PHOENIX
ENVIRONMENTAL SCIENCES

Terrestrial Vertebrate Fauna Survey for Anketell Point Rail Alignment and Port Projects

Prepared for Australian Premium Iron Management Pty Ltd

FINAL REPORT
26 July 2010

Terrestrial Vertebrate Fauna Survey for Anketell Point Rail Alignment and Port Projects

Final Report

Prepared for Australian Premium Iron Management Pty Ltd by Phoenix Environmental Sciences Pty Ltd

Authors: Greg Harewood, Karen Crews

Reviewer: Melanie White, Stewart Ford

Date: 26 July 2010

Submitted to: Michelle Carey

Phoenix Environmental Sciences Pty Ltd

1/511 Wanneroo Road

BALCATTA WA 6914

P: 08 9345 1608

F: 08 6313 0680

E: admin@phoenixenv.com.au

Project code: 925-AP-API-FAU

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

EXECUTIVE SUMMARY

Australian Premium Iron Management Pty Ltd (API) is developing the West Pilbara Iron Ore Project (WPIOP) on behalf of equal joint venture partners Aquila Resources Ltd and American Metals and Coal Industries. The current proposed infrastructure associated with the WPIOP includes port facilities at Anketell Point and a rail alignment to the port facilities.

In June 2009, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by API to undertake a Level 2 vertebrate fauna survey of the Anketell Point Rail Alignment (northern portion only) and Port Projects (collectively termed the study area). A Level 2 survey requires field surveys over two seasons. This report documents the results of two seasonal surveys conducted in June 2009 and March 2010.

A pre-survey desktop review was conducted to identify significant species that may occur within the study area. Several fauna habitats were identified within the study area: beaches, coastal dunes, coastal plains, drainage lines, hill slopes, mangroves, mudflats and samphire, and rocky outcrops.

Survey methodology conformed with requirements for a Level 2 survey as outlined in EPA Guidance Statement 56 (EPA 2004). Surveys of relevant habitats in the study area comprised:

- Systematic trapping for ground-dwelling mammals, reptiles and amphibians;
- Censusing of bird species;
- Recording of bat echolocation calls using Anabat™;
- Spotlighting for nocturnal species;
- Opportunistic searches for reptiles and any other species; and
- Targeted searches (hand searching and raking) for the fossorial skink *Lerista nevinae*.

Two hundred and four vertebrate species were recorded during the two surveys. This represents approximately 60% of the potentially occurring fauna identified in the desktop review.

The recorded fauna assemblage comprised three amphibians, 111 birds, 27 mammals and 63 reptiles. A total of 4369 individual records were made during the surveys.

A single listed threatened species and six DEC priority species were recorded during the fauna survey (Table 0-1). Eleven additional conservation significant species were identified from the desktop studies as potentially occurring in the study area but were not recorded in the surveys. Of these, seven are considered unlikely to occur in the study area due largely to lack of suitable habitat but four may occur within the study area (Table 0-1).

The fossorial skink *Lerista nevinae* was also recorded during the surveys. This highly restricted species was listed as Priority 1 in June 2010. It appears to be restricted to coastal dunes in the Anketell Point vicinity and Dixon Island. *L. nevinae* was recorded at three locations along the western side of Dixon Headland extending the known mainland habitat of the species approximately 2km north and 1.5km west. Targeted searches conducted on Dixon and Delambre Islands did not yield any records, however Biota recorded two individuals from Dixon Island in 2009 (SKM 2009).

Twenty-one avifauna listed as Migratory under the EPBC Act were recorded in the surveys.

Fauna habitats of highest conservation significance in the study area are the coastal dunes around Dixon Headland (and possibly Dixon Island) which support *Lerista nevinae* and the mangrove communities.

Table 0-1 Conservation significant vertebrate fauna summary[a].

Species	Status	Habitats recorded from in study area	Not Recorded, but likely to/may occur in these habitats	Not recorded and unlikely to occur
Chelonia mydas (Green Turtle)	Schedule 1, Endangered (EPBC Act)	Coastal dunes, ocean waters		
Mormopterus loriae cobourgiana (Little Northern Freetail Bat)	Priority 1	Anabat[tm] recordings from most habitat types		
Lerista nevinae	Priority 1	Coastal dunes		
Ardeotis australis (Australian Bustard)	Priority 4	Rocky outcropping on hill slope with hummock grassland		
Pseudomys chapmani (Western Pebble-mound Mouse)	Priority 4	Hill slope	Drainage lines, rocky outcrops.	
Numensis madagascariensis (Eastern Curlew)	Priority 4	Tidal mudflats and beaches		
Notoscincus butleri	Priority 4	Major drainage line		
Falco peregrinus (Peregrine Falcon)	Schedule 4		May hunt in the study area, but unlikely to nest.	
Burhinus grallarius (Bush Stone-curlew)	Priority 4		May occasionally inhabit open spinifex hummock grasslands	
Phaps histronica (Flock Bronzewing)	Priority 4			X
Neochmia ruficauda subclarescens (Star Finch)	Priority 4			X
Liasis olivaceus barroni (Pilbra Olive Python)	Vulnerable (EPBC Act), Schedule 1 (WC Act)			X
Dasycercus cristicauda (Mulgara)	Vulnerable (EPBC Act), Schedule 1 (WC Act)			X
Dasyurus hallucatus (Northern Quoll)	Endangered (EPBC Act), Schedule 1 (WC Act)		Hill slopes, rocky outcrops, minor drainage lines	
Lagostrophus fasciatus fasciatus (Banded Hare-wallaby)	Vulnerable (EPBC Act), Schedule 1 (WC Act)			X
Rhinonicteris aurantius (Pilbara form) (Pilbara Leaf-nosed Bat)	Vulnerable (EPBC Act), Schedule 1 (WC Act)			X
Macroderma gigas (Ghost Bat)	Priority 4			X
Leggadina lakedownensis (Short-tailed Mouse)	Priority 4		Stony spinifex hummock grasslands	

a – Three additional turtle species were also identified as potentially occurring but are not considered further in this assessment.

1.0 INTRODUCTION

In June 2009, Phoenix Environmental Sciences Pty Ltd (Phoenix) was commissioned by Australian Premium Iron Management Pty Ltd (API) to undertake a Level 2 vertebrate fauna survey of the Anketell Point Rail Alignment (northern portion only) and Port Projects (collectively termed the study area). A Level 2 survey requires field surveys over two seasons. This report documents the results of the two seasonal surveys conducted in June 2009 and March 2010.

1.1 BACKGROUND

Australian Premium Iron Management Pty Ltd (API) is developing the West Pilbara Iron Ore Project (WPIOP) on behalf of equal joint venture partners Aquila Resources Ltd and American Metals and Coal Industries. The current proposed infrastructure associated with the WPIOP includes port facilities at Anketell Point and a rail alignment to the port facilities.

The study area occurs within the Pilbara biogeographic region in the Shire of Roebourne, located approximately 1,500km north of Perth and 30km northeast of Karratha (Figure 1-1). The total survey area is approximately 56km^2. The study area covers the proposed port project and the northernmost part of the proposed rail corridor (Figure 1-2). The conceptual layout of the proposed port and rail line is shown in Figure 1-2.

The study area is located within a "Group 2" area, as defined by the Environmental Protection Authority (EPA) Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). As the proposed disturbance is greater than 50ha, a Level 2 survey was required.

Location of the Anketell Point Rail Alignment and Port Projects

Figure 1.1

0 10 20 30

Kilometres

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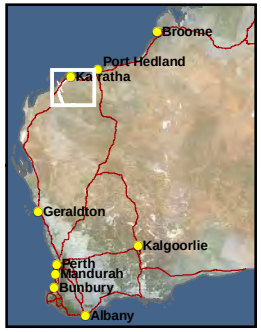

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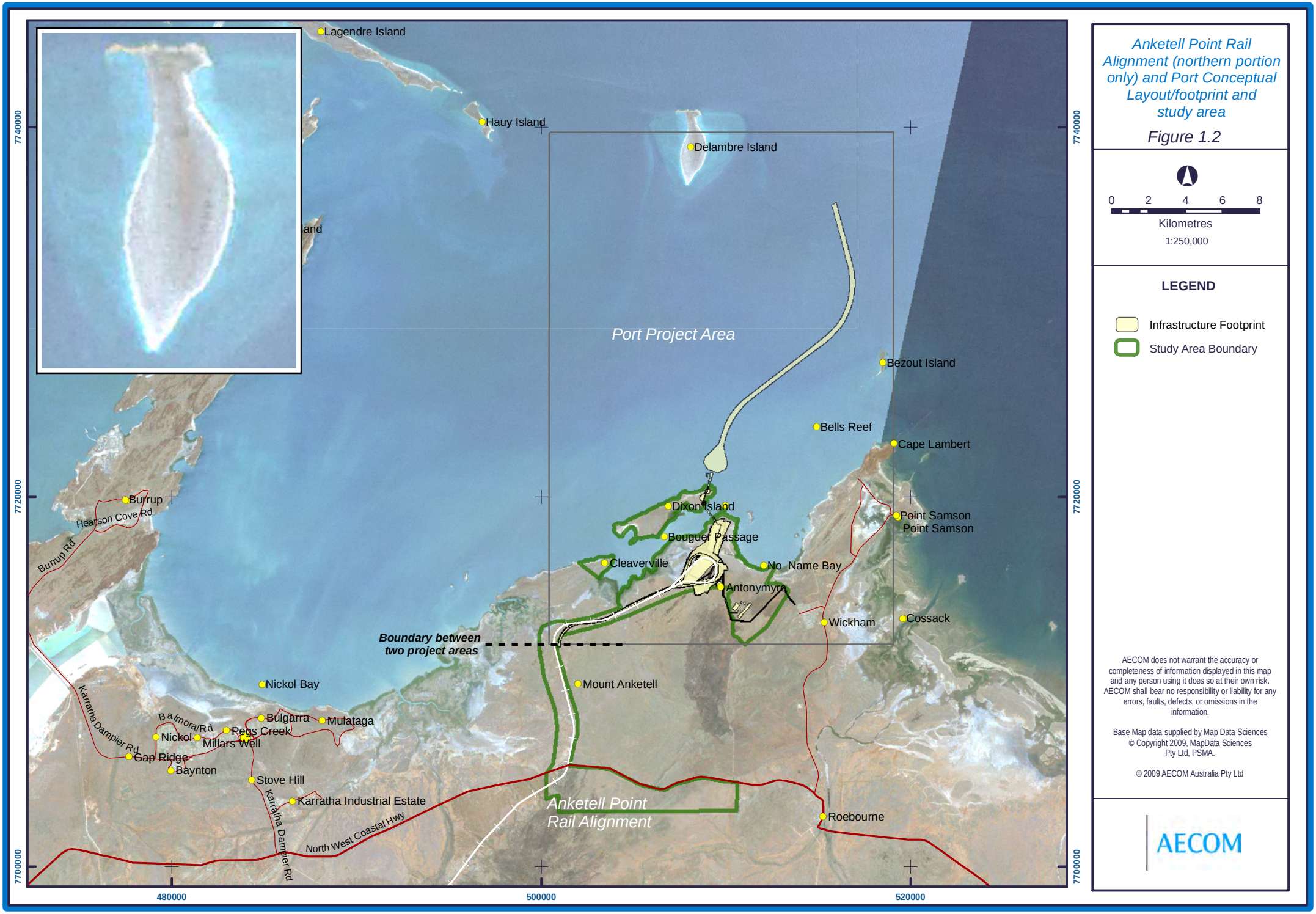

Anketell Point Rail Alignment (northern portion only) and Port Conceptual Layout/footprint and study area

Figure 1.2

0 2 4 6 8

Kilometres

1:250,000

LEGEND

Infrastructure Footprint

Study Area Boundary

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1.2 SCOPE OF WORK AND SURVEY OBJECTIVES

The aim of the Level 2 vertebrate fauna survey was to provide sufficient baseline information on vertebrate fauna and faunal assemblages occurring in the study area, to accurately assess the likely environmental impact that the proposed development will have on fauna values.

The scope of work was as follows:

1. Undertake a desktop review of existing reports of fauna surveys in the vicinity (where available) of the study area, and database searches to determine significant species occurring or potentially occurring in the study area;
2. Undertake a fauna habitat assessment;
3. Conduct a Level 2 fauna survey within the study area over two seasons; Autumn 2009 and Spring 2010;
4. Map fauna habitats;
5. Provide an interim technical report after the first survey on survey results that includes;
    a. Results of database searches;
    b. Results of the first survey, as well as results from previous relevant surveys (where available), including species lists;
    c. Review of species of conservation significance recorded in the surveys (local, regional, State and Commonwealth significance);
    d. A fauna habitat map;
    e. Assessment of regionally and/or locally significant habitats within the study area;
    f. Assessment of potential impacts of the proposed project on fauna, fauna habitats and biodiversity values; and
    g. Recommendations for management of potential impacts on fauna, fauna habitats and biodiversity values.
6. Provide a full draft report following the second survey that incorporates the results of the second seasonal survey into the interim report.

Subsequently, any reference to impact assessment was removed from this report at the client's request and all reference to assessment of the likely environmental impact that the proposed development will have on fauna values is discussed in relevant sections of the Mine Rail and Port Public Environmental Review documents.

1.3 EXISTING ENVIRONMENT

1.3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA (IBRA) REGION

The Anketell Point Rail Alignment and Port Projects fall within the Pilbara biogeographic region as defined by the IBRA (Thackway and Cresswell 1995). The Pilbara bioregion has four main geological components (subregions):

- The Hamersley Range, a mountainous area of Proterozoic sedimentary ranges and plateaux;
- The Fortescue Plains, consisting of alluvial plains and river frontages;

- The Chichester range comprising Archaean granite and basalt plains; and
- Roebourne, consisting of Quaternary alluvial plains.

The study area falls on the northern border of the Chichester and Roebourne subregions, mainly occurring within the former. The Chichester subregion is characterised by undulating Archaean granite and basalt plains including significant areas of basaltic ranges; the plains supporting a shrub steppe characterised by *Acacia pyrifolia* over *Triodia pungens* hummock grasslands; and *Eucalyptus leucophloeia* tree steppes occur on ranges. The Roebourne subregion is characterised by Quaternary alluvial and older colluvial coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia translucens* or *A. pyrifolia* and *A. inequilatera*. Uplands of the Roebourne subregion are dominated by *Triodia* hummock grasslands; ephemeral drainage lines support *Eucalyptus* woodlands; alluvial flats and river deltas contain samphire, *Sporobulus* and mangal; linear basalt ranges occur on the coastal plains; and islands comprise Quaternary sand accumulations, basalt and/or limestone (DEWHA 2009).

1.3.2 LAND SYSTEMS

The Department of Agriculture and Food WA has mapped the Land Systems of the region from aerial photography, providing the largest scale interpretation of vegetation units for the study area. The study area comprises the following Land Systems:

- **Boolgeeda:** Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands. A small section of this Land System occurs at the southern end of the study area.
- **Cheerawarra:** Sandy coastal plains and saline clay plains supporting soft and hard spinifex grasslands and minor tussock grasslands. Occurs in the north east part of the study area.
- **Horseflat:** Gilgaied clay plains supporting tussock grasslands and minor grassy snakewood shrublands. Occurs throughout the southern half of the study area.
- **Littoral:** Bare coastal mudflats with mangroves on seaward fringes, samphire flats, sandy islands, coastal dunes and beaches. Covers the northern coastal portion of the study area.
- **Rocklea:** Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands. A small section occurs to the north of the study area.
- **Ruth:** Hills and ridges of volcanic and other rocks supporting hard spinifex (occasionally soft spinifex) grasslands. Occurs in patches throughout much of the study area.

1.3.3 CLIMATE

The Pilbara region has a semi-desert to tropical climate with highly variable, mostly summer rainfall. The average rainfall over the broader Pilbara area ranges from about 200mm to 350mm, although rainfall may vary widely from the average from year to year (DEWHA 2009). The Roebourne and coastal Chichester subregions experience significant cyclonic activity, with several systems affecting the coast and hinterland annually (CALM 2003).

Average annual rainfall at Roebourne near the southeastern end of the study area is 312.5mm. The bulk of rainfall in the region occurs from January to March and is significantly influenced by cyclonic activity. Average summer maximum temperatures are 38.5°C and average winter maxima are 27.5°C (BOM 2009a; b).

1.4 PREVIOUS SURVEYS

A number of studies were reviewed as part of the desktop assessment and to inform the field surveys. These are discussed below.

1.4.1 FLORA AND VEGETATION

In May - July 2009, AECOM (2010a and b) conducted a flora and vegetation assessment on behalf of API for the Anketell Point Rail Alignment and Port projects.

Another flora and vegetation survey was conducted (Mattiske 2007) on behalf of Cape Lambert Iron Ore Ltd for the Cape Lambert Iron Ore Project. This survey overlaps some of the current study area, particularly Dixon Island. A total of 228 plant taxa (including subspecies and varieties) were recorded from 121 genera and 48 families. Six of the recorded species were introduced.

1.4.2 VERTEBRATE FAUNA

In 2008, a single season vertebrate fauna survey was conducted over part of the study area for Cape Lambert Iron Ore Ltd (Ninox 2008). Specifically, Ninox surveyed three sites on the eastern end of Dixon Island and conducted additional bird observations, but noted that insufficient time was spent surveying the island due to tidal restrictions.

In April 2009, Biota (2009) undertook a vertebrate fauna and short-range endemic invertebrate survey in the vicinity of the study area for an earlier proposed rail line option to the east of the current site. One site was located within the southern portion of the current study area and was resurveyed in the current survey.

Four targeted shorebird surveys have been conducted at Anketell Point between October 2008 and July 2009 (Western Wildlife 2008 and 2009a, b, c). These comprised a preliminary shorebird survey, a spring shorebird survey (southward migration), an autumn shorebird survey (northward migration), and a winter (breeding season) shorebird survey. A marine turtle beach survey of Delambre, Dixon and Bezout Islands was undertaken by Pendoley Environmental (2008).

Biota (2008b) conducted a fauna survey of the nearby Cape Lambert Port B Development project for Rio Tinto. Of significance to the current project was an additional targeted survey for the Priority 1 fossorial skink *Lerista nevinae*, undertaken by Biota (2008c) for the Cape Lambert project. *L. nevinae* represents a member of the recently revised *L. muelleri* species complex and is restricted to the vicinity of Cape Lambert and Anketell Point. The Biota survey made several records of *L. nevinae* from within the current study area.

2.0 METHODOLOGY

2.1 CONSULTATION

The Department of Environment and Conservation (DEC), Phoenix and API consulted on the proposed methodology for the fauna survey on 10-11 June 2009. The DEC (Steve van Leeuwen and Tania Jackson) provided the following advice regarding the survey:

- The survey timing for June 2009 is not optimal;
- A greater number of sites should be surveyed and general survey effort/intensity should be increased, particularly for *Lerista nevinae*; and
- Searches for *L. nevinae* should be extended to include Delambre Island.

In response to this advice, the number of trapping sites was increased from 10 to 11, with an additional site located in coastal dune habitat suitable for *L. nevinae* and targeted search effort for *L. nevina*e was increased on Dixon Headland and extended to include Delambre Island nature reserve.

2.2 DATABASE SEARCHES

Relevant environmental databases and maps were reviewed to identify significant species that may occur within the study area. The following databases were reviewed (see Section 4.1 and Appendix 2):

- EPBC Act Protected Matters database within the coordinates 20°43'28.6"S, 116°46'24.5"E; 20°59'35.5"S, 117°01'17.2"E; 20°48'10.6"S, 117°20'22.4"E; 20°31'28.2"S, 117°06'04.6"E (25km buffer from each boundary of the study area);
- DEC Threatened Fauna database within the coordinates 20°31’28.2”S, 20°59’35.5”S, 116°46’24.5”E, 117°20’22.4”E;
- WA Museum/DEC Naturemap within the coordinates 20°31' 25" S, 20°59' 35" S, 116°46' 25" E, 117°20' 20" E; and
- Birds Australia Birdata database for ten minute square containing the point -20.64868°S, 117.0734°E.

2.3 HABITAT ASSESSMENT AND SITE SELECTION

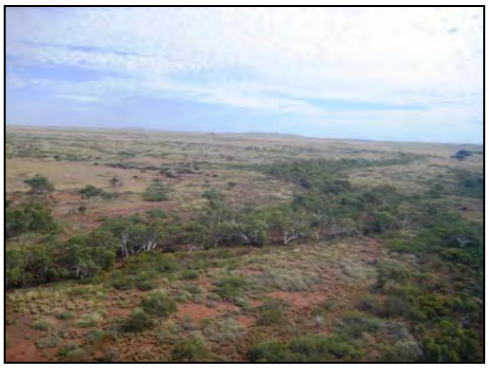
Prior to the June 2009 survey, existing vegetation mapping data (Mattiske 2007; AECOM 2010a and b) and aerial photography were reviewed to tentatively define fauna habitats. The habitats were further refined by ground-truthing during the first day of the field trip.

Eight fauna habitats were identified within the study area:

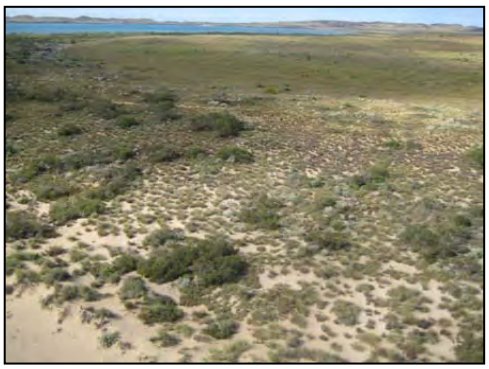
- Beaches;
- Coastal dunes;
- Coastal plains;
- Drainage lines;
- Hill slopes;
- Mangroves;
- Mudflats and samphire; and
- Rocky outcrops.

Trapping sites were established in all habitat types except beach and mangrove habitats, which were subject to inundation and were thought to support low densities of reptiles, mammals and amphibians. Vegetation was described at each of the fauna survey sites (Table 2-1). The fauna habitats were initially defined on the basis of aerial photography, vegetation mapping by AECOM (2010a and b) and Mattiske (2007), and substantiated by field observations. Fauna habitat mapping was subsequently undertaken by AECOM and was based on vegetation mapping by AECOM (2010a and b) and Mattiske (2007), and geospatial analysis of topography to distinguish hill slopes from coastal plains (see section 5.1). Eleven trapping sites were established in total (Figure 2-1). The habitats defined for the study area are present in adjacent areas and are representative of the wider region.

Table 2-1 Habitat descriptions[a] and photos of the Anketell Point Rail Alignment and Port Projects fauna survey sites.

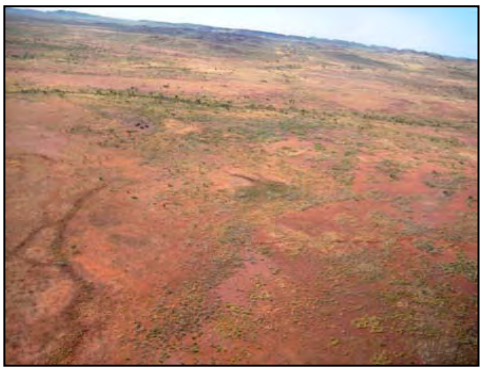
Vegetation descriptions	Representative photos
Drainage line Site 1, DEAT Vegetation type Rocky major drainage line containing Open Woodland of *Eucalyptus victrix* over a Tall Open Scrubland of *Acacia bivenosa* over an Open Grassland of *Triodia* spp. Traps were located at the base of large eucalyptus trees, on creek banks, or on dry island mounds within the creekline.	 

Coastal dune (Dixon Island) Site 2, Lit vegetation type Low lying coastal dune. Open shrubland of *Acacia* spp. over a Tussock Grassland. This habitat type borders Anketell point and sections of Dixon Island. However, at Dixon Island, the dunes are less undulating, with more bare ground. Traps were located in or between mature shrubs with maximum leaf litter.	 
Hill Slope (Dixon Island) Site 3, Thg Vegetation type Gently sloping hill. Closed Hummock Grasslands of *Triodia* spp. Traps were located mid-slope following the contour.	 
Coastal plain (Dixon Island)	

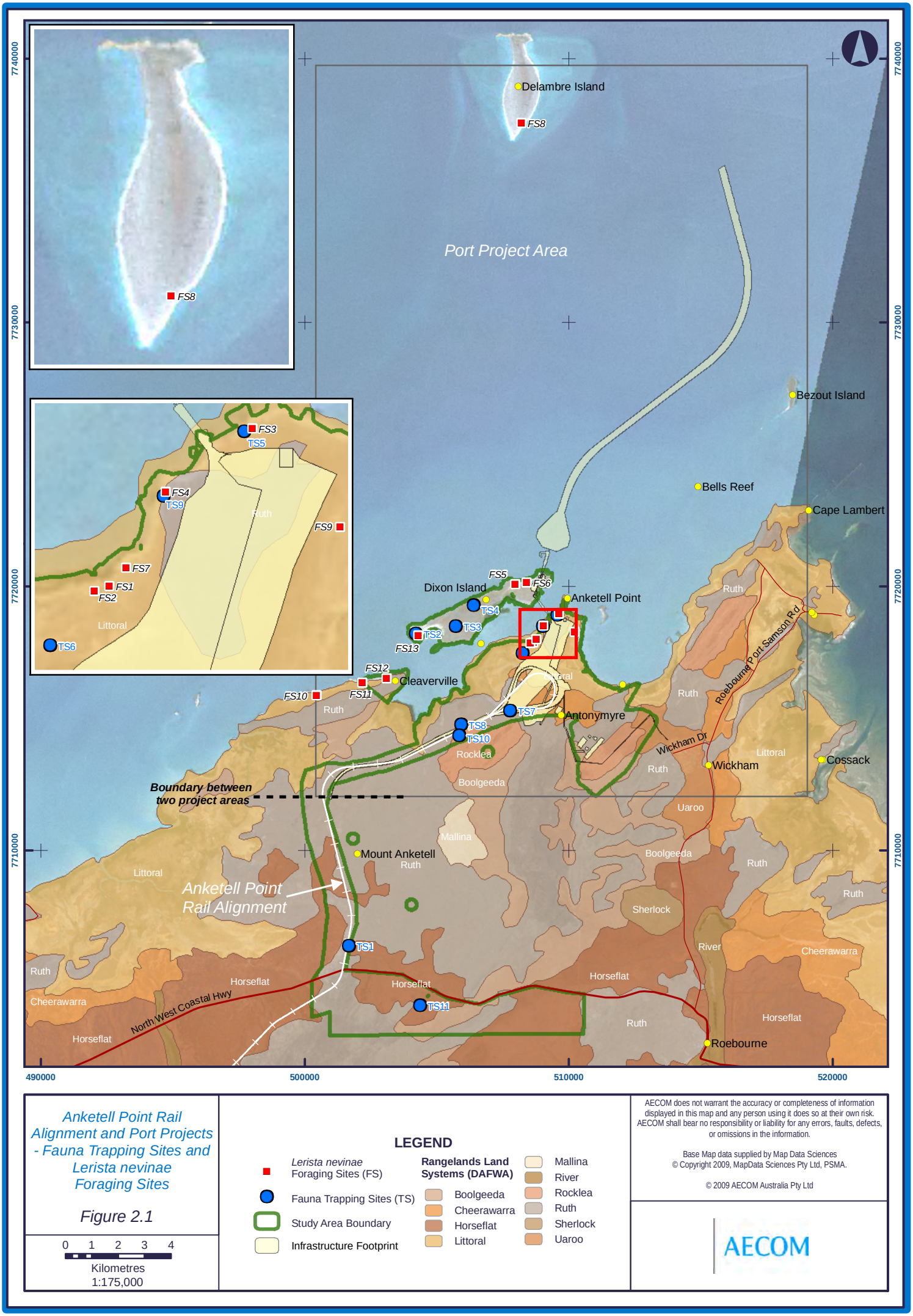
Site 4, Thg vegetation type Spinifex plain with red, slightly loamy sand. Closed *Triodia* Hummock Grasslands. Traps were located in or between mature shrubs.	 
Coastal dune Sites 5 and 9, Lit vegetation type Undulating coastal dune on Dixon Headland. Deep coarse sands in coastal dunes. Shrublands of *Acacia* spp. over Tussock Grassland. Traps were located in or between mature shrubs with maximum leaf litter.	 

Mudflat / samphire Site 6, Tidal mud flat vegetation type Chenopod Shrubland dominated by *Halosarcia halocnemoides* subsp. *tenuis*, *Halosarcia indica* subsp. *leiostachya*, *Frankenia ambita* and *Trianthema turgidifolia* and range of annual grasses on semi-inundated mud tidal flats (Mattiske Consulting 2007). Hummock Grassland of *Triodia wiseana* with occasional *Corymbia hamersleyana* (Mattiske Consulting 2007). Traps were located in Chenopod shrubland bordering raised Hummock Grassland.	 
Drainage line Site 7, MAT vegetation type Minor drainage line bordered by mixed Shrubland of *Acacia* spp. over a Hummock Grassland of *Triodia wiseana* and *Triodia epactica* on orange brown sandy soil with rocky nodules. Traps were located on both sides of the creek banks in generally dense Acacia shrubs.	 
Hill slope Site 8, Thg vegetation type Moderately sloping hill. Closed	

Triodia Hummock Grasslands. Traps were located mid-slope following the contour.	 
Rocky outcrop Site 10, Thg vegetation type Small rocky outcropping on minor hillslope. Closed *Triodia* Hummock Grasslands. Traps were located in a curving transect at the base of the breakaway.	 
Coastal plain Site 11, Mat vegetation type Mixed Shrubland of *Acacia* spp. over a Hummock Grassland of	

Triodia wiseana and *Triodia epactica* on orange brown sandy soil with rocky nodules. Traps were located along a 100m driftline transect. This was Biota Site AQD04 (Biota 2009.)	 

a – Vegetation descriptions based on vegetation mapping by AECOM (2010a and b) and site observations.



Anketell Point Rail Alignment and Port Projects - Fauna Trapping Sites and Lerista nevinae Foraging Sites

Figure 2.1

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Kilometres
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LEGEND

- *Lerista nevinae* Foraging Sites (FS)
- Fauna Trapping Sites (TS)
- Study Area Boundary
- Infrastructure Footprint

Rangelands Land Systems (DAFWA)

- Boolgeeda
- Cheerawarra
- Horseflat
- Littoral
- Mallina
- River
- Rocklea
- Ruth
- Sherlock
- Uaroo

AECOM

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2.4 FIELD METHODOLOGY

The first seasonal field survey took place from the 15th to the 26th of June 2009. The second seasonal field survey took place from the 10th to the 20th of March 2010. The field survey team consisted of Dr Stewart Ford (Lead Zoologist March 2010) Mr Greg Harewood (Lead Zoologist June 2009), Mr Glen Murray (Zoologist), Mr Simon Pynt (Zoologist), Mr Jason Nolthenius (Zoologist), Mr Michael Wood (Zoologist) and Mr Shane McAdam (Zoologist).

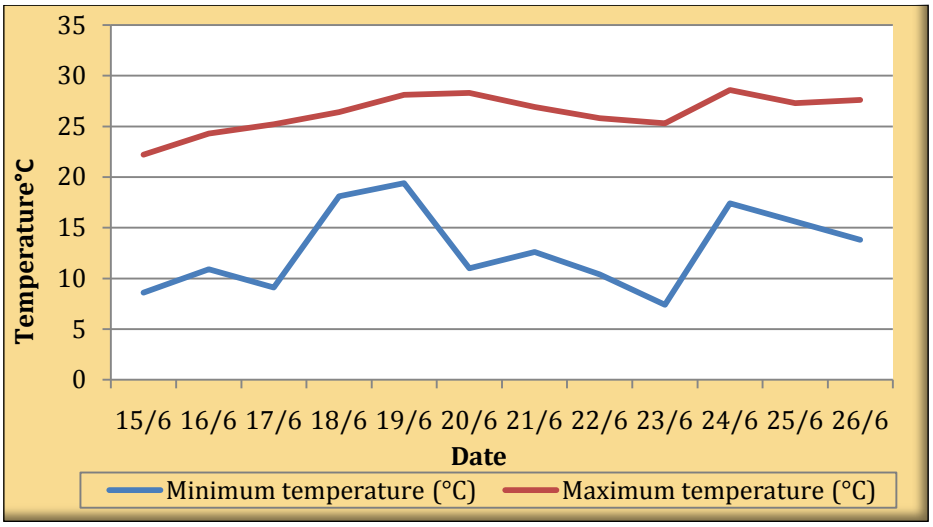
Survey work undertaken consisted of:

- Systematic trapping for ground-dwelling mammals, reptiles and amphibians;
- Censusing of bird species;
- Recording of bat echolocation calls using Anabat™;
- Spotlighting for nocturnal species; and
- Opportunistic searches for reptiles and any other species.

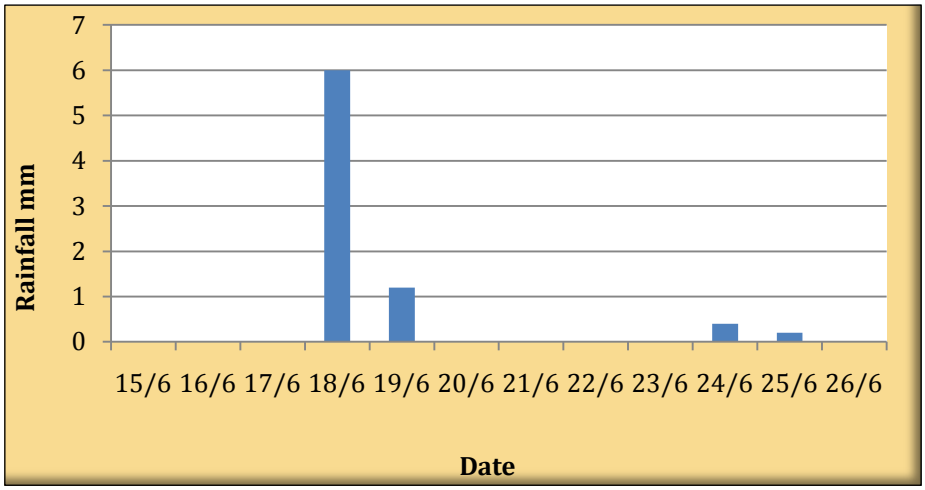
Opportunistic searches were conducted throughout the surveys in all habitat types. The survey methodology conforms to the Level 2 survey guidelines as outlined in EPA Guidance Statement 56 (EPA 2004).

Minimum and maximum temperatures at Roebourne during the June 2009 survey were 7.4°C – 19.4°C and 22.2°C – 28.6°C, respectively (Figure 2-2a). A total of 8mm of rain was recorded at Roebourne on the 18th June (Figure 2-2b), and the area received 224mm of rain in the four months preceding the second phase, which is above average rainfall for the period (average for Feb to May is 189.6mm). These favourable rainfall conditions may have partly offset the survey timing limitation.

During the March 2010 survey, temperatures were higher with the minimum temperature ranging from 23.1°C – 28.3°C, while the maximum temperature ranged from 35.6°C – 41.4°C (Figure 2-2c). Conditions prior to the second phase were drier, with 42.8mm of rain recorded in the four months preceding the second phase.



a)



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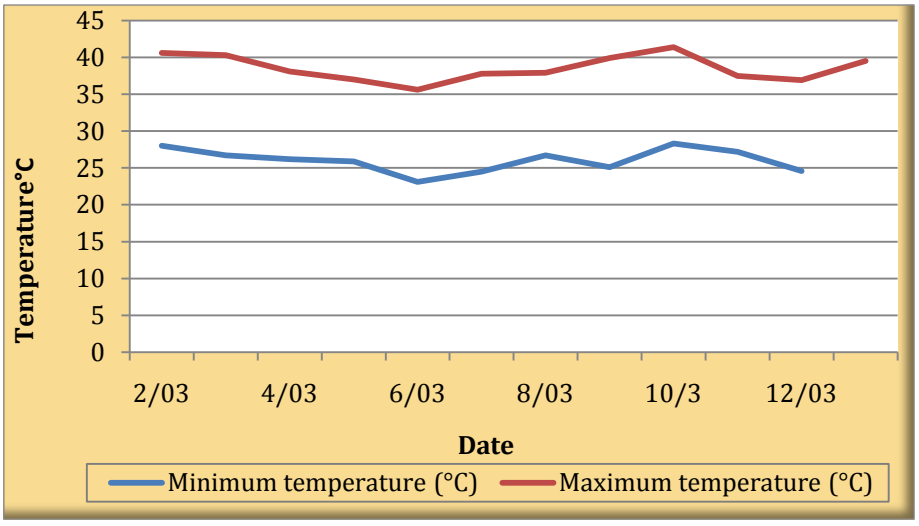


c)

Figure 2-2 a) Daily minimum and maximum temperatures at Roebourne during the first June 2009 survey, b) Daily rainfall prior to and during the June 2009 survey, and c) Daily minimum and maximum temperatures during the March 2010 survey.

Data source: Bureau of Meteorology, 2009b.

2.4.1 TRAPPING FOR GROUND-DWELLING MAMMALS, REPTILES AND AMPHIBIANS

Trapping for ground-dwelling mammals, reptiles and amphibians was undertaken at all sites. Sites were open for six consecutive nights during the first phase one and seven nights during the second phase. A summary of trapping effort and location of trap sites is provided in Table 2-2. Each site consisted of:

- Ten pit traps comprising five PVC pipes (150mm diameter x 500mm depth) and five buckets (20L) installed in a transect at approximately 20m intervals. The traps were installed flush with the substrate with a 5m long and 30cm high aluminium drift fence bisecting the bucket or pipe. Exceptions to this arrangement were:
    - Site 10, located in a rocky outcrop/breakaway, comprised only two 15L buckets (due to compacted, rocky soil) and ten drift fences with funnel traps (Plate 1); and,
    - Site 11, an existing fauna site installed by Biota Environmental Sciences (site AQD04; 2009) was 100m long with a 30cm high driftline fence, along which five PVC pipes (150mm diameter x 600mm depth) and five buckets (20L) were dug into the ground (Plate 2).
- Twenty funnel traps; one placed at each end of the 10 aluminium drift fences.
- Twenty Elliott traps; two placed parallel to each of the ten pit traps. A mixture of oats, peanut butter and sardines (universal bait) was used as bait.
- Two cage traps baited with universal bait.

Plate 1 Driftline with no pit (Site 10).

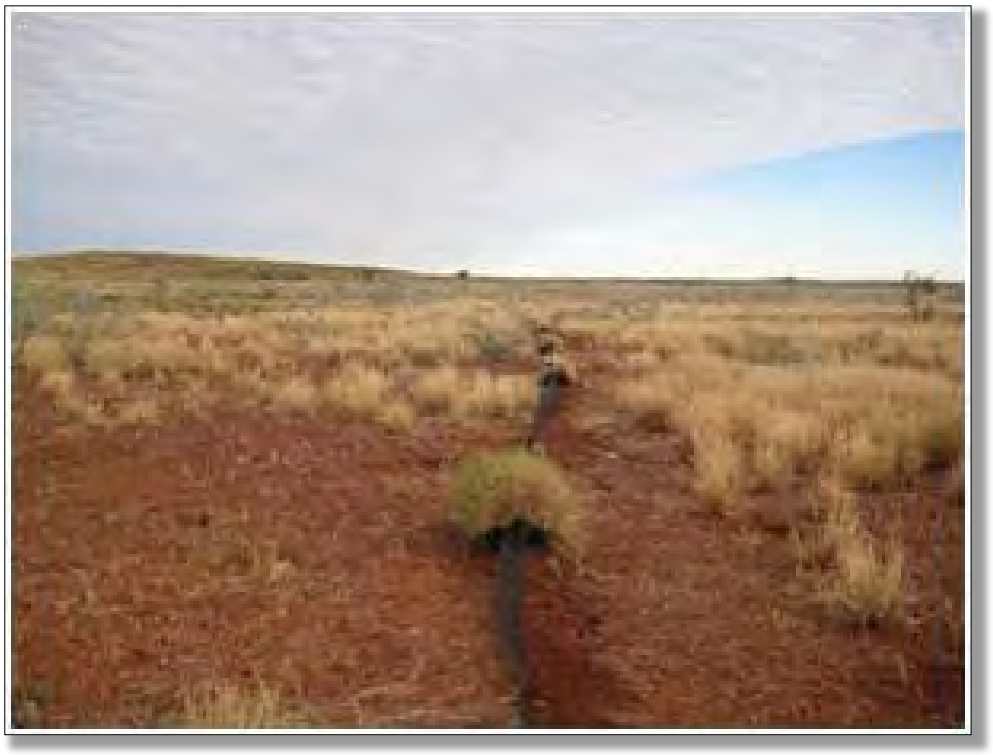


Plate 2 100m continuous driftline (Site 11).

2.4.2 AVIFAUNA CENSUSING

Two 20 to 40 minute bird censuses were conducted within each habitat type. Surveying for bird species took place as early as possible in the morning (sunrise until 11:45am). More than 50 hours of systematic avifauna surveys were undertaken (first phase, 18h10min; second phase, 33h20min).

2.4.3 BATS

Up to three Anabat™ detectors were used each night to record the ultrasonic calls of bat species. During the first survey, between four and ten hours of bat sound recordings were conducted at all survey sites and an additional 6 locations within the study area. During the second, recorders were left overnight at all 11 survey sites. On average about 16 hours of recording was achieved at each survey site. Mangrove, coastal dune, coastal cliff, coastal plain, rocky ridge and permanent water hole habitats were sampled.

All of the recordings were "continuous" made using Anabat II (Titley Electronics, Ballina, NSW) detectors, set to divide by 16, in conjunction with Portable Minidisk Recorder model MZ-NH600 (Sony, Japan). Minidisks were run in Hi-MD mode with Hi-LP setting allowing 10 hours of recording on an 80 min standard disc. The recordings were analysed by Mr Bob Bullen (Appendix 4).

2.4.4 SPOTLIGHTING

Night searches were undertaken to detect the presence of nocturnal species. These searches generally began at sunset and concluded at approximately 9:00pm, when conditions became less ideal for nocturnal activity. The nocturnal surveys comprised head torching, hand spotlighting and road spotlighting. During the first phase, three night searches were undertaken by a single team of three to four people. A total of about six hours (18 person hours) of vehicular spotlighting was undertaken within the study area along tracks between Dixon Headland and the main North West Coastal Highway (traversing most habitat types).

During the second phase, just under 36 hours of spotlighting was conducted across the 11 survey sites.

About two hours of head torching and hand spotlightling (8 person hours) was carried out on Dixon Island at the fauna sites during the first phase, and a further 9 person hours were conducted during the second phase.

One additional hour of head torching and hand spotlighting (three person hours) was carried out within rocky slope (trap site 8) and rocky outcrop habitat (trap site 10) within the mainland section of the study area.

2.4.5 TARGETED SEARCHES FOR LERISTA NEVINAE

Targeted searches were conducted for *Lerista nevinae* in suitable habitat on Dixon Headland, Dixon Island and Delambre Island. Thirteen foraging sites were targeted on the mainland (10 sites) and Dixon Island (three sites) over the two survey periods (Figure 2-1). Delambre Island was also surveyed on 25th June 2009 and accessed by boat.

The targeted searches comprised exposing individuals either by moving leaf litter and other debris, using a rake or by hand. Specimens observed were captured for positive identification either by hand or by filtering substrate using sample sieves (with 10mm sized holes).

In the June 2009 survey mainland searches for *L. nevinae* were confined to the coastal dunes bordering the Dixon Headland. In the March 2010 this area was searched again and survey aerial searches using helicopter identified additional potential habitat in the area between Clearverville and the Nickol River mouth. Raking was subsequently undertaken in this area.

In total 17 person hours of foraging were carried out at the 13 sites on the mainland and Dixon Island during the surveys. Approximately eight person hours were expended on Delambre Island in June 2009.

2.4.6 TARGETED SEARCHES FOR EASTERN OSPREY AND WHITE-BELLIED SEA-EAGLE NESTS

On 16 March 2010 a helicopter-based search of the coastline of the mainland and Dixon Island was undertaken, with the objective of identifying and recording Eastern Osprey and White-bellied Sea-Eagle nests.

2.4.7 OPPORTUNISTIC RECORDS

Opportunistic surveys for all fauna taxa were undertaken at each site. This comprised opening logs with crowbars, looking under bark, looking under rocks and raking leaf litter.

Opportunistic records of other species were also made throughout the surveys. Secondary evidence was also used to determine the presence of certain species, e.g. active pebble mounds, burrows and scats.

2.4.8 EXCLUDED FAUNA

The surveys did not target marine species. However, any marine species recorded on beaches (e.g. turtle remains) are discussed for completeness of results. A turtle survey of Delambre, Dixon and Bezout Islands was undertaken by Pendoley Environmental (2008).

Formal shorebird surveys were excluded from the survey scope and were conducted separately (Western Wildlife, 2008 and 2009a, b, c). Several shorebird species were recorded opportunistically, however, and are included in the results (Section 3).

2.5 TAXONOMY AND NOMENCLATURE

The taxonomy and nomenclature used in this report follows that of the most recent WA Museum checklist (WAM 2009), except for birds which follow Christidis and Boles (2008).

Table 2-2 Summary of trapping effort and location of trapping sites.

Site	Location (WGS84)	Dates open (June 2009)	Nights open	# pit traps	# funnel traps	# Elliott traps	# cage traps	Pit trap effort	Funnel trap effort	Elliott trap effort	Cage trap effort	Total trap effort
JUNE 2009												
1	50K 0501672 7706393	15 - 20	6	10	20	20	2	60	120	120	12	312
2	50K 0504212 7718221	16 - 21	6	10	20	20	2	60	120	120	12	312
3	50K 0505727 7718511	16 - 21	6	10	20	20	2	60	120	120	12	312
4	50K 0506402 7719311	17 - 22	6	10	20	20	2	60	120	120	12	312
5	50K 0509576 7718938	17 - 22	6	10	20	20	2	60	120	120	12	312
6	50K 0508252 7717477	18 - 23	6	10	20	20	2	60	120	120	12	312
7	50K 0507782 7715306	18 - 23	6	10	20	20	2	60	120	120	12	312
8	50K 0505925 7714788	19 - 24	6	10	20	20	2	60	120	120	12	312
9	50K 0509025 7718497	19 - 24	6	10	20	20	2	60	120	120	12	312
10	50K 0505851 7714373	20 - 25	6	2	20	20	2	12	120	120	12	264
11	50 K 0504369 7704148	20 - 25	6	10	20	20	2	60	120	120	12	312
Total			66	102	220	220	22	612	1320	1320	132	3384
Site	Location (WGS84)	Dates open (March 2010)	Nights open	# pit traps	# funnel traps	# Elliott traps	# cage traps	Pit trap effort	Funnel trap effort	Elliott trap effort	Cage trap effort	Total trap effort
MARCH 2010												
1	50K 0501672 7706393	12 - 18	7	10	20	20	2	70	140	140	14	423
2	50K 0504212 7718221	12 - 18	7	10	20	20	2	70	140	140	14	423
3	50K 0505727 7718511	12 - 18	7	10	20	20	2	70	140	140	14	423
4	50K 0506402 7719311	12 - 18	7	10	20	20	2	70	140	140	14	423
5	50K 0509576 7718938	12 - 18	7	10	20	20	2	70	140	140	14	423
6	50K 0508252 7717477	11 - 17	7	10	20	20	2	70	140	140	14	423
7	50K 0507782 7715306	11 - 17	7	10	20	20	2	70	140	140	14	423
8	50K 0505925 7714788	11 - 17	7	10	20	20	2	70	140	140	14	423
9	50K 0509025 7718497	12 - 18	7	10	20	20	2	70	140	140	14	423
10	50K 0505851 7714373	11 - 17	7	2	20	20	2	70	140	140	14	415
11	50 K 0504369 7704148	10 - 16	7	10	20	20	2	70	140	140	14	423
Total			77	102	220	220	22	770	1540	1540	154	4645

3.0 RESULTS

3.1 DESKTOP STUDY

A review of relevant databases and reports was conducted prior to the field surveys to obtain information on fauna species occurring or potentially occurring in the study area. Searches of the EPBC Act Protected Matters Database, the DEC Priority and Threatened Fauna Database and Birds Australia Birdata Database were undertaken to identify significant species that may occur in the study area. Previous survey reports were also reviewed including Biota (2007; 2008b; a; c; 2009) and Ninox (2008).

Based on these searches, 348 fauna species have the potential to occur, comprising nine amphibians, 181 birds, 50 mammals and 108 reptiles. These are shown in Appendix 2.

A total of 16 listed threatened and priority species were identified as potentially occurring in the study area (Table 3-1). In addition, 47 species of birds listed as Migratory under the EPBC Act were identified during the desktop studies as occurring or potentially occurring in the study area (Appendix 1). Two of these are also listed under the EPBC Act and DEC Priority lists.

Lerista nevinae (Priority 1) was also identified as potentially occurring in the study area, which at the time of the desktop study was not listed as a Priority fauna species but was thought to be highly restricted and therefore of interest. Species of conservation significance are also discussed further (Section 5.0).

Note that the listing below specifically excludes turtles, which were not part of the scope of this project, being the subject of an associated survey (Pendoley 2008).

Table 3-1 Threatened & Priority species identified during the desktop studies as occurring or potentially occurring in the study area.

Scientific Name	EPBC Act listing	WCA / DEC listing
Birds		
Falco peregrinus (Peregrine Falcon)	-	Schedule 4
Ardeotis australis (Australian Bustard)	-	Priority 4
Numenius madagascariensis (Eastern Curlew)	-	Priority 4
Burhinus grallarius (Bush Stone-curlew)	-	Priority 4
Phaps histrionica (Flock Bronzewing)	-	Priority 4
Neochmia ruficauda subclarescens (Star Finch)	-	Priority 4
Reptiles		
Liasis olivaceus barroni (Pilbra Olive Python)	Vulnerable	Schedule 1
Notoscincus butleri	-	Priority 4
Mammals		
Dasycercus cristicauda (Crest-tailed Mulgara)	Vulnerable	Schedule 1
Dasyurus hallucatus (Northern Quoll)	Endangered	Schedule 1
Lagostrophus fasciatus fasciatus (Banded Hare-wallaby)	Vulnerable	Schedule 1
Mormopterus loriae cobourgiana (Little Northern Freetail Bat)	-	Priority 1

Scientific Name	EPBC Act listing	WCA / DEC listing
Rhinonicteris aurantius (Pilbara form) (Pilbara Leaf-nosed Bat)	Vulnerable	Schedule 1
Macroderma gigas (Ghost Bat)	-	Priority 4
Leggadina lakedownensis (Short-tailed Mouse)	-	Priority 4
Pseudomys chapmani (Western Pebble-mound Mouse)	-	Priority 4

3.2 SUMMARY OF FAUNA RECORDS

A total of 204 vertebrate fauna species were recorded during the two surveys, with 4369 individual records made. The number in each group is shown in Table 3-2 and site by species records are presented in Appendix 3.

Overall approximately 60% of the potentially occurring fauna identified through the literature review was recorded (Table 3-2).

Table 3-2 Number of species recorded from each group during the surveys and percentage of potentially occurring species.

Group	Total	% of Potential
Amphibians	3	33
Birds	111	60
Mammals	27	54
Reptiles	63	58
Total	204	58

3.3 AMPHIBIANS

Three species were recorded. Two hylid frogs were recorded during the June 2009 survey, *Cyclorana maini* (Sheep Frog) and *Cyclorana platycephala* (Water-holding Frog). *C. maini* was recorded from a range of habitats including two drainage lines, samphire and coastal sand dunes. A single *C. platycephala* was captured in a pit trap at a major drainage line (Site 1).

A single member of the family Myobatrachidae, *Notaden nichollsi* (Desert Spadefoot), was captured in coastal sand dunes.

These species were recorded on the few mornings immediately following rainfall during the first phase only. No amphibians were recorded in the second phase.

3.4 BIRDS

A total of 111 bird species in 40 families were recorded during the surveys. The most speciose families were the Scolopacidae (12 species), Accipitridae (10 species) and Laridae (7 species), reflecting the coastal position of the project.

Widespread species included Nankeen Kestrel, Budgerigar, Singing Honeyeater, Orange Chat, Pied Butcherbird, Singing Bushlark, Spinifexbird, Zebra Finch and Painted Finch, all of which were recorded at 10 or more of the study sites (Appendix 3).

Twenty-one species recorded during the surveys are listed as Migratory under the EPBC Act, which summarises a number of international agreements including the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), the Convention on the Conservation of Migratory Species of Wild Animals

(Bonn) and the Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

Several opportunistic records of Eastern Curlew, listed as Priority 4 by the DEC, were made on Dixon Island and on beaches surrounding Dixon Headland during both phases. A single Australian Bustard (Priority 4) was observed inland at Site 10 during the second phase of the survey.

On 16th March 2010, several Eastern Osprey/White-bellied Sea-Eagle nests were discovered during a helicopter-based targeted search for nest platforms along the coastlines of the study area. At least two pairs of Eastern Osprey were present on the northern coastline of Dixon Island and one bird was observed on a nest (Table 3-3). No nest platforms were observed along the coastline in the mainland portion of the study area, nor further inland.

Table 3-3 Results of targeted survey for Eastern Osprey and White-bellied Sea-Eagle nest sites.

Coordinates[a]	Location	Notes
50K, 509153, 7719796	E Dixon Is.	Two individual Eastern Osprey
50K, 507711, 7720366	NE Dixon Is.	Eastern Osprey / White-bellied Sea-Eagle nest
50K, 506186, 7719582	N Dixon Is.	Eastern Osprey / White-bellied Sea-Eagle nest
50K, 505384, 7719170	N Dixon Is.	Eastern Osprey on nest (no eggs or chicks)
50K, 505147, 7719046	N Dixon Is.	Eastern Osprey / White-bellied Sea-Eagle nest, with two birds nearby
50K, 504682, 7718818	N Dixon Is.	Eastern Osprey / White-bellied Sea-Eagle nest
50K, 504613, 7718708	N Dixon Is.	Eastern Osprey / White-bellied Sea-Eagle nest

a – WGS84

3.5 MAMMALS

Twenty-seven mammal species were recorded during the surveys. These comprised four dasyurid species (carnivorous marsupials), four native rodent species, eleven bat species, two macropod species and the Echidna. Five introduced species were also recorded (Appendix 2).

The most abundant species recorded were the Euro, Red Kangaroo and the Sandy Inland Mouse. Most other species were recorded in low numbers. Sandy Inland Mouse and Finlayson's Cave Bat were the most widespread species, being recorded at 10 or more of the 11 trap sites.

The Priority 4 Western Pebble-mound Mouse (*Pseudomys chapmani*) was only recorded by way of three inactive mounds, one on Dixon Island and two on the mainland. No other evidence of this species was observed and it is unclear if this species is extant within the study area.

Planigales were not assigned to a species as the genus is currently undergoing a major revision. Previous surveys in the general area have assigned captured Planigales to the previously named *Planigale ingrami* (Biota 2008b; Ninox 2008) however this taxon is no longer considered to occur in the Pilbara.

The Priority 1 Little Northern Freetail Bat (*Mormopterus loriae cobourgiana*) was recorded at eleven locations throughout the study area, including Site 11 which is approximately 8 km from the nearest mangrove habitat. Full results and discussion on the bat species detected are provided in Appendix 4.

3.6 REPTILES

Sixty-three species of reptile in nine families were recorded during the surveys (Appendix 3). These records consisted of 23 species of skink, nine species of snakes (family Elapidae, Pythonidae and Typhlopidae), eleven species of gecko (family Gekkonidae), seven species of dragons (family Agamidae), eight species of goanna (family Varanidae), four species of legless lizards (family Pygopodidae) and a single turtle (family Cheloniidae).

Chelonia mydas **(**Green Turtle) was recorded during both phases of surveying. Remains of an individual were found on the beach near Site 9 during June 2009. It appeared (based on other evidence nearby) that the individual had been killed by traditional land owners for food. Six live individuals were recorded in the waters between Dixon Island and the headland during the March 2010 survey.

Approximately 42% of the reptile species recorded belonged to the family Scincidae, which also contained the most abundant species, *Ctenotus saxatilis* (530 records) followed by *Lerista bipes* (234 records). *C. saxatilis* was also the only species recorded at 10 or more sites.

Lerista nevinae (Priority 1) was recorded from trap sites and hand foraging locations within coastal dune habitat on Dixon Headland during both surveys. The species was not recorded on Dixon Island or Delambre Island, despite having three trapping sites on Dixon Island and conducting targeted hand foraging on both islands.

Notoscincus butleri (Priority 4) was recorded from a site 1, a major drainage line during both surveys.

3.7 SURVEY LIMITATIONS

The limitations of the Anketell Point Rail Alignment and Port Projects vertebrate fauna survey are outlined in Table 3-4.

Table 3-4 Survey limitations.

Potential limitation	Limitation present?	Comments
Competency / experience of the consultant carrying out the survey.	No	The Biologist/Zoologists who executed the survey are all suitably qualified and experienced in conducting level 1 and level 2 vertebrate fauna surveys in WA
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.)	No	The survey carried out was a Level 2 survey, comprising a desktop study and site visit that included a habitat assessment, trapping program, and opportunistic observations. No constraints on planned scope were encountered.

Potential limitation	Limitation present?	Comments
Proportion of fauna identified, recorded and/or collected.	Yes	The field surveys recorded about 60% of listed potential vertebrate species considered likely to be present in the study area. It should be noted that the potential species list is very likely an over estimation of the species that use the study area on a regular basis as suitable habitat does not exist for all species on the 'potential' species list.
Sources of information e.g. previously available information (whether historic or recent) as distinct from new data.	No	Previous surveys in the immediate area by Biota (2008a&b) and Ninox (2008), in addition to some work by the DEC and Birds Australia. At the bioregion level, the Pilbara has been the subject of many targeted biological surveys, primarily for the resource development sector
Timing/weather/season/cycle.	Yes	Timing was not considered to be optimal, however the results are consistent with similar surveys carried out in the vicinity in more optimal times of year (Biota 2008a; Ninox 2008). The pre-survey above average rainfall may have contributed to the good results. Temperatures during the second survey were higher and a greater diversity of fauna was recorded.
The proportion of the task achieved and further work which might be needed.	No	Survey completed adequately, with the trapping program and other aspects of the survey carried out to a sufficient level.
Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey.	No	No disturbances encountered.
Intensity (in retrospect, was the intensity adequate?)	No	Based on results achieved the survey is considered adequate. Survey effort was increased in response to DEC advice on the methodology.
Completeness (was relevant area fully surveyed?)	No	Density of trap lines and opportunist transects was above that generally carried out during the course of surveys of a similar type/area.
Remoteness and/or access problems.	Yes	Some sections of the study area are only accessible on foot/helicopter/boat. A helicopter was employed to access some areas.
Availability of contextual (e.g. biogeographic) information on the region.	No	WAM, DEC, Birds Australia and DEWHA databases, specialist books/publications and previous fauna survey data for general area were consulted.

Note: Potential survey limitations as identified by the EPA (EPA 2004)

4.0 CONSERVATION SIGNIFICANCE

4.1 LEGISLATION AND AGREEMENTS FOR THE PROTECTION OF SIGNIFICANT FAUNA IN WESTERN AUSTRALIA

International

Migratory species are protected under a number of international agreements:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA);
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn); and
- Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

Commonwealth

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), actions that have, or are likely to have, a significant impact on a matter of national environmental significance (NES) require approval from the Australian Government Minister for the Environment, Water, Heritage and the Arts (the Minister). The EPBC Act provides for the listing of nationally threatened native species. Fauna species of national conservation significance may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'conservation dependent'.

The EPBC Act is also the enabling legislation for protection of migratory species under the international agreements listed above.

State

Native species in Western Australia which are under identifiable threat of extinction are protected under the Western Australian *Wildlife Conservation Act 1950* (WC Act). Under the WC Act, the *Wildlife Conservation (Specially Protected Fauna) Notice 2010* recognises four classifications of rare and endangered fauna:

- **Schedule 1:** Fauna that is rare or is likely to become extinct.
- **Schedule 2:** Fauna presumed to be extinct.
- **Schedule 3:** Birds protected under an international agreement.
- **Schedule 4:** Other specially protected fauna.

In addition, the DEC produces a list of Priority species that have not been assigned statutory protection under the WC Act. Species on this list are considered to be of conservation priority because there is insufficient information to make an assessment of their conservation status or they are considered to be rare but not threatened and are in need of monitoring. The DEC Priority Fauna List categories are:

- **Priority 1:** Taxa with few, poorly known populations on threatened lands.
- **Priority 2:** Taxa with few, poorly known populations on conservation lands.
- **Priority 3:** Taxa with several, poorly known populations, some on conservation lands.
- **Priority 4:** Taxa in need of monitoring – considered not currently threatened but could be if present circumstances change.
- **Priority 5:** Taxa in need of monitoring – considered not currently threatened but subject to a conservation program, the cessation of which could result in the species becoming threatened.

Local or regional

Species may be of conservation significance from a local or regional perspective, for example, due to their distributions and migrating patterns. Native species are often considered valuable to local people, particularly to Traditional owners. These values are rarely recognised formally through conservation legislation.

Species restricted to the Pilbara Biogeographic Region, while generally not given additional protection under legislature, are considered to be of significance because of their restricted distribution. Bioregional endemics recorded within the study area include the following species:

- *Dasykaluta rosamondae* (Little Red Kaluta);
- *Ningaui timealeyi* (Pilbara Ningaui);
- *Pseudomys chapmani* (Western Pebble-mound Mouse) (P4);
- *Gehyra pilbara* (Pilbara Dtella);
- *Lucasium wombeyi*
- *Delma pax*;
- *Ctenotus duricola*;
- *Ctenotus rubicundus*;
- *Lerista clara* (Depuche Island only);
- *Lerista nevinae* (P1);
- *Notoscincus butleri*; and,
- *Demansia rufescens* (Rufous Whipsnake).

4.2 SPECIES OF CONSERVATION SIGNIFICANCE

4.2.1 SIGNIFICANT SPECIES RECORDED IN THE SURVEYS

A single listed endangered species and six Priority fauna species were recorded during the surveys (Table 4-1). The known distribution, ecology and records of each species are discussed below.

Table 4-1 Conservation significant species recorded during the surveys.

Name	Common name	Conservation status
Chelonia mydas	Green Turtle	Schedule 1/Endangered
Mormopterus loriae cobourgiana	Little Northern Freetail Bat	Priority 1
Lerista nevinae		Priority 1
Ardeotis australis	Australian Bustard	Priority 4
Pseudomys chapmani	Western Pebble-mound Mouse	Priority 4
Numenius madagascariensis	Eastern Curlew	Priority 4
Notoscincus butleri		Priority 4

Chelonia mydas (Green Turtle)

Status: Schedule 1 (WC Act), Endangered (EPBC Act)

Distribution and ecology: The Green Turtle has a worldwide distribution in tropical and subtropical seas with temperatures above 20°C. In Western Australia, Green Turtles nest on beaches from the Ningaloo coast northwards. There are significant rookeries on Barrow Island, in the Montebello Islands, the Dampier Archipelago and the Lacepede Islands, with

smaller rookeries on many smaller Pilbara islands, as well as in the Kimberley (Prince 1993).

Adults are herbivorous, feeding on seaweeds and seagrasses, while immature green turtles are carnivorous, feeding on jellyfish, small molluscs, crustaceans and sponges. Adult females breed approximately once every six years, although the nesting interval varies considerable from year to year, with very little breeding occurring in some years and more in others. Green Turtles nest very infrequently on the mainland beaches adjoining Cape Lambert (Biota 2008a).

Records: The Green Turtle was recorded during both phases of surveying. A dead specimen was found on the beach during the June 2009 survey (near Site 9). It appeared (based on other evidence nearby) that the individual had been killed by traditional land owners for food. Six individuals were recorded from a helipcopter in waters between Dixon Island and the headland during the March 2010 survey.

***Mormopterus loriae cobourgiana* (Little Northern Freetail Bat)**

Status: Priority 1

Distribution and ecology: The Little Northern Freetail Bat occurs along the northern coast of Western Australia and the Northern Territory. It occurs sparsely across its range but can form large transient aggregations (Milne et al 2008). WA populations have predominantly been recorded from mangrove stands, particularly those that include mature grey mangroves (*Avicennia marina*; Milne et al 2008). They emerge early in swarms and later disperse to forage for insects above and beside the forest canopy (Churchill 1998). The extent of their foraging range is not known. This species is of significance due to its restricted distribution and currently limited knowledge of the species.

Records: Little Northern Freetail Bat was recorded from 11 of the 17 Anabat^{TM} recording sites, including one approximately 10km inland from the mangrove habitat which is unusual for this species. Nine of the recordings were at a low level of activity, however two mainland sites close to the coast (and mangroves) showed medium and high levels of activity early in the evening. Biota (2008b) and Ninox (2008) also recorded this species at several locations within, and in the vicinity of, the study area.

Lerista nevinae

Status: Priority 1

Distribution and ecology: Members of the large Australian lizard genus *Lerista* are small fossorial (burrowing) and semi-fossorial skinks. Species of *Lerista* are divided into groups, one of which is the *Lerista muelleri* species-group. In 2007, the *L. muelleri* group underwent a major taxonomic revision in which 13 species were recognised, including *L. nevinae* (Smith and Adams 2007). The known distribution of this endemic Pilbara species was restricted to the coastal dunes between Popes Nose Creek and the south-east corner of Dixon Headland, with an estimated area of only 360ha of suitable habitat (Biota 2008b). In June 2010, *L. nevinae* was listed as a Priority 1 species due to its restricted distribution and development pressures adjacent to its habitat. It is due to be considered for listing under the Wildlife Conservation Act Specially Protected Fauna Notice in 2011.

Records: *L. nevinae* was recorded at three locations along the western side of Dixon Headland during the surveys. This represents a mainland range extension of approximately 2km north and 1.5km west. In total, eight individuals were recorded from trap site five and

ten from trap site 10. Two additional records were made further southwest around Dixon Headland from the trap site records. The species was not found on Dixon Island or Delambre Island during surveys for the Proposal but two records were made on Dixon Island by Biota in January 2009 (SKM 2009).

Ardeotis australis (Australian Bustard)

Status: Priority 4

Distribution and ecology: the Australian Bustard is a tall, stately bird of open inland plains (Johnstone and Storr 1998; Morcombe 2004). Once common throughout Australia, it is now considered rare due to extensive habitat loss. It occupies grassland, spinifex, arid scrub and open dry woodland of mulga, mallee and heath.

Records: *A. australis* was recorded from site 10 in the second phase.

Pseudomys chapmani (Western Pebble-mound Mouse)

Status: Priority 4

Distribution and ecology: The Western Pebble-mound Mouse is endemic to WA. Its current range extends from the ranges of the central and southern Pilbara to the ranges of the Little Sandy Desert. Suitable habitat for Western Pebble-mound Mice is common but patchily distributed in the Pilbara bioregion. The species is well-known for the characteristic pebble-mounds which it constructs over underground burrow systems. These mounds are most common on spurs and lower slopes of rocky hills. The persistence of abandoned mounds in the Gascoyne region, Murchison regions and isolated coastal ranges in the Pilbara indicates considerable decline in range (Van Dyck and Strahan 2008). This decline has been attributed to foxes and exotic herbivores and possibly other factors.

Records: Three inactive mounds classified as old to very old were observed. One was adjacent to trap site 8, another was recorded opportunistically on Dixon Is and a further recorded opportunistically on the mainland. No other evidence of this species was observed and it is unclear if this species is extant within the study area.

Numensis madagascariensis (Eastern Curlew)

Status: Priority 4

Distribution and ecology: This uncommon species is the largest wader in Australia and has been recorded from most of Australia's coastline. The species utilizes tidal mudflats, sand spits of estuaries, mangroves, lake shores and ocean beaches (Morcombe 2004). It is of conservation significance due to the reduction of its habitat in Australia and overseas.

Records: Eastern Curlews (20) were observed on a beach at the south end of Dixon Island during the first phase. The species was also recorded on two occasions (flock of 18 and flock of 2) at high tide on beaches bordering the mainland. Several opportunistic records of a single bird were also made during the second phase. Eastern Curlews were also recorded by Ninox (2008) on Dixon Island and by Biota (2008b) at Cape Lambert.

Notoscincus butleri

Status: Priority 4

Distribution and ecology: *Notoscincus butleri* is found in the arid, near coastal Pilbara (Wilson and Swan 2008) and is known only from the Dampier district and Harding River dam (Storr *et. al.* 1999). This small skink is diurnal and egg laying (Wilson and Knowles 1988). Its preferred habitat is typically spinifex dominated areas near creek and river margins (Wilson and Swan 2008).

Records: A single individual was captured in a funnel trap at trap site 1 (major drainage line) during the first phase. In the second phase, two were captured in funnel traps and one was caught opportunistically, also at site 1.

4.2.2 MIGRATORY LISTED AVIFAUNA

Twenty-one avifauna species listed as Migratory under the EPBC Act were recorded in the study area during the surveys:

- Eastern Reef Egret
- Eastern Osprey
- White-bellied Sea-Eagle
- Lesser Sand Plover
- Greater Sand Plover
- Black-tailed Godwit
- Bar-tailed Godwit
- Whimbrel
- Common Sandpiper
- Grey-tailed Tattler
- Common Greenshank
- Marsh Sandpiper
- Ruddy Turnstone
- Wood Sandpiper
- Red-necked Stint
- Little Tern
- Lesser Crested Tern
- Rainbow Bee-eater

These species are discussed below.

***Egretta sacra* (Eastern Reef Egret)**

Status: Migratory (CAMBA)

The Eastern Reef Egret occurs along much of Australia's coastline. Its habitat preferences include estuarine mudflats and inshore reefs. This species was observed on several occasions resting and foraging at the base of high cliffs on the west side of Dixon Island and on a rocky beach in the island's northwest coast.

***Pandion cristatus* (Eastern Osprey)**

Status: Migratory (Bonn)

The Eastern Osprey is common around the northern Australian coast and inhabits coastal waters and estuaries. It often travels long distances to find its prey usually following large rivers far inland to where large pools lie (Morcombe 2004). The species was observed on several occasions on Dixon Island and at near coastal sections of the mainland. Nest sites were also observed on Dixon Island (see Section 3.4). The species was also recorded by Ninox (2008) on Dixon Island and Biota (2008b) from Cape Lambert.

Haliaeetus leucogaster (White-bellied Sea-Eagle)

Status: Migratory (CAMBA)

The White-bellied Sea-Eagle is a large species which often perches conspicuously on cliffs or high tree limbs. It occurs in the vicinity of beaches, estuaries, mangroves and islands, among other locations. The species was observed on several occasions on Dixon Island and at near coastal sections of the mainland. Potential nest sites were also observed on Dixon Island (see Section 3.4). The species was also recorded by Ninox (2008) from Dixon Island and Biota (2008b) from Cape Lambert.

Charadrius mongolus (Lesser Sand Plover)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Lesser Sand Plover is a small plover species which may be found on intertidal sandflats, mudflats, beaches, sandbars, and reef flats (Morcombe, 2004). Several records were made during the March 2010 survey on mainland beach. This species was also recorded by Ninox (2008) on Dixon Island.

Charadrius leschenaultii (Greater Sand Plover*)*

Status: Migratory (Bonn, CAMBA, JAMBA, ROCKAMBA)

The Greater Sand Plover is a gregarious species, often found in mixed flocks on intertidal zones and estuaries (Morcombe, 2004). Greater Sand Plovers (31) were observed on a beach at the south end of Dixon Island during the June 2009 survey. It was recorded again in the March 2010 survey on the northern part of Dixon Headland. The species was also recorded by Biota (2008a) on tidal flats at Cape Lambert.

Limosa limosa (Black-tailed Godwit)

Status: Migatory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Black-tailed Godwit is a commonly found, relatively slender shorebird that normally inhabits estuaries, sheltered bays, and lagoons with extensive tidal mudflats (Morcombe, 2004). A single individual was noted at Site 2 on Dixon Island during the March 2010 survey.

Limosa lapponica (Bar-tailed Godwit)

Status: Migratory (Bonn, CAMBA, JAMBA, ROCKAMBA)

The Bar-tailed Godwit is a common migratory wader, inhabiting coastal mudflats, sandbars, estuaries and salt marshes. Bar-tailed Godwits (30) were observed on a beach at the south end of Dixon Island during the June 2009 survey and from tidal mudflats adjacent to Site 9 on Dixon Headland during the March 2010 survey. The species was also recorded by Ninox (2008) on Dixon Island and Biota (2008a) on tidal flats at Cape Lambert.

Numenius phaeopus (Whimbrel)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Whimbrel is a gregarious species that often feeds in small flocks of mixed waders on coastal mudflats, beaches and reefs (Morcombe, 2004). This species is common across northern Australia and one individual was seen during the March 2010 survey at Site 7. It was also recorded by Ninox on Dixon Island (2008).

Xenus cinereus (Terek Sandpiper)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Terek Sandpiper is a nervous species that inhabits coastal mudflats, sheltered estuaries and lagoons (Morcombe, 2004). One individual was opportunistically noted during the March 2010 survey from tidal mudflats adjacent to Site 9 on Dixon Headland during the March 2010 survey.

Actitis hypoleucops (Common Sandpiper)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Common Sandpiper has a widespread distribution but is more commonly found in the northern regions of Australia. It occurs in a variety of habitats including coastal and interior wetlands, muddy edges of billabongs and lagoons, river pools, and mangroves (Morcombe, 2004). A single individual was recorded during the second phase of the survey opportunistically on Anketell Point adjacent to Site 5. This species was recorded by Ninox (2008) on Dixon Island.

Tringa brevipes (Grey-tailed Tattler)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

Grey-tailed Tattlers occur in coastal habitat, foraging in inter-tidal pools, mudflats and sand beaches. The species is a common summer migrant to northern Australia. A flock of 15 was observed on a beach at the south end of Dixon Island and six individuals were recorded during high tide on a beach bordering the mainland during the June 2009 survey. The species was also observed at two locations on Dixon Headland during the March 2010 survey. Grey-tailed Tattlers were also recorded by Ninox (2008) on Dixon Island and by Biota (2008a) at sites near Cape Lambert.

Tringa nebularia (Common Greenshank)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Common Greenshank is a tall erect bird that occurs alone, or in small or large flocks, often with other waders. It occurs in a range of inland and coastal habitats on both permanent and temporary wetlands. It generally prefers wet and flooded mudflats and is a common widespread migrant present in Australia from September toApril (Morcombe, 2004). One individual was noted on Dixon Headland during the March 2010 survey.

Tringa stagnatilis (Marsh Sandpiper)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Marsh Sandpiper occurs along the Western Australian coast and throughout parts of eastern Australia. It inhabits coastal and inland wetlands, estuarine and mangrove mudflats, beaches, swamps, lakes and several other types of wetlands (Morcombe, 2004). The species was recorded on two occasions (flock of 30 and an individual) during high tide on beaches bordering the mainland in the June 2009 survey.

Arenaria interpres (Ruddy Turnstone)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

The Ruddy Turnstone is a gregarious species that usually occurs in small flocks. It is usually found on ocean coasts with exposed rock, stones, or shell beaches (Morcombe, 2004). One

individual was noted during the March 2010 survey on on Dixon Headland. Ninox (2008) recorded the species on Dixon Island.

Tringa glareola (Wood Sandpiper)

Status: Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

This graceful, active wader prefers shallows of wooded lakes or swamps with trees. It also inhabits freshwater swamps, lakes, flooded pastures and occasionally, mangroves. It occurs as solitary individuals or in large flocks of mixed waders and is an uncommon migrant (Morcombe, 2004). A single individual was observed on Dixon Headland in the March 2010 survey. Biota (2008) also recorded this species.

Calidris ruficollis (Red-necked Stint)

Status: Migratory (Bonn, CAMBA, JAMBA, ROCKAMBA)

The Red-necked Stint is a small, highly sociable wader inhabiting a range of habitats including mudflats, salt marshes, beaches, saltfields and temporary floodwaters (Morcombe, 2004). A single specimen was observed during the June survey on the dry saline coastal flats on the mainland in the company of numerous Red-capped Plovers during the June 2009 survey and a second record was made in the March 2010 survey on Dixon Headland. The species was also recorded by Biota (2008a) on tidal flats at Cape Lambert.

Sterna albifrons (Little Tern)

Status; Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)

This small tern tends to live and feed over shallow coastal waters including estuaries, lagoons and channels. It is usually found in small flocks, but will often congregate in much larger flocks at favoured roosting points. The Little Tern is widespread around the warmer seas of all continents (Morcombe, 2004). A single individual was observed on the mainland in the March 2010 survey. Biota (2008) and Ninox (2008) also recorded this species.

Hydroprogne caspia (Caspian Tern)

Status: Migratory (CAMBA, JAMBA)

The Caspian Term occurs along most of the WA coastline and throughout much of eastern Australia. Its preferred habitats include sheltered estuaries, inlets, bays and lagoons with mudflats (Morcombe, 2004). Small groups (2 or 3 individuals) of this species were observed on numerous occasions patrolling along the beaches on Dixon Island and the mainland in the June 2009 survey. The species was also observed along the large partly flooded creek that extends inland from the coast in the central northern section of the study area. Caspian Terns were also recorded during the March 2010 survey on Dixon Headland.

Thalasseus bengalensis (Lesser Crested Tern)

Status: Migratory (CAMBA)

The Lesser Crested Tern frequents shores of sandy beaches, mudflats of estuaries and creek channels, among other coastal habitats across the north of Australia. Small groups (2 or 3 individuals) of this species were observed on several occasions patrolling along the beaches on Dixon Island and the mainland in the June 2009 survey. Lesser Crested Terns were also recorded by Ninox (2008) on Dixon Island and by Biota (2008a) at sites near Cape Lambert

***Merops ornatus* (Rainbow Bee-eater)**

Status: Migratory (JAMBA)

The Rainbow Bee-eater is a fast flying brightly coloured bird which prefers open airspace for hunting. They are a common and regular summer migrant to southern Australia, and residents in northern Australia. Forteen Rainbow Bee-eaters were recorded in both surveys in a range of habitats. The species was also recorded by Ninox (2008) and Biota (2008).

4.2.3 OTHER SIGNIFICANT SPECIES IDENTIFIED AS POTENTIALLY OCCURRING

Eleven conservation significant species that were identified from the desktop studies as potentially occurring in the study area were not recorded during the course of the surveys. These are discussed below.

***Falco peregrinus* (Peregrine Falcon)**

Status: Schedule 4 (WC Act)

Distribution and ecology: The Peregrine Falcon is found across much of Australia, inhabiting a wide variety of habitats. This species is relatively long lived, with low reproductive rates and low population density (DEWHR, 2008). It has a large home range, foraging over long distances. Habitat loss is a major threat to the species as it typically nests on cliff faces and in woodland trees (DEWHR, 2008).

Likelihood of occurrence: Possible. This species may hunt, but is not likely to nest within the study area.

***Burhinus grallarius* (Bush Stone-curlew)**

Status: Priority 4

Distribution and ecology: The Bush Stone-curlew inhabits open woodland, often near beaches (Morcombe, 2004). It is considered uncommon to rare in the region.

Likelihood of occurrence: Possible. This species may occasionally frequent parts of the study area but little roosting or breeding habitat occurs in the study area.

***Phaps histrionica* (Flock Bronzewing)**

Status: Priority 4

Distribution and ecology: This species inhabits treeless or sparsely wooded grassy plains of north-west WA, south to Carnarvon, and also occurs in the Kimberley and in the arid and semi-arid north-eastern interior of Australia (Johnstone and Storr 1998). The species nests on bare ground amongst low-lying vegetation. It is often associated with permanent water (Garnett and Crowley, 2000).

Species numbers have declined greatly in the last century due to the degradation of its habitat by livestock. There were no records of this species in the Pilbara during the most recent Birds Australia Bird Atlas Project (Barrett *et. al.* 2003). The DEC database record for this species is dated 1968.

Likelihood of occurrence: Unlikely. While there is potential for this species to visit sections of the study area on rare occasions it is unlikely to specifically attract the species.

***Neochmia ruficauda subclarescens* (Star Finch)**

Status: Priority 4

Distribution and ecology: This subspecies of the Star Finch is found across north Western Australia, including the Pilbara region where it is patchily distributed. It feeds mainly on small grass seeds, but also flying ants, termites and other small insects and spiders. Typical Star Finch habitat is long grass or rushes around swamps and lagoons or permanent pools. It also frequents watered suburban gardens (Garnett and Crowley, 2000). The species usually occurs in pairs or small flocks and breeding occurs between February and October. Both parents incubate the eggs and care for the young (Johnstone and Storr 2004). The main threat to the species is considered to be overgrazing by stock along waterways, which destroys the riparian vegetation on which they depend (Garnett and Crowley 2000).

Likelihood of occurrence: Unlikely A single specimen of this species was recorded in the vicinity of the study area by Biota (2008a), within a coastal dune habitat. There is very little potential preferred habitat for this species in the study area and it is only likely to be a rare, seasonal visitor.

Liasis olivaceus barroni (Pilbra Olive Python)

Status: Vulnerable (EPBC Act), Schedule 1 (WC Act)

Distribution and ecology: The Pilbara Olive Python is one of Australia's largest snakes, growing up 6.5m (Wilson & Swan, 2008). The species is restricted to the Pilbara and Gascoyne regions occurring in the Burrup Peninsula, Ord Ranges and Meentheena south to Nanutarra and Newman (Storr *et al*., 2002). It is primarily found in gorges and dissected drainage lines (Wilson & Swan, 2008).

Likelihood of occurrence: Unlikely. No evidence was found to suggest that Pilbara Olive Python occurs within the study area. Habitat within the study area is unsuitable or at best very marginal for this species to persist. The lack of historical records also suggests the species does not inhabit the area.

Dasycercus cristicauda (Mulgara)

Status: Vulnerable (EPBC Act), Schedule 1 (WC Act)

Distribution and ecology: The Mulgara is a dasyurid marsupial occurring in the arid areas of Australia. Records in WA are from the Great Victoria Desert, Goldfields, Gascoyne, Sandy Desert and Pilbara regions. It is most frequently found in habitats dominated by mature spinifex (*Triodia* spp.) and lives in burrows that it digs on the flats between low sands dunes (Woolley, 2008; Baker, 1996). According to Maxwell *et. al*. (1996), the Mulgara has declined over 50 – 90% of its original range. Recent revisions of *Dasycercus* resulted in the predominantly Western Australian populations of *D. cristicauda* being classified as a separate species, *D. blythi* (Brush-tailed Mulgara), primarily based on tail morphology (Woolley, 2008). Based on the known distributions of the two species, it is assumed that the listing of *D. cristicauda* from the database searches refers to *D. blythi*.

Likelihood of occurrence: Unlikely. The nearest documented record is approximately 200km east of the study area in sandy arid regions.

Dasyurus hallucatus (Northern Quoll)

Status: Endangered (EPBC Act), Schedule 1 (WC Act)

Distribution and ecology: The Northern Quoll's distribution originally extended across Northern Australia from the Northwest Cape, Western Australia to south-east Queensland but has declined in recent years. Its distribution is now restricted to six main areas: the north and western top end of the Northern Territory, north of Cape York, the Atherton-Cairns area, the Carnarvon Range-Bowen area of Queensland (Menkhorst and Knight 2001), and the northwest Kimberley and Pilbara regions of Western Australia (Braithwaite and Griffiths 1994). It also occurs on numerous islands off the Australian coast (Abbott and Burbidge 1995; Burbidge and McKenzie 1978). Its preferred habitat is broken, rocky country and open eucalyptus forest within 150km of the coast (Strahan 2004). Small mammals, reptiles, worms, insects, honey and soft fruits constitute its main diet (Strahan 2004).

Likelihood of occurrence: Possible. Ninox (2008) found the distinctive footprints of the Northern Quoll in sand on the west side of Dixon Island. The most recent recorded capture of the species in the general area however, is dated 1986 (DEC database search in Biota 2008a). Because Northern Quoll is a habitat generalist, it may occur almost anywhere within the study area, but is mostly likely to occur on the rocky tors and associated rocky hillslopes inland of the development envelope.

Lagostrophus fasciatus fasciatus (Banded Hare-wallaby)

Status: Vulnerable (EPBC Act), Schedule 1 (WC Act)

Distribution and ecology: This subspecies of the Banded Hare-wallaby only occurs naturally on Bernier and Dorre Islands at Shark Bay. Attempts are being made to reintroduce it to Peron Peniusula. The mainland form, *Lagostrophus fasciatus albipilis*, is extinct.

Likelihood of occurrence: Highly unlikely. The DEC database search indicates that this species has been recorded at Cossack though no date is provided for the observation. It is assumed that the record is actually of the mainland subspecies and that it is not very recent.

Rhinonicteris aurantius (Pilbara form) (Pilbara Leaf-nosed Bat)

Status: Vulnerable (EPBC Act), Schedule 1 (WC Act)

Distribution and ecology: The Pilbara Leaf-nosed Bat is endemic to Australia and has a range stretching from the Pilbara to Queensland. The Pilbara form however, is restricted to the Pilbara region where it roosts in caves and mine adits with stable, warm and humid microclimates (Armstrong, 2001). Limited suitable habitats combined with its poor ability to maintain heat and water balance are the most important factors threatening the survival of this species (Baudinette *et al*. 2000).

Likelihood of occurrence: Unlikely. Despite intensive Anabat recordings during the surveys and those by Biota (2008a) and Ninox (2008), this species was not recorded. No suitable year round roosting habitats (e.g. deep caves/mine shafts) for this species were observed during the surveys.

Macroderma gigas (Ghost Bat)

Status: Priority 4

Distribution and ecology: Previously distributed across most of inland and northern Australia, the Ghost Bat is now restricted to the tropical north of the continent. The distribution of this large, white bat is determined by the availability of suitable caves and mine shafts for roosting. They forage for food over a wide range of habitats including arid spinifex hillsides, black soil grasslands, open savannah woodlands and other, more tropical habitats (Churchill 1998). Australia's only carnivorous bat, this species is a predator on large insects, frogs, lizards, birds, small mammals and even other bats (including bentwinged, horseshoe, leaf-nosed, sheathtailed, and the Little Cave Bat) (Strahan, 2004).

Likelihood of occurrence: Unlikely. Despite intensive Anabat^{TM} recordings during the surveys and those by Biota (2008a) and Ninox (2008), this species has not been not been recorded. These results suggest there are no significant roosting habitats for this species within or near the study area.

Leggadina lakedownensis (Short-tailed Mouse)

Status: Priority 4

Distribution and ecology: This secretive species occurs in the Pilbara and the Kimberley regions of WA as well as the Northern Territory and Queensland. It occupies a variety of habitats including hummock and tussock grasslands, tropical woodlands, samphire, sedgelands and stony ranges (Moro and Kutt 2008). Its populations rise and fall dramatically, probably in response to climatic fluctuations and availability of seeds.

Likelihood of occurrence: Possible. Not recorded during the surveys but was captured by Ninox (2008) at a location about 3km south and east of the current study area within a low shrubland associated with very minor drainage lines. It could possibly occur in limited areas of the study area where suitable habitat is present.

4.3 FAUNA HABITATS OF CONSERVATION SIGNIFICANCE

Fauna habitats may be of conservation significance because they are uncommon, support unique assemblages and/or support fauna of conservation significance (Biota 2006).

The study area contains fauna habitat types that are generally well represented in the Pilbara region. The likely distribution of each fauna habitat type was mapped in the study area (Figure 4-1).

Fauna habitats of highest conservation significance in the study area (locally significant) are the mangrove communities and the sand dune habitat on Dixon Headland (and possibly Dixon Island).

The mangroves are restricted in distribution, and support a number of species that are restricted to, or preferentially occur, in this habitat, including the conservation-significant Little Northern Freetail Bat (*Mormopterus loriae cobourgiana*; Figure 4-2). Mangrove communities are recognised by the EPA as being of significance, with guidelines specifically formulated to manage impacts to this community type on the Pilbara coast (EPA 2001). Recent research indicates that the mangroves of the Pilbara contain compositionally-distinct

bat communities compared with those of landward Pilbara environments (McKenzie and Bullen 2009).

The sand dune habitat on Dixon Headland supports the Priority 1 skink *Lerista nevinae*. The species appears to be restricted to the coastal dunes between Popes Nose Creek and the southwest corner of Anketell Point, as well as a few possible locations on Dixon Island. The species was not found on Dixon Island or Delambre Island during surveys for the Proposal but two records were made on Dixon Island by Biota (2009).

The extent of Lerista nevinae habitat in the immediate area of Anketell Point has been mapped (Figure 4-2). Biota (2009) considered the entire known range of the species in an updated assessment of the species habitat extent, concluding that its full range encompassed approximately 471.9 ha. This estimate does not include the habitat extent on Dixon Island and further investigations are warranted to better determine its distribution on the island.

7720000
7717500
7715000
7712500
7710000
7707500
7705000

Boundary between Port and Rail project areas

500000
502500
505000
507500
510000
512500

Fauna habitats occurring within the Anketell Point Rail Alignment and Port Projects

Figure 4.1

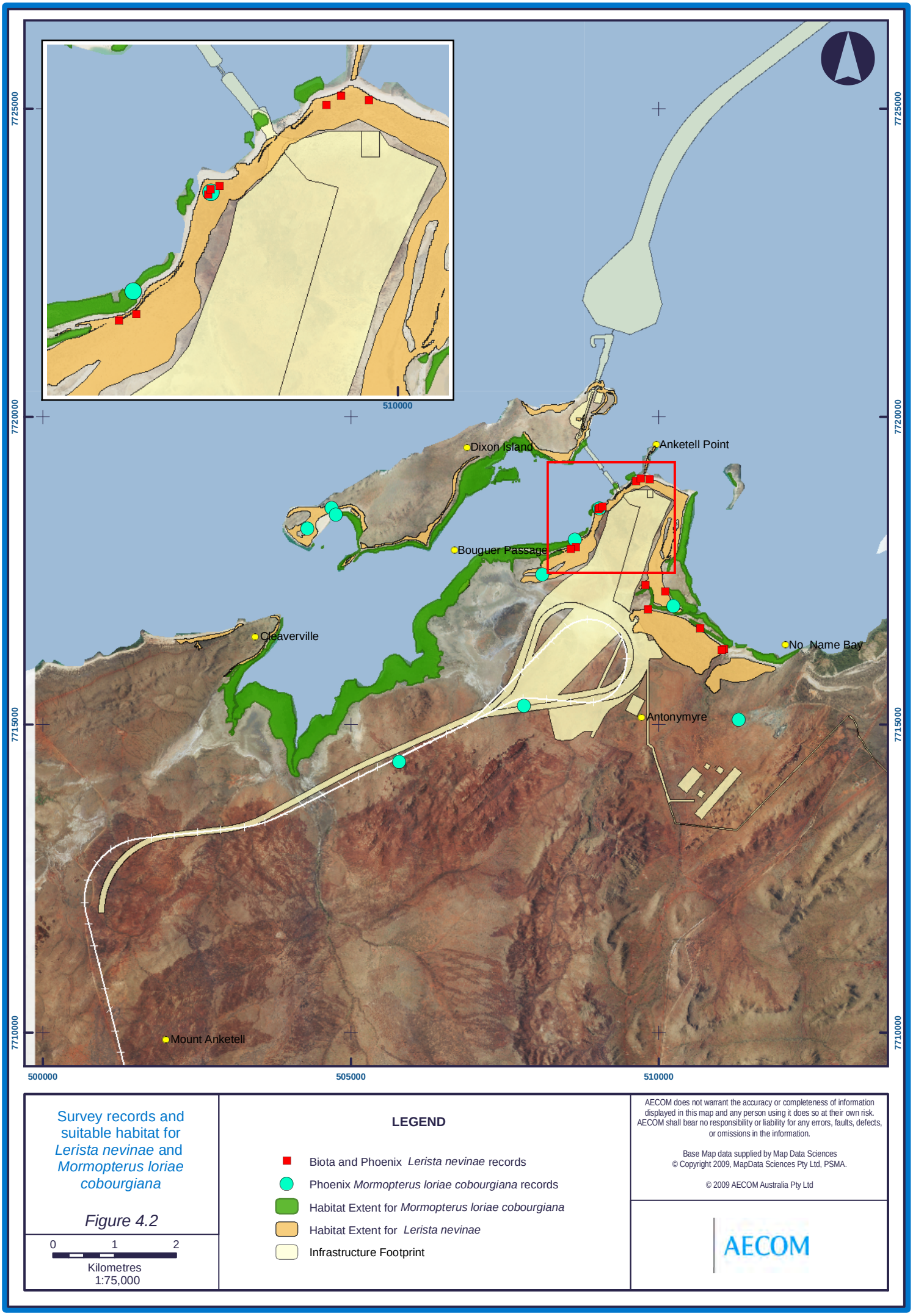
0 0.5 1 1.5 2
Kilometres
1:50,000

LEGEND

- Infrastructure Footprint
- **Derived Fauna Habitat**
- Not Classified
- Beach
- Coastal Dunes
- Drainage Line
- Hill Slope
- Mangroves
- Mudflats and samphire
- Plains
- Rocky Outcrops

AECOM

Date Modified: 15/07/2010
Author: KEJ J:\Client_Data\Australian_Premium_IronOre\60027030 - API Enviro PFS\Workspaces\Phoenix_Maps_20100715\4.1_Fauna_Habitat.mxd



Survey records and suitable habitat for *Lerista nevinae* and *Mormopterus loriae cobourgiana*

Figure 4.2

0 1 2
Kilometres
1:75,000

LEGEND

- Biota and Phoenix *Lerista nevinae* records
- Phoenix *Mormopterus loriae cobourgiana* records
- Habitat Extent for *Mormopterus loriae cobourgiana*
- Habitat Extent for *Lerista nevinae*
- Infrastructure Footprint

AECOM

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6.0 APPENDIX 1: MIGRATORY BIRDS IDENTIFIED AS OCCURRING OR POTENTIALLY OCCURRING IN THE STUDY AREA THROUGH DATABASE SEARCHES

Family	Scientific Name	Common name	Classification
Apodidae	*Apus pacificus*	Fork-tailed Swift	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
Fregatidae	*Fregata ariel*	Lesser Frigatebird	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
Ardeidae	*Ardea modesta*	Eastern Great Egret	Marine; Migratory(CAMBA, JAMBA)
	Ardea ibis	Cattle Egret	Marine; Migratory(CAMBA, JAMBA)
	Egretta sacra	Eastern Reef Heron	Marine; Migratory(CAMBA)
Accipitridae	*Pandion cristatus*	Eastern Osprey	Marine; Migratory(Bonn)
	Haliaeetus leucogaster	White-bellied Sea-Eagle	Marine; Migratory(CAMBA)
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Pluvialis squatarola	Grey Plover	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Charadrius mongolus	Lesser Sand Plover	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Charadrius leschenaultii	Greater Sand Plover	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Charadrius veredus	Oriental Plover	Marine; Migratory(Bonn, JAMBA, ROKAMBA)
Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Limosa limosa	Black-tailed Godwit	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Limosa lapponica	Bar-tailed Godwit	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Numenius minutus	Little Curlew	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Numenius phaeopus	Whimbrel	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Numenius madagascariensis	Eastern Curlew	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Xenus cinereus	Terek Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Actitis hypoleucos	Common Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Tringa brevipes	Grey-tailed Tattler	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Tringa nebularia	Common Greenshank	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Tringa stagnatilis	Marsh Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Tringa glareola	Wood Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Arenaria interpres	Ruddy Turnstone	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris tenuirostris	Great Knot	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris canutus	Red Knot	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris alba	Sanderling	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris ruficollis	Red-necked Stint	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris subminuta	Long-toed Stint	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris melanotos	Pectoral Sandpiper	Marine; Migratory(Bonn, JAMBA, ROKAMBA)

Family	Scientific Name	Common name	Classification
	Calidris acuminata	Sharp-tailed Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Calidris ferruginea	Curlew Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Limicola falcinellus	Broad-billed Sandpiper	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Philomachus pugnax	Ruff	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
Laridae	*Anous stolidus*	Common Noddy	Marine; Migratory(CAMBA, JAMBA)
	Onychoprion anaethetus	Bridled Tern	Marine; Migratory(CAMBA, JAMBA)
	Sternula albifrons	Little Tern	Marine; Migratory(Bonn, CAMBA, JAMBA, ROKAMBA)
	Hydroprogne caspia	Caspian Tern	Marine; Migratory(CAMBA, JAMBA)
	Chlidonias leucopterus	White-winged Black Tern	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
	Sterna dougallii	Roseate Tern	Marine; Migratory(JAMBA)
	Sterna hirundo	Common Tern	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
	Thalasseus bengalensis	Lesser Crested Tern	Marine; Migratory(CAMBA)
Cuculidae	*Cuculus optatus*	Oriental Cuckoo	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)
Meropidae	*Merops ornatus*	Rainbow Bee-eater	Marine; Migratory(JAMBA)
Hirundinidae	*Hirundo rustica*	Barn Swallow	Marine; Migratory(CAMBA, JAMBA, ROKAMBA)

7.0 APPENDIX 2: FULL LIST OF SPECIES OBTAINED FROM GENERAL DATABASE SEARCHES AND RELEVANT PREVIOUS REPORTS

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
AMPHIBIANS									
Myobatrachidae	*Notaden nichollsi*	Desert Spadefoot	LC	X	X			X	
	Uperoleia glandulosa	Glandular Toadlet	LC						
	Neobatrachus aquilonius	Northern Burrowing Frog	LC					X	
	Uperoleia russelli	Russell's Toadlet	LC					X	
	Limnodynastes spenceri	Spencer's Frog	LC						
Hylidae	*Litoria rubella*	Desert Tree Frog	LC			X		X	
	Cyclorana australis	Giant Frog	LC					X	
	Cyclorana maini	Sheep Frog	LC	X	X			X	
	Cyclorana platycephala	Water-holding Frog	LC	X					
BIRDS									
Casuariidae	*Dromaius novaehollandiae*	Emu	LC						X
Phasianidae	*Coturnix pectoralis*	Stubble Quail	LC						
	Coturnix ypsilophora	Brown Quail	LC	X	X			X	X
Anatidae	*Tadorna tadornoides*	Australian Shelduck	LC	X					
	Chenonetta jubata	Australian Wood Duck	LC					X	
	Anas rhynchotis	Australasian Shoveler	LC					X	
	Anas gracilis	Grey Teal	LC	X				X	
Columbidae	*Phaps chalcoptera*	Common Bronzewing	LC						X
	Phaps histrionica	Flock Bronzewing	P4 LC					X	
	Ocyphaps lophotes	Crested Pigeon	LC	X	X	X		X	X
	Geophaps plumifera	Spinifex Pigeon	LC	X	X	X		X	X
	Geopelia cuneata	Diamond Dove	LC	X				X	X
	Geopelia striata	Peaceful Dove	LC		X				X
	Geopelia humeralis	Bar-shouldered Dove	LC	X	X	X		X	X
Podargidae	*Podargus strigoides*	Tawny Frogmouth	LC					X	X
Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar	LC	X					
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	LC	X					X
Apodidae	*Apus pacificus*	Fork-tailed Swift	Migratory CA JA				X		

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
			LC						
Fregatidae	*Fregata ariel*	Lesser Frigatebird	Migratory CA JA LC						X
Anhingidae	*Anhinga novaehollandiae*	Australasian Darter	LC			X			X
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	LC	X					X
	Phalacrocorax carbo	Great Cormorant	LC						X
	Phalacrocorax sulcirostris	Little Black Cormorant	LC	X		X			X
	Phalacrocorax varius	Pied Cormorant	LC	X					X
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	LC	X		X			X
Ardeidae	*Ardea pacifica*	White-necked Heron	LC						X
	Ardea modesta	Eastern Great Egret	Migratory CA JA		X		X		X
	Ardea ibis	Cattle Egret	Migratory CA JA				X		
	Butorides striata	Striated Heron	LC	X		X			X
	Egretta novaehollandiae	White-faced Heron	LC	X					X
	Egretta garzetta	Little Egret	LC	X	X	X			X
	Egretta sacra	Eastern Reef Egret	Migratory CA LC	X					X
	Nycticorax caledonicus	Rufous Night Heron	LC						X
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	LC	X					X
	Threskiornis spinicollis	Straw-necked Ibis	LC						X
	Platalea regia	Royal Spoonbill	LC						X
Accipitridae	*Pandion cristatus*	Eastern Osprey	Migratory LC	X	X	X	X		X
	Elanus axillaris	Black-shouldered Kite	LC	X	X			X	X
	Hamirostra melanosternon	Black-breasted Buzzard	LC						X
	Haliaeetus leucogaster	White-bellied Sea-Eagle	Migratory CA LC	X	X	X	X		X
	Haliastur sphenurus	Whistling Kite	LC	X		X		X	X
	Haliastur indus	Brahminy Kite	LC	X	X	X		X	X
	Milvus migrans	Black Kite	LC	X					X
	Accipiter fasciatus	Brown Goshawk	LC	X		X			X
	Accipiter cirrocephalus	Collared Sparrowhawk	LC	X		X		X	X
	Circus assimilis	Spotted Harrier	LC	X				X	X
	Circus approximans	Swamp Harrier	LC						X
	Aquila audax	Wedge-tailed Eagle	LC	X		X		X	X
	Hieraaetus morphnoides	Little Eagle	LC						X
Falconidae	*Falco cenchroides*	Nankeen Kestrel	LC	X	X	X		X	X

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Falco berigora	Brown Falcon	LC	X	X	X		X	X
	Falco longipennis	Australian Hobby	LC	X		X			X
	Falco peregrinus	Peregrine Falcon	S4 LC					X	X
Gruidae	*Grus rubicunda*	Brolga	LC			X			X
Otididae	*Ardeotis australis*	Australian Bustard	P4 NT	X				X	X
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	P4 NT					X	X
	Esacus magnirostris	Beach Stone-curlew	LC					X	X
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	LC	X	X	X			X
	Haematopus fuliginosus	Sooty Oystercatcher	LC	X	X	X			X
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	LC	X	X				X
	Recurvirostra novaehollandiae	Red-necked Avocet	LC						X
	Cladorhynchus leucocephalus	Banded Stilt	LC						X
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	Migratory CA JA RK LC						X
	Pluvialis squatarola	Grey Plover	Migratory CA JA RK LC			X			X
	Charadrius ruficapillus	Red-capped Plover	LC	X	X	X		X	X
	Charadrius mongolus	Lesser Sand Plover	Migratory CA JA RK LC	X		X			X
	Charadrius leschenaultii	Greater Sand Plover	Migratory CA JA RK LC	X	X				X
	Charadrius veredus	Oriental Plover	Migratory JA LC				X		
	Elseyornis melanops	Black-fronted Dotterel	LC						X
	Erythrogonys cinctus	Red-kneed Dotterel	LC						X
	Vanellus tricolor	Banded Lapwing	LC						X
Scolopacidae	*Gallinago stenura*	Pin-tailed Snipe	Migratory CA JA RK LC						
	Limosa limosa	Black-tailed Godwit	Migratory CA JA RK LC	X					X
	Limosa lapponica	Bar-tailed Godwit	Migratory CA JA RK LC	X	X	X			
	Numenius minutus	Little Curlew	Migratory CA JA RK LC		X		X		

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Numenius phaeopus	Whimbrel	Migratory CA JA RK LC	X	X	X			X
	Numenius madagascariensis	Eastern Curlew	P4 Migratory CA JA RK LC	X	X	X		X	X
	Xenus cinereus	Terek Sandpiper	Migratory CA JA RK LC	X					X
	Actitis hypoleucos	Common Sandpiper	Migratory CA JA RK LC	X		X			X
	Tringa brevipes	Grey-tailed Tattler	Migratory CA JA RK LC	X	X	X			X
	Tringa nebularia	Common Greenshank	Migratory CA JA RK LC	X	X				X
	Tringa stagnatilis	Marsh Sandpiper	Migratory CA JA RK LC	X					X
	Tringa glareola	Wood Sandpiper	Migratory CA JA RK LC	X				X	X
	Arenaria interpres	Ruddy Turnstone	Migratory CA JA RK LC	X	X	X			X
	Calidris tenuirostris	Great Knot	Migratory CA JA RK LC						X
	Calidris canutus	Red Knot	Migratory CA JA RK LC						X
	Calidris alba	Sanderling	Migratory CA JA RK LC						X
	Calidris ruficollis	Red-necked Stint	Migratory CA JA RK LC	X	X				X
	Calidris subminuta	Long-toed Stint	Migratory CA JA RK LC						
	Calidris melanotos	Pectoral Sandpiper	Migratory JA RK LC						
	Calidris acuminata	Sharp-tailed Sandpiper	Migratory CA JA RK LC						X
	Calidris ferruginea	Curlew Sandpiper	Migratory CA JA RK LC			X			X
	Limicola falcinellus	Broad-billed Sandpiper	Migratory CA JA						

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
			RK LC						
	Philomachus pugnax	Ruff	Migratory CA JA RK LC						
Turnicidae	*Turnix velox*	Little Button-quail	LC	X		X		X	X
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	Migratory CA JA RK LC				X		X
	Stiltia isabella	Australian Pratincole	LC						
Laridae	*Anous stolidus*	Common Noddy	Migratory CA JA LC					X	
	Onychoprion anaethetus	Bridled Tern	Migratory CA JA LC						X
	Sternula albifrons	Little Tern	Migratory CA JA RK LC	X					
	Sternula nereis	Fairy Tern	LC						X
	Gelochelidon nilotica	Gull-billed Tern	LC	X					X
	Hydroprogne caspia	Caspian Tern	Migratory CA JA LC	X	X	X	X		X
	Chlidonias hybrida	Whiskered Tern	LC	X					
	Chlidonias leucopterus	White-winged Black Tern	Migratory CA JA RK LC						X
	Sterna dougallii	Roseate Tern	Migratory JA LC						
	Sterna hirundo	Common Tern	Migratory CA JA RK LC						X
	Thalasseus bengalensis	Lesser Crested Tern	Migratory CA LC	X	X	X			X
	Thalasseus bergii	Crested Tern	LC	X	X	X	X		X
	Chroicocephalus novaehollandiae	Silver Gull	LC	X	X	X	X		X
Cacatuidae	*Eolophus roseicapillus*	Galah	LC	X	X	X		X	X
	Cacatua sanguinea	Little Corella	LC	X	X				X
	Nymphicus hollandicus	Cockatiel	LC	X				X	X
Psittacidae	*Barnardius zonarius*	Australian Ringneck Parrot	LC	X					X
	Melopsittacus undulatus	Budgerigar	LC	X	X				X
Cuculidae	*Centropus phasianinus*	Pheasant Coucal	LC	X	X				X
	Chalcites basalis	Horsfield's Bronze Cuckoo	LC	X	X			X	X

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Cacomantis pallidus	Pallid Cuckoo	LC	X				X	X
	Cuculus optatus	Oriental Cuckoo	Migratory CA JA LC					X	
Strigidae	*Ninox novaeseelandiae*	Boobook Owl	LC						X
Tytonidae	*Tyto javanica*	Eastern Barn Owl	LC						X
Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra	LC	X					X
	Todiramphus pyrrhopygius	Red-backed Kingfisher	LC	X	X			X	
	Todiramphus sanctus	Sacred Kingfisher	LC	X	X	X		X	X
	Todiramphus chloris	Collared Kingfisher	LC	X	X			X	X
Meropidae	*Merops ornatus*	Rainbow Bee-eater	Migratory JA LC	X	X	X	X	X	X
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird	LC	X		X			X
Maluridae	*Malurus leucopterus*	White-winged Fairy-wren	LC	X	X			X	X
	Malurus lamberti	Variegated Fairy-wren	LC	X	X				X
Acanthizidae	*Smicrornis brevirostris*	Weebill	LC		X				X
	Gerygone fusca	Western Gerygone	LC	X				X	X
	Gerygone tenebrosa	Dusky Gerygone	LC	X	X			X	X
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote	LC	X		X			X
	Pardalotus striatus	Striated Pardalote	LC			X			X
Meliphagidae	*Certhionyx variegatus*	Pied Honeyeater	LC	X					
	Lichenostomus virescens	Singing Honeyeater	LC	X	X	X		X	X
	Lichenostomus keartlandi	Grey-headed Honeyeater	LC	X					X
	Lichenostomus penicillatus	White-plumed Honeyeater	LC	X				X	X
	Manorina flavigula	Yellow-throated Miner	LC	X	X	X		X	X
	Epthianura tricolor	Crimson Chat	LC	X				X	X
	Epthianura aurifrons	Orange Chat	LC	X				X	
	Sugomel niger	Black Honeyeater	LC	X					
	Lichmera indistincta	Brown Honeyeater	LC	X	X	X		X	X
	Melithreptus gularis	Black-chinned Honeyeater	LC					X	
Pomatostomidae	*Pomatostomus temporalis*	Grey-crowned Babbler	LC						X
	Pomatostomus superciliosus	White-browed Babbler	LC					X	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	LC	X	X	X		X	X
	Lalage sueurii	White-winged Triller	LC	X	X			X	X
Pachycephalidae	*Pachycephala melanura*	Mangrove Golden Whistler	LC	X		X		X	X

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Pachycephala rufiventris	Rufous Whistler	LC			X		X	X
	Pachycephala lanioides	White-breasted Whistler	LC	X				X	X
	Colluricincla harmonica	Grey Shrike-thrush	LC					X	
	Oreoica gutturalis	Crested Bellbird	LC	X	X	X		X	
Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow	LC	X	X	X		X	X
	Artamus personatus	Masked Woodswallow	LC					X	
	Artamus cinereus	Black-faced Woodswallow	LC	X	X	X		X	X
	Artamus minor	Little Woodswallow	LC						X
	Cracticus torquatus	Grey Butcherbird	LC						X
	Cracticus nigrogularis	Pied Butcherbird	LC	X	X	X		X	X
	Cracticus tibicen	Australian Magpie	LC	X		X			X
Rhipiduridae	*Rhipidura fuliginosa*	Grey Fantail	LC						X
	Rhipidura phasiana	Mangrove Grey Fantail	LC	X	X			X	X
	Rhipidura leucophrys	Willie Wagtail	LC	X	X	X		X	X
Corvidae	*Corvus bennetti*	Little Crow	LC					X	X
	Corvus orru	Torresian Crow	LC	X	X			X	X
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	LC	X	X	X		X	X
Petroicidae	*Petroica goodenovii*	Red-capped Robin	LC	X					
	Peneonanthe pulverulenta	Mangrove Robin	LC	X		X		X	
Alaudidae	*Mirafra javanica*	Singing Bushlark	LC	X	X			X	X
Megaluridae	*Eremiornis carteri*	Spinifexbird	LC	X		X		X	X
Timaliidae	*Zosterops luteus*	Yellow White-eye	LC	X	X	X		X	X
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow	LC	X					
	Hirundo rustica	Barn Swallow	Migratory CA JA LC				X		
	Hirundo neoxena	Welcome Swallow	LC	X		X		X	X
	Petrochelidon ariel	Fairy Martin	LC	X					X
	Petrochelidon nigricans	Tree Martin	LC	X				X	X
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	LC					X	X
Estrildidae	*Taeniopygia guttata*	Zebra Finch	LC	X	X	X		X	X
	Neochmia ruficauda subclarescens	Star Finch (western)	P4		X				X
	Emblema pictum	Painted Finch	LC	X	X	X		X	X

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
Motacillidae	*Anthus novaeseelandiae*	Australian Pipit	LC	X	X	X		X	X
MAMMALS									
Tachyglossidae	*Tachyglossus aculeatus*	Echidna	LC	X				X	
Dasyuridae	*Sminthopsis youngsoni*	Lesser Hairy-footed Dunnart	LC		X			X	
	Dasykaluta rosamondae	Little Red Kaluta	LC	X	X			X	
	Planigale ingrami	Long-tailed Planigale	LC		X				
	Dasycercus cristicauda	Mulgara	S1 VU VU				X		
	Dasyurus hallucatus	Northern Quoll	S1 EN NT			X	X	X	
	Ningaui timealeyi	Pilbara Ningaui	LC	X	X	X		X	
	Planigale sp	Planigale		X		X		X	
	Pseudantechinus roryi	Rory's Pseudantechinus						X	
	Sminthopsis macroura	Stripe-faced Dunnart	LC	X	X	X		X	
	Pseudantechinus woolleyae	Woolley's Pseudantechinus	LC						
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	LC						
Macropodidae	*Lagostrophus fasciatus fasciatus*	Banded Hare-wallaby	S1 VU VU					X	
	Macropus robustus	Euro, Biggada	LC	X	X	X		X	
	Macropus rufus	Red Kangaroo	LC	X	X				
	Petrogale rothschildi	Rothschild's Rock-wallaby	LC					X	
Megadermatidae	*Macroderma gigas*	Ghost Bat	P4 VU					X	
Pteropodidae	*Pteropus alecto*	Black Flying-fox	LC						
	Pteropus scapulatus	Little Red Flying-fox	LC						
Hipposideridae	*Rhinonicteris aurantius*	Orange Leaf-nosed Bat	S1 VU				X		
Emballonuridae	*Taphozous georgianus*	Common Sheathtail-bat	LC	X	X	X			
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	NT	X	X	X			
Molossidae	*Mormopterus beccarii*	Beccari's Freetail Bat	LC						
	Mormopterus loriae cobourgiana	Little Northern Freetail Bat	P1	X	X	X		X	
	Chaerephon jobensis	Northern Freetail Bat	LC	X					
	Tadarida australis	White-striped Freetail Bat	LC	X					
Vespertilionidae	*Nyctophilus geoffroyi palescens*		X						
	Nyctophilus arnhemensis	Arnhem Land Long-eared Bat	LC	X		X			

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Chalinolobus morio	Chocolate Wattled Bat	LC						
	Vespadelus finlaysoni	Finlayson's Cave Bat	LC	X	X	X		X	
	Chalinolobus gouldii	Gould's Wattled Bat	LC	X				X	
	Nyctophilus geoffroyi	Lesser Long-eared Bat	LC	X	X				
	Scotorepens greyii	Little Broad-nosed Bat		X					
	Nyctophilus bifax	Northwestern Long-eared Bat	LC						
	Vespadelus regulus	Southern Forest Bat	LC					X	
Muridae	*Rattus rattus*	Black Rat	Introduced	X				X	
	Zyzomys argurus	Common Rock-rat	LC					X	
	Pseudomys delicatulus	Delicate Mouse	NT					X	
	Pseudomys desertor	Desert Mouse	NT	X	X				
	Mus musculus	House Mouse	Introduced	X	X	X		X	
	Leggadina lakedownensis	Lakeland Downs Mouse	P4 NT					X	
	Pseudomys hermannsburgensis	Sandy Inland Mouse	LC	X	X	X		X	
	Notomys alexis	Spinifex Hopping-mouse	LC	X				X	
	Pseudomys chapmani	Western Pebble-mound Mouse	P4 LC	X				X	
	Pseudomys nanus	Western Chestnut Mouse	NT			X			
Canidae	*Canis lupus dingo*	Dingo	Introduced						
	Canis lupus familiaris	Dog/Dingo		X					
	Vulpes vulpes	Red Fox	Introduced	X	X	X			
Felidae	*Felis catus*	Cat	Introduced	X					
Bovidae	*Capra hircus*	Goat	Introduced		X				
REPTILES									
Cheloniidae	*Chelonia mydas*	Green Turtle	S1 VU EN	X			X		
Gekkonidae	*Diplodactylus mitchelli*							X	
	Diplodactylus savagei							X	
	Gehyra punctata			X	X			X	
	Gehyra purpurascens							X	
	Lucasium wombeyi			X		X		X	
	Oedura marmorata	Velvet Gecko		X				X	
	Strophurus elderi			X		X		X	

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Strophurus jeanae			X	X			X	
	Strophurus strophurus							X	
	Strophurus wellingtonae							X	
	Hemidactylus frenatus	Asian House Gecko						X	
	Rhynchoedura ornata	Beaked Gecko						X	
	Heteronotia binoei	Bynoe's Gecko		X	X	X		X	
	Crenadactylus ocellatus horni							X	
	Lucasium stenodactylum			X	X	X		X	
	Diplodactylus conspicillatus	Fat-tailed Gecko		X		X		X	
	Gehyra pilbara			X				X	
	Nephrurus levis							X	
	Strophurus ciliaris			X	X	X		X	
	Gehyra variegata			X	X	X		X	
Pygopodidae	*Delma borea*								
	Delma butleri			X					
	Delma haroldi								
	Delma nasuta							X	
	Delma pax			X	X	X		X	
	Lialis burtonis			X	X	X		X	
	Delma tincta			X	X			X	
	Pygopus nigriceps								
Agamidae	*Ctenophorus isolepis*	Crested Dragon		X	X	X		X	
	Ctenophorus nuchalis	Central Netted Dragon		X				X	
	Diporiphora winneckei	Blue Lined Dragon		X	X			X	
	Lophognathus longirostris			X	X			X	
	Tympanocryptis cephala					X		X	
	Lophognathus gilberti	Gilbert'sDragon		X	X	X		X	
	Ctenophorus caudicinctus	Ring-tailed Dragon		X	X	X		X	
	Ctenophorus reticulatus	Western Netted Dragon							
	Pogona minor minor							X	
	Pogona minor mitchelli			X	X	X		X	

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
Varanidae	*Varanus brevicauda*	Short Tailed Pygmy Monitor		X				X	
	Varanus bushi	Pilbara Mulga Monitor		X					
	Varanus giganteus	Perentie		X	X				
	Varanus panoptes	Yellow Spotted Monitor		X		X		X	
	Varanus pilbarensis	Pilbara Rock Monitor		X				X	
	Varanus tristis	Racehorse Monitor							
	Varanus gouldii	Sand Monitor		X					
	Varanus eremius	Pygmy Desert Monitor		X	X			X	
	Varanus acanthurus	Spiny-tailed Monitor		X	X	X		X	
Scincidae	*Carlia munda*			X	X	X		X	
	Carlia triacantha							X	
	Cryptoblepharus ustulatus			X				X	
	Ctenotus duricola			X		X		X	
	Ctenotus grandis titan			X	X	X		X	
	Ctenotus hanloni							X	
	Ctenotus helenae			X				X	
	Ctenotus robustus					X		X	
	Ctenotus rubicundus			X		X		X	
	Ctenotus rufescens								
	Ctenotus saxatilis	Rock Ctenotus		X	X	X		X	
	Ctenotus serventyi			X	X			X	
	Cyclodomorphus melanops	Slender Blue Tongue		X	X	X		X	
	Egernia depressa	Pygmy Spint Tailed Skink		X	X	X		X	
	Egernia formosa								
	Egernia pilbarensis	Pilbara Skink		X				X	
	Eremiascincus fasciolatus	Narrow Banded Sand Swimmer		X	X			X	
	Lerista bipes			X	X	X		X	
	Lerista clara			X				X	
	Lerista jacksoni							X	
	Lerista muelleri			X				X	
	Lerista nevinae			X	X			X	
	Lerista verhmens				X	X		X	
	Menetia surda							X	

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Morethia ruficauda			X	X	X		X	
	Notoscincus ornatus							X	
	Proablepharus reginae							X	
	Ctenotus schomburgkii			X					
	Tiliqua multifasciata	Central Blue Tongue Lizard		X	X			X	
	Menetia greyii			X	X	X		X	
	Cryptoblepharus buchananii							X	
	Ctenotus pantherinus ocellifer	Leopard Ctenotus		X	X	X		X	
	Notoscincus butleri		P4	X				X	
	Glaphyromorphus isolepis			X				X	
	Lerista elegans								
Typhlopidae	*Ramphotyphlops ammodytes*			X				X	
	Ramphotyphlops grypus				X			X	
	Ramphotyphlops braminus							X	
	Ramphotyphlops australis								
Pythonidae	*Aspidites melanocephalus*	Black-headed Python							
	Liasis olivaceus barroni	Pilbara Olive Python	S1 VU				X		
	Antaresia perthensis	Pygmy Python		X		X		X	
	Antaresia stimsoni	Stimson's Python						X	
Elapidae	*Hydrelaps darwiniensis*							X	
	Acanthophis pyrrhus	Desert Death-adder				X			
	Simoselaps anomalus	Desert Banded Snake						X	
	Pseudonaja nuchalis	Gwardar		X	X	X		X	
	Parasuta monachus			X					
	Furina ornata	Moon Snake			X			X	
	Pseudechis australis	Mulga Snake		X				X	
	Brachyurophis approximans				X	X			
	Acanthophis wellsi	Pilbara Death-adder		X				X	
	Vermicella snelli				X			X	
	Pseudonaja modesta	Ringed Brown Snake						X	

Family	Genus & Species	Common Name	Status	Phoenix	Biota	Ninox	EPBC	DEC	BA
	Suta fasciata	Rosen's Snake						X	
	Demansia rufescens	Rufous Whipsnake		X	X	X		X	
	Ephalophis greyae							X	
	Suta punctata	Spotted Snake		X				X	
	Demansia psammophis	Yellow-faced Whip Snake		X				X	
Homalopsinae	*Fordonia leucobalia*	White-bellied Mangrove Snake						X	

Key to table headings: Phoenix (results of this survey); Biota (Biota 2008b); Ninox (Ninox 2008); EPBC Seach Tool (EPBC Protected Matters Search Tool); DEC (DEC Threatened Fauna Database); BA (Birds Australia Database).

Key to status classifications (see section 4.1 for more information):

EPBC Act: CE (critically endangered); EN (endangered); VU (vulnerable); CD (conservation dependent)

Wildlife Conservation (Specially Protected Fauna) Notice 2010: S1 – S4 (Schedule 1 –4).

DEC Priority Fauna List: P1-P5 (Priority 1 – 5).

International agreements: JA (JAMBA); CA (CAMBA); RK (ROCKAMBA).

IUCN Red List Category definitions: EX (extinct); EW (extinct in the wild); CR (critically endangered); EN (endangered); VU (vulnerable); NT (near threatened); LC (least concern); DD (data deficient).

8.0 APPENDIX 3: SPECIES RECORDED FROM EACH SITE DURING THE SURVEYS

Family	Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	ML Opp	Dixon Is.Opp	Delam. Is.Opp
Amphibians																
Myobatrachidae	*Notaden nichollsi*	Desert Spadefoot					1									
Hylidae	*Cyclorana maini*	Main's Frog	3				2	1	5							
	Cyclorana platycephala	Water-holding Frog							1							
Birds																
Phasianidae	*Coturnix ypsilophora*	Brown Quail	4		6					1						
Anatidae	*Tadorna tadornoides*	Australian Shelduck									1					
	Anas gracilis	Grey Teal	2													
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	1	8	1	4		4	2	1	2		20		2	
	Geophaps plumifera	Spinifex Pigeon	1							5		10	2	2		
	Geopelia cuneata	Diamond Dove	2						15			20	11	3		
	Geopelia humeralis	Bar-shouldered Dove	1	6			4				2			2	7	
	Eurostopodus argus	Spotted Nightjar	1	2												
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-Nightjar	1											1		
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant													1	
	Phalacrocorax sulcirostris	Little Black Cormorant					1									
	Phalacrocorax varius	Pied Cormorant		1											3	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	1	1										1	1	
Ardeidae	*Butorides striata*	Striated Heron												1		
	Egretta novaehollandiae	White-faced Heron	1			2							1	6	2	
	Egretta garzetta	Little Egret												52	15	
	Egretta sacra	Eastern Reef Egret												1	3	
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis												1		
Accipitridae	*Pandion cristatus*	Eastern Osprey		1	1	3	1	2			1			1	8	1
	Elanus axillaris	Black-shouldered Kite		1	2	1				1			1	1	1	
	Haliaeetus leucogaster	White-bellied Sea Eagle			1	1		1					1	1	3	
	Haliastur sphenurus	Whistling Kite	3				1									
	Haliastur indus	Brahminy Kite	1		2		1							2	1	
	Milvus migrans	Black Kite											1	1		
	Accipiter fasciatus	Brown Goshawk						1	1				1			
	Accipiter cirrocephalus	Collared Sparrowhawk	1													
	Circus assimilis	Spotted Harrier	2		2		2		1	3			2	1		
	Aquila audax	Wedge-tailed Eagle					1			1		2		1		
Falconidae	*Falco cenchroides*	Nankeen Kestrel	1	1	3	3	2	2	4	3	1	1	3	1	3	
	Falco berigora	Brown Falcon	2					1		1				1	1	
	Falco longipennis	Australian Hobby					1	2						2		
Otididae	*Ardeotis australis*	Australian Bustard										1				
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher												11	5	2
	Haematopus fuliginosus	Sooty Oystercatcher									1			1	2	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt	1												10	
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover												39	3	
	Charadrius mongolus	Lesser Sand Plover												1		
	Charadrius leschenaultii	Greater Sand Plover													31	
Scolopacidae	*Limosa limosa*	Black-tailed Godwit		1												
	Limosa lapponica	Bar-tailed Godwit												1	30	
	Numenius phaeopus	Whimbrel							2							

Family	Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	ML Opp	Dixon Is.Opp	Delam. Is.Opp
	Numenius madagascariensis	Eastern Curlew					1						1	21	20	
	Xenus cinereus	Terek Sandpiper												1		
	Actitis hypoleucos	Common Sandpiper												1		
	Tringa brevipes	Grey-tailed Tattler												6	15	
	Tringa nebularia	Common Greenshank												1		
	Tringa stagnatilis	Marsh Sandpiper												31		
	Tringa glareola	Wood Sandpiper												1		
	Arenaria interpres	Ruddy Turnstone												1		
	Calidris ruficollis	Red-necked Stint												1		
Turnicidae	*Turnix velox*	Little Button-quail	2			1				1			2	2		
Laridae	*Sternula albifrons*	Little Tern												1		
	Gelochelidon nilotica	Gull-billed Tern								8				2	3	
	Hydroprogne caspia	Caspian Tern					4				1			5	5	
	Chlidonias hybrida	Whiskered Tern														
	Thalasseus bengalensis	Lesser Crested Tern												5		
	Thalasseus bergii	Crested Tern												1	155	5
	Chroicocephalus novaehollandiae	Silver Gull		5		2	2	1			3		1	7	8	
Cacatuidae	*Eolophus roseicapillus*	Galah	5					40					10			
	Cacatua sanguinea	Little Corella							1			7	6			
	Nymphicus hollandicus	Cockatiel	23							6						
Psittacidae	*Barnardius zonarius*	Australian Ringneck Parrot	2													
	Melopsittacus undulatus	Budgerigar	22	16	26	1	2	11	99	1	2	3	47	47		
Cuculidae	*Centropus phasianinus*	Pheasant Coucal									1					
	Chalcites basalis	Horsfield`s Bronze Cuckoo	1											1		
	Cacomantis pallidus	Pallid Cuckoo						1								
Halcyonidae	*Dacelo leachii*	Blue-winged Kookaburra	2					1					1			
	Todiramphus pyrrhopygius	Red-backed Kingfisher	1						1					3	3	
	Todiramphus sanctus	Sacred Kingfisher	8	1			4	3	4		4		8	1		
	Todiramphus chloris	Collared Kingfisher												1		
Meropidae	*Merops ornatus*	Rainbow Bee-eater				1		3	3		1		3	3		
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird							2							
Maluridae	*Malurus leucopterus*	White-winged Fairy-wren					5	7	1			7	2	2	3	
	Malurus lamberti	Variegated Fairy-wren					4	2	4	3			2	4		
Acanthizidae	*Gerygone fusca*	Western Gerygone					2		2					5	15	
	Gerygone tenebrosa	Dusky Gerygone	2								1					
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote							1	1						
Meliphagidae	*Certhionyx variegatus*	Pied Honeyeater		1		1				1						
	Lichenostomus virescens	Singing Honeyeater	12	12	8	6	3	2	2	4	4	18	6	6		
	Lichenostomus keartlandi	Grey-headed Honeyeater							2	3		2	1			
	Lichenostomus penicillatus	White-plumed Honeyeater	3					11				4	2	2		
	Manorina flavigula	Yellow-throated Miner	1					2	1	9		3		4		
	Epthianura tricolor	Crimson Chat	6						1							
	Epthianura aurifrons	Orange Chat	4	6	5	11	10		3	2	3	3	7	2	4	
	Sugomel niger	Black Honeyeater											1	1		
	Lichmera indistincta	Brown Honeyeater		1	1				2	2			15			
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	3				2	1	1	1	2	5	3			
	Lalage sueurii	White-winged Triller	1	1			1			3	1		1	1		
	Pachycephala melanura	Mangrove Golden Whistler												2		

Family	Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	ML Opp	Dixon Is.Opp	Delam. Is.Opp
	Pachycephala lanioides	White-breasted Whistler	7										2			
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird							2					1	1	
Artamidae	*Artamus leucorynchus*	White-breasted Woodswallow	4	4	4	3	5	1			3		2	2		
	Artamus cinereus	Black-faced Woodswallow	2	3	3	4		8	4	5		3		1	4	
	Cracticus nigrogularis	Pied Butcherbird	2	6	1	2	2	1	2	1	1	1			1	
	Cracticus tibicen	Australian Magpie	3						3	2		19	3	1		
Rhipiduridae	*Rhipidura phasiana*	Mangrove Grey Fantail	4	5	2	3			2	2	2	2	2	1	2	1
	Rhipidura leucophrys	Willie Wagtail	3	5		2	4	2			3	3	1			
Corvidae	*Corvus orru*	Torresian Crow	1			4			3	3		5	3			
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	2											2	4	
Petroicidae	*Petroica goodenovii*	Red-capped Robin			2				2	1						
	Peneonanthe pulverulenta	Mangrove Robin	1		2											
Alaudidae	*Mirafra javanica*	Singing Bushlark	1	4		1	4	2	1	3	8	4	1	3		
Megaluridae	*Eremiornis carteri*	Spinifexbird	2	70	9	23	12	4	1	1	1	2		3	25	15
Timaliidae	*Zosterops luteus*	Yellow White-eye	2					1			3		8	8		
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow	1		5	5				1						
	Hirundo neoxena	Welcome Swallow		1		2	1									
	Petrochelidon ariel	Fairy Martin					2									
	Petrochelidon nigricans	Tree Martin	9		1	3		2			4		4	4		
Estrildidae	*Taeniopygia guttata*	Zebra Finch		14	1	1	19	3	7	19	10	25	43	43		
	Emblema pictum	Painted Finch	14	5	21	6	70		130	53	3	13	40		5	
Motacillidae	*Anthus novaeseelandiae*	Australian Pipit	5	5		3		1	6	11	2	11				
Mammals																
Tachyglossidae	*Tachyglossus aculeatus*	Echidna										1		1	1	
Dasyuridae	*Dasykaluta rosamondae*	Little Red Kaluta						4		2	2					
	Sminthopsis macroura	Stripe-faced Dunnart										4				
	Ningaui timealeyi	Pilbara Ningaui	1													
	Planigale sp	Planigale								1		2				
Macropodidae	*Macropus robustus*	Euro, Biggada		10								1		7	103	
	Macropus rufus	Red Kangaroo												13		
Emballonuridae	*Taphozous georgianus*	Common Sheathtail-bat		1		1			1			1		1	2	
	Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	1									1	1	1		
Molossidae	*Mormopterus loriae cobourgiana*	Little Northern Freetail Bat		1				1	1		1	1	1	2	2	
	Chaerephon jobensis	Northern Freetail Bat												1		
	Tadarida australis	White-striped Freetail Bat	1	1												
Vespertilionidae	*Nyctophilus geoffroyi palescens*													1		
	Nyctophilus arnhemensis	Arnhem Land Long-eared Bat							1							
	Vespadelus finlaysoni	Finlayson's Cave Bat	1	1	1	1	1	1	1	1	1	1		2	3	
	Chalinolobus gouldii	Gould`s Wattled Bat	1										1			
	Nyctophilus geoffroyi	Lesser Long-eared Bat							1					1		
	Scotorepens greyii	Little Broad-nosed Bat	1						1					1		
Muridae	*Rattus rattus*	Black Rat	2											1		
	Pseudomys desertor	Desert Mouse			2	1		1	2							
	Notomys alexis	Spinifex Hopping Mouse						1								
	Mus musculus	House Mouse	1		1	2	14	1	4							
	Pseudomys hermannsburgensis	Sandy Inland Mouse	2	9	4	4	6	1	2	1		2	2			
	Pseudomys chapmani	Western Pebble-mound Mouse								mound				2 mounds		
Canidae	*Canis lupis*	Dog		1										1	1	

Family	Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	ML Opp	Dixon Is.Opp	Delam. Is.Opp
	Vulpes vulpes	Red Fox		1										4		1
Felidae	*Felis catus*	Cat									1		1	3		
Reptiles																
Cheloniidae	*Chelonia mydas*	Green Turtle												7		
Gekkonidae	*Gehyra punctata*		7		1					22		8	2	1	9	
	Heteronotia binoei	Bynoe's Gecko	4						1							
	Lucasium wombeyi		1										1			
	Lucasium stenodactylum			9	1	2		4	1							
	Strophurus elderi		2													
	Strophurus jeanae							5			4					
	Diplodactylus conspicillatus	Fat-tailed Gecko							17	1						
	Oedura marmorata	Velvet Gecko							1							
	Gehyra pilbara											3				
	Strophurus ciliaris						3	17	17		6		1	1		
	Gehyra variegata		9	2	2		3		2							
Pygopodidae	*Delma butleri*						5		1							
	Delma tincta								1							
	Delma pax		2	2			1	1	2							
	Lialis burtonis		1					1		1	1	1				
Agamidae	*Ctenophorus isolepis*	Crested Dragon					8	13	4	2	4					
	Lophognathus longirostris		7				7	2	2		6					
	Diporiphora winneckei	Blue-lined Dragon	1						5							
	Ctenophorus nuchalis	Central Netted-Dragon					3				4					
	Lophognathus gilberti	Gilbert's Dragon	4				2		8				1			
	Ctenophorus caudicinctus	Ring-tailed Dragon	2		4			1	2	21				9		
	Pogona minor mitchelli				11	1			6	7		2				
Varanidae	*Varanus panoptes*	Yellow-spotted Monitor	2			1			1				3			
	Varanus eremius	Pygmy Desert Monitor	1				1									
	Varanus brevicauda	Short-tailed Pygmy Monitor								1			2			
	Varanus giganteus	Perentie												1		
	Varanus bushi	Pygmy Mulga Monitor	1													
	Varanus pilbarensis	Pilbara Rock Monitor								1						
	Varanus gouldii	Sand Monitor												1		
	Varanus acanthurus	Spiny-tailed Monitor							2	4		4	2			
Scincidae	*Carlia munda*		15						2							
	Egernia depressa	Pygmy Spiny-tailed Skink								1						
	Egernia pilbarensis	Pilbara Skink								1		1				
	Eremiascincus fasciolatus	Narrow Banded Sandswimmer					1				2					
	Ctenotus grandis titan								1							
	Ctenotus duricola		3		1				15	3	2					
	Ctenotus rubicundus									2		1				
	Ctenotus saxatilis	Rock Ctenotus	4	53	145	130	22	11	59	46	21	37	1	1		
	Ctenotus serventyi					3		2	2		1		2			
	Lerista bipes			51	8	42	47	13	5		51			3	5	9
	Lerista clara															1
	Lerista muelleri		1						5				11			2
	Lerista nevinae						8				10			2		
	Morethia ruficauda		1						2	13		4		2		

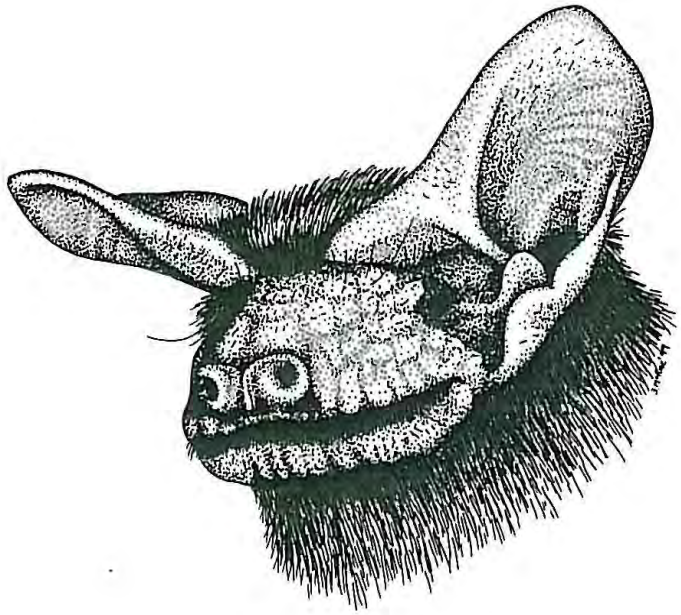
Family	Scientific Name	Common Name	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	ML Opp	Dixon Is.Opp	Delam. Is.Opp
	Ctenotus schomburgkii							1					7			
	Menetia greyii						1	2								
	Ctenotus pantherinus ocellifer	Leopard Ctenotus						6	4	1			18			
	Tiliqua multifasciata	Central Blue-tongued Skink						1								
	Notoscincus butleri		4													
	Ctenotus helenae								1				1			
	Cyclodomorphus melanops	Slender Blue-tongued Skink	1											3		
	Crytoblepharus ustulatus													3		
	Glaphyromorphus isolepis								3							
Typhlopidae	*Ramphotyphlops ammodytes*								1	1			1			
Pythonidae	*Antaresia perthensis*	Pygmy Python										3				
Elapidae	*Pseudonaja nuchalis*	Gwardar				2	2	1			2					
	Acanthophis wellsi	Pilbara Deathadder							2		1					
	Parasuta monachus		1													
	Pseudechis australis	Mulga Snake								1						
	Demansia rufescens	Rufous Whipsnake			3					4	1	2				
	Suta punctata	Spotted Snake												1		
	Demansia psammophis	Yellow-faced Whipsnake											2			

Key to headings – Opp: opportunistic observations.
ML = Mainland opportunistic site
Dixon = Dixon Island opportunistic site
Delam. Is. Opp = Delambre Island Opportunstic site

9.0 APPENDIX 4: ANALYSIS OF BAT CALL RECORDINGS

Bat Survey of proposed Anketell Port, Western Australia.
June 2009 - March 2010

Echolocation Survey of Bat Activity in the Anketell Point Study Area.
Revision 2



Prepared for Phoenix Environmental Science

Prepared by BAT CALL WA
30 Mar 2010

Bat Call WA
ABN 83 701 600 981
43 Murray Drive
Hillarys Western Australia 6025

Prepared by:
R. D. Bullen – Bat Call WA
March 2010

Front cover artwork by J. McRae

Echolocation Survey of Bat Activity in the Anketell Point Port Study Area.

Contents.

1.0 Summary

1.1 Background and Methods

Chiroptera species presence, with an estimate of activity level, is presented for an area of the proposed Anketell Port study area. Phoenix Environmental Science (PES) carried out a systematic echolocation based survey during June of 2009 and again in March 2010. Bat Call WA has reviewed the recordings made and provided species lists for the bats present.

1.2 Habitats

Sites for the Chiroptera survey were chosen by PES. The survey was carried out over 10 days in June 09 and 4 days in March 2010 with the intention of recording the bat fauna in a number of habitats, both on the mainland and on Dixon Island.

1.3 Bat Fauna

A microbat assemblage of 12 insectivorous species was confirmed as present in the study area. One conservation significant species listed by WA Department of Environment and Conservation as A Priority 1 species, *Mormopterus loriae cobourgiana*, was found to be present in the study area during both surveys.

Five microbat species that are known to be present in the Pilbara bioregion were not detected to date during the study.

There are two frugivorous megabat species that are recorded in the region, *Pteropus alecto* and *P. scapulatus*. This survey, being echolocation based, does not address their presence.

2.0 Introduction

2.1 Background to the Anketell Port Bat Survey.

PES has been commissioned to complete a fauna survey of the project area. A component of this survey is an echolocation-based survey of bat activity.

The project area is located approximately 10km west of Wickham, WA, and is approximately 17 kilometres (north-south) by 10 kilometres (east-west). It includes Dixon Island and the coastal plain stretching inland to the North West Coastal Highway.

2.2 Scope and Objectives of the Study

This report documents the results of an echolocation-based survey of the project area. The area includes a number of habitat types that offer a variety of foraging and roosting opportunities for the local bat assemblage. This includes Dixon Island, the mangal fringing Port Robinson and the mainland coastal plain.

The objectives of the study are:

- To provide baseline information based on a systematic survey of bat activity. This survey was designed to cover dry season conditions.
- Provide a measure of bat activity in the project area, by habitat.
- Assess the presence of any listed species of microbat.

2.3 Purpose of the Report

This report describes surveys of the bat fauna activity undertaken by PES (with Bat Call WA) in the dry season (winter) of 2009 and late wet season (March) of 2010. The survey and identification work undertaken by PES and Bat Call WA was subject to certain limitations that are outlined in Section 3.7 below.

2.4 Existing Environment

The project area is situated in the Pilbara bioregion within the Chichester subregion. The study area is dominated by the coastal plain surrounding Port Robinson. It includes Dixon Island, extensive stands of mangrove and rocky ridges and hills. The dominant microhabitat is shrub steppe over hummock grasslands (McKenzie, N.L., May, J.E. and McKenna, S. 2003). There are also extensive areas of tidal mudflat and samphire. The study area occurs in a semi arid to arid tropical climatic that is characterised by relatively warm dry winters and hot summers with unreliable summer rainfall. The Biogeographical region, climate and land systems of the study area are discussed in further detail in the PES (2009) terrestrial vertebrate fauna report.

There are no major natural riparians in the study region.

3.0 Methodology

3.1 Data Base Searches

- Bat Call WA prepared an initial list of species and relevant taxonomy from Van Dyke and Strahan 2008.
- Bat Call WA conducted searches of NatureMap (Department of Environment and Conservation 2009) for records of Chiroptera species known from the study area.
- Bat Call WA supplemented this data from its own database of recent records from various reliable sources.

3.2 Survey Timing, Moon Phase and Weather

The June 2009 systematic echolocation survey was conducted over 10 days. Five overnight recordings were made between 17th and the 22nd June covering locations on Dixon Island. Eight overnight recordings were made between 18th and the 24th June covering locations on mainland within 5 kilometres of the coast. Four overnight recordings were made between 16th and the 25th June covering locations on mainland at the southern study area approximately 10 kilometres inland. The survey was conducted in a cool and dry period. All sampling evenings were fine and clear with temperatures between 20 and 25^{O}C at twilight. The moon in this period moved from third quarter to new.

The March 2010 survey was conducted over a 7 day period. Six recordings were made between 10th and the 14th march covering mainland locations within 5 kilometres of the coast. Two overnight recordings were made on the 17th March covering locations at the southern study area. The survey was conducted in a hot and humid period. All sampling evenings were fine and clear with minimum temperatures between 25 and 30^{O}C. The moon in this period moved from third quarter to new.

3.3 Survey Team

The bat sampling work was conducted by PES. No activities were conducted that directly impacted upon the bat fauna present.

R.D. Bullen of Bat Call WA completed analysis of echolocation recordings for both periods.

3.4 Systematic Sampling

The systematic survey consisted of completing between four and ten hours of bat sound recordings, beginning at twilight, at 17 locations within the survey

area. Refer to Table 4.1 below for details. Mangrove, coastal dune, coastal cliff, coastal plain, rocky ridge and permanent water hole habitats were sampled. All of the recordings were "continuous" made using Anabat II (Titley Electronics, Ballina, NSW) detectors, set to divide by 16, in conjunction with Portable Minidisk Recorder model MZ-NH700 (Sony, Japan). Minidisks were run in Hi-MD mode with Hi-LP setting allowing 10 hours of recording on a 80 min standard disk.

COOL EDIT 2000 (Now available as AUDITION from Adobe Systems Inc.) was used to display each "continuous call" sequence for identification. Only good quality call sequences were used.

Bat activity was then characterised as "Low", "Medium" or "High" based on the rate of call sequences recorded.

- Low species activity is referred when a species is recorded with call spacing greater than ten minutes,
- Medium species activity refers to call recordings more often than 10 minutes but less often than two minutes apart for a significant time period.
- High species activity refers to call recording more often than two minutes apart for significant periods.

3.5 Non-systematic Sampling

No non-systematic data are included in this report.

3.6 Vegetation Types and Fauna Habitat Classification at each survey site.

Potential bat habitats within the project area were assessed during the initial stages of survey activity. Recordings were made over nine nights within these locations Descriptions of these sites are included in the PES (2009) report.

Descriptions of the 17 locations surveyed during the focussed survey activity are included in Table 4.1. Plates 3.1 to 3.6 below present examples of the habitat surveyed.

Plate 3.1 Example of open shrubland over grass – Site 11.01

Plate 3.2 Example of inland edge of mangrove on Dixon Island.

Plate 3.3 Example of spinifex grassland on rocky ridge

Plate 3.4 Example of open shrubland over open grass on coastal dune

Plate 3.5 Partially collapsed section of high rocky cliff on Dixon Is.

Plate 3.6 Mangrove site east of headland on mainland

Plate 3.7 Eucalyptus over drainage near site 1.

3.7 Survey Limitations

All sites surveyed were accessible on foot and the recorders were set at ground level with the microphone pointing upward. Orientation was either directly upward or at 45^{O} to align the detector with a local flyway. Bat sound recording was carried out between four and ten hours beginning at twilight. The survey method may be biased against species that are known to forage close to the ground due to the conical shape of the Anabat microphone polar. Species that may be under-represented as a result may include *Nyctophilus geoffroyi* that is known to occasionally glean from the ground.

Bat species density is impossible to estimate from echolocation records. Bat activity is therefore substituted as an approximate guide to the relative numbers of each species using the study area.

4.0 Bat Fauna Survey Data

4.1 Survey Results

There are seventeen species and prominent sub-species of microbat extant on the Pilbara bioregion. Of these, twelve were detected during the survey. The results are presented in Tables 4.1 to 4.4. Diagrams showing the locations of the sites surveyed and the sites where conservation significant species were detected are presented in Figures 4.1 and 4.2. In general the inland southern study area showed the highest species diversity with ten of the twelve species present albeit in low numbers (only the two mangrove obligate Nyctophilus were not detected here). The mainland and Dixon Island sites showed a microbat fauna typical of the Pilbara mangrove/coastal areas, dominated by airsuperiority *Chalinolobus, Mormopterus, Taphozous* and *Vespadelus* species (McKenzie and Bullen 2009) with both species of mangrove obligate Nyctophilinae present.

4.2 Microbat species present in the study area.

Chalinolobus gouldii (Gould's wattled bat) is ubiquitous throughout temperate and tropical Western Australia. It is a medium size (13g) insectivore and commonly roost in tree hollows (Churchill 1988). Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general. It was only detected with certainty in the southern study area in 2009 but was present generally during the wet season survey.

Chaerephon jobensis (Northern free-tailed bat) is a mid size (20 g) insectivore. It is common along the riparian lines of the tropical north of WA. Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general away from the larger river systems.

Mormopterus beccarii (Beccari's free-tailed bat) is common across tropical WA. It is a medium size (12g) insectivore that forages over the canopy of the woodlands and floodplain margins. Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general.

Mormopterus loriae cobourgiana (Species 5, pops U and V in Adams *et al*. 1988, under revision), (Western little free-tailed bat), is a small (8g) insectivore. In Western Australia it is a mangrove obligate roosting species occurring north of Exmouth Gulf. Its conservation status is a DEC Priority 1 species. It was detected at 11 of the sites surveyed with 9 being at low level of activity. Two mainland sites close to the coast showed medium and high levels of activity early in the evening.

Nyctophilus arnhemensis (Northern long-eared bat) is a small (7g) insectivore. In the Pilbara it is a mangrove obligate roosting species (McKenzie and Bullen

2009). Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general. It was detected at only one site.

Nyctophilus geoffroyi (Lesser long-eared bat) is ubiquitous throughout temperate and tropical Western Australia. It is a small (6g) insectivore. In the Pilbara it is found in all habitats between the coastal plain to the uplands (McKenzie and Bullen 2009). Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general. It was detected at only two sites.

Nyctophilus geoffroyi palescens (No common name) is a small (6g) insectivore. It is a sub-species of *N. geoffroyi* that it is a mangrove obligate roosting species (McKenzie and Bullen 2009). It is distinguished from *N.g*. on cranial and external measures (McKenzie and Bullen 2009). It formal taxonomic status is under review. Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study. It was detected at only one site, a mangrove edge location.

Saccolaimus flaviventris (Yellow-bellied sheath-tailed bat) is a large (45g) insectivore. It is common throughout tropical northwestern WA. Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study that is in line with the Pilbara region in general.

Scotorepens greyii (Little broad-nosed bat) is ubiquitous throughout tropical Western Australia. It is a small (8g) insectivore and commonly roost in tree hollows (Churchill 1988). Its conservation status is not listed (EPBC Act 1999). The activity level of this species is characterised as low during this study despite being recorded at a medium activity level at a permanent freshwater dam.

Tadarida australis (white-striped free-tailed bat) is a large (35g) insectivorous molossid. It forages above the canopy and expands and contracts its range from all cooler regions (present year round) to tropical regions of WA during the winter (Bullen and McKenzie 2005). During the study it was recorded at Low activity levels at two sites. This species is known to move in numbers north along the coastal plain and adjacent uplands during the autumn and south again during the spring. The result of this survey is consistent with that behaviour. It commonly roosts in large (old or dead) eucalypts often occupying the hollow trunks (Rhodes and Richards 2008). Its conservation status is not listed (EPBC Act 1999). It is considered to be extant across the entire study region in low numbers between April and September.

Taphozous georgianus (Common sheath-tailed bat) is a mid size (25 g) insectivore. It is common in the Pilbara and Kimberley regions of the tropical north of WA. Its conservation status is not listed (EPBC Act 1999). It roosts in caves, hollows and mines throughout the region. Its echolocation call is known to be almost identical to its con-generic *T. hilli*. The identification in this study

is based on the majority of the calls recorded being in the lower half of the frequency range used by the two, identifying it as the *T. georgianus*. The activity level of this species is characterised as low on the mainland and medium to high on Dixon Island. This indicates the probability of a roost cave on the Island that harbours a significant number of this species.

Vespadelus finlaysoni (Finlayson's cave bat) is the smallest (~5g) insectivore found across the shrubland and ridges of the Pilbara. They forage close to the vegetation of the lower canopy and the understorey (Churchill 1998). They commonly roost in caves and mines but use other locations such as man made structures. This species was the most commonly recorded bat found at nearly all sites showing activity levels from low to high. Its conservation status is not listed (EPBC Act 1999). It is considered to be extant and common across the study region.

4.3 Microbat species not detected in the study area.

There are five microbat species known from the Pilbara bioregion that were not detected during the survey. Two, *Chalinolobus morio* and *Taphozous hilli* are not known from the Chichester or Roebourne Plain sub-regions. The remaining three, *Macroderma gigas*, *Nyctophilus bifax daedalus* and *Rhinonicteris aurantia* are present in low numbers in this region of the Pilbara but were not detected during these surveys.

4.4 Megabat species present in the study area.

There were no frugivorous megabats detected during the study. There are two flying fox species that may be expected to transit the study area from time to time. These are *Pteropus alecto* and *P. scapulatus*. Neither is listed as conservation significant. Extended visits to the study area by these species cannot be ruled out.

Table 4.1 Summary of Site Specific details.

Date	Site	Habitat	Recording duration (hr.min.)	Easting	Northing
16Jun 09 17 Mar 10	Site 1	Drainage – Open woodland over tall shrubland	6 00 10 15	501580	7706390
16Jun 09 17 Mar 10	Site 11	Flats – Open shrubland over grassland	4 30 10 15	504375	7704140
17 Jun 09	Dixon Is.	Inland edge of mangroves on shoreline	4 20	504760	7718410
17 Jun 09	Dixon Is.	Spinifex grass with scattered shrubs on rocky ridge.	4 10	504690	7718515
17 Jun 09	Site 2	Tall open shrubland on subtle coastal dune	4 20	504295	7718165
18 Jun 09 10 Mar 10	Site 7	Drainage – Tall shrubland over grassland – small pool.	10 15 10 15	507815	7715300
19 Jun 09 14 Mar 10	Site 9	Very open shrubland over very open grassland on subtle coastal dune	10 15 0 59	509040	7718510
21 Jun 09 10 Mar 10	Site 8	Tall open shrubland over spinifex grassland at base of rocky slope	10 15 10 15	505975	7714715
21 Jun 09 13 Mar 10	Site 10	Spinifex grass with scattered shrubs in gap in rocky hills.	10 15 3 13	505790	7714395
22 Jun 09	Site 4	Flats – Tall open shrubland over open spinifex grassland	7 10	506245	7719340
22 Jun 09	Dixon Is.	Partially collapsed section of high rocky cliff	10 15	506370	7719570
23 Jun 09	Headland - east	Mangroves on tidal creek	10 15	510240	7716925

23 Jun 09	Headland - west	Inland edge of mangroves on shoreline	10 15	508640	7718000
23 Jun 09 14 Mar 10	Site 6	Samphire flats	10 15 10 15	508115	7717440
24 Jun 09	NE study area	Freshwater dam – Laydown area.	10 15	511300	7715080
24 Jun 09	Sth study area	Drainage – Open woodland over open tall shrubland over grass	10 15	503370	7705380
25 Jun 09	Sth study area	Slope of rocky ridge facing valley with minor drainage	8 30	507025	7703925
13 Mar 10	Site 5	Coastal dune site	4 22	TBA	TBA

Note : All locations are MGA Zone 50

Table 4.2: Summary of Echolocation call characteristics for microbat species present.

Genus species Authority	Common name	Ave. F_{peakC} kHz	Ave. Q	Typical Duration msec	Typical Call Shape
Chalinolobus gouldii (Grey 1841)	Gould's wattled bat	32	10	7 - 11	FM
Chaerephon jobensis (Miller 1902)	Northern free-tailed bat	20	5	8 - 15	Shallow FM
Mormopterus beccarii Peters 1881	Beccari's free-tailed bat	26	10	8 – 13	Shallow FM
Mormopterus loriae cobourgiana Johnson 1959	Western little free-tailed bat	31	10	7 - 14	Shallow FM
Nyctophilus arnhemensis Johnson 1959	Northern long-eared bat	51	2.5	5	Steep FM
Nyctophilus geoffroyi Leach 1821	Lesser long-eared bat	47	2.5	5	Steep FM
Nyctophilus geoffroyi palescens (Taxonomic status under review)		47	2.5	5	Steep FM
Saccolaimus flaviventris (Peters 1867)	Yellow-bellied sheath-tailed bat	18	9	12 - 21	CF - FM
Scotorepens greyii (Gray 1843)	Little broad-nosed bat	38	10	7 - 13	FM
Tadarida australis (Grey 1838)	white-striped free-tailed bat	12	7	12 - 23	CF– shallow FM
Taphozous georgianus Thomas 1915	Common sheath-tailed bat	24.5	14	9 - 18	CF– shallow FM
Vespadelus finlaysoni (Kitchener, Jones and Caputi 1987)	Inland cave bat	55	14	4 - 8	FM

Note: FpeakC and Q are defined in McKenzie and Bullen 2009

Table 4.3. June 2009 microbat lists obtained presented by site.

Date	Site	*Chalinolobus gouldii*	*Chaerephon jobensis*	*Mormopterus beccarii*	*Mormopterus loriae cobourgiana*	*Nyctophilus arnhemensis*	*Nyctophilus geoffroyi*	*N. g. palescens*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Tadarida australis*	*Taphozous georgianus*	*Vespadelus finlaysoni*
Southern study area													
16 Jun	Site 1	Low							Low	Low	Low		Low
16 Jun	Site 11								Low				
24 Jun	Drainage site	Low	Low		Low		Low		Low	Low			Low
25 Jun	Ridge site								Low	Low		Low	
Dixon Island													
17 Jun	Mangrove Site				Low			Low				Med	Low
17 Jun	Ridge Site				Low							High	Med
17 Jun	Site 2				Low						Low	Low	Med
22 Jun	Site 4											Low	Low
22 Jun	Cliff site											Low	Low

Mainland coastal sites								
18 Jun	Site 7	High	Low	Low		Low	Low	High
19 Jun	Site 9	Med						Low
21 Jun	Site 8							Low
21 Jun	Site 10	Low			Low		Low	Low
23 Jun	Headland east	Low						Low
23 Jun	Headland west	Low						Low
23 Jun	Site 6	Low						Low
24 Jun	Freshwater dam	Low				Med	Low	Low

Low activity refers to call spacings that repeat less often than 10 minutes.
Med activity refers to call records that repeat more often than 10 minutes but less often than 2 minutes for significant periods of time then sporadically for the duration of the recording.
High activity refers to calls that repeat more often than 2 minutes for significant periods of time then periodically for the duration of the recording.

Table 4.4. March 2010 microbat lists obtained presented by site.

Date	Site	*Chalinolobus gouldii*	*Chaerephon jobensis*	*Mormopterus beccarii*	*Mormopterus loriae cobourgiana*	*Nyctophilus arnhemensis*	*Nyctophilus geoffroyi*	*N. g. palescens*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Tadarida australis*	*Taphozous georgianus*	*Vespadelus finlaysoni*
Southern study area													
17 Mar	Site 1	Low		Low			Low		Low	Low		Low	Low
17 Mar	Site 11	Low							Low			Low	
Mainland coastal sites													
10 Mar	Site 7	Low	Low		Low		Low					Low	Low
10 Mar	Site 8	Low					Low			Low		Low	Low
13 Mar	Site 10	Low										Low	
13 Mar	Site 5	Low								Low		Low	Low
14 Mar	Site 6	Low			Low					Low		Low	Low
14 Mar	Site 9	Low			Low					Low			

Low activity refers to call spacings that repeat less often than 10 minutes.


22/06/2009 - 2
22/06/2009 - 1
17/06/2009 - 2
17/06/2009 - 1
17/06/2009 - 3
19/06/2009 - 1
23/06/2009 - 2
23/06/2009 - 3
23/06/2009 - 1
18/06/2009 - 1
21/06/2009 - 1
21/06/2009 - 2
24/06/2009 - 1
16/06/2009 - 1
24/06/2009 - 2
16/06/2009 - 2
25/06/2009 - 1
Legend
Study Area
Bat Detector Sites
0 1 2 3 4 5
Kilometres
MGA Zone 50
Bat Survey
Anketel
Anabat Sites in Study Area
DRAWN: G Harewood
DATE : July 2009
SCALE: 1: 52 500
Figure: 4.1


Legend
Study Area
Mormopterus loriae cobourgiana
0 1 2 3 4 5
Kilometres
MGA Zone 50
Bat Survey
DRAWN: G Harewood
DATE : July 2009
SCALE: 1: 52 500
Anketel
Sites where Conservation Significant species were detected
Figure: 4.2

5.0 Bat fauna habitat implications.

This survey has confirmed that there is a bat fauna of twelve insectivorous microbat species extant across the study area.

One study area species in particular, *Mormopterus loriae cobourgiana* is listed as a DEC Priority 1 species indicating "a taxa with few, poorly known populations on threatened lands". It was pleasing to detect this species in significant numbers. Retention of this species within the area is considered important for the biodiversity of the region. Given that it is an obligate mangrove roosting species, its continuing presence locally is considered to be closely linked to the retention of healthy roosting conditions in conjunction with a stable mangrove stand with a continuous canopy in good condition. Maintenance of a narrow buffer of 250 m along the landward edge of the mangrove stand on the mainland and Dixon Island is suggested.

Five insectivorous microbat species that are known to be present in the Pilbara were not found in the study. Two are not considered extant in the area. Three may be present but were not detected

Occasional visits by frugivorous megabats may occur at any time.

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PHOENIX
ENVIRONMENTAL SCIENCES

1/511 Wanneroo Road
Balcatta WA 6023

Ph/Fx: (08) 9345 1608
E: admin@phoenixenv.com.au

Tuesday, 28 September 2010

Ms Michelle Carey
API Management Pty Ltd
Level 2, Aquila Centre
1 Preston Street, Como WA 6152

Dear Ms Carey,

ADDENDUM TO VERTEBRATE FAUNA REPORT FOR ANKETELL POINT[1] – REVISION TO LERISTA NEVINAE HABITAT

Please find enclosed a revised dataset for the *Lerista nevinae* habitat in and around the vicinity of the Anketell Port project area. As you are aware, we have updated this mapping following identification of some possible minor errors in the dataset.

The original mapping methodology relied largely on the vegetation mapping by AECOM[2] to identify coastal dune habitats that *L. nevinae* may occupy. On closer inspection of aerial photography it appeared that the coastal dune boundaries in a few areas did not correspond with likely *L. nevinae* habitat, for example where it could be seen that red soils were present rather than pale sands. To address this issue, we have undertaken a more detailed desktop assessment followed by groundtruthing to more accurately define the likely extent of *L. nevinae* habitat within and around the Anketell Port project area. The methodology used is outlined below.

1. Desktop review

Aerial photography of the area was overlain with the original *L. nevinae* habitat dataset (Phoenix 2010[1]). Where discrepancies were observed between the pale coastal dune sands and the habitat boundary, the dataset was revised to more closely match the boundary of pale sands in the air photos to the extent possible.

It was difficult to accurately define some boundaries as the transition from pale coastal dune sand to other habitat types is gradational. Also, at least one area marked as *L. nevinae* habitat was identified as likely to be mudflat.

2. Groundtruthing

On 30-31 August, Mr Greg Harewood (Zoologist) and Ms Alexandra Sleep (Botanist) went to site to groundtruth the revised habitat boundary. Prior to the site visit, Greg identified a number of priority locations to be groundtruthed and marked these up in a GPS. Greg and Alexandra then travelled by helicopter to each site and walked the boundaries using a GPS with the habitat map loaded. waypoints defining the habitat boundary were marked at closely spaced intervals (5-10m) and an airphoto printout was also marked up.

[1] Phoenix Environmental Sciences (2010). Terrestrial Vertebrate Fauna Survey for Anketell Point Rail Alignment and Port Projects. Unpublished report prepared for Australian Premium Iron Management Pty Ltd.
[2] AECOM (2010a). Level 2 Flora and Vegetation Assessment of Proposed Anketell Point and Dixon Island proposed Port Development areas. Unpublished report prepared for Australian Premium Iron Management Pty Ltd.

PHOENIX
ENVIRONMENTAL SCIENCES

1/511 Wanneroo Road
Balcatta WA 6023

Ph/Fx: (08) 9345 1608
E: admin@phoenixenv.com.au

Delineation of the habitat boundaries was based on:

- substrate - presence of pale coastal sands of suitable depth (i.e. thin sand veneer over rock or heavy soil was excluded) and particle size (i.e. sands composed of rock/gravel-sized shell fragments were excluded) and
- vegetation (presence of scattered shrubs).

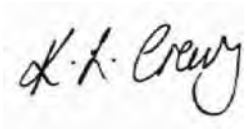
Boundaries in some areas were difficult to define. The pale coastal dunes with scattered shrubs were relatively easy to locate but in most areas this was confined to a narrow (30m wide max strip) immediately adjacent to beach. These mostly grade slowly inland into progressively darker sand (dark grey, light brown, brown, dark brown) which in some cases still looked suitable and had a shrub layer. The point at which the habitat becomes unsuitable was in some cases difficult to pick and a precautionary approach was taken in these instances.

The attached map shows the revised habitat extent. The spatial extent of the desktop and groundtruthing exercise includes all areas within this map. Some of the smaller areas of potential habitat (especially on eastern end of Dixon Island) may be too small to maintain a population of *L. nevinae* (e.g. 5m wide strips of pale loose sand amongst boulders with widely scattered shrubs) but we have not considered minimum area required for population viability.

Please note that this dataset is a customised *L. nevinae* habitat extent map. It does not correspond exactly with the 'coastal dunes' in the general fauna habitat map (Phoenix 2010). As a result of this exercise, we have determined that not all areas mapped as 'coastal dunes' in the vegetation dataset are suitable habitat for *L. nevinae* and some areas mapped as 'plains' are subdued sandy flats (containing sandy shrubs) which represent potential *L. nevinae* habitat.

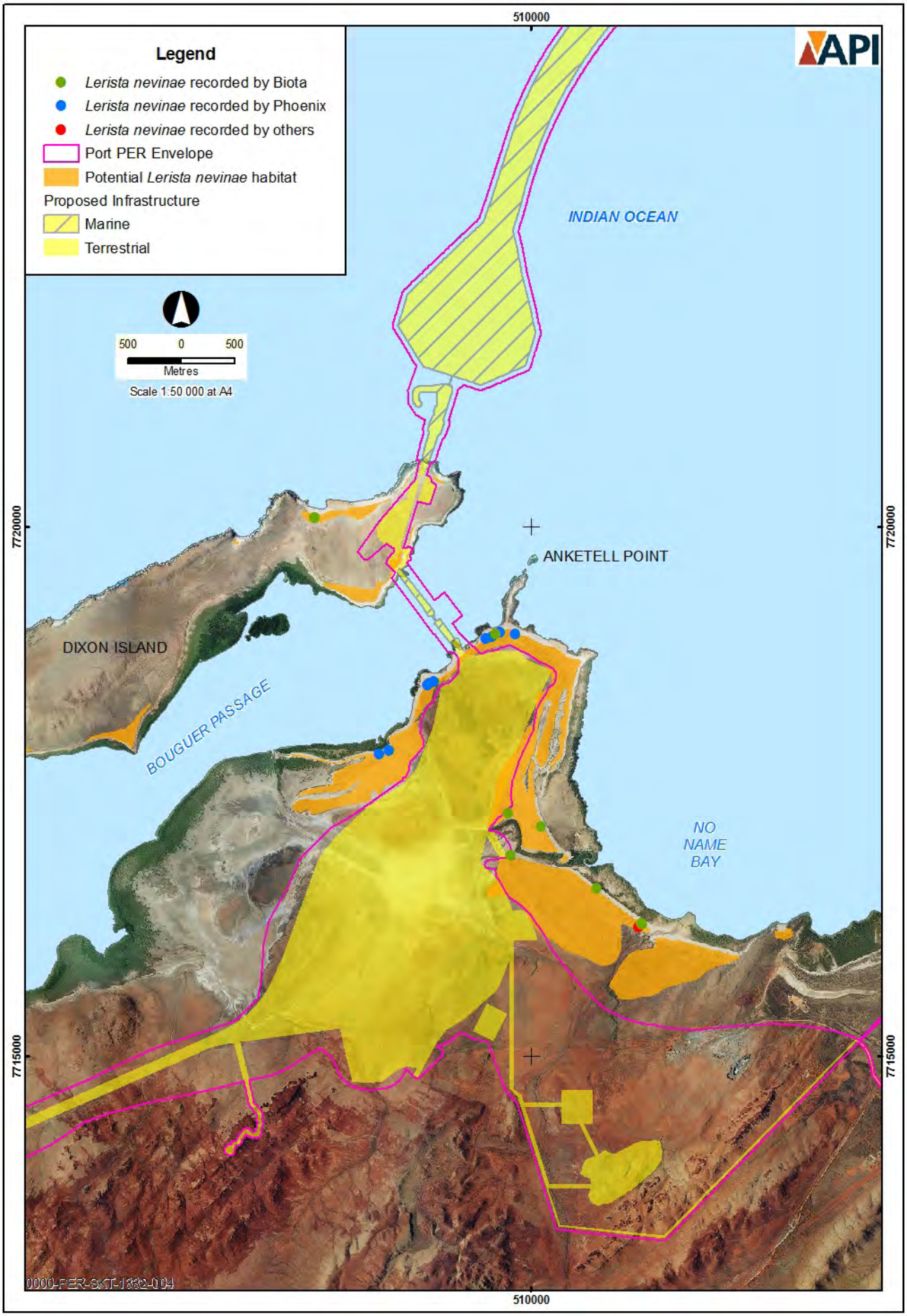
If you have any further queries, please don't hesitate to contact us.

Yours Sincerely,



Karen Crews

Senior Environmental Advisor


Legend
Lerista nevinae recorded by Biota
Lerista nevinae recorded by Phoenix
Lerista nevinae recorded by others
Port PER Envelope
Potential Lerista nevinae habitat
Proposed Infrastructure
Marine
Terrestrial
500 0 500
Metres
Scale 1:50 000 at A4
510000
7720000
7715000
INDIAN OCEAN
ANKETELL POINT
DIXON ISLAND
BOUGUER PASSAGE
NO NAME BAY
0000-PER-SKT-1632-004