http://www.bom.gov.

	(133.5 mm; BoM 2018)					au/climate/data/index.shtml
Summary of survey techniques and survey effort	Target searches (9 hr), remote pilot drone searches (1.5 hrs). SM4 bat detectors at 6 sites for 2 nights/site. Bird acoustic recorders for Night Parrot at 3 sites, total 8 nights. Motion Cameras at 3 sites, total 15 nights	Opportunistic visual and aural survey	360 cage trap nights, 1320 pit-trap nights, 1320 funnel trap nights, 2640 Elliot trap nights, 46 hrs bird census, 60 hrs opportunistic searching, 16 hrs bat acoustic recording, 19 hrs night searching	126 cage trap nights, 250 pit-trap nights, 322 funnel trap nights, 1330 Elliot trap nights, 22 person hrs hand searching, 19 hrs bird census, 19 hrs nocturnal spotlighting, target searches 38 hrs	316 cage trap nights, 980 pit-trap nights, 1960 funnel trap nights, 176 Elliot trap nights, 60 person hrs (combined for hand searching, opportunistic, and target searches) 7 hrs bird census, 12 hrs nocturnal spot lighting. Bat acoustic detectors (SD1 and SM2) set for one or two nights at 5 locations	Target searches (throughout study area), active foraging (20 locations), bird census (5 locations), SM4 (locations throughout study area) .
Species richness within survey area (species recorded)	36 vertebrate species total comprising: 8 mammals (3 introduced), 20 bird species, 8 reptile species	34 vertebrate species total comprising 6 mammals (5 introduced), 26 birds, 2 reptile species	180 vertebrate species total comprising 23 mammal (5 introduced), 85 birds, 52 reptile species	92 vertebrate species total comprising 16 mammals, (6 introduced), 47 birds, 27 reptiles, 2 amphibian species	139 vertebrate species total comprising 23 mammals, (3 introduced), 50 birds, 54 reptiles, and 2 amphibian species	71 vertebrate species recorded comprising 13 mammals, 7 reptiles, 51 birds
Conservation significant species recorded	Brush-tailed Mulgara, Greater Bilby, Ghost Bat (active)	None detected	Ghost Bat and Pilbara Leaf-nosed Bat bats observed roosting in a mine adit close to Jimblebar Creek to the adjacent west of survey area. These were subsequently determined to be erroneous records based on a later study involving harp	Western Pebble-mound Mouse	Western Pebble-mound Mouse	None detected.

			traps and ultrasound recordings (Armstrong and Konishi 2009). An active foraging bat observed within western portion.			
Taxonomic changes for conservation significant species	No taxonomic or conservation status changes	Australian Bustard was listed P4. But now de-listed	Australian Bustard was listed P4, and Rainbow Bee-eater (migratory) have been de-listed	Australian Bustard, Bush Stone-curlew and Rainbow Bee-eater have been de-listed	Australian Bustard, Bush Stone-curlew and Rainbow Bee-eater have been de-listed	No taxonomic or conservation status changes
Survey limitations	Lack of nocturnal searches highlighted in report as limitation. All other potential limitations addressed	No limitations listed or addressed in report. Survey effort not quantified. No survey techniques listed	Survey limitations described as nil to negligible. Species accumulation curves show 60% of species recorded	No significant limitations highlighted in report	No significant limitations highlighted in report	Poor seasonal conditions noted for the survey timing in September 2018.

4. Results

4.1 Fauna habitats

There were seven broad habitat types (excluding disturbed areas) recorded during the field survey from the survey area. These habitat types closely align with the different vegetation types and landforms within the survey area. The habitat types recorded in the survey area are described in Table 13 and mapped in Figure 3, Appendix A. The seven broad fauna habitat types are:

- Major Drainage lines
- Hillcrest/ Hillslope
- Sand Plain
- Mulga Woodland
- Minor Drainage lines
- Stony Plain
- Claypan
- Disturbed areas.

Sixty seven broad habitat points were collected during the survey and are compiled in Appendix D.

4.1.1 Habitat linkages

The survey area represents a large continuous tract of fauna habitat that retains high connectivity to the habitats directly adjacent. Current disturbances to all habitat types in the survey area include damage from drought (poor rainfall in 2018/2019), pastoralism (grazing, trampling of vegetation, soil compaction along cattle trails, small amounts of clearing (for tracks, artificial water sources and exploration) as well as grazing from feral animals (donkeys) and native kangaroos. While the structural complex of some habitat types show stress signs of grazing and reduced water availability, the majority of the site is uncleared and represents good, intact habitat.

The habitats in the survey area have direct connectivity to surrounding habitats. From what could be observed, no additional obvious habitat types were detected in immediately surrounding lands that are not present on the survey area. Small ranges/hill formations are to the south of the survey area (where a known Ghost Bat roost is present), and a number of riparian channels were spread over the greater landscape, which run from the surrounding hillcrest and slope areas.

4.1.2 Quality of habitat

The quality of the fauna habitats is currently affected by the impacts described above in Section 4.1.1. Whilst the vegetation is mostly intact the impact by grazing in some environments was evident, particularly the Major Drainage lines which is generally in poor to good condition. With this in mind the overall quality of the remainder of the survey area is in good to very good condition.

The survey results (i.e. species recorded) identified that the micro habitats within the broad habitat types played a significant part in the species present. The majority of the Hill crest/ Hill slopes have few areas of outcropping, breakaway or exfoliation, rather are covered in pebbles

and small scattered rocks on very hard substrates. This environmental structure reduced the opportunity for species to hide or create refugia and therefore reducing the species present. For example saxicoline (rock inhabiting) species such as Southern Pilbara Rock Monitor (*Varanus pilbarensis*).

Where small areas of micro-habitat (outcropping or exposed rock) was present it provided high quality resources for a diverse suite of fauna particularly reptiles and small mammals. This micro-habitat supports numerous saxicoline species such as Wooley's False Antechinus, Hamersley Range Dtella, Rock Ctenotus and Western Pilbara Spiny-tail Skink. The Western Pilbara Spiny-tail Skink is endemic to the region and solely thigmotactic. These environments provide refuge, breeding, feeding and disbursal for the species.

A large fire had occurred recently on the sand plain in the eastern portion of the survey area. This fire looks to have removed approximately half of the sandplain habitat available. The remaining habitat appeared to be a mosaic of previous burn scar ages and varying amounts of rain received.

4.1.3 Habitat scatter plot

The similarity between sites in terms of species assemblage is based on the GHD trapping data versus habitat was examined using PRIMER. The cluster analysis and resulting MDS (Chart 1) shows that according to the species recorded the sand plain, major drainage lines and Hillcrest/Hillslope sites demonstrate uniqueness in the species assemblages recorded and demonstrate isolating or clustering. The mulga woodlands species had similarities with the sand plain sites and therefore are loosely clumped and relatively similar to sand plain. The sand plain also demonstrated good species richness and uniqueness demonstrating its tight clustering. The 2D stress value of 0 indicates a good fit of data.

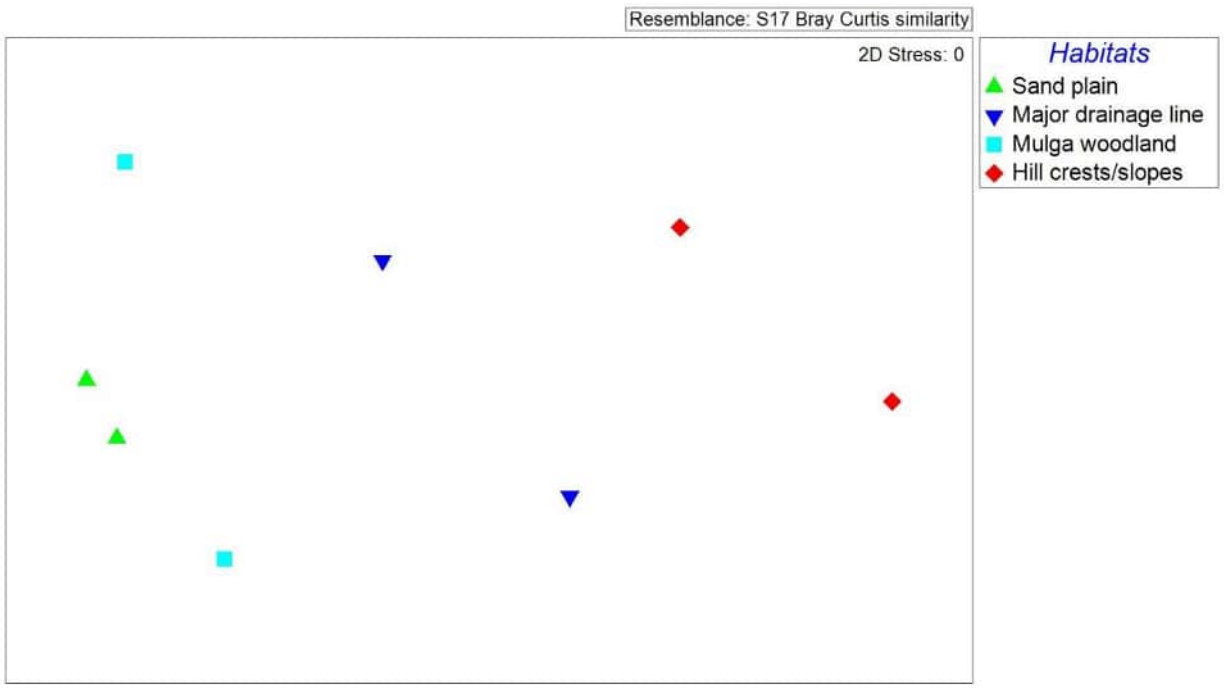

Chart 1 MDS of habitats based on species

Table 13 Major habitat types within the survey area

Description	Extent in the Survey area	Representative Images
Hillcrest/Hillslope **Low sparse shrubland of *Acacia* sp. *Senna* sp. and *Solanum lasiophyllum* over tussock grassland of *Triodia* sp.** Within the northern and western portion of the survey area is undulating low hills of Ironstone with areas of low rocky ridge line and associated rocky slopes. This habitat type supports limited vegetation (likely due to shallow soil profiles). However the environment supports scattered mixed shrubs of *Acacia*, *Senna* sp., *Eremophila* sp., *Solanum* and *grevillea* sp.. The environment had few ground covers, litter, logs or debris present. This is due to the lack of vegetative material and/or grazing from Cattle. There was no evidence of fire in this environment. The low rocky slopes are a mosaic of quartz and iron stone composition with scattered minor outcropping, crevasses, slopes, rock sizes and stability. No typical caves were recorded in outcropping but ground level undermined areas were recorded around some small breakaways. These appeared to be utilised by Euro (*Macropus robustus*), Echidna (*Trachyglossus aculeatus*), Woolleys's Pseudantechinus (*Pseudantechinus woolleyae*) and/or large monitor lizards. Due to the lack of cover and shallow soils (difficulty for species to dig and hide) few specimens were trapped in this environment. Locally and regionally an extensive habitat type occurring to the west and south throughout the Hamersley subregion. There is a minor representation of Breakaway within the northwest portion of approximately 18.3 ha total area (Figure 3). **Conservation significant fauna** Few fauna species were recorded in this environment however two species are known to persist. The rocky slopes and ridgeline would provide core habitat for the Long-tailed Dunnart (*Sminthopsis longicaudata*) (i.e. denning and population persistence) and Pilbara Pebble-mound mouse (*Pseudomys chapmani*) (i.e. denning and population persistence). Where the hill crest and hill slopes have out cropping or gullies the Gane's Blind Snake (*Anilios ganei*) and Pilbara Olive Python (*Liasis olivaceus barroni*) may likely persist. Ghost Bat (*Macroderma gigas*), Peregrine Falcon (*Falco peregrinus*) and Grey Falcon (*Falco hypoleucos*) may also utilise these areas for foraging.	2689.7 ha	 

Description	Extent in the Survey area	Representative Images
High value (High value in gullys and rock outcrops, moderate for low hills with no features)		
Major Drainage Line **Low open woodland of *Eucalyptus camaldulensis* over *Melaleuca* sp. and *Acacia coriacea* subsp. pendens over grassland of *Poaceae* sp.** Two major drainage lines ran through the survey area and consisted of Caramulla Creek and Jimblebar Creek. The drainage lines lie in the western and eastern portions of the survey area and generally run in a north south direction. Both drainage features were dry during the survey however Jimblebar Creek was receiving water discharge at the time of the survey and large pools were present just outside of the survey area. The creek and other small ephemeral creeks supports generally narrow, linear low open woodlands and was more structurally diverse than the surrounding habitats. The vegetation along these drainage lines is dominated by *Acacia* species with scattered mixed shrubs including *Eucalyptus camaldulensis,* with herbs and grassland. Buffel Grass was prominent along the creek banks. In areas this environment was densely vegetated particularly where associated to sandy soils, heavier soils had little vegetation. Areas had good litter and debris present including large branches and logs creating numerous usable habitat options for fauna species. The drainage lines have a mosaic of substrates with a complex and variable mix of rocky, stony and sandy profiles. The substrates would vary and erode in response to rainfall and flooding. There was no evidence of fire in this habitat type. These linear patches of habitat provide a corridor for the movement of fauna through the local landscape. Small birds (such as the Striated Pardalote (*Pardalotus striatus*) and honeyeaters) would utilise this denser vegetation for foraging, movement and nesting. Two species of frog the Water holding Frog (*Cyclorana platycephala*) and Sheep Frog (*Cyclorana maini*) were also recorded in this habitat. The water in Jimblebar Creek triggered Little red tree Frogs (*Littoria rubella*) and Pilbara Toadlet (*Uperoleia saxatalis*) to become active. The water bodys also attracted other water birds such as the Black Duck (*Anus supercilosa*) and Black Swan (*Cygnus atratus*). A localised habitat type, confined to linear areas. **Conservation significant fauna** The increased structural diversity and substrate variation in this environment is likely to support a broader suit of fauna species than the surrounding habitat types. Additionally these drainage lines would be utilised as dispersal corridors for species. The Short-tailed Mouse (*Leggadina*	574.8 ha	 Caramulla Creek  Jimblebar Creek

Description	Extent in the Survey area	Representative Images
lakedownensis), Pilbara Olive Python and Spectacled Hair Wallaby (*Lagorchestes conspicillatus leichardti*) may utilise the dense habitat features of the drainage lines while the Ghost Bat, Peregrine and Grey Falcon are likely to utilise these well vegetated corridors for hunting/foraging. **High Value**		
Minor Drainage Line **Shrublands of Mixed *Acacia* with *Hakea lorea, Cymbopogon ambiguus* over grassland of *Poaceae sp*. on heavy loam/clay soils** Numerous minor drainage lines ran through the survey area particularly where run off formed between hillcrests and slopes, which are ephemeral drainage lines that support generally narrow, linear shrublands and supportive grasses. The drainage lines support a more structurally diverse shrubland than the surrounding habitats. The vegetation along these drainage lines is dominated by *Acacia* species with scattered mixed shrubs including *Cymbopogon, Grevillea, Hakea* with *Triodia* and *Poaceae* sp. grassland. The drainage lines follow the gradient of the survey area, depending on the slope of the associated hills. The drainage lines have a mosaic of substrates with a complex and variable mix of rocky, stony and sandy profiles. The substrates would vary and erode in response to rainfall and flooding. No fire events were recorded in this habitat type and increased soil erosion was evident in several locations. These linear patches of habitat provide a corridor for the movement of fauna through the local landscape. Small birds (such as the Variegated Fairy-wren (*Malurus lamberti*) and White-winged Fairy-wren (*Malurus leucopteris*) that rarely move though open habitats would utilise this denser vegetation for foraging, movement and nesting. A moderately extensive habitat type habitat confined to linear areas. **Conservation significant fauna** The increased structural diversity and substrate variation in this environment is likely to support a broader suit of fauna species than the surrounding habitat types. Additionally these drainage lines are likely to be utilised as corridors for species. The Short-tailed Mouse and Spectacled Hair Wallaby may utilise the dense habitat features of the drainage lines while the Ghost Bat, Peregrine and Grey Falcon are likely utilise these well vegetated corridors for hunting/foraging.	84.1 ha	

Description	Extent in the Survey area	Representative Images
High Value		
Sand Plain **Isolated trees *Corymbia hamersleyana* over tall sparse shrubland *Senna* sp. and *Hakea lorea* over herbland of *Kennedia* sp. and tussock grassland of *Triodia* sp.** The sand plain is present in the eastern portion of the survey area. The vegetation consisted of mixed shrublands of *Acacia, Eremophila, Grevillia*, *Hakea* and scattered *Corymbia*. This habitat was diverse in structure and was evidently sculptured by moving waters. Some areas were deep sands while others loam. There were high points in the environment and areas where water ran or pooled. This habitat type would provide a variety of habitat resources for fauna species, and patches had a greater structural diversity (patches of shrubs) than the surrounding plain. The shrubs that occur on the plains amongst *Triodia* would also provide good habitat for cryptic, secretive species (such as Spectacled Hare Wallaby) given the cover provided. Approximately 50% of this habitat had been previously burnt with the remainder appearing to be a mosaic of previous fire scars. Where older fire scars are present the micro-habitats include leaf litter, floristic and structural diversity, fallen woody debris and scattered logs. Species only recorded in this habitat include the Central Military Dragon (*Ctenophorus isolepis*) and a number of skink species. Regionally an extensive habitat type occurring to the north in association with the Fortescue subregion. Locally extensive in the eastern Hamersley subregion, and very extensive to the east where it is associated with the Little Sandy Desert. **Conservation significant fauna** The Greater Bilby (*Macrotis lagotis*) was previously recorded in this habitat type via a burrow. The burrow was re visited this survey but had been taken over by a monitor species. The habitat type would be considered core habitat for the species. Additionally the Brush-tailed Mulgara (*Dasycercus blythi*) was recorded in this habitat type. The species was recorded via burrow (both old and active) and via prints. The Short-tailed Mouse and Spectacled Hair Wallaby may utilise the denser habitat features of the sand plain while the Peregrine and Grey Falcon would utilise these well vegetated corridors for hunting/foraging. **High Value**	2771.4 ha	 

Description	Extent in the Survey area	Representative Images
Mulga Woodland **Tall open shrubland of *Acacia aneura* and *Acacia* spp. over low shrubland of *Senna* sp. and *Chenopodiaceae* sp. over sparse hummock grassland of *Triodia* spp.** The Mulga Woodland comprised a relatively large area surrounding the Sandplain, Major drainage lines and Hillcrest/hillslopes habitats. The plain comprised loamy sands over a layer of heavy loam with an over storey dominated by hardy, shrub species. The dominant plant species was *Acacia aneura* which often was growing as sheet flow Mulga. Other species scattered throughout the habitat included *Eremophila*, *Atriplex, Hakea* with herbs and grasses. *Triodia* was dominant in areas however this was patchy. Where the Mulga Woodland intersected the Major Drainage line (and seasonal water features) grazing was most evident and mulga appeared to be dying and in decline. Bovine grazing (showing signs of heavy grazing, soil compaction and trampling) noticeably impacted the Mulga Woodland in these areas. There was no evidence of fire in this environment. A regionally very extensive habitat type occurring throughout the Hamersley subregion, wider Pilbara and adjacent bioregions. **Conservation significant fauna** Historically this habitat would have supported a large list of locally extinct species (Chuditch, Burrowing Bettong, Rufous Hair Wallaby). However due to feral species few can persist in this habitat (Burbidge 2004). The Peregrine and Grey Falcon would utilise this habitat for hunting/foraging. While Spectacle Hair wallaby and Greater Bilby may opportunistically utilise it for disbursal or foraging. **Moderate Value**	4002.1 ha	 

Description	Extent in the Survey area	Representative Images
Clay Pan **Shrublands of Mixed *Acacia* with *Cymbopogon ambiguus* and *Poaceae* sp. on loam/clay soils** Clay Pan comprised a very small portion of the survey area. The vegetation primarily comprises *Acacia* shrubs over native and introduced grasses. A large proportion of the *Acacia* shrublands has been previously disturbed by cattle grazing, resulting in large areas with very limited understorey or groundcover vegetation. There are also areas with little evidence of disturbance, which retain some structural diversity. The environment had areas of good ground covers, litter, logs or debris. There was no evidence of fire in this habitat. In areas where the shrubland is denser, this vegetation would provide suitable habitat for a variety of fauna species, in particular foraging opportunities, breeding habitat and refugia for bush birds and small mammals. Where the shrubland was more open, and on loamy soils, large termitaria were present. Termitaria provide habitat and food source for numerous small reptiles, mammals and birds Locally relatively limited and localised to small areas within Hamersley subregion. Regionally moderately extensive around Fortescue **Conservation significant fauna** Seasonally numerous species (opportunistic migratory bird species) may utilise this habitat particularly if water is maintained for prolonged periods. The Peregrine and Grey Falcon would utilise these well vegetated areas for hunting/foraging. **Moderate Value**	113.9 ha	
Stony Plain **Scattered Low Shrublands of *Acacia, Eremophila, Grevillia, Hakea* amongst *Triodia* on stony hard loam soils** Some small area of stony plain occur over the survey area and throughout the immediate surrounding area. The stony plain are usually associated with low vegetation types due to the shallow soils and comprise *Acacia, Eremophila, Grevillia* and *hakea* over hummock *Triodia* grassland. The environment had areas of good ground covers (*Triodia*), with little litter and debris and totally lacked logs due to the type vegetation present. Due to the lack of cover and hard soils limited fauna activity was observed. There was no evidence of fire in this habitat. No trap sites were established in this habitat type due to its small size relative to other habitat types. *Triodia* over cracks and scattered larger rocks would provide a majority of the habitat for reptiles and small mammals to hide. Locally and regionally moderately extensive habitat type	61.4 ha	

Description	Extent in the Survey area	Representative Images
occurring to the east and south, and very extensive to the west throughout the Hamersley subregion. **Conservation significant fauna** Due to the lack of micro habitat features few species would utilise this habitat. Saxicoline species such as Long-tailed Dunnart may utilise this habitat. Peregrine and Grey Falcon may also utilise these areas for foraging. **Moderate Value**		

4.2 Fauna diversity

The fauna surveys recorded 144 vertebrate fauna species utilising the survey area, including 28 mammals, 66 birds, 46 reptiles and four amphibians. A breakdown of the fauna assemblages for the survey results is provided below.

4.2.1 Mammals

The survey recorded 28 mammal species within the survey area, including four introduced and 24 native mammals. A breakdown of mammal families recorded during the surveys is provided in Table 14. The composition of native species includes 11 bats, four native rodents, two macropod, five small dasyurids, Echidna and Dingo.

The most specious family was the dasyurids (5 species), microchiropteran Vespertilion bats (4 species), emballonurids bats (4 species), murids (4 species), with macropods and Molossid bats each having two species. The remaining families were all singular. Fifty individual mammals (excluding bats as actual number cannot be determined from call data) were recorded over the trapping program from 10 species, with the most abundant being the Red Kangaroo and Spinifex hopping Mouse. Twenty-five Red Kangaroo were recorded (50% of total native mammal recordings) with seven Lesser Hairy-footed Dunnarts (14% of total native mammal recordings).

Bats were only recorded via echolocation, therefore only presence or absence information could be collected. Some species overlap in call identification and therefore may represent multiple species (such as in the *Nyctophilus* group).

Table 14 Mammal families recorded during the field surveys

Mammal Family	No. of species
Bovidae (Ruminants)	1
Camelidae (Camel)	1
Canidae (Dingo)	1
Dasyuridae (Dunnarts)	5
Emballonuridae (Sheath tailed Bats)	4
Equidae (Donkey)	1
Felidae (Cat)	1
Megadermatidae (Ghost Bat)	1
Molossidae (Freetail Bats)	2
Macropodidae (Kangaroos)	2
Muridae (Rodents)	4
Tachyglossidae (Echidna)	1
Vespertilionidae (Bats)	4
Total	**28**

4.2.2 Birds

The survey identified 66 bird species from 31 families. The most specious families were the Meliphagidae (8 species), Accipitridae (6 species) Acanthizidae (4 species), Falconidae (4 species) and Artamidae (4 species). Five hundred and twenty three individual birds were recorded over the trapping program. The most abundant species were the Zebra Finch with 53 records (10% of total bird recordings), Galah with 44 records (8.5% of total bird recordings) and Little Corella with 42 records (8% of total bird records). A breakdown of bird families recorded during the survey is provided in Table 15.

The Night Parrot (*Pezoporus occidentalis*) was specifically targeted for assessment in suspected habitat areas (Sand Plain and Mulga Woodland). The Sand plain within the survey area was relatively small with large areas burnt over the last wet season. The Mulga Woodland was targeted due to portions having good coverage of Spinifex present.

The results of the target Night Parrot survey are based on four Bird Acoustic Recorder SM4 units deployed in four locations during the survey period for a combined total of 16 nights of bioacoustic recordings. A total of 9795 acoustic detections were analysed for Night Parrot. No calls of Night Parrots were detected. Calls that were detected were identified from five non-target bird species including Horsefield's Bronze-Cuckoo, Black-eared Cuckoo, Owlet Nightjar, Galah, and Willie Wagtail. The call frequency range of these non-target species overlaps with Night Parrot calls, therefore it is highly likely that the detectors would have recorded Night Parrot calls if vocalisation had occurred.

Table 15 Bird families recorded during the field surveys

Bird Family	No. of species
Accanthizidae (Weebill/Gerygone)	4
Accipitridae (Diurnal birds of prey)	6
Aegothelidae (Owlet Nightjar)	1
Anatidae (Ducks)	2
Artamidae (Magpie group)	4
Cacatuidae (Cockatoo group)	2
Campephagidae (Cuckoo-shrikes)	2
Charadriidae (Plover)	1
Columbidae (Doves)	3
Corvidae (Crow)	1
Cuculidae (Cuckoos)	3
Dicaeidae (Mistletoebird)	1
Estrildidae (Finchs)	1
Eurostopodidae (Nightjar)	1
Falconidae (Falcons)	4
Halcyonidae (Kingfishers)	2
Maluridae (Wrens)	2
Megaluridae (Grassbirds)	1
Meliphagidae (Honeyeaters)	8
Meropidae (Bee-eater)	1
Monarchidae (Lark)	1
Motacillidae (Pipit)	1
Otididae (Bustard)	1
Pachycephalidae (Whistlers)	3
Pardalotidae (Pardalote)	2
Petroicidae (Robin)	2
Pomatostomidae (Babblers)	1
Psittacidae (Parrots)	2
Psophodidae (Quail Thrush)	1
Ptilonorhynchidae (Bowerbird)	1
Rhipiduridae (Fantail)	1
Total	**66**

4.2.3 Reptiles

A total of 46 reptile species were recorded during the field surveys from eight families. The most specious families were the Scincids (18 species), Diplodactylids (5 species), Agamids (4 species), Gekkonids (4 species), Pythonids (4 species) and Elapids (4 species). One hundred and fifty reptiles were recorded in the survey area over the trapping program. The most abundant species were Helen's skink with 25 records (17% of total reptile recordings), Leopard skink with 14 records (9.5% of total reptile recordings) and Northern Military Dragon with 13 records (9.4% of total reptile recordings). A breakdown of reptile families recorded during the survey is provided in Table 16.

Table 16 Reptile families recorded during the field surveys

Reptile Family	No. of species
Agamidae (Dragons)	4
Diplodactylidae (Geckos)	5
Elapidae (Snakes)	4
Gekkonidae (Geckos)	4
Pygopodidae (Legless Lizards)	3
Pythonidae (Pythons)	4
Scincidae (Skinks)	18
Varanidae (Monitors)	4
Total	**46**

4.2.4 Amphibians

Four amphibian species were recorded in the survey area (from trap site 3 and near to the Adit) during the surveys from two families, myobatrachidae and hylidae. Due to climatic conditions few were active with only three Water Holding Frogs (*Cyclorana platycephala*) and two Sheep Frogs (*Cyclorana maini*) showing sign of activity. Two additional species were randomly calling from habitat along Jimblebar Creek. The species were Little Red Tree Frog (*Litoria rubella*) and Pilbara Toadlet (*Uperoleia saxatalis*). A breakdown of amphibian families recorded during the survey is provided in Table 17.

Table 17 Amphibian families recorded during the field survey

Amphibian Family	No. of species
Hylidae (Tree Frogs)	3
Myobatrichidae (Ground Frogs)	1

4.2.5 Introduced species

Mammals comprised the only group in which introduced fauna were recorded. In total four species were observed;

- Cattle (*Bos taurus*)
- Donkey (*Equus asinus*)
- Cat (*Felis catus*)
- Camel (*Camelus dromedarius*).

The cattle are managed fauna by Sylvania station, while the remaining species are considered feral fauna species to the region.

4.2.6 Species accumulation curve

An accumulation curve was run for the data collected during the field survey within 8 models in Primer V6 (Chart 2). Chao1, Chao2, Jacknife1, Bootstrap, MM and Jacknife2 curves demonstrate poor fit to the data, while the remaining curve start to reach a curve asymptote (very few new species were recorded) after trap night 8. Model UGE demonstrated the best fit of data by the end of the survey. Chart 2 indicates that of the species active at the time of the survey most were sampled prior to the end of the project. The raw data from *NatureMap* of reptile, frogs and small mammals that could be present in the survey area based on habitats present is approximately 102. This study recorded approximately 40 species (actually trapped) less than half of those considered to potentially occur within the habitat available. This discrepancy demonstrates that the time of year or environmental factors (i.e. poor rainy season) may have impacted on the number of species recorded.

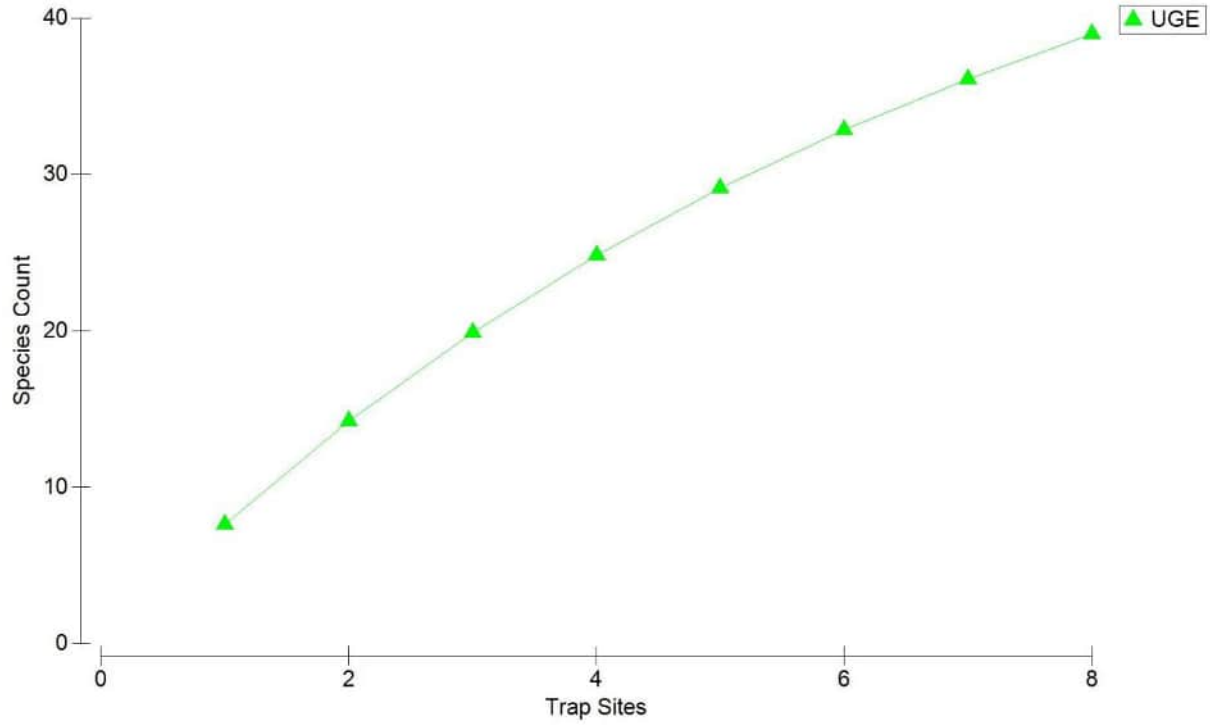

Chart 2 Accumulation curve of trap data combined

4.3 Conservation significant fauna

Four conservation significant fauna species were recorded within (or close to within) the survey area during the field survey, this included:

- Ghost Bat (*Macroderma gigas*) – listed under Vulnerable under the BC Act and Vulnerable under the EPBC Act
- Peregrine Falcon (*Falco peregrinus*) – listed as Other Special Protection under the BC Act
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – Listed as Priority 4 under DBCA fauna listings
- Brush-tailed Mulgara (*Dasycercus blythi*) – Listed as Priority 4 under DBCA fauna listings.

Likelihood of occurrence assessment

In addition to the field survey results, an assessment on the likelihood of conservation significant species occurring in the survey area was undertaken. This assessment is based on species' biology, habitat requirements, the quality and availability of suitable habitat as determined during the field survey and records of the species in the survey area and locality. Species-specific searches of the DBCA *NatureMap* database with a buffer of 40 km were also conducted in order to gather information about the broader regional occurrence of species to further inform the likelihood of occurrence assessment. Some species identified in the Protected Matters Search tool are not realistically considered to occur in the survey area or are not terrestrial vertebrate species and have been excluded from the assessment.

Excluding those recorded above an additional seven other species are likely to occur in the survey area. Table 18 summarises the species of conservation significance that are either known or considered likely to occur in the survey area. A brief description of these species and their associated habitat types within the survey area are described below. The parameters of assessment for this likelihood of occurrence assessment and the full likelihood of occurrence assessment are provided in Appendix D.

Table 18 Summary of likelihood of occurrence assessment for conservation significant fauna species deemed known or likely to occur

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Birds			
Peregrine Falcon (*Falco peregrinus*)	-	OS	**Known.** The species was recorded and is known from the region, however use would be opportunistic for all habitat types for foraging purposes only. No breeding habitat is present in the survey area.
Grey Falcon (*Falco hypoleucos*)		Vu	**Likely.** The species is known from the region. Closest record is approximately 85 km north east of the survey area. No specimens were recorded during the field survey, however the sand plain and Mulga woodland would provide habitat.
Mammals			
Ghost Bat (*Macroderma gigas*)	Vu	Vu	**Known.** A small amount of feeding evidence was recorded under an overhang in the survey area. A Ghost Bat was recorded active in the western portion of the site (Figure 4) during a previous survey (Ecologia 2006). Additionally a cave approximately 600 m south of the survey area had fresh scats present, suggesting up to five bats utilising the roost.
Western Pebble-mound Mouse (*Pseudomys chapmani*)		P4	**Known.** The species was recorded in the undulating low hills via their pebble mound structures. Mounds were assessed as both active and non-active.
Brush-tailed Mulgara (*Dasycercus blythi*)		P4	**Known.** The species was recorded and is known from the region, however is restricted to Sand Plain habitat in the eastern portion of the survey area.
Long-tailed dunnart (*Sminthopsis longicaudata*)	-	P4	**Likely.** The species is known from the region with records present east, west and north of the survey area. The closest record is approximately 6 km north of the survey area. No specimens were recorded during the field survey however Hillcrest/ Hillslope habitat would be considered suitable habitat.

Species	EPBC Act	BC Act/ DBCA	Assessment outcome
Spectacled Hare Wallaby (*Lagorchestes conspicillatus leichardti*)		P4	**Likely.** A very cryptic species. The species is known from the region.. The closest record is approximately 11 km south west of the survey area.No specimens were recorded during the field survey however some habitat is present within the Sand Plain habitat.
Greater Bilby (*Macrotis lagotis*)	Vu	Vu	**Likely.** A very cryptic species often with evidence recorded only (burrows, prints, digs or scats). The species is known from the region and was previously recorded on the Sand Plain with the detection of an inactive burrow within the eastern portion (Biologic 2018). However this burrow currently remains inactive with no sign of recent Bilby use. Due to the nomadic habits of this species, current presence or persistence within the survey area based on this disused burrow cannot be confirmed. Closest records include two historical NatureMap records from Jigalong approximately 40 km east of the survey area. No specimens or evidence recorded during the field survey however suitable habitat is present in the Sand Plain habitat, and there is connectivity with extensive suitable habitat to the north, east and south.
Northern Short-tailed Mouse (*Leggadina lakedownensis*)		P4	**Likely.** The species is known from the region with records present west and north of the survey area. No specimens were recorded during the field survey however suitable Sand Plain habitat is present.
Reptiles			
Pilbara Flat-headed Blind Snake (*Anilios ganei)*		P1	**Likely.** The species is known from the region with records present west of the survey area. No specimens were recorded during the field survey however some habitat is present in Hillcrest/ Hillslope habitat..
Pilbara Olive Python *(Liasis olivaceus barroni)*	Vu	Vu	**Likely.** The species is known from the region with records present west of the survey area. The closest record is approximately 15 km west of the survey area No specimens were recorded during the field survey however some habitat is present along major creek lines and undulating low hills. No standing rock pools were located within the survey area.

Key – (SP) = Other Special Protection under BC Act, (Vu) = Vulnerable under the EPBC Act and/ or BC Act, P1 = Priority 1 under DPaW, P4 = Priority 4 under DPaW. For breakdown of code meaning see Appendix B.

Fauna species recorded or formerly recorded in the survey area

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Special Protection under the Biodiversity Conservation Act.

The Peregrine Falcon is a large falcon species, which predominantly preys aerially on medium sized birds such as pigeon, Galah and ducks. The species prefers areas with deep gorges or large cliff faces with riparian or plain habitat surrounding. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of buildings in cities (Morcombe 2004). The Peregrine Falcon is wide ranging, mobile and aerial in nature, and therefore is likely to utilise all of the habitats within the survey area.

No large rocky cliff faces are present within the survey area, however habitat is available to the south (outside of the survey area) where this species was actually recorded (approximately 500

m to the south of the survey area). The species may utilise the survey area for foraging. There are no suitable nesting areas for this species present within the survey area.

Given the availability of suitable habitat in the local area and surrounding region, and that the Peregrine Falcon is a wide ranging and highly mobile species, the survey area is unlikely to be significant to the survival of the Peregrine Falcon at either the local or regional levels.

Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is listed Priority 4 under DBCA Priority fauna listing.

The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the species can be found on stony hills or hillsides with hummock grasslands. It constructs large mounds of pebbles on stony hills which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan, 2008). Additionally an active mound has pebbles that do not or are not settled, meaning that the mound is being worked and pebbles continuously manipulated.

Evidence of the species was recorded in 8 locations within the survey area (as shown below in Table 19 and in Figure 4, Appendix A). In total four active and four inactive mounds were recorded on the Hillcrest/Hillslope of low stony hills.

Western Pebble-mound Mouse mounds have previously been recorded within the survey are in 2005 (Ecologia 2006) and 2011 (ENV 2012) in the Hashimoto region. These locations are likely to still support active mounds but these areas were not re-assessed during this investigation. *NatureMap* records (DPaW, 2007) indicate that this species is widespread in the eastern Pilbara region. However this species is known to be sensitive to external impacts and populations are known to decline in areas where disturbance has occurred.

Table 19 Western Pebble-mound Mouse mounds recorded in the survey area

Mound	Lats.	Longs.	Habitat	Active/in active	Image
1	-23.355677	120.290053	Hillcrest/ Hillslope	Inactive	
2	-23.355767	120.287982	Hillcrest/ Hillslope	Inactive	

3	-23.356035	120.269407	Hillcrest/ Hillslope	Active	
4	-23.355774	120.290602	Hillcrest/ Hillslope	Active	
5	-23.355765	120.288203	Hillcrest/ Hillslope	Active	
6	-23.355877	120.268987	Hillcrest/ Hillslope	Inactive	
7	-23.356013	120.265289	Hillcrest/ Hillslope	Active	
8	-23.355676	120.268920	Hillcrest/ Hillslope	Recently Inactive, probably due to termite incusion	

Brush-tailed Mulgara (*Dasycercus blythi*)

The Brush-tailed Mulgara is listed Priority 4 under DBCA Priority fauna listing.

The Brush-tailed Mulgara is primarily nocturnal, shelters in burrows and feeds on insects, other arthropods and small vertebrates. This species inhabits spinifex grasslands and, in central Australia, lives in burrows that it digs on the flats (sand plain) or between or on low sand dunes (Van Dyck and Strahan 2008). The Mulgara is a solitary species exhibiting high site fidelity and a low propensity for dispersal once a home range has been established (Masters and Crowther 2003). Males and females maintain home ranges of 1.4 to 14 ha (Masters and Crowther 2003) which on average, overlap by less than 20% (Masters and Crowther 2003). The species is known to occur locally and has been recorded in East Jimblebar survey area previously (Biologic 2018) The Sand Plains habitat in the eastern portion of the survey area represents suitable and typical habitat for the species. There is a high degree of connectivity between this habitat and similar habitat beyond the survey area with extensive areas to the north, south and east.

During this survey the species was identified via prints and burrows both active and inactive. Due to the cryptic nature of burrows (burrows under *Triodia*) the species is likely to be present over the sand plain habitat. Table 20 below shows some of the evidence recorded and is also presented on Figure 4, Appendix 1.

Table 20 Brush-tailed Mulgara evidence recorded in the survey area

Evidence	Lats.	Longs.	Habitat	Active/in active	Image
Burrow	-23.372013	120.349545	Sand Plain	Inactive, old burrow trampled by cattle.	
Tracks	-23.370732	120.348203	Sand Plain	Active	No image
Burrow	-23.377454	120.324141	Sand Plain	Inactive	
Burrow	-23.377223	120.321382	Sand Plain	Inactive	No image
Burrow	-23.365107	120.393037	Sand Plain	Active, burrow in *Triodia* a number of used pop/ escape holes around *Triodia* rim.	

Ghost Bat (*Macroderma gigas*)

The Ghost Bat (*Macroderma gigas*) is listed as Vulnerable under the EPBC Act and under the BC Act.

The Ghost Bat occurs in a wide range of habitats (foraging), and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost (roosting and breeding). It is patchily distributed across Australia with an isolated population persisting in the Pilbara region, and is sensitive to disturbance (Van Dyck and Strahan 2008).

The Ghost Bat has been previously recorded in the survey area during spot lighting surveys (Ecologia 2006). One individual was visually recorded flying close to a major drainage line (Jimblebar Creek) presumably hunting. This location is mapped in Figure 4.

Of the areas searched there is limited landforms available to support large cave systems within the East Jimblebar survey area. Two locations were identified, along one associated ridgeline in the northern portion of the survey area and comprise an overhang identified as a feeding location and a potential cave that was unable to be assessed due to its location. Further details are presented below in Table 21.

The habitat present in this area consist of Hillcrest/ Hillslope in low hills and valleys with isolated breakaways on ridgelines. These areas potentially provide roost and feeding caves for this species. Figure 3 shows the locations of limited Breakaway within the study area. The surrounding hills are low with patches of ironstone outcropping. Very few instances of breakaway habitat is present in this area (Figure 3). The vegetation present is primarily shrublands over hummock grasslands and is mostly unburnt.

Studies undertaken on Ghost Bat foraging found that the species will move up to 2 km from a roost cave utilising large trees as vantage point to hunt (Churchill 1998). In the East Jimblebar area the only large trees are located along Jimblebar and Caramulla Creek or along the valleys with deep gullies. Typically the low hills do not have the vegetation structure to support the species foraging habits. Within the survey area suitable foraging habitat for Ghost Bats occurs as Major Drainage Line, Minor Drainage Line and Breakaway habitat.

Table 21 East Jimblebar Ghost Bat evidence

Cave and location	Ghost Bats present/ other evidence	Cave Type	Image	Comments
EJ 1 Longitude: 120.232005 Latitude: - 23.362824	No / Yes, potential feeding evidence	Overhang used as a feeding area.	 Old Budgie wings and remains	Partial feeding remains present of numerous small birds, mainly Budgies. Typical feeding locations have portions of birds or small mammals consisting of those parts less palatable while in the feeding process. In the image two wings and a portion of tail can be seen.

EJ 2 Longitude: 120.233219 Latitude: - 23.362467	Undetermined	Undetermined possible roost in rock face		Approx. 70 m from feeding overhang a potential cave in rock face which was not possible to be investigated safely.

The survey included assessment of an adit to the east of the survey area and cave (South Cave) south of the East Jimblebar survey area for Ghost Bat activity. The results for these assessment are as follows.

Adit

The adit is a constructed horizontal shaft (at approximately 2 metres high x 2.5 metres wide and at last 25 metres long) located approximately 20 metres west of the west of the Innawally Pool. A large pile of rubble has been placed at the entrance to presumably prevent access however a small oblong shaped (approximately 0.75 metres high x 1.5 metres wide) opening allows access for microchriopteran bats and other fauna. Upon entering the adit the humidity was obviously elevated compared to outside the adit and temperature maintained a consistent overnight 28-29 degrees Celsius for the survey period This temperature is within the range of suitability for Ghost Bat roost cave requirements based on literature (Armstrong and Anstee 2000)

Two nights of visual emergence assessment were undertaken (5 and 6 May) one using infrared night vision googles and other without. Three small birds were recorded utilising the adit on dusk of night one and none night two. First small micro bats started emerging at 17.45 and 17.48 respectively. In total 16 small bats and 6 medium to large bats were recorded on night one and 13 small and 15 large on night two. During these assessments bat recorders were used and identified six bats utilising the cave and surrounding habitat and include *T. georgianus, Vespadelus finlaysoni, Chalinolobus gouldii, Chaerophon jobensis, Scotorepens greyii* and *Austronomus australis*. The analysis of bat detectors data can be seen in Appendix E.

No Ghost Bats were recorded utilising the adit. This is consistent with previous studies undertaken on the adit.

South Cave

The South Cave area was investigated via visual inspection only. The cave is positioned high on a ridgeline in undulating hills and valleys. The vegetation present is sparse due to a recent fire, however the surrounding plain remains unburnt Mulga shrublands and plain. On approach to South Cave a smaller cave was located SC1 (see Table 22). This cave had no evidence of Ghost Bat present but due to its size, location, structure and microclimate characteristics could be considered a potential day roost location. South Cave (SC2) (see Table 22) is positioned approximately 30 meters east of SC1 and did show evidence of use, as seen in Table 22. A cat was also flushed from this cave.

Table 22 Ghost Bat evidence south of the survey area

Cave and location	Image	Ghost Bats present / other evidence	Cave Type and comments
SC1 Longitude: 120.202755 Latitude: - 23.407653	 	No / none	Potential day roost (occasional use) for Ghost Bat. Comments: Approx. 30 metres west of the previously identified roost cave. May occasionally support one or two Ghost Bat as diurnal roost. Ghost bat may occasionally use site for feeding.
SC2 (Previously identified roost cave) Longitude: 120.203006 Latitude: - 23.407849	 	No / Other evidence was recorded including one obvious Pile of Ghost Bat scat, including very old to recently fresh scat. 2 x *T. georgianus* recorded in main chamber	Day roost - potential breeding roost. Notable increase in temperature and humidity levels upon entering the main chamber of the cave. Comments: No Ghost Bats present but they may have retreated from the cave on approach. Given the large deposit of scats with recent and historical presence, hot and humid climate and structure of the cave it is likely

			that a small number of Ghost Bats (e.g. approx 5 individuals) regularly use the roost. This is based on the small number of fresh scats within the greater scat pile. Additional surveys required to determine potential for breeding roost.

Greater Bilby (*Macrotis lagotis*)

The Greater Bilby (*Macrotis lagotis*) is listed as Vulnerable under the EPBC Act and the BC Act.

The Greater Bilby's distribution in Western Australia is restricted to the north, including the southern Kimberley, Pilbara, Sandy and Gibson Deserts (Southgate 1990a). Extant population of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990b). Populations are known to move long distances when current habitat ranges become unsuitable and resources depleted. Bilbies are largely solitary, widely dispersed and found in low numbers.

The Greater Bilby was formerly identified as occurring in the survey area (Biologic 2018). The species was recorded via an old burrow on the sand plain habitat of the survey area. The burrow was revisited this survey and re assessed for use. The burrow was still present at the GPS location provided, however had eroded from previous images assessed (Table 23). No fresh or current activity was recorded in the burrow area. Additionally a camera was set on the burrow for 8 nights and did not record any Greater Bilby activity. The camera did identify a large Sand Goanna (*Varanus panoptes*) near the burrow. The burrow is positioned on a low sandy rise on the sand plain and has numerous other burrows and mounds (burrow spoil) present. It is likely that this area is an extinct Burrowing Bettong colony with residual burrow presence and with accumulated extensive mound of sand persisting. Greater Bilby, Goanna and rabbit (and other species) may utilise this area for sheltering and denning.

Fourteen Greater Bilby search plots were also assessed on the Sand plain and within Mulga Woodland. No evidence of Greater Bilby was recorded during these assessments. Greater Bilby are known from the region with records from 42 km north, 39 km east, 55 km south east and 58 km west (DPaW 2007). The Greater Bilby is a highly mobile species and is likely to be present within the survey area given the previously recorded burrow, the extensive suitable foraging and burrowing habitat, and the extent and connectivity of the Sand Plain habitat to the north and east of the survey area.

Table 23 Old Greater Bilby burrow in the survey area

Evidence	Lat.	Long.	Image	Comments
Old Burrow	-23.371319	120.379413	 	Burrow appeared long used by Greater Bilby. A sand Goanna was recorded on camera at the burrow and presumed to utilise it with tail drags present around burrow entrance.

Fauna species Likely to occur in the survey area

Grey Falcon (*Falco hypoleucos*)

The Grey Falcon inhabits lightly timbered country, especially stony plains and lightly timbered acacia scrub. This species is considered scarce to rare and is usually found singularly or sometimes in pairs (Morcombe 2004). In Northern Pilbara/Southern Kimberley WA, the Grey Falcon is very rare. The distribution of the Grey Falcon is typically centred on inland drainage systems, where it frequents timbered lowland plains, particularly acacia shrublands intersected by tree-lined watercourses to forage. It also hunts in treeless areas and frequents tussock grassland and open woodland, especially in winter, but it generally avoids deserts.

Grey Falcons are known from the region, all be it in low numbers. The closest and most recent recorded individuals was in 2001 approximately 85 km north and in 1996 approximately 120 km north east of the survey area. The habitat type in the survey area provide suitable foraging (Mulga Woodlands) and breeding habitat (Major Drainage Lines) for this species.

Long-tailed Dunnart (*Sminthopsis longicaudata*)

The Long-tailed Dunnart is listed as Priority 4 under DBCA priority fauna listing.

The Long-tailed Dunnart is a unique species of Dunnart as it's the only species which tail is double the length of its body with a terminal tuft (Menkhorst and Knight 2004). The longer tail enables the species to negotiate and move rapidly within rocky challenging environments. The species utilises rocky ranges, outcrops and breakaways environments within the Pilbara, Gascoyne, Murchison and northern Goldfields (Van Dyck et al. 2013). The records of the Long-tailed Dunnart come from widely scattered localities in the arid zone where it inhabits rugged, rocky areas including scree slopes, boulder and stony plateaus, and adjacent stony plains with shrubs over spinifex grasslands (Van Dyck et al. 2013). The scattered records are possibly an artefact of the environment which it utilises and difficulty in surveying these areas. However the species may be locally common at times and numerous records are represented from some localities. The species is known to feed on arthropods, including mainly beetles and ants, but also spiders, cockroaches, centipedes, grasshoppers, flies and various larvae (Van Dyck et al. 2013).

During the field survey no Long-tailed dunnarts were recorded however the species has been recorded in the region and general area, with the closest record 6 km north of the eastern portion of the survey area in 2006. Two animals were recorded at this location. Hillcrests/ Hillslopes habitat within the survey area is suitable habitat.

Spectacled Hare Wallaby (*Lagorchestes conspicillatus leichardti*)

The Spectacled Hare Wallaby (*Lagorchestes conspicillatus leichardti*) is listed as Priority 4 under DBCA priority fauna listing.

The Spectacled hare-wallaby inhabits *Triodia* hummock grasslands and Acacia Shrublands in northern Australia (Menkhorst and Knight 2004). The species is often cryptic within their habitat and often over looked during assessment. Very little is known about the species in the Pilbara region.

During the field survey no Spectacled Hare Wallaby were recorded however this species has been recorded historically in the area and surrounding region with the closest record 11 km south west of the survey area (no date provided). Sand Plains and Mulga Woodlands are suitable habitat within the survey area.

Northern Short-tailed Mouse (*Leggadina lakedownensis*)

The Northern Short-tailed Mouse (*Leggadina lakedownensis*) is listed as Priority 4 under DBCA priority fauna listing.

The Northern Short-tailed Mouse occupies a diverse range of habitats from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, tropical *Eucalyptus* and *Melaleuca* woodlands and stony ranges (Menkhorst and Knight 2004). Most habitats, however, are seasonally inundated on red or white sandy-clay soils (Kutt and Kemp 2006) . This species is a boom/bust species in that during good time can experience rapid population growth and then decline to almost undetectable number during harsher conditions.

During the field survey no Northern Short-tailed Mouse were recorded however the species has previously been recorded in the region with several records approximately 79 km north of the survey area. The records are from the Fortescue Marsh area and all from 2004. Sand Plains and Mulga Woodlands are suitable habitat within the survey area and with good connectivity for dispersal within adjacent similar habitat.

Pilbara Flat-headed Blind Snake (*Anilios ganei*)

The Pilbara Flat-headed Blind Snake (*Anilios ganei*) is listed as Priority 1 under DBCA priority fauna listing.

The Pilbara Flat-headed Blind Snake is an endemic species to the Pilbara found only between Newman and Pannawonica. The species is moderately robust with greyish/ brown above and cream below. An irregular junction is present between the darker lateral and paler underside areas (Wilson & Swan 2017). This species has a cryptic fossorial habit and is rarely encountered during surveys. Little is known of the species' ecology but like most other blind snakes, it is insectivorous, feeding on termites and their eggs, and larvae and pupae of ants (Wilson & Swan 2017). This species of blind snake is known from widely separated areas. The habitat preferences of this species are not well understood however it appears to be mostly associated with moist gorges and gullies, and other rocky or stony habitats (Wilson and Swan, 2017).

During the field survey no Pilbara Flat-headed Blind Snake were recorded however the species has previously been recorded in the region with one record approximately 17 km north west of the survey area. It has also been recorded within alluvial plain habitats at Jimblebar, 15 Km

west of the survey area (Outback Ecology Services 2009b). Within the survey area, Hillcrests/ Hillslopes and Major Drainage Lines are considered suitable habitat.

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python (*Liasis olivaceus barroni*) is listed as Vulnerable under the EPBC Act and the BC Act.

The Pilbara Olive Python's range is restricted to the Pilbara region, north Western Australia, and the Dampier Archipelago. Habitat consists of rocky escarpments, gorges and waterholes. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps, railway embankments and sewerage treatment ponds. The species breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2017).

During the field survey no Pilbara Olive Python were recorded however the species has previously been recorded in the region with one record approximately 15 km west of the survey area. The rocky ridgeline habitats and drainage lines (and associated riparian vegetation) in the area around and within the survey area are core habitat for this species.

4.4 Fauna survey limitations

Guidance Statement No. 56 (EPA 2004) states that fauna and faunal assemblage survey reports for environmental impact assessment in Western Australia should contain a section describing the limitations of the survey methods used. The limitations and constraints associated with the fauna component of this field survey are discussed in Table 24.

Table 24 Fauna survey limitations

Limitations	Constraints	Impact on Survey outcomes
Scope (what faunal groups were sampled? and were some sampling methods not able to be employed because of constraints such as weather conditions?, e.g. pitfall trapping in waterlogged soils or inability to use pitfall traps because of rocky terrain)	Minimal	All fauna groups were able to be sampled however in rocky areas that were unable to be dug pit traps were substituted with funnels. This was only done for 2 to 3 lines per site which meant bucket and pipes were able to be installed in the remaining 7 or 8 trap locations. A cool period was experienced on night six, which reduced captures at some of the trapping lines. The survey was extended from 7 to 9 nights (at some sites) of trapping to alleviate any impacts weather conditions had on results.
Seasonal environmental conditions	Moderate	The Pilbara and this survey area in 2018/2019 summer period had below average rainfall in the region. Typically the Newman area averages 329 mm per year however Newman over this period only received 103 mm. This was reflective on the ground with limited fauna activity recorded. Due to reduced captures in traps additional active search and remote camera deployment was undertaken.
Proportion of fauna identified, recorded and/or collected	Nil	All fauna was identified and released on site.
Proportion of the task achieved and further work which might be needed.	Minimal	The Level 2 survey was successful and did identify the key conservation significant fauna species as being present. The Greater Bilby is a highly nomadic species that can appear and disappear as resource become available or depleted. Additional work would be required over the sand plain if this area was to be disturbed.
Remoteness and/or access problems	Minor	There were no issues with remoteness as the survey area is located within a pastoral and mining lease area. Most areas of the survey area were able to be accessed during the surveys. Approximately 50% of the sand plain had recently been burnt reducing potential trap location sites. However due to the remainder of habitat available the constraint had minor effect.

5. Discussion and Conclusion

In total seven broad fauna habitat types (excluding disturbed areas) were recorded in the survey area during the field survey. These different habitat types are closely aligned with the different vegetation types and landforms within the survey area. The habitat include Major Drainage lines, Hillcrest/ Hillslope, Sand Plain, Mulga Woodland, Minor Drainage lines, Stony Plain and Claypan. Some disturbed areas are also present.

The fauna survey recorded 144 vertebrate fauna species utilising the survey area, including 28 mammals, 66 birds, 46 reptiles and four amphibians. Of these four species were introduced including the Feral Cat, Camel, Donkey and Cattle. The Cattle are managed under pastoral lease.

Four species of conservation significance were recorded during the survey and included the Ghost Bat, Brush-tailed Mulgara, Western Pebble-mound Mouse and Peregrine Falcon.

Ghost Bat was recorded within the survey area via one location of old feeding evidence within a rocky overhang. Whilst the East Jimblebar survey area provides foraging and potentially some day roost habitat, the survey area has a paucity of bisected rocky areas, therefore the landform characteristics within the survey area are not conducive to formation of suitable maternity caves for Ghost Bats. Hillcrest/ Hillslope in low hills and valleys with isolated breakaways on ridgelines represent limited areas of potential roost cave and feeding cave habitat. Major and Minor Drainage Lines represent potential foraging habitat due to the presence of trees.

The sand plain habitat has been previously identified as known Mulgara habitat, and potential Greater Bilby habitat. This survey identified both active and inactive Mulgara burrows as well as recent tracks on the sand plain. No Greater Bilby evidence was recorded in the survey area despite the previously recorded burrow being re visited and 14 evidence based Greater Bilby assessment plots conducted. Due to the size of the sandplain available any future disturbance of this habitat may require a pre-clearance surveys specifically for Mulgara and Greater Bilby.

The Western Pebble-mound Mouse was recorded via active and inactive pebble mounds on Hillcrest/ Hillslope habitat in the survey area. This species has been recorded in the survey area previously and is patchily distributed through the rocky substrate habitats (often on the hill crest or slope areas) within the survey area. The Western Pebble-mound Mouse is highly susceptible to disturbance and is known to disappear from areas impacted.

The survey detected several previously un-recorded cryptic reptile species including Woma (*Aspidites ramsayi*) and Legless Lizard (*Delma butleri*). Other unrecorded species included the Purple Dtella (*Gehyra purpurascens*) which can be confused with other species and persist only in the major drainage lines on large *Eucalyptus camaldulensis*. The detection of these species is largely due to survey effort, particularly foraging (hand searching) methods employed in desired habitats.

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Appendices

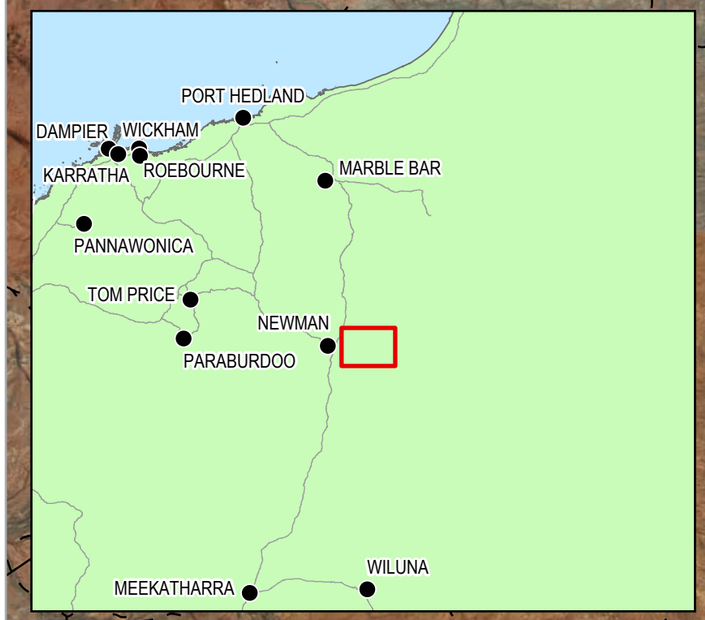
Appendix A – Map Figures

Marble Bar Rd

Jigalong Mission Rd

Legend

- Adit and South Cave
- Road
- Track
- Study Area



Paper Size ISO A3

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Kilometres

Map Projection: Transverse Mercator
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Grid: GDA 1994 MGA Zone 51

N

GHD

BHP
East Jimblebar Fauna Survey

Project Location

Project No. **61-38152**
Revision No. **0**
Date **19/08/2019**

FIGURE 1

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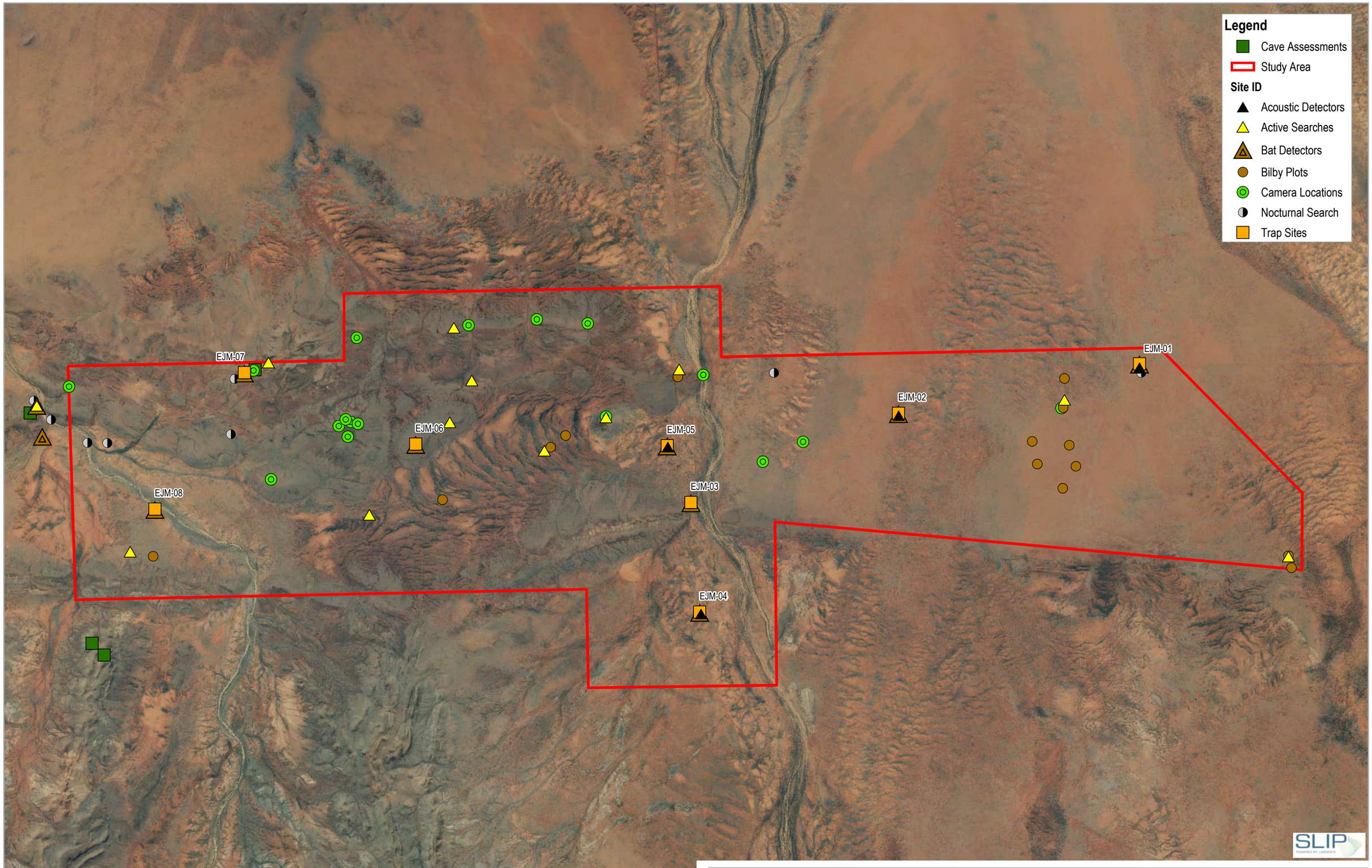

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Kilometres

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East Jimblebar Fauna Survey

Survey Methods

Project No. **61-38152**
Revision No. **0**
Date **19/08/2019**

FIGURE 2

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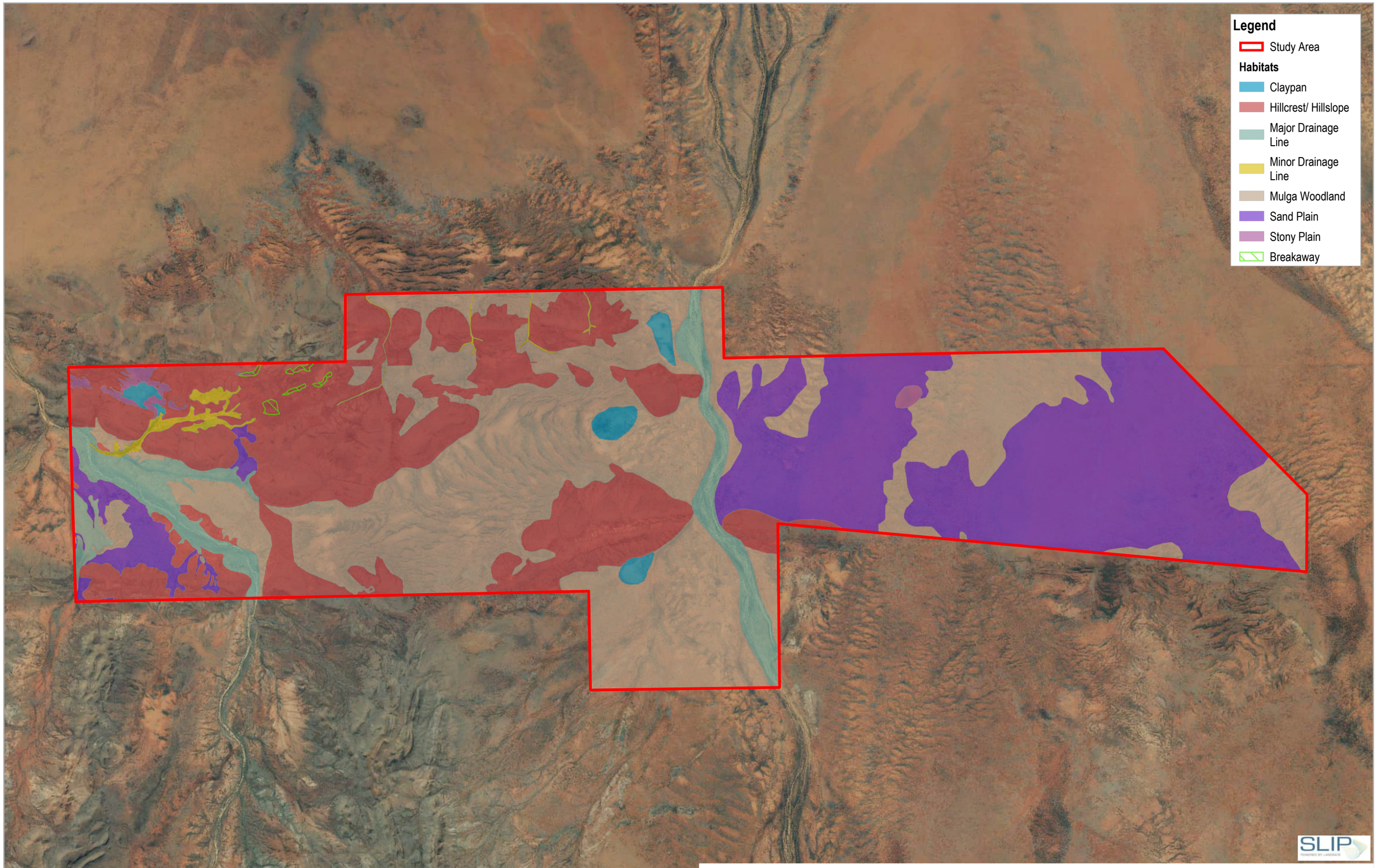

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Kilometres

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East Jimblebar Fauna Survey

Fauna Habitats

Project No. **61-38152**
Revision No. **0**
Date **19/08/2019**

FIGURE 3

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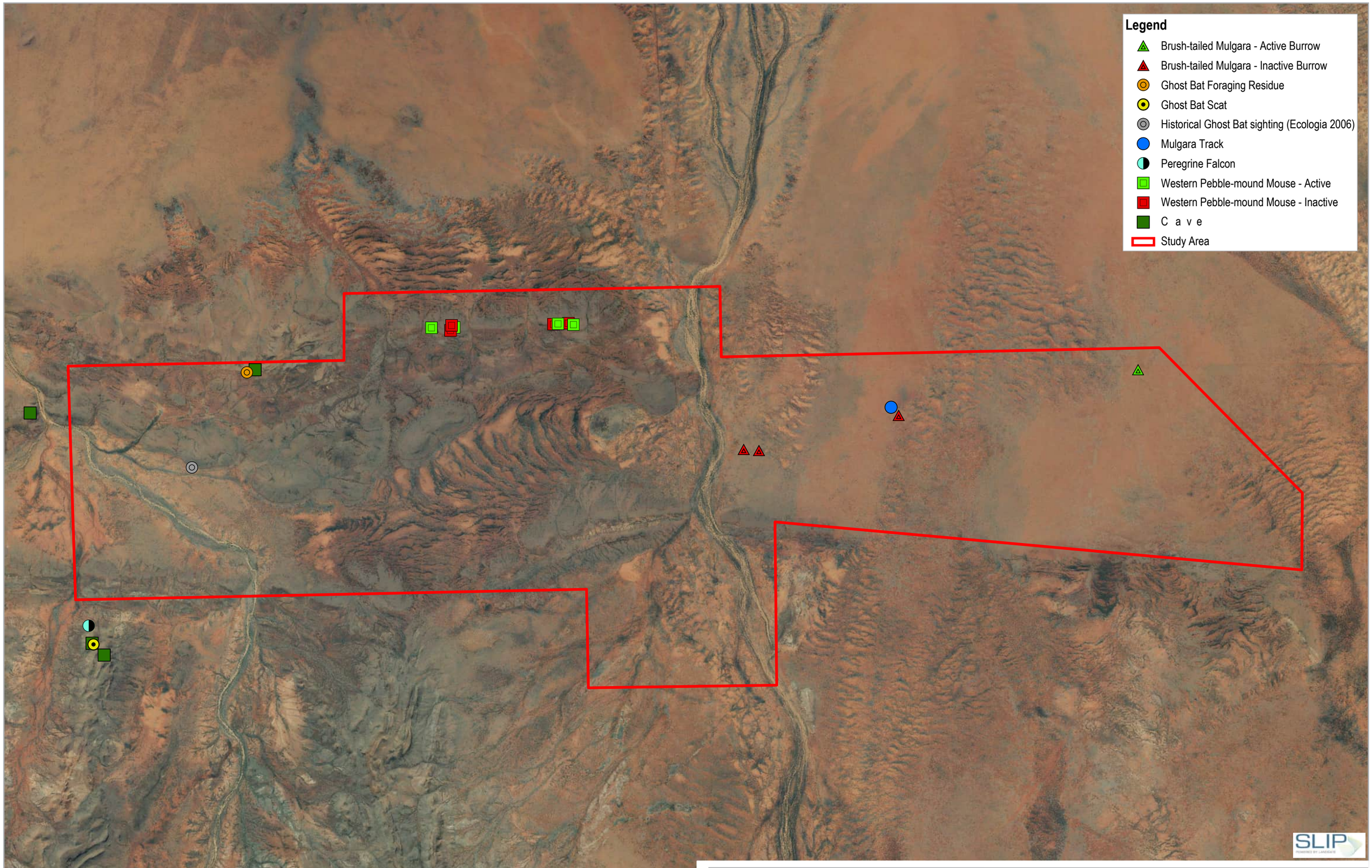

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Kilometres

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N

GHD

BHP
East Jimblebar Fauna Survey

Fauna Results

Project No. **61-38152**
Revision No. **0**
Date **19/08/2019**

FIGURE 4

G:\61\38152\GIS\Maps\Working\Working\Working.aprx\Figure 4 - Fauna Results
Print date: 19 Aug 2019 - 16:01

Data source: GHD: Fauna Results - 20190404, Study Area - 20190627; Imagery - August 2013. Created by: bmorgan

Appendix B – Relevant legislation, background information and conservation codes

Relevant legislation to Fauna

Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities
- Migratory species

A person must not undertake an action that has, will have, or is likely to have a significant impact (direct or indirect) on MNES, without approval from the Federal Minister for the Environment.

The EPBC Act is administered by the Department of the Environment and Energy (DEE).

State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. The Act allows the Environmental Protection Authority (EPA), to prevent, control and abate pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing. Part IV of the EP Act is administered by the EPA and makes provisions for the EPA to undertake environmental impact assessment of significant proposals, strategic proposals and land use planning schemes.

The Department of Water and Environment Regulation (DWER) is responsible for administering the clearing provisions of the EP Act (Part V). Clearing of native vegetation in Western Australia requires a permit from the DWER, unless exemptions apply. Applications for clearing permits are assessed by the Department and decisions are made to grant or refuse the application in accordance with the Act. When making a decision the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a) Native vegetation should not be cleared if it comprises a high level of biodiversity.

b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c) Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d) Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

Exemptions for clearing include clearing that is a requirement of a written law or authorised under certain statutory processes (listed in Schedule 6 of the EP Act) and exemptions for prescribed low impact day-to-day activities (prescribed in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004); these exemptions do not apply in environmentally sensitive areas (ESAs).

State *Biodiversity and Conservation Act 2016*

The *Biodiversity Conservation Act 2016* (BC Act) provides for the conservation and protection of biodiversity and biodiversity components, as well as the promotion of the ecologically sustainable use of biodiversity components in Western Australia. The BC Act replaces both the repealed *Wildlife Conservation Act 1950* (WC Act) and the *Sandalwood Act 1929* (Sandalwood Act), as well as their associated regulations. To attain the objectives of the BC Act, principles of ecological sustainable development have been established:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
- The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
- The conservation of biodiversity and ecological integrity should be a fundamental consideration indecision-making
- Improved valuation, pricing and incentive mechanisms should be promoted.

The BC Act is administered by the Department of Biodiversity Conservation and Attractions (DBCA).

State *Biosecurity and Agriculture Management Act 2007*

The *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations are administered by the Department of Primary Industries and Regional Development (DPIRD) and replace the repealed *Agriculture and Related Resources Protection Act 1976.* The main purposes of the BAM Act and its regulations are to:

- Prevent new animal and plant pests (vermin and weeds) and diseases from entering WA
- Manage the impact and spread of those pests already present in the state
- Safely manage the use of agricultural and veterinary chemicals
- Increased control over the sale of agricultural products that contain violative chemical residues.

The Western Australian Organism List (WAOL) provides the status of organisms which have been categorised under the BAM Act. A Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) of the Act is in force. Declared Pests may be assigned a control category including: C1 (exclusion), C2 (eradication) and C3 (management). The category may apply to the whole of the State, LGAs, districts, individual properties or even paddocks, and all landholders are obliged to comply with the specific category of control. Categories of control are defined below.

DPIRD Categories for Declared Pests under the BAM Act

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

Fauna Conservation codes

Conservation significant fauna

The Federal conservation level of fauna species and their significance status is assessed under the EPBC Act. The significance levels for fauna used in the EPBC Act align with the International Union for Conservation of Nature (IUCN) Red List criteria, which are internationally recognised as providing best practice for assigning the conservation status of species. The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

The State conservation level of fauna species and their significance status also follows the IUCN Red List criteria. Under the BC Act fauna can be listed as Threatened, Extinct and as Specially Protected species.

Threatened species are those are species which have been adequately searched for and are deemed to be, in the wild, either rare, under identifiable threat of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of Threatened species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria. Specially protected species meet one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection. Species that are listed as Threatened or Extinct species under the BC Act cannot also be listed as Specially Protected species.

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna List under Priorities 1, 2 or 3. These three categories are ranked in order

of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

For the purposes of this assessment, all species listed under the EPBC Act, BC Act and DBCA Priority species are considered conservation significant.

Conservation categories and definitions for EPBC Act and BC Act listed fauna species

Conservation category	Definition
Threatened species	
Critically Endangered (CR)	Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
Endangered (EN)	Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines
Vulnerable (VU)	Threatened species considered to be "facing a high risk of extinction in the wild in the medium term future, as determined in accordance with criteria set out in the ministerial guidelines". Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.
Extinct species	
Extinct (EX)	Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
Extinct in the Wild (EW)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form", and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).
Specially protected species	

Conservation category	Definition
Migratory (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species
Species of special conservation interest (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 fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Conservation codes for DBCA listed Priority fauna

Priority category	Definition
Priority 1	Poorly-known taxa Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2	Poorly-known taxa Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3	Poorly-known taxa Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority category	Definition
Priority 4	Rare, Near Threatened and other taxa in need of monitoring A. Rare: Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. B. Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. C. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

Other significant fauna

Fauna species may be significant for a range of reasons other than those protected by international agreement or treaty, Specially Protected or Priority Fauna. Significant fauna may include short-range endemic species, species that have declining populations or declining distributions, species at the extremes of their range, or isolated outlying populations, or species which may be undescribed (EPA 2010).

References

ANZECC 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

EPA 2010, *Technical Guide – Terrestrial Fauna Surveys*, EPA, Perth, WA.

Appendix C – Desktop searches

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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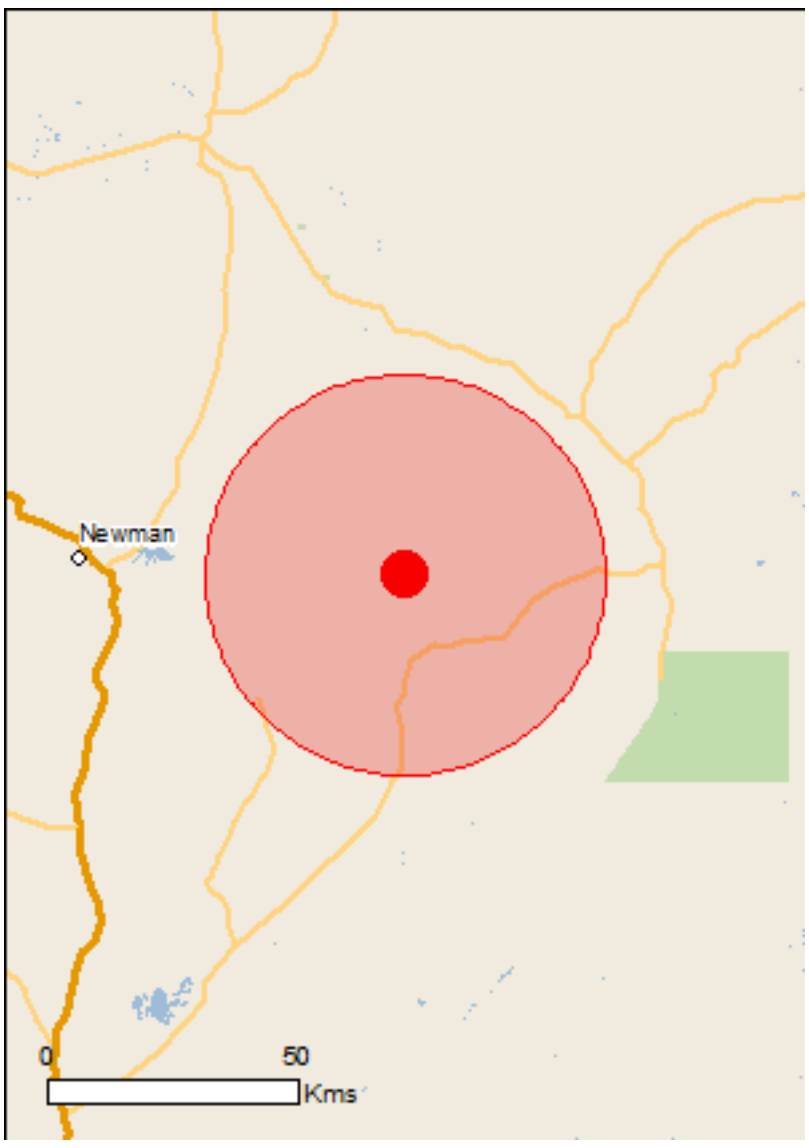
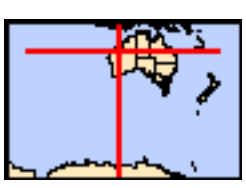


This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 40.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	9
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis		
Night Parrot [59350]	Endangered	Species or species habitat likely to occur within area
Polytelis alexandrae		
Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus		
Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Plants		
Pityrodia augustensis		
Mt Augustus Foxglove [4962]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Liasis olivaceus barroni		
Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		

Name	Threatened	Type of Presence
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area

Extra Information

Invasive Species	[Resource Information]

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

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

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

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

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

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

Coordinates

-23.38333 120.31667

Acknowledgements

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

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 07/06/2019

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	120° 19' 00" E,23° 23' 00" S
Buffer	40km
Group By	Species Group

Species Group	Species	Records
Amphibian	6	88
Bird	114	3156
Invertebrate	192	773
Mammal	32	329
Reptile	92	1139
TOTAL	**436**	**5485**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Amphibian					
1.	25375	*Cyclorana maini (Sheep Frog)*			
2.	25376	*Cyclorana platycephala (Water-holding Frog)*			
3.	25392	*Litoria rubella (Little Red Tree Frog)*			
4.	25430	*Notaden nichollsi (Desert Spadefoot)*			
5.	42306	*Platyplectrum spenceri (Centralian Burrowing Frog)*			
6.	41428	*Uperoleia saxatilis (Pilbara Toadlet)*			
Bird					
7.	24559	*Acanthagenys rufogularis (Spiny-cheeked Honeyeater)*			
8.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
9.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
10.	24264	*Acanthiza robustirostris (Slaty-backed Thornbill)*			
11.	24265	*Acanthiza uropygialis (Chestnut-rumped Thornbill)*			
12.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
13.	25536	*Accipiter fasciatus (Brown Goshawk)*			
14.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
15.	25544	*Aegotheles cristatus (Australian Owlet-nightjar)*			
16.	25647	*Amytornis striatus (Striated Grasswren)*			
17.	24540	*Amytornis striatus subsp. whitei (Rufous Grasswren)*			
18.	25670	*Anthus australis (Australian Pipit)*			
19.	24599	*Anthus australis subsp. australis (Australian Pipit)*			
20.	25528	*Aphelocephala leucopsis (Southern Whiteface)*			
21.	24268	*Aphelocephala nigricincta (Banded Whiteface)*			
22.	24285	*Aquila audax (Wedge-tailed Eagle)*			
23.	24340	*Ardea novaehollandiae (White-faced Heron)*			
24.	24341	*Ardea pacifica (White-necked Heron)*			
25.	24610	*Ardeotis australis (Australian Bustard)*			
26.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
27.	24355	*Artamus minor (Little Woodswallow)*			
28.	24356	*Artamus personatus (Masked Woodswallow)*			
29.		*Barnardius zonarius*			
30.	24359	*Burhinus grallarius (Bush Stone-curlew)*			
31.	25715	*Cacatua roseicapilla (Galah)*			
32.	24725	*Cacatua roseicapilla subsp. assimilis (Galah)*			
33.	25716	*Cacatua sanguinea (Little Corella)*			
34.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
35.	24564	*Certhionyx variegatus (Pied Honeyeater)*			
36.	47909	*Cheramoeca leucosterna (White-backed Swallow)*			
37.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
38.	24434	*Chrysococcyx osculans (Black-eared Cuckoo)*			
39.	25580	*Cinclosoma castaneothorax (Chestnut-breasted Quail-thrush)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
40.	24289	*Circus assimilis (Spotted Harrier)*			
41.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
42.	24613	*Colluricincla harmonica subsp. rufiventris (Grey Shrike-thrush)*			
43.	24361	*Coracina maxima (Ground Cuckoo-shrike)*			
44.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
45.	24416	*Corvus bennetti (Little Crow)*			
46.	25593	*Corvus orru (Torresian Crow)*			
47.	24671	*Coturnix pectoralis (Stubble Quail)*			
48.	24420	*Cracticus nigrogularis (Pied Butcherbird)*			
49.	25595	*Cracticus tibicen (Australian Magpie)*			
50.	25596	*Cracticus torquatus (Grey Butcherbird)*			
51.	25547	*Dacelo leachii (Blue-winged Kookaburra)*			
52.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
53.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
54.	24470	*Dromaius novaehollandiae (Emu)*			
55.		*Elanus axillaris*			
56.	25540	*Elanus caeruleus (Black-shouldered Kite)*			
57.	47937	*Elseyornis melanops (Black-fronted Dotterel)*			
58.	24631	*Emblema pictum (Painted Finch)*			
59.		*Eolophus roseicapillus*			
60.	24570	*Epthianura tricolor (Crimson Chat)*			
61.	24837	*Eremiornis carteri (Spinifex-bird)*			
62.	24368	*Eurostopodus argus (Spotted Nightjar)*			
63.	25621	*Falco berigora (Brown Falcon)*			
64.	25622	*Falco cenchroides (Australian Kestrel, Nankeen Kestrel)*			
65.	25623	*Falco longipennis (Australian Hobby)*			
66.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
67.	42314	*Gavicalis virescens (Singing Honeyeater)*			
68.	24401	*Geopelia cuneata (Diamond Dove)*			
69.	25585	*Geopelia striata (Zebra Dove)*			
70.	24404	*Geophaps plumifera (Spinifex Pigeon)*			
71.	25530	*Gerygone fusca (Western Gerygone)*			
72.	24443	*Grallina cyanoleuca (Magpie-lark)*			
73.	24295	*Haliastur sphenurus (Whistling Kite)*			
74.	24297	*Hamirostra melanosternon (Black-breasted Buzzard)*			
75.	47965	*Hieraaetus morphnoides (Little Eagle)*			
76.	24572	*Lacustroica whitei (Grey Honeyeater)*			
77.	24367	*Lalage tricolor (White-winged Triller)*			
78.	25661	*Lichmera indistincta (Brown Honeyeater)*			
79.		*Lophoictinia isura*			
80.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
81.	25652	*Malurus leucopterus (White-winged Fairy-wren)*			
82.	25654	*Malurus splendens (Splendid Fairy-wren)*			
83.	24583	*Manorina flavigula (Yellow-throated Miner)*			
84.	47997	*Melanodryas cucullata (Hooded Robin)*			
85.	24736	*Melopsittacus undulatus (Budgerigar)*			
86.	24598	*Merops ornatus (Rainbow Bee-eater)*			
87.	25542	*Milvus migrans (Black Kite)*			
88.	25545	*Mirafra javanica (Horsfield's Bushlark, Singing Bushlark)*			
89.	24737	*Neophema bourkii (Bourke's Parrot)*			
90.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
91.	24742	*Nymphicus hollandicus (Cockatiel)*			
92.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
93.	24618	*Oreoica gutturalis (Crested Bellbird)*			
94.	34012	*Oreoica gutturalis subsp. pallescens (Crested Bellbird, central)*			
95.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
96.	24627	*Pardalotus rubricatus (Red-browed Pardalote)*			
97.	25682	*Pardalotus striatus (Striated Pardalote)*			
98.	48060	*Petrochelidon ariel (Fairy Martin)*			
99.	24659	*Petroica goodenovii (Red-capped Robin)*			
100.	24409	*Phaps chalcoptera (Common Bronzewing)*			
101.	25721	*Platycercus zonarius (Australian Ringneck, Ring-necked Parrot)*			
102.	24751	*Platycercus zonarius subsp. zonarius (Port Lincoln Parrot)*			
103.	25703	*Podargus strigoides (Tawny Frogmouth)*			
104.	25706	*Pomatostomus temporalis (Grey-crowned Babbler)*			
105.		*Ptilonorhynchus guttatus*			
106.	25724	*Ptilonorhynchus maculatus (Spotted Bowerbird)*			
107.	24757	*Ptilonorhynchus maculatus subsp. guttatus (Western Bowerbird)*			
108.	42323	*Ptilotula keartlandi (Grey-headed Honeyeater)*			
109.	24278	*Pyrrholaemus brunneus (Redthroat)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
110.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
111.	30948	*Smicrornis brevirostris (Weebill)*			
112.	25656	*Stipiturus ruficeps (Rufous-crowned Emu-wren)*			
113.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
114.	30870	*Taeniopygia guttata (Zebra Finch)*			
115.	42351	*Todiramphus pyrrhopygius (Red-backed Kingfisher)*			
116.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
117.	48141	*Tribonyx ventralis (Black-tailed Native-hen)*			
118.	24851	*Turnix velox (Little Button-quail)*			
119.	25762	*Tyto alba (Barn Owl)*			
120.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			

Invertebrate

121.		*Acariformes sp.*			
122.		*Adelotopus laevis*			
123.		*Aeolosoma sp. 2 (PSS)*			
124.		*Agraptocorixa parvipunctata*			
125.		*Allodessus bistrigatus*			
126.		*Alona cf. verrucosa*			
127.		*Amphipoda sp.*			
128.		*Aname aragog*			Y
129.		*Aname mellosa*			
130.		*Anisops hackeri*			
131.		*Anopheles annulipes s.l.*			
132.		*Arcella sp.*			
133.		*Areacandona 'scanlonii' (PSS)*			
134.		*Areacandona sp.*			
135.		*Argiope protensa*			
136.		*Asadipus yundamindra*			
137.		*Asplanchna sieboldi*			
138.		*Australobolbus pseudobscurius*			
139.		*Australutica sp.1*			
140.		*Austroepigomphus (Xerogomphus) gordoni*			
141.		*Austrolestes analis*			
142.		*Bdelloidea sp. 2:2*			
143.		*Bennelongia barangaroo lineage*			
144.		*Bennelongia nimala*			
145.		*Berosus dallasae*			
146.		*Bezzia sp. P4 (PSW) (=Ceratopogon?)*			
147.		*Blackburnium neocavicolle*			
148.		*Boeckella triarticulata*			
149.		*Bolboleaus truncatus*			
150.		*Bolborhachium inclinatum*			
151.		*Bosmina meridionalis*			
152.		*Brachionus angularis*			
153.		*Brachionus dichotomus*			
154.		*Brachionus quadridentatus*			
155.		*Brachionus urceolaris s.l.*			
156.		*Brithysternum nodosum*			Y
157.		*Buddelundia sp.*			
158.		*Bursaria sp.*			
159.		*Calanoida sp.*			
160.		*Calosoma schayeri*			
161.		*Candonocypris fitzroyi*			
162.		*Carenum venustum*			
163.		*Cavisternum clavatum*			
164.		*Cephalodella cf forficula*			
165.		*Cephalodella gibba*			
166.		*Ceriodaphnia n. sp. a (Berner sp.#3) (SAP)*			
167.		*Cethegus fugax*			
168.		*Chaoborus punctilliger*			
169.		*Chironomus aff. alternans (V24) (CB)*			
170.		*Chironomus tepperi*			
171.		*Chlaenius australis*			
172.		*Chydorus eurynotus*			
173.		*Cloeon sp.*			
174.		*Coelopynia pruinosa*			
175.		*Conochilus sp.*			
176.		*Conochironomus cygnus*			
177.		*Conopterum leai*			
178.		*Conopterum pyripenne*			

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179.		*Cormocephalus strigosus*			
180.		*Cryptochironomus griseidorsum*			
181.		*Culex palpalis*			
182.		*Cypretta 'reticulata' (PSW)*			
183.		*Cypretta sp PSW074*			
184.		*Cypricercus sp. 444/885 (CB)*			
185.		*Diacyclops humphreysi humphreysi*			
186.		*Dicrotendipes jobetus*			
187.		*Difflugia sp. P1*			
188.		*Diplacodes bipunctata*			
189.		*Diplacodes haematodes*			
190.		*Ecnomus pilbarensis*			
191.		*Enteroplea cf. lacustris (PSW)*			
192.		*Euasteron carnarvon*			
193.		*Euchlanis dilatata*			
194.		*Eucyclops australiensis*			
195.		*Euryscaphus waterhousei*			
196.		*Eurysticta coolawanyah*			
197.		*Eylais sp.*			
198.		*Filinia longiseta*			
199.		*Flosculariidae sp.*			
200.		*Gastrotricha sp.*			
201.		*Gelastocoridae sp.*			
202.		*Gigadema bostocki*			
203.		*Gnaphalopoda lugubris*			
204.		*Grayenulla australensis*			
205.		*Haliplus pinderi*			
206.		*Harpacticoida sp*			
207.		*Hemicordulia tau*			
208.		*Hexarthra intermedia*			
209.		*Hexarthra mira*			
210.		*Hydraena sp.*			
211.		*Hydrochus eurypleuron*			
212.		*Hydrochus obscuroaeneus*			
213.		*Hydrodroma sp.*			
214.		*Hyphydrus sp.*			
215.		*Ilyodromus viridulus*			
216.		*Indolpium sp.*			
217.		*Ischnura aurora aurora*			
218.		*Isidorella egraria*			
219.		*Keratella procurva*			
220.		*Keratella tropica*			
221.		*Laccophilus sharpi*			
222.		*Lanatomyia sp.*			
223.		*Larsia albiceps*			
224.		*Leberis cf. diaphanus*			
225.		*Lecane bulla*			
226.		*Lecane luna*			
227.		*Lecane papuana*			
228.		*Lecane subtilis*			
229.		*Lecane ungulata*			
230.		*Lepadella patella*			
231.		*Limnesia sp. 4 (PSW)*			
232.		*Lophocharis salpina*			
233.		*Loxandrus laevigatus*			
234.		*Loxandrus micantior*			
235.		*Lychas sp. 2*			
236.		*Lycidas sp. 2*			
237.		*Macrothrix breviseta*			
238.		*Macrothrix indistincta*			
239.		*Meedo yarragin*			
240.		*Mesocyclops brooksi*			
241.		*Mesovelia vittigera*			
242.		*Microcyclops varicans*			
243.		*Micronecta adelaidae*			
244.		*Micronecta micra*			
245.		*Micronecta n. sp. P1 (PSW)*			
246.		*Microvelia sp.*			
247.		*Minasteron minusculum*			
248.		*Miralona victoriensis*			

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249.		*Missulena rutraspina*			
250.		*Naididae (ex Tubificidae)*			
251.		*Necterosoma regulare*			
252.		*Nematoda sp.*			
253.		*Nitocrella sp. 1 (PSS)*			Y
254.		*No invertebrates*			
255.		*Notommata cf. pachyura (PSW)*			
256.		*Notsodipus meedo*			
257.		*Oecetis sp. Pilbara 5 (PSW)*			
258.		*Onthophagus consentaneus*			
259.		*Onthophagus margaretensis*			
260.		*Onthophagus pugnacior*			
261.		*Onthophagus sloanei*			
262.		*Origocandona gratia*			
263.		*Ostracoda (unident.)*			
264.		*Oxus orientalis*			
265.		*Ozestheria packardi*			
266.		*Paracladopelma M1 [SFM)*			
267.		*Paramerina sp. D (PSW)*			
268.		*Parastenocarididae sp.*			
269.		*Parastenocaris jane*			
270.		*Pellenes bitaeniata*			
271.		*Phorticosomus gularis*			
272.		*Phreodrilid with dissimilar ventral chaetae*			
273.		*Pilbaracandona eberhardi*			
274.		*Piona cumberlandensis*			
275.		*Plationus patulus*			
276.		*Polyarthra dolichoptera*			
277.		*Polypedilum leei*			
278.		*Polypedilum nubifer*			
279.		*Procladius paludicola*			
280.		*Pseudagrion microcephalum*			
281.		*Pseudohydryphantes sp. P1 (PSW)*			
282.		*Pyralidae Pilbara sp 2 (PSW)*			
283.		*Ranatra diminuta*			
284.		*Scaridium bostjani*			
285.		*Scirtidae sp.*			
286.		*Scolopendra laeta*			
287.		*Scolopendra morsitans*			
288.		*Stenocypris cf. bolieki*			
289.		*Sternopriscus pilbarensis*			
290.		*Sternopriscus sp.*			
291.		*Tabanidae sp.*			
292.		*Tasmanocoenis arcuata*			
293.		*Tesserodon granulatum*			
294.		*Tesserodon novaehollandiae*			
295.		*Testudinella patina*			
296.		*Thermocyclops decipiens*			
297.		*Tiporus sp.*			
298.		*Triaenodes sp.*			
299.		*Trichocerca braziliensis*			
300.		*Trichocerca pusilla*			
301.		*Trichocerca similis*			
302.		*Trichocerca sp.*			
303.		*Trichocerca weberi*			
304.		*Trichocyclus nigropunctatus*			
305.		*Trichocyclus warianga*			
306.		*Tropocyclops confinis (ex Paracyclops sp. 6)*			
307.		*Tyrannochthonius aridus*			
308.		*Wesmaldra hirsti*			
309.		*Wydundra kennedy*			
310.		*Zebraplatys keyserlingi*			
311.		*Zenodorus orbiculatus*			
312.		*Zenodorus sp. 1*			

Mammal

313.	24251	*Bos taurus (European Cattle)*	Y		
314.	24254	*Camelus dromedarius (Dromedary, Camel)*	Y		
315.	24181	*Chaerephon jobensis (Greater Northern Freetail-bat, Northern Mastiff Bat)*			
316.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
317.	30903	*Dasycercus blythi (Brush-tailed Mulgara, Ampurta)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				P4	
318.	24089	*Dasycercus cristicauda (Crest-tailed Mulgara, minyiminyi)*		P4	
319.	24091	*Dasykaluta rosamondae (Little Red Kaluta)*			
320.	24257	*Equus asinus (Donkey)*	Y		
321.	24041	*Felis catus (Cat)*	Y		
322.	24122	*Lagorchestes conspicillatus subsp. leichardti (Spectacled Hare-wallaby (mainland))*		P4	
323.	24180	*Macroderma gigas (Ghost Bat)*		T	
324.	25489	*Macropus robustus (Euro, Biggada)*			
325.	24136	*Macropus rufus (Red Kangaroo, Marlu)*			
326.	24223	*Mus musculus (House Mouse)*	Y		
327.	24095	*Ningaui timealeyi (Pilbara Ningaui)*			
328.	24224	*Notomys alexis (Spinifex Hopping-mouse)*			
329.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
330.	24144	*Petrogale rothschildi (Rothschild's Rock-wallaby)*			
331.	24105	*Pseudantechinus roryi (Rory's Pseudantechinus)*			
332.	24106	*Pseudantechinus woolleyae (Woolley's Pseudantechinus)*			
333.	24233	*Pseudomys chapmani (Western Pebble-mound Mouse, Ngadji)*		P4	
334.	24235	*Pseudomys desertor (Desert Mouse)*			
335.	24237	*Pseudomys hermannsburgensis (Sandy Inland Mouse)*			
336.	24200	*Scotorepens greyii (Little Broad-nosed Bat)*			
337.	24108	*Sminthopsis crassicaudata (Fat-tailed Dunnart)*			
338.	24115	*Sminthopsis longicaudata (Long-tailed Dunnart)*		P4	
339.	24116	*Sminthopsis macroura (Stripe-faced Dunnart)*			
340.	24117	*Sminthopsis ooldea (Ooldea Dunnart)*			
341.	24120	*Sminthopsis youngsoni (Lesser Hairy-footed Dunnart)*			
342.	24175	*Taphozous georgianus (Common Sheath-tailed Bat)*			
343.	24205	*Vespadelus finlaysoni (Finlayson's Cave Bat)*			
344.	24248	*Zyzomys argurus (Common Rock-rat)*			
Reptile					
345.	30833	*Amphibolurus longirostris (Long-nosed Dragon)*			
346.	25318	*Antaresia perthensis (Pygmy Python)*			
347.	25331	*Brachyurophis approximans (North-western Shovel-nosed Snake)*			
348.	25017	*Carlia triacantha (Desert Rainbow Skink)*			
349.	25339	*Chelodina steindachneri (Flat-shelled Turtle)*			
350.	30893	*Cryptoblepharus buchananii*			
351.	30892	*Cryptoblepharus ustulatus*			
352.	25458	*Ctenophorus caudicinctus (Ring-tailed Dragon)*			
353.	24865	*Ctenophorus caudicinctus subsp. caudicinctus (Ring-tailed Dragon)*			
354.	25459	*Ctenophorus isolepis (Crested Dragon, Military Dragon)*			
355.	24875	*Ctenophorus isolepis subsp. gularis (Central Military Dragon)*			
356.	24876	*Ctenophorus isolepis subsp. isolepis (Crested Dragon, Military Dragon)*			
357.	24882	*Ctenophorus nuchalis (Central Netted Dragon)*			
358.	24886	*Ctenophorus reticulatus (Western Netted Dragon)*			
359.	25025	*Ctenotus ariadnae*			
360.	25036	*Ctenotus duricola*			
361.	25462	*Ctenotus grandis*			
362.	25043	*Ctenotus grandis subsp. titan*			
363.	25044	*Ctenotus hanloni*			
364.	25045	*Ctenotus helenae*			
365.	25052	*Ctenotus leonhardii*			
366.	25463	*Ctenotus pantherinus (Leopard Ctenotus)*			
367.	25064	*Ctenotus pantherinus subsp. ocellifer (Leopard Ctenotus)*			
368.	25066	*Ctenotus quattuordecimlineatus*			
369.	25071	*Ctenotus rutilans*			
370.	25073	*Ctenotus saxatilis (Rock Ctenotus)*			
371.	25074	*Ctenotus schomburgkii*			
372.	25465	*Ctenotus uber (Spotted Ctenotus)*			
373.	25081	*Ctenotus uber subsp. johnstonei (Spotted Ctenotus (northeast), Spotted Skink (Balgo, NE WA))*		P2	
374.	25080	*Ctenotus uber subsp. uber (Spotted Ctenotus)*			
375.	25466	*Cyclodomorphus melanops (Slender Blue-tongue)*			
376.	25090	*Cyclodomorphus melanops subsp. melanops (Slender Blue-tongue)*			
377.	30830	*Delma desmosa*			
378.	24998	*Delma elegans*			
379.	25000	*Delma haroldi*			
380.	25001	*Delma nasuta*			
381.	25002	*Delma pax*			
382.	25004	*Delma tincta*			
383.	25468	*Demansia psammophis (Yellow-faced Whipsnake)*			
384.	25295	*Demansia psammophis subsp. cupreiceps (Yellow-faced Whipsnake)*			

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385.	24926	*Diplodactylus conspicillatus (Fat-tailed Gecko)*			
386.	24940	*Diplodactylus pulcher*			
387.	24899	*Diporiphora valens (Southern Pilbara Tree Dragon)*			
388.	41406	*Egernia cygnitos (Western Pilbara Spiny-tailed Skink)*			
389.	25092	*Egernia depressa (Southern Pygmy Spiny-tailed Skink)*			
390.	25109	*Eremiascincus richardsonii (Broad-banded Sand Swimmer)*			
391.	24956	*Gehyra pilbara*			
392.	24958	*Gehyra punctata*			
393.	24959	*Gehyra variegata*			
394.	24961	*Heteronotia binoei (Bynoe's Gecko)*			
395.	24962	*Heteronotia spelea (Desert Cave Gecko, Pilbara Cave Gecko)*			
396.	25125	*Lerista bipes*			
397.	25135	*Lerista flammicauda*			
398.	25155	*Lerista muelleri*			
399.	25156	*Lerista neander*			
400.	42411	*Lerista timida*			
401.	25183	*Lerista zietzi*			
402.	25005	*Lialis burtonis*			
403.	41417	*Liopholis striata (Night Skink)*			
404.	30933	*Lucasium stenodactylum*			
405.	30934	*Lucasium wombeyi*			
406.	25184	*Menetia greyii*			
407.	24904	*Moloch horridus (Thorny Devil)*			
408.	25495	*Morethia ruficauda*			
409.	25193	*Morethia ruficauda subsp. exquisita*			
410.	24972	*Nephrurus wheeleri subsp. cinctus*			
411.	25499	*Notoscincus ornatus*			
412.	25197	*Notoscincus ornatus subsp. ornatus*			
413.	24976	*Oedura marmorata (Marbled Velvet Gecko)*			
414.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
415.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
416.	25261	*Pseudechis australis (Mulga Snake)*			
417.	42416	*Pseudonaja mengdeni (Western Brown Snake)*			
418.	25263	*Pseudonaja modesta (Ringed Brown Snake)*			
419.	25264	*Pseudonaja nuchalis (Gwardar, Northern Brown Snake)*			
420.	25009	*Pygopus nigriceps*			
421.	24982	*Rhynchoedura ornata (Western Beaked Gecko)*			
422.	24927	*Strophurus elderi*			
423.	24932	*Strophurus jeanae*			
424.	24949	*Strophurus wellingtonae*			
425.	25269	*Suta fasciata (Rosen's Snake)*			
426.	25307	*Suta punctata (Spotted Snake)*			
427.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
428.	25209	*Varanus acanthurus (Spiny-tailed Monitor)*			
429.	25210	*Varanus brevicauda (Short-tailed Pygmy Monitor)*			
430.	25211	*Varanus caudolineatus*			
431.	25212	*Varanus eremius (Pygmy Desert Monitor)*			
432.	25216	*Varanus giganteus (Perentie)*			
433.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
434.	25524	*Varanus panoptes (Yellow-spotted Monitor)*			
435.	25224	*Varanus pilbarensis (Pilbara Rock Monitor, Northern Pilbara Rock Goanna)*			
436.	25526	*Varanus tristis (Racehorse Monitor)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Fauna species data

Species recorded from studies and database searches

The table presents all vertebrate fauna species recorded in previous studies within or in proximity to the survey area, and database searches within a 40 kilometre radius of the survey area.

Genus	Species	Common Name	Conservation status		Database searches			Literature review					
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	Current survey
Birds													
ACANTHIZIDAE													
Acanthiza	apicalis	Inland Thornbill			X						X	X	
Acanthiza	chrysorrhoa	Yellow-rumped Thornbill			X			X					
Acanthiza	robustirostris	Slaty-backed Thornbill			X			X					X
Acanthiza	uropygialis	Chestnut-rumped Thornbill			X			X	X				X
Aphelocephala	leucopsis	Southern Whiteface			X								
Aphelocephala	nigricincta	Banded Whiteface			X								
Gerygone	fusca	Western Gerygone			X				X	X		X	
Pyrrholaemus	brunneus	Redthroat			X								X
Smicrornis	brevirostris	Weebill						X	X	X	X	X	X
ACCIPITRIDAE													
Accipiter	cirrocephalus	Collared Sparrowhawk			X								
Accipiter	fasciatus	Brown Goshawk			X			X					X
Aquila	audax	Wedge-tailed Eagle			X			X	X		X	X	X
Circus	assimilis	Spotted Harrier			X			X			X		
Elanus	caeruleus	Black-shouldered Kite			X								X
Haliastur	sphenurus	Whistling Kite			X			X	X		X	X	X
Hamirostra	melanosternon	Black-breasted Buzzard			X			X	X			X	X
Hieraaetus	morphnoides	Little Eagle			X			X	X			X	X
Lophoictinia	insura	Square-tailed Kite			X								
Milvus	*migrans*	Black Kite			X				X			X	

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
AEGOTHELIDAE													
Aegotheles	*cristatus*	Owlet-nightjar			X			X		X	X		X
ALAUDIDAE													
Mirafra	*cantillans*	Singing Bushlark			X			X	X				
Mirafra	*javanica*	Horesfield's Bushlark										X	
ALCEDINIDAE													
Todiramphus	*pyrrhopygia*	Red-backed Kingfisher			X			X	X	X	X	X	X
Todiramphus	*sanctus*	Sacred Kingfisher			X			X		X			X
Dacelo	*leachii*	Blue-winged Kookaburra			X			X					
ANATIDAE													
Anus	*superciliosa*	Pacific Black Duck			X								X
Chenonetta	*jubata*	Wood Duck						X					
Tadoma	*tadornoides*	Australian Shelduck			X			X					
Cygnus	*atratus*	Black Swan											X
APODIDAE													
Apus	*pacificus*	Fork-tailed Swift	IA	Mi		X							
ARDEIDAE													
Ardea	*pacifica*	White-necked Heron			X			X					
Areada	*alba*	Great Egret			X								
Ardea	*ibis*	Cattle Egret			X								
Egretta	*garzetta*	Little Egret			X								
Nycticorax	*caledonicus*	Rufous Night Heron			X								
Egretta	*novaehollandiae*	White-faced Heron						X					
ARTAMIDAE													
Artamus	*cinereus*	Black-faced Woodswallow			X			X	X		X	X	X
Artamus	*minor*	Little Woodswallow			X						X		X

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Artamus	*personatus*	Masked Woodswallow			X				X			X	
Cracticus	*nigrogularis*	Pied Butcherbird			X			X	X		X	X	X
Cracticus	*torquatus*	Grey Butcherbird			X			X		X	X		
Cracticus	*tiibicen*	Australian Magpie			X				X		X	X	X
BURHINIDAE													
Burhinus	*grallarius*	Bush-stone Curlew			X				X			X	
CACATUIDAE													
Nymphicus	*hollandicus*	Cockatiel			X			X			X		
Eremiornis	*carteri*	Spinifex Parrot			X								
Cacatua	*sanguinea*	Little Corella			X			X	X			X	X
Eolophus	*roseicapilla*	Galah			X			X		X	X		X
CAMPEPHAGIDAE													
Cacomantis	*pallidus*	Pallid Cuckoo			X			X					X
Chalcites	*basalis*	Horsefield's Bronze-cuckoo			X			X					X
Chalcites	*osculans*	Black-eared Cuckoo			X	X					X		X
Centropus	*phasianinus*	Pheasant Coucal						X					
Lalage	*tricolor*	White-winged Triller			X			X					X
Coracina	*maxima*	Ground Cuckoo-shrike			X			X					
Coracina	*novaehollandiae*	Black-faced Cuckoo-shrike			X			X	X		X	X	X
CAPRIMULGIDAE													
Eurostopodus	*argus*	Spotted Nightjar			X			X			X		
CASUARIIDAE													
Dromaius	*novaehollandiae*	Emu			X								
CHARADRIIDAE													
Elseyornis	*melanops*	Black-fronted Dotterel			X			X					X
Charadrius	*veredus*	Oriental Plover	IA	Mi		X							

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
CLIMACTERIDAE													
Climacteris	*melanura*	Black-tailed Treecreeper						X					
COLUMBIDAE													
Geopelia	*cuneatus*	Diamond Dove			X			X			X		
Geopelia	*striata*	Peaceful Dove			X			X					
Geophaps	*plumifera*	Spinifex Pigeon			X			X	X	X	X	X	X
Ocyphaps	*lophotes*	Crested Pigeon			X			X	X	X	X	X	X
Phaps	*chalcoptera*	Common Bronzewing			X			X			X		X
Comulba	*livia*	Domestic Pigeon	int			X							
CORVIDAE													
Corvus	*bennetti*	Little Crow			X			X					
Corvus	*orru*	Torresian Crow			X			X	X	X	X	X	X
DICAEIDAE													
Dicaeum	*hirundinaceum*	Mistletoebird			X			X					X
ESTRILDIDAE													
Emblema	*pictum*	Painted Finch			X			X			X		
Taeniopygia	*guttata*	Zebra Finch			X			X	X	X	X	X	X
Neochmia	*ruficauda*	Star Finch											
FALCONIDAE													
Falco	*berigora*	Brown Falcon			X			X	X	X	X	X	X
Falco	*cenchroides*	Nankeen Kestrel			X			X	X	X	X	X	X
Falco	*longipennis*	Australian Hobby			X			X					X
Falco	*peregrinus*	Peregrine Falcon	Sp		X		X						X
Faloc	*hypoleucoides*	Grey Falcon	Vu										
HIRUNDINIDAE													
Hirundo	*rustica*	Barn Swallow	IA	Mi		X							

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Cheramoeca	*leucosterna*	White-backed Swallow			X			X	X			X	
Hirundo	*ariel*	Fairy Martin			X								
Hirundo	*neoxena*	Welcome Swallow											
Petrochelidon	*nigricans*	Tree Martin											
LARIDAE													
Hydroprogne	*caspia*	Caspian Tern	IA	Mi			X						
LOCUSTELLIDAE													
Eremiornis	*carteri*	Spinifexbird							X		X		X
Cinclorramphus	*mathewsi*	Rufous Songlark						X			X		
Cinclorramphus	*cruralis*	Brown Songlark											
MALURIDAE													
Malurus	*lamberti*	Variegated Fairy-wren			X			X	X		X	X	X
Malurus	*leucopterus*	White-winged Fairy-wren			X			X	X		X	X	X
Malurus	*splendens*	Splendid Fairy-wren			X								
Stipiturus	*ruficeps*	Rufous-crowned Emu-wren			X								
Amytornis	striatus	Striated Grasswren			X			X	X		X	X	
Amytornis	striatus subsp. whitei	Rufous Grasswren			X			X					
MEGAPODIIDAE													
Manorina	*flavigula*	Yellow-throated Miner			X			X	X	X	X	X	X
Acanthagenys	*rufogularis*	Spiny-cheeked Honeyeater			X			X		X	X		X
Certhionyx	*niger*	Black Honeyeater						X					
Certhionyx	*variegatus*	Pied Honeyeater			X			X					X
Epthianura	*tricolor*	Crimson Chat			X			X		X			X
Lacustroica	*whitei*	Grey Honeyeater			X								
Gavicalis	*virescens*	Singing Honeyeater			X			X	X		X	X	X
Lichmera	*indistincta*	Brown Honeyeater			X			X					X

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Ptilotula	*keartlandi*	Grey-headed Honeyeater			X				X		X	X	X
Ptilotula	*pendiculata*	White-plumed Honeyeater						X	X		X	X	X
MEROPIDAE													
Merops	*ornatus*	Rainbow Bee-eater			X	X		X	X		X	x	X
MONARCHIDAE													
Grallina	*cyanoleuca*	Magpie-lark			X			X	X	X		X	X
MOTACILLIDAE													
Anthus	*novaeseelandiae*	Australian Pipit			X			X	X	X	X	X	X
Motacilla	*cinerea*	Grey Wagtail	IA	Mi		X							
Motacilla	*flava*	Yellow Wagtail	IA	Mi		X							
NEOSITTIDAE													
Daphoenositta	*chrysoptera*	Varied Sittella			X			X					
OTIDIDAE													
Ardeotis	*australis*	Australian Bustard			X			X	X	X	X	X	X
PACHYCEPHALIDAE													
Oreoica	*gutturalis*	Crested Bellbird			X			X			X		X
Pachycephala	*rufiventris*	Rufous Whistler			X			X	X	X	X	X	X
Colluricincla	*harmonica*	Grey Shrike-thrush			X			X	X	X	X	X	X
PARDALOTIDAE													
Pardalotus	*striatus*	Striated Pardalote			X								X
Pardalotus	*rubicatus*	Red-browed Pardalote			X			X			X		X
PETROICIDAE													
Melanodryas	*cucullata*	Hooded Robin			X			X	X			X	X
Petroica	*goodenovii*	Red-capped Robin			X			X	X			X	X
PHAETHONTIDAE													
Phalacrocorax	*carbo*	Great Cormorant			X								

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Phalacrocorax	*sulcirostris*	Little Black Cormorant						X					
PHASIANIDAE													
Coturnix	*pectoralis*	Stubble Quail			X						X		
Coturnix	*ypsilophora*	Brown Quail						X					
PODARGIDAE													
Podargus	*strigoides*	Tawny Frogmouth			X			X		X	X		
POMATOSTOMIDAE													
Pomatostomus	*temporalis*	Grey-crowned Babbler			X			X	X	X	X	X	X
PSITTACIDAE													
Barnardius	*zonarius*	Australian Ringneck			X			X	X	X	X	X	X
Melopsittacus	*undulatus*	Budgerigar			X			X	X		X	X	X
Neopsephotus	*bourkii*	Bourke's Parrot			X			X					
Pezoporus	*occidentalis*	Night Parrot	Cr	En		X							
Polytelis	*alexandrae*	Princess Parrot	P4	Vu		X	X						
PSOPHODIDAE													
Cinclosoma	*clarum*	Chestnut-breast Quail-thrush			X								X
PTILINORHYNCHIDAE													
Ptilonorhynchus	*guttatus*	Western Bowerbird			X			X			X		X
RALLIDAE													
Gallinula	*ventralis*	Black-tailed Native-hen			X			X					
RHIPIDURIDAE													
Rhipidura	*leucophrys*	Willie Wagtail			X			X	X	X	X	X	X
SCOLOPACIDAE													
Actitis	*hypoleucos*	Common Sandpiper	IA	Mi	X	X	X						
Calidris	*acuminata*	Sharp-tailed Sandpiper	IA	Mi		X	X						
Calidris	*ferruginea*	Curlew Sandpiper	Cr	Cr	X	X	X						

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Calidris	*melanotos*	Pectoral Sandpiper	IA	Mi		X							
Calidris	*ruficollis*	Red-necked Stint	IA	Mi			X						
Calidris	*subminuta*	Long-toed Stint	IA	Mi			X						
Calidris	*veredus*	Oriental Plover	IA	Mi			X						
Tringa	*glariola*	Wood Sandpiper	IA	Mi			X						
Tringa	*nebularia*	Common Greenshank	IA	Mi			X						
Tringa	*stagnatilis*	Marsh Sandpiper	IA	Mi			X						
STRIGIDAE													
Ninox	*novaeseelandiae*	Southern Boobook						X	X	X	X	X	
STURNIDAE													
Gelochelidon	*nilotica*	Gull-billed Tern					X						
THRESKIORNITHIDAE													
Plegadis	*falcinellus*	Glossy Ibis	IA	Mi									
TURNICIDAE													
Turnix	*velox*	Little Button-quail			X			X			X		
TYTONIDAE													
Tyto	*alba*	Barn Owl			X				X			X	
Reptiles													
AGAMIDAE													
Gowidon	*longirostris*	Long-snouted Tree Dragon			X			X		X	X	X	X
Ctenophorus	*caudicinctus*	Ring-tailed Dragon			X			X	X	X	X	X	X
Ctenophorus	*isolepis subsp. gularis*	Central Military Dragon			X								
Ctenophorus	*isolepis subsp. isolepis*	Northern Military Dragon			X						X	X	X
Ctenophorus	*nuchalis*	Central Netted Dragon			X			X	X			X	X
Ctenophorus	reticulatus	Western Netted Dragon			X						X		
Diporiphora	*valens*	Pilbara Tree Dragon			X						X		

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Moloch	*horridus*	Thorny Devil			X								
Pogona	*minor subsp. minor*	Western Bearded Dragon			X			X			X		
CARPHODACTYLIDAE													
Nephrurus	*wheeleri cinctus*	Banded Knob-tailed Gecko			X								
CHELIDAE													
Chelodina	*steindachneri*	Flat-shelled Turtle			X			X					
DIPLODACTYLIDAE													
Diplodactylus	*conspicillatus? laevis*	Fat-tailed Gecko			X			X	X		X	X	X
Diplodactylus	*pulcher*	Pretty Gecko			X								
Diplodactylus	*savagei*	Pilbara Beak-faced Gecko			X								
Lucasium	*stenodactylum*	Box-patterned Ground Gecko			X			X	X		X	X	X
Lucasium	*wombeyi*	Pilbara Ground Gecko			X			X			X		
Oedura	*fimbria (marmorata)*	Marbled Velvet Gecko			X						X		
Rhynchoedura	*ornata*	Western Beaked Gecko			X			X			X		X
Strophurus	*elderi*	Jewelled Gecko			X						X		X
Strophurus	*jeanae*	Phasmid Gecko			X						X		
Strophurus	*wellingtonae*	Betty's Gecko			X			X			X		X
ELAPIDAE													
Brachyurophis	*approximans*	Shovel-nosed Snake			X						X		
Demansia	*psammophis cupriceps*	Yellow-faced Whip Snake			X			X			X		
Furina	*ornata*	Orange-napped Snake											X
Pseudechis	*australis*	Mulga Snake			X			X	X			X	X
Pseudonaja	*modesta*	Five-ringed Brown Snake			X			X					
Pseudonaja	*mengdeni*	Gwardar			X			X	X			X	X
Suta	*fasciata*	Rosen's Snake			X						X		X
Suta	*punctata*	Little Spotted Snake			X								

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Vermicella	*snelli*	Pilbara Bandy Bandy									X		
GEKKONIDAE													
Gehyra	*punctata? fenestrula*	Hamersley range Dtella			X				X		X	X	X
Gehyra	*pilbara*	Pilbara Dtella			X						X		
Gehyra	*purpurascens*	Purple Arid Dtella											X
Gehyra	*variegata*	Tree Dtella			X			X	X		X	X	X
Heteronotia	*binoei*	Bynoe's Gecko			X			X	X		X	X	X
Heteronotia	*spelea*	Desert Cave Gecko			X			X			X		
PYGOPODIDAE													
Delma	*butleri*	Butler's Delma											X
Delma	*desmosa*	Desert Delma			X								
Delma	*elegans*	Elegant Delma			X			X			X		
Delma	*haroldi*	Neck-barred Delma			X			X			X		
Delma	*nasuta*	Sharp-snout Delma			X								X
Delma	*pax*	Peace Delma			X			X	X			X	
Delma	*tincta*	Black-necked Delma			X				X		X	X	
Lialis	*burtonis*	Burton's Legless Lizard			X			X	X			X	X
Pygopus	*nigriceps*	Hooded Scaly-foot			X			X					
PYTHONIDAE													
Antaresia	*perthensis*	Pygmy Python			X			X					X
Antaresia	*stimsoni subsp. stimsoni*	Stimson's Python			X								X
Aspidites	*melanocephalus*	Black-headed Python						X					X
Aspidties	*ramsayi*	Woma											X
Liasis	*olivaceus subsp. barroni*	Pilbara Olive Python	Vu	Vu		X	X						
SCINCIDAE													
Carlia	*munda*	Shaded-litter Rainbow Skink			X			X					

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Carlia	*triacantha*	Desert Rainbow Skink			X						X		
Cryptoblepharus	*buchananii*	Buchanan's Skink			X								
Cryptoblepharus	*ustulatus*	Russet Snake-eyed Skink			X								
Ctenotus	*ariadnae*	Arid Ctenotus			X								X
Ctenotus	*duricola*	Pilbara Striped Ctenotus			X			X	X		X	X	X
Ctenotus	*grandis titan*	Giant Desert Ctenotus			X			X	X		X	X	X
Ctenotus	*hanloni*	Hanlon's Skink			X								X
Ctenotus	*helenae*	Helen's Skink			X			X	X			X	X
Ctenotus	*leonhardii*	Leonhard's Ctenotus			X								X
Ctenotus	*pantherinus*	Leopard Skink			X			X	X		X	X	X
Ctenotus	*quatturodecimlineatus*	Fourteen-lined Skink			X								
Ctenotus	*rutilans*	Rusty-shouldered Ctenotus			X			X			X		
Ctenotus	*saxatilis*	Rock Ctenotus			X			X	X		X	X	X
Ctenotus	*schomburgkii*	Wedge-snout Ctenotus			X			X					
Ctenotus	*uber johnstonei*	Spotted Ctenotus	P2		X								
Ctenotus	*uber uber*	Spotted Ctenotus			X			X	X			X	X
Cyclodomorphus	*melanops*	Slender Blue-tongue			X			X					
Egernia	*cygnitos*	Western Pilbara Spiny-tail			X								X
Egernia	*depressa*	Southern Pygmy Spiny-tail			X			X					
Eremiascincus	*richardsonii*	Broad-banded Sand-swimmer			X			X					X
Lerista	*bipes*	Western Two-toed Slider			X			X					X
Lerista	*flammicauda*	Pilbara Flame-tailed Slider			X						X		
Lerista	*jacksoni*	Jackson's Slider									X		
Lerista	*muelleri*	Mueller's Three-toed Slider						X	X		X	X	X
Lerista	*neander*	Robust Pilbara Slider			X			X				X	X
Lerista	*timida*	Dwarf Three-toed Slider			X						X		X

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Lerista	*zietzi*	Pilbara Blue-tailed Slider			X			X					
Liopholis	*kintorei*	Great Desert Skink	Vu	Vu			X						
Liopholis	*striata*	Night Skink			X								
Menetia	*greyii*	Common Dwarf Skink			X			X	X		X	X	X
Morelia	*ruficauda exquisita*	Fire-tail Skink			X			X					X
Notoscincus	*ornatus*	Ornate Snake-eyed Skink			X								
Tiliqua	*multifasciata*	Central Blue-tongue			X			X	X			X	X
TYPHLOPIDAE													
Anilios	*ammodytes*	Pilbara Blind Snake									X		
Anilios	*ganei*	Blind Snake	P1				X						
Anilios	*grypus*	Northern Beaked Blind Snake						X			X		
Anilios	*hamatus*	Hook-snout Blind Snake						X	X			X	
VARANIDAE													
Varanus	*acanthurus*	Spiny-tailed Monitor			X			X	X		X	X	
Varanus	*brevicauda*	Short-tailed Pygmy Monitor			X						X		
Varanus	*caudolineatus*	Striped-tailed Monitor			X				X		X	X	X
Varanus	*eremius*	Pygmy Desert Monitor			X						X		X
Varanus	*giganteus*	Perentie			X			X					
Varanus	*gouldii*	Gould's Monitor			X			X	X		X	X	X
Varanus	*panoptes*	Yellow-spotted Monitor			X			X					X
Varanus	*tristis*	Black-headed Monitor			X			X	X			X	
Amphibians													
HYLIDAE													
Cyclorana	*platycephala*	Water-holding Frog			X			X					X
Cyclorana	*maini*	Sheep Frog			X			X					X
Litoria	*rubella*	Little Red Tree Frog			X			X	X			X	X

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
LIMNODYNASTIDAE													
Platyplectrum	*spenceri*	Central Burrowing Frog			X			X					
Notaden	*nichollsi*	Desert Spadefoot			X								
MYOBATRACHIDAE													
Uperoleia	*russelli*	Russell's Toadlet						X	X				
Uperoleia	*saxatilis*	Pilbara Toadlet			X							X	X
Mammals													
BOVIDAEIDAE													
Bos	*taurus*	Domestic Cattle	int		X	X		X	X	X	X	X	X
CAMELIDAE													
Camelus	*dromedarius*	Camel	int		X	X				X	X	X	X
CANIDAE													
Canus	*lupis dingo*	Dingo						X	X		X		X
Canus	*familiaris*	Dog	int			X							
Vulpes	*vulpes*	Fox	int			X							
DASYURIDAE													
Dasyurus	*hallucatus*	Northern Quoll	En	En		X							
Dasycercus	*blythi*	Brush-tailed Mulgara	P4		X		X					X	X
Dasykaluta	*rosamondae*	Little Red Kaluta			X			X	X		X		X
Pseudantechinus	*woolleyi*	Woolleyi's Antechinus			X				X				X
Ningaui	*timealeyi*	Pilbara Nungaui			X			X					
Sminthopsis	*crassicaudata*	Fat-tailed dunnart			X			X					
Sminthopsis	*longicaudata*	Long-tailed Dunnart	P4		X		X						
Sminthopsis	*ooldea*	Ooldea Dunnart			X								
Sminthopsis	*macroura*	Stripe-faced Dunnart			X			X	X			X	X
Sminthopsis	*youngsoni*	Lesser Hairy-footed Dunnart							X		X	X	X

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
EMBALLONURIDAE													
Saccolaimus	*flaviventris*	Yellow-belly Sheath-tail Bat			X			X			X		X
Scotorepens	*greyii*	Little Broad-nosed Bat			X			X			X		X
Taphozous	*hilli*	Hill's Sheath-tail Bat											X
Taphozous	*georgianus*	Common Sheath-tail Bat			X			X			X		X
EQUIDAE													
Equus	*asinus*	Donkey	int		X	X		X	X			X	X
Equus	*caballus*	Horse	int			X			X			X	
FELIDAE													
Felis	*catus*	Cat	int		X	X			X	X		X	X
HIPPOSIDARIDAE													
Rhinonicteris	*aurantia (Pilbara pop'n)*	Pilbara Leaf-nosed Bat	Vu	Vu		X		X					
LEPORIDAE													
Oryctolagus	*cuniculus*	European Rabbit	int			X				X			
MACROPODIDAE													
Lagorchestes	*conspicillatus leichardti*	Spectacled Hare-wallaby	P4		X		X						
Osphranter	*robustus erubescens*	Euro			X			X	X		X		X
Osphranter	*rufus*	Red Kangaroo			X			X	X	X		X	X
Petrogale	*lateralis*	Black-flanked Rock-wallaby	En	En			X						
Petrogale	*rothchildi*	Rothchild's Rock Wallaby			X								
MEGADERMATIDAE													
Macroderma	*gigas*	Ghost Bat	Vu	Vu	X	X	X	X					X
MOLOSSIDAE													
Austronomus	*australis*	White-striped freetail Bat											X
Chaerephon	*jobensis*	Northern Mastiff Bat			X								X
MURIDAE													

Genus	Species	Common Name	Conservation status		Database searches			Literature review					Current survey
			BC Act	EPBC Act	NatureMap	DoEE PMST	DBCA threatened fauna	Ecologia 2006	Outback Ecology 2009	GHD 2009	ENV 2012	Biolocic 2018	
Mus	*musculus*	House Mouse	int		X			X	X			X	
Notomys	*alexis*	Spinifex Hopping Mouse			X			X					X
Pseudomys	*chapmani*	Pebble-mound Mouse	P4		X		X		X		X	X	X
Pseudomys	*desertor*	Desert Mouse			X			X					
Pseudomys	*hermannsburgensis*	Sandy Inland Mouse			X			X	X		X	X	X
Zyzomys	*argurus*	Rock Rat			X			X	X		X	X	X
NOTORYCTIDAE													
Notoryctes	*caurinus*	Northern Marsupial Mole					X						
TACHYGLOSSIDAE													
Tachyglossus	*aculeatus*	Echidna							X			X	X
THYLACOMYIDAE													
Macrotis	*lagotis*	Greater Bilby	Vu	Vu		X	X						
VESPERTILIOIDAE													
Chalinolobus	*gouldii*	Gould's Wattle Bat			X			X			X		X
Chalinolobus	*morio*	Chocolate Wattle Bat											X
Nyctophilus	*geoffroyi or species*	Lesser Long-eared Bat			X				X		X		X
Vespadelus	*finlaysoni*	Inland Cave Bat			X			X			X		X

Key; X- recorded species, Pr- Probable recorded of species via bat detection or calls overlap with another species, ?- Nyctophilus sp. Recorded and could be either or both species, int- Introduced species, Vu- Vulnerable listed under either/or both EPBC or BC Acts, En- Endangered listed under either/or both EPBC or BC Acts, Cr- Critically Endangered listed under either/or both EPBC or BC Acts, IA- International Agreement listed under BC Act, Mi/Ma Migratory / Ma Migratory listed under EPBC Act, Sp - Special Protection listed under BC Act, P1-4-Priority species listed by DBCA.

Fauna likelihood of occurrence assessment guidelines

Assessment outcome	Description
Present	Species recorded during the field survey or from recent, reliable records from within or close proximity to the survey area.
Likely	Species are **likely** to occur in the survey area where there is suitable habitat within the survey area and there are recent records of occurrence of the species in close proximity to the survey area. OR Species known distribution overlaps with the survey area and there is suitable habitat within the survey area.
Unlikely	Species assessed as **unlikely** include those species previously recorded within 10 km of the survey area however: • There is limited (i.e. the type, quality and quantity of the habitat is generally poor or restricted) habitat in the survey area. • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area. OR Those species that have a known distribution overlapping with the survey area however: • There is limited habitat in the survey area (i.e. the type, quality and quantity of the habitat is generally poor or restricted). • The suitable habitat within the survey area is isolated from other areas of suitable habitat and the species has no capacity to migrate into the survey area.
Highly unlikely	Species that are considered **highly unlikely** to occur in the survey area include: • Those species that have no suitable habitat within the survey area. • Those species that have become locally extinct, or are not known to have ever been present in the region of the survey area.

Source information - desktop searches

NM – DBCA *NatureMap* (accessed March 2019)

PMST – DEE Protected Matters Search Tool (PMST) to identify fauna listed under the EPBC Act potentially occurring within the study area (accessed March 2019)

Definitions

Term	Description
study area	a 40 km buffer around the survey area
survey area	the area subject to the current survey
region	the area within an approximate 40 km radius of the survey area
Cr	Critically endangered under the EPBC Act or BC Act
En	Endangered under the EPBC Act or BC Act
Vu	Vulnerable under the EPBC Act or BC Act
IA	Migratory birds protected under an international agreement
Mi	Migratory
CD	Conservation dependent fauna
OS	Other specially protected fauna
P1	Priority 1: Poorly known fauna. Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2	Priority 2: Poorly known species. Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3	Priority 3: Poorly known species. Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4	Priority 4: Rare, Near Threatened and other species in need of monitoring. (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Fauna likelihood of occurrence assessment of conservation significant species identified in the desktop assessment as potentially occurring within the survey area.

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
	Birds							
Falco hypoleucos Grey Falcon		Vu				X	The Grey Falcon inhabits lightly timbered country, especially stony plains and lightly timbered *Acacia* scrub. This species is considered scarce to rare and is usually found singularly or sometimes in pairs. (Morcombe, 2004).	Likely Suitable habitat is present for the species within the survey area and surrounds (Major Drainage Lines and Mulga woodlands) and the species is known from the region, therefore likely to occur. Closest record is approximately 85 km north of the survey area.
Falco peregrinus Peregrine Falcon		OS				X	The Peregrine Falcon is uncommon but wide-ranging across Australia. Habitat is extremely diverse, from rainforest to arid scrub, from coastal heath to alpine, and also occurs in urban environments and city scapes. The Peregrine Falcon nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities (Morcombe 2004).	Present, the species was recorded just outside of the survey area. Foraging habitat is present in the hillcrest/ hillslope, mulga woodland, and major drainage lines for the species however no breeding habitat is available.
Elanus scriptus Letter-winged Kite			P4			X	Occurs in grasslands, open grassy woodlands and tree-lined creeks and rivers. Nests mainly in spring in trees along watercourses or other wooded areas where seasonal prey is abundant (Pizzey and Knight 2012).	Unlikely, habitat is available to this species and may occur on an occasional basis, however this

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
								species is nomadic and resource dependant, with resident populations occurring in Queensland, New South Wales and South Australia. Records outside central eastern Australia are rare, occasionally following exceptionally good breeding conditions. Occurrence within eastern Pilbara is rare or as vagrant.
Pezoporus occidentalis Night Parrot	En	Cr		X		X	The Night Parrot inhabits arid and semi-arid areas that are characterised by having dense, low vegetation. Based on accepted records, the habitat of the Night Parrot consists of old growth (long unburnt)*Triodia* hummock grasslands in stony or sandy environments and of samphire and chenopod shrublands, including genera such as *Atriplex, Bassia* and *Maireana*, on floodplains and claypans, and on the margins of saltlakes, creeks or other sources of water (Parker, 1980). It has also been observed to enter dense Muehlenbecki growth when flushed from a more typical habitat (Boles et al. 1994).	Unlikely, some habitat is available for this species on the sand plain, however due to recent fires in the eastern portion of the survey area, this habitat are unsuitable owing to the species requirement for long unburnt Triodia(Murphy 2016). Sampling methods did not identify the species during the survey. Use maybe irregular and opportunistic.

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
Polytelis alexandrae Princess Parrot	Vu		P4	X		X	The Princess Parrot inhabits sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands that usually consist of scattered stands of *Eucalyptus* (including *E. gongylocarpa, E. chippendalei* and mallee species), *Casuarina* or *Allocasuarina* trees; an understorey of shrubs such as Acacia (especially *A. aneura*), *Cassia*, *Eremophila, Grevillea, Hakea* and *Senna*; and a ground cover dominated by *Triodia* species (Allen 1987; Baxter & Henderson 2000). It also frequents *Eucalyptus or Allocasuarina* trees in riverine or littoral areas.	Unlikely, habitat is available to this species and it may opportunistically occur however this species is nomadic and resource dependant, with resident populations occurring in Northern Territory, South Australia and the eastern arid region of Western Australia.
	Migratory Birds							
Apus pacificus Fork-tailed Swift	Mi	IA		X			A highly nomadic and very wide ranging but sparcely scattered species occurring in a wide variety of habitats throughout Australia. They are widespread in coastal and sub-coastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands, venturing into inland areas following storms and cyclonic events. This species is almost exclusively aerial, flying less than 1 m to at least 300 m above ground. (DSEWPaC 2013).	Unlikely, An almost exclusively aerial species that may opportunistically utilise the area during storm or cyclone events.
Hirundo rustica Barn Swallow	Mi	IA		X			In Australia, the Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires, and also in or over freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland.	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
Hydroprogne caspia Caspian Tern	Mi	IA				X	The Caspian Tern is mostly found in sheltered coastal embayments (harbours, lagoons, inlets, bays, estuaries and river deltas) and those with sandy or muddy margins are preferred. They also occur on near-coastal or inland terrestrial wetlands that	Highly Unlikely, No habitat is present for this species.

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							are either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks. They also use artificial wetlands, including reservoirs, sewage ponds and saltworks. In offshore areas the species prefers sheltered situations, particularly near islands, and is rarely seen beyond reefs (Higgins & Davies 1996). Large numbers may shelter along the coast, behind coastal sand-dunes or coastal lakes during rough weather, and have been recorded inland after storms (Higgins & Davies 1996). The Caspian Tern usually forages in open wetlands, including lakes and rivers near to the coast. (Higgins & Davies 1996).	
Motacilla cinerea Grey Wagtail	Mi	IA		X			The Grey Wagtail is an opportunistic migrant to Australia. The species typically migrates to Indonesia occasionally landing in Australia. Most records for the species are from Northern Australia and South Australia (Morcombe 2004). The non-breeding habitat only of the Grey Wagtail has a strong association with water, particularly rocky substrates along water courses but also lakes and marshes (DotE 2016). It can be found mainly in banks and rocks in fast-running freshwater habitats: rivers, creeks, streams, and around waterfalls, both in forest and open country; but occurs almost anywhere during migration (Johnstone & Storr 2004).	Highly Unlikely
Motacilla flava Yellow Wagtail	Mi	IA		X			The Yellow Wagtail occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra (IUCN Redlist 2017). In Australia, the Yellow Wagtail is a very uncommon except in the Broome region. They can often be found in northern towns wherever there are well watered grass areas (DotEE 2017).	Highly Unlikely
Actitis hypoleucos Common Sandpiper	Mi	IA		X	X	X	The species utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. The Common Sandpiper has been recorded in estuaries and deltas of streams, as well as on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans, and	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							occasionally piers and jetties. The muddy margins utilised by the species are often narrow, and may be steep. The species is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Geering et al. 2007; Higgins & Davies 1996). Foraging environments: Generally the species forages in shallow water and on bare soft mud at the edges of wetlands; often where obstacles project from substrate, e.g. rocks or mangrove roots. Birds sometimes venture into grassy areas adjoining wetlands (Higgins & Davies 1996). Roost sites: Roost sites are typically on rocks or in roots or branches of vegetation, especially mangroves. The species is known to perch on posts, jetties, moored boats and other artificial structures, and to sometimes rest on mud or 'loaf' on rocks (Higgins & Davies 1996).	is nomadic and resource dependant
Calidris acuminata Sharp-tailed Sandpiper	Mi	IA		X		X	In Australasia, the Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. This includes lagoons, swamps, lakes and pools near the coast, and dams, waterholes, soaks, bore drains and bore swamps, saltpans and hypersaline saltlakes inland. They also occur in saltworks and sewage farms. They use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when they dry. They use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, and also swamps and creeks lined with mangroves. They tend to occupy coastal mudflats mainly after ephemeral terrestrial wetlands have dried out, moving back during the wet season. They may be attracted to mats of algae and water weed either floating or washed up around terrestrial wetlands, and coastal areas with much beach cast seaweed. Sometimes they occur on rocky shores and rarely on exposed reefs (Higgins & Davies 1996).	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
Calidris ferruginea Curlew Sandpiper	Cr	Cr		X		X	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and	Unlikely, some habitat is available to this

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996). Curlew Sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm, deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beach cast seagrass or seaweed.	species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
Calidris melanotos Pectoral Sandpiper	Mi	IA		X		X	In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. The species is usually found in coastal or near coastal habitat but occasionally found further inland. It prefers wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. The species has also been recorded in swamp overgrown with lignum. They forage in shallow water or soft mud at the edge of wetlands (Higgins & Davies 1996).	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
Calidris ruficollis Red-necked Stint	Mi	IA				X	In Australasia, the Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores. Occasionally they have been recorded on exposed or ocean beaches, and sometimes on stony or rocky shores, reefs or shoals. They also occur in saltworks and sewage farms; saltmarsh; ephemeral or permanent shallow wetlands near the coast or inland, including lagoons, lakes, swamps, riverbanks, waterholes, bore drains,	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							dams, soaks and pools in saltflats. They sometimes use flooded paddocks or damp grasslands. They have occasionally been recorded on dry gibber plains, with little or no perennial vegetation (Higgins & Davies 1996).	
Calidris subminuta Long-toed Stint	Mi	IA				X	In Australia, the Long-toed Stint occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. It has also been observed at open, less vegetated shores of larger lakes and ponds and is common on muddy fringes of drying ephemeral lakes and swamps. The Long-toed Stint also frequents permanent wetlands such as reservoirs and artificial lakes. They are uncommon, but not unknown, at tidal estuaries, saline lakes, saltponds and bore swamps (Higgins & Davies 1996). The Long-toed Stint forages on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around the edges of wetlands. They occasionally feed on open water, well away from the shore; this is more common in drying ephemeral wetlands. They roost or loaf in sparse vegetation at the edges of wetlands and on damp mud near shallow water. It also roosts in small depressions in the mud (Higgins & Davies 1996).	Unlikely, some habitat is available to this species and may it opportunistically but irregularly occur, however this species is nomadic and resource dependant
Charadrius veredus Oriental Plover	Mi	IA		X		X	Immediately after arriving in non-breeding grounds in northern Australia, Oriental Plovers spend a few weeks in coastal habitats such as estuarine mudflats and sandbanks, on sandy or rocky ocean beaches or nearby reefs, or in near-coastal grasslands, before dispersing further inland. Thereafter they usually inhabit flat, open, semi-arid or arid grasslands, where the grass is short and sparse, and interspersed with hard, bare ground, such as claypans, dry paddocks, playing fields, lawns and cattle camps or open areas that have been recently burnt (Storr, 1980).	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
Tringa glariola Wood Sandpiper	Mi	IA				X	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums *Eucalyptus camaldulensis* and often with fallen timber. They also frequent inundated grasslands, short herbage or wooded floodplains, where floodwaters are temporary or receding, and irrigated crops. They are also found at some small wetlands only when they are drying. They are rarely found using brackish wetlands, or dry stunted saltmarsh. Typically they do not use coastal flats, but are occasionally recorded in stony wetlands. This species uses artificial wetlands, including open sewage ponds, reservoirs, large farm dams, and bore drains (Higgins & Davies 1996). In Western Australia, within wetlands, birds often occur within a few metres of one another and are concentrated at a few sites in a wetland (Higgins & Davies 1996).	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
Tringa nebularia Common Greenshank	Mi	IA				X	The Common Greenshank is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayments, harbours, river estuaries, deltas and lagoons and are recorded less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and saltflats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores. The edges of the wetlands used are generally of mud or clay, occasionally of sand, and may be bare or with emergent or fringing vegetation, including short sedges and saltmarsh, mangroves, thickets of rushes, and dead or live trees. It was once recorded with Black-winged Stilts *(Himantopus himantopus*) in	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							pasture, but are generally not found in dry grassland (Higgins & Davies 1996).	
Tringa stagnatilis Marsh Sandpiper	Mi	IA				X	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks. They are recorded less often at reservoirs, waterholes, soaks, bore-drain swamps and flooded inland lakes. In north Australia they prefer intertidal mudflats (Higgins & Davies 1996). At the Top End they often use ephemeral pools on inundated freshwater and tidal floodplains (Higgins & Davies 1996). Three of the five sites with highest recorded numbers are saltwater habitats (Hunter Estuary, NSW; Port Hedland Saltworks, Western Australia; Tullakool Evaporation Ponds, NSW) and in the south-east Gulf of Carpentaria they have been recorded round both saline and fresh waters (Garnett 2011).	Unlikely, some habitat is available to this species and it may opportunistically but irregularly occur, however this species is nomadic and resource dependant
	Mammals							
Dasycercus blythi Brush-tail Mulgara			P4		X	X	The Brush-tailed Mulgara is primarily nocturnal, shelters in burrows and feeds on insects, other arthropods and small vertebrates. This species inhabits spinifex grasslands and, in central Australia, lives in burrows that it digs on the flats between low sand dunes (Van Dyck and Strahan 2008). The Mulgara is a solitary species exhibiting high site fidelity and a low propensity for dispersal once a home range has been established (Masters and Crowther 2003). Males and females maintain home ranges of 1.4 to 14 ha (Masters and Crowther 2003) which on average, overlap by less than 20% (Masters and Crowther 2003). Known to occur locally and has been recorded in East Jimblebar survey area (Biologic 2018). The *Triodia* sandplains represents suitable habitat.	Present. Recorded within survey area within sand plain habitat
Dasyurus hallucatus Northern Quoll	En	En		X		X	The Northern Quoll once occurred across the majority of northern Australia but its range has significantly contracted. It occurs in the Pilbara region but in disjunct populations. The Northern Quoll inhabits a range of vegetation associations but is especially	Unlikely, despite some habitat being present (Hillcrest/ hillslope and major drainage line) no

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. It is known to den in rock crevices and rock piles and favours rocky areas. They are predominantly nocturnal but are occasionally active during the day, particularly during the mating season and are known to have a large home range (Van Dyck and Strahan 2008). Not known to occur locally. The Jimblebar – Caramulla area is beyond the south-eastern limit of current geographic range.	Northern Quoll have been recorded. There is a recognised paucity of record within the south eastern Hamersley Range which is an area considered to be beyond the south-eastern limit of the species range based on historical records. Nearest records are from Bonney Downs located approximately 120 km north west, and a record 120 km west of the survey area.
Macrotis lagotis Greater Bilby	Vu	Vu		X		X	The Greater Bilby distribution in Western Australia is restricted to the north, including the Pilbara, Sandy and Gibson Deserts. The Greater Bilby usually spends the daytime in burrows, often built against termite mounds, spinifex hummock or shrubs (Van Dyck and Strahan 2008). Extant population of the Greater Bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. It occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas. Laterite and rock feature substrates are an important part of Greater Bilby habitat. These habitat support shrub species, such as *Acacia kempeana, A. hilliana* and *A. rhodophylla*, which have root-dwelling larvae that provide a constant food source for the Greater Bilby. After dark they leave their burrows to feed and populations are known to move long distances when current habitat ranges become	Likely, habitat is present for the species on the sand plain. An old burrow was previously recorded on the sand plain (Biologic 2018). No evidence of the species was recorded during this survey.

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							unsuitable. Bilbies are largely solitary, widely dispersed and found in low numbers. The current occurrence of the Greater Bilby is strongly associated with higher rainfall and temperatures, which promote areas of higher plant and food production. The Greater Bilby may also prefer these conditions as higher rainfall and temperatures are not well tolerated by foxes (Pavey 2006; Southgate et al. 2007). Biologic (2018) recorded an old (inactive) burrow within the East Jimblebar survey area.	
Macroderma gigas Ghost Bat	Vu	Vu		X	X	X	The Ghost Bat occurs in a wide range of habitats, and requires an undisturbed cave, deep fissure or disused mine shaft in which to roost. It is patchily distributed across Australia, and is sensitive to disturbance (Van Dyck and Strahan 2008).	Present, The species was recorded via feeding evidence in the surveys area. The species has previously been recorded in the survey area (Ecologia 2006). A roost site is present approximately 1 km south of the survey area. Hillcrest/ hillslope is potentially suitable roost and feeding cave habitat. Foraging habitat is major drainage lines and mulga woodlands
Rhinonicteris aurantia Pilbara leaf-nosed Bat	Vu	Vu		X			The Pilbara Leaf-nosed Bat roosts in deep caves or mine shafts in the wet season and forages nearby. This species occurs in the Pilbara region where its populations are scattered and localised. There are a few known populations of this species in the western Pilbara, roosting in caves formed in gorges that dissect massive siliceous sedimentary geology. It is most often observed in flight over waterholes in gorges (Van Dyck and Strahan 2008). Optimal roosts are thought to occur in caves that form between ascending rock layers, where humidity is maintained from seeping groundwater (Van Dyck and Strahan 2008). Roosts are commonly	Unlikely, Foraging habitat is present (major and minor drainage lines, and hillcrest/ hillslope) for the species however there are few caves in the region. The hillcrest/ hillslope habitat within the

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
							located over pools of water, or areas deep within the mine or cave structure which provides elevated temperature and humidity. Foraging habitat includes: Triodia hummock grasslands covering low rolling hills and shallow gullies, with *Eucalyptus camaldulensis* along the creeks; over small watercourses throughout granite boulder terrain; over pools and low shrubs in ironstone gorges; and in and around gravelly watercourses with *Melaleuca leucodendron*.	survey area lacks caves to support a population of the species. No calls were identified during the current survey. The nearest confirmed records are approximately 55 km west north west of the survey area. This species has been previously recorded within an old adit near Caramulla Creek to the adjacent west of the survey area (Ecologia 2006), however the species has not been recorded at this location since, despite several searches
Lagorchestes conspicillatus leichardti Spectacled Hare Wallaby			P4		X	X	The Spectacled Hare-wallaby was once widely distributed across the lower latitudes of northern Australia from eastern Queensland, through Northern territory to the Pilbara and Kimberley in Western Australia, with a subspecies on Barrow Island. In the Pilbara region this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grasslands has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008). They live in open woodlands, shrublands and hummock grasslands, sheltering under vegetation or in burrows during the day and searching for herbs, grass and fruits at night.	Likely, habitat is present for this species on the sand plain. The closest record is approximately 11 km south west of the survey area. Sand Plains and Mulga Woodlands are suitable habitat within the survey area.

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
Leggadina lakedownensis Northern Short-tailed Mouse			P4			X	The Lakeland Downs Mouse occupies a diverse range of habitats from the monsoon tropical coast to semiarid climates, including spinifex and tussock grasslands, samphire and sedgelands, Acacia shrublands, tropical Eucalyptus and Melaleuca woodlands and stony ranges. Most habitats, however, are seasonally inundated on red or white sandy-clay soils. They are nocturnal, largely solitary, and individuals spend the day in simple, single-chambered burrows (Van Dyck and Strahan 2008).	Likely, habitat is present for this species on the sand plain. The closest record is approximately 79 km north of the survey area. Sand Plains and Mulga Woodlands are suitable habitat within the survey area and having good connectivity for dispersal within adjacent similar habitat.
Pseudomys chapmani Western Pebble-mound Mouse			P4		X	X	The Western Pebble-mound Mouse is restricted to the Pilbara region where it is recognised as an endemic species. Habitat for the Western Pebble-mound Mouse can be found on stony hillsides with hummocky grasslands and little or no soil. It constructs large mounds of pebbles on stony slopes which cover an area of 0.5-9.0 square metres. 'Active' mounds are characterized by volcano-like cones capped by 'craters' that mark occluded entrances to subterranean burrow systems in which the mice live, often gregariously (Van Dyck and Strahan 2008).	Present, the species was recorded in the survey area via both active and non-active mounds. Hillcrest/ Hillslope is suitable habitat.
Sminthopsis longicaudata Long-tailed Dunnart			P4		X	X	The Long-tailed Dunnart occurs throughout the Gibson Desert, Murchison, southern Carnarvon Basin and the Pilbara in Western Australia. Its habitat includes rugged, rocky areas with hummock grasses, shrubs and tall open shrublands and woodlands. In the Young Range in the Gibson Desert, the Long-tailed Dunnart has been found to be associated with plateaus, composed of boulders and stones, with some fine red soils, and sparsely vegetated Mulga (*Acacia aneura*) and Miniritchie (*A. grasbyi*) shrubs over spinifex (Van Dyck and Strahan 2008).	Likely, habitat is present for this species particularly in the rocky features within the undulating low hills (Hillcrests/ Hillslopes). The closest record is approximately 6 km

Species name	Status			Source			Habitat requirements	Likelihood of occurrence within the survey area
	EPBC Act	BC Act	DBCA	PMST	NM	TS & P search		
								north of the survey area.
	Reptiles							
Anilios ganei Pilbara Flat-headed Blind Snake			P1			X	*Ramphotyphlops ganei* is a moderately robust blind snake known from widely separated areas between Newman and Pannawonica. A very cryptic species. Most often recorded in rocky or stony areas, and considered to be possibly associated with moist gorges and gullies (Wilson and Swan 2017).	Likely, habitat is present for this species particularly in the rocky features within the undulating low hills (Hillcrests/ Hillslopes). The closest record is approximately 17 km north west of the survey area.
Liasis olivaceus barroni Pilbara Olive Python	Vu	Vu		X		X	The Olive Python (Pilbara subspecies) is a dull olive-brown to pale fawn or rich-brown python with a white underside and pale finely dotted lips. This species reaches an average size of 2.5 m but can grow up to 4 m long. The Olive Python's range is restricted to the Pilbara region, north Western Australia, and the Dampier Archipelago. Habitat consists of rocky escarpments, gorges and waterholes within the Pilbara region. The preferred microhabitats for this species are under rock piles, on top of rocks, and under spinifex as well as in man-made features such as overburden heaps, railway embankments and sewerage treatment ponds. The species' breeding season occurs from June to August, with males moving long distances in search of breeding females (Wilson and Swan 2017).	Likely, habitat is present for the species particularly along Jimblebar and Carramulla Creeks. Also within rocky features within the undulating low hills. The closest record is approximately 15 km west of the survey area (Outback Ecology 2009b

Species recorded on remote camera within the survey area

Family, Genus, Species	Common name																						
Birds		Cam C19	Cam 115	Cam B1	Cam C25a	Cam C77	Cam 15b	Cam 2	Cam 1	Cam GHDC	Cam 20	Cam 27	Cam 16	Cam 14	Cam A	Cam 99	Cam 2A	Cam 29	Cam 24	Cam 25b	Cam 31	Cam 8
COLUMBIDAE																						
Ocyphaps lophotes	Crested Pigeon									1												
CORVIDAE																						
Corvus orru	Torresian Crow	9	4		3													2				1
PACHYCEPHALIDAE																						
Oreoica gutturalis	Crested Bellbird						2			1			1		1							
PETROICIDAE																						
Melanodryas cucullata	Hooded Robin									1												
Rhipidura leucophrys	Willie Wagtail		1																			
Reptiles																						
SCINCIDAE																						
Eremiascincus richardsonii	Broad-banded Sand-swimmer		1																			
VARANIDAE																						
Varanus panoptes	Yellow-spotted Monitor						1														1	2
Varanus Sp.			1																			
Mammals																						
DASYURIDAE																						
Dasykaluta rosamondae	Little Red Kaluta											3										
Pseudantechinus woolleyi	Woolley's Antechinus																1		1			
Sminthopsis macroura	Stripe-faced Dunnart									1												
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart											1										
Sminthopsis sp.												2										
FELIDAE																						
Felis catus	Cat				1			1							1	1						
MURIDAE																						
Pseudomys hermannsburgensis	Sandy Inland Mouse											7										
Zyzomys argurus	Rock Rat																		4			

Fauna species recorded per trap site, active searches and opportunistically for the survey area

Family, Genus, Species	Common name		Trap Site 1						Trap Site 2						Trap Site 3						Trap Site 4						Trap Site 5					Trap Site 6						Trap Site 7						Trap Site 8								
		Status	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Search	Noct.	Bat Census	Active Searches	Opp.	Totals
Birds																																																		
ACANTHIZIDAE																																																		
Acanthiza robustirostris	Slaty-backed Thornbill																										5																						5
Acanthiza uropygialis	Chestnut-rumped Thornbill															4											8																						12
Pyrrholaemus brunneus	Redthroat																										4																						6
Smicrornis brevirostris	Weebill															4					4						4														4									16
ACCIPITRIDAE																																																	
Accipiter fasciatus	Brown Goshawk																																															1	1
Aquila audax	Wedge-tailed Eagle				1																						1																				2	2	6
Elanus caeruleus	Black-shouldered Kite										1																																					1
Haliastur sphenurus	Whistling Kite																																															4	5
Hamirostra melanosternon	Black-breasted Buzzard										1					1																																1	3
Hieraaetus morphnoides	Little Eagle																																														2	2
AEGOTHELIDAE																																																	
Aegotheles cristatus	Owlet-nightjar																																														1	1
ANATIDAE																																																	
Anus superciliosa	Pacific Black Duck																																														2	2
Cygnus atratus	Black Swan																																														1	1
ARTAMIDAE																																																	
Artamus cinereus	Black-faced Woodswallow				6																	2					8					2						1								6	25
Artamus minor	Little Woodswallow																																														2	2
Cracticus nigrogularis	Pied Butcherbird										1											2											2													2	8
Cracticus tiibicen	Australian Magpie																																														4	4
CACATUIDAE																																																	
Cacatua sanguinea	Little Corella																																														42	42
Eolophus roseicapilla	Galah															5					4						19																				12	44
CAMPEPHAGIDAE																																																	
Lalage tricolor	White-winged Triller															1																																2	3
Coracina novaehollandiae	Black-faced Cuckoo-shrike				3																																										2	5
CHARADRIIDAE																																																	
Elseyornis melanops	Black-fronted Dotterel																																														1	1
COLUMBIDAE																																																	
Geophaps plumifera	Spinifex Pigeon																																														10	10
Ocyphaps lophotes	Crested Pigeon															3					3																										2	8
Phaps chalcoptera	Common Bronzewing															1																															1
CORVIDAE																																																	
Corvus orru	Torresian Crow				4						4					3					1					3														4						3		1	4	27
CUCULIDAE																																																	
Cuculus pallidus	Pallid Cuckoo										1																																					1
Chalcites basalis	Horsefield's Bronze-cuckoo																																														1	1
Chrysococcyx osculans	Black-eared Cuckoo																																														1	
DICAEIDAE																																																	
Dicaeum hirundinaceum	Mistletoebird																																															1	1
ESTRILDIDAE																																																	
Taeniopygia guttata	Zebra Finch				19						4					18																															12	53
EUROSTOPODIDAE																																																	
Eurostopodus argus	Spotted Nightjar																																															F	1
FALCONIDAE																																																	
Falco berigora	Brown Falcon				2						1					1					2																										4	10
Falco cenchroides	Nankeen Kestrel																																														1	1
Falco longipennis	Australian Hobby															1																															2	3
Falco peregrinus	Peregrine Falcon	OS																																													1	1

Family, Genus, Species	Common name	Status	Trap Site 1						Trap Site 2						Trap Site 3						Trap Site 4						Trap Site 5						Trap Site 6						Trap Site 7						Trap Site 8								
			Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Noct. Search	Bat Census	Active Searches	Opp.	Totals
HALCYONIDAE																																																		
Todiramphus pyrrhopygia	Red-backed Kingfisher																																													1	1
Todiramphus sanctus	Sacred Kingfisher																																														1	1
MALURIDAE																																																	
Malurus lamberti	Variegated Fairy-wren																												4																			4
Malurus leucopterus	White-winged Fairy-wren																																4														4
MEGALURIDAE																																																	
Eremiornis carteri	Spinifexbird																																														1	1
MELIPHAGIDAE																																																	
Manorina flavigula	Yellow-throated Miner										2																						3														8	13
Acanthagenys rufogularis	Spiny-cheeked Honeyeater										1																																			2	2	5
Certhionyx variegatus	Pied Honeyeater																																														1	1
Epthianura tricolor	Crimson Chat				18																																										18
Lichenostomus virescens	Singing Honeyeater				2						4						1						10						2						2						1					3	1	26
Lichmera indistincta	Brown Honeyeater				2																																										1	3
Ptilotula keartlandi	Grey-headed Honeyeater																																														2	2
Ptilotula pendiculata	White-plumed Honeyeater																																													4	6	10
MEROPIDAE																																																	
Merops ornatus	Rainbow Bee-eater										2																																				4	6
MONARCHIDAE																																																	
Grallina cyanoleuca	Magpie-lark																1																														2	3
MOTACILLIDAE																																																
Anthus novaeseelandiae	Australian Pipit				2																																										1	3
OTIDIDAE																																																	
Ardeotis australis	Australian Bustard				P						P						P						2, P						P										F						P	1	1
PACHYCEPHALIDAE																																																	
Oreoica gutturalis	Crested Bellbird																						2						1																	4	7
Pachycephala rufiventris	Rufous Whistler																1																								1				2		2	2	8
Colluricincla harmonica	Grey Shrike-thrush										1						1						1																		1						1	5	10
PARDALOTIDAE																																																	
Pardalotus striatus	Striated Pardalote																																															1	2	3
Pardalotus rubicatus	Red-browed Pardalote																																															3	3
PETROICIDAE																																																	
Melanodryas cucullata	Hooded Robin																																															4	4
Petroica goodenovii	Red-capped Robin																												2																			2	6
POMATOSTOMIDAE																																																	
Pomatostomus temporalis	Grey-crowned Babbler																5						11																		N					6	4		26
PSITTACIDAE																																																	
Barnardius zonarius	Australian Ringneck																																															2		4	6
Melopsittacus undulatus	Budgerigar				14						8																																							25
PSOPHODIDAE																																																	
Cinclosoma castaneothorax	Chestnut-breast Quail-thrush																																															3	3
PTILINORHYNCHIDAE																																																	
Ptilonorhynchus guttatus	Western Bowerbird																																															1	1
RHIPIDURIDAE																																																	
Rhipidura leucophrys	Willie Wagtail				3																								1																			1	1	6
Reptiles																																																	
AGAMIDAE																																																	
Amphibolurus longirostris	Long-snouted Tree Dragon														1																																	1
Ctenophorus caudicinctus	Ring-tailed Dragon																																															4
Ctenophorus isolepis isolepis	Northern Military Dragon		3	6			1	3																																								13
Ctenophorus nuchalis	Central Netted Dragon																																														2	1	3
DIPLODACTYLIDAE																																																
Diplodactylus laevis	Fat-tailed Gecko		4																																												4

Family, Genus, Species	Common name		Trap Site 1					Trap Site 2					Trap Site 3					Trap Site 4					Trap Site 5					Trap Site 6					Trap Site 7					Trap Site 8							
		Status	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	search	Active Census	Bird Search	Noct.	Bat Census	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Noct.	Search	Bat Census	Trap	Active search	Bird Census	Noct.	Search	Bat Census	Traps	Active search	Bird Census	Noct.	Search	Bat Census	Active Searches	Opp.	Totals
Lucasium stenodactylum	Box-patterned Ground Gecko					1																																						1
Rhynchoedura ornata	Western Beaked Gecko					5						2																																7
Strophurus elderi	Jewelled Gecko																																											1	1
Strophurus wellingtonae	Betty's Gecko					1						1																																2
ELAPIDAE																																												
Furina ornata	Orange-napped Snake																																1											1
Pseudechis australis	Mulga Snake		3																																									3
Pseudonaja mengdeni	Gwardar									1																																			1
Suta fasciata	Rosen's Snake																																											1	1
GEKKONIDAE																																												
Gehyra fenestrula	Hamersley Range Dtella																																			2						3			5
Gehyra purpurascens	Purple Arid Dtella													1																														1
Gehyra variegata	Tree Dtella																																	2		4							1		7
Heteronotia binoei	Binoe's Gecko																																						1						1
PYGOPODIDAE																																												
Delma butleri	Butler's Delma																															1													1
Delma nasuta	Sharp-snout Delma																															1			1										2
Lialis burtonis	Burton's Legless Lizard																																											1	1
PYTHONIDAE																																												
Antaresia perthensis	Pygmy Python																																											1	1
Antaresia stimsoni	Stimson's Python																																											1	1
Aspidties ramsayi	Woma Python																																											1	1
Aspidties melanocephalus	Black-headed Python																																											1	1
SCINCIDAE																																												
Ctenotus ariadnae	Ariadna's Ctenotus		7	1				1																																			9
Ctenotus duricola	Pilbara Striped Ctenotus																													1														1
Ctenotus grandis titan	Giant Desert Ctenotus		1																																								1
Ctenotus hanloni	Hanlon's Skink		1																																								1
Ctenotus helenae	Helen's Skink		24					1																																			25
Ctenotus leonhardii	Leonhard's Ctenotus								1									1																										2
Ctenotus pantherinus	Leopard Skink		4	2				4																4																			14
Ctenotus saxatilis	Rock Ctenotus												1																				1											2
Ctenotus uber uber	Spotted Ctenotus																							1																			1
Egernia cygnitos	Western Pilbara Spiny-tail																																	2										2
Eremiascincus richardsonii	Broad-banded Sand-swimmer																																						1						1
Lerista bipes	Western Two-toed Slider							1																																				1
Lerista muelleri	Mueller's Three-toed Slider																																						1						1
Lerista neander	Robust Pilbara Slider													3																										1						4
Lerista timida	Dwarf Three-toed Slider												1																																1
Menetia greyii	Common Dwarf Skink							1					2											1																					4
Morelia ruficauda exquisita	Fire-tail Skink																																						1						1
Tiliqua multifasciata	Central Blue-tongue			4					1																1																				6
VARANIDAE																																												
Varanus caudolineatus	Striped-tailed Monitor																																										1		1
Varanus eremius	Pygmy Desert Monitor		3																																									3
Varanus gouldii	Gould's Monitor																																										1	1	2
Varanus panoptes	Yellow-spotted Monitor								2										P																									1	3
Amphibians																																													
HYLIDAE																																												
Cyclorana platycephala	Water-holding Frog													1		1																												1		3
Cyclorana maini	Sheep Frog												2																																2
Litoria rubella	Little Red Tree Frog																																										calling		many
MYOBATRACHIDAE																																												
Uperoleia saxatilis	Pilbara Toadlet																																										calling		many

Family, Genus, Species	Common name		Trap Site 1						Trap Site 2						Trap Site 3						Trap Site 4						Trap Site 5						Trap Site 6						Trap Site 7						Trap Site 8								
		Status	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Search	Noct.	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Trap	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Noct. Search	Bat Census	Traps	Active search	Bird Census	Noct. Search	Bat Census	Active Searches	Opp.	Totals
Mammals																																																	
BOVIDAEIDAE																																																	
Bos taurus	Domestic Cattle	int		8, P						P					P						S, P						S, P												S, P							many		many
CAMELIDAE																																																
Camelus dromedarius	Camel	int		P						P											P																											3
CANIDAE																																																
Canus lupis dingo	Dingo			P																								P																		S		3
DASYURIDAE																																																
Dasycercus blythi	Brush-tailed Mulgara	P4		B						P, B																																					E
Dasykaluta rosamondae	Little Red Kaluta								5																																							5
Pseudantechinus woolleyei	Woolley's Antechinus																																														1, C	1
Sminthopsis macroura	Stripe-faced Dunnart																																													2	C	2, C
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart		3						2																2																							7
EMBALLONURIDAE																																																
Saccolaimus flaviventris	Yellow-belly Sheath-tail Bat																																		PR													PR
Scotorepens greyii	Little Broad-nosed Bat						D											D																D										D		D
Taphozous georgianus	Common Sheath-tail Bat																	D				PR												D								1	D			1
Taphozous hilli	Hill's Sheath-tail Bat																	PR																PR													PR
EQUIDAE																																																
Equus asinus	Donkey	int		S																	E																											E
FELIDAE																																																
Felis catus	Cat	int		P						1, P		1					1																															3
MACROPODIDAE																																																
Macropus robustus	Euro																																															2
Macropus rufus	Red Kangaroo			7		2				3		5			2		2				2		2																									25
MEGADERMATIDAE																																																
Macroderma gigas	Ghost Bat																																																E
MOLOSSIDAE																																																
Austronomus australis	White-striped freetail Bat												D											PR											D													D
Chaerephon jobensis	Northern Mastiff Bat																	PR						PR																								PR
MURIDAE																																																
Notomys alexis	Spinifex Hopping Mouse																				B																											E
Pseudomys chapmani	Pebble-mound Mouse																																															M	E
Pseudomys hermannsburgensis	Sandy Inland Mouse																																															C	C
Zyzomys argurus	Rock Rat																																																C	C
TACHYGLOSSIDAE																																																
Tachyglossus aculeatus	Echidna																																															Digs	E
VESPERTILIOIDAE																																																
Chalinolobus gouldii	Gould's Wattle Bat						D											D												D				D				D								D
Chalinolobus morio	Chocolate Wattled Bat																	PR						PR										PR													PR
Nyctophilus sp.	Long-eared Bat																																																D
Vespadelus finlaysoni	Inland Cave Bat																							D						D				D													D

Key = E, Evidence of use recorded, multiple types - either feeding, scats, feathers fur etc

C, recorded on remote camera

D, Actual detection on bat detector

Pr, probably the species recorded on bat detector but call either poor or not clear

P, prints recorded, B, burrows recorded

Calling, species recorded via calling only

Int, introduced species

Table 27 Habitat points recorded during the field survey

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
EJM-01	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	fauna trap array	-23.364717	120.393297	
EJM-02	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	fauna trap array	-23.372013	120.349545	
EJM-03	Major Drainage Line	Major Drainage Line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Large Patches	1	Old (6+ yrs)	Cattle Grazing	fauna trap array	-23.386019	120.311648	
EJM-04	Mulga Woodland	Mulga Woodland	Flat	Flat	Medium Clay	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	fauna trap array	-23.404546	120.313091	
EJM-05	Mulga Woodland	Mulga Woodland	Flat	Flat	Medium Clay	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	2	Old (6+ yrs)	None Discernible	fauna trap array	-23.376532	120.307659	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
EJM-06	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North	Moderate	Medium Clay	Scarce	Moderate Outcropping	CID	Gravel (1-4cm)	Scarce	0	Old (6+ yrs)	None Discernible	fauna trap array	-23.375400	120.262022	
EJM-07	Hillcrest/ Hillslope	Hillcrest/ Hillslope	East	Moderate	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Pebbles(5-10cm)	Few Large Patches	0	Old (6+ yrs)	None Discernible	fauna trap array	-23.362887	120.231725	
EJM-08	Major Drainage Line	Major Drainage Line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Large Patches	1	Old (6+ yrs)	Cattle Grazing	fauna trap array	-23.385428	120.214607	
CAM-115	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.371332	120.379345	
CAM-2	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	motion camera	-23.355714	120.271998	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
CAM-29	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Gravel (1-4cm)	Hillcrest/ Hillslope	0	Old (6+ yrs)	None Discernible	motion camera	-23.362824	120.232005	
CAM-15b	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Medium Clay	Many large Patches	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	motion camera	-23.354941	120.284379	
CAM-7	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.379434	120.324811	
CAM-19	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.376236	120.332154	
CAM-1	Hillcrest /Hillslope	Hillcrest/ Hillslope	Flat	Flat	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.357455	120.251727	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
CAM-77	Minor Drainage Line	Minor Drainage Line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	motion camera	-23.355786	120.293580	
CAM-99	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North/ East	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.372147	120.248166	
CAM-A	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South/ West	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Gravel (1-4cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.371491	120.250342	
CAM-14	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.371828	120.251647	
CAM-20	Major Drainage line	Major Drainage line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Large Patches	1	Old (6+ yrs)	Cattle Grazing	motion camera	-23.364745	120.314311	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
CAM-A2	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Negligible	Scarce	2	Old (6+ yrs)	None Discernible	motion camera	-23.373956	120.249765	
CAM-25	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South/ East	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.362588	120.232928	
CAM-24	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South/ East	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.364684	120.199481	
CAM-14a	Claypan	Claypan	Flat	Flat	Medium Clay	Many large Patches	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	motion camera	-23.371416	120.296569	
CAM-16	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South/ West	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.371062	120.249452	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
CAM-13	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South/ East	Moderate	Medium Clay	Scarce	Minor Outcropping	CID	Gravel (1-4cm)	Scarce	0	Old (6+ yrs)	None Discernible	motion camera	-23.380843	120.235727	
SM-1	Hillcrest/ Hillslope	Hillcrest/ Hillslope	East	Moderate	Medium Clay	Scarce	Moderate Outcropping	CID	Large Rocks (21-60cm)	Scarce	0	Old (6+ yrs)	None Discernible	additional bat detector	-23.372831	120.194474	
SM-2	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North/ East	Moderate	Medium Clay	Scarce	Moderate Outcropping	CID	Large Rocks (21-60cm)	Scarce	0	Old (6+ yrs)	None Discernible	additional bat detector	-23.367655	120.193573	
SM-3	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North/ East	Moderate	Medium Clay	Scarce	Moderate Outcropping	CID	Large Rocks (21-60cm)	Scarce	0	Old (6+ yrs)	None Discernible	additional bat detector	-23.367655	120.193573	
FOR-1	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.369898	120.379603	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
FOR-2	Hillcrest/ Hillslope	Hillcrest/ Hillslope	Flat	Flat	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.361192	120.235658	
FOR-3	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.386953	120.253391	
FOR-4	Claypan	Claypan	Flat	Flat	Medium Clay	Many large Patches	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.371416	120.296569	
FOR-5	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.364833	120.272391	
FOR-6	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.376789	120.285291	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
FOR-7	Sand Plain	Mulga Woodland	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.392360	120.209968	
FOR-8	Hillcrest/ Hillslope	Hillcrest/ Hillslope	Flat	Flat	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles(5-10cm)	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.355957	120.269325	
FOR-9	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.363621	120.309959	
FOR-10	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.396757	120.419651	
FOR-11	Hillcrest/ Hillslope	Hillcrest/ Hillslope	Flat	Flat	Medium Clay	Scarce	Moderate Outcropping	CID	Gravel (1-4cm)	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.371752	120.268264	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
FOR-12	Hillcrest/ Hillslope	Hillcrest/ Hillslope	Flat	Flat	Medium Clay	Scarce	Moderate Outcropping	CID	Pebbles(5-10cm)	Few Small Patches	0	Old (6+ yrs)	None Discernible	additional active search	-23.367655	120.193573	
BAR-4	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	SM4 acoustic	-23.364717	120.393297	
BAR-1	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	SM4 acoustic	-23.372013	120.349546	
BAR-3	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	SM4 acoustic	-23.404546	120.313091	
BAR-2	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	0	Old (6+ yrs)	None Discernible	SM4 acoustic	-23.376532	120.307659	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
NOC-1	Hillcrest/ Hillslope	Hillcrest/ Hillslope	East	Low	Medium Clay	Scarce	Minor Outcropping	CID	Gravel (1-4cm)	Scarce	0	Old (6+ yrs)	None Discernible	Nocturnal search	-23.366909	120.193063	
NOC-2	Major Drainage line	Major Drainage line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	Cattle Grazing	Nocturnal search	-23.370158	120.196129	
NOC-3	Major Drainage line	Major Drainage line	Flat	Flat	Silty Clay Loam	Many large Patches	Negligible	None Discernible	Negligible	Few Large Patches	2	Old (6+ yrs)	Cattle Grazing	Nocturnal search	-23.374126	120.202627	
NOC-4	Mulga Woodland	Mulga Woodland	Flat	Flat	Sandy Clay Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Small Patches	1	Old (6+ yrs)	None Discernible	Nocturnal search	-23.374243	120.206218	
NOC-5	Hillcrest/ Hillslope	Hillcrest/ Hillslope	North/ East	Low	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles (5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	Nocturnal search	-23.373180	120.228612	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
NOC-6	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	Nocturnal search	-23.364610	120.327124	
NOC-7	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Scarce	0	Old (6+ yrs)	None Discernible	Nocturnal search	-23.365731	120.393585	
NOC-8	Hillcrest/ Hillslope	Hillcrest/ Hillslope	South	Low	Medium Clay	Scarce	Minor Outcropping	CID	Pebbles (5-10cm)	Scarce	0	Old (6+ yrs)	None Discernible	Nocturnal search	-23.363936	120.229476	
BIL-1	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.377622	120.380328	
BIL-2	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.371332	120.379345	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
BIL-3	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.398762	120.420158	
BIL-4	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.384782	120.266694	-
BIL-5	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.380670	120.374483	-
BIL-6	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.374451	120.289196	-
BIL-7	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.384798	120.379009	
BIL-8	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.381157	120.381460	-
BIL-9	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.376877	120.373633	
BIL-10	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.365000	120.309715	-
BIL-11	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.393318	120.214114	-
BIL-12	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.376356	120.286435	

Site id	Habitat type	Landform	Aspect	Slope	Soil type	Soil availability	Outcrop	Rock outcropping	Rock size	Vegetation litter	Hollow count	Last fire	Disturbance	Comments	Latitude	Longitude	Photo
BIL-13	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.396757	120.419651	
BIL-14	Sand Plain	Sand Plain	Flat	Flat	Sandy Loam	Evenly Spread	Negligible	None Discernible	Negligible	Few Large Patches	0	Old (6+ yrs)	None Discernible	target spp transect	-23.366453	120.379685	-

Appendix E – Bat Analysis data

Bat call identification from Jimblebar, Western Australia

Type:	Acoustic analysis
Prepared for:	GHD Pty Ltd
Date:	12 May 2019
Job No.:	SZ495
Prepared by:	Dr Kyle Armstrong and Yuki Konishi Specialised Zoological ABN 92 265 437 422 Tel 0404 423 264 kyle.n.armstrong@gmail.com http://szool.com.au

This report should be included as an appendix in any larger submission to Government, and cited as:

Specialised Zoological (2019). Bat call identification from Jimblebar, Western Australia. Acoustic analysis. Unpublished report by Specialised Zoological for GHD Pty Ltd, 12 May 2019, Job number SZ495.

Summary

Bat identifications from acoustic recordings are provided from near Jimblebar, in the Pilbara region of Western Australia. Six species of bat were identified as being present (**Tables 1** and **2**). The identification of bat species from full spectrum WAV-format recordings of their echolocation calls was based on measurements of characteristic frequency, observation of pulse shape, and the pattern of harmonics. No calls of the Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* or the Ghost Bat *Macroderma gigas* were observed. Representative echolocation calls for each identification are illustrated (**Figures 1–3**), as recommended by the Australasian Bat Society (ABS 2006). Further details are available should verification be required.

Methods

The data provided were recorded in full spectrum WAV format with a Wildlife Acoustics EchoMeter Touch bat detector (sampling rate 256 kHz, recorded manually on walking transects; 65 WAV files) and a Titley Scientific AnaBat Swift bat detector (sampling rate 320 kHz, set for overnight triggered recording; 1198 WAV files). All WAV files were inspected in a spectrogram in Adobe Audition CS6 version 5.0.2, with particular attention given to the detection of calls from the Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* and the Ghost Bat *Macroderma gigas*. Certain non-echolocation calls of the Common Sheath-tailed Bat *Taphozous georgianus* made inside roosts can resemble the echolocation calls of *M. gigas*, so all WAV files were checked carefully a second time. Species were identified based on the author's unpublished data; and nomenclature follows Jackson and Groves (2015).

Limitations

The identifications presented in this report have been made within the following context:

1. The identifications made herein were based on the ultrasonic acoustic data recorded and provided by a 'third party' (the client named on the front of this report).
2. The scope of this report extended to providing information on the identification of bat species in bulk ultrasonic recordings. Further comment on these species and the possible impacts of a planned project on bat species were not part of the scope.
3. In the case of the present report, the recording equipment was not set up and supplied by Specialised Zoological. The equipment was operated by the third party during the survey.
4. Other than the general location of the study area, Specialised Zoological has not been provided with detailed information of the survey area, has not made a visit to observe the habitats available for bats, nor have we visited the specific project areas on a previous occasion.
5. Specialised Zoological has had no input into the overall design and timing of this bat survey, recording site placement, nor the degree of recording site replication.
6. While Specialised Zoological has made identifications to the best of our ability given the available materials, and reserves the right to re-examine the data and revise any identification following a query, it is the client's and / or proponent's responsibility to

provide supporting evidence for any identification, which might require follow-up trapping effort or non-invasive methods such as video recordings. Specialised Zoological bears no liability for any follow-up work that may be required to support an identification based initially on the analysis of acoustic recordings undertaken and reported on here.

7. There are a variety of factors that affect the 'detectability' of each bat species, given the frequency, power and shape characteristics of their calls. Further information on the analysis and the various factors that can impinge on the reliability of identifications can be provided upon request.

8. The analysis of ultrasonic recordings is one of several methods that can be used to survey for bats, and comprehensive surveys typically employ more than one method. If an identification in the present report is ambiguous or in question, a trapping programme would help to resolve the presence of the possibilities in the project area.

References

ABS (2006). Recommendations of the Australasian Bat Society Inc for reporting standards for insectivorous bat surveys using bat detectors. *The Australasian Bat Society Newsletter* 27: 6–9. [ISSN 1448-5877]

Jackson, S.M. and Groves, C.P. (2015). *Taxonomy of Australian mammals*. CSIRO Publishing, Victoria.

Table 1. Species identified in the present survey from all sites combined.

EMBALLONURIDAE	
Common Sheath-tailed Bat	*Taphozous georgianus*
VESPERTILIONIDAE	
Gould's Wattled Bat	*Chalinolobus gouldii*
Little Broad-nosed Bat	*Scotorepens greyii*
Finlayson's Cave Bat	*Vespadelus finlaysoni*
MOLOSSIDAE	
White-striped Free-tailed Bat	*Austronomus* (=*Tadarida*) *australis*
Greater Northern Free-tailed Bat	*Chaerephon jobensis*

Table 2. Species identifications, with the degree of confidence indicated by a code. Date and serial/unit number correlates with site; see **Table 1** for full species names. Times are given for when bat calls are first detected after the recorder turns on, and for calls just before it turns off at sunrise—these calls were all from bats inside the roost structure.

		A. australis	***C. gouldii***	***C. jobensis***	***S. greyii***	***T. georgianus***	***V. finlaysoni***	**First bat detected**	**Last bat detected**
EchoMeter Touch	5/05/2019	◆	◆	◆	◆	◆	◆	17:45:17	19:11:02
Swift 513984	2/05/2019	—	◆	—	—	◆	◆	17:00:52	06:20:00
	3/05/2019	◆	◆	◆	—	◆	◆	17:00:43	06:56:24
	4/05/2019	◆	◆	—	—	◆	◆	17:01:51	06:57:46
	5/05/2019	—	◆	◆	—	◆	◆	17:00:22	06:58:02

Definition of confidence level codes:

— Not detected.

◆ Unambiguous identification of the species at the site based on measured call characteristics and comparison with available reference material. Greater confidence in this ID would come only after capture and supported by morphological measurements or a DNA sequence.

NC Needs Confirmation. Either call quality was poor, or the species cannot be distinguished reliably from another that makes similar calls. Alternative identifications are indicated in the *Comments on identifications* section of this report. If this is a species of conservation significance, further survey work might be required to confirm the record.

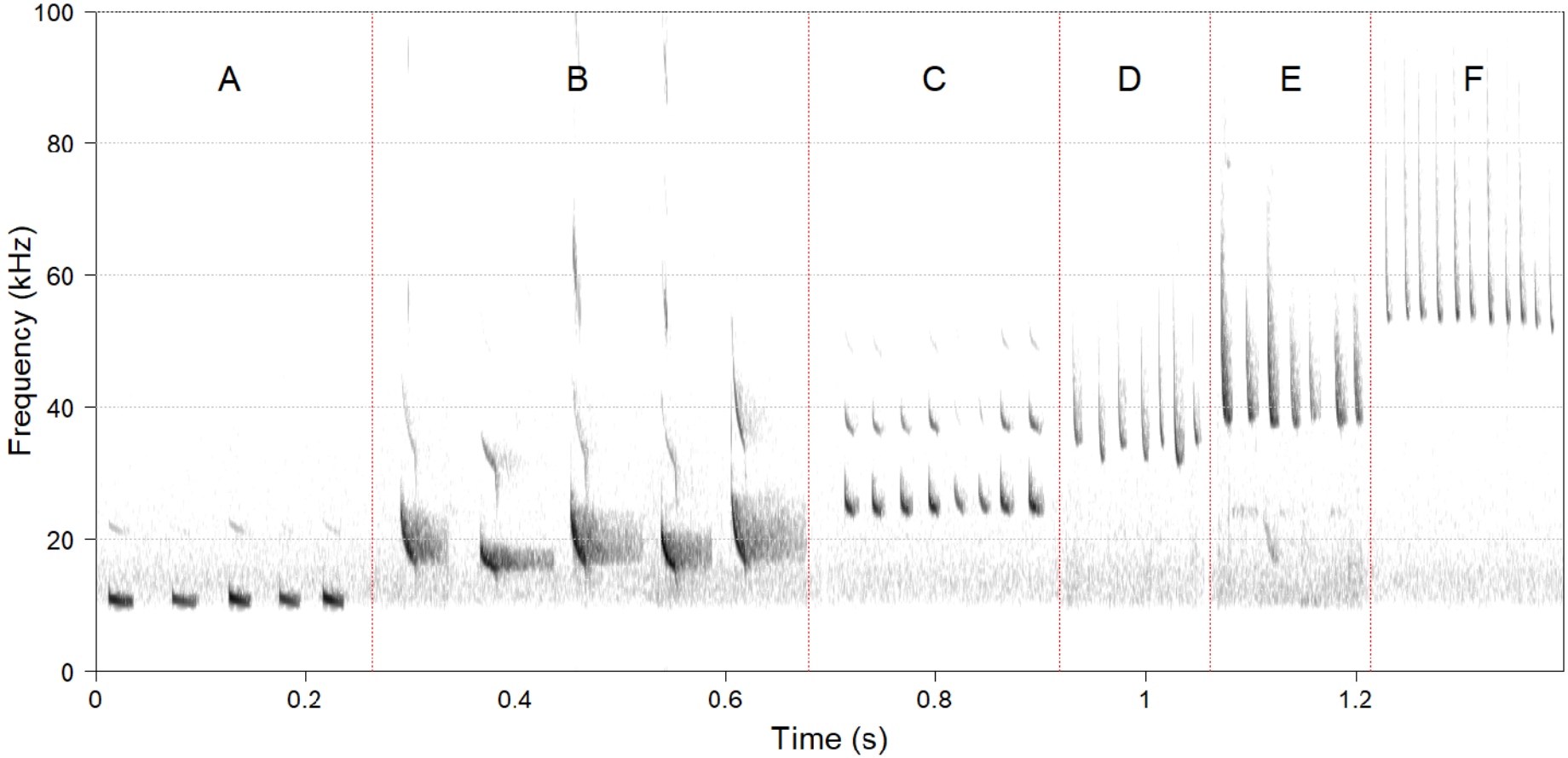

Figure 1. Representative echolocation call sequence portions of the species identified (**A**: *Austronomus australis*; **B**: *Chaerephon jobensis*; **C**: *Taphozous georgianus*; **D**: *Chalinolobus gouldii*; **E**: *Scotorepens greyii*; **F**: *Vespadelus finlaysoni*; time between pulses has been compressed).

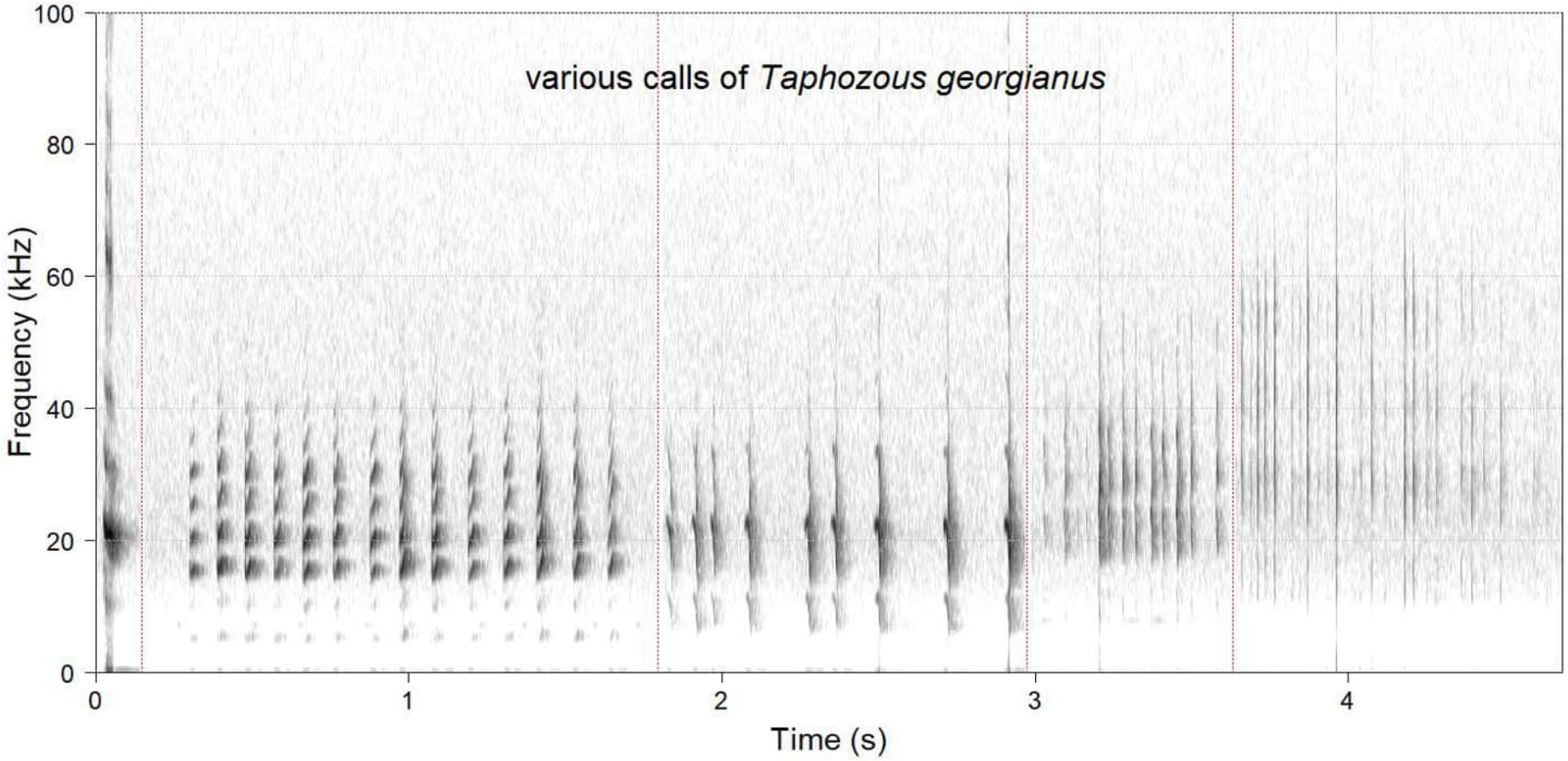

Figure 2. Non-echolocation call sequences from *Taphozous georgianus*, made while in the roost.

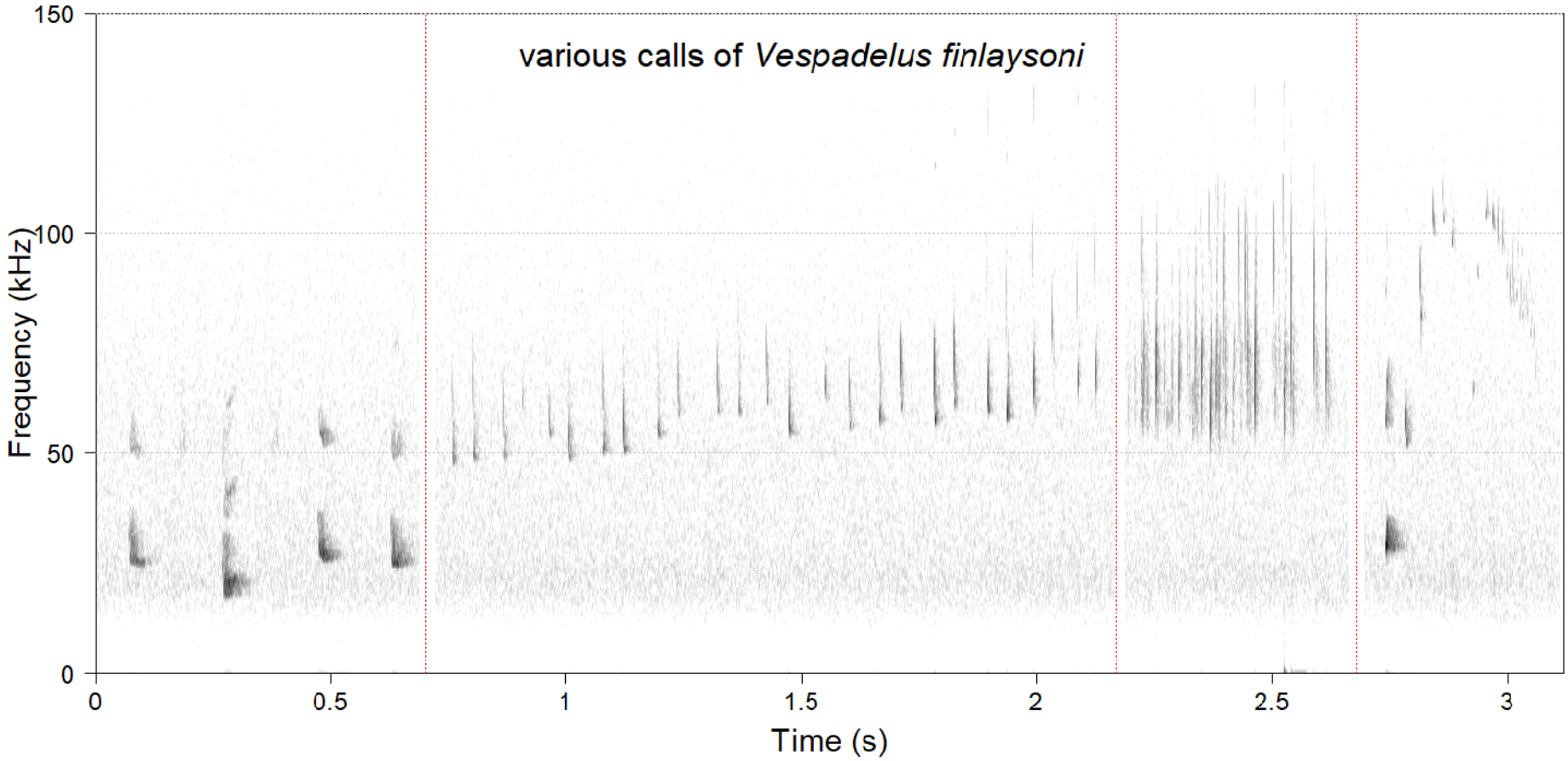

Figure 3. Non-echolocation call sequences from *Vespadelus finlaysoni*, made while in the roost.

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