PHOENIX
ENVIRONMENTAL SCIENCES

Detailed terrestrial fauna and Migratory shorebird surveys for the Eramurra Solar Salt Project

Prepared for Leichhardt Salt Pty Ltd

June 2023

Final

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EXECUTIVE SUMMARY

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (the 'Project'), located approximately 55 km west-southwest of Karratha, Western Australia (Figure 1-1). The Project aims to develop high purity industrial grade Sodium Chloride salt from seawater via solar evaporation, using a series of evaporation and crystallisation ponds.

This report documents the results of zoological surveys undertaken by Phoenix Environmental Sciences Pty Ltd (Phoenix) to address the requirements of the Project's Environmental Scoping Document in relation to baseline surveys for the environmental factor 'Terrestrial fauna'.

Two main lines of enquiry were pursued concerning the fauna values of the Development Envelope (DE) and surrounds and accordingly two study areas were defined:

- Terrestrial fauna – being vertebrate fauna and short-range endemic (SRE) invertebrates within the Terrestrial fauna study area (TFSA).
- Migratory shorebirds – with particular emphasis on the 37 species listed under the EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed Migratory shorebird species (DoEE 2017), taking place within the Shorebird study area (SBSA).

Herein we document the results of Detailed and Targeted terrestrial fauna surveys which built on a desktop study and site reconnaissance to inform the Project's pre-feasibility study (Phoenix 2018), Targeted surveys for Migratory shorebirds, Night Parrot and Northern Quoll and a Detailed multi-season SRE invertebrate survey, including a regional survey for reference purposes.

All surveys completed comply with State and Federal survey requirements in relation to documenting the area's terrestrial fauna biodiversity/terrestrial fauna assemblage and targeted species sampling.

A brief description of each survey and the timing and applicable guidelines under which they were conducted are detailed below in Table 0.

Table 0 Details, timing and applicable guidelines under which all surveys were conducted

Survey type	Applicable policies and survey guideline	Season	Dates
Shorebirds helicopter survey (x4 transects); Night Parrot audio recording units (x4) set.	DoEE (2017) DPaW (2017a)	Summer	9-11 December 2019
Shorebirds helicopter survey (x4 transects, plus one incomplete); Night Parrot audio recording units (x4) moved and reset; SRE wet pit sites (x5) established.	DoEE (2017) DPaW (2017a) EPA (2016d)	Summer	13-18 January 2020
Shorebirds helicopter survey (x4 transects); Night Parrot audio recording units collected; SRE wet pit sites (x3) established.	DoEE (2017) EPA (2016d)	Summer	2-5 February 2020
Shorebirds helicopter survey (x4 transects).	DoEE (2017)	Summer	10-12 February 2020

Survey type	Applicable policies and survey guideline	Season	Dates
Systematic trapping sites (x8) established, each with pit/funnel/Elliott trapping, avifauna surveys, foraging, nocturnal foraging; camera trapping (x7 sites); Ultrasonic bat recording (x6 sites); SRE wet pits collected (x8 sites), SRE foraging/sieving at wet pit sites; opportunistic fauna records and site descriptions during movements in and around study area. Flora and vegetation survey by Phoenix botanical team 15-23 April.	EPA (2016a) EPA (2016c) EPA (2016d) EPA (2016e)	Autumn	15-27 April 2020
Shorebirds helicopter survey (x4 transects).	DoEE (2017)	Winter	6-8 July 2020
Targeted SRE survey.	EPA (2016d)	Wet season (summer)	24–27 April 2021 – trap installation and foraging 24–26 May 2021 – trap pickup
Basic/Targeted survey. Undertaken in response to DE expansion to south and east.	EPA (2016a) EPA (2016c) EPA (2016e)	Summer	29 November – 7 December 2021

The vegetation descriptions from quadrats and relevés from the associated botanical survey (Phoenix 2022) were grouped according to prevalent community structure (i.e., woodland, shrubland, etc.) and species composition. The vegetation boundaries were mapped utilising ArcGIS ESRI imagery and from vegetation boundaries recorded using a GPS during field surveys. Fauna habitat mapping was derived from the vegetation mapping undertaken for the Project (Phoenix 2022), whereby the vegetation description/structure was considered along with landform and soil type and applied to each polygon.

The desktop review of vertebrate fauna identified 457 terrestrial vertebrate taxa recorded or predicted within the desktop search area extent. Excluding marine aquatic taxa, 73 vertebrate species were identified in the desktop review as having conservation significance. Of these, 21 species are listed as Threatened or Specially Protected under the EPBC Act and/or BC Act, 54 bird species listed as Migratory under the *Environmental Protection and Biodiversity Conservation Act 1999* and *Biodiversity Conservation Act 2016*, and a further 12 species listed as Priority by the Department of Biodiversity, Conservation and Attractions (DBCA).

The general area has been documented previously to support significant environmental values in terms of species present. Thirty-two significant vertebrate species (two marine and two terrestrial reptiles, 24 birds, and four mammals) have previously been recorded within or adjacent to the study area.

The SRE desktop review identified records of three Confirmed SRE taxa and 38 Potential SRE taxa from within the desktop search area, including four from within or immediately adjacent to the TFSA.

The botanical and fauna surveys determined a total of 16 fauna habitat types were present within the TFSA. The habitat types were further classified into eight broad groupings based on vegetation and landform type. Tussock grasslands (63%), shrubland over spinifex grassland (20%) and bare mudflats and saltflats (9%) dominate the TFSA.

All of the habitats mapped are considered to be 'low' potential SRE habitat. The terrain is generally flat and comprised of vegetation types which are widespread or do not provide microhabitats typically

associated with SREs. All vegetation communities identified in the study area are common across the wider landscape (i.e., shrublands and grasslands) and are impacted by cattle.

Surveys of the TFSA and SBSA recorded 201 terrestrial vertebrate species, representing 68 families and 132 genera, based on 5,773 individuals. The assemblage included 198 native species and three introduced mammal species. The recorded assemblage represents 44% of the species identified in the desktop review (Table 5-5).

A total of 39 significant vertebrate fauna species were recorded. These include seven Threatened species (five birds and two mammals) and three Priority species (one reptile, one bird and one mammal) (Table 5-6) and 33 Migratory species listed under either the EPBC Act or BC Act. A total of 35 significant bird species were recorded.

Within the TFSA five Threatened and Priority species were recorded. Northern Quoll (EN) appears to be resident throughout the study area, based on presence at six sites. There is minor denning/shelter habitat occurring as granite outcrops on creeklines that are likely capable of supporting low breeding numbers; however, these populations are likely supplemented by larger populations in the ranges to the south of the Project, which are connected via wooded creeklines. Northern Quoll was even recorded in tidal samphire shrubland, just 800m from the coast (3.8 km SSW of 40 Mile Beach campground).

The Pilbara Leaf-nosed Bat (VU) is not a resident as no geological formations are present to form suitable roost caves. The record of a single detection in April suggests a post-maternity, dispersing individual.

Grey Falcon (VU) was recorded immediately to the east of the TFSA, at a known nest site on a communications tower on the Northwest Coastal Highway. The species has a large foraging range and will forage within the TFSA.

Two 'terrestrial' Migratory bird species were also recorded, Fork-tailed Swift and Osprey. The Fork-tailed Swift is an occasional visitor to the area. Ospreys were recorded on 33 occasions and occurs as a resident throughout the study area, but primarily at the coast.

The lined soil-crevice skink (Dampier) (P4) was recorded from a single site, on a creekline as is typical of the species.

A number of range extensions were recorded. The most significant is probably the Common Brush-tailed Possum, which was recorded in 2020 and 2021 at the eastern and western margins of the TFSA and is thus considered resident to creeklines in the area. While there are known records of the species on the Robe River at Pannawonica, there are no modern coastal Pilbara records in publicly available data sources.

The Shining Flycatcher is also not listed under the EPBC Act or BC Act; however, the record at Eramurra represents a range extension of some 800km, being the first record west of Beagle Bay in the Kimberley (ALA 2020).

The Lesser Hairy-footed Dunnart is also not listed under the EPBC Act or BC Act; however, the record at Eramurra is a range extension of approximately 100 km to the north and 160 km to the west, of known records (ALA 2020).

The Migratory shorebirds surveys detected a diverse and abundant assemblage of shorebirds, including numerous Threatened and Priority species, also listed as Migratory, many of which were in nationally and internationally significant numbers. A total of 31 species listed as Migratory were recorded, including Osprey, which is not a shorebird.

In addition, six Threatened Migratory species were recorded:

- **Critically Endangered**
  - Curlew Sandpiper
  - Eastern Curlew
  - Great Knot

- **Endangered**
  - Lesser Sand Plover
  - Red Knot
- **Vulnerable**
  - Greater Sand Plover

One DBCA Priority 4 species was also recorded:

- Grey-tailed Tattler

Twenty-one of the 37 Migratory species listed under DoEE (2017) were recorded. Of these, 14 (66% of recorded species or 38% of the 37 Migratory species listed under DoEE 2017) were recorded in nationally significant numbers, including (species in bold are also Threatened or Priority species):

- **Greater Sand Plover (VU/Mig. EPBC Act; VU BC Act)**
- Oriental Pratincole (Mig. EPBC & BC Acts)
- Ruddy Turnstone (Mig. EPBC & BC Acts)
- Sharp-tailed Sandpiper (Mig. EPBC & BC Acts)
- Sanderling (Mig. EPBC & BC Acts)
- **Red Knot (EN/Mig. EPBC Act; EN BC Act)**
- **Curlew Sandpiper (CR/Mig. EPBC Act; CR BC Act)**
- Red-necked Stint (Mig. EPBC & BC Acts)
- Bar-tailed Godwit (Mig. EPBC & BC Acts)
- **Eastern Curlew (CR/Mig. EPBC Act; CR BC Act)**
- Whimbrel (Mig. EPBC & BC Acts)
- **Grey-tailed Tattler (Mig. EPBC & BC Acts; P4 DBCA list)**
- Common Greenshank (Mig. EPBC & BC Acts)
- Terek Sandpiper (Mig. EPBC & BC Acts)

A total of three species were recorded in internationally significant numbers:

- Oriental Pratincole (Mig. EPBC & BC Acts) – up to 75,377 individuals recorded in a single transect in February 2020, which represents 2.6% of the world's population
- Ruddy Turnstone (Mig. EPBC & BC Acts)
- Grey-tailed Tattler (Mig. EPBC & BC Acts; P4 DBCA list)

The SRE surveys recorded a total of 40 taxa from SRE groups, comprising 20 taxa in the TFSA and 23 taxa from the regional targeted survey. Three taxa were common to both areas, while seven (21% of recorded taxa) were identified in the desktop review or are known from outside the area of the desktop review.

Within the TFSA, 12 taxa are considered Potential SREs and eight are widespread species or indeterminate (Uncertain) taxa. Within the regional targeted survey 16 Potential SREs were recorded. None of the 25 SREs recorded from the field surveys are named species. As a surrogate, morphospecies identification was used: the separation of taxa according to easily identifiable morphological characteristics.

Fifteen taxa are newly discovered that have not been collected before (60% of SREs, or 37.5% of the total assemblage). These include:

- mygalomorph spider – *Conothele* 'MYG726' (TFSA)
- scorpions –
  - *Lychas* 'erramurra' (regional study area)
  - *Urodacus* 'erramurra' (TFSA)
- Pseudoscorpions
  - Indolpium 'erramurra1' (regional study area)

  - Indolpium 'erramurra2' (regional study area)
- *Antichiropus* millipede –
  - *A*. 'Phoenix0072' (regional study area)
  - *A*. 'Phoenix0088' (regional study area)
- *Cryptops* centipedes –
  - *C*. Phoenix0069 (regional study area)
  - *C*. Phoenix0073 (regional study area)
- isopods –
  - *Acanthodillo* sp. A (erramurra) (TFSA and regional study area)
  - *Acanthodillo* sp. B (erramurra) (TFSA)
  - Buddelundiinae 'erramurra') (TFSA)
- *Rhagada* land snails
  - *R*. 'Phoenix0070' (regional study area)
  - *R*. 'Phoenix0071' (regional study area)
  - *R*. 'Phoenix0087' (regional study area)

However, just four taxa are known only from the Indicative Disturbance Footprint (IDF):

- Mygalomorph spider
  - *Conothele* 'MYG726' (Potential SRE) – a single female excavated from a burrow at site FAU06 in Tussock grassland
- Scorpion
  - *Urodacus* 'erramurra'(Potential SRE) – a single female excavated from a burrow at site SRE04 in shrubland over spinifex grassland.
- Isopods (slaters)
  - *Acanthodillo* sp. B (erramurra) (Potential SRE) – a single female excavated from a burrow at sites SRE03, SRE04, both in shrubland over spinifex grassland.
  - Buddelundiinae 'erramurra' (Potential SRE) – a single female excavated from a burrow at site SRE07 in shrubland over spinifex grassland.

The surveys have documented a diverse and abundant assemblage of significant vertebrate fauna species across the TFSA and SBSA with 39 significant vertebrate fauna species being recorded from an identified potentially occurring 73 species, as well as a number of range extensions for non-listed species and SREs. The majority of the significant species are Migratory bird species and shorebirds in particular.

We recorded 21 of the 37 Migratory Shorebird species listed under DoEE (2017) and accordingly, the shorebird habitat within and adjacent to the Project area is considered nationally important wetland habitat on the following basis:

- 14 species were recorded in nationally significant numbers – threshold is one species
- >2,000 Migratory shorebirds were regularly recorded in a single transect
- 21 Migratory shorebird species were recorded in total – criterion is 15 species.

No criteria were met for internationally important wetland habitat based on total abundance.

Northwestern Australia supports some of the largest numbers of shorebirds on the Australian continent (Bamford *et al.* 2008; Minton 2006), primarily at Roebuck Bay and Eighty Mile beach in the Kimberley region. In the Pilbara region, there are several recognised important Migratory shorebird sites at the national and international scale, mainly to the north and west of the Project. However, there are two other nearby areas that have been demonstrated to contain nationally important

wetland habitat, the coast adjacent the Mardie Salt Project (from the Fortescue River mouth, south-west to Onslow) (Phoenix 2020) and Forestier Bay east, 90 km east of Karratha (Phoenix 2013a).

As was discussed in Phoenix (2020), the same five to six species are repeatedly identified across the Pilbara coast as being present in large numbers: Bar-tailed Godwit, Greater Sand Plover, Grey-tailed Tattler, Ruddy Turnstone Red-necked Stint, Oriental Pratincole and Terek Sandpiper. The Eramurra Project area, as with the Mardie Salt Project area, appears also to be particularly important to the larger 'wetland species' (within the context of the Pilbara): Whimbrel, Curlew Sandpiper and Eastern Curlew. This is likely a result of the large extent of largely uninterrupted mangrove tidal creeks and associated intertidal samphire wetlands sitting immediately inland of large expanses of mudflats and sand banks that are exposed at low tides.

Heat maps of aggregate abundance per aerial transect explicitly demonstrate the movement of shorebirds with the tide, in both seasons, in and out of the Project area. The maps show that on low tide when the intertidal mudflats are exposed, the shorebirds move out of the SBSA and are highly concentrated in the bay and Great Sandy Island Nature Reserve immediately north of the Project, and in the 'delta' south of Cape Preston to the west of the Project, again feeding within exposed mudflats and sandbars. At high tide when the mudflats and sandbars are inundated, the birds move back into the SBSA to forage and roost in the tidal samphire shrublands and mangroves and on exposed sand bars in the tidal channels but are more diffuse. Moderately sized roosting aggregations occur on high tide on the beaches west of 40 Mile Beach, Great Sandy Island and at the delta south of Cape Preston, but no large roosting aggregations were seen elsewhere within the SBSA, and it is postulated that shorebirds roost on nearby islands, west of Cape Preston, or simply diffusely within the tidal habitats of the SBSA. The same pattern is evident in winter, but there are far fewer birds in the area at that time.

While it is difficult to say whether the area surveyed here is more or less important compared with other Pilbara shorebird sites due to the different survey methods applied, timing of those surveys etc, it is clearly very important in its own right, as a diverse assemblage of shorebirds, including Threatened species, occur in nationally and internationally significant numbers throughout the summer months. The area represents an important stepping-stone in the movement up and down the coast, particularly between Broome and Lake Macleod near Carnarvon. The corridor is of increased strategic significance considering the potential loss of habitat associated with the approved Mardie Salt Project and proposed Ashburton Salt Project, both to the south-west of the Project. These three Project areas are likely to create a feeding/foraging and refugia gap in the chain between Karratha and Exmouth. Conversely, salt works are known to support diverse and abundant shorebird assemblages. Indeed locally, Dampier and Port Hedland salt works are designated as Important Bird Areas (IBAs) for shorebirds (Birdlife International 2020), although shorebird abundance and diversity at the Port Hedland saltworks has declined in recent years (Birdlife International 2022). Thus, the installation of salt ponds at Mardie and Eramurra (and possibly Ashburton) may be a windfall or result in no net loss for some species, e.g. Red-necked Stint, Red-capped Plover, Sharp-tailed Sandpiper and Oriental Plover. Further the pond walls are likely to present new roosting opportunities.

Given the rapid recent decline of Australian shorebird numbers within the East Asian-Australasian Flyway (EAAF), particularly at the southern extent of their migratory ranges (i.e., on the south coast of Australia and Tasmania), retention of important habitats close to the major staging grounds in and around Broome is critical to supporting the remaining shorebirds that make it to Australia from their northern hemisphere breeding grounds each year.

All that being said, when the shorebird data was analysed at the scale of the DE and IDF (as is demonstrated in section 5.2.2.2), the number of EAAF flyway species (as per DoEE 2017), Threatened species and species occurring in nationally and internationally significant numbers, all decline substantially. Within the DE the number of species recorded at nationally significant numbers declines from 14 to six species. At the scale of the IDF, species in nationally significant numbers decline from 14 to just one, the Ruddy Turnstone. Oriental Pratincole remains at internationally significant numbers

at the scale of both the DE and IDF. These two species will likely be largely displaced by the ponds on the bare mudflats. It is uncertain which other species will be impacted, this is dependent on the depth and salinity of each pond and the habitat it displaces. As a general rule however, deeper ponds will displace smaller birds that can no longer reach the sediments; The first two ponds, with salinities closer to that of seawater will likely continue to support larger birds that can reach the sediment, but as the salinity increases beyond pond 2, it is likely most shorebirds will be displaced where those ponds replace suitable foraging habitat, such as tidal samphire habitat.

With regard to the terrestrial faunal assemblage, a mix of expected and unexpected significant fauna were recorded in 2020 and 2021. Lined soil-crevice skinks (Dampier) (P4), Osprey (Mig.), Grey Falcon (VU), and Peregrine Falcon (OS) were expected, whereas Northern Quoll (EN) and Common Brushtail Possum were not. That being said, Northern Quoll are known from Cape Preston, on a creekline 25 km east of the Project, and immediately south of Karratha (DBCA 2018b) and recently on rocky hills south of Mardie (Phoenix 2020, 2021). They are also regularly recorded on creeklines nearer the coast that drain the hills parallel to the coast between Karratha and Port Hedland. So, while the TFSA contains only small pockets of granite outcropping that would be considered denning/shelter habitat, the records at Eramurra are not entirely surprising.

The data suggest Common Brushtail Possum occurs as a resident population present given it was recorded at the eastern and western margins of the Project, 19 months apart. All records of Common Brush-tailed Possum and Northern Quoll are on creeklines that drain into the study areas from the rocky hills to the south. These creeklines are thus considered important movement corridors or linkages between those inland hills and the coast for several species. The creeklines also represent important feeding grounds for bat species such as the Northern Coastal Free-tailed Bat (P1) and birds generally, as riparian habitat can support more flowering/fruiting and high insect activity, compared with surrounding shrubland and grassland. Several of these creeklines hold surface water for extended periods where granite outcrops push shallow groundwater to the surface, or, near to the coast where the permeable alluvial sands meet the marine-deposited, impermeable sediments saturated with denser (saline) ground water. These pools offer important late summer and winter (dry season) refugia for a variety of terrestrial species. However, these Project has been designed to avoid direct impacts to the two most important creeks Mckay Creek and Devil Creek.

Short-range endemic invertebrate taxa from within the TFSA comprised a variety of taxa, including a total of 16 Potential or Confirmed SRE taxa and 15 taxa which could not be matched morphologically or genetically to any other species. Three species collected during the field surveys were previously known only from Barrow Island. And lastly, just four taxa recorded are currently known from only the IDF.

So while there was a relatively high number of new taxa recorded, and four taxa remain unknown outside the IDF, all but five of the 20 taxa recorded within the TFSA are known from other areas (including significant range extensions) and there appears to be no restricted habitat present within the TFSA; all of which indicates the Proposal presents a low risk to SREs.

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Appendix 5 Dasyurid Specimen from Eramurra, Western Australia - Brief report to Phoenix Environmental Sciences (K. Travouillon, WAM Mammalogy)

LIST OF ABBREVIATIONS

Abbreviation	Description
AGRF	Australian Genomic Research Facility
ASS	Acid Sulphate Soil
BC Act	*Biodiversity Conservation Act 2016*
BLAST	Basic Local Alignment Search Tool
BoM	Bureau of Meteorology
Bonn	Convention on the Conservation of Migratory Species of Wild Animals
CAMBA	China-Australia Migratory Bird Agreement
CD	Species listed as Conservation Dependent under the EPBC Act
CR	Species listed as Critically Endangered under the EPBC Act or BC Act
DAWE	Commonwealth of Australia Department of Agriculture, Water and the Environment
DBCA	Government of Western Australia Department of Biodiversity, Conservation and Attractions
DBCA list	Department of Biodiversity, Conservation and Attractions list of Priority Species
DCCEEW	Commonwealth of Australia Department of Climate Change, Energy, the Environment and Water
DE	Development Envelope
DEC	Department of Environment and Conservation
EAAF	East Asian-Australasian Flyway
EIA	Environmental impact assessment
EN	Species listed as Endangered under the EPBC Act or BC Act
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Areas as defined by the Environmental Protection (Environmentally Sensitive Areas) Notice 2005
ESD	Environmental Scoping Document
EW	Species listed as Extinct in the Wild under the EPBC Act
EX	Species listed as Extinct under the EPBC Act or BC Act
IBA	Important Bird Area
IBRA	Interim Biogeographic Regionalisation of Australia
IDF	Indicative Disturbance Footprint
IUCN	International Union for Conservation of Nature
JAMBA	Japan-Australia Migratory Bird Agreement
LOO	Likelihood of Occurrence
Mig.	Species listed as Migratory under the EPBC Act or BC Act
NES	National Environmental Significance
OS	Species otherwise in need of special protection listed under the BC Act
PEC	A biological community listed as a Priority Ecological Community under the BC Act
PRISM	Program for Regional and International Shorebird Monitoring
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SP	Species listed as Specially Protected under the BC Act

Abbreviation	Description
SRE	Short-range endemic
TEC	A biological community listed as a Threatened Ecological Community under the EPBC Act or BC Act
TFSA	Terrestrial fauna study area
VU	Species listed as Vulnerable under the EPBC Act or BC Act
WA	Western Australia

1 INTRODUCTION

Leichhardt Salt Pty Ltd (Leichhardt) is seeking to develop the Eramurra Solar Salt Project (the 'Project'), located approximately 55 km west-southwest of Karratha, Western Australia (WA; Figure 1-1). The Project aims to develop high purity industrial grade Sodium Chloride salt from seawater via a solar evaporation, crystallisation and raw salt purification operation.

This report documents the results of zoological surveys undertaken by Phoenix Environmental Sciences Pty Ltd (Phoenix) to address the requirements of the Projects' Environmental Scoping Document (ESD) in relation to baseline surveys for the environmental factor 'Terrestrial fauna'.

Herein we document the results of Detailed and Targeted terrestrial fauna surveys which were built on a desktop study and site reconnaissance to inform the Project's pre-feasibility study (Phoenix 2018).

The study area is located in the City of Karratha and the Eremaean Botanical Province as defined by (EPA 2016b).

1.1 BACKGROUND

Leichhardt proposes to construct and operate the Eramurra Solar Salt Project, a solar salt project to extract up to 4.2 million tonnes per annum (Mtpa) of high-grade salt (Sodium Chloride (NaCl)) from seawater, using a series of evaporation and crystallisation ponds and processing plant, transport corridor, stockpiling, and export from the Cape Preston East Port (the Project). The evaporation and crystalliser ponds will be located on a Mining Lease.

The export of salt is proposed to be via a trestle jetty. The jetty and associated stockpiles will be located at the Cape Preston East Port approved by Ministerial Statement (MS) 949. Dredging of the proposed channel and berth pocket will be undertaken as part of this Proposal to remove high points at the Cape Preston East Port. Dredged material will either be disposed of at one or more offshore disposal locations, or onshore within the Ponds and Infrastructure DE. The Cape Preston East Port jetty and associated stockpiles are excluded from the Proposal.

Bitterns will be transported by pipeline attached to the trestle jetty structure and discharged via a diffuser located off the trestle jetty.

1.2 SCOPE OF WORK

The scope of works to inform the impact assessment concerning terrestrial vertebrate and invertebrate (short-range endemic; 'SRE') fauna and Migratory shorebirds was as follows:

- undertake a desktop fauna study in accordance with Environmental Protection Authority (EPA) technical guidance for terrestrial fauna to determine the fauna that may be present within the Development Envelope (DE)
- undertake Detailed (previously Level 2), Targeted (focussing on various species that might occur), SRE (Detailed) and Migratory shorebird surveys to document the terrestrial fauna assemblage, including significant species, and determine what shorebird species occur and analyse them against national and international importance criteria as per DoEE (2017)
- prepare a technical report that documents the results of the desktop assessment and field surveys, including:
    - data analyses, sample processing and species identifications for species observed and specimens collected during the field surveys

- terrestrial fauna habitat mapping
- identification and discussion of significant fauna species recorded
- population and habitat description for any listed fauna that were found
- likelihood of occurrence assessment of significant fauna not detected
- presence of introduced fauna species.

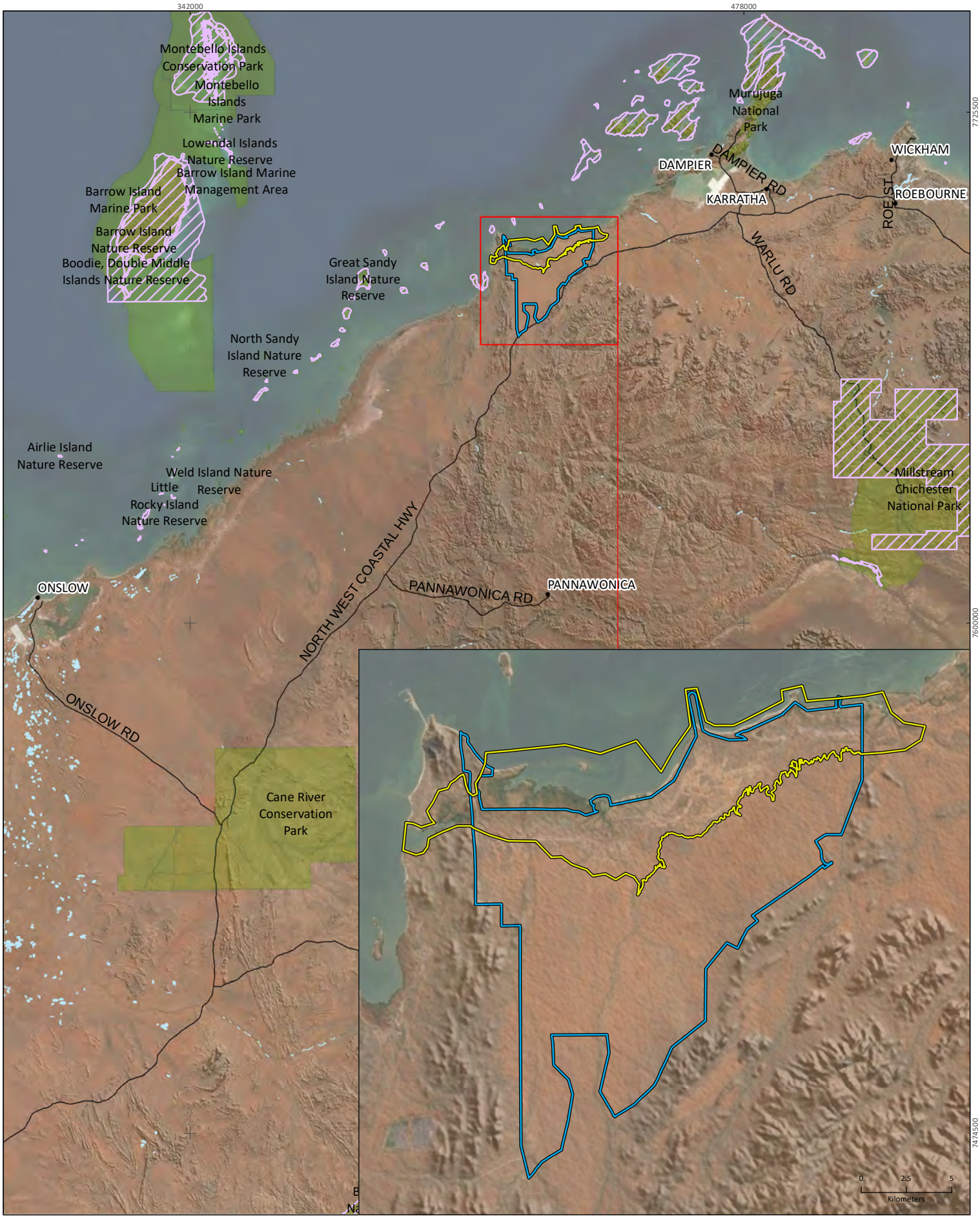
Where practicable, survey design, methodology and report-writing adhere to relevant principles and guidelines, including:

- EPA Position Statement No. 3: *Terrestrial biological surveys as an element of biodiversity protection* (EPA 2002)
- *Environmental Factor Guideline: Terrestrial fauna. Environmental Protection Authority, Perth, WA* (EPA 2016a, 2020)
- *Technical Guidance: Terrestrial fauna surveys* (EPA 2016e)
- *Technical Guidance: Sampling methods for terrestrial vertebrate fauna* (EPA 2016c).

1.3 STUDY AREAS

Two study areas were defined (Figure 1-1):

1. Terrestrial Fauna Study Area (TFSA) – 19,133 ha in size, the main study area for the surveys is an irregular polygon with a northwest corner on the coast approximately 1.5 km east of Cape Preston, extending for approximately 22 km west-east and 25 km north–south, with total area of 26,448.9 ha. The northern boundary is mostly within coastal dunes and mangroves (with a seaward projection at Gnoorea Point), with the southern boundary extending in part just beyond the North West Coastal Highway. Cape Preston airport lies within the southern part of the study area. The TFSA comprises all or part of tenements E08/3042, E47/3072, E08/2592, E47/3447, E08/2361, L08/045, E47/4015, E47/3301 and some areas not covered by tenements.
2. Migratory Shorebird study area (SBSA) – 12,591.1 ha in size, overlaps the TFSA. The SBSA was designed with consideration of DoEE (2017), whereby it is expected that a minimum survey coverage should include all of the habitat thought to be used by the same population of shorebirds and the entire area of contiguous habitat where shorebirds may occur. As such, the SBSA extends further east to include Devils Creek and its delta, and west to include the tidal channel that creates Cape Preston. The SBSA has a maximum width east to west of approximately 29.5 km, ending typically <1 km offshore to the north (but up to 3 km) and typically extending approximately 4 km inland from the coast, where it took in vast areas of unvegetated mudflat.



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- Shorebird study area
- Terrestrial fauna study area
- Environmentally sensitive areas
- DBCA managed land
- Lake
- Road

Figure 1-1

Project location and study area

PHOENIX ENVIRONMENTAL SCIENCES

2 LEGISLATIVE CONTEXT

The protection of fauna in WA is principally governed by three acts:

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- Western Australian *Biodiversity Conservation Act 2016* (BC Act)
- Western Australian *Environmental Protection Act 1986* (EP Act).

The BC Act came into full effect on 1 January 2019 and replaced the functions of the *Wildlife Conservation Act 1950* (WC Act).

2.1 COMMONWEALTH

The EPBC Act is administered by the Federal Department of Climate Change, Energy, the Environment and Water (DCCEEW). The EPBC Act provides for the listing of Threatened fauna as matters of National Environmental Significance (MNES). Under the EPBC Act, actions that have, or are likely to have, a significant impact on a MNES, require approval from the Australian Government Minister for the Environment through a formal referral process.

Conservation categories applicable to Threatened fauna species under the EPBC Act are as follows:

- Extinct (EX)[1] – there is no reasonable doubt that the last individual has died
- Extinct in the Wild (EW) – taxa known to survive only in captivity
- Critically Endangered (CR) – taxa facing an extremely high risk of extinction in the wild in the immediate future
- Endangered (EN) – taxa facing a very high risk of extinction in the wild in the near future
- Vulnerable (VU) – taxa facing a high risk of extinction in the wild in the medium-term
- Conservation Dependent (CD)[1] – taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation dependent taxon would be classified as Vulnerable, Endangered or Critically Endangered.

The EPBC Act is also the enabling legislation for protection of Migratory species as MNES under several 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)
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

More detailed information on the EPBC Act policy framework for the survey, reporting and protection of Migratory birds is provided in section 3.8.2.

[1] Species listed as Extinct and Conservation Dependent are not MNES and therefore do not trigger the EPBC Act.

2.2 STATE

2.2.1 Threatened and Priority species

In WA, the BC Act provides for the listing of Threatened fauna species (Government of Western Australia 2018a, b)[2] in the following categories:

- Critically Endangered (CR) – species facing an extremely high risk of extinction in the wild in the immediate future[3]
- Endangered (EN) – species facing a very high risk of extinction in the wild in the near future[3]
- Vulnerable (VU) – species facing a high risk of extinction in the wild in the medium-term future[3].

Species may also be listed as specially protected (SP) under the BC Act in one or more of the following categories:

- species of special conservation interest (conservation dependent fauna, CD) – species with a naturally low population, restricted natural range, of special interest to science, or subject to or recovering from a significant population decline or reduction in natural range
- Migratory species (Mig.), including birds subject to international agreement
- species otherwise in need of special protection (OS).

The Department of Biodiversity, Conservation and Attractions (DBCA) administers the BC Act and also maintains a non-statutory list of Priority fauna. Priority species are still considered to be of conservation significance – that is they may be Threatened – but cannot be considered for listing under the BC Act until there is adequate understanding of threat levels imposed on them. Species on the Priority fauna lists are assigned to one of four Priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern.

2.2.2 Critical habitat

Under the BC Act, habitat is eligible for listing as critical habitat if it is critical to the survival of a Threatened species or a Threatened Ecological Community (TEC) and its listing is otherwise in accordance with the ministerial guidelines.

2.2.3 Other significant fauna

Under the EPA's environmental factor guidelines, fauna may be considered significant for a range of reasons other than listing as a Threatened or Priority species.

In addition to listing as Threatened or Priority, EPA (2016a) identifies the following attributes that constitute significant fauna:

- species with restricted distribution (see also section 3.8.3)
- species subject to a degree of historical impact from threatening processes
- providing an important function required to maintain the ecological integrity of a significant ecosystem.

[2] The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species under Part 2 of the BC Act.

[3] As determined in accordance with criteria set out in the ministerial guidelines.

3 EXISTING ENVIRONMENT

The calculations and mapping presented here are for the TFSA only as the SBSA extends well beyond the boundaries of the DE and Indicative Disturbance Footprint (IDF).

3.1 INTERIM BIOGEOGRAPHIC REGIONALISATION OF AUSTRALIA

The Interim Biogeographic Regionalisation of Australia (IBRA) classifies Australia's landscapes into 'bioregions' and 'subregions' based on similarities in climate, geology, landform, native vegetation and species composition (DoEE 2016). Except where it intersects non-terrestrial areas occupied by marine habitats, the study area is located in the Roebourne subregion (PIL04) of the Pilbara bioregion (Figure 3-1) which is characterised as (Kendrick & McKenzie 2001):

> "Quaternary alluvial and older colluvial coastal and subcoastal plains with a grass savannah of mixed bunch and hummock grasses, and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. Uplands are dominated by *Triodia* hummock grasslands. Ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands. Samphire, *Sporobolus* and mangal occur on marine alluvial flats and river deltas. Resistant linear ranges of basalts occur across the coastal plains, with minor exposures of granite. Islands are either Quaternary sand accumulations, or composed of basalt or limestone, or combinations of any of these three. Climate is arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually. Subregional area is 2,008,983 ha."

3.2 LAND SYSTEMS

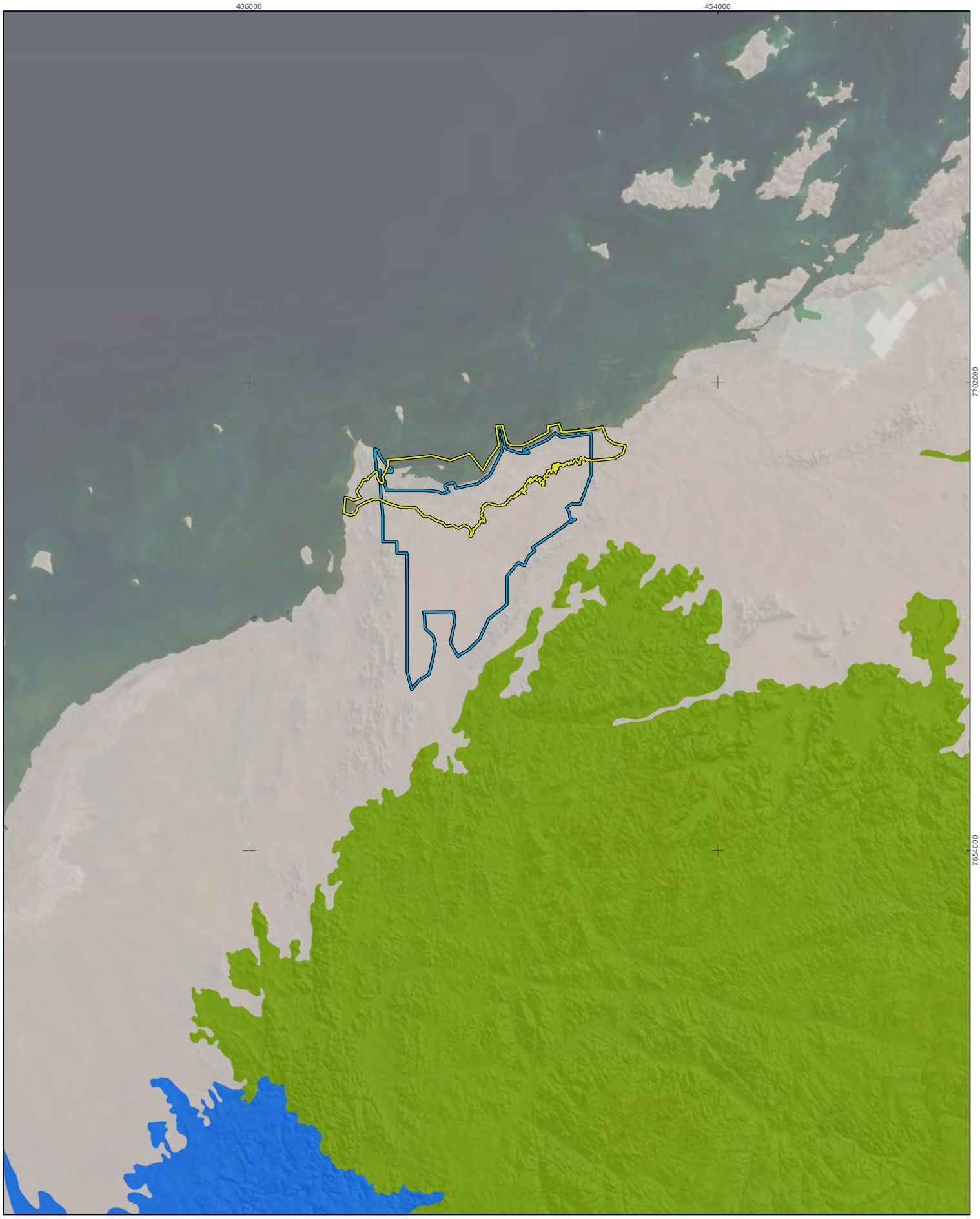
The Department of Primary Industries and Regional Development (DPIRD) undertakes land system mapping for WA using a nesting soil-landscape mapping hierarchy (Schoknecht & Payne 2011). While the primary purpose of the mapping is to inform pastoral and agricultural land capability, it is also useful for informing biological assessments. Under this hierarchy, land systems are defined as areas with recurring patterns of landforms, soils, vegetation and drainage (Payne & Leighton 2004).

The TFSA intersects eight land systems; 62.8% of the study area is dominated by the Horseflat System, and approximately one fifth (20.1%) belongs to the Littoral System. The SBSA intersects five land systems and is dominated by the Littoral System (63.2%). A small portion of coastward locations within the TFSA and SBSA (0.4% and 16.1% respectively) are represented by no land system (Table 3-1; Figure 3-2).

Table 3-1 Land systems and extent in TFSA

Land system	Description	Area (ha) in TFSA	% of TFSA	Area (ha) in SBSA	% of SBSA
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	925.0	3.5	0.0	0.0
Cheerawarra	Sandy coastal plains and saline clay plains supporting soft and hard spinifex grasslands and minor tussock grasslands.	2,754.3	10.4	1,858.6	14.8
Horseflat	Gilgaied clay plains supporting Roebourne Plains grass grasslands	16,610.6	62.8	652.7	5.2

Land system	Description	Area (ha) in TFSA	% of TFSA	Area (ha) in SBSA	% of SBSA
	and minor grassy snakewood shrublands.				
Littoral	Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes, and beaches, supporting samphire low shrublands, sparse Acacia shrublands and mangrove forests.	5,321.0	20.1	7,956.5	63.2
Macroy	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex shrubby grasslands.	194.5	0.7	0.0	0.0
River	Narrow, seasonally active flood plains and major river channels supporting moderately close, tall shrublands or woodlands of acacias and fringing communities of eucalypts sometimes with tussock grasses or spinifex.	88.9	0.3	22.9	0.2
Rocklea	Basalt hills, plateaux, lower slopes, and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	407.3	1.5	67.9	0.5
Ruth	Hills and ridges of volcanic and other rocks supporting shrubby hard spinifex and occasionally soft spinifex grasslands.	39.3	0.1	0.0	0.0
NA	No land systems description available. Occurs in locations considered to be inundated with ocean.	108.1	0.4	2,032.5	16.1
Total area represented by Land Systems		**26,340.9**	**99.8**	**10,558.6**	**83.9**
Total area		**26,449.0**	**100**	**12,591.1**	**100**



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Shorebird study area
Terrestrial fauna study area

IBRA region and subregion

Pilbara, Chichester
Pilbara, Hamersley
Pilbara, Roebourne

Figure 3-1

Study area in relation to IBRA bioregions and subregions

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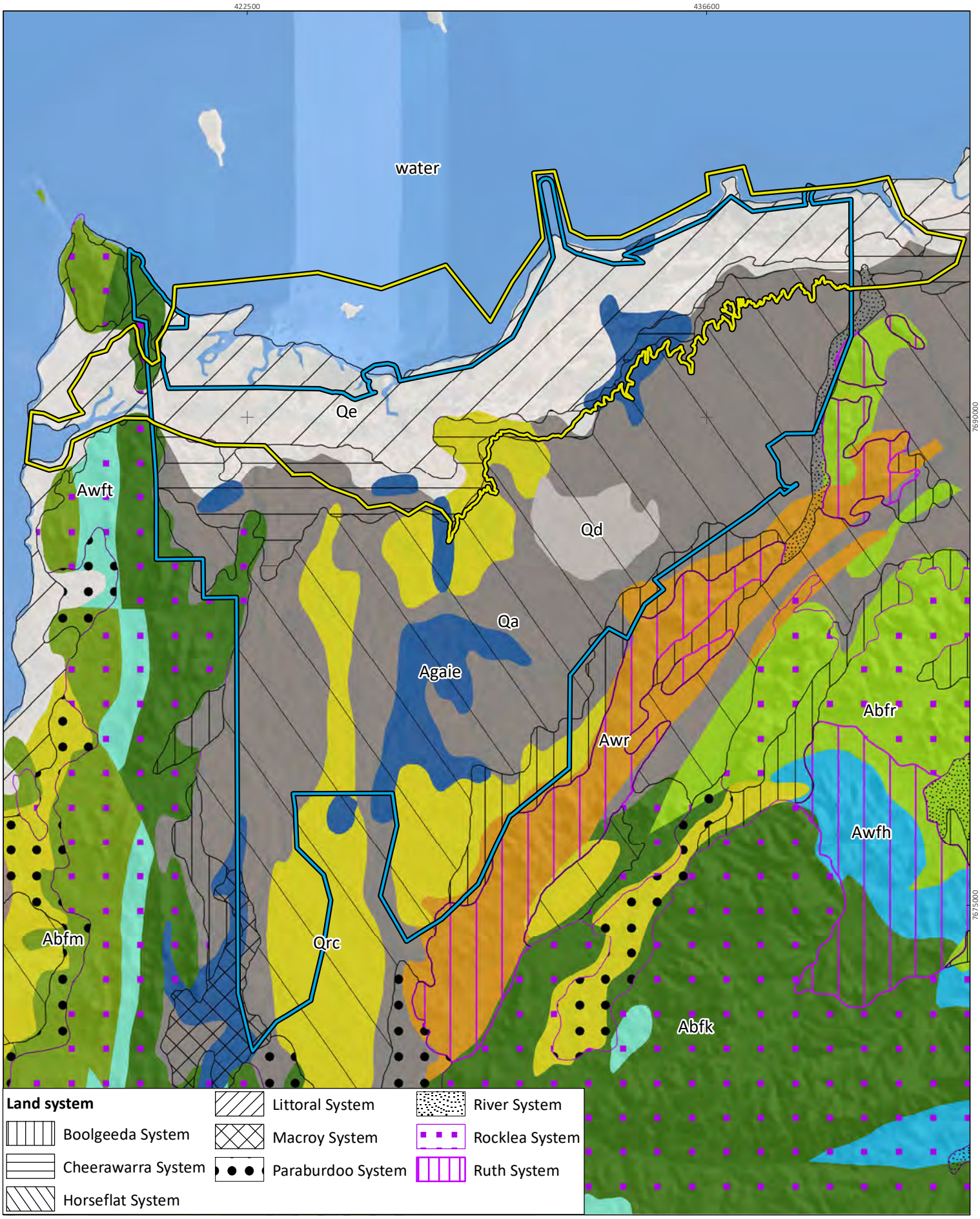

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Shorebird study area
Terrestrial fauna study area

Surface geology

Abfk
Abfm
Abfr
Agaie
Awfh
Awft
Awr
Qa
Qd
Qe
Qrc
water

Figure 3-2

Land systems and surface geology of the TFSA

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3.3 SURFACE GEOLOGY

The western margin of the study area overlies or abuts rocks of the Hamersley Basin extending as a north–south ridge to Cape Preston, while the remainder lies on the older Dampier granitoid complex (Hickman & Strong 2003). Some of these older igneous rocks are exposed as dykes and sills forming low outcrop on plains and in drainage lines, but most are covered by Quaternary alluvium, colluvium and delta deposits. According to the Surface Geology of Australia 1:1,000,000 scale, WA database (Stewart *et al*. 2008), the TFSA intersects eight geological formations and the SBSA intersects six geological formations (Table 3-2; Figure 3-2). The TFSA is dominated by alluvium (46.5%) and the SBSA is dominated by estuarine and delta deposits (63.3%) and water (18.5%).

Table 3-2 Surface geology of the TFSA, extent by deposit type

Surface geology	Abbrev-iation	Description	Area (ha) in TFSA	% of TFSA	Area (ha) in SBSA	% of SBSA
Alluvium 38485	Qa	Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	12,292.8	46.5	1,105.2	8.8
Colluvium 38491	Qrc	Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	4,348.6	16.4	442.8	3.5
Dunes 38496	Qd	Dunes, sandplain with dunes and swales; may include numerous interdune claypans; residual and aeolian sand with minor silt and clay; aeolian red quartz sand, clay, and silt, in places gypsiferous; yellow hummocky sand.	829.1	3.1	0.0	0.0
Eramurra Monzogranite	Agaie	Seriate biotite monzogranite containing mafic schleiren and veins of pegmatite. Composite, including pegmatite veins of Sisters Supersuite rock.	2,270.0	8.6	623.6	5.0
Estuarine and delta deposits 38489	Qe	Coastal silt and evaporite deposits; estuarine, lagoonal, and lacustrine deposits.	5,659.0	21.4	7,967.6	63.3
Kylena Formation	Abfk	Basalt, andesite, dacite, high-Mg basalt, rhyolite; basaltic agglomerate; dolerite; grey carbonate rock with microbial laminations and stromatolites; sandstone; pillow breccia; tuff, limestone, conglomerate.	589.5	2.2	117.7	0.9

Surface geology	Abbrev-iation	Description	Area (ha) in TFSA	% of TFSA	Area (ha) in SBSA	% of SBSA
Mount Roe Basalt	Abfr	Massive, porphyritic, vesicular, amygdaloidal and doleritic basalt; some high-Mg basalt, agglomerate, volcanic breccia, tuff, mafic wacke, shale, polymictic conglomerate and sandstone, siliceous limestone, and dolomite.	4.8	<0.12	0.0	0.0
Roebourne Group	Awr	Basalt, komatiite, serpentinised peridotite, chert, banded iron formation, carbonate, ferruginous clastic rocks, felsic volcanic and intrusive rocks, amphibole schist, quartz-mica schist, jaspilite; metamorphosed, locally sheared, and foliated.	299.5	1.1	0.0	0.0
Tumbiana Formation	Awft	Pisolitic tuff, siliceous limestone and dolomite, mudstone, tuffaceous shale, siltstone, sandstone, volcaniclastic sandstone and siltstone, calcareous sandstone, local basalt and basaltic breccia, chert, local conglomerate, shale, jasper.	0.0	0.0	1.3	<0.01
Water	water	Indian Ocean.	155.7	0.6	2,332.9	18.5
		Total	**26,449.0**	**100**	**12,591.1**	**100**

3.4 SOILS

The TFSA intersects four soil mapping units (Northcote *et al.* 1960-1968) and is dominated by alluvial plains with deep cracking clays (Table 3-3). The northern portion of the TFSA is characterised as salt flats.

Table 3-3 Soils of the TFSA

Soil unit	Description	Area (ha) in TFSA	% of TFSA
Fa19	Steep stony hills and ranges on metamorphosed basic and ultrabasic rock.	690.6	2.6
Gf1	Steep ranges on basic lavas along with dolomites, tuff, banded iron formations, and dolerite dykes, with some narrow valley plains and high-level gently undulating areas of limited extent. The soils are generally shallow and stony and there are large areas without soil cover: chief soils are brown loams (Um6.23) along with significant areas of earthy loam (Um5.51) soils. (Dr2.33) soils occur on lower slopes with (Uf6.71) and (Ug5.37) soils on valley floors.	3,407.5	12.9
MM17	Alluvial plains with occasional stony residuals of basic and ultrabasic rocks: chief soils are deep cracking clays (Ug5.38) but extensive areas of (Dr2.33) and (Uf6.71) soils occur. (Uc5.32) and (Uc1.22) soils occur as narrow bands along stream channels.	17,118.6	64.7
SV8	Salt flats.	5,178.4	19.6
NA	No soil unit description available.	53.8	0.2
	Total	**26,448.9**	**100**

3.5 HYDROLOGY

3.5.1 Groundwater

Hydrological studies of relevance to the TFSA have been conducted for the Fortescue River alluvials to the southwest of the TFSA (Commander 1994; CQG Consulting 2014). More recently, groundwater models have been compiled for the Balmoral South and Sino Iron Ore Projects to the west of the TFSA (Bennelongia 2008a; CloudGMS 2017).

Depth to groundwater at the Fortescue River mouth is 5–15 m; depth to groundwater within the Balmoral South Project is about 20–35 m. Groundwater is mostly fresh (1,500-7,000 mg/L TDS), although more saline water has also been recorded (Bennelongia 2008a). This is consistent with results from other studies in the Fortescue River aquifer, that show salinity in the aquifer rises from 345 mg/L TDS close to the river to more than 1,000 mg/L near the tidal flats where there is a saltwater interface (Commander 1994).

Much of the TFSA is mapped as Acid Sulphate Soil (ASS) risk Class 1, 'High to moderate risk of ASS within 3 m of ground surface' (DWER 2014). The TFSA is located in the Port Hedland Coast catchment within the Pilbara groundwater resource allocation region, which is divided into the Ashburton and East Pilbara Groundwater sub-areas (CQG Consulting 2014).

3.5.2 Surface water

The TFSA and SBSA are situated in the Port Hedland Coast Basin, extending within 2.5 km of the Fortescue River Basin in the southwest. Two seasonal/ephemeral creek systems draining north into the tidal salt flats intersect the TFSA and SBSA, Eramurra Creek in the west and Mckay Creek near the centre. Devil Creek lies just outside the TFSA to the east, but the lower course of both Devil Creek and Yanyare River (converging from the southeast) intersect the eastern end of the SBSA (Figure 3-3) (names and locations of geographic features are from ANZLIC Committee on Surveying and Mapping (2018); Google Maps labels some features in the study area incorrectly, e.g. 'Wooramel River' and 'Harding River' on the drainage identified in the gazetteer as Mckay Creek).

Unnamed tidal creeks opening southeast and southwest of Cape Preston are connected by a tidal wetland, forming a channel cutting through the ridge south of the Cape (crossed by powerlines and road on a causeway). This channel and associated tidal flats are within the SBSA but mostly outside the TFSA.

3.6 CONSERVATION RESERVES AND ENVIRONMENTALLY SENSITIVE AREAS

There are no gazetted nature conservation reserves on the mainland within or immediately adjacent to the TFSA or SBSA. Great Sandy Island Nature Reserve (Class B, R 33831) includes numerous small offshore islands, five of which are within 10 km of the study area, with one small island within the SBSA (three to the east of Cape Preston, two southwest). These are managed by DBCA for the conservation of flora and fauna and are vested with the Conservation and Parks Commission of WA.

The eastern part of TFSA intersects or abuts former portions of Mardie and Karratha Stations (LR3156/104, LR3156/105, LR3156/156, P410036 350) excised in 2015 and proposed for conservation of the Horseflat Land System of the Roebourne Plains Priority Ecological Community (PEC) (Figure 1-1).

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Shorebird study area
Terrestrial fauna study area

Category

Administrative area
Energy
Landform
Water point
Waterway

Figure 3-3

Surface water systems in the vicinity of the TFSA

PHOENIX ENVIRONMENTAL SCIENCES

3.7 CLIMATE AND WEATHER

The Pilbara bioregion has an arid to tropical climate with average maximum temperatures over 40°C from November to February and an average maximum of 25°C during the winter months (Leighton 2004; McKenzie *et al.* 2009). Annual rainfall across the broader Pilbara region averages approximately 290 mm and is most prevalent over the summer months in association with cyclonic activity to the north and northwest, though annual rainfall is highly variable (McKenzie *et al.* 2009). The climate of the Roebourne subregion is described as arid (semi-desert) tropical with highly variable rainfall, falling mainly in summer. Cyclonic activity is significant, with several systems affecting the coast and hinterland annually (Kendrick & Stanley 2001). The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Mardie (no. 005008; Latitude 21.19°S, Longitude 115.98°E), located 30 km southwest of the study area.

Mardie records the highest mean maximum monthly temperature (37.9°C) in January (lowest in July, 27.8°C) and the lowest minimum mean monthly temperature (12.0°C) in July (highest in February, 25.4°C; Figure 3-4) (BoM 2022). Average annual rainfall is 276.3 mm, with February and March recording the highest monthly averages (62.4 and 48.5 mm respectively) corresponding to cyclonic events, and a distinct lower peak in May-June (37.1 and 37.0 mm respectively; Table 3-4) The rainfall and temperature data relevant to each survey is summarised in Table 3-4, Figure 3-4 and Figure 3-5.

Records from Mardie show a dry year preceding the 2020 surveys except for significant rainfall associated with Tropical Cyclone Damien (early February) and a tropical low in March (Figure 3-4).

Conditions during December 2019 and January 2020 visits (shorebird surveys and audio recordings targeting Night Parrot) were hot and dry. Rainfall in February-March 2020 and high humidity extending through April were conducive to high fauna activity during invertebrate and vertebrate trapping surveys. The high rainfall levels preceding the April 2021 survey provided the optimal wet season conditions for SRE sampling.

Table 3-4 Summary of climate data in the three months preceding each field survey. Survey dates are also displayed in Figures 3-4 and 3-5

Survey	Survey dates	Season	Rainfall	Temperature
1	9-11 Dec. 2019	Summer	There was no rainfall in the three months preceding the survey.	Both minimum and maximum temperatures were higher (~0.5-3.1°C) than the long-term average.
2	13-18 Jan. 2020	Summer	There was no rainfall in the three months preceding the survey, with rainfall during the survey month being substantially lower than expected (-36.6 mm).	Both minimum and maximum temperatures were higher (~0.6-3.4°C) than the long-term average.
3	2-5 Feb. 2020	Summer	Rainfall was significantly lower than the long-term average in the three months prior, with only 1 mm in total.	Both minimum and maximum temperatures were slightly higher (~0.7-3.4°C) than the long-term average.
4	10-12 Feb. 2020	Summer	Rainfall was significantly lower than the long-term average in the three months prior, with only 1 mm in total. Rainfall during the survey month was lower 20.6 mm lower than expected.	Both minimum and maximum temperatures were slightly higher (~0.7-3.4°C) than the long-term average.

Survey	Survey dates	Season	Rainfall	Temperature
5	15-27 April 2020	Autumn	Rainfall was higher in March (+11.3 mm) but lower in the two months prior (Jan & Feb). There was only 0.2 mm during the month of the survey.	Maxima fluctuated around the long-term climate average (within 1.3°C). Minima were slightly higher (1.9°C).
6	6-8 July 2020	Winter	Rainfall was lower than average in the three months prior, with June receiving substantially less than the average (-35 mm).	Both minimum and maximum temperatures were slightly higher (~0.7-2.7°C) than the long-term average.
7	24–27 April 2021	Autumn	Rainfall was higher-on-average in the three months prior, with February receiving more than double the long-term average rainfall (+64.2 mm).	For February and March, maximum temperatures were lower (~1.7-3°C) than the long-term average, and minimum temperatures were consistent. January temperatures were slightly higher than expected.
8	29 Nov. – 7 Dec. 2021	Spring - summer	Total rainfall for the three months was marginally higher than the long-term average, with November accounting for all 3.8 mm.	Maxima and minima fluctuated around the long-term climate average (within 1.3°C).

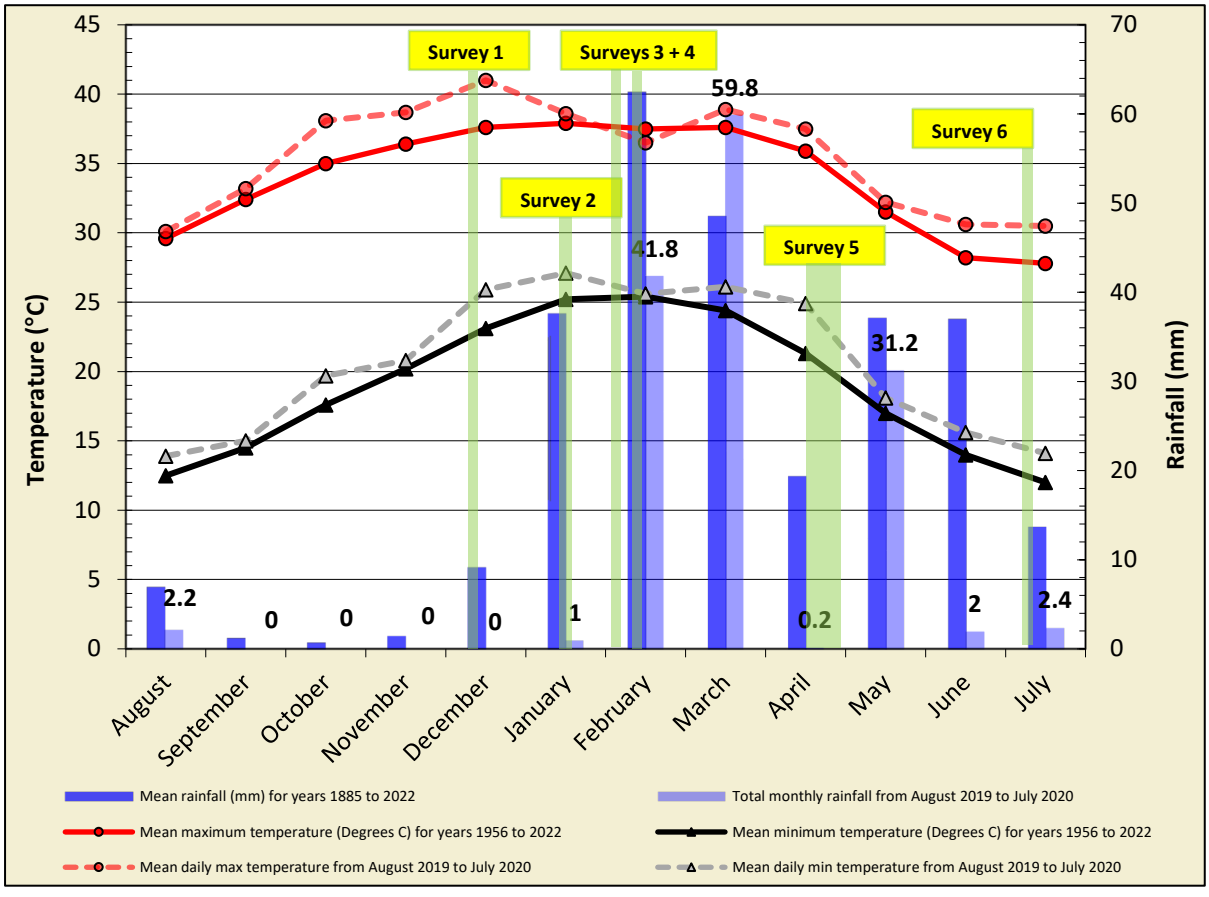


Figure 3-4 **Annual climate and weather data for Mardie (no. 005008) and mean monthly data for the 12 months preceding the 2019 and 2020 surveys (BoM 2022)**

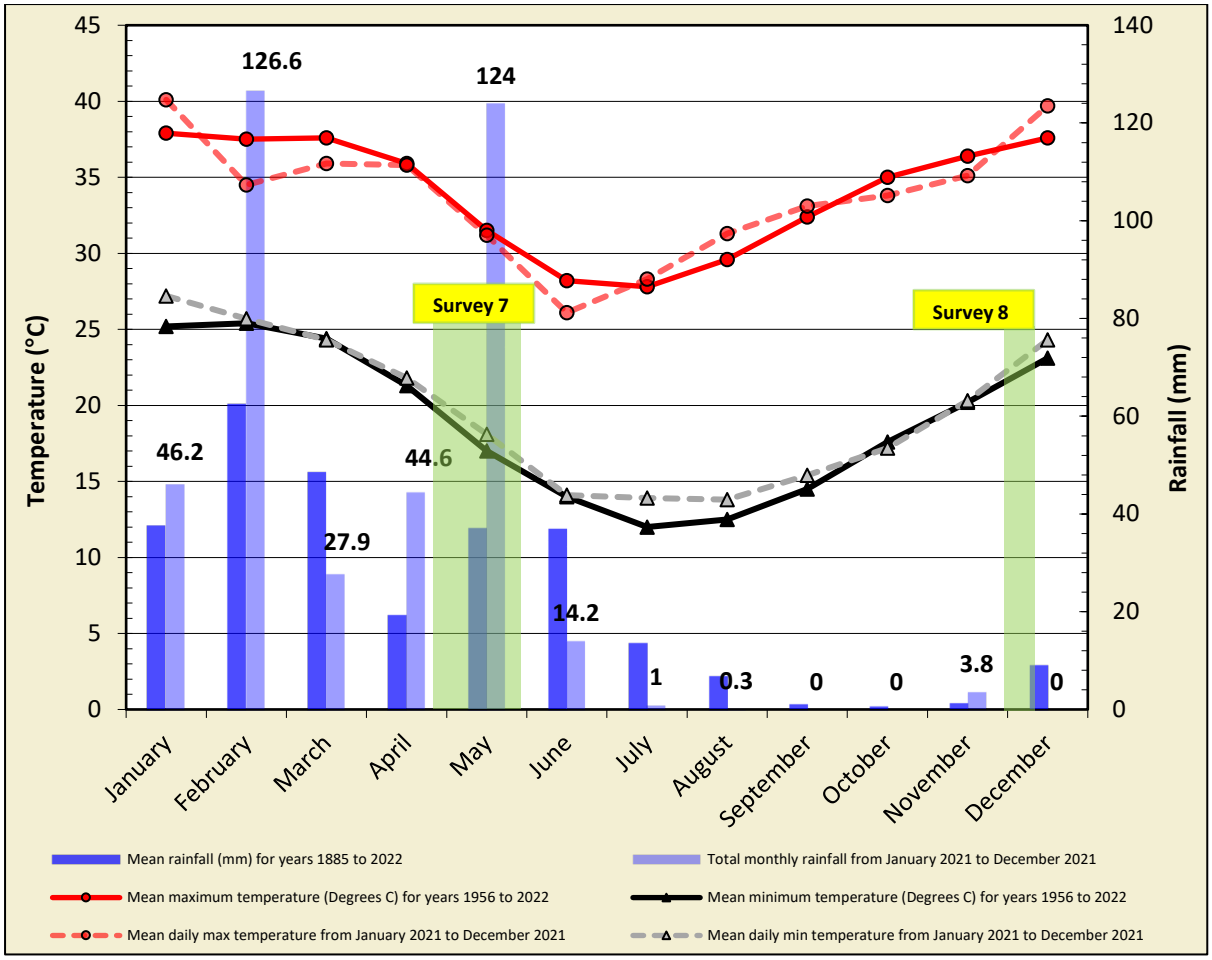


Figure 3-5 **Annual climate and weather data for Mardie (no. 005008) and mean monthly data for the 12 months preceding the 2021 surveys (BoM 2022)**

3.8 BIOLOGICAL CONTEXT

The Pilbara accommodates a rich species assemblage comprising a diverse array of vertebrate and invertebrate fauna (Van Vreeswyk *et al.* 2004). Fauna within the region have adapted to survive in the harsh Pilbara climatic regime. Multiple Pilbara fauna species are listed as Threatened or Priority species in need of protection or research.

A comprehensive biological survey of the Pilbara was conducted by the Department of Environment and Conservation (DEC) from 2002–2007 (McKenzie *et al.* 2009). This survey provided a benchmark for environmental assessment studies in the Pilbara as it comprehensively surveyed the biota and summarised fauna and floristic data for many groups of plants and animals in the region. Survey data have provided substantial background information on the small mammal, bat, bird and reptile fauna of the region (Baynes & McDowell 2010; Burbidge *et al.* 2010; Doughty *et al.* 2011b; Gibson & McKenzie 2009; McKenzie & Bullen 2009), and for selected invertebrates, including target SRE taxa such as spiders (Durrant *et al.* 2010) and scorpions (Volschenk *et al.* 2010).

3.8.1 Vertebrate fauna

According to the DBCA Threatened and Priority fauna list (last updated 13 June 2022), 50 vertebrate species that occur in the Pilbara are listed as Threatened under the EPBC Act and/or BC Act (DBCA

2022). This assemblage includes 35 terrestrial and freshwater species, two elasmobranchs, five marine turtles, five whales (four baleen and one odontocete) and two sea snakes. A further 56 (including 17 invertebrates but omitted as subterranean species) are Priority fauna; four of these are listed as OS under the BC Act. Nine mammal species are now consisted Extinct.

A total of 56 Migratory bird species known to occur in the Pilbara are listed under international agreements, including several of the Threatened species (DBCA 2019).

The Pilbara bioregion is relatively high in endemism with 23 described bioregional endemic vertebrate species and several undescribed species only recorded from the bioregion (Catullo *et al.* 2011; Doughty *et al.* 2011a; Doughty *et al.* 2012; Doughty & Oliver 2011; Doughty *et al.* 2010; Maryan *et al.* 2014; McKenzie *et al.* 2003; McKenzie *et al.* 2009).

3.8.2 EAAF Migratory shorebirds

The EPBC Act provides protection for 105 Migratory bird species (not including subspecies) listed under numerous international agreements that Australia is a signatory to (section 2.1). Of these, 37 Migratory shorebird species (Table 3-3) are given special consideration through recently updated guidelines: *Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed Migratory shorebird species* (DoEE 2017).

Australia is a geographically and ecologically important location for Migratory shorebirds within the East Asian-Australasian Flyway (EAAF, 'the flyway'). Thirty-six of the 37 Australian Migratory shorebird species breed in the northern hemisphere and migrate annually to southern non-breeding areas including Australia; Double-banded Plovers are the exception which migrate between Australia and breeding grounds in New Zealand, rather than north–south through the flyway. The flyway stretches from Siberia and Alaska, southwards through east and south-east Asia, to Australia and New Zealand.

Under the EPBC Act, 'important habitat' is a key concept for Migratory species (Department of the Environment 2013; DoEE 2017). Important habitats in Australia for Migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. The accepted and applied approach to identifying internationally important shorebird habitat has been through the use of criteria adopted under the Ramsar Convention on Wetlands (DoEE 2017).

According to that approach:

- internationally important habitat regularly supports:
    - 1% of the individuals in a population of one species or subspecies of waterbird; or
    - a total abundance of at least 20,000 waterbirds.
- nationally important habitat regularly supports:
    - 0.1% of the flyway population of a single species of Migratory shorebird; or
    - a total abundance of at least 2,000 Migratory shorebirds; or
    - at least 15 Migratory shorebird species.

Table 3-5 East Asian-Australasian Flyway population estimates (Hansen *et al.* 2016)

Common name	Final population estimate	1% flyway population	0.1% flyway population
Asian Dowitcher	14,000	140	14
Bar-tailed Godwit	325,000	3250	325
Black-tailed Godwit	160,000	1600	160
Broad-billed Sandpiper	30,000	300	30
Common Greenshank	110,000	1100	110

Common name	Final population estimate	1% flyway population	0.1% flyway population
Common Redshank	75,000-150,000	750	75
Common Sandpiper	190,000	1900	190
Curlew Sandpiper	90,000	900	90
Double-banded Plover	19,000	190	19
Far Eastern Curlew	35,000	350	35
Great Knot	425,000	4250	425
Greater Sand Plover	200,000-300,000	2000	200
Grey Plover	80,000	800	80
Grey-tailed Tattler	70,000	700	70
Latham's Snipe	30,000	300	30
Lesser Sand Plover	180,000-275,000	1800	180
Little Curlew	110,000	1100	110
Little Ringed Plover	150,000	1500	150
Long-toed Stint	230,000	2300	230
Marsh Sandpiper	130,000	1300	130
Oriental Plover	230,000	2300	230
Oriental Pratincole	2,880,000	28,800	2880
Pacific Golden Plover	120,000	1200	120
Pectoral Sandpiper	1,220,000-1,930,000	12,200	1220
Pin-tailed Snipe	170,000	1700	170
Red Knot	110,000	1100	110
Red-necked Phalarope	250,000	2500	250
Red-necked Stint	475,000	4750	475
Ruddy Turnstone	30,000	300	30
Ruff	25,000-100,000	250	25
Sanderling	30,000	300	30
Sharp-tailed Sandpiper	85,000	850	85
Swinhoe's Snipe	40,000	400	40
Terek Sandpiper	50,000	500	50
Wandering Tattler	10,000-25,000	100	10
Whimbrel	65,000	650	65
Wood Sandpiper	130,000	1300	130

3.8.3 Short-range endemic invertebrates

SRE fauna are defined as animals that display restricted geographic distributions, nominally less than 10,000 km^2, that may also be disjunct and highly localised (Harvey 2002). EPA (2016a) identifies species with restricted distributions as being significant fauna (2.2.3 above) in the context of environmental impact assessments (EIA). SRE fauna need to be considered in EIA as localised, small

populations of species that are generally at greater risk of changes in conservation status due to environmental change than other, more widely distributed taxa.

Short-range endemism in terrestrial invertebrates is believed to have evolved through two primary processes (Harvey 2002):

- Relictual – where the drying climate reduced the area of suitable habitat available to a species, forcing a range contraction. Such habitats typically maintain historic mesic conditions (e.g., south-facing rock faces or slopes of mountains or gullies)
- Habitat speciality – where species settled in particular isolated habitat types (e.g., rocky outcrops) by means of dispersal and evolved in isolation into distinct species.

However, SRE invertebrates have also been reported in more widespread habitats such as spinifex plains or woodlands, mainly in groups with low dispersal capabilities, for example mygalomorph spiders and millipedes (see for example Car & Harvey 2014; Rix *et al*. 2018).

There can be uncertainty in categorising a specimen as a SRE due to several factors including poor regional survey density, lack of taxonomic research and problems of identification, i.e., specimens that may represent SREs cannot be identified to species level based on the life stage at hand. For example, in contrast to mature males, juvenile and female millipedes, mygalomorph spiders and scorpions cannot be identified to species level. Molecular techniques such as 'barcoding' (Hebert *et al.* 2003a; Hebert *et al.* 2003b) are routinely employed to overcome taxonomic or identification problems.

Currently, there is no accepted system to determine the likelihood that a species is an SRE. The WA Museum applies four categories which were adopted in this assessment: confirmed, potential, uncertain and not SRE. Confirmed SREs are taxa for which the distribution is known to be less than 10,000 km^2, the taxonomy is well known and the group is well represented in collections and/or via comprehensive sampling (WAM 2013). Potential SREs include those taxa for which there is incomplete knowledge of the geographic distribution of the group and its taxonomy, and the group is not well represented in collections.

3.9 LAND USE

Over two-thirds (70.1%) of land in the Roebourne subregion is used for grazing of native vegetation. Of the quarter (26.5%) of lands in Primary Class 1 (Conservation and natural environments), only about 7% of land is protected with some form of conservation status, since the 8.8% of land classified in the "other minimal use" category is offered no formal protection. Intensive land uses (0.5%) and water bodies of various natural and man-made types (2.9%) make up the remaining relatively small land uses in Roebourne.

Table 3-6 Land use within the Roebourne IBRA subregion (ABARES 2018)

Land Use Class (Primary and Tertiary)	Area (ha)	Area (%)
1 Conservation and natural environments	**530259.7**	**26.5**
1.1.1 Strict nature reserves	11958.2	0.6
1.1.3 National Park	125332.6	6.3
1.1.6 Protected landscape	0.8	< 0.1
1.2.0 Managed resource protection	3.9	< 0.1
1.3.0 Other minimal use	176668.2	8.8
1.3.1 Defence land - natural areas	287.7	< 0.1
1.3.3 Residual native cover	216008.3	10.8
2 Production from relatively natural environments	**1402003.8**	**70.1**
2.1.0 Grazing native vegetation	1402003.8	70.1
3 Production from dryland agriculture and plantations	**394.6**	**< 0.1**

Land Use Class (Primary and Tertiary)	Area (ha)	Area (%)
3.6.1 Degraded land	394.6	< 0.1
4 Production from irrigated agriculture and plantations	**0.4**	**< 0.1**
4.4.1 Irrigated tree fruits	0.4	< 0.1
5 Intensive uses	**9118.8**	**0.5**
5.1.1 Production nurseries	26.3	< 0.1
5.2.7 Saleyards/stockyards	7.1	< 0.1
5.3.0 Manufacturing and industrial	1715.1	0.1
5.3.1 General purpose factory	154.6	< 0.1
5.4.1 Urban residential	1891.0	0.1
5.4.2 Rural residential with agriculture	197.4	< 0.1
5.5.1 Commercial services	1057.1	0.1
5.5.2 Public services	117.3	< 0.1
5.5.3 Recreation and culture	909.0	< 0.1
5.6.1 Fuel powered electricity generation	14.1	< 0.1
5.6.5 Electricity substations and transmission	6.9	< 0.1
5.6.6 Gas treatment, storage and transmission	211.2	< 0.1
5.7.1 Airports/aerodromes	250.0	< 0.1
5.7.2 Roads	985.5	< 0.1
5.8.0 Mining	232.6	< 0.1
5.8.2 Quarries	58.0	< 0.1
5.8.3 Tailings	910.2	< 0.1
5.8.4 Extractive industry not in use	11.7	< 0.1
5.9.0 Waste treatment and disposal	9.3	< 0.1
5.9.1 Effluent pond	102.9	< 0.1
5.9.3 Solid garbage	189.3	< 0.1
5.9.5 Sewage/sewerage	62.2	< 0.1
6 Water	**58533.5**	**2.9**
6.0.0 Water	18.2	< 0.1
6.1.0 Lake	4554.7	0.2
6.2.1 Reservoir	4.2	< 0.1
6.2.2 Water storage - intensive use/farm dams	7.4	< 0.1
6.2.3 Evaporation basin	16017.0	0.8
6.3.0 River	28280.6	1.4
6.5.0 Marsh/wetland	4520.8	0.2
6.6.0 Estuary/coastal waters	5130.4	0.3
Total	**2000310.7**	**100.0**

4 METHODS

The Detailed fauna survey was conducted in accordance with relevant survey guidelines and guidance, including:

- EPA Environmental Factor Guideline: Terrestrial fauna (EPA 2016a)
- EPA Technical Guidance: Terrestrial fauna surveys (EPA 2016e)
- EPA Technical Guidance: Sampling methods for terrestrial vertebrate fauna (EPA 2016c)
- EPA Technical Guidance: Sampling of short-range endemic invertebrate fauna (EPA 2016d)
- EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed Migratory shorebird species (DoEE 2017)
- Interim guideline for preliminary surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017a)

4.1 DESKTOP REVIEW

Searches of several biological databases were undertaken to identify and prepare lists of significant fauna that may occur within the study area (Table 4-1). A literature search was conducted for accessible reports for biological surveys conducted either within 50 km of the study area, or up to 200 km on the coastal plain, to build on the lists developed from the database searches (Table 4-2). Compiled species lists, incorporating taxonomic updates where available, are given in Appendix 3; species recorded in more distant surveys (e.g., Onslow region, Barrow Island) are omitted if there are no closer or mainland records. Where a species and one of its subspecies are both recorded, they are counted as a single taxon; in cases where two subspecies are recorded (if not attributed to error) they are listed as distinct.

Table 4-1 Database searches conducted for the desktop review

Database	Target group/s	Search coordinates and extent
Protected Matters Search Tool (DoEE 2018)	MNES: EPBC Act Threatened, Migratory and Marine fauna and Ecological Communities	Approximate centre point of TFSA (20.90°S, 116.36°E) with 40 km buffer
DBCA Threatened and Priority fauna Database (DBCA 2018b)	Threatened and Priority fauna	TFSA plus a 40 km buffer
DBCA Threatened and Priority Ecological Communities Database (DBCA 2017b)	TECs and PECs	TFSA plus a 40 km buffer
DBCA NatureMap Database (DBCA 2018a)	Terrestrial fauna	TFSA plus a 40 km buffer
BirdLife BirdData (BirdLife Australia 2018a)	Avifauna	TFSA plus a 40 km buffer
Atlas of Living Australia (ALA 2020)	Terrestrial fauna	TFSA plus a 40 km buffer
WA Museum Arachnid and Myriapod Database, Mollusca Database	Arachnid, myriapod and mollusc SREs	Search area encompassing the TFSA, between 20.45°S, 115.89°E (northwest corner) and 21.35°S, 116.79°E (southeast corner)

Table 4-2 Survey reports included in the desktop review

Report author	Location relative to study area	Survey description	Project
Storr & Harold (1985)	50-150 km W	Reptile and amphibian review and survey	Herpetofauna of the Onslow Region, WA
Biota and Trudgen & Associates (2001)	overlap	Flora, vegetation, and fauna survey	Austeel Cape Preston Iron Project
Biota (2005a)	approx. 200 km SW	Fauna and fauna assemblage survey	Yannarie Salt Project fauna survey
Biota (2005b)	approx. 200 km SW	Mangrove and coastal ecosystem	Yannarie Salt Project mangrove and coastal ecosystem study. Baseline ecological assessment
Bennelongia (2008b)	adjacent	Shorebird habitat assessment and survey	Report on shorebird numbers and shorebird values at Cape Preston
Maunsell AECOM (2008a)	adjacent	Fauna assessment	Balmoral South. Consolidated vegetation, flora, and fauna assessment
Maunsell AECOM (2008b)	adjacent	Fauna survey	Cape Preston Mining Estate. Consolidated vegetation, flora, and fauna assessment
Pendoley (2009)	overlap	Marine turtle survey	Cape Preston marine turtle surveys January and March 2009
Phoenix (2009b)	adjacent	Fauna survey, with summary of previous survey results	Fauna Survey: Cape Preston Iron Ore Precinct
Phoenix (2009a)	adjacent	SRE invertebrate survey	Short-range endemic invertebrate fauna survey of the Mineralogy Cape Preston Iron Ore Mining Project
ENV Australia (2011)	135 km SW	Fauna assessment	Onslow Townsite Strategy. Flora, vegetation, and fauna assessment
Doughty *et al.* (2011b)	local (Dampier-Roebourne) and S-adjacent (Onslow-Yarraloola) regions	Herpetofauna surveys	Herpetological assemblages of the Pilbara biogeographic region, WA
Johnstone *et al.* (2013)	Inclusive	Bird surveys and review, distribution maps [~50 km radius used for Appendix 3]	Birds of the Pilbara region, including seas and offshore islands, WA: distribution, status, and historical changes
GHD (2013)	substantial overlap	Fauna review	Cape Preston East Environmental Studies. Flora and fauna review
Imbricata (2013)	substantial overlap	Marine turtle habitat assessment	Marine turtle nesting habitat and light spill assessment on the Eastern Beach of Cape Preston, WA

Report author	Location relative to study area	Survey description	Project
Chevron (2014)	45 km SW	Terrestrial fauna survey [only mainland survey results shown in Appendix 3, excluding Barrow Island]	Gorgon Gas Development and Jansz Feed Gas Pipeline: terrestrial and subterranean baseline state and environmental impact report
360 Environmental (2014)	31 km E	Terrestrial fauna survey	Mount Regal, Karratha: Flora, Vegetation and Fauna Assessment
Ecoscape (2016a)	adjacent	Northern Quoll targeted survey, camera trapping	Cape Preston Northern Quoll reconnaissance survey
Ecoscape (2016b)	adjacent	Northern Quoll targeted survey, cage trapping	Cape Preston Northern Quoll targeted survey
Phoenix (2017)	32 km W	Desktop review and reconnaissance survey	Environmental desktop review and reconnaissance site visit for the Mardie Salt Project
Astron Environmental Services Pty Ltd (2018)	42 km NE	Fauna assessment (only three fauna species recorded in survey, not shown in Appendix 3)	Burrup Peninsula Interconnector Pipeline Flora and Fauna Survey June 2018
Phoenix (2018)	substantial overlap	Desktop review and reconnaissance survey	Environmental desktop review and reconnaissance site visit for the Eramurra Industrial Salt Project
Phoenix (2020)	32 km W	Terrestrial fauna, shorebird survey	Level 2 targeted terrestrial fauna survey assessment for the Mardie Project

4.2 FIELD SURVEYS

4.2.1 Survey timing and sampling methods

Field survey dates and personnel on each survey are provided in Table 4-3. Where possible the same personnel were used for each component, for example John Scanlon supervised all the shorebird surveys conducted by specialist staff from Ornithological Technical Services (OTS); but this was not always possible as the surveys were completed over several years.

Table 4-3 Survey dates and applicable survey guidelines

Survey	Survey type and brief description	Applicable policies and survey guideline	Season	Dates	Surveyors
1	• shorebirds helicopter survey (x4 transects) • Night Parrot audio recording units (x4) set.	DoEE (2017) DPaW (2017a)	Summer	9-11 Dec. 2019	Dr John Scanlon, Floyd Holmes

Survey	Survey type and brief description	Applicable policies and survey guideline	Season	Dates	Surveyors
2	• shorebirds helicopter survey (x4 transects, plus one incomplete) • Night Parrot audio recording units (x4) moved and reset • SRE wet pit sites (x5) established.	DoEE (2017) DPaW (2017a) EPA (2016d)	Summer	13-18 Jan. 2020	Dr John Scanlon, Nick Hart
3	• shorebirds helicopter survey (x4 transects) • Night Parrot audio recording units collected • SRE wet pit sites (x3) established.	DoEE (2017) EPA (2016d)	Summer	2-5 Feb. 2020	Dr John Scanlon, Floyd Holmes
4	• shorebirds helicopter survey (x4 transects).	DoEE (2017)	Summer	10-12 Feb. 2020	Dr John Scanlon, Bill Rutherford
5	• systematic trapping sites (x8) established, each with pit/funnel/Elliott trapping, avifauna surveys, foraging, nocturnal foraging • camera trapping (x7 sites) • ultrasonic bat recording (x6 sites) • SRE wet pits collected (x8 sites), SRE foraging/sieving at wet pit sites • opportunistic fauna records and site descriptions during movements in and around study area.	EPA (2016a) EPA (2016c) EPA (2016d) EPA (2016e)	Autumn	15-27 April 2020	Simon Pynt, Dr Michael Lohr, Dr John Scanlon, Ryan Carter
6	• shorebirds helicopter survey (x4 transects).	DoEE (2017)	Winter	6-8 July 2020	Dr John Scanlon, Nick Hart
7	• Targeted SRE survey.	EPA (2016d)	Wet season (summer)	24–27 April 2021 – trap installation and foraging 24–26 May 2021 – trap pickup	Anna Jacks, Dr John Scanlon, Paula Strickland
8	• Basic/Targeted survey – Undertaken in response to DE expansion to south and east.	EPA (2016a) EPA (2016c) EPA (2016e)	Summer	29 Nov.– 7 Dec. 2021	Dr Floyd Holmes, Brendan Thomson

4.2.2 Vegetation and habitat mapping

Vegetation mapping was undertaken at a scale of 1:10,000 using National Vegetation Information System (NVIS) sub-association level (L5) for structural descriptions (ESCAVI 2003). The vegetation descriptions from quadrats and relevés from the survey were grouped according to similarity of community structure (i.e., canopy levels), species composition and combination of species and the prevalent community structure (i.e., woodland, shrubland, etc.). The vegetation boundaries were

mapped utilising ArcGIS ESRI imagery and from vegetation boundaries recorded on GPS during the field survey.

Once the vegetation description/structure was completed, landform and soil type were used to derive fauna habitats for each polygon. This method typically results in multiple vegetation types being grouped into a single fauna habitat. Derived fauna habitats may also be grouped depending on the variability of the vegetation/fauna habitats, condition and the scale of the Project, as was the case here. Detailed methods on the classification of vegetation units are provided in Phoenix (2022).

4.2.3 Terrestrial fauna

Field methods for the terrestrial fauna survey included:

- habitat assessment (see 4.2.3.1)
- systematic trapping (4.2.3.2)
- active diurnal and nocturnal searches (4.2.3.3, 4.2.3.4)
- avifauna surveys (4.2.3.5)
- bat echolocation recordings (4.2.3.6)
- camera trapping (4.2.3.7)Targeted survey for Night Parrot (4.2.3.8)
- SRE invertebrate sampling (4.2.3.9)
- molecular sequencing (4.2.3.10)
- analysis of survey completeness (4.2.3.11)

A total of 75 survey sites were sampled, including 34 SRE sites (Table 4-4; Table 4-5).

The suite of fauna surveys undertaken are equivalent to a Detailed and Targeted survey in accordance with EPA guidance (EPA 2020).

4.2.3.1 Habitat assessment

Initial habitat characterisation was undertaken using various remote geographical tools, including aerial photography (Google Earth®), land system maps and topographic maps. Habitats with the potential to support significant terrestrial fauna species were identified based on known habitats of such species within the Pilbara bioregion. Tentative sites were selected for the terrestrial fauna survey to represent all habitat types. Final survey site selection was conducted after ground-truthing of site characteristics.

At the broadest scale, site selection considered aspect, topography and land systems. At the finer scale, consideration was given to the proximity of water bodies (drainage lines and creeks), vegetation complexes and condition and soil type. Sites were primarily chosen to represent the best example of distinct habitats (BOO sites – Best on Offer) within the broader habitat associations of the study area with a focus on species of conservation significance identified in the desktop review. Habitat descriptions and characteristics were recorded at all systematic trapping and targeted survey sites (**Figure** 4-1; Table 4-4; Appendix 2)

4.2.3.2 Systematic trapping

Eight systematic trapping sites were established to capture terrestrial mammals, reptiles and amphibians (**Figure** 4-1). Each site comprised five 'sub-sites' which consisted of a PVC pipe (15 cm diameter x 60 cm depth), a 20 L bucket, four funnel traps (75 cm x 18 cm x 18 cm) and two Elliot traps (9 cm x 10 cm x 33 cm). The pipes and buckets were installed flush with the substrate, with a 6 m long,

30 cm high aluminium mesh drift fence bisecting both pits at each sub-site. Funnel traps were positioned at the start and finish of each drift fence, and on each side in the middle between the pits.

The Elliott traps were baited with a universal bait mixture consisting of oats, peanut butter and sardines to attract small mammals. Elliott and funnel traps were shrouded with reflective closed cell insulation (R2.5 rated) to provide shade and protection for any captured animals. All traps were given as much shade as possible under/around vegetation. Styrofoam trays and leaf litter were used to provide protection from the elements in the bottom of all buckets.

Traps were open for seven consecutive nights and checked within three hours of sunrise. Baits were removed and replaced every second day.

The total vertebrate trapping effort for the eight systematic trapping sites during the surveys was 2240 trap-nights (Table 4-4) where a trap-night is defined as one trap remaining open for one night.

4.2.3.3 Active diurnal searches

Active searches were undertaken at each systematic site and three additional sites in the study area (**Figure** 4-1). Active searches primarily targeted diurnal herpetofauna and mammals from direct sightings and secondary evidence. Searches focused primarily on significant species identified in the desktop review as potentially occurring within the study area, including Northern Quoll.

Searches were undertaken in any observable microhabitats considered likely to support mammals, reptiles and amphibians. Techniques included: raking leaf and bark litter, overturning logs, searching beneath the bark of trees, investigating dead trees and logs, investigating burrows, investigating infrastructure ruins or disused building materials such as sheet tin piles, and identifying any secondary evidence including tracks, diggings, scats, fur, or sloughs (shed skins), predation or feeding sites and fauna constructed structures such as pebble mounds or nests. Approximately 2.0 person-hours were spent actively searching at each site for a total of 19 hours over the duration of the field survey (Table 4-4).

4.2.3.4 Active nocturnal searches

Nocturnal searches were undertaken to detect the presence of any nocturnal fauna species. Nocturnal searches were undertaken between sunset and 9 pm when activity levels were highest for most nocturnal species. Survey efforts consisted of searches on foot using head torches and in vehicles to detect animal movement, eye shine, or other evidence of species' presence. These searches particularly targeted reptiles and mammals, but also nocturnal birds. Due to limited tracks and the size of the TFSA, spotlighting for nocturnal species was restricted to the most prospective sites/habitats. Approximately 15.4 person-hours of nocturnal searches were undertaken during the field survey.

4.2.3.5 Avifauna surveys

Twenty-minute 2ha avifauna surveys were undertaken at each systematic trapping site and two additional sites in the study area (**Figure** 4-1; Table 4-4). Avifauna surveys were confined to the habitat type (up to 2 ha) represented by each site to collect assemblage data for each habitat. Avifauna surveys were undertaken throughout the day with a focus on periods of higher activity around sunrise and sunset. Surveys consisted of bird identifications and approximate counts from visual sightings and call recognition. A total of 19.2 person-hours of avifauna census was undertaken during the field survey (Table 4-4).

Additional avifauna observations were also recorded opportunistically while other field work was being completed, including observations made during active searches and travel between sites.

4.2.3.6 Bat echolocation recordings

SongMeter SM2Bat recording devices were used to record bat echolocation calls at six sites during the April field survey and four sites during the November 2021 survey (Table 4-4; Figure 4-1); these recording devices have a frequency detection range capable of capturing most microchiropteran species typical of the area, including the regionally significant Pilbara Leaf-nosed Bat. Recording devices were deployed at each site for five nights of recording for approximately ten continuous hours per night. Devices were aimed at a 45° angle to the ground. T.

The April 2020 survey recordings were analysed by Dr Kyle Armstrong and Yuki Konishi (Specialised Zoological) and the November 2021 recordings were analysed by Mr Bob Bullen.

4.2.3.7 Camera trapping

Five camera traps were deployed at each of 15 sites considered to represent habitat for Northern Quoll and/or other significant fauna. Cameras were baited (universal bait) and left in place for a minimum four nights, with baits replaced every second day.

4.2.3.8 Targeted survey for Night Parrot

SongMeters were deployed in areas considered to be the best representation of potential habitat for Night Parrot, i.e., areas of relatively large, old spinifex hummocks. These methods were implemented to comply with the guidelines for Night Parrot survey published by DPaW (2017a).

Recording devices were deployed at 13 sites to record bird calls and activity over a longer period outside of disturbance periods during the field survey (sites NP01-08; **Figure** 4-1). Four devices were deployed during the December 2019 survey, moved to new sites in January, and retrieved in February 2020 (Table 4-3). Three devices were deployed during the November 2021 survey and moved after six nights to a further two locations for two nights (Table 4-4). The resultant recordings were analysed by Phoenix and Robert Bullen (Bat Call WA) independently, with results communicated by email.

Table 4-4 Terrestrial fauna survey effort

Site	Site type	Site description	Audio recording (nights)	Ultrasonic recording (nights)	Camera trap (nights)	Foraging (hours)	Foraging nocturnal (hours)	Birding (hours)	Bucket (trap-nights)	Pipe (trap-nights)	Elliott (trap-nights)	Funnel (trap-nights)
Site01	Systematic	+				3.4	0.7	2.0	35	35	70	140
Site02	Systematic	+				1.7	2.8	3.5	35	35	70	140
Site03	Systematic	+				1.4	0.6	2.0	35	35	70	140
Site04	Systematic	+				2.3	2.9	2.0	35	35	70	140
Site05	Systematic	+				2.0	2.3	2.0	35	35	70	140
Site06	Systematic	+				2.0	0.5	2.0	35	35	70	140
Site07	Systematic	+				2.2	2.3	2.0	35	35	70	140
Site08	Systematic	+				1.4	1.7	2.0	35	35	70	140
Bat01	Targeted	+		4								
Bat02	Targeted	+		4								
Bat03	Targeted	+		4								
Bat04	Targeted	+		4	3							
NP01	Targeted	+	36									
NP02	Targeted	+	36									
NP03	Targeted	+	35									
NP04	Targeted	+	36									
NP05	Targeted	+	18									
NP06	Targeted	+	18									
NP07	Targeted	+	18									
NP08	Targeted	+	18									
NP09	Targeted	+	6									
NP10	Targeted	+	6									
NP11	Targeted	+										
NP12	Targeted	+	6									

Site	Site type	Site description	Audio recording (nights)	Ultrasonic recording (nights)	Camera trap (nights)	Foraging (hours)	Foraging nocturnal (hours)	Birding (hours)	Bucket (trap-nights)	Pipe (trap-nights)	Elliott (trap-nights)	Funnel (trap-nights)
NP13	Targeted	+	2									
NP14	Targeted	+	2									
NQ01	Targeted	+		5	15	0.7						
NQ02	Targeted	+		5	15			1.4				
NQ03	Targeted	+		5	15							
NQ05	Targeted	+		5	15							
NQ06	Targeted	+		5	15	1.1	1.6	0.3				
NQ07	Targeted	+		5	15							
NQ08	Targeted	+			18							
NQ09	Targeted	+			12							
NQ10	Targeted	+			12							
NQ11	Targeted	+			6							
NQ12	Targeted	+			6							
NQ13	Targeted	+			6							
NQ14	Targeted	+			6	0.8						
Salt-cam	Targeted	+			15							
Water Trough	Targeted	+			4							
Total			**237**	**46**	**178**	**19**	**15.4**	**19.2**	**280**	**280**	**560**	**1120**

4.2.3.9 SRE invertebrate sampling

Sampling for SRE invertebrates was conducted at 34 sites (**Figure** 4-1), in areas identified as suitable habitat for SREs. Sampling comprised the following methods:

- wet pit trapping
- active foraging
- litter sieving.

Sixteen wet pitfall trapping sites were established during the survey, eight during January and February 2020 and eight during April 2021 (Table 4-3), each comprising five one-litre plastic containers with a 70 mm diameter dug in flush with the surface in suitable microhabitats at each site. Pit traps were half-filled with propylene glycol, which has been shown to preserve DNA under laboratory conditions in invertebrates (Vink *et al.* 2005) and Phoenix has successfully sequenced COI from specimens caught in propylene glycol pitfall traps from previous surveys. All traps were covered with a plastic lid elevated 25 mm above the trap with wooden blocks to minimise by-catch of vertebrates where possible. Traps remained open for 4-13 weeks.

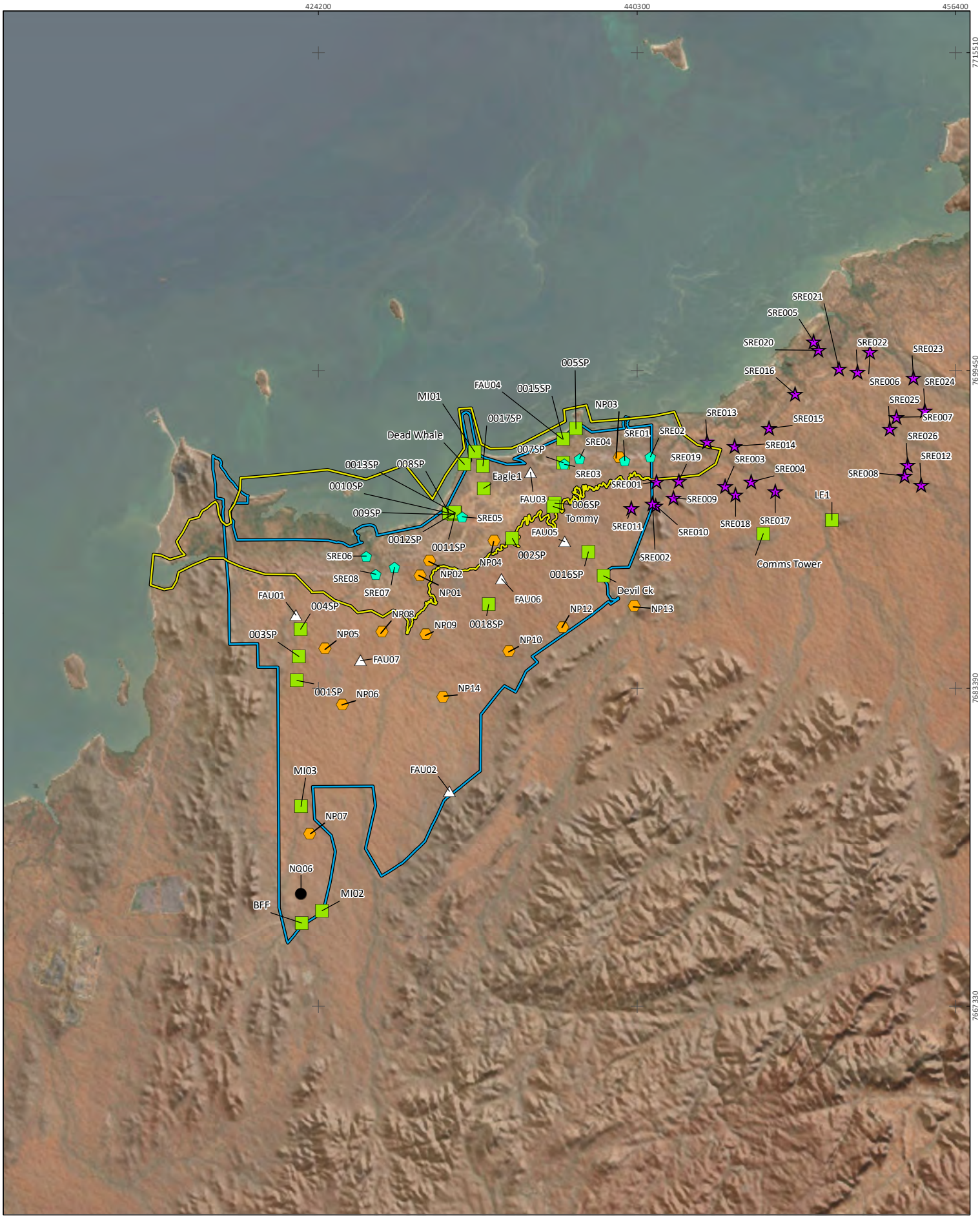
Active foraging for SRE invertebrate groups comprised inspection of spinifex hummocks, shrubs and plant debris (no rocks or trees occurred at these sites). Each wet pitfall site was sampled for one person hour, and an additional 18 sites were sampled during the 2021 survey, for a total search effort of approximately 34 hours at SRE sites (Table 4-4).

Combined litter/soil sifts were undertaken at 34 sites, with up to three sifts conducted at each site dependent on abundance of leaf litter. In total, 102 sifts were undertaken (Table 4-4). The collection of leaf litter samples was standardised volumetrically by the diameter and height (310 mm x 50 mm = 1.55 L) of the sieves which were completely filled with compressed litter and the upper layers of underlying soil. Samples were sieved through three stages of decreasing mesh size over a round tray and invertebrates were picked from the sieves and tray with forceps while in the field.

Table 4-5 Targeted SRE survey effort

Site	Site type	Sample method[1]	Site description	SRE Foraging (hours)	Wet pitfall (trap-nights)	Litter sieve (#)
1320-SRE01	Study area	WP, Fo and LS	✓	1	485	3
1320-SRE02	Study area	WP, Fo and LS	✓	1	485	3
1320-SRE03	Study area	WP, Fo and LS	✓	1	480	3
1320-SRE04	Study area	WP, Fo and LS	✓	1	480	3
1320-SRE05	Study area	WP, Fo and LS	✓	1	480	3
1320-SRE06	Study area	WP, Fo and LS	✓	1	390	3
1320-SRE07	Study area	WP, Fo and LS	✓	1	390	3
1320-SRE08	Study area	WP, Fo and LS	✓	1	390	3
Site01 (FAU01)	Study area	Fo and LS	✓	1		3
Site02 (FAU02)	Study area	Fo and LS	✓	1		3
Site03 (FAU03)	Study area	Fo and LS	✓	1		3
Site04 (FAU04)	Study area	Fo and LS	✓	1		3
Site05 (FAU05)	Study area	Fo and LS	✓	1		3
Site06 (FAU06)	Study area	Fo and LS	✓	1		3
Site07 (FAU07)	Study area	Fo and LS	✓	1		3
Site08 (FAU08)	Study area	Fo and LS	✓	1		3
1392-SRE001	Reference	WP, Fo and LS	✓	1	155	3

Site	Site type	Sample method[1]	Site description	SRE Foraging (hours)	Wet pitfall (trap-nights)	Litter sieve (#)
1392-SRE002	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE003	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE004	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE005	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE006	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE007	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE008	Reference	WP, Fo and LS	✓	1	155	3
1392-SRE009	Reference	Fo and LS	✓	1		3
1392-SRE010	Reference	Fo and LS	✓	1		3
1392-SRE011	Study area	Fo and LS	✓	1		3
1392-SRE012	Reference	Fo and LS	✓	1		3
1392-SRE013	Reference	Fo and LS	✓	1		3
1392-SRE014	Reference	Fo and LS	✓	1		3
1392-SRE015	Reference	Fo and LS	✓	1		3
1392-SRE016	Reference	Fo and LS	✓	1		3
1392-SRE017	Reference	Fo and LS	✓	1		3
1392-SRE018	Reference	Fo and LS	✓	1		3
1392-SRE019	Reference	Fo and LS	✓	1		3
1392-SRE020	Reference	Fo and LS	✓	1		3
1392-SRE021	Reference	Fo and LS	✓	1		3
1392-SRE022	Reference	Fo and LS	✓	1		3
1392-SRE023	Reference	Fo and LS	✓	1		3
1392-SRE024	Reference	Fo and LS	✓	1		3
1392-SRE025	Reference	Fo and LS	✓	1		3
1392-SRE026	Reference	Fo and LS	✓	1		3
			Total	**42**	**4820**	**126**



Western Australia

PERTH

Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	11/30/2022
Drawn by	IN
Map author	JC

0 3.5 7
Kilometers

1:246,700 (at A4) GDA 1994 MGA Zone 50

All information within this map is current as of 11/30/2022. This product is subject to COPYRIGHT and is property of Phoenix Environmental Sciences (Phoenix). While Phoenix has taken care to ensure the accuracy of this product, Phoenix make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.

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Shorebird study area
Terrestrial fauna study area

Vertebrate fauna sites
- Opportunistic sighting
- Night Parrot audio recording sites
- Detailed trapping sites

SRE sites
- SRE opportunistic sighting
- SRE wet pitfall trap
- SRE reference site

Figure 4-1

Terrestrial fauna survey sites for the TFSA

PHOENIX ENVIRONMENTAL SCIENCES

4.2.3.10 Molecular sequencing

DNA was extracted from the tissue of animals collected during the survey. DNA barcoding sequences from the Cytochrome Oxidase subunit I (COI) gene were amplified by polymerase chain reaction (PCR) and sequenced at the Australian Genomic Research Facility (AGRF) Perth node, using universal primers (Folmer *et al.* 1994). DNA sequences were compared against publicly accessible sequences in GenBank using the Basic Local Alignment Search Tool (BLAST) and with data sets derived from current research projects in collaboration with the WA Museum. The top ten blast hits for each major taxon were gathered, duplicates removed, and analysed with a Maximum Likelihood phylogenetic analysis using a GTR+G model of evolution and 100 bootstrap pseudo-replicates (RAxML). Distances were calculated via tree-based estimates of identical bases in Geneious v11.1.5 (Biomatters 2018).

Seven specimens were sequenced: five mygalomorph spiders, including a reference spider from a Barrow Island collection, and two scorpions.

4.2.3.11 Analysis of survey completeness

Species accumulation curves were produced on a samples and abundance basis using Primer V6 (Clarke & Gorley 2006) to obtain an estimate of survey completeness (i.e. whether the collection adequately represents the vertebrate fauna assemblage of the Study Area) for systematic methods completed within the TFSA (overall and per Class), and separately for the Migratory shorebird transects. All sample types were aggregated per site and no data transformation was undertaken. The maximum permutations was set at 999.

4.2.4 Migratory shorebird surveys

Migratory shorebird surveys were conducted over five phases (four summer, one winter) by personnel from Phoenix and Ornithological Technical Services, a specialist avifauna consultancy (Table 4-6). Habitats sampled included tidal channels, beaches, mangrove areas, intertidal sand/mudflats and supratidal mudflats.

DoEE (2017) acknowledges that in large study areas and where many birds occur, it may be impossible to achieve a complete ('instantaneous') survey of shorebirds. PRISM (2018) details survey methods for monitoring non-breeding shorebirds. They recommend sampling be undertaken wherever possible within discrete, manageable spatial units, such that an instantaneous sample can be achieved, preferably within 2–3 hours, centred around tidal movements (as the area of available habitat changes with time and being aligned with peak tides means the most 'stable' area of habitat availability is surveyed) and thereby reducing the risk of observer fatigue.

The study area was large and thus the methodology was designed to achieve as close to an instantaneous survey as possible and was based on experience gained assessing an almost identical Project just 30 km to the west-southwest (Phoenix 2020).

Aerial (R44 helicopter) counts were the main method employed but ground counts were also completed in areas of high density/activity. An R44 helicopter was considered the most effective method to access such a large area of coastline and associated habitat. The alternative survey craft were boat and fixed-wing plane which were determined to be unviable. Boats were not considered suitable as:

- survey by boat would have taken much longer in each phase to achieve coverage meaning a 'snap-shot' could not be attained as significant numbers of birds could move in and out of the area in any survey period
- mangrove roosting birds are difficult to flush, identify and count (DoEE 2017)

- large parts of the SBSA were not accessible by boat, particularly landward roosting and feeding grounds which would not have even been identified without aerial support
- flocks could not be reliably tracked and therefore the risk of double-counting was considered too high.

Therefore, using a boat would likely have resulted in a very limited and/or biased dataset. A fixed-wing plane was not considered suitable as:

- the inability to rapidly respond to bird movements, slow down or stop, would have resulted in large numbers being missed or double-counted on return
- no ground counts could be achieved.

Survey from helicopter was, therefore, chosen as the most viable method for shorebird surveys, capable of overcoming the above limitations. It was particularly effective at detecting birds active in the extensive mangroves of the SBSA (a habitat unit where assessment is often inadequate; DoEE 2017) as the helicopter was able to fly along both seaward and landward faces, or over the top of mangroves, as necessary.

Aerial transects were typically three hours in duration, centred on the peak low and high tide each day. A total of 21 survey events were completed (including one incomplete survey interrupted due to a mechanical issue with the aircraft) equating to 54.5 hours of aerial survey time. Full details of the tide regime, survey dates and personnel involved are provided in Table 4-6. The survey program methods, therefore, largely met the considerations detailed in PRISM (2018).

Each sample transect commenced in the east and tracked west, then returned east and then west and east again. On high tides, they commenced on the landward side of the SBSA and on low tides they commenced on the coast over the exposed tidal mudflats, reefs, and near-shore islands, finishing over the inland mudflats.

Where large congregations were encountered, the helicopter hovered or slowly circled so that the full complement of a flock could be identified and counted. Care was taken to track flocks so as not to double-count birds. The helicopter was also landed so that ground counts could be completed at certain areas, e.g., in areas of high foraging/roosting density/activity. Care was always taken to avoid disturbance of feeding or roosting activity, primarily by flying low and slow towards any congregations identified. It was apparent that this typically resulted in the birds taking to the wing for short periods of time before landing back in the same location. There were no observed events of congregations departing an area permanently due to disturbance by the helicopter observations. Some point recordings (GPS positions) were made over a different habitat to that in which they were observed; pulling apart such records from the large dataset attained was not possible.

While conducting the surveys, a primary observer was positioned in the front of the helicopter who called out species names and numbers to the be recorded by a secondary observer who also made other observations, identified, and tracked flocks, as required.

As per Phoenix (2020) it was estimated that identifications could reliably made on average 150 m either side of the helicopter. Based on this, an area of 11,902.8 ha was reliably surveyed in total, including 10,086.9 within the SBSA, which represents over 80% of the SBSA over the course of the 21 transects completed.

A ‘site’ comprised both single and multiple species records, as required. In total, 5,288 site point-locations were marked during the five survey phases in the 54.5 hours of aerial and ground count surveys. These comprised 4,752 within the SBSA and 536 outside.

Table 4-6 Summary of Migratory shorebird survey dates, predicted tide ranges and personnel

Phase	Date	Transects	Tides (m)				Surveyors
			Highest	Lowest	Range	Tide cycle	
1	9-11 Dec 2019	1 - 4	4.31	1.06	3.25	Spring (large)	John Scanlon[1] and Floyd Holmes[1,2]
2	13-18 Jan 2020	5 – 9	4.53	0.57	3.97	Spring (large)	John Scanlon and Nick Hart[2]
3	2-5 Feb 2020	10 - 13	2.99	1.47	1.52	Neap (moderate)	John Scanlon and Floyd Holmes
4	10-12 Feb 2020	14 - 17	4.11	0.15	3.96	Spring (large)	John Scanlon and Bill Rutherford[2]
5	6-8 July 2020	18 - 21	3.94	0.17	3.77	Spring (large)	John Scanlon and Nick Hart

1 – Phoenix Environmental Sciences; 2 – Ornithological Technical Services

4.2.5 Likelihood of occurrence assessment for significant species

Following the field surveys, the likelihood of occurrence for each significant fauna species identified in the desktop review was assessed and assigned to one of four categories:

- recorded – species recorded within the study area by a previous or current survey
- likely – the study area is within the current known range of species and suitable habitat within the study area and home range of the species intersects the study area based on known records
- possible – the study area is within the current known range of species and suitable habitat within the study area and home range of the species does not intersect the study area based on known records
- unlikely – the study area is outside the current known range of species or no suitable habitat is present in the study area.

4.2.6 Survey personnel

The personnel involved in the field surveys are listed in Table 4-7. All survey work was carried out under relevant licences issued by DBCA under the BC Act (Table 4-7). Specialist taxonomists used, both invertebrate and vertebrate, are listed in Table 4-8,

Table 4-7 Survey personnel

Name	Permit	Qualifications	Role/s
Dr Michael Lohr	Fauna taking (biological assessment) licence no. BA27000242	BSc Wildlife/Fish Science (Hons); MSc Wildlife Ecology; PhD	Senior zoologist, terrestrial fauna field survey
Simon Pynt		BSc Zoology	Senior zoologist, terrestrial fauna field survey
Dr John Scanlon		BSc Zoology (Hons); PhD	Senior zoologist, shorebird survey, terrestrial fauna survey, reporting
Ryan Carter		BSc Science(Conservation Biology/Marine & Freshwater Science)	Zoologist, terrestrial fauna field survey
Anna Jacks		BSc Environmental Science (Hons)	Invertebrate data management
Jarrad Clark		BSc Environmental management	Project management, spatial analysis and reporting
Dr Floyd Holmes (OTS and later Phoenix)		BSc Physics and Conservation Biology, Hons Biological Sciences, PhD	Ornithologist, shorebird and terrestrial fauna field surveys
Nicholas Hart (OTS)		BSc Environmental Sciences (Hons)	Ornithologist, shorebird survey
Bill Rutherford (OTS)		HND Conservation Management; ONC Ecology and Conservation; Cert. 4 Training and Assessment; WA Regional Organiser for the Australian Bird and Bat Banding Scheme	Ornithologist, shorebird survey
David Leach	FB62000045	BSc Applied Sciences (Conservation & Park Management; Hons); PhD	Senior botanist, vegetation mapping
Ikrom Nishanbaev	NA	BSc Computer Science; MSc GIS, PhD	Spatial analysis, mapping

Table 4-8 Specialist taxonomists used identify invertebrate specimens and audio recordings of animals

Name	Qualifications	Role/s
Kyle Armstrong & Yuki Konishi (Specialised Zoological)	PhD	April 2020 bat ultrasonic call analysis
Bob Bullen (Bat Call WA)	Ba.Eng. (Aero)	November 2021 bat ultrasonic call analysis, and Night Parrot recordings
Kenny Travouillon (WAM)	PhD	Mammal taxonomy
Mark Harvey (WAM)	PhD	Invertebrate taxonomy (spiders)
Julianne Waldock (WAM)	PhD	Invertebrate taxonomy (millipedes)
Simon Judd (independent contractor)	PhD	Invertebrate taxonomy (isopods)
Erich Volschenk (Alacran)	PhD	Invertebrate taxonomy (scorpions)

5 RESULTS

5.1 DESKTOP REVIEW

5.1.1 Terrestrial fauna

5.1.1.1 Vertebrate fauna

The desktop review identified 457 terrestrial vertebrate taxa recorded or predicted within the desktop search extent. Aquatic marine taxa (fishes, sea turtles, seasnakes and cetaceans) were also identified in the review and are listed in Appendix 3, but not considered in most sections of this report. The non-marine fauna comprised three freshwater fish, nine frogs, 130 reptiles, 261 birds including four naturalised species, and 54 mammals including 12 introduced (Table 5-1; Appendix 3).

Previous surveys within or adjacent to the study area (Bennelongia 2008b; Biota & Trudgen & Associates 2001; Ecoscape 2016a, b; GHD 2013; Maunsell AECOM 2008a, b; Pendoley 2009; Phoenix 2009b) recorded three frog species, 75 terrestrial reptiles (and four marine), 134 birds (all native) and 33 mammals (seven introduced).

Table 5-1 Summary of terrestrial fauna desktop results

Class	Native	Introduced	Total
Freshwater Fish	3	0	3
Amphibians	9	0	9
Reptiles	128	2	130
Birds	257	4	261
Mammals	42	12	54
Total	**439**	**18**	**457**

Excluding marine aquatic taxa, 73 vertebrate species were identified in the desktop review as having conservation significance. Of these, 21 species are listed as Threatened or Specially Protected under the EPBC Act and/or BC Act, 54 bird species listed as Migratory under the EPBC Act and BC Act and a further 12 species listed as Priority by DBCA (Table 5-2).

The area has been documented previously to support significant environmental values in terms of species present. Thirty-two significant vertebrate species (two marine and two terrestrial reptiles, 24 birds and four mammals) have previously been recorded within or adjacent to the study area (Figure 5-1):

- Green Turtle *Chelonia mydas* (VU, Mig; Marine), presence and nesting recorded by Maunsell AECOM (2008a, 2008b) and Pendoley (2009)
- Flatback Turtle *Natator depressus* (VU, Mig; Marine), recorded nesting by Pendoley (2009)
- Airlie Island Ctenotus *Ctenotus angusticeps* (P3), recorded by GHD (2013) as a likely but unconfirmed sighting in littoral samphire habitat
- Lined soil-crevice skink *Notoscincus butleri* (P4), Phoenix (2009b)
- Osprey *Pandion cristatus* (Mig), recorded by four surveys
- Grey Falcon *Falco hypoleucos* (VU), Ecoscape (2016b)
- Peregrine Falcon *Falco peregrinus* (OS), GHD (2013)
- Greater Sand Plover *Charadrius leschenaultii* (VU, Mig), Bennelongia (2008b) and Phoenix (2009b)

- Lesser Sand Plover *Charadrius mongolus* (EN, Mig), Bennelongia (2008b) and Phoenix (2009b)
- Oriental Plover *Charadrius veredus* (Mig), Phoenix (2009b)
- Grey Plover *Pluvialis squatarola* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Common Sandpiper *Actitis hypoleucos* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Ruddy Turnstone *Arenaria interpres* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Sharp-tailed Sandpiper *Calidris acuminata* (Mig), GHD (2013)
- Sanderling *Calidris alba* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Curlew Sandpiper *Calidris ferruginea* (CR, Mig), Bennelongia (2008b)
- Red-necked Stint *Calidris ruficollis* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Great Knot *Calidris tenuirostris* (CR, Mig), Bennelongia (2008b), Phoenix (2009b) and GHD (2013)
- Bar-tailed Godwit *Limosa lapponica* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Eastern Curlew *Numenius madagascariensis* (CR, Mig), Bennelongia (2008b) and Phoenix (2009b)
- Little Curlew *Numenius minutus* (Mig), Ecoscape (2016b)
- Whimbrel *Numenius phaeopus* (Mig), Bennelongia (2008b), Phoenix (2009b) and Ecoscape (2016b)
- Grey-tailed Tattler *Tringa brevipes* (Mig, P4), Bennelongia (2008b) and Phoenix (2009b)
- Common Greenshank *Tringa nebularia* (Mig), Bennelongia (2008b), Phoenix (2009b) and Ecoscape (2016b)
- Marsh Sandpiper *Tringa stagnatilis* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Terek Sandpiper *Xenus cinereus* (Mig), Phoenix (2009b)
- Gull-billed Tern *Gelochelidon nilotica* (Mig), Phoenix (2009b)
- Bridled Tern *Onychoprion anaethetus* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Crested Tern *Sterna bergii* (Mig), Bennelongia (2008b) and Phoenix (2009b)
- Northern Quoll *Dasyurus hallucatus* (EN), Ecoscape (2016a, 2016b)
- Northern Coastal Free-tailed Bat *Ozimops cobourgianus* (P1), Biota and Trudgen & Associates (2001) and Phoenix (2009b)
- Northern Short-tailed Mouse *Leggadina lakedownensis* (P4), Maunsell AECOM (2008a, 2008b) and Phoenix (2009b)
- Western Pebble-mound Mouse *Pseudomys chapmani* (P4), Phoenix (2009b) and Ecoscape (2016b).

Table 5-2 Significant vertebrate fauna identified in the desktop review

Species	Status	Proximity to study area	Habitat
Freshwater fish (1)			
Leiopotherapon aheneus Fortescue Grunter	P4 (DBCA)	18.6 km SW	Slow to fast flowing streams and permanent pools of the Fortescue, Robe and Ashburton systems (Morgan *et al.* 2009).
Terrestrial reptiles (4)			
Ctenotus angusticeps Airlie Island Ctenotus	P3 (DBCA)	51 km E, just east of the City of Karratha	Coastal tussock and hummock grasslands and low shrublands including samphire in littoral zone, uses crab burrows (Browne-Cooper & Maryan 1990; Maryan *et al.* 2013).
Lerista quadrivincula Dark-streaked Slider	P1 (DBCA)	40 km SE	Habitat unknown, recorded from a single specimen collected in 1980 near Maitland River south of Karratha; possibly extinct (Maryan *et al.* 2015; Wilson *et al.* 2017).
Notoscincus butleri lined soil-crevice skink	P4 (DBCA)	16.5 km E	Rocky and spinifex-dominated areas near creek and river margins (Wilson & Swan 2017).
Liasis olivaceus barroni Pilbara Olive Python	VU (EPBC Act, BC Act)	31.6 km NE	Rocky creeks, gorges, outcrops, cliffs, usually near permanent water (Pearson 2003).
Birds (58)			
Oxyura australis Blue-billed Duck	P4 (DBCA)	15.3 km E	Mainly aquatic, shows fairly regular seasonal movements between breeding sites on inland ephemeral wetlands (winter and spring), and permanent wetlands closer to the coast (summer and autumn) (Guay *et al.* 2010); rare visitor to the Pilbara (Johnstone *et al.* 2013).
Oceanites oceanicus Wilson's Storm-petrel	Mig (EPBC Act, BC Act)	18.3 km N	Breeds on Antarctic coasts and islands, migrating north during southern winter; strictly pelagic when non-breeding (May-Nov) but sometimes observed on coasts after storms (DoEE 2019; Johnstone *et al.* 2013).
Ardenna carneipes Flesh-footed Shearwater	Mig (EPBC Act, BC Act), VU (BC Act)	26 km N	Breeds on offshore islands of southern Australia, south-western WA population migrates to northern Indian Ocean (Arabian Sea, Gulf of Oman) and possibly northern Pacific (DoEE 2019), but rarely recorded in northwestern coastal waters.
Ardenna pacifica Wedge-tailed Shearwater	Mig (EPBC Act, BC Act)	5.9 km N	Mainly a tropical Indo-Pacific shearwater, nests in burrows on vegetated offshore islands including those off the Pilbara coast where more than 1 million individuals are reported to occur, and may be present for most of the year (Jun-Apr) (DBCA 2017a; Johnstone *et al.* 2013).

Species	Status	Proximity to study area	Habitat
Calonectris leucomelas Streaked Shearwater	Mig (EPBC Act, BC Act)	-	Pelagic species, nesting in northern summer on islands and coasts of Japan and Korea, foraging mostly in the seas around New Guinea but found across Pacific and Indian Oceans as far south as southern Australian waters (Pilbara offshore records Mar-May); coastal and rare inland records occur after severe storms (DBCA 2018a; IUCN 2019).
Macronectes giganteus Southern Giant Petrel	EN, Mig (EPBC Act, BC Act)	-	Breeds on subantarctic islands, feeds in coastal and pelagic waters around southern continents, occurring as far north as Carnarvon; not recorded from the Pilbara coast (Johnstone *et al.* 2013), but one inland record following a cyclone (DBCA 2018a; IUCN 2019).
Puffinus huttoni Hutton's Shearwater	EN (BC Act)	27.6 km N	Breeds on coasts of mainland New Zealand (Sep-Mar), spends non-breeding periods feeding at sea mainly in Australian waters, with individuals recorded circumnavigating the continent over several years (Marchant & Higgins 1990); common passage migrant in offshore Pilbara waters (Johnstone *et al.* 2013).
Plegadis falcinellus Glossy Ibis	Mig (EPBC Act, BC Act)	27.0 km SW	Predominantly inhabits terrestrial wetlands, foraging in shallow water over soft substrate or on grassy or muddy verges of wetlands providing a variety of water depths. Inland, freshwater wetlands are preferred, especially permanent or ephemeral waterbodies on floodplains and shallow swamps with abundant aquatic flora (Johnstone *et al.* 2013; Marchant & Higgins 1990).
Fregata ariel Lesser Frigatebird	Mig (EPBC Act, BC Act)	18.4 km N	Tropical and subtropical seabird, breeding on offshore islands and feeding mainly offshore (Johnstone *et al.* 2013).
Sula leucogaster Brown Booby	Mig (EPBC Act, BC Act)	14.7 km W	Mainly found in tropical waters, often staying close to breeding islands, but approaches mainland coastlines more than other boobies; has been recorded in coastal waters, harbours, and estuaries and near offshore islands but seldom flying over land. Off north-west WA, Brown Boobies are most abundant 18–36 km from land (Abbott 1979; Marchant & Higgins 1990).
Pandion cristatus Osprey	Mig (EPBC Act, BC Act)	within study area	Mostly found in littoral and coastal habitats, sometimes in terrestrial wetlands or along major rivers (DoEE 2019; Johnstone & Storr 1998).
Charadrius leschenaultii Greater Sand Plover	VU, Mig (EPBC Act, BC Act)	within study area	Almost entirely coastal (littoral and estuarine) in Australia, mainly on beaches but occasionally saltmarsh habitats. Predominantly occurs in northern Australia, and a small proportion of the population winters in southern areas (DoEE 2019).
Charadrius mongolus Lesser Sand Plover	EN, Mig (EPBC Act, BC Act)	6.1 km N	Non-breeding in Australia, may be present between September and May. Forages by day for small terrestrial and aquatic invertebrates; coastal, not recorded at inland sites (DoEE 2019).

Species	Status	Proximity to study area	Habitat
Charadrius veredus Oriental Plover	Mig (EPBC Act, BC Act)	25.2 km NE	Non-breeding visitor to Australia, widely distributed but most records are along the northwestern coast between Exmouth Gulf and Derby. Inland habitats occupied by the species include sparsely vegetated plains or recently burnt open areas (DoEE 2019).
Pluvialis fulva Pacific Golden Plover	Mig (EPBC Act, BC Act)	within study area	Most Australian sightings occur on coastal beaches, rocky shorelines and saltmarshes, also with some inland records that are mostly on major river systems (Marchant & Higgins 1990).
Pluvialis squatarola Grey Plover	Mig (EPBC Act, BC Act)	within study area	Occurs mostly in coastal embayments, estuaries and lagoons with mudflats and sandflats, and occasionally on rocky coasts with wave-cut platforms or reef flats, or on reefs within muddy lagoons. They also occur around terrestrial wetlands such as near-coastal lakes and swamps, or salt-lakes (Marchant & Higgins 1990).
Rostratula australis Australian Painted Snipe	EN (EPBC & BC Acts)	-	Foraging and breeding habitats are in shallow water surrounded with dense vegetation. The species is found inland as well as on the coast across continental Australia. WA records are almost exclusively from the south-west and the Kimberley (DBCA 2018a), but also inland parts of the Pilbara (Johnstone *et al.* 2013).
Actitis hypoleucos Common Sandpiper	Mig (EPBC Act, BC Act)	24.9 km NE	Breeds in temperate Eurasia during the northern hemisphere summer. A small population winters in Australia (3000 individuals). They are found across a wide range of wetlands, mostly coastal with some inland records (Geering *et al.* 2007).
Arenaria interpres Ruddy Turnstone	Mig (EPBC Act, BC Act)	within study area	Non-breeding migrant, common on the Pilbara coast mainly from late Aug – Apr, but may be present year-round as juvenile birds overwinter here (Johnstone *et al.* 2013).
Calidris acuminata Sharp-tailed Sandpiper	Mig (EPBC Act, BC Act)	18.4 km N	Mainly coastal, occasionally on large inland wetlands after significant rainfall; numbers in north-eastern Pilbara highest Sep-Nov, apparently moving further south for summer feeding, and not known to overwinter here (Johnstone *et al.* 2013).
Calidris alba Sanderling	Mig (EPBC Act, BC Act)	within study area	Non-breeding visitor along coast, adults mostly seen Sept.-April, but non-breeders may be present in all months (Johnstone *et al.* 2013).
Calidris canutus Red Knot	EN, Mig (EPBC Act, BC Act)	18.4 km N	Non-breeding visitor along coast, adults mostly seen Aug-Apr (Johnstone *et al.* 2013).
Calidris ferruginea Curlew Sandpiper	CR, Mig (EPBC Act, BC Act)	within study area	In Australia they are mostly found on the coast but can also forage inland, in open shallow wetlands; in the Pilbara they mainly occur east from Karratha (Johnstone *et al.* 2013).
Calidris melanotos Pectoral Sandpiper	Mig (EPBC Act, BC Act)	38.3 km NE	Found in wetlands, inland as well as on the coast. The species typically uses shallow fresh to saline wetlands such as coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (DoEE 2019).

Species	Status	Proximity to study area	Habitat
			In the Pilbara, regarded as a visitor to freshwater rather than coastal habitats (Johnstone *et al.* 2013).
Calidris ruficollis Red-necked Stint	Mig (EPBC Act, BC Act)	14.8 km E, W	Occurs in great numbers along the East Asian – Australasian Flyway: 325,000 total individuals overall, 270.000 in Australia (Geering *et al.* 2007). Very common visitor on the Pilbara coast, present all months but mainly Aug-Apr (Johnstone *et al.* 2013); found across a wide range of open mudflat-like habitats in salt as well as in freshwater systems (DoEE 2019).
Calidris subminuta Long-toed Stint	Mig (EPBC Act, BC Act)	34.0 km E	Uncommon visitor (Aug-Mar), reportedly restricted to freshwater habitats in the Pilbara and with no overwintering records (Johnstone *et al.* 2013).
Calidris tenuirostris Great Knot	CR, Mig (EPBC Act, BC Act)	within study area	Common visitor, especially to north-eastern part of Pilbara coast, mostly Aug-May but present in all months; favours tidal mud and sand flats and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Gallinago stenura Pin-tailed Snipe	Mig (EPBC Act, BC Act)	16.5 km E	Uncommon visitor to freshwater habitats, mainly in northeast Pilbara (late Sep-Apr) (Johnstone *et al.* 2013).
Limicola falcinellus Broad-billed Sandpiper	Mig (EPBC Act, BC Act)	28.9 km NE	Visitor to coast and coastal plains, present in all months but mostly Aug-Apr (Johnstone *et al.* 2013).
Limosa lapponica Bar-tailed Godwit ▪ *Limosa lapponica baueri* (W. Alaska) ▪ *Limosa lapponica menzbieri* (N. Siberia)	Mig (EPBC Act, BC Act) VU, Mig (EPBC Act, BC Act) CR, Mig (EPBC Act, BC Act)	within study area	Only the Siberian subspecies is a regular migrant to Australia, occurring on the Pilbara coastline in all months but mostly from Sep-Apr; forages on tidal mudflats, beaches, and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Limosa limosa Black-tailed Godwit	Mig (EPBC Act, BC Act)	36.6 km N	Regular but uncommon migrant present on Pilbara coast Aug-Apr, not known to overwinter there; mainly at low-salinity saltwork ponds but also rocky and muddy coasts, and may roost/loaf on sandy beaches (Johnstone *et al.* 2013).
Numenius madagascariensis Eastern Curlew	CR, Mig (EPBC Act, BC Act)	within study area	Non-breeding visitor between October and February, when it is considered moderately common along tidal mudflats, reef flats, low-salinity saltwork ponds and sandy beaches of the Pilbara coast (Johnstone *et al.* 2013; Johnstone & Storr 1998).

Species	Status	Proximity to study area	Habitat
Numenius minutus Little Curlew	Mig (EPBC Act, BC Act)	within study area	Regular migrant to coast and coastal plain Sep-Apr, more common in northeast Pilbara and 'scarce' southwest of Port Hedland; samphire and grass flats, tidal mudflats (Johnstone *et al.* 2013).
Numenius phaeopus Whimbrel	Mig (EPBC Act, BC Act)	within study area	Regular migrant to coasts and larger islands, present in all months due to overwintering of non-breeding birds, but mainly Aug-Apr; mainly tidal mudflats, also sandy beaches and low-salinity saltwork ponds (Johnstone *et al.* 2013).
Phalaropus lobatus Red-necked Phalarope	Mig (EPBC Act, BC Act)	28.9 km NE	Rare visitor Aug-Apr, occurring offshore and on islands, mainland records mostly from Port Hedland saltworks including hypersaline ponds producing brine shrimp (Johnstone *et al.* 2013).
Tringa brevipes Grey-tailed Tattler	Mig (EPBC Act, BC Act), P4 (DBCA)	within study area	Moderately common migrant to coasts and islands, mainly Aug-Apr but present in all months; tidal mudflats, reef flats, mangrove creeks, sandy beaches, saltwork ponds, sewage ponds and brackish lagoons (Johnstone *et al.* 2013).
Tringa glareola Wood Sandpiper	Mig (EPBC Act, BC Act)	16.3 km E	Most abundant in north-west Australia, with all areas of national importance located in WA (Watkins 1993). It uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes (DoEE 2019).
Tringa nebularia Common Greenshank	Mig (EPBC Act, BC Act)	within study area	Found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity, including coastal mudflats, saltmarsh and mangroves; occurs in Pilbara Aug-Jun (DoEE 2019; Johnstone *et al.* 2013).
Tringa stagnatilis Marsh Sandpiper	Mig (EPBC Act, BC Act)	15.9 km W	Found on coastal and inland wetlands throughout Australia in the non-breeding season (Aug-Apr), but in WA less common and mainly found around the coast in small groups and occasionally flocks up to 200 (DoEE 2019; Johnstone *et al.* 2013).
Tringa totanus Common Redshank	Mig (EPBC Act, BC Act)	38.1 km NE	Regular but uncommon visitor to the Pilbara, found at sheltered coastal wetlands such as bays, river estuaries, lagoons and saltmarsh, most records of single birds (DoEE 2019; Johnstone *et al.* 2013).
Xenus cinereus Terek Sandpiper	Mig (EPBC Act, BC Act)	36.3 km N	Uncommon to scarce summer visitor to Australian coasts (rarely found inland) with no overwintering records in the Pilbara, found on tidal mudflats and low-salinity saltwork ponds (DoEE 2019; Johnstone *et al.* 2013).
Glareola maldivarum Oriental Pratincole	Mig (EPBC Act, BC Act)	12.5 km E	Breeds in southern, south-eastern, and eastern Asia, most of the global population overwintering in northern Australia (Oct-Apr); occurs in small groups to very large flocks on the Pilbara coast (and more dispersed inland), usually over open plains with short grassland, samphire, or bare ground, feeding mostly aerially on insects. Large flocks often associated

Species	Status	Proximity to study area	Habitat
			with thundery and cyclonic storms, as well as pre-departure aggregations (DoEE 2019; Johnstone *et al.* 2013).
Anous stolidus Common Noddy	Mig (EPBC Act, BC Act)	43.6 km NE	Widespread in tropical and subtropical seas (with four subspecies, of which only one occurs in the region), breeding on rocky or sandy islands, and occurring mainly at sea (gleaning fish, squid etc. from the surface) when not breeding; no mainland records in the Pilbara (DoEE 2019; Johnstone *et al.* 2013).
Chlidonias leucopterus White-winged Black Tern	Mig (EPBC Act, BC Act)	1.8 km SW	Non-breeding migrant in Australia (Sep-May), usually inhabiting coastal wetlands of varying salinity and vegetation types (DoEE 2019; Johnstone *et al.* 2013).
Onychoprion anaethetus Bridled Tern	Mig (EPBC Act, BC Act)	14.8 km W	Common summer visitor (Sep-Apr), breeding in the Dampier Archipelago and various other Pilbara islands and wintering north of the Equator near Sulawesi and the Philippines; usually forages well offshore, rarely found on mainland coasts (DoEE 2019; Johnstone *et al.* 2013).
Sterna albifrons Little Tern (or *Sternula*)	Mig (EPBC Act, BC Act)	14.8 km W	Uncommon to moderately common visitor to Pilbara coast, derived from two populations breeding in eastern Asia and the Kimberley respectively. The preferred habitat of this species comprises sheltered seas, estuaries, and mangrove creeks. It is mainly a non-breeding visitor (all months, mostly Sep-Jun) (DoEE 2019; Johnstone *et al.* 2013).
Sterna bergii Crested Tern	Mig (EPBC Act, BC Act)	within study area	Mainly resident in the Pilbara region, breeding on islands (Mar-May) but may also include migrants from Asia or southern areas; favours sheltered seas, estuaries and saltwork ponds, only rarely inland after storms (DoEE 2019; Johnstone *et al.* 2013).
Sterna caspia Caspian Tern	Mig (EPBC Act, BC Act)	within study area	Moderately common breeding resident, nesting on low islands, mainland beaches (including at Cape Preston) and terrestrial wetlands; forages in open wetlands including shallow margins of lakes and rivers, but also in open coastal waters (DoEE 2019; Johnstone *et al.* 2013).
Sterna dougallii Roseate Tern	Mig (EPBC Act, BC Act)	6.0 km N	Occurs in coastal and marine areas in subtropical and tropical seas, usually associated with coral reefs and blue water; resident subspecies *S. dougallii gracilis* breeding on offshore islands including in the Pilbara region (reported May-Jun and Oct), some non-breeding individuals of northern subspecies *bangsi* may also occur (DoEE 2019; Johnstone *et al.* 2013).
Sterna hirundo Common Tern	Mig (EPBC Act, BC Act)	12.7 km E	Regular non-breeding summer visitor to Pilbara coast and islands (Aug-Apr), sometimes locally common in inshore areas including intertidal zone, estuaries, beaches, saltworks and sewage ponds; also forages in terrestrial wetlands. Mostly the east-Asian subspecies *S. hirundo longipennis* occurs in Australia, but occasional records of individuals from more westerly populations occur (DoEE 2019; Johnstone *et al.* 2013).

Species	Status	Proximity to study area	Habitat
Sterna nereis nereis Fairy Tern (or *Sternula*)	VU (BC Act)	5.6 km W	The Australian *S. n. nereis* is one of three subspecies, the other two breeding in New Zealand and New Caledonia respectively. Dampier Archipelago is at the approximate northern limit of where breeding occurs; the Pilbara population is resident to the Pilbara region but is supplemented by southern birds in the non-breeding season. Birds nest on coral shingle or open sandy beaches of islands, estuaries, coastal lakes and mainland coastline and feed on small fish by hovering and diving into shallow blue water (DoEE 2019; Johnstone *et al.* 2013).
Sterna nilotica Gull-billed Tern (or *Gelochelidon*)	Mig (EPBC Act, BC Act)	25.1 km NE	At least two distinct populations occur in the region, an endemic Australian subspecies *S. nilotica macrotarsa* (regular visitor to coast, coastal plains, and islands of the Pilbara and occasionally at Fortescue Marsh inland, sometimes breeding) and the Asian *S. nilotica affinis* (regularly occurs at Broome and recorded in the north-eastern Pilbara). Inhabits shallow wetlands of coasts and inland areas, rarely found over the ocean (Birdlife Australia 2018b; DoEE 2019; Johnstone *et al.* 2013).
Apus pacificus Fork-tailed Swift	Mig (EPBC Act, BC Act)	14.2 km E	Non-breeding migrant in southern Summer, forages and roosts in flight so not limited by terrestrial habitat (DoEE 2019); flocks most often seen ahead of cyclones or during thunderstorms (Johnstone *et al.* 2013).
Falco hypoleucos Grey Falcon	VU (EPBC Act, BC Act)	9.4 km W	In the Pilbara, mostly recorded from the coastal plain between the de Grey and Ashburton Rivers. Preferred habitat of this species comprises lightly wooded coastal and riverine plains (Johnstone & Storr 1998).
Falco peregrinus Peregrine Falcon	OS (BC Act)	5.0 km E	Preferred habitat includes cliffs and wooded watercourses. Nesting occurs mainly on cliff ledges, granite outcrops, quarries and in trees with old raven or Wedge-tailed Eagle nests (Johnstone & Storr 1998). Pilbara records mostly inland or on offshore islands (Johnstone *et al.* 2013).
Pezoporus occidentalis Night Parrot	EN (EPBC Act), CR (BC Act)	-	For roosting and nesting, Night Parrot appears to favour areas of dense vegetation comprising old-growth spinifex (*Triodia* spp.), especially hummocks that form rings (often > 50 years unburnt). It is thought that spinifex hummocks that are <40-50 cm in height are not likely to provide adequate shelter for roosting and nesting (DPaW 2017a). These areas of suitable habitat may also be associated with dense chenopod shrubs. *Triodia* species are thought to provide a food resource while flowering and seeding. The succulent genus *Sclerolaena* has also been shown to be a source of food and moisture and other succulent chenopods species are also considered likely to be important. Foraging habitat is likely to be more important if it is adjacent to or within about 10 km of patches of *Triodia* deemed suitable as roosting habitat. Foraging appears to take place in habitats

Species	Status	Proximity to study area	Habitat
			containing various native grasses and herbs in addition to spinifex, and these areas may or may not contain shrubs or low trees. Favoured sites may vary with the season and local conditions, and may not necessarily occur within or adjacent to roosting areas, as they have been observed to fly up to 40 km in a night (DPaW 2017b). Home range is up to 3000 ha (Murphy *et al.* 2017).
Hirundo rustica Barn Swallow	Mig (EPBC Act & BC Act)	20.8 km NE	Uncommon summer visitor to parts of northern Australia.
Motacilla cinerea Grey Wagtail	Mig (EPBC Act & BC Act)	-	A rare summer vagrant to Australia (Nov-Apr) that inhabits fast flowing streams and rivers (IUCN 2019); the few Pilbara records are far inland (DBCA 2018a).
Motacilla flava Yellow Wagtail	Mig (EPBC Act & BC Act)	-	Uncommon but regular visitor to Pilbara; primarily inhabits a range of damp or wet habitats with low vegetation including damp meadows, marshes, waterside pastures, and sewage farms (IUCN 2019; Johnstone *et al.* 2013).
Mammals (10)			
Dasyurus hallucatus Northern Quoll	EN (EPBC & BC Acts)	1.1 km NW	Most common on dissected rocky escarpments, but also found in eucalypt forest and woodland (Oakwood 2008). Potential denning/shelter habitat (considered critical for quoll survival) includes rocky gorges, gullies and escarpments associated with *Corymbia* woodland, boulder fields, termite mounds, and small caves. Rugged rocky areas are considered to be the core habitat and refuge for quolls because they provide a greater diversity of environments, many sites for shelter and protection from predators and weather, and both immediate refuge from fire and more likelihood of retaining patchiness post-fire (Woinarski *et al.* 2007). Foraging or dispersal habitat is considered to include any areas of predominantly native vegetation up to 2 km from denning habitat (DSEWPaC 2011a).
Macrotis lagotis Greater Bilby	VU (EPBC & BC Acts)	-	Bilby habitat preferences include hummock grassland in plains and alluvial areas, open tussock grassland on uplands and hills, and mulga woodland/shrubland on ridges and rises (DSEWPaC 2011b) but areas where it is now regionally extinct include many other habitat types.
Petrogale lateralis lateralis Black-flanked Rock-wallaby	EN (EPBC & BC Acts)	-	Habitat depends on availability of suitable refuge (cliff, rock-pile, talus, or escarpment) close to sufficient vegetation to provide food; there were remnant populations on the Pilbara mainland up to the 1990s, but they are now considered extinct on the mainland (Carwardine *et al.* 2014; Pearson 2013).

Species	Status	Proximity to study area	Habitat
Macroderma gigas Ghost Bat	VU (EPBC & BC Acts)	6.9 km E	Survival is critically dependent on natural roosts in caves, crevices, deep overhangs, and artificial roosts such as abandoned mine adits (Hall *et al*. 1997); the most suitable roosting locations in the Pilbara occur in the Marra Mamba Iron Formation (Armstrong & Anstee 2000).
Rhinonicteris aurantia (Pilbara) Pilbara Leaf-nosed Bat	VU (EPBC & BC Acts)	10.1 km S	Normally restricted to caves and mine adits (horizontal shafts) with stable, warm and humid microclimates (Van Dyck & Strahan 2008), but temporary roosts such as crevices and tree hollows may be used in warm and humid conditions, allowing greater dispersal during the wet season. The roosting site is often at depth in mines; in small crevices within caves, usually those ascending between sedimentary rock layers; and with associated groundwater seeps (Armstrong 2000). Simple vertical shafts are not used and shallow caves beneath mesa bluffs are also unlikely roost sites. Foraging in the Pilbara has been observed in the following habitats: *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the; over small watercourses amongst granite boulder terrain and around nearby koppies; over pools and low shrubs in ironstone gorges; and above low shrubs and around pools in gravelly watercourses with *Melaleuca leucodendron*, such as in Barlee Range Nature Reserve (Armstrong 2000; Churchill 2008).
Ozimops cobourgianus Northwestern Freetail-Bat *(ex loriae)*	P1 (DBCA)	3.2 km W	Restricted to mangrove habitats of the northwest coast of WA.
Hydromys chrysogaster Rakali, Water-rat	P4 (DBCA)	5.1 km N	In the Pilbara, restricted to shoreline habitats including mangroves and islands.
Lagorchestes conspicillatus leichardti Spectacled Hare-wallaby	P3 (DBCA)	4.9 km SE	They live in habitat dominated by spinifex, where large hummocks are available. They spend the day hidden in these hummocks in which they tunnel a shelter.
Leggadina lakedownensis Northern Short-tailed Mouse	P4 (DBCA)	2.3 km W	Mainly associated with areas of cracking clay soils.
Pseudomys chapmani Western Pebble-mound Mouse	P4 (DBCA)	within study area	Mounds occur on gravel on lower slopes and tops of hills.

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Status

- CR (EPBC Act; BC Act)
- CR/Mig./CR (EPBC Act; BC Act)
- CR/Mig./VU/Mig. (EPBC Act; BC Act)
- EN (EPBC Act, BC Act)
- EN/CR (EPBC Act; BC Act)
- EN/Mig. (EPBC Act; BC Act);
- EN/Mig./EN (EPBC Act; BC Act)
- EN/Mig./VU (EPBC Act; BC Act)
- VU/Mig. (EPBC Act; BC Acts)
- VU ((EPBC Act; BC Act)
- VU/CD (EPBC Act; BC Act)
- VU/Mig./VU (EPBC Act; BC Act)
- Mig. (BC Act)
- Mig. (EPBC Act; BC Act)
- Mig. (EPBC Act)
- Mig. (EPBC Act; BC Act); P4 (DBCA list)
- Mar/Mig. (EPBC Act; BC Act)
- OS (BC Act)
- P1 (DBCA list)
- P3 (DBCA list)
- P4 (DBCA list)

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Eramurra Solar Salt Project

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Date	2/06/2022
Drawn by	IN
Map author	JC

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1:370,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Desktop study area

Figure 5-1

Desktop records of significant vertebrate fauna

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5.1.1.2 SRE invertebrate fauna

The SRE desktop review identified records of three Confirmed SRE taxa and 38 Potential SRE taxa from within the desktop search area (Table 5-3; Figure 5-2). A further 11 taxa of uncertain SRE status were identified from the same area. The three Confirmed SRE taxa represent one scorpion (*Urodacus butleri*) and two millipedes (*Boreohesperus delicatus* and *Boreohesperus undulatus*). Of these, four potential SRE taxa have previously been recorded within the TFSA:

- *Aname* `MYG001 group' (Potential), was recorded by Biota in 2004 from the northwest corner of the study area. This form taxon is considered likely to include many cryptic species; it has been collected from several locations throughout the Pilbara including nearby Anketell Point and Turner River through to more inland Wonmunna and Lake Maitland (Phoenix internal data).
- *Aname* 'MYG579' (Potential), recorded by Biota in 2009. There are four records from one location in the southwest of the study area. An additional four records from two locations outside of the study area are also known.
- *Kwonkan* 'MYG195' (Potential), one record from approximately 30 m outside of the north-eastern border of the study area and was collected by DEC in 2009. No other records of this species are known.
- *Rhagada* 'Cape Preston' n. sp. (Potential), two records from one location have been collected close to the western border of the study area. No other records of this species are known.

An additional taxon has been recorded within 30 m of the TFSA (*Aname* 'sp. indet') (Figure 5-2). All five taxa known from within the TFSA (or within 30 m) are undescribed 'morpho-species' but are formally recognised by the WA Museum as being morphologically distinct.

Of the 41 confirmed or potential SRE taxa, 13 are named species comprising two scorpions, two millipedes and nine land snails. The remaining 29 comprise taxa named only to morphospecies codes as applied by the WA Museum or are not identified to confirmed species level (i.e., "sp." or "cf.") (Table 5-3).

Table 5-3 SRE taxa identified in the desktop review

Higher taxon, family	Species	SRE category	Proximity to study area	Habitat records
Class Arachnida, infraorder Mygalomorphae (trap-door spiders) (9)				
Actinopodidae (mouse spiders)	*Aurecocrypta* 'po3'	Potential	16.5 km SW	Unknown
	Synothele 'preston'	Potential	28 km SW	Unknown
Anamidae	*Aname* 'MYG001 group'	Potential	Within study area	Unknown
	Aname 'MYG271-DNA'	Potential	2 km SE	Unknown
	Aname 'MYG516'	Potential	18 km SW	Unknown
	Aname 'MYG579'	Potential	Within study area	Unknown
	Aname 'sp. indet'	Uncertain	Within study area	Unknown
	Kwonkan 'MYG195'	Potential	Within study area	Unknown
	Kwonkan 'po2'	Potential	4 km S	Unknown
Class Arachnida, Order Pseudoscorpiones (pseudoscorpions) (2)				
Garypidae	*Synsphyronus* 'Mortland River'	Potential	15.5 km E	Unknown
	Synsphyronus 'sp. indet'	Uncertain	25 km NE	Islands off Dampier

Higher taxon, family	Species	SRE category	Proximity to study area	Habitat records
Class Arachnida, Order Scorpiones (scorpions) (7)				
Buthidae	*Lychas* 'glauerti' (now 'SCO039/glauerti')	Potential	9 km S	Unknown
	Lychas 'bituberculatus complex'	Potential	17 km S	Unknown
	Lychas 'multipunctatus complex'	Potential	12 km E	Unknown
	Lychas 'nubby'	Potential	16 km SW	Unknown
Urodacidae	*Urodacus* 'sp. 7'	Potential	12 km W	Unknown
	Urodacus butleri	Confirmed	9 km E	Unknown
	Urodacus hoplurus	Potential	15 km W	Unknown
Class Diplopoda (millipedes) (5)				
Paradoxosomatidae	*Boreohesperus delicatus*	Confirmed	150 m W	Unknown
	Boreohesperus undulatus	Confirmed	150 m W	Unknown
	Antichiropus 'DIP025'	Potential	20 km E	Unknown
	Antichiropus 'DIP049'	Potential	2 km W	Unknown
	Antichiropus 'sp. indet'	Uncertain	2 km W	Unknown
Class Crustacea, Order Isopoda (slaters) (5)				
Armadillidae	*Barrowdillo* '2'	Potential	14 km SE	Unknown
	Buddelundia '14hr'	Potential	14 km SE	Unknown
	Buddelundia '33'	Potential	35 km E	Unknown
	Buddelundia '36'	Potential	32 km S	Unknown
	Buddelundia '61'	Potential	14 km SE	Unknown
Class Gastropoda (land snails) (15)				
Camaenidae	*Quistrachia herberti* or *Quistrachia* cf. *herberti*	Potential	1.5 km W	Burrup and nearby islands
	Quistrachia legendrei	Potential	39 km NE	Burrup and nearby islands
	Quistrachia legendrei sp. 'Burrup'	Potential	25 km NE	Burrup and nearby islands
	Quistrachia legendrei sp. 'Dampier Arch.'	Potential	23 km NE	Burrup and nearby islands
	Rhagada 'Cape Preston' n.sp.	Potential	Within study area	Hummock grassland (Phoenix vegetation and habitat mapping) **Known only from the study area**
	Rhagada angulata	Potential	41 km NE	Burrup and nearby islands
	Rhagada cf. *convicta*	Potential	35 km E	Unknown
	Rhagada cf. *radleyi*	Potential	1 km W	Unknown
	Rhagada dampierana	Potential	34 km NE	Burrup and nearby islands
	Rhagada elachystoma	Potential	35 km NE	Islands
	Rhagada intermedia	Potential	25 km NE	Islands

Higher taxon, family	Species	SRE category	Proximity to study area	Habitat records
	Rhagada minima	Potential	25 km NE	Islands
	Rhagada ngurrana	Potential	38 km NE and SE	Burrup and creekline
	Rhagada perprima	Potential	25 km NE	Burrup and nearby islands
	Rhagada radleyi 'Du Boulay' n.sp.	Potential	16 km S	Minor drainage next to road

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Western Australia
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Map author	JC

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Terrestrial fauna study area
Desktop study area

SRE status

- Confirmed
- Potential
- Uncertain
- Not SRE

Figure 5-2

Desktop records of SRE invertebrates

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5.2 FIELD SURVEY

5.2.1 Terrestrial fauna of the TFSA

5.2.1.1 Vertebrate fauna

5.2.1.1.1 Habitats

A total of 16 fauna habitat types were identified in the study area (Table 5-4; Figure 5-3), which can be classified in eight broad groupings based on vegetation and landform:

1. Tussock grasslands on beaches and dunes
2. Mangal forests
3. Eucalypt forests and woodlands (typically on drainage lines)
4. Samphire shrublands (tidal and inland) which are indistinguishable floristically
5. Tussock grasslands, with varying degrees of shrub cover/dominance
6. Spinifex grasslands
7. Tidal creeks and ocean
8. Bare ground/cleared

Two habitat types dominate the TFSA. Tussock grasslands collectively comprise almost 60% and spinifex grasslands comprise almost 21%.

Tussock grasslands recorded only a single significant species, the Northern Coastal Free-tailed Bat (P1). The record here is associated with a drainage line and is consistent with other survey records in the region (Phoenix 2013b, 2020), where the species was recorded several kilometres inland from its coastal roosting sites.

Habitats within the spinifex grasslands group were found to directly support four significant species, the Grey Falcon (VU), Northern Quoll (EN), Northern Coastal Free-tailed Bat (P1), Pilbara Leaf-nosed Bat (VU) and the lined soil-crevice skink (P4).

The vast majority of proposed disturbance occurs on mudflat or salt flat and tidal samphire habitat, which collectively comprises just over 9% of the TFSA. A total of 24 Migratory bird species were associated with mudflat and salt flat habitat while conducting aerial shorebird transects; though it must be noted that the GPS location taken is for the location of the helicopter at that moment, and not the flock of birds on the wing, or ground congregation of birds being observed; that being said all effort was made to get a GPS fix where birds were first sighted.

Within the tidal samphire habitat, 16 Migratory bird species were recorded while conducting aerial shorebird transects. A Northern Quoll scat was also recorded in this habitat, just 790m from the coast, and isolated from other Northern Quoll habitat features typically targeted when attempting to determine presence/absence of the species. That being said the species is clearly resident within the TFSA with numerous records from the eastern half, and historic records immediately to the west at Cape Preston.

Mangal communities support Northern Coastal Free-tailed Bat (P1) which was recorded from four locations and occurs extensively within mangal communities of the region. This habitat also supports foraging and roosting of numerous Migratory shorebirds, such as Whimbrel (Mig. EPBC and BC Acts), and the Shining Flycatcher which was recorded as a range extension.

A number of drainage lines carry water from the south and east towards the coast and these typically support narrow strips of riparian eucalypt open woodlands and woodlands. Here, where the inland alluvial, more porous soils meet the marine-deposited soils of the mudflats above the current tide line, fresher groundwater is forced to the surface over the denser marine groundwater and pools. Further, if granite outcropping occurs, surface water persistence is often extended (mainly in the northeast). Due to the scale of the mapping (1:10,000) all such instances of water accumulation and

eucalypt woodland may not be identified in Figure 5-3. These habitats are typically heavily impacted by cattle and have likely suffered significant changes to the vegetation structure and composition. Despite the impacts, these habitat areas support Northern Quoll (EN) dispersal down the drainage lines from the hills to the south and shelter/denning opportunities where granite outcropping occurs. This habitat also recorded Common Brushtail Possum as a range extension. The occurrence of persistent surface water in this habitat is also an important water source for most species of bird and mammal through the dry season.

Tidal samphire shrublands predominantly support foraging by the diverse and abundant shorebird assemblage recorded; of which 31 species were present (including six Threatened species) often in nationally significant numbers and occasionally in internationally significant numbers (see section 5.2.2.1). It is also important habitat for Airlie Island Ctenotus (*Ctenotus angusticeps*) (P3).

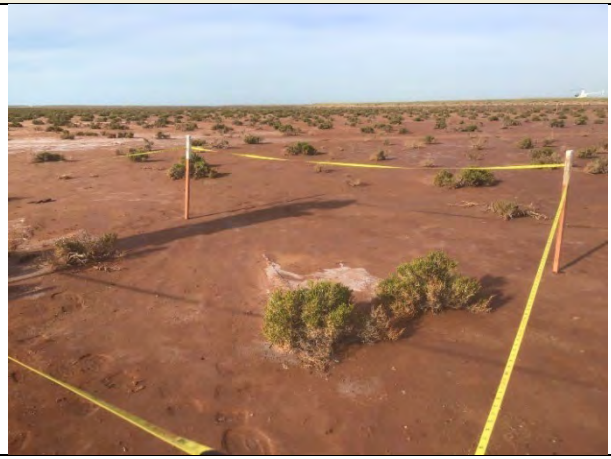
All habitats support foraging for Peregrine Falcon and Grey Falcon, both of which were recorded.

Table 5-4 Extent and description of each fauna habitat in the study area

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Beach	Beach	16.4 (0.1%)	No sites – see shorebird data	
Cleared	Cleared, no native vegetation	142.1 (0.5%)	0016SP, 006SP, BFF, Habitat Description 03, MI01, MI01, MI02	No photo

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Forest of *Eucalyptus* spp. over tall shrubland over grassland	Variably present open forest of *Eucalyptus victrix* and/or *E. camaldulensis* (s.l.), over tall variably present open shrubland of *Acacia coriacea* (s.l.), over mid grassland to closed grassland of *Chrysopogon fallax*, *Eriachne flaccida*, and *Cenchrus* spp. (EvAcCf)	54.6 (0.2%)	NQ05	
Mangal community	Mangrove forests and thickets	285.1 (1.1%)	No sites – see shorebird data	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Mudflat or salt flat	Bare, unvegetated mudflats and salt flats	2,419.7 (9.1%)	No sites – see shorebird data	
Samphire shrubland (inland)	Low open shrubland to shrubland of *Tecticornia* spp., variably with *Surreya diandra* and *Frankenia pauciflora*, over variably present isolated tussock grasses to tussock grassland of *Eragrostis falcata* and *Xerochloa laniflora* (Tspp).	295.1 (1.1%)	No sites	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Samphire shrubland (tidal)	Low open shrubland to shrubland of *Tecticornia* spp., variably with *Surreya diandra* and *Frankenia pauciflora*, over variably present isolated tussock grasses to tussock grassland of *Eragrostis falcata* and *Xerochloa laniflora* (Tspp).	593.7 (2.2%)	0010SP, 0011SP, 0012SP, 009SP, Eagle1, Salt-cam	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Shrubland over spinifex grassland	Mid sparse to open shrubland of *Acacia bivenosa*, with occasional *A. stellaticeps* and *A. coriacea* (s.l.), over low hummock grassland of *Triodia wiseana* (AbTw). Variably present mid isolated shrubs of *Acacia coriacea* (s.l.) and *A. bivenosa*, over mid isolated forbs of *Evolvulus alsinoides* var. *villosicalyx*, *Arivela viscosa*, and *Rhynchosia minima*, over mid open to closed hummock grassland of *Triodia epactia* and **Cenchrus ciliaris* (Te). Tall sparse shrubland to shrubland of *Acacia coriacea* (s.l.), *A. ligulata*, and/or *A. sclerosperma* subsp. *sclerosperma*, over low isolated shrubs to open shrubland of **Aerva javanica*, *Corchorus walcottii*, and *Rhagodia eremaea*, over low sparse hummock grassland to hummock grassland of *Triodia epactia* with **Cenchrus ciliaris* and *Whiteochloa airoides* (AcAjTe).	5,326.5 (20.1%)	39 sites	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Shrubland over tussock grassland	Variably present tall sparse shrubland to shrubland of *Acacia sclerosperma* subsp. *sclerosperma, A. coriacea* (s.l.), and *A. inaequilatera*, over low sparse grassland to closed grassland of **Cenchrus ciliaris*, *Dactyloctenium radulans*, and **C. setiger* (AssCc). Low sparse to open shrubland of **Aerva javanica* and *Solanum lasiophyllum*, over low sparse grassland to grassland of **Cenchrus* spp. with *Whiteochloa airoides* and/or *Sorghum plumosum* (AjCspp). Mid sparse shrubland to open shrubland of *Acacia xiphophylla*, over low isolated forbs of *Sida fibulifera, Ptilotus exaltatus,* and *Rhynchosia minima,* over low sparse to open tussock grassland of *Eragrostis xerophila, Dichanthium sericeum* subsp*. humilius,* and *Aristida contorta* (AxEx) Mid to tall open shrubland to shrubland of *Myoporum montanum*, *Acacia ampliceps*, and *Rhagodia eremaea*, over low isolated chenopod shrubs of *Tecticornia* spp. and *Threlkeldia diffusa*, over mid tussock grassland of *Sporobolus virginicus* with occasional **Cenchrus ciliaris* and *Triodia epactia* (MmTsppSv).	3,805.2 (14.4%)	14 sites	 

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Shrubland over spinifex grassland on drainage	Tall sparse shrubland of *Acacia inaequilatera*, with occasional *Ipomoea costata* and *A. coriacea* (s.l.), over mid sparse shrubland of *Eremophila longifolia*, with occasional *Acacia pyrifolia* var. *pyrifolia* and *A. bivenosa*, over low open hummock grassland to hummock grassland of *Triodia wiseana* with **Cenchrus ciliaris* and occasional *T. epactia* (AiElTw).	100 (0.4%)	Bat 03, NP11	
Spinifex grassland	Low isolated shrubs of **Aerva javanica, Corchorus walcottii*, and *Indigofera linnaei*, over mid open to closed hummock grassland of *Triodia epactia*, co-dominant with *Whiteochloa airoides* and some presence of **Cenchrus ciliaris* (TeWA).	120.5 (0.5%)	No sites	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Tidal channel and ocean	Tidal channel and ocean	155.9 (0.6%)	No sites	
Tussock grassland	Isolated low shrubs of *Abutilon lepidum*, *Indigofera monophylla*, and *Triumfetta clementii*, over isolated forbs of *Trichodesma zeylanicum* var. *zeylanicum*, *Ptilotus auriculifolius* or *P. clementii*, and *Evolvulus alsinoides* var. *villosicalyx*, over low hummock grassland of *Triodia wiseana* (Tw). Hybrid or mosaic of two vegetation types. Low isolated forbs of *Sida fibulifera*, *Rhynchosia minima*, and *Indigofera trita*, over low tussock grassland to closed tussock grassland of *Eragrostis xerophila, Dichanthium sericeum* subsp. *humilius,* and *Sorghum plumosum* (Ex).	12,914.6 (48.8%)	23 sites	
Tussock grassland on beach and dune	Not mapped.	0.03 (<0.1%)	No sites	No photo

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Tussock grassland on granite outcrop	Exposed granite areas containing low isolated shrubs of *Hibiscus sturtii* var. *campylochlamys*, over isolated forbs of *Indigofera linifolia*, *Arivela viscosa*, and *Boerhavia coccinea*, over low isolated grasses of **Cenchrus ciliaris*, *Enneapogon caerulescens*, and *Sporobolus australasicus* (HscIlCc).	9.5 (<0.1%)	No sites	
Upright outcrop - shrubland over spinifex grassland	Mid sparse to open shrubland of *Acacia bivenosa*, with occasional *A. stellaticeps* and *A. coriacea* (s.l.), over low hummock grassland of *Triodia wiseana* (AbTw).	0.5 (<0.1%)	1320-NQ06, NQ06	

Habitat type	Vegetation descriptions	Extent in TFSA and % of TFSA	Sites	Representative photograph
Woodland of Eucalyptus spp. over tussock grassland on drainage	Mid open woodland to woodland variably composed of *Eucalyptus camaldulensis* (s.l.), *E. victrix*, and *Corymbia hamersleyana*, over tall sparse shrubland to shrubland of *Acacia coriacea* (s.l.) and *A. trachycarpa* with occasional stands of *Melaleuca glomerata*, over mid sparse grassland to grassland of **Cenchrus setiger, Dactyloctenium radulans*, and **C. ciliaris* (EcAcCs). Mid open woodland to woodland of *Eucalyptus victrix* and occasional *E. camaldulensis* (s.l.), over mid to tall open shrubland composed variably of *Sesbania cannabina*, *Acacia sericophylla*, or *A. coriacea* (s.l.), over low open tussock grassland to grassland of *Sporobolus virginicus* (EvScSv). Low woodland of *Eucalyptus camaldulensis* (s.l.), over tall open shrubland of *Acacia coriacea* (s.l.), *Melaleuca linophylla*, and *M. glomerata*, over mid open hummock grassland of *Triodia epactia* with **Cenchrus ciliaris* and *Eulalia aurea* (EcAcTe).	209.4 (0.8%)	Bat 02, Bat 04, Habitat Description 11, NQ08, NQ14, Opportunistic Sighting 03, Regional Op 08	
	Total	**26,448.8 (100%)**		

435365 440110 444855

7698870 7694160 7689440

Aves

Falco hypoleucos, Grey Falcon, VU (BC Act)

Pandion cristatus, Osprey, Mig. (EPBC, BC Acts)

Mammalia

Dasyurus hallucatus, Northern Quoll, (EN EPBC, BC Acts)

Ozimops cobourgianus, Northern Coastal Free-tailed Bat, P1 (DBCA list)

Range extensions

Sminthopsis youngsoni, Lesser Hairy-footed Dunnart, (range ext.)

Trichosurus vulpecula, Common Brushtail Possum, (range ext.)

0 2.5 5
Kilometers

Tidal channel and ocean
Beach
Mangal community
Spinifex grassland
Mudflat or salt flat
Samphire shrubland (inland)
Shrubland over tussock grassland
Cleared
Tussock grassland
Samphire shrubland (tidal)
Woodland of Eucalyptus spp. over tussock grassland on drainage
Shrubland over spinifex grassland
Tussock grassland on granite outcrop
Shrubland over spinifex grassland on drainage

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Map author	JC

0 1 2
Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

Beach
Mangal community
Mudflat or salt flat
Samphire shrubland (inland)
Samphire shrubland (tidal)
Shrubland over spinifex grassland
Shrubland over spinifex grassland on drainage
Shrubland over tussock grassland
Spinifex grassland
Tidal channel and ocean
Tussock grassland
Tussock grassland on granite outcrop
Woodland of Eucalyptus spp. over tussock grassland on drainage
Cleared

Figure 5-3a

Fauna habitats and significant terrestrial fauna records in the TFSA from the field surveys

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425875 430620 435365

7700280 7695520 7690760 7686000

Aves

- *Apus pacificus*, Fork-tailed Swift, Mig. (EPBC, BC Acts)
- *Falco peregrinus*, Peregrine Falcon, OS (BC Act)
- *Pandion cristatus*, Osprey, Mig. (EPBC, BC Acts)

Mammalia

- *Dasyurus hallucatus*, Northern Quoll, (EN EPBC, BC Acts)
- *Ozimops cobourgianus*, Northern Coastal Free-tailed Bat, P1 (DBCA list)
- *Kogia sima*, Dwarf Sperm Whale

0 2.5 5
Kilometers

Mangal community
Spinifex grassland
Shrubland over tussock grassland
Samphire shrubland (tidal)
Mudflat or salt flat
Cleared
Tidal channel and ocean
Tussock grassland on beach and dune
Tussock grassland on granite outcrop
Shrubland over spinifex grassland on drainage
Shrubland over spinifex grassland
Samphire shrubland (inland)
Tussock grassland
Forest of Eucalyptus spp. over tall shrubland over grassland
Woodland of Eucalyptus spp. over tussock grassland on drainage

Western Australia
PERTH

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Map author	JC

0 1 2
Kilometers

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Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-3b

Fauna habitats and significant terrestrial fauna records in the TFSA from the field surveys

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416385 421130 425875

7697020

Aves

Falco peregrinus, Peregrine Falcon, OS (BC Act)

Pandion cristatus, Osprey, Mig. (EPBC, BC Acts)

Mammalia

Ozimops cobourgianus, Northern Coastal Free-tailed Bat, P1 (DBCA list)

Range extensions

Myiagra alecto, Shining Flycatcher, (range ext.)

Reptilia

Notoscincus butleri, lined soil-crevice skink (Dampier), P4 (DBCA list)

0 2.5 5
Kilometers

Spinifex grassland
Shrubland over tussock grassland
Beach
Tidal channel and ocean
Tussock grassland on beach and dune
Mangal community
Mudflat or salt flat
Samphire shrubland (tidal)
Shrubland over spinifex grassland
Samphire shrubland (inland)
Cleared
Tussock grassland
Tussock grassland on granite outcrop
Forest of Eucalyptus spp. over tall shrubland over grassland
Woodland of Eucalyptus spp. over tussock grassland on drainage
Shrubland over spinifex grassland on drainage

7692270

7687510

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Kilometers

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Terrestrial fauna study area

Fauna habitat

- Beach
- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-3c

Fauna habitats and significant terrestrial fauna records in the TFSA

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422240
427000
431760
7682100
7677310
7672520

Shrubland over spinifex grassland on drainage

Forest of Eucalyptus spp. over tall shrubland over grassland

Shrubland over tussock grassland

Tussock grassland

Cleared

Tussock grassland on granite outcrop

Shrubland over spinifex grassland

Woodland of Eucalyptus spp. over tussock grassland on drainage

Upright outcrop - shrubland over spinifex grassland

0 2.5 5
Kilometers

Mammalia

Rhinonicteris aurantia (Pilbara), Pilbara leaf-nosed bat, (VU EPBC, BC Acts)

Ozimops cobourgianus, Northern Coastal Free-tailed Bat, P1 (DBCA list)

Range extensions

Trichosurus vulpecula, Common Brushtail Possum, (range ext.)

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0 1 2
Kilometers

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Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Tussock grassland
- Tussock grassland on granite outcrop
- Upright outcrop - shrubland over spinifex grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-3d

Fauna habitats and significant terrestrial fauna records in the TFSA from the field surveys

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5.2.1.1.2 Assemblage

A total of 201 terrestrial vertebrate species representing 68 families and 132 genera were recorded in the study areas during the field surveys (Appendix 3) based on 5,773 individuals recorded from surveys completed in the TFSA and aerial transects completed in the SBSA. The assemblage included 198 native species and three introduced mammal species. A site by species matrix for all systematic survey sites is provided in Appendix 4. The recorded assemblage represents 44% of the species identified in the desktop review (Table 5-5).

Table 5-5 Number of vertebrate species recorded in survey in comparison to desktop results, by group

Group	No. species identified in desktop review	No. species recorded in survey	% recorded against desktop species list
Freshwater fish	3	0	0
Amphibians	9	2	22
Reptiles	130	48	37
Birds	261	128	49
Mammals	54 (inc. 12 introduced)	23 (inc. 3 introduced)	43
Total	**457**	**201**	**44**

Freshwater fish were not targeted in surveys, and none were recorded.

Two frog species were recorded, one only as by-catch in invertebrate wet pits, and one at a single vertebrate trapping site.

Terrestrial reptiles included 48 lizard taxa from nine families (two not positively identified to species level) and included seven agamids, including one '*Amphibolurus*' species not positively identified from single sighting; three gekkonids; one carphodactylid track, not identified to species; three diplodactylids; three pygopodids; 19 scincids; five varanids and eight snakes from three families (one typhlopid, two pythonids and five elapids).

Birds recorded included 96 non-passerines from 29 families, which included one anatid, one podicipedid, one ciconiid, six ardeids, one pelecanid, four phalacrocoracids, eight accipitrids, one pandionid, one otidid, one turnicid, one burhinid, two haematopodids, three recurvirostrids, nine charadriids, 16 scolopacids, one glareolid, 11 larids, four columbids, one cuculid, one strigid, one podargid, one eurostopodid, one alcedinid, one meropid, three falconids (plus one sighted during travel outside the study area), and three cacatuids.

For passerines, 32 taxa were recorded, representing 17 families, and included one climacterid, one malurid, three meliphagids, one pardalotid, three acanthizids, three artamids, two cracticids, one campephagid, one oreoicid, two pachycephalids, two rhipidurids, two monarchids, one corvid, one petroicid, one alaudid, three locustellids, one possible cisticolid, one zosteropid, two estrildiids, and one motacillid.

Mammals were represented by 23 species, including three introduced species (Cats, Dogs, Cattle), two Threatened species (Northern Quoll, EN and Pilbara Leaf-nosed Bat, VU), one Priority species (Northern Coastal Free-tailed Bat, P1) and two range extensions (Common Brushtail Possum and Lesser Hairy-footed Dunnart). The assemblage comprised 11 families, including four dasyurid species and 11 species of bat in four families (55% of native species recorded). Macropods were represented by two species, Euro and Rothschild's Rock-wallaby. The Common Rock-rat was the only rodent recorded. The mammal assemblage in the absence of bats, therefore, is considered depauperate, which is likely a result of the long period of low rainfall conditions experienced prior to the 2020 Detailed (trapping) survey.

An estimate of survey completeness is provided via species accumulation curves presented in Figure 5-4 for all Classes combined and separately for reptiles, birds, and mammals. The curves indicate that the land-based systematic survey sites completed for the TFSA have detected a majority of species likely to occur, but that additional taxa remain undetected. The sites-samples included in the analysis comprised 123 species, whereas the additional species records from non-systematic sites-samples comprised an additional 34 species, resulting in a total of 157 species detected via land-based surveys.

The records from the extensive shorebird transects undertaken within the SBSA took the total number of species detected up to 201. Survey adequacy for that component of this Project is tested in Figure 5-5, where it can be seen that the 21 aerial transects completed were well and truly adequate; with no new species being detected after the 13th sample, according to the Jacknife1 measure, whereas the other three measures suggested that the complete species list was not achieved until the final, 21st transect.

Therefore, the accumulation curves presented in Figure 5-4 do not satisfactorily represent the effort expended and do not tell the whole story. That being said, given the scale of the Project, the number of habitats present, and the extensive rocky hills located immediately west and south of the TFSA, no doubt numerous species that utilise the TFSA permanently, and from time to time, were not detected (see Table 5-14).

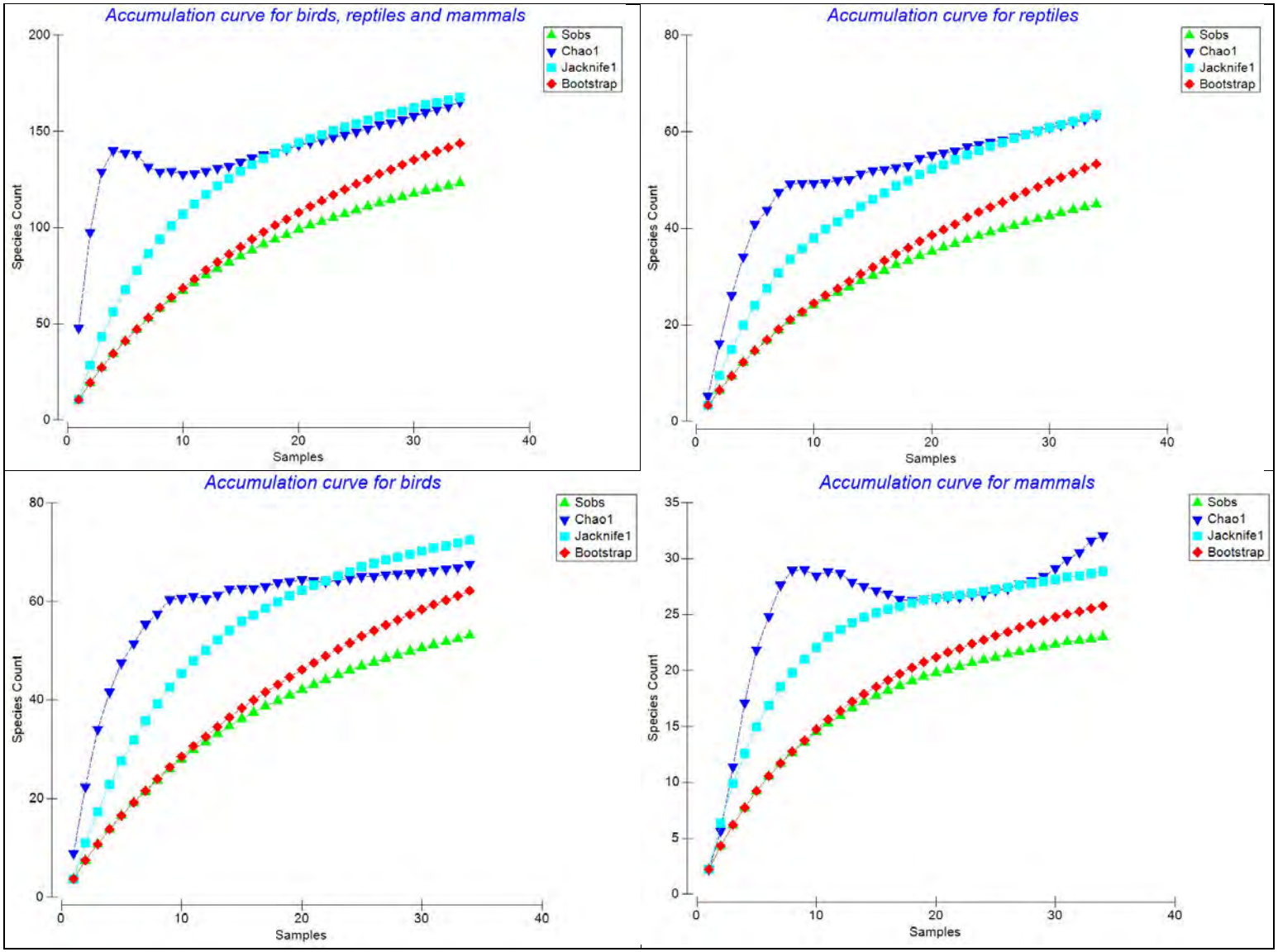

Figure 5-4 Species accumulation curves per Class for systematic sample sites within the TFSA

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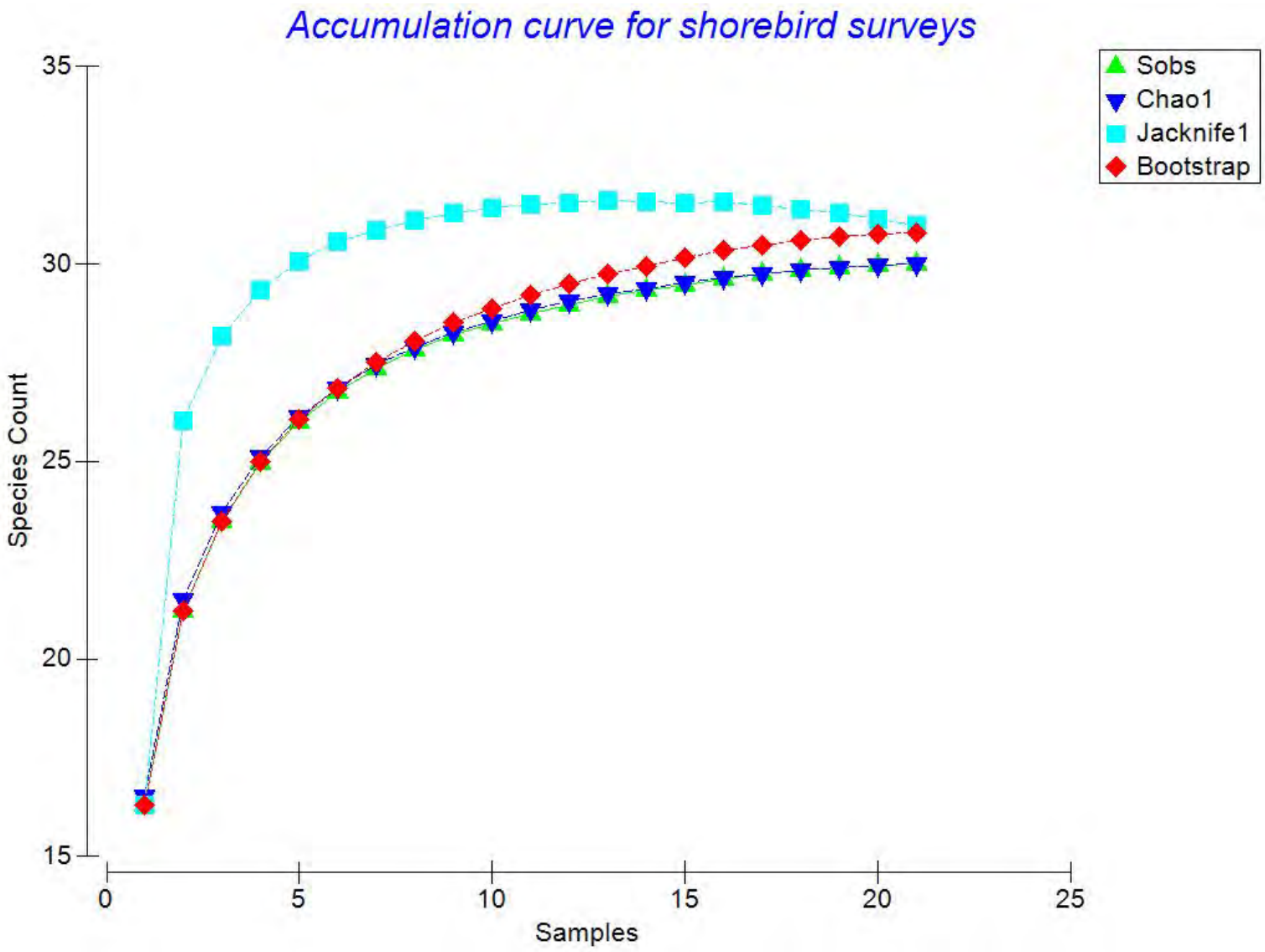

Figure 5-5 Species accumulation curve for the Migratory shorebird survey

5.2.1.1.3 Significant vertebrate fauna

The data presented here largely details the Threatened and Priority vertebrate fauna species recorded during surveys of the TFSA, as Migratory shorebird results from the SBSA are presented in detail below in section 5.2.2. However, for completeness, all significant species (Threatened, Migratory and Priority) are summarised immediately below in Table 5-6.

The summary shows that 39 significant vertebrate fauna species were recorded. These include seven Threatened species (comprising five birds and two mammals), three Priority species (one reptile, bird and mammal) (Table 5-6), and 33 Migratory species listed under either the EPBC Act or BC Act (the majority to be detailed below in section 5.2.2). A total of 35 significant bird species were recorded.

Table 5-7 provides details on the significant 'terrestrial' species recorded (thus excludes Migratory shorebirds). It also includes details of three range extensions and the first regional sighting of the Dwarf Sperm Whale.

Two Threatened mammal species were recorded: Northern Quoll (EN) and Pilbara Leaf-nosed Bat (VU). Northern Quoll appears to be resident throughout the study area, based on presence at six sites, including from tidal samphire shrubland, just 800m from the coast (3.8km SSW of 40 Mile Beach camp). There is minor denning/shelter habitat occurring as granite outcrops on creeklines that are likely to be capable of supporting low breeding numbers; however, these populations are likely supplemented by larger populations in the ranges to the south of the Project.

Pilbara Leaf-nosed Bat is not a resident as no geological formations are present to form suitable roost caves. The record of a single detection in April suggests a post-maternity, dispersing individual. Only certain diurnal roost sites are considered habitat critical for survival of the species (Bullen 2021), so that no critical habitat is present in the TFSA.

Grey Falcon (VU) was recorded immediately to the east of the TFSA, at a known nest site on a communications tower on the Northwest Coastal Highway. The species has a large foraging range and will forage within the TFSA.

Two 'terrestrial' Migratory bird species were also recorded, Fork-tailed Swift and Osprey. The Fork-tailed Swift was observed as a flock of 30 overhead at 40 Mile Beach campground. The species will forage widely and is likely to forage over the Project area on occasion. Osprey were recorded on 33 occasions and occurs as a resident throughout the study area, but primarily at the coast.

The lined soil-crevice skink (Dampier) (P4) was recorded from a single site, on a creekline as is typical of the species.

A number of range extensions or vagrants were recorded. The most significant is probably the Common Brushtail Possum, which was recorded in 2020 and 2021 at the eastern and western margins of the TFSA and is thus considered resident on creeklines in the area. While the species is not listed under the EPBC Act or BC Act, the records are the first for the west Pilbara coast (ALA 2020) and are thus of importance. The species was recorded in association with Northern Quolls.

The Shining Flycatcher is also not listed under the EPBC Act or BC Act; however, the record at Eramurra is some 800km from its nearest record, being the first record west of Beagle Bay in the Kimberley (ALA 2020). It was recorded from mangroves during an early February shorebird survey west of the TFSA.

The Lesser Hairy-footed Dunnart is also not listed under the EPBC Act or BC Act; however, the record at Eramurra is a 100 km northern and a 160 km western range extension from known records (ALA 2020). Identification of the 2020 specimen was confirmed by Dr Travouillon of the WA Museum (Appendix 5). The 2021 specimens were identified by Dr John Scanlon of Phoenix based on experience gained working with Dr Travouillon on the 2020 specimen.

While marine species were not part of the scope of the surveys, one interesting record of note is the observation of a dead Dwarf Sperm Whale on the west side of Gnoorea Point, sighted during shorebird aerial surveys, presumably washed up after a cyclone. The record represents the first for the Pilbara region.

Table 5-6 Summary of significant vertebrate fauna recorded per Class

Class	EPBC Act		BC Act		DBCA list	Total
	Threatened	Migratory	Threatened	Migratory		
Freshwater Fish	0	0	0	0	0	**0**
Reptiles	0	0	0	0	1	**1**
Birds	5	31	8	27	1	**35**
Mammals	2		2		1	**3**
Total	**7**	**31**	**10**	**27**	**3**	**39**

Table 5-7 Details of significant vertebrate fauna recorded during the field survey

Species	Status	Survey records	Photograph
Reptiles			
Notoscincus butleri lined soil-crevice skink (Dampier)	P4 (DBCA list)	Recorded from one site, Site01, in a pipe. The site is drainage line associated (80m east), mapped as shrubland over spinifex grassland.	No photo
Birds			
Apus pacificus Fork-tailed Swift	Mig. (EPBC & BC Acts)	Regional Op 12: Seen as a flock of 30 overhead at 40 Mile Beach campground.	No photo
Falco hypoleucos Grey Falcon	VU (EPBC Act, BC Act)	See multiple times at site “Comms Tower”, 6 km east of the study area. This is a known nesting location.	No photo
Pandion cristatus Osprey	Mig. (EPBC & BC Acts)	Recorded as single individuals, on 33 separate occasions. The species is resident throughout the study area, but primarily at the coast.	No photo
Myiagra alecto Shining Flycatcher	Range extension (no conservation listing)	Recorded in mangroves during early February shorebird survey west of the study area. The records represent a range extension of some 800km, being the first record west of Beagle Bay in the Kimberley.	No photo
Mammals			

Dasyurus hallucatus Northern Quoll	EN (EPBC Act, BC Act)	Eight records, from six sites (0012SP, Bat 04, NQ08, NQ14, Regional Op10 and Tommy), with evidence including photographs, tracks, and scats, and from tidal samphire shrubland,<800m from the coast, 3.8km SSW of 40 Mile Beach camp.	 

Species	Status	Survey records	Photograph
			
Sminthopsis youngsoni Lesser Hairy-footed Dunnart	Range extension (no conservation listing)	Recorded as by-catch from wet pitfall trap site SRE02 in 2020 and SRE001, SRE003, SRE004, SRE007 and SRE008 in 2021. ID confirmed by WAM (Appendix 5).	

Species	Status	Survey records	Photograph
Trichosurus vulpecula Common Brush-tailed Possum	Range extension (no conservation listing)	Recorded from three sites, one in 2020 (NQ02) and two in 2021 (NQ08 and NQ13), all on camera traps. All records are on or very close to drainage lines both at the eastern and western borders of the TFSA. Found in association with Northern Quolls at site NQ08, within the study area. The records are the first for the west Pilbara coast.	 

Species	Status	Survey records	Photograph
			
Rhinonicteris aurantia Pilbara Leaf-nosed Bat	VU (EPBC Act, BC Act)	NQ06 (upright outcrop): ultrasonic call recording.	No photo
Kogia sima Dwarf Sperm Whale	First regional record (no conservation listing)	Dead Whale site (beach with mangroves, West side of Gnoorea Point): opportunistic sighting during shorebird helicopter survey, washed up after cyclone.	

5.2.1.2 SRE invertebrate fauna

5.2.1.2.1 Habitats

A total of 16 vegetated habitats (excludes 'cleared') are present within the study areas which collectively occupy 98.87% of the study area (Table 5-8; Figure 5-6). The remaining 1.13% of the study area is not SRE habitat, comprised of areas that are either cleared, tidal channel or ocean. The SRE habitats are overwhelmingly dominated by a single habitat type, tussock grassland (48.82%), followed by shrubland over spinifex grassland (20.14%) and shrubland over tussock grassland (14.38%). The remaining 14 SRE habitats comprise 16.66% of the TFSA, 12 of which occupy less than 1.00% of the total.

All of the habitats mapped are considered to be 'low' potential SRE habitat. The terrain is generally flat and comprised of vegetation types which are widespread or do not provide microhabitats typically associated with SREs. Several geographical features are present within the study area (e.g., granite outcrop, upright outcrop, and drainage); however, these also contain the same vegetation communities as the wider landscape (i.e. shrublands and grasslands) and are typically heavily impacted by grazing from introduced cattle.

Table 5-8 Extent and description of important SRE habitat in the study areas

Habitat type	Area (ha)	% of study area	Potential habitat rating
Beach	16.40	0.06%	Low
Cleared	142.13	0.54%	None
Forest of Eucalyptus spp. over tall shrubland over grassland	54.65	0.21%	Low
Mangal community	285.08	1.08%	Low
Mudflat or salt flat	2,419.73	9.15%	Low
Rocky slope	2.92	0.01%	Low
Samphire shrubland (inland)	295.07	1.12%	Low
Samphire shrubland (tidal)	593.72	2.24%	Low
Shrubland over spinifex grassland	5,326.46	20.14%	Low
Shrubland over spinifex grassland on drainage	100.01	0.38%	Low
Shrubland over tussock grassland	3,805.24	14.38%	Low
Spinifex grassland	120.50	0.46%	Low
Stony plain	1.88	0.01%	Low
Tidal channel and ocean	155.86	0.59%	None
Tussock grassland	12,914.62	48.82%	Low
Tussock grassland on beach and dune	0.03	0.00%	Low
Tussock grassland on granite outcrop	9.47	0.04%	Low
Upright outcrop - shrubland over spinifex grassland	0.47	0.00%	Low
Woodland of Eucalyptus spp. over tussock grassland on drainage	209.38	0.79%	Low
Total	**26,453.64**	**100.00%**	

5.2.1.2.2 SRE records

A total of 40 taxa from SRE groups were collected from the field surveys of the TFSA and the regional targeted survey area to the east, comprising 20 taxa in the TFSA and 23 taxa from the regional targeted survey (Figure 5-6; Table 5-9; Table 5-10).

Three species were common to both the TFSA and the regional targeted survey, all isopods:

- *Acanthodillo* 'sp. indet.' A (erramurra),
- *Buddelundia* '32',
- *Buddelundia* '34'.

Seven species were identified in the desktop review or are known from outside the area of the desktop review (21% of recorded taxa):

- *Aname sinuata*
- *Beierolpium* '8/2'
- *Buddelundia* `33`
- *Lychas* 'bituberculatus complex' (however those from the survey are distinctly different morphologically from those of the Hamersley Range)
- *Rhagada convicta*
- *Urodacus* 'pilbara 1'
- *Urodacus* 'pilbara 5'

Within the TFSA 12 taxa are considered Potential SREs and eight are widespread species or indeterminate (Uncertain) taxa. The 12 Potential SRE taxa included five isopods, four scorpions and three mygalomorph spiders. The remaining six taxa collected from the regional targeted survey are widespread species or indeterminate taxa.

Within the regional targeted survey 16 Potential SREs were recorded. These included five isopods, three pseudoscorpions, three land snails, three *Antichiropus* millipedes, two *Cryptops* centipedes, and one scorpion. The remaining seven taxa collected from the regional targeted survey are widespread species or indeterminate taxa.

None of the 25 SREs recorded from the field surveys are named species. All are morphospecies, which are specimens that have been confidently identified as a distinct taxon.

Fifteen taxa are newly discovered and have never been collected before (60% of SREs, or 37.5% of the total assemblage). These include:

- mygalomorph spider – *Conothele* 'MYG726' (TFSA)
- scorpions –
    - *Lychas* 'erramurra' (regional study area)
    - *Urodacus* 'erramurra' (TFSA)
- Pseudoscorpions
    - *Indolpium* 'erramurra1' (regional study area)
    - *Indolpium* 'erramurra2' (regional study area)
- *Antichiropus* millipede –
    - *Antichiropus* 'Phoenix0072' (regional study area)
    - *Antichiropus* 'Phoenix0088' (regional study area)
- *Cryptops* centipedes –
    - *Cryptops* Phoenix0069 (regional study area)
    - *Cryptops* Phoenix0073 (regional study area)

- isopods –
    - *Acanthodillo* sp. A (erramurra) (TFSA and regional study area)
    - *Acanthodillo* sp. B (erramurra) (TFSA)
    - Buddelundiinae ('erramurra') (TFSA)
- *Rhagada* land snails
    - *Rhagada* 'Phoenix0070' (regional study area)
    - *Rhagada* 'Phoenix0071' (regional study area)
    - *Rhagada* 'Phoenix0087' (regional study area)

Accordingly, four taxa are currently known only from the IDF:

- Mygalomorph spider
    - *Conothele* 'MYG726' (Potential SRE) – a single female excavated from a burrow at site FAU06 in Tussock grassland
- Scorpion
    - *Urodacus* 'erramurra'(Potential SRE) – a single female excavated from a burrow at site SRE04 in Shrubland over spinifex grassland.
- Isopods (slaters)
    - *Acanthodillo* sp. B (erramurra) (Potential SRE) – a single female excavated from a burrow at sites SRE03, SRE04, both in Shrubland over spinifex grassland.
    - Buddelundiinae 'erramurra' (Potential SRE) – a single female excavated from a burrow at site SRE07 in Shrubland over spinifex grassland.

437380 442090 446800

7698870 7694160 7689440

0 2.5 5
Kilometers

Tidal channel and ocean
Beach
Mangal community
Spinifex grassland
Mudflat or salt flat
Shrubland over spinifex grassland
Samphire shrubland (tidal)
Samphire shrubland (inland)
Tussock grassland
Woodland of Eucalyptus spp. over tussock grassland on drainage
Cleared
Shrubland over tussock grassland
Shrubland over spinifex grassland on drainage

Confirmed

- 1, *Antichiropus simmonsi*

Potential

- 2, *Acanthodillo* sp. indet. A (erramurra)
- 3, *Acanthodillo* sp. indet. B (erramurra)
- 5, *Antichiropus* 'Phoenix0072'
- 7, *Buddelundia* '32'
- 8, *Buddelundia* '33'
- 9, *Buddelundia* '34'
- 10, *Buddelundia* '41'
- 13, *Cryptops* 'Phoenix0069'
- 14, *Cryptops* 'Phoenix0073'
- 16, *Indolpium* 'erramurra2'
- 19, *Lychas* 'SCO039/glauerti'
- 21, *Rhagada* 'Phoenix0070'
- 22, *Rhagada* 'Phoenix0071'
- 23, *Rhagada* 'Phoenix0087'
- 25, *Urodacus* 'erramurra'

Uncertain

- 29, Camaenidae sp. indet.
- 30, *Cryptops* sp. indet.
- 31, *Indolpium* sp. indet.
- 32, *Laevophiloscia* sp. indet.
- 33, *Urodacus* sp. indet.

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Map author	JC

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Kilometers

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Terrestrial fauna study area

Fauna habitat

- Beach
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-6a

SRE habitats and recorded SRE taxa

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425875 430620 435365

7695520 7690760 7686000

0 2.5 5
Kilometers

Spinifex grassland
Shrubland over tussock grassland
Samphire shrubland (tidal)
Cleared
Tidal channel and ocean
Mangal community
Tussock grassland on beach and dune
Mudflat or salt flat
Tussock grassland on granite outcrop
Shrubland over spinifex grassland
Samphire shrubland (inland)
Tussock grassland
Forest of Eucalyptus spp. over tall shrubland over grassland
Woodland of Eucalyptus spp. over tussock grassland on drainage
Shrubland over spinifex grassland on drainage

7 30 2 3
20 28 19
2 4 30 7
19 9
7 31
31 11 7 30 2 24
31 2 7
19 12 17 30 9
9 18

Potential

- 2, *Acanthodillo* sp. indet. A (erramurra)
- 3, *Acanthodillo* sp. indet. B (erramurra)
- 4, *Aname* 'MYG593'
- 7, *Buddelundia* '32'
- 9, *Buddelundia* '34'
- 11, Buddelundiinae 'erramurra'
- 12, *Conothele* 'MYG726'
- 17, *Isometroides* 'SCO051'
- 18, *Lychas* 'bituberculatus complex'
- 19, *Lychas* 'SCO039/glauerti'
- 20, *Lychas* sp. indet.
- 24, *Synothele* 'MYG335'

Uncertain

- 28, *Buddelundia* sp. indet.
- 30, *Cryptops* sp. indet.
- 31, *Indolpium* sp. indet.

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Kilometers

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Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-6b

SRE habitats and recorded SRE taxa

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416896 421648 426400

7697020 7692270 7687510

Potential

- 2, *Acanthodillo* sp. indet. A (erramurra)
- 7, *Buddelundia* '32'
- 9, *Buddelundia* '34'
- 11, Buddelundiinae 'erramurra'
- 18, *Lychas* 'bituberculatus complex'
- 19, *Lychas* 'SCO039/glauerti'
- 24, *Synothele* 'MYG335'

Uncertain

- 30, *Cryptops* sp. indet.
- 31, *Indolpium* sp. indet.

0 2.5 5
Kilometers

Spinifex grassland
Shrubland over tussock grassland
Beach
Tidal channel and ocean
Tussock grassland on beach and dune
Mangal community
Mudflat or salt flat
Samphire shrubland (tidal)
Shrubland over spinifex grassland
Samphire shrubland (inland)
Cleared
Tussock grassland
Tussock grassland on granite outcrop
Forest of Eucalyptus spp. over tall shrubland over grassland
Woodland of Eucalyptus spp. over tussock grassland on drainage
Shrubland over spinifex grassland on drainage

7 31
31 11 7 24 30
31 7 2
2
19
9
18

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Kilometers

1:47,000 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Fauna habitat

- Beach
- Forest of Eucalyptus spp. over tall shrubland over grassland
- Mangal community
- Mudflat or salt flat
- Samphire shrubland (inland)
- Samphire shrubland (tidal)
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Spinifex grassland
- Tidal channel and ocean
- Tussock grassland
- Tussock grassland on beach and dune
- Tussock grassland on granite outcrop
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-6c

SRE habitats and recorded SRE taxa

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422240
427000
431760
7682100
7677310
7672520

Shrubland over spinifex grassland on drainage

Forest of Eucalyptus spp. over tall shrubland over grassland

18

9

Tussock grassland

Shrubland over spinifex grassland

Cleared

Tussock grassland on granite outcrop

Shrubland over tussock grassland

19

Woodland of Eucalyptus spp. over tussock grassland on drainage

Upright outcrop - shrubland over spinifex grassland

0 2.5 5
Kilometers

Potential

- 9, *Buddelundia* '34'
- 18, *Lychas* 'bituberculatus complex'
- 19, *Lychas* 'SCO039/glauerti'

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Terrestrial fauna study area

Fauna habitat

- Forest of Eucalyptus spp. over tall shrubland over grassland
- Shrubland over spinifex grassland
- Shrubland over spinifex grassland on drainage
- Shrubland over tussock grassland
- Tussock grassland
- Tussock grassland on granite outcrop
- Upright outcrop - shrubland over spinifex grassland
- Woodland of Eucalyptus spp. over tussock grassland on drainage
- Cleared

Figure 5-6d

SRE habitats and recorded SRE taxa

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Table 5-9 Specimens from SRE groups recorded in the field survey

Shaded cells indicate specimens recorded from the TFSA.

Family	Taxon	Site/s	Habitat/s	No. specimens	SRE status	Comments
Arachnida – Mygalomorphae (trap-door spiders) (4)						
Anamidae	*Aname* 'MYG593'	1320 site: SRE05	Shrubland over spinifex grassland	4	Potential	Morphologically similar to the widespread *A. mellosa*; however, molecular sequencing has identified it as *A.* 'MYG593' which was previously known only from Barrow Island.
	Aname sinuata	1320 site: SRE08	Shrubland over spinifex grassland	1	Not SRE	Widely distributed throughout the Pilbara, Carnarvon, Little Sandy Desert and Great Sandy Desert.
Barychelidae	*Synothele* 'MYG335'	1320 site: SRE07	Shrubland over spinifex grassland	1	Potential	*S.* 'MYG335' is known from the mainland and Barrow Island. It may be synonymous with *S. butleri* as it is morphologically similar; however, molecular comparison could only be made with a female specimen from Barrow Island.
Halonoproctidae	*Conothele* 'MYG726'	1320 site: FAU06	Tussock grassland	1	Potential	A newly discovered species with no other known close relatives. **Known only from the IDF.**
Arachnida – Scorpiones (scorpions) (9)						
Buthidae	*Isometroides* 'SCO051/barrow'	1320 site: FAU06	Tussock grassland	1	Potential	This specimen represents a known but undescribed species which was only known previously from Barrow Island.
	Lychas 'bituberculatus complex'	1320 site: FAU07	Tussock grassland	6	Potential	This taxon contains at least three morphologically identical species according to recent molecular sequencing of specimens. The specimens collected in this survey appear different morphologically to those collected from the Hamersley Ranges.

Family	Taxon	Site/s	Habitat/s	No. specimens	SRE status	Comments
	Lychas 'erramurra'	1392 sites: SRE003, SRE007, SRE015, SRE017, SRE018, SRE026	Not mapped	15	Potential	Records of this species are only known from the western Pilbara.
	Lychas 'SCO039/glauerti'	1320 sites: FAU03, FAU06, FAU01, FAU05, FAU02	Shrubland over tussock grassland, shrubland over spinifex grassland	19	Potential	*L.* 'SCO039/glauerti' is known from both the mainland and Barrow Island.
	Lychas sp. indet.	1320 site: FAU03	Shrubland over tussock grassland	1	Uncertain	
Urodacidae	*Urodacus* 'erramurra'	1320 site: SRE04	Shrubland over spinifex grassland	1	Potential	A newly discovered species not collected before. **Known only from the IDF.**
	Urodacus 'pilbara1'	1392 site: SRE008	Not mapped	1	Not SRE	A widespread species.
	Urodacus 'pilbara5'	1320 sites: SRE01, SRE02, FAU01	Shrubland over spinifex grassland, shrubland over tussock grassland	5	Not SRE	A widespread species.
	Urodacus sp. indet.	1320 site: SRE04	Shrubland over spinifex grassland	1	Uncertain	
Arachnida – Pseudoscorpiones (false scorpions) (6)						
Olpiidae	*Austrohorus* 'sp. indet.'	1392 site: SRE006	Not mapped	1	Uncertain	
	Beierolpium '8/2'	1392 site: SRE006	Not mapped	1	Potential	Part of a complex that is not well known.
	Beierolpium 'sp. indet.'	1392 site: SRE008	Not mapped	2	Uncertain	
	Indolpium 'erramurra1'	1392 sites: SRE0035 SRE006, SRE008	Not mapped	8	Potential	A taxon potentially only known from the survey.
	Indolpium 'erramurra2'	1392 sites: SRE001, SRE004	Not mapped	3	Potential	A taxon potentially only known from the survey.
	Indolpium sp. indet.	1320 sites: SRE01, SRE06, SRE07, SRE08	Shrubland over spinifex grassland	16	Uncertain	This could represent an SRE or non-SRE taxon, however morphological and molecular information on this genus is very poor. All specimens from a single, widespread habitat.

Family	Taxon	Site/s	Habitat/s	No. specimens	SRE status	Comments
Myriapoda – Diplopoda (millipedes) (2)						
Paradoxo-somatidae	*Antichiropus* Phoenix0088'	1392 site: SRE016	Not mapped	1	Confirmed	This specimen is 4.9% divergent from MK735891 (*Antichiropus simmonsi,* 50 km E. of Port Hedland) and could be considered conservatively conspecific; however, due to the low sequence divergence between some species-pairs in *Antichiropus* (Car *et al.* 2019: 68), we have left it as a distinct taxon.
	Antichiropus 'Phoenix0072'	1392 site: SRE014	Not mapped	1	Potential	The closest molecular match is Phoenix specimen *A*. 'DNA02' which is 8.5% divergent.
Myriapoda – Chilopoda (centipedes) (3)						
Cryptopidae	*Cryptops* sp. indet	1320 sites: FAU06, SRE01, SRE03, SRE04, SRE05, SRE07	Shrubland over spinifex grassland	16	Uncertain	This could represent an SRE or non-SRE taxon, however morphological and molecular information on this taxon is lacking. All specimens from a single, widespread habitat.
	Cryptops 'Phoenix0069'	1392 site: SRE002	Not mapped	3	Potential	A newly discovered species not collected before. **Known only from the survey**.
	Cryptops 'Phoenix0073'	1392 site: SRE014	Not mapped	2	Potential	A newly discovered species not collected before. **Known only from the survey**.
Crustacea – Isopoda (slaters) (11)						
Armadillidae	*Acanthodillo* sp. A (Erramurra)	1320 sites: SRE02, SRE03, SRE04, SRE05, SRE07, SRE08, 1392 site: SRE06	Shrubland over tussock grassland, shrubland over spinifex grassland	34	Potential	*Acanthodillo* is a poorly studied group. It is a widespread but rarely collected genus so their biology and distribution is largely unknown.
	Acanthodillo sp. B (Erramurra)	1320 sites: SRE03, SRE04	Shrubland over spinifex grassland	2	Potential	*Acanthodillo* is a poorly studied group. It is a widespread but rarely collected genus so their biology and distribution is largely unknown. **Known only from the IDF.**

Family	Taxon	Site/s	Habitat/s	No. specimens	SRE status	Comments
	Buddelundia '14'	1320 sites: SRE04, FAU03, FAU05, NQ06	Upright outcrop, shrubland over tussock grassland, shrubland over spinifex grassland, tussock grassland	7	Not SRE	*Buddelundia* 14 is a common and widespread morphospecies.
	Buddelundia '14re'	1392 sites: SRE001, SRE011, SRE014, SRE015, SRE019	Not mapped	88	Not SRE	These specimens differ morphologically from other *Buddelundia* 14 forms occurring further south. These specimens match those from an area significantly east of this study. This morphospecies also occurs near Onslow. There is no evidence to suggest that it is a SRE species.
	Buddelundia '32'	1320 sites: FAU04, SRE01, SRE02, SRE03, SRE04, SRE05, SRE06, SRE07, SRE08 1392 sites: SRE002, SRE005, SRE006, SRE011, SRE012, SRE020	Shrubland over tussock grassland, shrubland over spinifex grassland	414	Potential	Previously only known from Barrow Island.
	Buddelundia '33'	1392 sites: SRE002, SRE010	Not mapped	3	Potential	Also known from Anketell Point and from a location 75 km SE of the study area. These specimens are similar but not the same species as those found on Barrow Island (*B.* 35) and differs from *B.* 20 & 36.
	Buddelundia '34'	1320 sites: FAU05, FAU06, FAU07 1392 sites: SRE001, SRE003, SRE004, SRE007, SRE009, SRE011, SRE014, SRE0015, SRE017, SRE018, SRE19, SRE024, SRE024, SRE026	Shrubland over tussock grassland, tussock grassland, 1392 sites unmapped	1,543	Potential	Also known from populations 40 and 55 km to the east of the study area.

Family	Taxon	Site/s	Habitat/s	No. specimens	SRE status	Comments
	Buddelundia '41'	1392 sites: SRE002, SRE006, SRE008, SRE016, SRE023	Not mapped	34	Potential	The species is also known from one location approximately 100 km SE. of the study area.
	Buddelundia sp. indet.	1320 site: FAU03	Shrubland over tussock grassland	1	Uncertain	Possibly *B*. '14', a widespread species recorded at five other sites within the study area.
	Buddelundiinae 'erramurra'	1320 site: SRE07	Shrubland over spinifex grassland	1	Potential	The species belongs to an undescribed genus closely related to *Buddelundia*. **Known only from the IDF.**
Philosciidae	*Laevophiloscia* 'sp. Indet.'	1392 sites: SRE001, SRE003, SRE006, SRE007, SRE008	Not mapped	38	Uncertain	
Land snails (4)						
Camaenidae	Camaenidae 'sp. indet.'	1392 sites: SRE004 SRE016	Not mapped	3	Uncertain	
	Rhagada convicta	1392 sites: SRE005, SRE006, SRE008, SRE015, SRE019, SRE021, SRE026	Not mapped	29	Not SRE	Distributed through the west Pilbara and islands.
	Rhagada 'Phoenix0087'	1392-SRE001	Not mapped	1	Potential	The closest molecular match to this specimen is *Rhagada elachystoma* known only from islands in the Dampier Archipelago. At 5.1% genetic divergence, this specimen is >2x the average genetic distance (2.3%) between species of *Rhagada* on the Dampier Archipelago (Johnson *et al.* 2004). Further, mainland *Rhagada* typically have non-overlapping ranges spanning 200 km or more (Solem 1997).Therefore this specimen must be treated as a distinct from *R.elachystoma*
	Rhagada 'Phoenix0070'	1392 site: SRE002	Not mapped	1	Potential	The closest molecular match to this specimen is *Rhagada* sp. 'Pilbara Banded' at 8.9% divergence.
	Rhagada 'Phoenix0071'	1392 site: SRE010	Not mapped	1	Potential	The closest molecular match to this specimen is *Rhagada* sp. at 12.4% divergence.

Table 5-10 SRE survey site-species matrix

Species in bold are constrained to within the IDF. Species highlighted in yellow are common to both study areas.

Species name	SRE status	Survey sites within the TFSA																Regional survey sites																							Total abund. per sp.	Cnt of sites per sp.
		1320-FAU01	1320-FAU02	1320-FAU03	1320-FAU04	1320-FAU05	1320-FAU06	1320-FAU07	1320-NQ06	1320-SRE01	1320-SRE02	1320-SRE03	1320-SRE04	1320-SRE05	1320-SRE06	1320-SRE07	1320-SRE08	1392-SRE001	1392-SRE002	1392-SRE003	1392-SRE004	1392-SRE005	1392-SRE006	1392-SRE007	1392-SRE008	1392-SRE009	1392-SRE010	1392-SRE011	1392-SRE012	1392-SRE014	1392-SRE015	1392-SRE016	1392-SRE017	1392-SRE018	1392-SRE019	1392-SRE021	1392-SRE023	1392-SRE024	1392-SRE026		
Arachnida – Mygalomorphae (trap-door spiders) (4)																																									
Aname 'MYG593'	Pot.													4																										**4**	**1**
Aname sinuata	WS																1																								**1**	**1**
***Conothele* 'MYG726'**	**Pot.**						**1**																																	**1**	**1**
Synothele 'MYG335'	Pot.															1																									**1**	**1**
Arachnida – Pseudoscorpiones (6)																																									
Austrohorus sp. indet.	Unc.																						1																		**1**	**1**
Beierolpium '8/2'	Pot.																						1																		**1**	**1**
Beierolpium sp. indet.	Unc.																								2																**2**	**1**
Indolpium 'erramurra1'	Pot.																					4	3		1																**8**	**3**
Indolpium 'erramurra2'	Pot.																	1			2																				**3**	**2**
Indolpium sp. indet.	Unc.									1					10	3	2																								**16**	**4**
Arachnida – Scorpions (8)																																									
Isometroides 'SCO051'	Pot.						1																																	**1**	**1**
Lychas 'bituberculatus complex'	Pot.							6																																	**6**	**1**
Lychas 'erramurra'	Pot.																			1				1							2		8	1					2	**15**	**6**
Lychas 'SCO039/glauerti'	Pot.	1	1	11		4	2																																	**19**	**5**
Lychas sp. indet.	Unc.			1																																				**1**	**1**
***Urodacus* 'erramurra'**	**Pot.**												**1**																											**1**	**1**
Urodacus 'pilbara 1'	WS																								1																**1**	**1**
Urodacus 'pilbara 5'	WS	2								1	2																														**5**	**3**
Urodacus sp. indet.	Unc.												1																												**1**	**1**
Chilopoda (Centipedes) (3)																																									
Cryptops 'Phoenix0069'	Pot.																		3																						**3**	**1**
Cryptops 'Phoenix0073'	Pot.																													2											**2**	**1**
Cryptops sp. indet.	Pot.						6			3		2	1	3		1																									**16**	**6**
Diplopoda (Millipedes) (2)																																									

Species name	SRE status	Survey sites within the TFSA																Regional survey sites																							Total abund. per sp.	Cnt of sites per sp.
		1320-FAU01	1320-FAU02	1320-FAU03	1320-FAU04	1320-FAU05	1320-FAU06	1320-FAU07	1320-NQ06	1320-SRE01	1320-SRE02	1320-SRE03	1320-SRE04	1320-SRE05	1320-SRE06	1320-SRE07	1320-SRE08	1392-SRE001	1392-SRE002	1392-SRE003	1392-SRE004	1392-SRE005	1392-SRE006	1392-SRE007	1392-SRE008	1392-SRE009	1392-SRE010	1392-SRE011	1392-SRE012	1392-SRE014	1392-SRE015	1392-SRE016	1392-SRE017	1392-SRE018	1392-SRE019	1392-SRE021	1392-SRE023	1392-SRE024	1392-SRE026		
Antichiropus 'Phoenix0072'	Pot.																													1											**1**	**1**
Antichiropus 'Phoenix0088'	Pot.																															1									**1**	**1**
Gastropoda (Land snails) (6)																																										
Camaenidae sp. indet.	Unc.																				2											1									**3**	**2**
Rhagada convicta	WS																					1	2		6						3				1	10			6	**29**	**7**
Rhagada 'Phoenix0070'	Pot.																		1																						**1**	**1**
Rhagada 'Phoenix0071'	Pot.																										1														**1**	**1**
Rhagada 'Phoenix0087'	Pot.																	1																							**1**	**1**
Camaenidae sp. indet.	Unc.																				2											1									**3**	**2**
Malacostraca (Isopods) (11)																																										
Acanthodillo sp. indet. A (erramurra)	Pot.										10	3	2	2		5	12						1																		**35**	**7**
***Acanthodillo* sp. indet. B (erramurra)**	**Pot.**											1	1																												**2**	**2**
Buddelundia '32'	Pot.				3					15	18	75	64	8	23	25	139		2			6	6					10	17						3					**414**	**15**
Buddelundia '33'	Pot.																		2								1													**3**	**2**
Buddelundia '34'	Pot.					11	2	2										54		112	4607			305		11		319		6	53		10	34	4			7	6	**5543**	**16**
Buddelundia '41'	Pot.																		23				1		3							3					4			**34**	**5**
Buddelundia 'sp. 14'	WS			1		2			3				1																											**7**	**4**
Buddelundia 'sp. 14re'	<>SRE																	6										13		15	51				3					**88**	**5**
Buddelundia sp. indet.	Unc.			1																																				**1**	**1**
***Buddelundiinae* 'erramurra'**	**Pot.**															1																									**1**	**1**
Laevophiloscia sp. indet.	Unc.																	4		18			1	13	2																**38**	**5**
Total abundance per site		**3**	**1**	**14**	**3**	**17**	**12**	**8**	**3**	**20**	**30**	**81**	**71**	**17**	**33**	**36**	**154**	**66**	**31**	**131**	**4611**	**11**	**16**	**319**	**15**	**11**	**2**	**342**	**17**	**24**	**109**	**5**	**18**	**35**	**11**	**10**	**4**	**7**	**14**	**6312**	
Species count per site		**2**	**1**	**4**	**1**	**3**	**5**	**2**	**1**	**4**	**3**	**4**	**7**	**4**	**2**	**6**	**4**	**5**	**5**	**3**	**3**	**3**	**8**	**3**	**6**	**1**	**2**	**3**	**1**	**4**	**4**	**3**	**2**	**2**	**4**	**1**	**1**	**1**	**3**		

5.2.2 Migratory shorebirds of the SBSA

5.2.2.1 Migratory shorebirds in the SBSA

A summary of the Migratory shorebird dataset per transect is presented in Table 5-11 and all shorebird records are shown visually, variously in Figure 5-7 - Figure 5-15. The survey found a diverse and abundant assemblage of shorebirds, including numerous Threatened and Priority species, also listed as Migratory, many of which were in nationally and internationally significant numbers. A total of 31 species listed as Migratory were recorded. This includes Osprey, which is not a shorebird and thus is not included in the analysis below.

The shorebird assemblage was dominated by species (15) in the family Scolopacidae (Snipes, Sandpipers, Godwits and Curlews); members of this family dominated the list of species in nationally and internationally significant numbers. Species in the family Laridae (Gulls, Noddys and Terns) were also common (seven species), as were those in the family Charadriidae (Dotterels, Plovers, and Lapwings), which were represented by five species (Table 5-11).

The longitudinal nature of the surveys emphasises the highly variable shorebird numbers in time and space (including between tides) and between transects (survey periods) (Table 5-11). It is clear from the data that different species arrive at different times and stay within the SBSA for variable lengths of time.

The data below concerning threshold criteria are based on the maximum aggregate abundance of each species per transect. However, it is also instructive to look at the distribution of the abundance data in order to understand what is the best approximation, or typical abundance, for each species. The distribution of aggregate abundance for each species is provided as box and whisker plots (Figure 5-7; Figure 5-8; Figure 5-9). Figure 5-7 and Figure 5-8 detail the results for summer transects, for high and low tides, respectively. Due to relatively low overall counts in winter, both high and low tide data are combined in Figure 5-9.

All data are presented as the aggregate abundance in descending order of any outliers. There are a lot of data in those figures and thus just a few highlights are presented (Figure 5-7; Figure 5-8; Figure 5-9). Oriental Pratincole has been removed as an extreme outlier that results in the charts being difficult to read. As many as 75,377 Oriental Pratincoles were recorded in a single transect, but the median aggregate abundance was 389, highlighting how extreme the changes in abundance can be in time and space. It was recorded from 13 of 17 summer transects and was not recorded overwintering. Similarly for the Red-necked Stint, which is typically the most abundant species within the SBSA at high tide, it was recorded in numbers approaching 3,500 in one transect but was typically recorded (median) at approximately 900 individuals on a given high tide transect. In comparison, at low tide the median aggregate abundance was closer to 100 individuals. Grey-tailed Tattler was one of the most abundant species, being highly abundant at both high and low tides, but far more so on high tides. Bar-tailed Godwit numbers on the other hand, appear to be relatively stable on both tides.

The movement of the shorebird population is visualised as heat maps of aggregate abundance (Log_{10} transformed to account for the large variation in abundance) in Figure 5-10 – Figure 5-13. Transect data is combined for summer high tide (Figure 5-10), summer low tide (Figure 5-11), winter high tide (Figure 5-12) and winter low tide (Figure 5-13). The maps explicitly demonstrate the movement of shorebirds with the tide, in both seasons, in and out of the Project area.

It is evident from the heat maps that on low tide when the intertidal mudflats are exposed the shorebirds move out of the SBSA and are highly concentrated in the bay and island immediately north of the Project, and in the 'delta' south of Cape Preston, to the west of the Project. At high tide when the mudflats are inundated, the birds move back into the SBSA to forage in the tidal samphire shrublands and mangroves, and on exposed sand bars in the tidal channels, but are more diffuse. However, important aggregations (roosting) still occur on high tide on the beaches west of 40 Mile

Beach, on the island offshore and also at the delta south of Cape Preston. The same pattern is evident in winter, but there are obviously far fewer birds in the area at that time.

Turning to individual species, six Threatened Migratory species were recorded, including three Critically Endangered species, two Endangered species and one Vulnerable species (Table 5-11; Figure 5-15):

- Critically Endangered
  - Curlew Sandpiper
  - Eastern Curlew
  - Great Knot
- Endangered
  - Lesser Sand Plover
  - Red Knot
- Vulnerable
  - Greater Sand Plover.

One DBCA Priority 4 species was also recorded:

- Grey-tailed Tattler.

Twenty-one of the 37 Migratory species listed under DoEE (2017) were recorded. Of these, 14 (66% of recorded species or 38% of the 37 Migratory species listed under DoEE 2017) were recorded in nationally significant numbers, including (species in bold are also Threatened or Priority species):

- **Greater Sand Plover (VU/Mig. EPBC Act; VU BC Act)** – recorded in nationally significant numbers twice in February
- Oriental Pratincole (Mig. EPBC & BC Acts) – recorded in nationally significant numbers three times in February
- Ruddy Turnstone (Mig. EPBC & BC Acts) – recorded in nationally significant numbers in every transect in January and February
- Sharp-tailed Sandpiper (Mig. EPBC & BC Acts) – recorded in nationally significant numbers in 30% of summer transects
- Sanderling (Mig. EPBC & BC Acts) – recorded in nationally significant numbers once in December 2019
- **Red Knot (EN/Mig. EPBC Act; EN BC Act)** – recorded in nationally significant numbers once in February 2020
- **Curlew Sandpiper (CR/Mig. EPBC Act; CR BC Act)** – recorded in nationally significant numbers once in February 2020
- Red-necked Stint (Mig. EPBC & BC Acts) – recorded in nationally significant numbers in 35% of summer transects
- Bar-tailed Godwit (Mig. EPBC & BC Acts) – recorded in nationally significant numbers once in January and twice in February
- **Eastern Curlew (CR/Mig. EPBC Act; CR BC Act)** – recorded in nationally significant numbers twice in February. They appear to have arrived in larger numbers in early February and remained on site throughout February
- Whimbrel (Mig. EPBC & BC Acts) – recorded in nationally significant numbers in 53% of summer transects
- **Grey-tailed Tattler (Mig. EPBC & BC Acts; P4 DBCA list)** – recorded in nationally significant numbers throughout January and February, and also in July (overwintering)
- Common Greenshank (Mig. EPBC & BC Acts) – recorded in nationally significant numbers twice in December and three times in February
- Terek Sandpiper (Mig. EPBC & BC Acts) – recorded in nationally significant numbers twice in February.

Three species were recorded in internationally significant numbers:

- Oriental Pratincole (Mig. EPBC & BC Acts) – up to 75,377 individuals recorded in the air, in a single transect in February 2020, which represents 2.6% of the world's population
- Ruddy Turnstone (Mig. EPBC & BC Acts) – 513 individuals recorded in January 2020, which represents 1.7% of the world's population
- Grey-tailed Tattler (Mig. EPBC & BC Acts; P4 DBCA list) – as above the area supports a large number of this species throughout summer, with as much as 3.15% of the world's population being recorded in a single transect.

According to this summary the SBSA is an internationally important wetland site, as the area was found to regularly support >1% of the individuals in a population of one species or subspecies (DoEE 2017). Due to a large aggregation of Oriental Pratincole in February (75,377 individuals) the area has recorded close to 100,000 individuals in a single transect, which if that were to occur regularly, would also exceed the second threshold criteria for internationally important wetland habitat, being a total abundance of at least 20,000 waterbirds. However, typically the area recorded less than 10,000 waterbirds on any given transect, even when factoring in that only 80% of the SBSA was typically reliably surveyed in each transect, and it must be said that the extremely large flock of Oriental Pratincole were observed in the air and were not observed to land within the SBSA. Thus, the SBSA is not considered an internationally important wetland site on the basis of total abundance.

The SBSA does, however, me*et all three* threshold criteria for nationally significant wetland habitat, being that:

- 14 species were recorded in nationally significant numbers (criteria is one species; see section 3.8.2)
- >2000 Migratory shorebirds were regularly recorded in a single transect
- 21 Migratory shorebird species were recorded in total (criteria is 15 species; section 3.8.2).

Table 5-11 Sum of Migratory shorebird abundance per transect and EAAF threshold numbers

HT = 'High tide'; LT = 'Low tide'; Species in bold are also Threatened or Priority species.

Scientific name	Vernacular	Consig. status	EAAF nat.	EAAF intl.	Summer 2020-2021																	Total	Winter 2020				Total	Grand total
					LT 1	HT 2	LT 3	HT 4	LT 5	HT 6	LT 7	HT 8	LT 9	HT 10	LT 11	HT 12	LT 13	HT 14	LT 15	HT 16	LT 17		LT 18	HT 19	LT 20	HT 21		
Charadriidae																												
Charadrius leschenaultii	**Greater Sand Plover**	**(VU/Mig. EPBC Act; VU BC Act)**	200	2000	11	80			4		16	1		16	94	302	158	27	436	170	113	**1428**					**0**	**1428**
Charadrius mongolus. Atrifrons	**Lesser Sand Plover**	**(EN/Mig. BC Act)**	180	1800							2	1										**3**					**0**	**3**
Charadrius veredus	Oriental Plover	(Mig. EPBC & BC Acts)	230	2300					14	197		9			31					1		**252**					**0**	**252**
Pluvialis fulva	Pacific Golden Plover	(Mig. EPBC & BC Acts)	120	1200										2	60							**62**					**0**	**62**
Pluvialis squatarola	Grey Plover	(Mig. EPBC & BC Acts)	80	800	49	7								13	8	59	2	1	1	3	3	**146**					**0**	**146**
Glareolidae																												
Glareola maldivarum	Oriental Pratincole	(Mig. EPBC & BC Acts)	2880	28800		108		3	33	670		12	17	135	13	302	6508	1328	75377	479	6462	**91447**					**0**	**91447**
Laridae																												
Chlidonias leucopterus	White-winged Black Tern	(Mig. EPBC & BC Acts)			9	12		1	60	2												**84**					**0**	**84**
Gelochelidon nilotica	Gull-billed Tern	(Mig. BC Act)							119	134	23	88	61		3	5		5	135	3	34	**610**	72	52	49	34	**207**	**817**

Scientific name	Vernacular	Consig. status	EAAF nat.	EAAF intl.	Summer 2020-2021																		Winter 2020					Grand total
					LT 1	HT 2	LT 3	HT 4	LT 5	HT 6	LT 7	HT 8	LT 9	HT 10	LT 11	HT 12	LT 13	HT 14	LT 15	HT 16	LT 17	Total	LT 18	HT 19	LT 20	HT 21	Total	
Hydroprogne caspia	Caspian Tern	(Mig. EPBC & BC Acts)			8	6	29	20	2	18	6	3	6	9	21	10	6	12	6	5		**167**	4	13	7	9	**33**	**200**
Sterna bergii	Crested Tern	(Mig. EPBC & BC Acts)			5	2	10		1	330	3	93	200	4	13	26	2	4	134	1	46	**874**	30		25	7	**62**	**936**
Sterna dougallii	Roseate Tern	(Mig. EPBC & BC Acts)																	11	8	19	**38**					**0**	**38**
Sterna hirundo	Common Tern	(Mig. EPBC & BC Acts)				31	9	21	1					9	20	11	60	8				**170**					**0**	**170**
Sternula albifrons	Little Tern	(Mig. EPBC & BC Acts)							2		3	8		8	39	2	102	27	82	44	23	**340**					**0**	**340**
Scolopacidae																												
Actitis hypoleucos	Common Sandpiper	(Mig. EPBC & BC Acts)	190	1900	4	5	20	5	6	4	1	6	2	30	12	44	21		27	1	9	**197**	1				**1**	**198**
Arenaria interpres	Ruddy Turnstone	(Mig. EPBC & BC Acts)	30	300	3	21			109	513	88	115	207	63	65	510	85	100	193	71	62	**2205**	7	18	13	17	**55**	**2260**
Calidris acuminata	Sharp-tailed Sandpiper	(Mig. EPBC & BC Acts)	85	850		143	97	660						304	25	2	220			1		**1452**					**0**	**1452**
Calidris alba	Sanderling	(Mig. EPBC & BC Acts)	30	300	4	287	10	6						42	6			13		5		**373**					**0**	**373**
Calidris canutus	**Red Knot**	**(EN/Mig. EPBC Act; EN BC Act)**	110	1100	6	1	6	2	5		16			48	170	70	35	7		8	16	**390**					**0**	**390**

Scientific name	Vernacular	Consig. status	EAAF nat.	EAAF intl.	Summer 2020-2021																		Winter 2020					Grand total
					LT 1	HT 2	LT 3	HT 4	LT 5	HT 6	LT 7	HT 8	LT 9	HT 10	LT 11	HT 12	LT 13	HT 14	LT 15	HT 16	LT 17	Total	LT 18	HT 19	LT 20	HT 21	Total	
Calidris ferruginea	**Curlew Sandpiper**	**(CR/Mig. EPBC Act; CR BC Act)**	90	900	20			4	9							106			4	5		**148**					**0**	**148**
Calidris ruficollis	Red-necked Stint	(Mig. EPBC & BC Acts)	475	4750	185	209	119	3406	145	902	68	70	1214	28	966	1361	1094	13	220	178	88	**10266**		58	205	153	**416**	**10682**
Calidris tenuirostris	**Great Knot**	**(CR/Mig. EPBC Act; CR BC Act)**	425	4250	6	9	10	26	2		20			3		26		22	94	38	82	**338**					**0**	**338**
Limosa lapponica	Bar-tailed Godwit	(Mig. EPBC & BC Acts)	325	3250	52	3		5	315	418	205	153	1191	326	131	209	101	225	350	126	141	**3951**	45		45	36	**126**	**4077**
Limosa limosa	Black-tailed Godwit	(Mig. BC Act)	160	1600										2			5					**7**					**0**	**7**
Numenius madagascariensis	**Eastern Curlew**	**(CR/Mig. EPBC Act; CR BC Act)**	35	350	3	1	3	3	21	29	1	21	34	43	104	8	17	2	2		1	**293**	6	1	1		**8**	**301**
Numenius phaeopus	Whimbrel	(Mig. EPBC & BC Acts)	65	650	1	8	7	34	78	102	34	69	122	193	159	375	125	8	28	21	155	**1519**	46	62	54	28	**190**	**1709**
Tringa brevipes	**Grey-tailed Tattler**	**(Mig. EPBC & BC Acts; P4 DBCA list)**	70	700	16	11	1	11	308	471	342	199	533	129	947	2209	1108	267	814	152	800	**8318**	24	323	481	373	**1201**	**9519**
Tringa nebularia	Common Greenshank	(Mig. EPBC & BC Acts)	110	1100	9	26	783	844	38	68	52	23	72	146	138	38	128	21	30	13	23	**2452**		7	1	10	**18**	**2470**

Scientific name	Vernacular	Consig. status	EAAF nat.	EAAF intl.	Summer 2020-2021																	Total	Winter 2020				Total	Grand total
					LT 1	HT 2	LT 3	HT 4	LT 5	HT 6	LT 7	HT 8	LT 9	HT 10	LT 11	HT 12	LT 13	HT 14	LT 15	HT 16	LT 17		LT 18	HT 19	LT 20	HT 21		
Xenus cinereus	Terek Sandpiper	(Mig. EPBC & BC Acts)	50	500	1	2		4	7					33	154	192	6	2	5	5	15	**426**					**0**	**426**
Sulidae																												
Sula leucogaster	Brown Booby	(Mig. EPBC & BC Acts)				3																**3**					0	**3**
Total abundance					392	975	1104	5055	1279	3858	880	871	3659	1586	3179	5867	9783	2092	77949	1338	8092		235	534	881	667		
Extrapolated total abundance					470	1170	1325	6066	1535	4630	1056	1045	4391	1903	3815	7040	11740	2510	93539	1606	9710		282	641	1057	800		
Diversity					18	21	13	17	21	14	16	16	12	22	22	21	19	19	19	22	18		9	8	10	9		
Internationally important wetland based on abundance of individual species											Y				Y	Y	Y	Y	Y	Y	Y							
Internationally important wetland based on total waterbird abundance																			*									
Nationally important wetland based on abundance of individual species						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y		
Nationally important wetland based on diversity					Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y							
Nationally important wetland based on total waterbird abundance							Y	Y		Y			Y		Y	Y	Y	Y	Y	Y	Y							

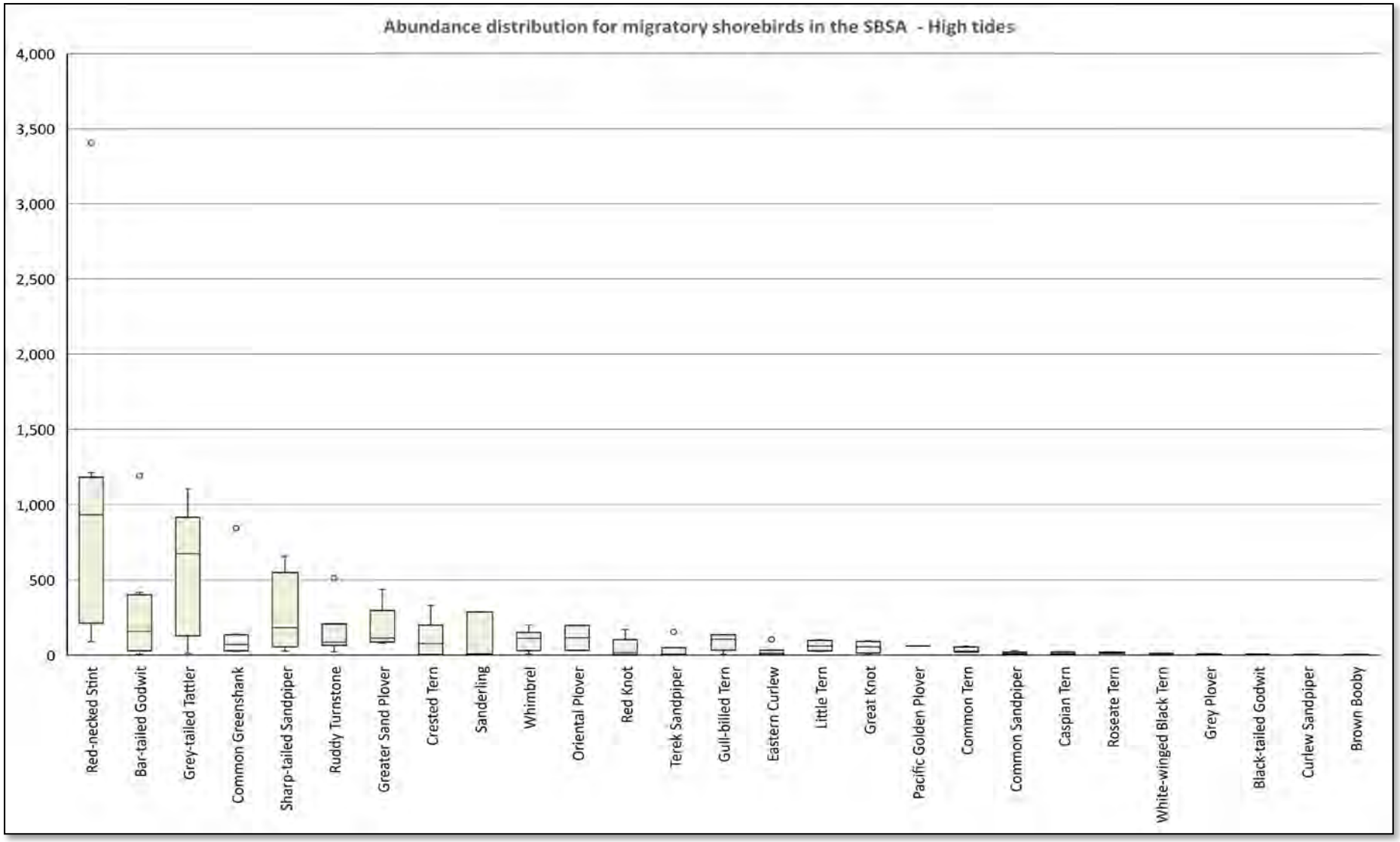

Figure 5-7 Abundance distribution for Migratory shorebirds in the SBSA at high tides in summer

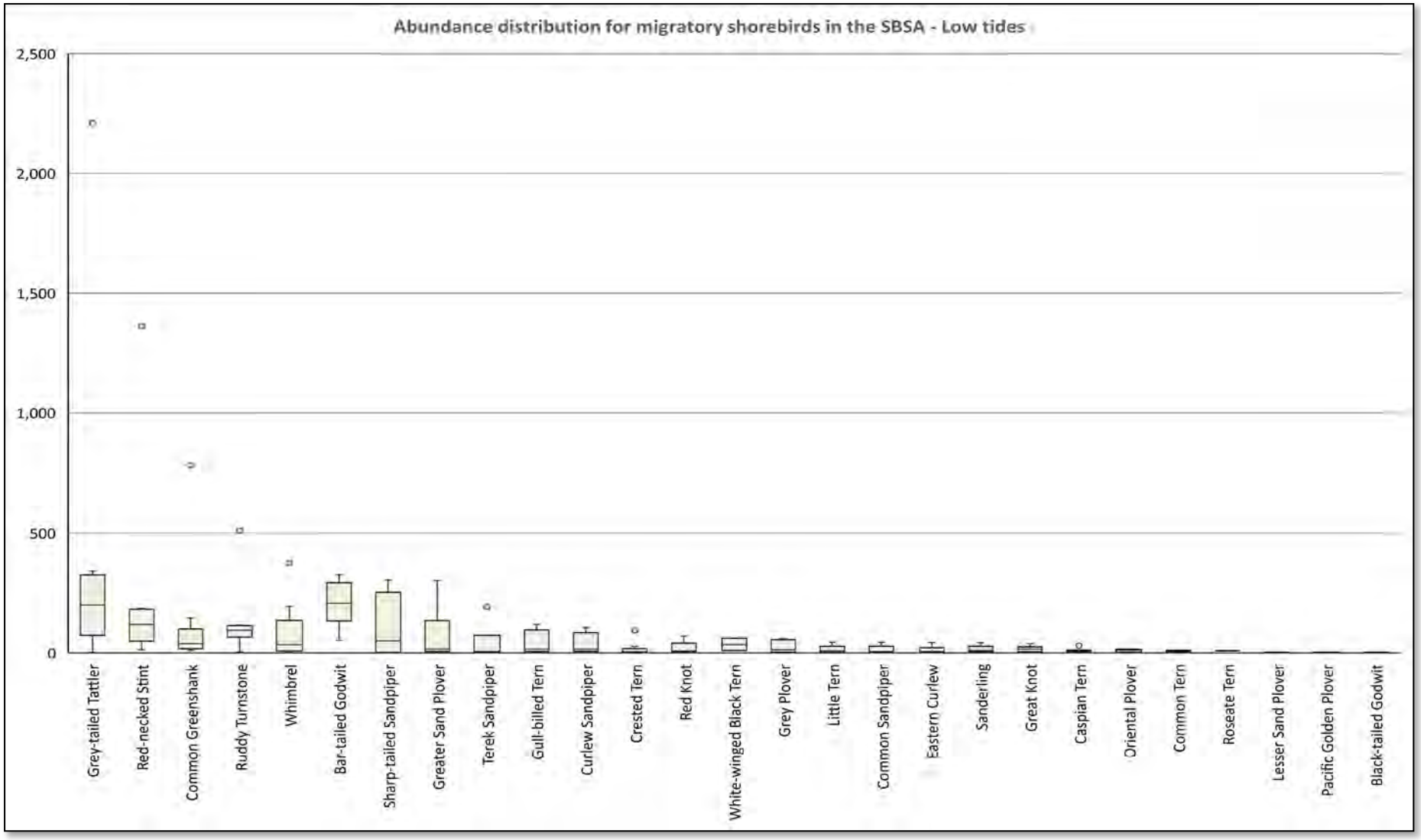

Figure 5-8 Abundance distribution for Migratory shorebirds in the SBSA at low tides in summer

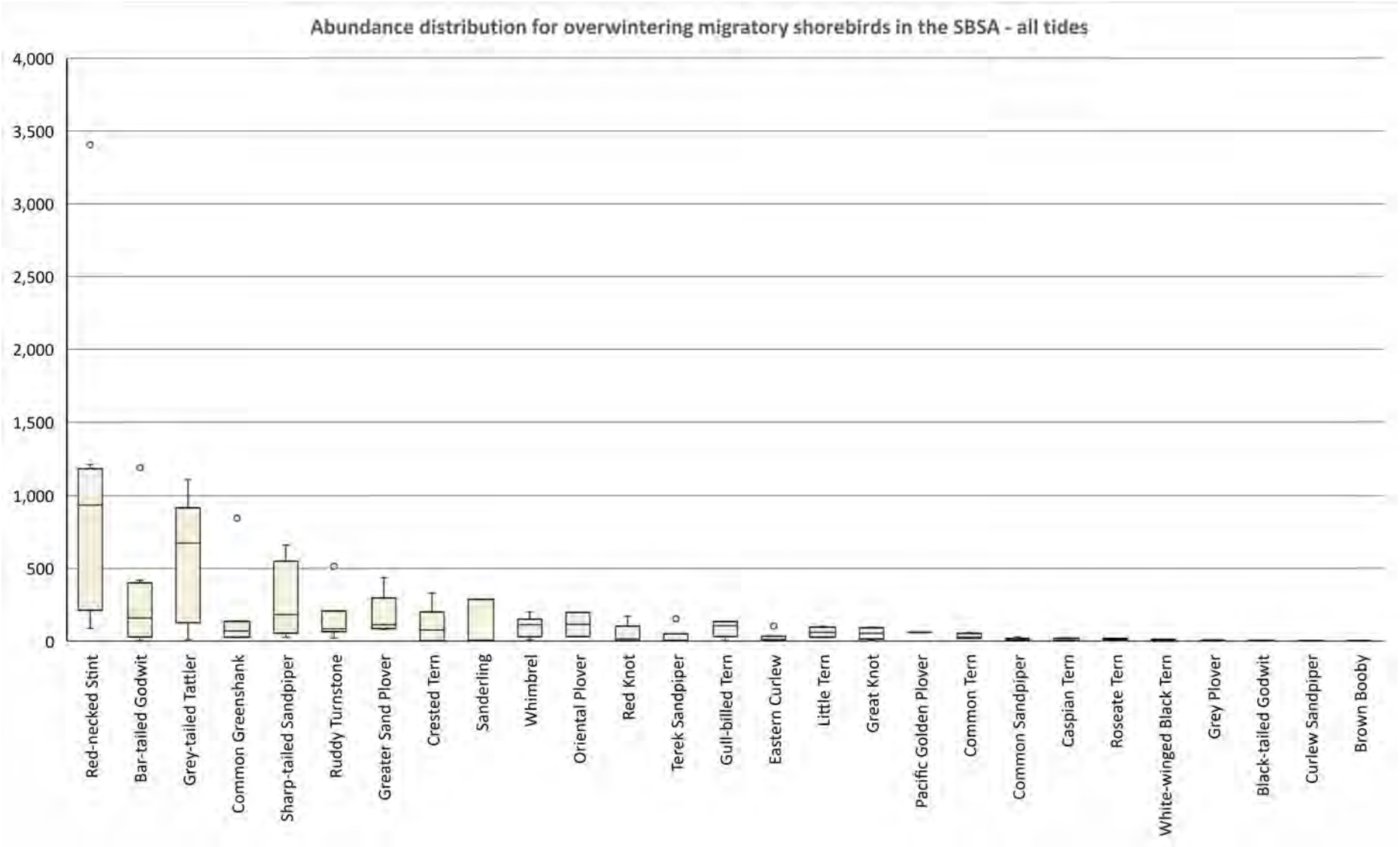

Figure 5-9 Abundance distribution for overwintering Migratory shorebirds in the SBSA at all tides

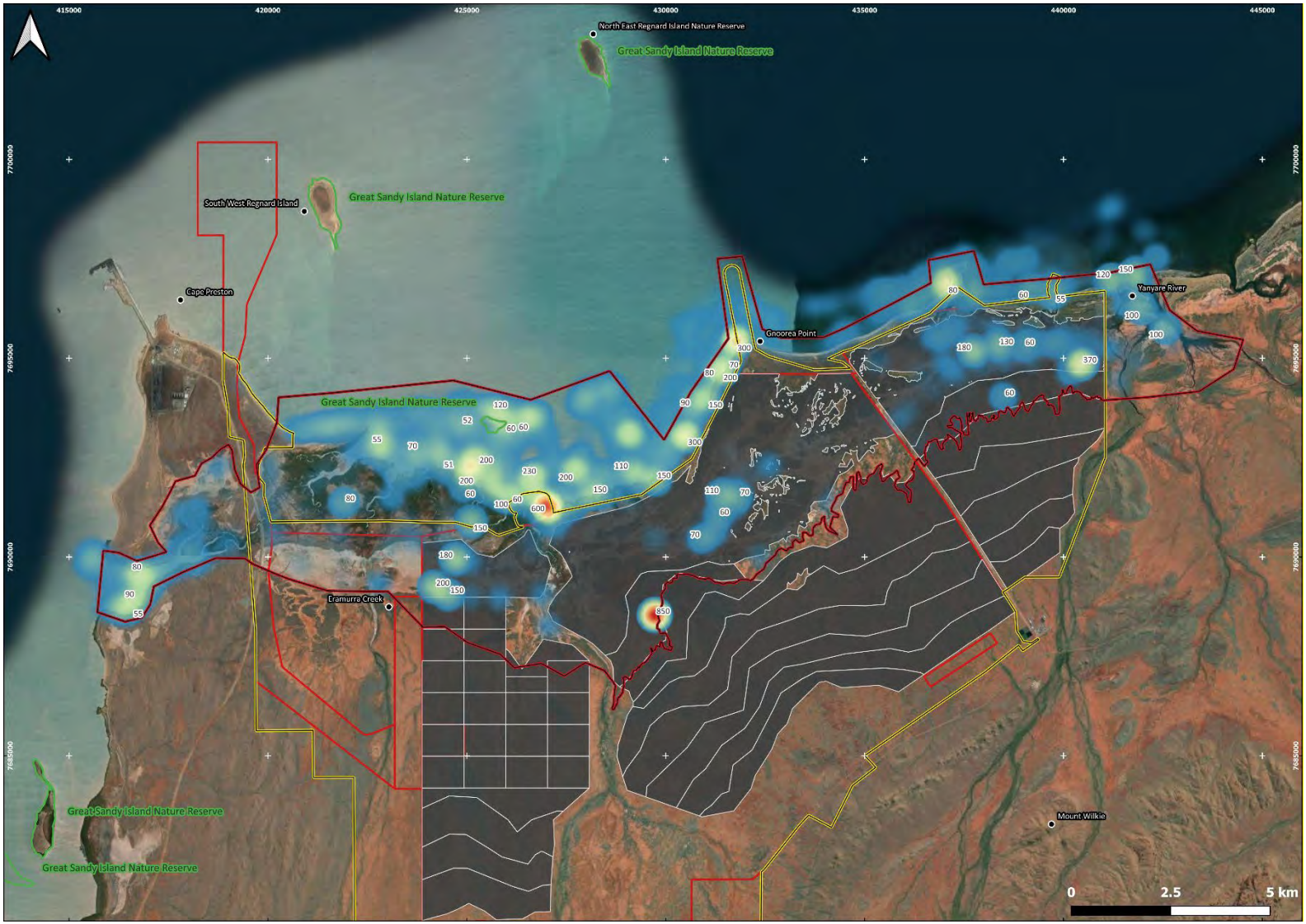

Figure 5-10 Summer low tide heat map for all birds recorded during shorebird transects based on Log_{10}(abundance)

Figure 5-11 Summer high tide heat map for all birds recorded during shorebird transects based on Log_{10}(abundance)

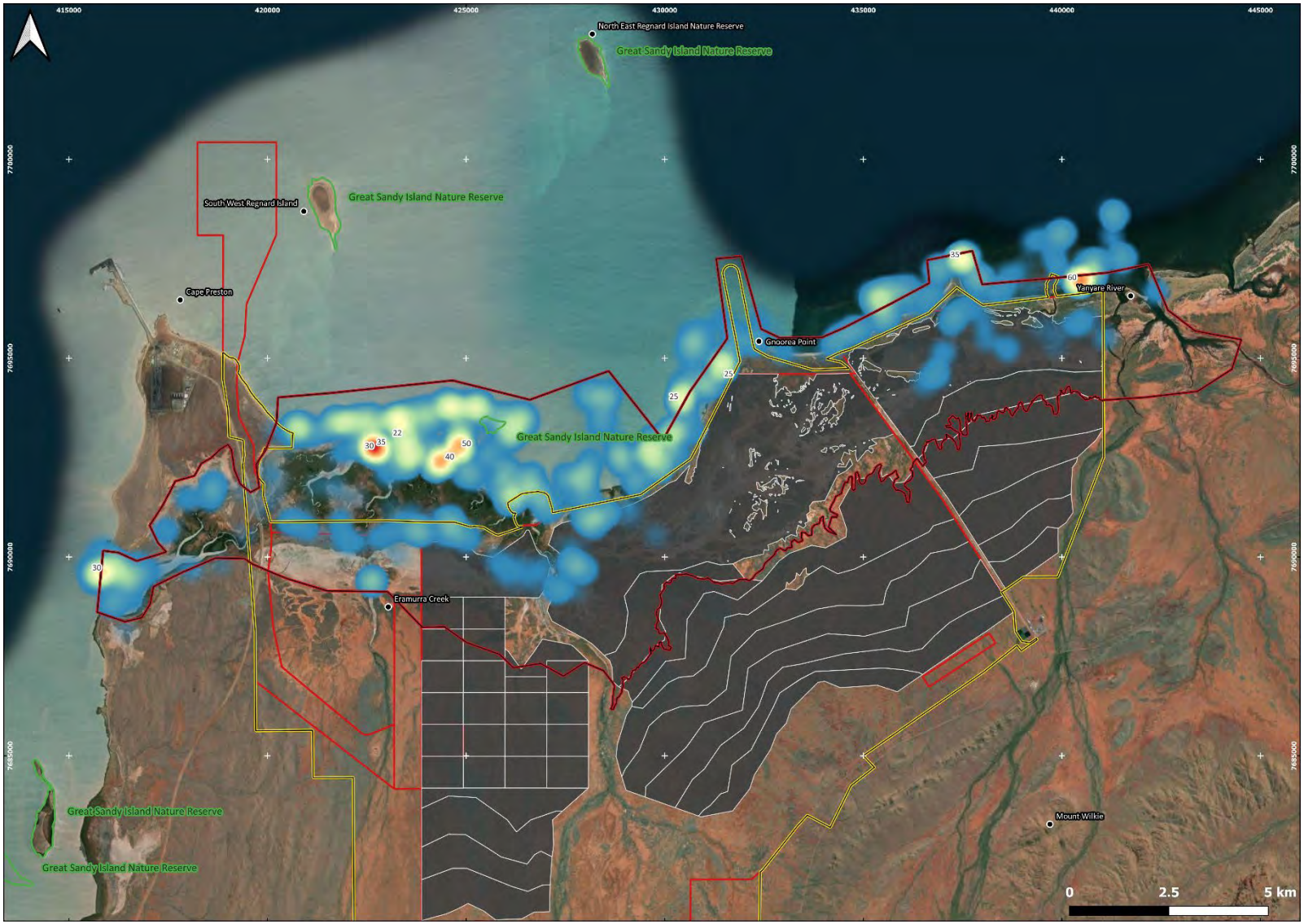

Figure 5-12 Winter low tide heat map for all birds recorded during shorebird transects based on Log_{10}(abundance)

Figure 5-13 Winter high tide heat map for all birds recorded during shorebird transects based on Log_{10}(abundance)

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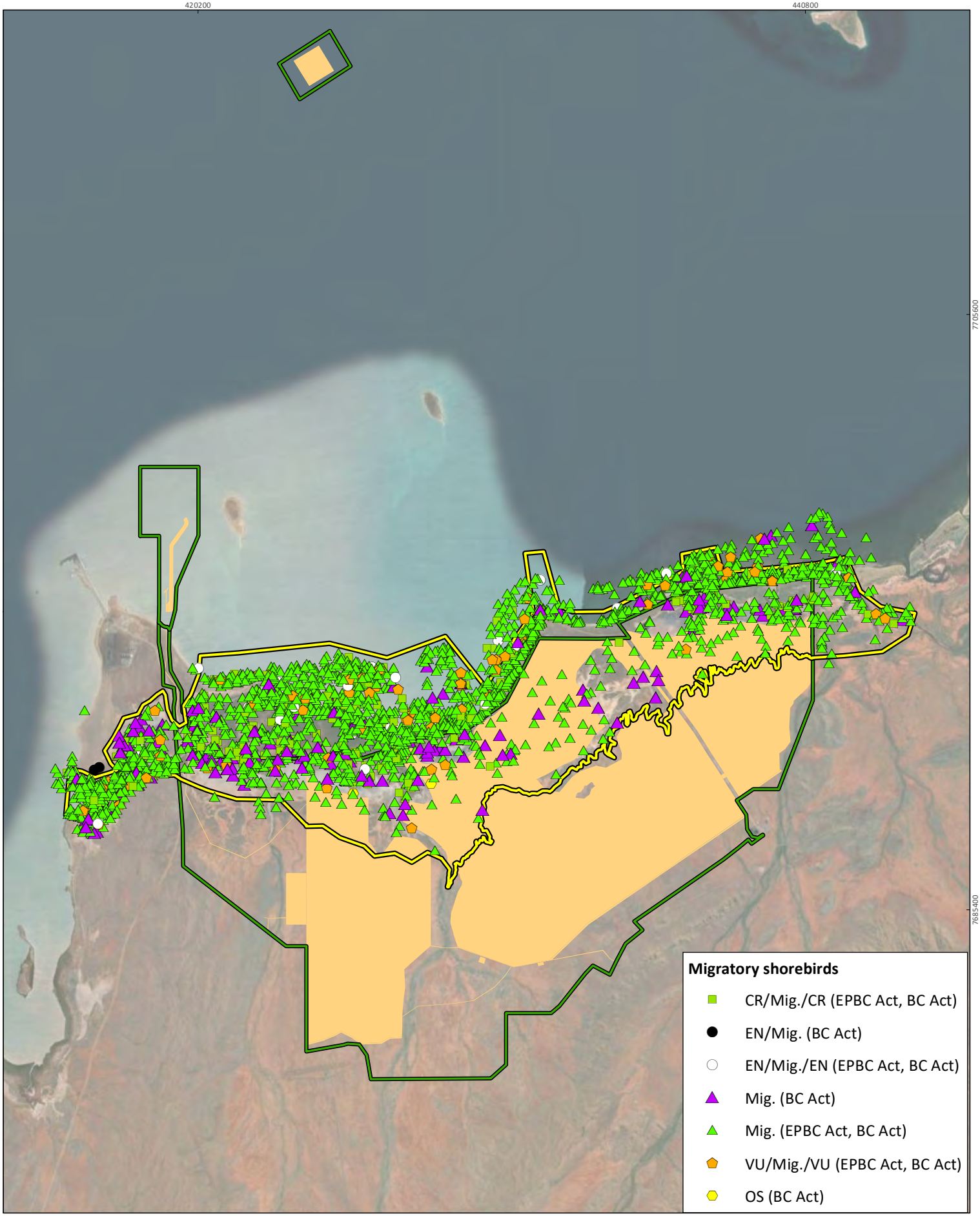

Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	15/05/2023
Drawn by	BK
Map author	JC

0 2 4
Kilometers

1:165,600 (at A4) GDA 1994 MGA Zone 50

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Shorebird study area
Development envelope
Indicative disturbance area

Figure 5-14

Location of all Migratory shorebirds

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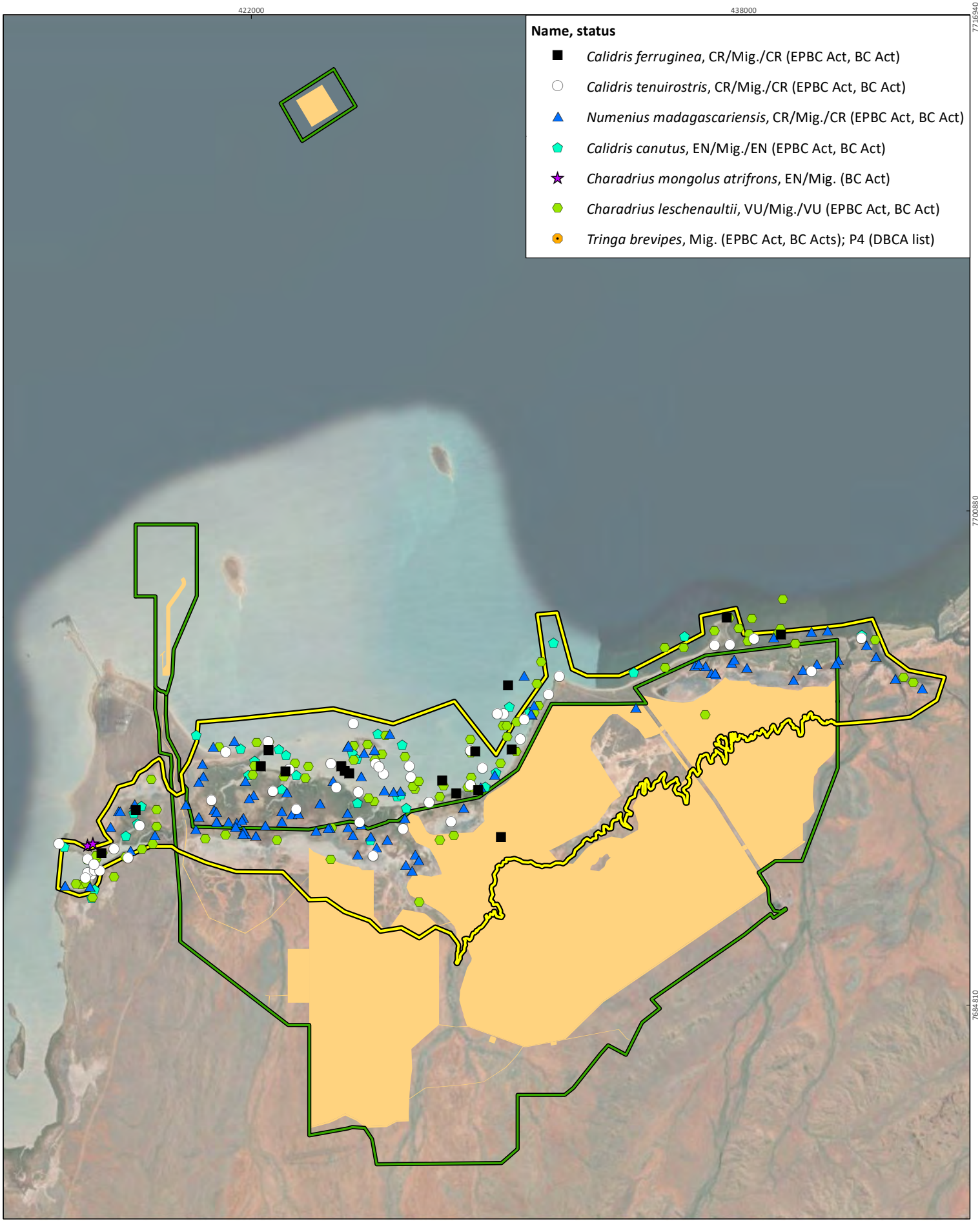

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Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	15/05/2023
Drawn by	BK
Map author	JC

0 2 4
Kilometers

1:158,700 (at A4) GDA 1994 MGA Zone 50

Shorebird study area
Development envelope
Indicative disturbance area

Figure 5-15

Location of Threatened and Priority Migratory shorebirds

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5.2.2.2 Migratory shorebirds in relation to the DE and IDF

A comparison is made for the Migratory shorebird results between the SBSA, DE and IDF in Table 5-12. The data clearly indicates that there is a large difference in the number of species occurring, their abundance, and thus, those species occurring in nationally and internationally significant numbers, when the different Project scales are considered.

As detailed above, 14 species were found occur in nationally or internationally significant numbers at the scale of the SBSA; however, when the data are analysed at the scale of the DE and IDF, that declines to seven and one species (Oriental Pratincole), respectively.

The Grey-tailed Tattler is the only species to overwinter at nationally significant numbers but was not present within the DE or IDF at that time of the surveys.

Table 5-12 Comparison of seasonal maximum Migratory shorebird transect counts between the SBSA, DE and IDF

Species	Vernacular	Consig. status	Summer			Winter		
			SBSA	DE	IDF	SBSA	DE	IDF
Charadriidae (5)								
Charadrius leschenaultii	**Greater Sand Plover**	**(EN/Mig. EPBC Act; EN BC Act)**	**436**	**93**	**70**			
Charadrius mongolus atrifrons	**Lesser Sand Plover**	**(EN/Mig. BC Act)**	**2**					
Charadrius veredus	Oriental Plover	(Mig. EPBC & BC Acts)	197	127	101			
Pluvialis fulva	Pacific Golden Plover	(Mig. EPBC & BC Acts)	60					
Pluvialis squatarola	Grey Plover	(Mig. EPBC & BC Acts)	59	4	4			
Glareolidae (1)								
Glareola maldivarum	Oriental Pratincole	(Mig. EPBC & BC Acts)	75,377	75,377	13,977			
Laridae (7)								
Chlidonias leucopterus	White-winged Black Tern	(Mig. EPBC & BC Acts)	60	16				
Gelochelidon nilotica	Gull-billed Tern	(Mig. BC Act)	135	120	67	72	59	1
Hydroprogne caspia	Caspian Tern	(Mig. EPBC & BC Acts)	29	25	25	13		
Sterna bergii	Crested Tern	(Mig. EPBC & BC Acts)	330	200	30	30		
Sterna dougallii	Roseate Tern	(Mig. EPBC & BC Acts)	19	11				
Sterna hirundo	Common Tern	(Mig. EPBC & BC Acts)	60	20				
Sternula albifrons	Little Tern	(Mig. EPBC & BC Acts)	102	1				
Scolopacidae (15)								
Actitis hypoleucos	Common Sandpiper	(Mig. EPBC & BC Acts)	44	4		1		

Species	Vernacular	Consig. status	Summer			Winter		
			SBSA	DE	IDF	SBSA	DE	IDF
Arenaria interpres	Ruddy Turnstone	(Mig. EPBC & BC Acts)	513	100	40	18		
Calidris acuminata	Sharp-tailed Sandpiper	(Mig. EPBC & BC Acts)	660	21				
Calidris alba	Sanderling	(Mig. EPBC & BC Acts)	287					
Calidris canutus	**Red Knot**	**(EN/Mig. EPBC Act; EN BC Act)**	**170**	**15**				
Calidris ferruginea	**Curlew Sandpiper**	**(CR/Mig. EPBC Act; CR BC Act)**	**106**	**4**	**4**			
Calidris ruficollis	Red-necked Stint	(Mig. EPBC & BC Acts)	3,406	562	151	205	205	15
Calidris tenuirostris	**Great Knot**	**(CR/Mig. EPBC Act; CR BC Act)**	**94**	**87**				
Limosa lapponica	Bar-tailed Godwit	(Mig. EPBC & BC Acts)	1,191	180	1	45	25	
Limosa limosa	Black-tailed Godwit	(Mig. BC Act)	5					
Numenius madagascariensis	**Eastern Curlew**	**(CR/Mig. EPBC Act; CR BC Act)**	**104**	**19**	**2**	**6**	**1**	
Numenius phaeopus	Whimbrel	(Mig. EPBC & BC Acts)	375	40	15	62	16	2
Tringa brevipes	**Grey-tailed Tattler**	**(Mig. EPBC & BC Acts; P4 DBCA list)**	**2,209**	**105**	**31**	**481**	**10**	
Tringa nebularia	Common Greenshank	(Mig. EPBC & BC Acts)	844	30	15	10	1	
Xenus cinereus	Terek Sandpiper	(Mig. EPBC & BC Acts)	192	5	2			
Sulidae (1)								
Sula leucogaster	Brown Booby	(Mig. EPBC & BC Acts)	3					

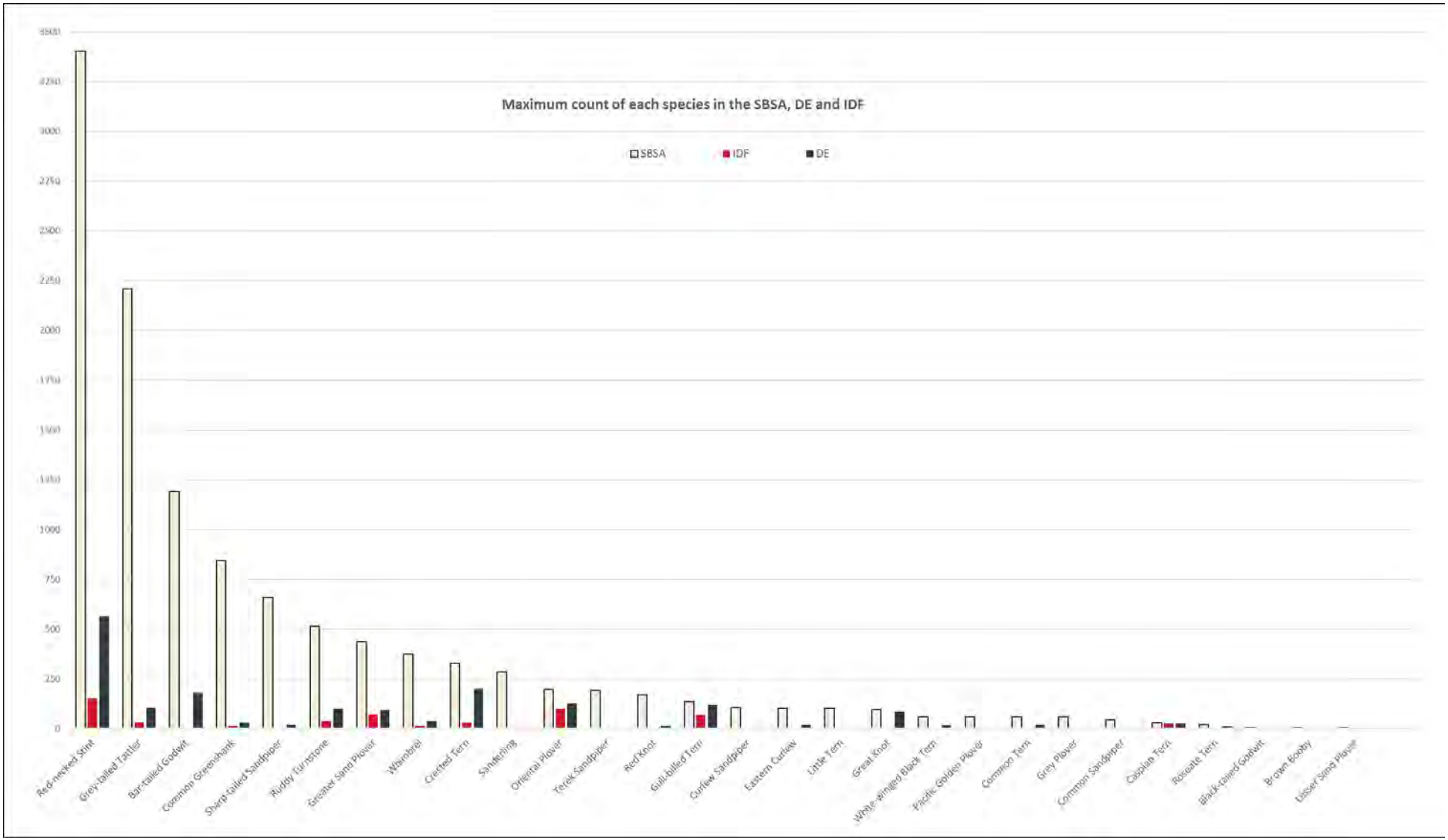

Figure 5-16 Maximum summer count of each species in the SBSA, DE and IDF

5.2.3 Likelihood of occurrence assessment

The likelihood of occurrence assessment (as per methods in section 4.2.5) for the significant species identified in the desktop review (Table 5-2) is summarised below in Table 5-13, with further details for each species provided in Table 5-14.

As above, 39 significant species were recorded (section 5.2.1.1.3) from a possible 73 (49%; Table 5-13), according to the desktop review (section 5.1.1.1).

The assessment determined that eight species (three mammals, four birds and one reptile) are Unlikely to occur. The occurrence of six birds and one reptile is Possible. A further 21 species that were not detected by the field surveys are considered Likely to occur based on habitats present; meaning, the TFSA and SBSA at least 'possibly' support up to 64 significant species, or 89% of the significant fauna identified in the desktop review.

Table 5-13 Summary of likelihood of occurrence assessment

Class	Unlikely	Possible	Likely	Recorded	Total	Pct of potentially occurring species recorded
Freshwater Fish	0	1	0	0	**1**	**0%**
Reptiles	1	1	1	1	**4**	**25%**
Birds	4	6	16	35	**61**	**55%**
Mammals	3	0	4	3	**10**	**30%**
Total	**8**	**8**	**21**	**39**	**76**	**49%**

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Table 5-14 Likelihood of occurrence for significant vertebrate fauna identified in the desktop review

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Fish (1)										
Leiopotherapon aheneus Fortescue Grunter	P4 (DBCA)	**Possible,** recorded in adjacent Fortescue River catchment			✓ (pools)					
Reptiles (4)										
Ctenotus angusticeps Airlie Island Ctenotus	P3 (DBCA)	**Possible**, previous uncertain record in study area	✓	✓		✓	✓		✓	
Lerista quadrivincula Dark-streaked Slider	P1 (DBCA)	**Unlikely**? – known from single record; habitat and status unknown	?	?	?					
Notoscincus butleri lined soil-crevice skink	P4 (DBCA)	**Recorded**	✓	✓	✓					
Liasis olivaceus barroni Pilbara Olive Python	VU (EPBC Act, BC Act)	**Likely**, suitable habitat present	✓	✓	✓	✓				
Birds (58)										
Oxyura australis Blue-billed Duck	P4 (DBCA)	**Likely** as occasional visitor			✓ (pools)					
Oceanites oceanicus Wilson's Storm-Petrel	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Ardenna carneipes Flesh-footed Shearwater	Mig (EPBC Act, BC Act), VU (BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Ardenna pacifica Wedge-tailed Shearwater	Mig (EPBC Act, BC Act)	**Likely occasional visitor,** but will not nest within the SBSA				✓			✓	✓
Calonectris leucomelas Streaked Shearwater	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Macronectes giganteus Southern Giant Petrel	EN (EPBC Act), Mig (EPBC Act, BC Act)	**Possible** as occasional visitor, but will not nest within the SBSA				✓			✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Puffinus huttoni Hutton's Shearwater	EN (BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Plegadis falcinellus Glossy Ibis	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓	✓	✓	✓	✓
Fregata ariel Lesser Frigatebird	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Sula leucogaster Brown Booby	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor, but will not nest within the SBSA				✓			✓	✓
Pandion cristatus Osprey	Mig (EPBC Act, BC Act)	**Recorded**, breeding resident				✓	✓	✓	✓	✓
Charadrius leschenaultii Greater Sand Plover	VU, Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Charadrius mongolus Lesser Sand Plover	EN, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers** twice in February, migrant				✓	✓	✓	✓	✓
Charadrius veredus Oriental Plover	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers**, migrant				✓	✓	✓	✓	✓
Pluvialis fulva Pacific Golden Plover	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Pluvialis squatarola Grey Plover	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Rostratula australis Australian Painted Snipe	EN (EPBC & BC Acts)	**Unlikely**			✓ (pools)					
Actitis hypoleucos Common Sandpiper	Mig (EPBC Act, BC Act)	**Recorded**, migrant				✓	✓	✓	✓	✓
Arenaria interpres Ruddy Turnstone	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers in January 2020**, migrant				✓	✓	✓	✓	✓
Calidris acuminata Sharp-tailed Sandpiper	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers in 30% of summer transects**, migrant				✓	✓	✓	✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Calidris alba Sanderling	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers once in December 2019**, migrant				✓	✓	✓	✓	✓
Calidris canutus Red Knot	EN, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers once in February 2020**, migrant				✓	✓	✓	✓	✓
Calidris ferruginea Curlew Sandpiper	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers once in February 2020**, migrant				✓	✓	✓	✓	✓
Calidris melanotos Pectoral Sandpiper	Mig (EPBC Act, BC Act)	**Recorded** (previously)				✓	✓	✓	✓	✓
Calidris ruficollis Red-necked Stint	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers in 35% of summer transects**				✓	✓	✓	✓	✓
Calidris subminuta Long-toed Stint	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓	✓	✓	✓
Calidris tenuirostris Great Knot	CR, Mig (EPBC Act, BC Act)	**Recorded**				✓	✓	✓	✓	✓
Gallinago stenura Pin-tailed Snipe	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor			✓					
Limicola falcinellus Broad-billed Sandpiper	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓			
Limosa lapponica baueri Bar-tailed Godwit (western Alaskan)	VU, Mig (EPBC Act, BC Act)	**Possible** as occasional visitor				✓	✓	✓	✓	✓
Limosa lapponica menzbieri Bar-tailed Godwit (northern Siberian)	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers once in January and twice in February**				✓	✓	✓	✓	✓
Limosa limosa Black-tailed Godwit	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓	✓	✓	✓
Numenius madagascariensis Eastern Curlew	CR, Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers twice in February.**				✓	✓	✓	✓	✓
Numenius minutus Little Curlew	Mig (EPBC Act, BC Act)	**Recorded** (previously)				✓	✓	✓	✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Numenius phaeopus Whimbrel	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers in 53% of summer transects**				✓	✓	✓	✓	✓
Phalaropus lobatus Red-necked Phalarope	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor				✓	✓	✓	✓	✓
Tringa brevipes Grey-tailed Tattler	Mig (EPBC Act, BC Act), P4 (DBCA)	**Recorded in internationally significant numbers –** - area supports a large number of this species throughout summer, with as much as 3.15% of the world's population being recorded on the wing in a single transect				✓	✓	✓	✓	✓
Tringa glareola Wood Sandpiper	Mig (EPBC Act, BC Act)	**Possible** occasional visitor			✓	✓	✓			
Tringa nebularia Common Greenshank	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers twice in December and twice in February**				✓	✓	✓	✓	✓
Tringa stagnatilis Marsh Sandpiper	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor				✓	✓	✓	✓	✓
Tringa totanus Common Redshank	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor in very small numbers				✓	✓	✓	✓	✓
Xenus cinereus Terek Sandpiper	Mig (EPBC Act, BC Act)	**Recorded in nationally significant numbers twice in February**				✓	✓	✓	✓	✓
Glareola maldivarum Oriental Pratincole	Mig (EPBC Act, BC Act)	**Recorded in internationally significant numbers** – to 75,377 individuals recorded in the air, in a single transect in February 2020, which represents 2.6% of the world's population	✓	✓		✓	✓	✓	✓	✓
Anous stolidus Common Noddy	Mig (EPBC Act, BC Act)	**Unlikely**								
Chlidonias leucopterus White-winged Black Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Onychoprion anaethetus Bridled Tern	Mig (EPBC Act, BC Act)	**Unlikely**							✓	✓
Sterna albifrons Little Tern (or *Sternula*)	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna bergii Crested Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna caspia Caspian Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna dougallii Roseate Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna hirundo Common Tern	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Sterna nereis nereis Fairy Tern (or *Sternula*)	VU (BC Act)	**Recorded**				✓	✓		✓	✓
Sterna nilotica Gull-billed Tern (or *Gelochelidon*)	Mig (EPBC Act, BC Act)	**Recorded**				✓	✓		✓	✓
Apus pacificus Fork-tailed Swift	Mig (EPBC Act, BC Act)	**Recorded**	✓	✓	✓	✓	✓	✓	✓	✓
Falco hypoleucos Grey Falcon	VU (BC Act)	**Likely** (nest 6 km E)	✓	✓	✓	✓	✓	✓	✓	
Falco peregrinus Peregrine Falcon	OS (BC Act)	**Likely** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	
Pezoporus occidentalis Night Parrot	EN (EPBC Act), CR (BC Act)	**Unlikely**; habitat present that is known to support the species, but given the sparsity and age of historic nearby records, and grazing history on the TFSA it is considered unlikely		✓	✓		✓			
Hirundo rustica Barn Swallow	Mig (EPBC Act, BC Act)	**Likely** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	
Motacilla cinerea Grey Wagtail	Mig (EPBC Act, BC Act)	**Unlikely**	✓	✓		✓	✓	✓	✓	
Motacilla flava Yellow Wagtail	Mig (EPBC Act, BC Act)	**Possible** as occasional visitor	✓	✓	✓	✓	✓	✓	✓	
Mammals (10)										
Dasyurus hallucatus Northern Quoll	EN (EPBC & BC Acts)	**Recorded** - resident	✓	✓	✓	✓	✓		✓	
Macrotis lagotis Bilby	VU (EPBC & BC Acts)	**Unlikely**		✓						

Species	Status	Likelihood of occurrence	Terrestrial habitats						Marine habitats	
			Tussock grasslands	Spinifex grassland	Eucalypt woodland	Tussock grasslands on beaches and dunes	Samphire shrublands	Mudflats and salt flats	Mangal forests	Tidal creeks and ocean
Petrogale lateralis lateralis Black-flanked Rock-wallaby	EN (EPBC & BC Acts)	**Unlikely**; no habitat present								
Macroderma gigas Ghost Bat	VU (EPBC & BC Acts)	**Likely** (foraging only, no roost sites present, hence no critical habitat)	✓	✓	✓					
Rhinonicteris aurantia (Pilbara) Pilbara Leaf-nosed Bat	VU (EPBC & BC Acts)	**Recorded** - foraging only, no roost sites present, hence no critical habitat	✓	✓	✓					
Ozimops cobourgianus Northwestern Freetail-Bat*(ex loriae)*	P1 (DBCA)	**Recorded -** roosting in mangroves, foraging elsewhere	✓	✓	✓	✓	✓	✓	✓	
Hydromys chrysogaster Rakali, Water-rat	P4 (DBCA)	**Likely**			✓		✓		✓	
Lagorchestes conspicillatus leichardti Spectacled Hare-wallaby	P3 (BC Act)	**Unlikely**; species requires old/mature spinifex hummocks, given the sparsity and age of historic nearby records, and grazing history on the TFSA it is considered unlikely								
Leggadina lakedownensis Northern short-tailed mouse	P4 (DBCA)	**Likely**	✓	✓	✓					
Pseudomys chapmani Western Pebble-mound Mouse	P4 (DBCA)	**Likely**; minor extent of suitable habitat along western margin		✓	✓					

5.3 SURVEY LIMITATIONS

The limitations of the terrestrial fauna surveys have been considered in accordance with EPA guidance (EPA 2016e) (Table 5-15).

Table 5-15 Consideration of potential survey limitations

Limitations	Comments
Availability of contextual information at a regional and local scale	There was ample information concerning species and habitats in the vicinity of the study area from nearby surveys and research.
Competency/experience of the team carrying out the survey	All members of the survey team have had appropriate training and experience in terrestrial fauna surveys within the Pilbara region, with specialised zoologists engaged where appropriate, e.g., ornithologists with experience in shorebird surveys from OTS.
Scope and completeness	All faunal groups were sampled using systematic methods. Substantial targeted search efforts were made to assess the presence of significant fauna species thought most likely to occur based on desktop records.
Proportion of fauna recorded and/or collected, any identification issues	Approximately 44% of the species identified in the desktop review were recorded in the field surveys, including 49% of significant species, and including a number of important range extensions being documented. No difficulties were encountered in identifying targeted terrestrial fauna species when encountered. Number of SRE taxa were not able to be identified to species/taxon level.
Access within the study area	Adequate access to all parts of the study area.
Timing, rainfall, season	The area experienced prolonged lower than average rainfall in the years and month preceding the 2020 systematic surveys, and this may have impacted detectability of some groups such as rodents; however there are few significant rodents likely to occur. The study area was sampled over multiple years, seasons, and conditions between 2019 and 2021. Shorebird surveys were conducted at both spring and neap low tides, in summer and winter, and were replicated well above the minimum expectations of the recommended survey effort detailed in DoEE (2017). SRE sampling was conducted within the optimal survey period (November to April).
Disturbance that may have affected the results of the survey	No direct human disturbances were apparent that may have affected the survey results.

6 DISCUSSION

The surveys have documented a diverse and abundant assemblage of vertebrate fauna species across the TFSA and SBSA including 39 significant vertebrate fauna species being recorded (from an identified potential 73 species) as well as a number of range extensions for non-listed species and SREs. All conservation significant shorebird and terrestrial fauna species are shown below in Figure 6-3. SREs have been excluded from the map as they are all either known from outside or are considered likely to occur outside the DE and IDF.

6.1 VERTEBRATE FAUNA

A mix of expected and unexpected terrestrial fauna (some conservation significant) were recorded in 2020 and 2021. Lined soil-crevice skink (Dampier) (P4) (Figure 6-1), Osprey (Mig.), Grey Falcon (VU), and Peregrine Falcon (OS) were expected, whereas Northern Quoll (EN) and Common Brushtail Possum co-occurring on the same creeklines was not. That being said, Northern Quoll are known from Cape Preston, on a creekline 25 km east of the Project, immediately south of Karratha (DBCA 2018b) and have been recently recorded on rocky hills south of Mardie (Phoenix 2020, 2021). They are also regularly recorded on creeklines nearer the coast that drain the hills parallel to the coast between Karratha and Port Hedland. Therefore, the records at Eramurra are not entirely surprising. The TFSA contains a few small pockets of granite outcropping that could be considered denning/shelter habitat but only one is of sufficient size to support breeding (Figure 6-2), the remaining habitat is thus foraging/dispersal habitat (Figure 6-2).

The Common Brushtail Possum formally occupied much of the Pilbara bioregion, based on sub-fossil and other evidence (Abbott 2012; Baynes & McDowell 2010) and indeed there are a few recent records (2016, 2017 and 2018) relatively close to the TFSA (e.g. on the Robe River near Pannawonica; ALA 2020), however, the species was not returned as part of the desktop review and was thus unexpected. There is clearly a resident population present given it was recorded at the eastern and western margins of the Project 19 months apart. All records of Common Brush-tailed Possum and Northern Quoll are on creeklines that drain into the study areas from the rocky hills to the south. These creeklines are thus considered important movement corridors or linkages between those inland hills and the coast, for several species.

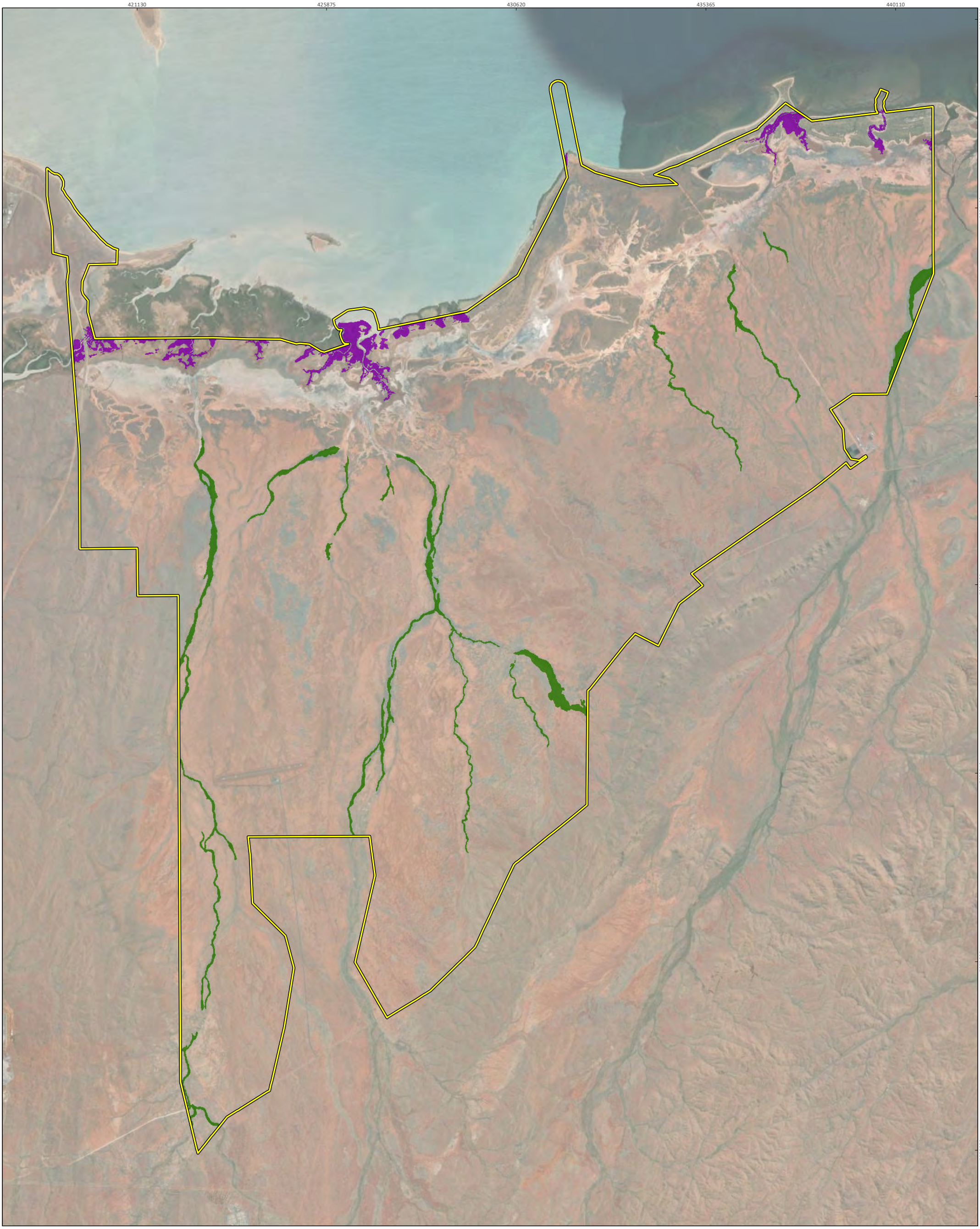
The Mangal community habitat present is all considered to be critical roosting habitat for the Northern Coastal Free-tailed Bat (*Ozimops cobourgianus*; P1) (Figure 6-1). The creeklines of the TFSA are also represent important feeding grounds for the species (as well as for birds generally), as riparian habitats tend to support more flowering/fruiting and thus associated insect activity.

Lined soil-crevice skink (Dampier) (*Notoscincus butleri*; P4) is thought to be largely confined to creeklines. It was recorded from the central-western portion of the TFSA on a creekline; significant creeklines in the TFSA are therefore mapped as important habitat for this species (Figure 6-1).

As mentioned above, several creeklines hold surface water for extended periods where granite outcrops push shallow groundwater to the surface, or, nearer to the coast, where the permeable alluvial sands meet the marine-deposited, impermeable sediments saturated with denser (saltier) ground water. These pools offer important late summer and winter refugia for a variety of terrestrial species.

421130 425875 430620 435365 440110

7698870 7694160 7689440 7684730 7680010 7675300 7670580



Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	15/06/2023
Drawn by	FK
Map author	JC

0 2 4
Kilometers

1:86,768 (at A3) GDA 1994 MGA Zone 50

Terrestrial fauna study area

Lined soil-crevice skink (Dampier) habitat

Northern Coastal Free-tailed Bat critical roosting habitat

Figure 6-1

Lined soil-crevice skink (Dampier) habitat and Northern Coastal Free-tailed

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P:\Data\Projects\EramurraSalt\1320-ESP-LI-VER\Mapping\MapDocuments\Figures\Maps_June_2022\Figure_6_1_Lined_soil_crevice_skink_(Dampier)_habitat_and_Northern_Coastal_Free_tailed_Bat_critical_roosting_habitat - Copy.mxd

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Critical denning/shelterhabitat

Western Australia

PERTH

Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	15/06/2023
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Kilometers

1:86,768 (at A3) GDA 1994 MGA Zone 50

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Terrestrial fauna study area

Northern Quoll habitat

Critical denning/shelter habitat

Foraging/disperal habitat

Figure 6-2

Northern Quoll habitat

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P:\Data\Projects\EramurraSalt\1320-ESP-LI-VER\Mapping\MapDocuments\Figures\Maps_June_2022\Figure_6_2_Northern_Quoll_habitat.mxd

6.2 MIGRATORY SHOREBIRDS

The majority of the significant species are Migratory bird species and shorebirds in particular. A total of 31 bird species listed as Migratory were recorded, including Osprey, which is not a shorebird. We recorded 21 of the 37 Migratory Shorebird species listed under *EPBC Act Policy Statement 3.21* (DoEE 2017). A total of 14 were recorded in nationally significant numbers and three in internationally significant numbers (Oriental Pratincole, Ruddy Turnstone and Grey-tailed Tattler). Accordingly, the shorebird habitat within and adjacent to the DE is considered nationally important wetland habitat on the following basis:

- 14 species were recorded in nationally significant numbers – threshold is one species
- >2,000 Migratory shorebirds were regularly recorded in a single transect
- 21 Migratory shorebird species were recorded in total – criterion is 15 species.

No criteria were met for internationally important wetland habitat based on total abundance. Of the 21 Migratory Shorebirds recorded, six are listed as Threatened Migratory species including three Critically Endangered species (Curlew Sandpiper, Eastern Curlew and Great Knot), two Endangered species (Lesser Sand Plover and Red Knot) and one Vulnerable species (Greater Sand Plover). Eastern Curlew was the only Threatened bird species recorded in nationally significant numbers. One DBCA Priority 4 species, Grey-tailed Tattler, occurred in internationally significant numbers.

Northwestern Australia supports some of the largest numbers of shorebirds of the Australian continent (Bamford *et al.* 2008; Minton 2006), primarily at Roebuck Bay and Eighty Mile beach in Broome. In the Pilbara region, there are several recognised important Migratory shorebird sites at the national and international scale, mainly to the north and west of the Project.

In close proximity to the Project, Cape Preston was found to be important for Sanderling and Ruddy Turnstone over a decade ago (Bennelongia 2008b). And to the east, the Dampier Saltworks (approximately 22 km northeast) supports internationally significant numbers of Curlew Sandpiper and Oriental Plover (Birdlife Australia no date).

Most recently, Phoenix (2020) conducted a Migratory bird survey for the Mardie Salt Project, at a similar scale and using identical survey methods. The results are remarkably similar to that presented here. At Mardie, 20 of the 37 species listed under *EPBC Act Policy Statement 3.21* (DoEE 2017) were recorded, compared with 20 at Eramurra. The same six Threatened species were recorded, and Grey-tailed Tattler (P4) was typically the most abundant species. And finally, the same national importance criteria were met.

To the west of the Project, Bamford and Moro (2011) identified Barrow Island and other islands off the Pilbara coast as important staging and destination sites for several species. Internationally significant numbers of Red-necked Stint, Grey-tailed Tattler, Ruddy Turnstone and Greater Sand Plover have been documented at Barrow Island (Bamford & Moro 2011). Overall abundance (max. count 20,428) and richness records (>22 species) for EAAF shorebirds were also high for Barrow Island (Bamford & Moro 2011).

Further afield, Phoenix (2013a) recorded 26 species of Migratory shorebird and a total abundance (max. count >24,000) at Forestier Bay (90 km east of Karratha), making it an area of national and international importance, which has not been formally recognised. At this site, Bar-tailed Godwit and Grey-tailed Tattler were recorded in internationally significant numbers, and a further 11 species were recorded in nationally significant numbers. This site contained a wide range of habitats available for many species (reefs, intertidal flats, mangrove, sand beaches, upper tidal salt flat and samphire flats) and a very large extent (>17,000 ha) of tidal mud flats exposed at low tide.

Bennelongia (2011) reported internationally significant numbers of Grey-tailed Tattler and nationally significant numbers of Greater Sand Plover, Bar-tailed Godwit, Terek Sandpiper, Ruddy Turnstone and

Red-necked Stint, in the Port Hedland area. Johnstone *et al.* (2013) note the importance of the Port Hedland saltworks in this area in providing a reliable, stable environment that supports many species.

Finally, further to the south, Biota (2005b) recorded five species in internationally significant numbers on the eastern side of Exmouth Gulf, ~200 km southwest of the Project. They also reported that Whimbrel, Eastern Curlew and Terek Sandpiper were relatively abundant.

As was discussed in Phoenix (2020), the same five to six species are repeatedly identified across the Pilbara coast as being present in large numbers, e.g. Bar-tailed Godwit, Greater Sand Plover, Grey-tailed Tattler, Ruddy Turnstone, Red-necked Stint, Oriental Pratincole and Terek Sandpiper. The Eramurra Project area, as with the Mardie Salt Project area, appears also to be particularly important to the larger 'wetland species' (within the context of the Pilbara), Whimbrel, Curlew Sandpiper and Eastern Curlew. This is likely a result of the large extent of largely uninterrupted mangrove tidal creeks and associated intertidal samphire wetlands, sitting immediately inland of large expanses of mudflats and sand banks that are exposed at low tides. As was demonstrated in the heat maps above (Figure 5-10 – Figure 5-13) the shorebirds move with the tides, being present in the SBSA and landward surrounds at high tide (but more diffuse), and offshore on the exposed mudflats at low tide. While an intuitive pattern, the extensive use of helicopters to complete the surveys has strongly documented this twice-daily movement pattern and the importance of protected, high tide feeding and roosting habitat in close proximity to the offshore, low tide feeding grounds.

While it is difficult to say whether the area surveyed here is more or less important compared with other Pilbara shorebird sites due to the different survey methods applied, timing of those surveys etc, it is clearly very important, as a diverse assemblage of shorebirds (including numerous Threatened and Priority species) occur in nationally and internationally significant numbers throughout the summer months. The area also represents an important refugium during cyclonic events in the region and important linkage in the movement corridor up and down the coast, particularly between Broome and Lake Macleod south of Exmouth. The corridor is becoming important considering the potential loss of habitat associated with the approved Mardie Salt Project and proposed Ashburton Salt Project, both to the west. These three Project areas likely create a feeding/foraging gap in the chain between Karratha and Exmouth. On the other hand, salt works are known to be advantageous to certain shorebird species/size classes, indeed locally, Dampier and Port Hedland salt works are known important shorebird sites, thus the installation of salt ponds at Mardie and Eramurra (and possibly Ashburton) would advantage certain species, at least within the first two ponds.

Given the rapid, recent decline of Australian EAAF shorebird numbers, and in particular, comparatively large declines at the southern extent of their migratory ranges (i.e., in the southern half of Australia, including Tasmania) (Clemens *et al.* 2016), retention of important habitats close to the major staging grounds in and around Broome is critical to supporting the remaining shorebirds that make it to Australia from their northern hemisphere breeding grounds each year.

All that being said, as was demonstrated in section 5.2.2.2, when the shorebird data was analysed at the scale of the DE and IDF, the number of EAAF flyway species (as per DoEE 2017), Threatened species and species occurring in nationally and internationally significant numbers all decline substantially. Within the DE the number of species recorded at nationally significant numbers declines from 14 to six species:

- Oriental Pratincole
- Ruddy Turnstone
- Sanderling
- Red-necked Stint
- Whimbrel
- Grey-tailed Tattler (P4)
- Common Greenshank.

Further, at the scale of the IDF, species in nationally significant numbers decline from 14 to just one, Ruddy Turnstone. However, Oriental Pratincole remains at internationally significant numbers at the scale of both the DE and IDF. Here, though, it is worth noting that the large flocks of Oriental Pratincole recorded on 11 February 2020 were not observed using the SBSA but were encountered in the air (and on that day close to 3% of the EAAF population of Oriental Pratincole was recorded). Thus, while the areas where the evaporation ponds are proposed to be located were observed to be utilised by an array of shorebird species, the numbers were far lower than further north in the tidal samphire shrublands and associated mangrove habitat. This is evident from the heat maps also, where it can be seen that the numbers were far more diffuse within the DE and IDF.

6.3 SRE INVERTEBRATE FAUNA

The SRE taxa from within the TFSA comprised a variety of widespread and potentially restricted taxa, including a total of 16 SRE (Potential or Confirmed) taxa, and 14 taxa which could not be matched morphologically or genetically to any other species, i.e., they are new taxa.

The habitat within the TFSA is comprised entirely of low potential SRE habitats which extend beyond the study area and are dominated by three similar types comprised of landforms and vegetation types that are unlikely to restrict the dispersal of SREs fauna.

Generally, the SREs within the TFSA appear to have an affinity with the SRE fauna of nearby mainland coastal areas. Of significance, three taxa collected during the field surveys were previously known only from Barrow Island, which is located approximately 85 km to the west of the study area. These comprise of one mygalomorph spider (*Aname* 'MYG593'), one scorpion (*Isometroides* 'SCO051/barrow'), and one isopod (*Buddelundia* '32'). These records have significantly increased the known range of these taxa. An additional two taxa are known from both Barrow Island and the mainland: one mygalomorph spider (*Synothele* 'MYG335') and one scorpion (*Lychas* 'SCO051/glauerti').

Further to this, one land snail (*Rhagada* 'Phoenix0087') is most closely related to *Rhagada elachystoma* (5.1% genetic divergence), known only from islands in the Dampier Archipelago (WAM 2020), and the Montebello Islands group and Barrow Island (ALA 2020). At 5.1% genetic divergence between these taxa, *Rhagada* 'Phoenix0087'is >2x the average genetic distance (2.3%) between species of *Rhagada* on the Dampier Archipelago (Johnson *et al.* 2004). Further, mainland *Rhagada* typically have non-overlapping ranges spanning 200 km or more (Solem 1997).Therefore this specimen must be treated as a distinct from *R.elachystoma*.

Molecular sequencing revealed *Synothele* 'MYG335' is conspecific with a female specimen collected from Barrow Island. This species may be synonymous with *S. butleri* which is described from a single male collected from Barrow Island in 1964; however, no genetic material is available for reference. The male specimen collected from the field survey is morphologically similar to the male specimen originally collected in 1964 and described by Raven (1994).

All but five of the 20 species recorded within the TFSA are already known from other areas indicating there is habitat connectivity outside the study area. Further to this, the paucity of systematic SRE surveys undertaken within the general mainland coastal area (as opposed to nearby islands of the Dampier Archipelago, and Barrow Island, which have been extensively surveyed for invertebrates, particularly land snails) is likely to be the reason these taxa have not been recorded before. The range extensions documented for three taxa previously known only from Barrow Island is further evidence that many species in the area are more widespread than currently known.

Of the five species known only from the TFSA, four were recorded by the current field survey and are restricted to the IDF, and one is known from the desktop review. They comprise of one mygalomorph spider, one scorpion, three isopods (slaters) and one land snail:

- Mygalomorph spider

  - *Conothele* 'MYG726' (restricted to the IDF)
- Scorpion
  - *Urodacus* 'erramurra' (restricted to the IDF)
- Isopods (slaters)
  - *Acanthodillo* sp. B (erramurra) (restricted to the IDF)
  - Buddelundiinae 'erramurra' (restricted to the IDF)
- Land snail
  - *Rhagada* 'cape preston'.

6.3.1 Mygalomorph spiders

6.3.1.1 *Conothele* 'MYG726'

Mygalomorphs spiders from the genus *Conothele* are known as cork-lid trap-door spiders due to the cork-like lid they use to plug their burrows (Raven 1994). It is this lid which blends into the surroundings and makes burrows easily missed with the naked eye. Three species of *Conothele* are known from the desktop search area, two are endemic to Barrow Island and one is known from a single record 90 km south of the study area (Raven 1994).

The burrow of the female collected in this survey was sighted during SRE foraging at site FAU06 within the TFSA. Molecular sequencing determined that it had no close relatives and is thus a new taxon. This record was from the most widespread, unrestricted habitat within the study area, tussock grassland. Importantly, as the record comes from a burrow excavation, we know that this habitat type also supports breeding females. It is likely this species can occur throughout the coastal tussock grasslands.

6.3.2 Scorpions

6.3.2.1 *Urodacus* 'erramurra'

A single male specimen of the scorpion *Urodacus* 'erramurra' was collected in a wet pitfall trap at site SRE04 and morphologically identified as a unique species. Some species of scorpion exhibit cryptic speciation whereby species are morphologically identical but molecular analyses reveal interspecific divergences, often correlating with distribution patterns. However, this specimen was morphologically dissimilar to any other known species and was therefore not sequenced. It was collected in shrubland over spinifex grassland habitat which is widespread in the TFSA and surrounds.

6.3.3 Isopods

Two species of isopod are known only from the study area. One is from the genus *Acanthodillo* which is a widespread genus. The second is from an undescribed genus from the same family (Armadillidae).

6.3.3.1 *Acanthodillo* sp. B (erramurra)

Specimens from the genus *Acanthodillo* are typically small and cryptic, so are rarely collected. Therefore, very little is known about the biology or distribution of taxa within the genus. Two specimens were collected from two sites (SRE003 and SRE04), both within shrubland over spinifex grassland habitat and approximately 800 m apart from each other. The *A*. sp. A (erramurra) specimens were collected from seven sites, including SRE003 and SRE004 from shrubland over tussock grassland and shrubland over spinifex grassland habitats respectively. *A.* sp. A (erramurra) and *A*. sp. B (erramurra) are considered likely to have similar distributions.

6.3.3.2 Buddelundiinae 'erramurra'

This is considered to represent an undescribed genus that is closely related to *Buddelundia*. Buddelundiinae 'erramurra' is distinctly different from most other specimens of the genus in the Pilbara. It was represented by a single specimen collected from a wet pitfall trap from one site (SRE07), within the TFSA. This specimen was collected from the widely occurring shrubland over spinifex grassland habitat.

6.3.4 Land snails

One taxon of land snail is known only from within the TFSA. It is from the genus *Rhagada* which is known to have both SRE and widespread taxa and is endemic to WA, particularly in the northwest. Some species within this genus are morphologically identical to others, or cannot be reliably identified using morphological characteristics, and rely on molecular sequencing to confirm distinct taxa (Johnson *et al.* 2016). Conversely, some taxa exhibit diverse morphologies depending on their habitat (Johnson *et al.* 2016).

6.3.4.1 *Rhagada* 'cape preston'

Rhagada 'cape preston' is a record from the desktop review, being collected from a previous survey in the area (circa 2007) (WAM 2020). The collection site was in the locally widespread tussock grassland habitat. As no molecular information is available for this specimen, it is possible this species is synonymous with another undescribed taxon such as *R*. 'Phoenix0070', *R*. 'Phoenix0071', and *R*. 'Phoenix0087', all of which were recorded 21.5 km to the east (200 to 1,200m apart from each other along a creekline) in the regional survey. These new records may represent specimens that have originated upstream or downstream rather than from the habitat they were recorded from.

6.4 CONCLUSION

The fauna surveys of the TFSA, SBSA and regional SRE survey areas have documented a diverse and abundant assemblage, with a number of significant range extensions of both vertebrate and invertebrate species, and 15 SRE species new to science.

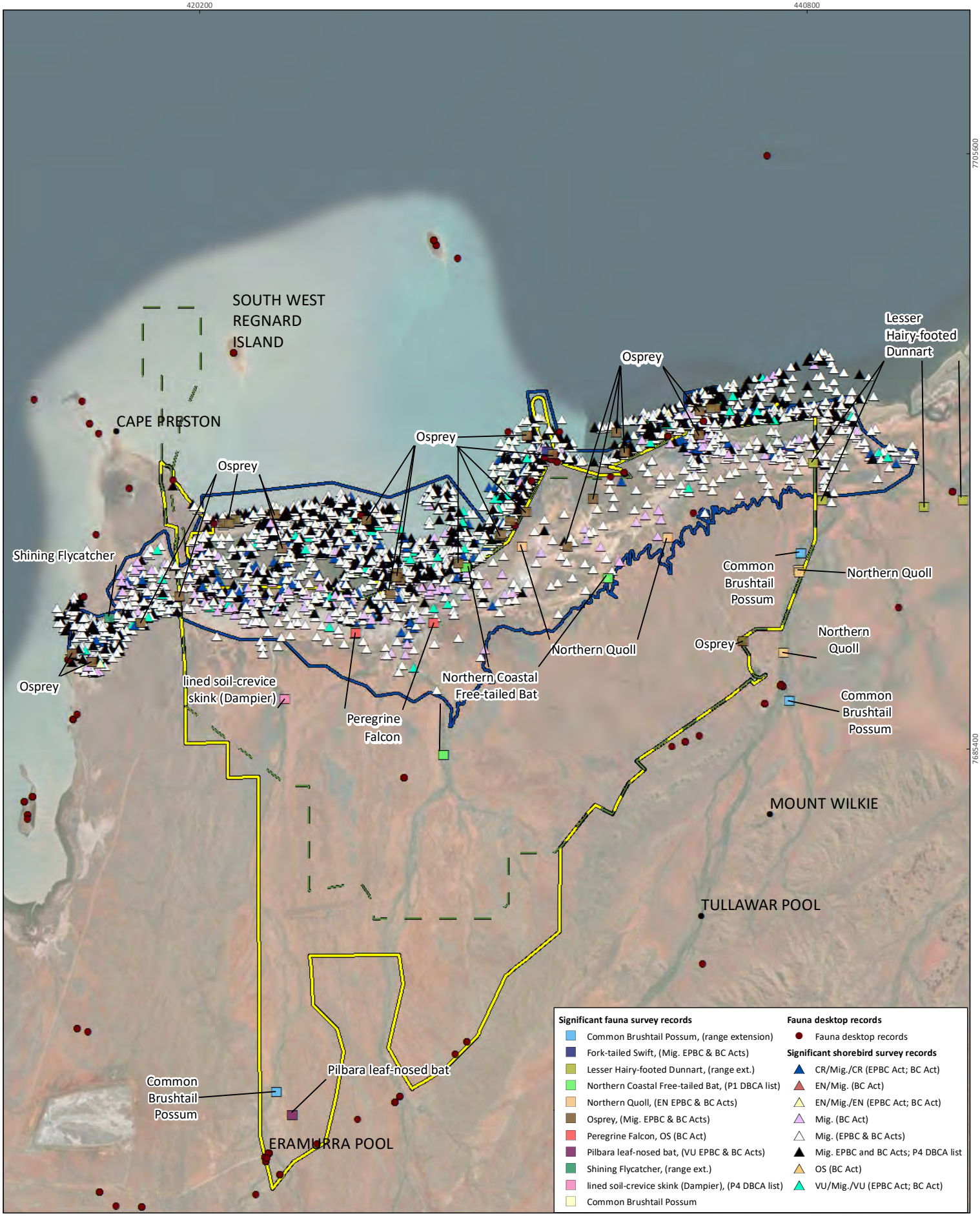
The coastal, near-shore and tidal environment of the bay bounded by Cape Preston in the west and Gnoorea Point in the east, and further to the east, west of the mouths of the Devil Creek/Yanyare River is considered nationally important wetland habitat for Migratory shorebirds, many of which occur in internationally and nationally significant numbers and are Threatened or Priority species. The area is likely an import linkage/movement corridor for shorebirds on the Pilbara coast providing foraging opportunities amongst a chain of similar habitats from Port Hedland to the Exmouth Gulf, in particular the coast adjacent to Mardie station (Phoenix 2020) south-west of the Project area, and at Forestier Bay (Phoenix 2013a), to the north-east of Karratha. Of note, however, is the fact that no obvious, important shorebird roosting sites were identified within the SBSA, and it is postulated that the birds either move outside the SBSA, possibly to offshore islands to the north and north-west, or to other coastal locations west of Cape Preston, or simply diffusely disperse within the SBSA. The shorebirds were documented to overwhelmingly forage within the offshore tidal mud and sand flats at low tide, habitats which will not be impacted by the Proposal (Figure 6-3). At high tide the shorebirds move back over the coast into the tidal samphire shrublands and bare mudflats, large areas of which will be replaced with evaporation and crystalliser ponds in consequence of implementation of the Proposal (see Figure 6-3) and into the mangrove creek systems, which would be much less impacted. Conversely, it is considered likely that the pond walls may afford roosting opportunities for some species in close proximity to these important feeding grounds, that currently do not exist.

The TFSA was found to support a limited number of habitat-dependent significant terrestrial fauna species on the landward side (Northern Quoll and lined soil-crevice skink (Dampier)), plus additional significant species that are habitat generalists (Fork-tailed Swift, Grey Falcon, Osprey). However, the likelihood of occurrence assessment determined that a number of significant species that were not recorded may occur, being one freshwater fish, two reptiles, 22 birds (mostly Migratory shorebirds) and four mammals; meaning, the TFSA (and SBSA) at least 'possibly' support up to 64 significant species.

The mangal community represents critical roosting habitat for Northern Coastal Free-tailed Bat (*Ozimops cobourgianus*; P1) (Figure 6-1).

The creeklines and adjoining habitats represent import linkages/movement corridors for species such as Northern Quoll and Common Brushtail Possum (Figure 6-2), supporting movement between the more expansive denning/shelter habitat of the hills to the south and the productive coastal habitats; indeed, Northern Quoll were recorded in a number of foraging habitats within the TFSA, including very close to the coast, and in particular on Devil Creek. Devil Creek and Mckay Creek also support foraging for Northern Coastal Free-tailed Bat that roosts in the mangroves (Figure 6-1), and lined soil-crevice skink (Dampier) (Figure 6-1). The creeklines also hold surface waters for extended periods and thus support reptiles, birds, and mammals after the wet season and into the dry season; The Project has however been designed to avoid impact to these creeks which will continue to flow to the coast.

The SRE fauna of the study area appear to have a connection with the fauna of nearby mainland coastal areas and Barrow Island. Notably, three taxa previously only known from Barrow Island were recorded. Fifteen taxa collected are new to science, but just four remain unknown outside the IDF; however, this is considered an artefact of the paucity of regional Detailed SRE surveys and further, the habitats within the TFSA are neither restricted, nor contain geographical features that would limit the dispersal of SREs and therefore, implementation of the Proposal would appear to present little risk to these four taxa.



Leichhardt Salt Pty Ltd
Eramurra Solar Salt Project

Project No	1320-ESP-LI-VER
Date	15/06/2023
Drawn by	BK
Map author	JC

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Kilometers

1:165,600 (at A4) GDA 1994 MGA Zone 50

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Terrestrial fauna study area
Shorebird study area
Development envelope

Figure 6-3

All conservation significant species records from the current survey and compiled desktop data

PHOENIX ENVIRONMENTAL SCIENCES

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Appendix 1 Survey site locations

Site	Site type	Latitude	Longitude
Site01	Systematic	-20.915	116.26023
Site02	Systematic	-20.996	116.33438
Site03	Systematic	-20.85	116.37442
Site04	Systematic	-20.834	116.39002
Site05	Systematic	-20.882	116.39126
Site06	Systematic	-20.899	116.36023
Site07	Systematic	-20.936	116.29143
Site08	Systematic	-20.943	116.27431
Bat 01	Targeted	-20.909	116.36803
Bat 02	Targeted	-20.868	116.42852
Bat 03	Targeted	-20.909	116.40539
Bat 04	Targeted	-20.877	116.42806
NP01	Targeted	-20.9	116.32063
NP02	Targeted	-20.894	116.32531
NP03	Targeted	-20.847	116.41755
NP04	Targeted	-20.885	116.35663
NP05	Targeted	-20.933	116.2742
NP06	Targeted	-20.959	116.28263
NP07	Targeted	-21.018	116.26638
NP08	Targeted	-20.926	116.30205
NP09	Targeted	-20.927	116.3233
NP10	Targeted	-20.935	116.36369
NP11	Targeted	-20.924	116.3898
NP12	Targeted	-20.927	116.37303
NP13	Targeted	-20.915	116.42454
NP14	Targeted	-20.956	116.33139
NQ01	Targeted	-20.932	116.31185
NQ02	Targeted	-21.035	116.25694
NQ03	Targeted	-20.874	116.32017
NQ05	Targeted	-20.915	116.2595
NQ06	Targeted	-21.042	116.26198
NQ07	Targeted	-20.878	116.36567
NQ08	Targeted	-20.869	116.42845
NQ09	Targeted	-20.916	116.40871
NQ10	Targeted	-20.925	116.37507
NQ11	Targeted	-20.927	116.408
NQ12	Targeted	-20.914	116.42716
NQ13	Targeted	-20.916	116.42466

Site	Site type	Latitude	Longitude
NQ14	Targeted	-20.876	116.42803
Salt-cam	Targeted	-20.863	116.34156
Water Trough	Targeted	-20.904	116.36424
SRE01	SRE	-20.845	116.4203
SRE02	SRE	-20.843	116.43274
SRE03	SRE	-20.847	116.39101
SRE04	SRE	-20.844	116.39836
SRE05	SRE	-20.87	116.34114
SRE06	SRE	-20.888	116.29448
SRE07	SRE	-20.893	116.30814
SRE08	SRE	-20.897	116.2991
SRE-FOR01	SRE	-20.862	116.44378
SRE-FOR02	SRE	-20.866	116.43516
SRE-FOR03	SRE	-20.867	116.42339
SRE-FOR04	SRE	-20.857	116.56421
SRE-FOR05	SRE	-20.836	116.46025
SRE-FOR06	SRE	-20.839	116.47362
SRE-FOR07	SRE	-20.83	116.49042
SRE-FOR08	SRE	-20.815	116.50307
SRE-FOR09	SRE	-20.859	116.49338
SRE-FOR10	SRE	-20.861	116.47395
SRE-FOR11	SRE	-20.854	116.44647
SRE-FOR12	SRE	-20.795	116.51439
SRE-FOR13	SRE	-20.803	116.52434
SRE-FOR14	SRE	-20.805	116.53338
SRE-FOR15	SRE	-20.808	116.56058
SRE-FOR16	SRE	-20.823	116.56605
SRE-FOR17	SRE	-20.831	116.54907
SRE-FOR18	SRE	-20.847	116.55769
SRE-WPT01	SRE	-20.855	116.43572
SRE-WPT02	SRE	-20.865	116.43353
SRE-WPT03	SRE	-20.857	116.46897
SRE-WPT04	SRE	-20.855	116.48161
SRE-WPT05	SRE	-20.791	116.5121
SRE-WPT06	SRE	-20.796	116.53956
SRE-WPT07	SRE	-20.826	116.55233
SRE-WPT08	SRE	-20.852	116.55617

Appendix 2 Terrestrial fauna survey site descriptions

Site details			
Site	**1320-SRE01**	**Position (WGS84)**	-20.844969, 116.420301
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Litter sieve	2376	1	15 Jan 2020	23 Apr 2020
2	Foraging	2376	0	15 Jan 2020	23 Apr 2020

Site description - visit 1 (15 Jan 2020)

Spinifex and low chenopods on low dunes around salt lake

Habitat	spinifex grassland		
Disturbance	exploration (drill pads and access tracks);		
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	10	**Litter cover (%)**	0
Grass cover (%)	60		
Herb cover (%)	0		

Site details			
Site	**1320-SRE02**	**Position (WGS84)**	-20.843289, 116.432742
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Litter sieve	2376	1	15 Jan 2020	23 Apr 2020
2	Foraging	2376	0	15 Jan 2020	23 Apr 2020

Site description - visit 1 (15 Jan 2020)

Spinifex on low dunes around salt lake, low chenopods on flats nearby

Habitat	spinifex grassland		
Disturbance	vehicle tracks;		
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	1	**Litter cover (%)**	0
Grass cover (%)	60		
Herb cover (%)	0		

Site details			
Site	**1320-SRE03**	**Position (WGS84)**	-20.846678, 116.39101
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	2352	1	16 Jan 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Litter sieve	2376	1	15 Jan 2020	23 Apr 2020
2	Foraging	2376	0	15 Jan 2020	23 Apr 2020

Site description - visit 1 (16 Jan 2020)

Mixed low-mid shrubs over spinifex on low dune beside saltlake

Habitat	shrubland		
Disturbance			
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	30	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	15	**Litter cover (%)**	0
Grass cover (%)	20		
Herb cover (%)	0		

Site details			
Site	**1320-SRE04**	**Position (WGS84)**	-20.843916, 116.398362
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	2352	1	16 Jan 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Litter sieve	2376	1	15 Jan 2020	23 Apr 2020
2	Foraging	2376	0	15 Jan 2020	23 Apr 2020
1	Foraging	0	0	21 Apr 2020	21 Apr 2020

Site description - visit 1 (16 Jan 2020)

Mixed tussock grass and spinifex with few low shrubs on low dune near salt lake

Habitat	tussock grassland		
Disturbance			
Vegetation condition	Excellent	**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	80	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	0.1	**Litter cover (%)**	0
Grass cover (%)	80		
Herb cover (%)	0		

Site details			
Site	**1320-SRE05**	**Position (WGS84)**	-20.87036, 116.341141
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

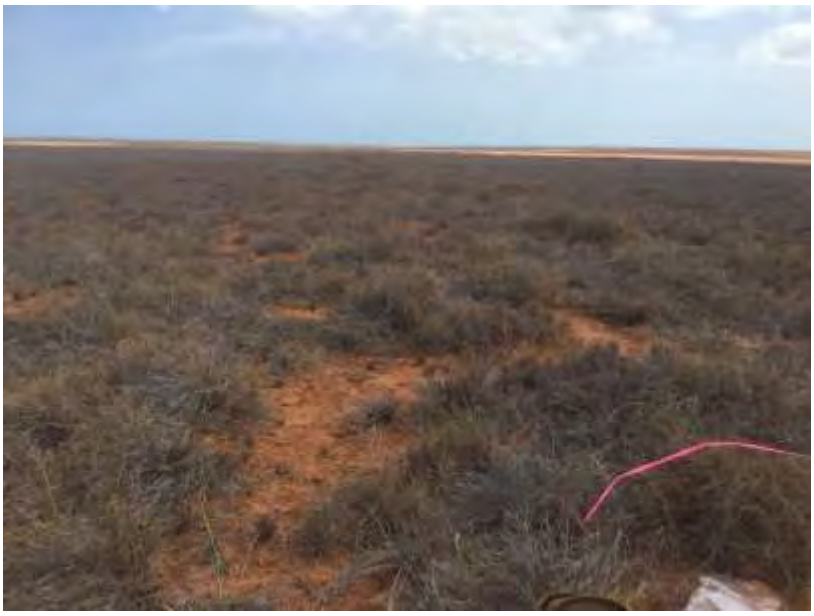
Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	2352	1	16 Jan 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	2376	1	15 Jan 2020	23 Apr 2020
2	Litter sieve	2376	1	15 Jan 2020	23 Apr 2020
2	Foraging	2376	0	15 Jan 2020	23 Apr 2020

Site description - visit 1 (16 Jan 2020)

Spinifex and tussock grass on low dune beside saltlake

Habitat	grassland		
Disturbance	grazing medium; livestock tracks;		
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	40	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	0	**Litter cover (%)**	0
Grass cover (%)	40		
Herb cover (%)	0		



Site details			
Site	**1320-SRE06**	**Position (WGS84)**	-20.888206, 116.29448
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Litter sieve	1896	1	04 Feb 2020	23 Apr 2020
2	Foraging	1896	0	04 Feb 2020	23 Apr 2020

Site description - visit 1 (04 Feb 2020)

Scattered mid Acacia etc. shrubs over spinifex on low rise of gritty sand island within chenopod mudflat; wattle flowering on April visit

Habitat	shrubland		
Disturbance			
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	30	**Litter distribution**	
Tree cover (%)	0.5	**Litter depth(cm)**	0
Shrub cover (%)	2	**Litter cover (%)**	0
Grass cover (%)	30		
Herb cover (%)	0		

Site details			
Site	**1320-SRE07**	**Position (WGS84)**	-20.893325, 116.308143
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Litter sieve	1896	1	04 Feb 2020	23 Apr 2020
2	Foraging	1896	0	04 Feb 2020	23 Apr 2020

Site description - visit 1 (04 Feb 2020)

Spinifex on small low island in bare mudflat

Habitat	spinifex grassland		
Disturbance			
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	50	**Litter distribution**	none
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	0	**Litter cover (%)**	0
Grass cover (%)	50		
Herb cover (%)	0		

Site details			
Site	**1320-SRE08**	**Position (WGS84)**	-20.896501, 116.299095
Topography		**Soil texture**	
Slope		**Rock type**	
Soil colour		**Rock cover (%)**	0

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Wet pitfall trap (prop. glycol)	1896	1	04 Feb 2020	23 Apr 2020
2	Litter sieve	1896	1	04 Feb 2020	23 Apr 2020
2	Foraging	1896	0	04 Feb 2020	23 Apr 2020

Site description - visit 1 (04 Feb 2020)

Spinifex and scattered low chenopods on low sandy island in mudflat with patchy chenopod shrubs

Habitat	spinifex grassland		
Disturbance	livestock tracks;		
Vegetation condition	Excellent	**Fire age**	
Total veg. cover (%)	70	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	2	**Litter cover (%)**	0
Grass cover (%)	70		
Herb cover (%)	0		

Site details			
Site	**Bat 01**	**Position (WGS84)**	-20.909256, 116.368031
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	chert, ferrous - ironstone, granite - rocks, quartz
Soil colour	red-brown	**Rock cover (%)**	30

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	96	1	29 Nov 2021	03 Dec 2021

Site description - visit 1 (29 Nov 2021)

Open shrubland over spinifex and tussock grassland on red brown clay loam soil.

Habitat	shrubland		
Disturbance	grazing-medium, livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	65	**Litter distribution**	under vegetation
Tree cover (%)	2	**Litter depth(cm)**	1
Shrub cover (%)	40	**Litter cover (%)**	15
Grass cover (%)	20		
Herb cover (%)	1		

Site details			
Site	**Bat 02**	**Position (WGS84)**	-20.867818, 116.428521
Topography	drainage line	**Soil texture**	gravel / alluvial, clay loam
Slope	moderate	**Rock type**	chert, ferrous - ironstone, granite - rocks
Soil colour	red-brown	**Rock cover (%)**	40

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	96.05	1	29 Nov 2021	03 Dec 2021

Site description - visit 1 (29 Nov 2021)

Eucalyptus and acacia over tussock grasses on red brown gravel alluvial/clay loam soil.

Habitat	riparian zone		
Disturbance	livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	90	**Litter distribution**	scattered
Tree cover (%)	30	**Litter depth(cm)**	3
Shrub cover (%)	15	**Litter cover (%)**	60
Grass cover (%)	45		
Herb cover (%)	2		

Site details			
Site	**Bat 03**	**Position (WGS84)**	-20.909165, 116.405394
Topography	drainage line	**Soil texture**	loamy sand, clay
Slope	gentle	**Rock type**	granite - rocks
Soil colour	brown	**Rock cover (%)**	10

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	88.53	1	03 Dec 2021	07 Dec 2021

Site description - visit 1 (03 Dec 2021)

Minor depression, seasonal drainage channel edged with tussock and triodia flats. Dense tussock under acacia.

Habitat	shrubland		
Disturbance	erosion channels, grazing-low		
Vegetation condition	Degraded	**Fire age**	moderate (>5 years)
Total veg. cover (%)	95	**Litter distribution**	
Tree cover (%)	5	**Litter depth(cm)**	0
Shrub cover (%)	20	**Litter cover (%)**	0
Grass cover (%)	95		
Herb cover (%)	5		

Site details			
Site	**Bat 04**	**Position (WGS84)**	-20.87677, 116.428056
Topography	creek	**Soil texture**	gravel / alluvial, clay loam
Slope	gentle	**Rock type**	ferrous - ironstone, granite - rocks
Soil colour	red-brown	**Rock cover (%)**	80

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	96	1	03 Dec 2021	07 Dec 2021
1	Camera trap	72	1	03 Dec 2021	06 Dec 2021

Site description - visit 1 (03 Dec 2021)

Open eucalyptus woodland bordering creekline over acacia shrubs over scattered tussock and spinifex grassland on red brown clay loam soil.

Habitat	riparian zone		
Disturbance	livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	45	**Litter distribution**	scattered
Tree cover (%)	30	**Litter depth(cm)**	1
Shrub cover (%)	10	**Litter cover (%)**	2
Grass cover (%)	5		
Herb cover (%)	1		

Site details			
Site	**NP01**	**Position (WGS84)**	-20.900495, 116.320633
Topography	plain	**Soil texture**	gravel–alluvial, sand
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, quartz
Soil colour	red–brown	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	888	1	10 Dec 2019	16 Jan 2020

Site description - visit 1 (10 Dec 2019)

Scattered low-mid shrubs over patchy mid spinifex grassland

Habitat	spinifex grassland		
Disturbance	livestock tracks		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	50	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	1	**Litter cover (%)**	0
Grass cover (%)	50		
Herb cover (%)	1		

Site details			
Site	**NP02**	**Position (WGS84)**	-20.893607, 116.325309
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, chert, quartz
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	888	1	10 Dec 2019	16 Jan 2020

Site description - visit 1 (10 Dec 2019)			
Patchy *Acacia* shrubland over low-mid spinifex.			
Habitat	spinifex grassland		
Disturbance	livestock tracks		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	5	**Litter cover (%)**	0
Grass cover (%)	60		
Herb cover (%)	0		

Site details			
Site	**NP03**	**Position (WGS84)**	-20.846965, 116.417553
Topography	plain	**Soil texture**	gravel–alluvial, clay loam
Slope	negligible	**Rock type**	granite - rocks, quartz, basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	840	1	11 Dec 2019	15 Jan 2020

Site description - visit 1 (11 Dec 2019)

Well-grown spinifex with scattered low saltbush on low stony rises, samphire and mid *Acacia* shrubs in channels.

Habitat	spinifex grassland		
Disturbance	evidence of feral animals		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	40	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	2	**Litter cover (%)**	0
Grass cover (%)	40		
Herb cover (%)	0		

Site details			
Site	**NP04**	**Position (WGS84)**	-20.884669, 116.356632
Topography	undulating plain	**Soil texture**	gravel–alluvial, sandy loam, rocks
Slope	gentle	**Rock type**	granite - rocks, quartz, basalt
Soil colour	red–brown, red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	864	1	11 Dec 2019	16 Jan 2020

Site description - visit 1 (11 Dec 2019)

Well grown spinifex on low rises, *Acacia* shrubs over spinifex in channels.

Habitat	spinifex grassland		
Disturbance	livestock tracks,		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	70	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	5	**Litter cover (%)**	0
Grass cover (%)	70		
Herb cover (%)	0		

Site details			
Site	**NP05**	**Position (WGS84)**	-20.933464, 116.274202
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, quartz, basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	432	1	17 Jan 2020	04 Feb 2020

Site description - visit 1 (17 Jan 2020)

Acacia mid open shrubland over spinifex, tall and thick in parts, on clay with gravel lag.

Habitat	shrubland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	15	**Litter cover (%)**	0
Grass cover (%)	50		
Herb cover (%)	0		

Site details			
Site	**NP06**	**Position (WGS84)**	-20.959274, 116.28263
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, quartz, basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	432	1	17 Jan 2020	04 Feb 2020

Site description - visit 1 (17 Jan 2020)

Acacia over mid spinifex.

Habitat	shrubland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	70	**Litter distribution**	
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	10	**Litter cover (%)**	0
Grass cover (%)	70		
Herb cover (%)	0		

Site details			
Site	**NP07**	**Position (WGS84)**	-21.018095, 116.266381
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, quartz, calcrete, limestone
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	432	1	17 Jan 2020	04 Feb 2020

Site description - visit 1 (17 Jan 2020)

Mixed *Acacia* shrubs over spinifex remnant patches, rest burnt within last couple of years.

Habitat	shrubland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	30	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	0
Shrub cover (%)	5	**Litter cover (%)**	0
Grass cover (%)	25		
Herb cover (%)	0		

Site details			
Site	**NP08**	**Position (WGS84)**	-20.926159, 116.302051
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, chirt, quartz
Soil colour	red–brown, red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	432	1	17 Jan 2020	04 Feb 2020

Site description - visit 1 (17 Jan 2020)

Acacia and *Hakea* patchy shrubs over thick spinifex.

Habitat	shrubland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	
Tree cover (%)	0.1	**Litter depth(cm)**	0
Shrub cover (%)	2	**Litter cover (%)**	0
Grass cover (%)	75		
Herb cover (%)	0		

Site details			
Site	**NP09**	**Position (WGS84)**	-20.927258, 116.323303
Topography	plain	**Soil texture**	sand
Slope	negligible	**Rock type**	ferrous - ironstone, granite - rocks, quartz
Soil colour	brown	**Rock cover (%)**	2

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	142.72	1	29 Nov 2021	05 Dec 2021

Site description - visit 1 (29 Nov 2021)

Isolated patch of small shrubs mostly mixed *Acacia* surrounded by cattle trampled grassland. Some spinifex (hard, laticed, slightly senescent).

Habitat	shrubland		
Disturbance	grazing-high, historic clearing, vehicle tracks, weed infestation		
Vegetation condition	Degraded	**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	under vegetation
Tree cover (%)	20	**Litter depth(cm)**	5
Shrub cover (%)	60	**Litter cover (%)**	20
Grass cover (%)	50		
Herb cover (%)	10		

Site details			
Site	**NP10**	**Position (WGS84)**	-20.935238, 116.363686
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	calcrete, chert, ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	15

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	140.63	1	29 Nov 2021	05 Dec 2021

Site description - visit 1 (29 Nov 2021)

Low open shrubland over spinifex and tussock grassland on red brown clay loam soil. Spinifex <50cm, with seeds.

Habitat	shrubland		
Disturbance	grazing-medium, livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	85	**Litter distribution**	under vegetation
Tree cover (%)	5	**Litter depth(cm)**	1
Shrub cover (%)	50	**Litter cover (%)**	15
Grass cover (%)	80		
Herb cover (%)	2		

Site details			
Site	**NP11**	**Position (WGS84)**	-20.92421, 116.389797
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	calcrete, chert, ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	50

Site description - visit 1 (29 Nov 2021)			
Low open shrubland over spinifex grassland (30cm in seed, senescent) and tussock grassland on red brown clay loam soil.			
Habitat	shrubland		
Disturbance	grazing-low, livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	under vegetation
Tree cover (%)	3	**Litter depth(cm)**	2
Shrub cover (%)	30	**Litter cover (%)**	25
Grass cover (%)	70		
Herb cover (%)	1		

Site details			
Site	**NP12**	**Position (WGS84)**	-20.926968, 116.373028
Topography	plain	**Soil texture**	sandy clay
Slope	negligible	**Rock type**	granite - rocks, quartz
Soil colour	brown	**Rock cover (%)**	5

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	144	1	29 Nov 2021	05 Dec 2021

Site description - visit 1 (05 Dec 2021)

Tall, close to 50cm hard lattice spinifex under scattered mixed *Acacia*.

Habitat	shrubland		
Disturbance	none evident		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	95	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	30	**Litter cover (%)**	0
Grass cover (%)	95		
Herb cover (%)	0		

Site details			
Site	**NP13**	**Position (WGS84)**	-20.914721, 116.424544
Topography	creek	**Soil texture**	gravel / alluvial
Slope	moderate	**Rock type**	granite - rocks, quartz
Soil colour	red-brown	**Rock cover (%)**	65

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	41.28	1	05 Dec 2021	07 Dec 2021

Site description - visit 1 (05 Dec 2021)

Eucalyptus woodland over scattered *Acacia* shrubs over spinifex grassland (30-200cm) and tussock grassland on red brown gravel alluvial clay loam soil.

Habitat	riparian zone		
Disturbance	livestock tracks, vehicle tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	90	**Litter distribution**	under vegetation
Tree cover (%)	20	**Litter depth(cm)**	2
Shrub cover (%)	10	**Litter cover (%)**	10
Grass cover (%)	55		
Herb cover (%)	2		

Site details			
Site	**NP14**	**Position (WGS84)**	-20.955903, 116.331388
Topography	plain	**Soil texture**	sandy loam
Slope	negligible	**Rock type**	chert, ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	25

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Audio recording	48	1	05 Dec 2021	07 Dec 2021

Site description - visit 1 (05 Dec 2021)

Long unburned spinifex (>50cm) forming dense clumps.

Habitat	grassland		
Disturbance	exploration (drill pads and access tracks), grazing-high, vehicle tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	90	**Litter distribution**	scattered
Tree cover (%)	20	**Litter depth(cm)**	1
Shrub cover (%)	10	**Litter cover (%)**	5
Grass cover (%)	90		
Herb cover (%)	2		

Site details			
Site	**NQ01**	**Position (WGS84)**	-20.932387, 116.311849
Topography	riparian zone	**Soil texture**	ALUV
Slope	negligible	**Rock type**	granite - outcropping
Soil colour	BLK	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	131.28	1	20 Apr 2020	26 Apr 2020
1	Foraging	0.67	0	20 Apr 2020	20 Apr 2020
1	Camera trap	411.75	1	20 Apr 2020	26 Apr 2020

Site description - visit 1 (20 Apr 2020)

Major drainage with granite outcropping and water pool; *Acacia* mid open shrubland over mixed tussock and hummock grasses and herbs.

Habitat	shrubland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	5	**Litter depth(cm)**	
Shrub cover (%)	40	**Litter cover (%)**	
Grass cover (%)	50		
Herb cover (%)	15		

Site details			
Site	**NQ02**	**Position (WGS84)**	-21.034615, 116.256935
Topography	riparian zone	**Soil texture**	gravel–alluvial, sand
Slope	gentle	**Rock type**	granite - outcropping
Soil colour	brown, grey	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	96.1	1	20 Apr 2020	24 Apr 2020
1	Camera trap	414.22	1	20 Apr 2020	26 Apr 2020
1	Birding	1.42	0	20 Apr 2020	20 Apr 2020

Site description - visit 1 (20 Apr 2020)

Pool in a major drainage with granite outcropping. Eucalypts to 7 m and diverse shrubs to 4 m along the edge of the water. Sparse eucalypts over grasses to 30 cm in adjacent areas.

Habitat	riparian zone		
Disturbance	grazing – low, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	40	**Litter distribution**	
Tree cover (%)	10	**Litter depth(cm)**	
Shrub cover (%)	10	**Litter cover (%)**	
Grass cover (%)	10		
Herb cover (%)	10		

Site details			
Site	**NQ03**	**Position (WGS84)**	-20.874389, 116.320166
Topography	tidal creek	**Soil texture**	sand
Slope	gentle	**Rock type**	
Soil colour	grey, whitish	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	135.95	1	20 Apr 2020	26 Apr 2020
1	Camera trap	408.68	1	20 Apr 2020	26 Apr 2020

Site description - visit 1 (20 Apr 2020)

Mangrove bordering tidal channel through coastal dune.

Habitat	mangrove		
Disturbance	litter, vehicle tracks		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)		**Litter distribution**	
Tree cover (%)		**Litter depth(cm)**	
Shrub cover (%)		**Litter cover (%)**	
Grass cover (%)			
Herb cover (%)			

Site details			
Site	**NQ05**	**Position (WGS84)**	-20.915233, 116.259503
Topography	drainage line	**Soil texture**	sandy clay
Slope	gentle	**Rock type**	
Soil colour	red-orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	137.38	1	20 Apr 2020	26 Apr 2020
1	Camera trap	413.57	1	20 Apr 2020	26 Apr 2020

Site description - visit 1 (16 Apr 2020)

Eucalypt woodland over mixed *Acacia* shrubs over mixed predominantly tussock grasses with *Triodia* and *Ptilotus* over mixed herbs on red-orange clay loam with 5-10 cm deep leaf litter under trees and shrubs and additional patches of deep litter transported to the site along major drainage line.

Habitat	open woodland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	70	**Litter distribution**	
Tree cover (%)	15	**Litter depth(cm)**	
Shrub cover (%)	15	**Litter cover (%)**	
Grass cover (%)	70		
Herb cover (%)	20		

Site details			
Site	**NQ06**	**Position (WGS84)**	-21.042341, 116.261981
Topography	hill slope	**Soil texture**	sandy loam, clay loam
Slope	moderate	**Rock type**	basalt
Soil colour	red–brown	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	134	1	20 Apr 2020	26 Apr 2020
1	Foraging nocturnal	1.62	0	22 Apr 2020	22 Apr 2020
1	Foraging	1.12	0	20 Apr 2020	20 Apr 2020
1	Camera trap	369.6	1	20 Apr 2020	26 Apr 2020
1	Birding	0.27	0	25 Apr 2020	25 Apr 2020

Site description - visit 1 (20 Apr 2020)

Two large basalt rock piles with grasses and vines on the lower slopes. Scattered *Acacia* trees and shrubs.

Habitat	shrubland		
Disturbance	grazing – medium, livestock tracks, weed infestation		
Vegetation condition	Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	40	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	
Shrub cover (%)	1	**Litter cover (%)**	
Grass cover (%)	35		
Herb cover (%)	5		

Site details			
Site	**NQ07**	**Position (WGS84)**	-20.878413, 116.36567
Topography	drainage line	**Soil texture**	clay loam, rocks
Slope	gentle	**Rock type**	granite - bolders, quartz, basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Ultrasonic recording	137.03	1	20 Apr 2020	26 Apr 2020
1	Camera trap	410.53	1	20 Apr 2020	26 Apr 2020

Site description - visit 1 (20 Apr 2020)

Major drainage line with granite boulders and outcropping with basalt intrusion and free standing water.

Habitat	shrubland		
Disturbance	evidence of feral animals, vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	75	**Litter distribution**	
Tree cover (%)	20	**Litter depth(cm)**	
Shrub cover (%)	15	**Litter cover (%)**	
Grass cover (%)	25		
Herb cover (%)	5		

Site details			
Site	**NQ08**	**Position (WGS84)**	-20.869096, 116.42845
Topography	drainage line	**Soil texture**	gravel / alluvial, clay loam
Slope	gentle	**Rock type**	basalt, ferrous - ironstone, granite - rocks
Soil colour	red-brown	**Rock cover (%)**	50

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	431.93	1	30 Nov 2021	06 Dec 2021

Site description - visit 1 (30 Nov 2021)

Scattered Eucalyptus trees over scattered *Acacia* shrubs over scattered spinifex and tussock grassland on red brown gravel alluvial and clay loam soil.

Habitat	riparian zone		
Disturbance	livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	under vegetation
Tree cover (%)	30	**Litter depth(cm)**	3
Shrub cover (%)	5	**Litter cover (%)**	80
Grass cover (%)	25		
Herb cover (%)	1		

Site details			
Site	**NQ09**	**Position (WGS84)**	-20.915657, 116.408707
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	chert, ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	85

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	1295.75	1	30 Nov 2021	06 Dec 2021

Site description - visit 1 (30 Nov 2021)

Scattered *Acacia* woodland over low *Acacia* shrubland on sparsely scattered spinifex grassland on red brown clay loam soil.

Habitat	shrubland		
Disturbance	none evident		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	50	**Litter distribution**	under vegetation
Tree cover (%)	10	**Litter depth(cm)**	2
Shrub cover (%)	15	**Litter cover (%)**	20
Grass cover (%)	20		
Herb cover (%)	1		

Site details			
Site	**NQ10**	**Position (WGS84)**	-20.924801, 116.375072
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	chert, ferrous - ironstone, quartz
Soil colour	red-brown	**Rock cover (%)**	70

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	576	1	30 Nov 2021	06 Dec 2021

Site description - visit 1 (30 Nov 2021)

Open scattered low *Acacia* shrubland over scattered spinifex grassland on red brown clay loam soil.

Habitat	shrubland		
Disturbance	none evident		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	40	**Litter distribution**	under vegetation
Tree cover (%)	0	**Litter depth(cm)**	1
Shrub cover (%)	10	**Litter cover (%)**	5
Grass cover (%)	30		
Herb cover (%)	1		

Site details			
Site	**NQ11**	**Position (WGS84)**	-20.927351, 116.408002
Topography	hill top	**Soil texture**	clay loam
Slope	steep	**Rock type**	ferrous - Banded Iron Formation
Soil colour	red-brown	**Rock cover (%)**	90

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	288	1	30 Nov 2021	06 Dec 2021

Site description - visit 1 (30 Nov 2021)

Spinifex and tussock grasses on BIF hilltop on red brown clay loam soil.

Habitat	rockshelf		
Disturbance	grazing-low		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	30	**Litter distribution**	under vegetation
Tree cover (%)	0	**Litter depth(cm)**	1
Shrub cover (%)	0	**Litter cover (%)**	4
Grass cover (%)	25		
Herb cover (%)	1		

Site details			
Site	**NQ12**	**Position (WGS84)**	-20.913764, 116.42716
Topography	hill top	**Soil texture**	gravel / alluvial, clay loam
Slope	steep	**Rock type**	chert, quartz
Soil colour	red-brown	**Rock cover (%)**	70

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	120	1	01 Dec 2021	06 Dec 2021

Site description - visit 1 (01 Dec 2021)

Fig tree and sparsely scattered low *Acacia* shrubs on spinifex and tussock grassland on rove hill top on red brown gravel alluvial clay loam soil.

Habitat	spinifex grassland		
Disturbance	grazing-low		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	under vegetation
Tree cover (%)	1	**Litter depth(cm)**	1
Shrub cover (%)	5	**Litter cover (%)**	5
Grass cover (%)	55		
Herb cover (%)	1		

Site details			
Site	**NQ13**	**Position (WGS84)**	-20.916093, 116.424658
Topography	creek	**Soil texture**	gravel / alluvial, clay loam
Slope	gentle	**Rock type**	chert, ferrous - ironstone, granite - rocks, quartz
Soil colour	red-brown	**Rock cover (%)**	80

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	120	1	01 Dec 2021	06 Dec 2021

Site description - visit 1 (01 Dec 2021)

Eucalyptus woodland over scattered *Acacia* shrubland over spinifex and tussock grassland on red brown gravel alluvial clay loam soil.

Habitat	riparian zone		
Disturbance	none evident		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	55	**Litter distribution**	scattered
Tree cover (%)	10	**Litter depth(cm)**	1
Shrub cover (%)	15	**Litter cover (%)**	50
Grass cover (%)	30		
Herb cover (%)	1		

Site details			
Site	**NQ14**	**Position (WGS84)**	-20.875862, 116.428025
Topography	creek	**Soil texture**	clay loam
Slope	gentle	**Rock type**	granite - rocks
Soil colour	red-brown	**Rock cover (%)**	65

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Foraging	0.82	0	03 Dec 2021	03 Dec 2021
1	Camera trap	72	1	03 Dec 2021	06 Dec 2021

Site description - visit 1 (03 Dec 2021)

Eucalyptus woodland bordering creekline over scattered *Acacia* shrubs over tussock grassland on red brown clay loam soil.

Habitat	riparian zone		
Disturbance	livestock tracks		
Vegetation condition		**Fire age**	moderate (>5 years)
Total veg. cover (%)	45	**Litter distribution**	under vegetation
Tree cover (%)	50	**Litter depth(cm)**	1
Shrub cover (%)	10	**Litter cover (%)**	5
Grass cover (%)	30		
Herb cover (%)	2		

Site details			
Site	**Site01**	**Position (WGS84)**	-20.914913, 116.260225
Topography	drainage line	**Soil texture**	clay loam
Slope	gentle	**Rock type**	
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	840	5	18 Apr 2020	25 Apr 2020
1	Funnel	3360	20	18 Apr 2020	25 Apr 2020
1	Foraging nocturnal	0.67	0	22 Apr 2020	22 Apr 2020
1	Foraging	3.4	0	18 Apr 2020	18 Apr 2020
1	Elliot trap (large)	1680	10	18 Apr 2020	25 Apr 2020
1	Bucket	840.08	5	18 Apr 2020	25 Apr 2020

Site description - visit 1 (18 Apr 2020)

Eucalypt woodland over mixed *Acacia* shrubs over mixed predominantly tussock grasses with *Triodia* and *Ptilotus* over mixed herbs on red-orange clay loam with 5-10 cm deep leaf litter under trees and shrubs and additional patches of deep litter transported to the site along major drainage line.

Habitat	woodland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	70	**Litter distribution**	
Tree cover (%)	15	**Litter depth(cm)**	
Shrub cover (%)	15	**Litter cover (%)**	
Grass cover (%)	70		
Herb cover (%)	20		

Site details			
Site	**Site02**	**Position (WGS84)**	-20.995633, 116.334375
Topography	plain	**Soil texture**	clay loam
Slope	negligible	**Rock type**	
Soil colour	red–orange	**Rock cover (%)**	

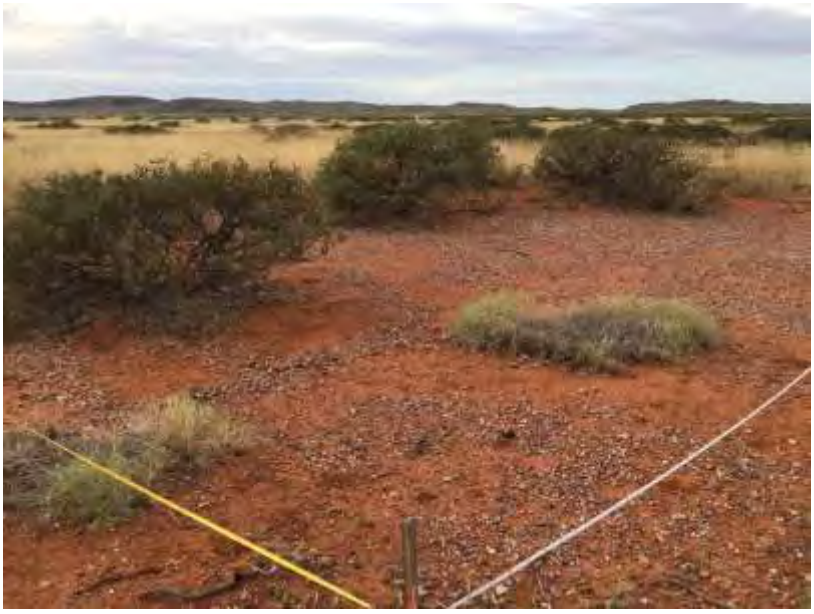
Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	844.83	5	18 Apr 2020	25 Apr 2020
1	Funnel	3360	20	18 Apr 2020	25 Apr 2020
1	Foraging	1.67	0	21 Apr 2020	21 Apr 2020
1	Elliot trap (large)	1680	10	18 Apr 2020	25 Apr 2020
1	Bucket	860	5	18 Apr 2020	25 Apr 2020
1	Birding	3.5	0	25 Apr 2020	25 Apr 2020

Site description - visit 1 (18 Apr 2020)

Mid open Acacia shrubland over patchy spinifex grassland on gravelly red clay cloam

Habitat	shrubland		
Disturbance			
Vegetation condition	Very Good	**Fire age**	not evident
Total veg. cover (%)	50	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	0
Shrub cover (%)	20	**Litter cover (%)**	0
Grass cover (%)	30		
Herb cover (%)	2		



Site details			
Site	**Site03**	**Position (WGS84)**	-20.850166, 116.374423
Topography	undulating plain	**Soil texture**	sand, clay loam
Slope	gentle	**Rock type**	
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	840	5	16 Apr 2020	23 Apr 2020
1	Funnel	3360	20	16 Apr 2020	23 Apr 2020
1	Foraging nocturnal	0.6	0	24 Apr 2020	24 Apr 2020
1	Foraging	1.4	0	25 Apr 2020	25 Apr 2020
1	Elliot trap (large)	1680	10	16 Apr 2020	23 Apr 2020
1	Bucket	840	5	16 Apr 2020	23 Apr 2020
1	Birding	2	0	20 Apr 2020	20 Apr 2020

Site description - visit 1 (16 Apr 2020)

Tussock grassland mixed with *Triodia* hummock over mixed herbs on red-orange sandy clay loam with no leaf litter (unknown shrubs in low point).

Habitat	grassland		
Disturbance	evidence of feral animals, vehicle tracks, weed infestation		
Vegetation condition	Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	85	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	
Shrub cover (%)	10	**Litter cover (%)**	
Grass cover (%)	80		
Herb cover (%)	30		

Site details			
Site	**Site04**	**Position (WGS84)**	-20.83429, 116.390016
Topography	dune	**Soil texture**	sand
Slope	moderate	**Rock type**	
Soil colour	red–orange, whitish	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	840	5	19 Apr 2020	26 Apr 2020
1	Funnel	3360	20	19 Apr 2020	26 Apr 2020
1	Foraging nocturnal	2.87	0	24 Apr 2020	24 Apr 2020
1	Foraging	2.27	0	22 Apr 2020	22 Apr 2020
1	Elliot trap (large)	1680	10	19 Apr 2020	26 Apr 2020
1	Bucket	840	5	19 Apr 2020	26 Apr 2020

Site description - visit 1 (19 Apr 2020)

Open coastal shrubland over *Triodia* hummock and tussock grasses with *Solanum* and other herbs on whitish sand dunes.

Habitat	shrubland		
Disturbance	evidence of feral animals, vehicle tracks		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	60	**Litter distribution**	
Tree cover (%)	1	**Litter depth(cm)**	
Shrub cover (%)	25	**Litter cover (%)**	
Grass cover (%)	60		
Herb cover (%)	2		

Site details			
Site	**Site05**	**Position (WGS84)**	-20.88167, 116.391257
Topography	drainage line	**Soil texture**	clay loam, rocks
Slope	gentle	**Rock type**	basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	830.5	5	16 Apr 2020	23 Apr 2020
1	Funnel	3410.33	20	16 Apr 2020	23 Apr 2020
1	Foraging nocturnal	2.27	0	24 Apr 2020	24 Apr 2020
1	Foraging	2	0	25 Apr 2020	25 Apr 2020
1	Elliot trap (large)	1660.83	10	16 Apr 2020	23 Apr 2020
1	Bucket	802.25	5	16 Apr 2020	23 Apr 2020

Site description - visit 1 (16 Apr 2020)

Scattered *Acacia* shrubs over predominantly tussock grassland with *Triodia* grasses over mixed herbs on red-orange rocky (basalt) clay loam with leaf litter transported to site down drainage line.

Habitat	grassland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	85	**Litter distribution**	
Tree cover (%)		**Litter depth(cm)**	
Shrub cover (%)	5	**Litter cover (%)**	
Grass cover (%)	70		
Herb cover (%)	15		

Site details			
Site	**Site06**	**Position (WGS84)**	-20.898832, 116.360234
Topography	plain	**Soil texture**	sand, clay loam
Slope	negligible	**Rock type**	
Soil colour	red–orange	**Rock cover (%)**	

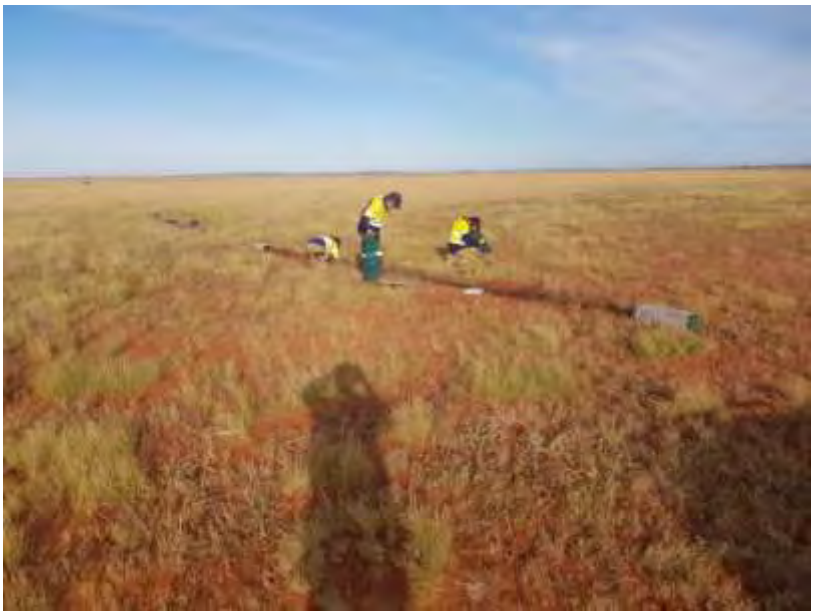
Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	840	5	17 Apr 2020	24 Apr 2020
1	Funnel	3360	20	17 Apr 2020	24 Apr 2020
1	Foraging nocturnal	0.53	0	23 Apr 2020	23 Apr 2020
1	Foraging	2	0	21 Apr 2020	21 Apr 2020
1	Elliot trap (large)	1680	10	17 Apr 2020	24 Apr 2020
1	Bucket	840	5	17 Apr 2020	24 Apr 2020

Site description - visit 1 (17 Apr 2020)

Mixed tussock grassland with small *Triodia* hummocks over mixed herbs on red-orange sandy clay loam with no leaf litter. Pockets of sinkhole/cracks in substrate as main fauna refuge.

Habitat	grassland		
Disturbance	vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	
Shrub cover (%)	2	**Litter cover (%)**	
Grass cover (%)	80		
Herb cover (%)	20		



Site details			
Site	**Site07**	**Position (WGS84)**	-20.935852, 116.29143
Topography	drainage line	**Soil texture**	sand, clay loam
Slope	negligible	**Rock type**	
Soil colour	red–orange	**Rock cover (%)**	

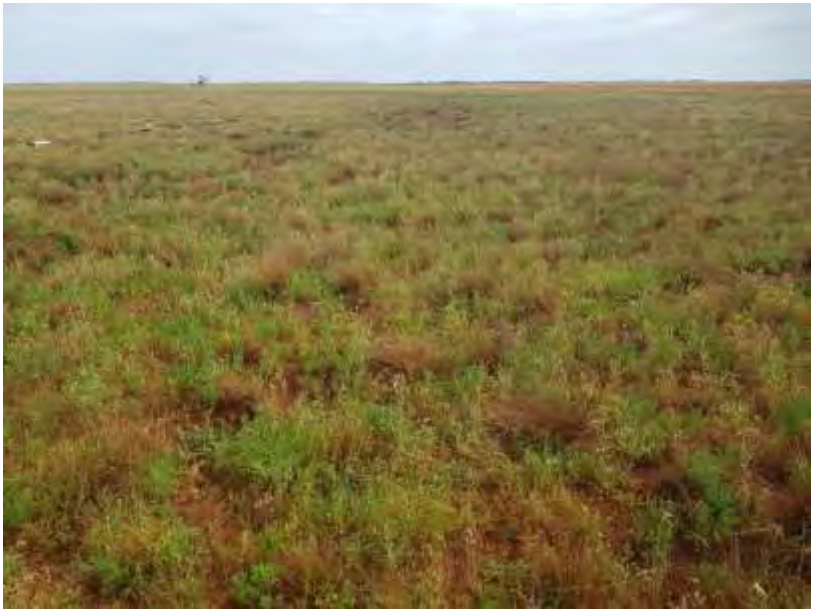
Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	839.92	5	17 Apr 2020	24 Apr 2020
1	Funnel	3360	20	17 Apr 2020	24 Apr 2020
1	Foraging nocturnal	2.27	0	23 Apr 2020	23 Apr 2020
1	Foraging	2.2	0	20 Apr 2020	20 Apr 2020
1	Elliot trap (large)	1679.83	10	17 Apr 2020	24 Apr 2020
1	Bucket	840	5	17 Apr 2020	24 Apr 2020
1	Birding	2	0	20 Apr 2020	20 Apr 2020

Site description - visit 1 (17 Apr 2020)

Mixed tussock and *Triodia* hummock grassland over mixed low herbs on red-orange cracking clay loam with no leaf litter.

Habitat	grassland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	90	**Litter distribution**	
Tree cover (%)	0	**Litter depth(cm)**	
Shrub cover (%)	0	**Litter cover (%)**	
Grass cover (%)	85		
Herb cover (%)	30		



Site details			
Site	**Site08**	**Position (WGS84)**	-20.943215, 116.274313
Topography	plain	**Soil texture**	sand, clay loam
Slope	negligible	**Rock type**	ferrous - Ironstone, granite - rocks, quartz, basalt
Soil colour	red–orange	**Rock cover (%)**	

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Pipe	840	5	19 Apr 2020	26 Apr 2020
1	Funnel	3360	20	19 Apr 2020	26 Apr 2020
1	Foraging nocturnal	1.67	0	23 Apr 2020	23 Apr 2020
1	Elliot trap (large)	1680	10	19 Apr 2020	26 Apr 2020
1	Bucket	840	5	19 Apr 2020	26 Apr 2020

Site description - visit 1 (19 Apr 2020)

Mixed *Acacia* shrubland over predominantly *Triodia* hummock with scattered mixed tussock grasses over sporadic mixed herbs on red-orange rocky (granite, basalt, quartz, calcrete small rocks) clay loam with rare leaf litter under vegetation.

Habitat	shrubland		
Disturbance	evidence of feral animals, livestock tracks, vehicle tracks, weed infestation		
Vegetation condition	Very Good	**Fire age**	moderate (>5 years)
Total veg. cover (%)	80	**Litter distribution**	
Tree cover (%)	5	**Litter depth(cm)**	
Shrub cover (%)	40	**Litter cover (%)**	
Grass cover (%)	55		
Herb cover (%)	5		

Site details			
Site	**Water Trough 01**	**Position (WGS84)**	-20.904089, 116.364238
Topography	plain	**Soil texture**	sandy loam
Slope	negligible	**Rock type**	calcrete, chert, ferrous - ironstone
Soil colour	red-brown	**Rock cover (%)**	10

Sample and effort summary

Visit	Sample method	Sample quant. (hrs)	Repli-cation	Date start	Date stop
1	Camera trap	196.86	1	29 Nov 2021	03 Dec 2021

Site description - visit 1 (29 Nov 2021)

Open low shrubland over spinifex and tussock grassland on red brown sandy clay loam soil,

Habitat	grassland		
Disturbance	exploration (drill pads and access tracks), grazing-high, livestock tracks, vehicle tracks		
Vegetation condition		**Fire age**	relatively recent (1-5 years)
Total veg. cover (%)	30	**Litter distribution**	under vegetation
Tree cover (%)	1	**Litter depth(cm)**	1
Shrub cover (%)	5	**Litter cover (%)**	5
Grass cover (%)	85		
Herb cover (%)	2		

Appendix 3 Vertebrate fauna desktop and field survey results

Cells in blue are marine species

Families	Species	Common name	Status	Introduced	Desktop sources																					PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
Fish																										
Lamnidae	*Carcharodon carcharias*	White Shark	VU/Mig. (EPBC Act)			●																				
Odontaspididae	*Carcharias taurus* (W. coast pop.)	Grey Nurse Shark	VU (EPBC Act)			●																				
Rhincodontidae	*Rhincodon typus*	Whale Shark	VU/Mig. (EPBC Act)			●																				
Pristidae	*Pristis clavata*	Dwarf Sawfish	VU/Mig. (EPBC Act)			●																				
	Pristis zijsron	Green Sawfish	VU/Mig. (EPBC Act)			●																				
	Anoxypristis cuspidata	Narrow Sawfish	Mig. (EPBC Act)			●																				
Mobulidae	*Manta alfredi*	Reef Manta Ray	Mig. (EPBC Act)			●																				
	Manta birostris	Giant Manta Ray	Mig. (EPBC Act)			●																				
Melanotaeniidae	*Melanotaenia australis*	Western Rainbowfish									●															
Terapontidae	*Leiopotherapon aheneus*	Fortescue Grunter	P4 (DBCA)		●		●				●															
	Leiopotherapon unicolor	Spangled Perch									●															
Syngnathidae	*Acentronura larsonae*	Helen's Pygmy Pipehorse				●																				
	Bulbonaricus brauni	Pug-headed Pipefish				●																				
	Campichthys tricarinatus	Three-keel Pipefish				●																				
	Choeroichthys brachysoma	Short-bodied Pipefish				●																				
	Choeroichthys latispinosus	Muiron Island Pipefish				●																				
	Choeroichthys suillus	Pig-snouted Pipefish				●																				
	Doryrhamphus dactyliophorus	Banded Pipefish				●																				
	Doryrhamphus janssi	Cleaner Pipefish				●																				
	Doryrhamphus multiannulatus	Many-banded Pipefish				●																				
	Doryrhamphus negrosensis	Flagtail Pipefish				●																				
	Festucalex scalaris	Ladder Pipefish				●																				
	Filicampus tigris	Tiger Pipefish				●																				
	Halicampus brocki	Brock's Pipefish				●																				
	Halicampus grayi	Mud Pipefish				●																				
	Halicampus nitidus	Glittering Pipefish				●																				
	Halicampus spinirostris	Spiny-snout Pipefish				●																				

Families	Species	Common name	Status	Introduced	Desktop sources																					PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
	Haliichthys taeniophorus	Ribboned Pipehorse				●																			
	Hippichthys penicillus	Beady Pipefish				●																			
	Hippocampus angustus	Western Spiny Seahorse				●																			
	Hippocampus histrix	Spiny Seahorse				●																			
	Hippocampus kuda	Spotted Seahorse				●																			
	Hippocampus planifrons	Flat-face Seahorse				●																			
	Hippocampus trimaculatus	Three-spot Seahorse				●																			
	Micrognathus micronotopterus	Tidepool Pipefish				●																			
	Phoxocampus belcheri	Black Rock Pipefish				●																			
	Solegnathus hardwickii	Pallid Pipehorse				●																			
	Solegnathus lettiensis	Gunther's Pipehorse				●																			
	Solenostomus cyanopterus	Robust Ghostpipefish				●																			
	Syngnathoides biaculeatus	Double-end Pipehorse				●																			
	Trachyrhamphus bicoartatus	Bentstick Pipefish				●																			
	Trachyrhamphus longirostris	Straightstick Pipefish				●																			
Amphibians																									
Hylidae	*Cyclorana maini*	Sheep Frog			●			●			●	●			●					●		●			●
	Litoria rubella	Little Red Tree Frog			●			●			●	●			●										
Limnodynastidae	*Neobatrachus aquilonius*	Northern Burrowing Frog			●																				
	Neobatrachus kunapalari	Kunapalari Frog			●																				
	Notaden nichollsi	Desert Spadefoot			●								●												●
Myobatrachidae	*Platyplectrum spenceri*	Spencer's Burrowing Frog						●																	
	Uperoleia russelli	Northwest Toadlet										●			●										
	Uperoleia saxatilis	Pilbara Toadlet			●																				
Reptiles																									
Dermochelyidae	*Dermochelys coriacea*	Leatherback Turtle	EN/Mig.; VU (EPBC Act; BC Act)			●																			
Cheloniidae	*Caretta caretta*	Loggerhead Turtle	EN/Mig.; EN (EPBC Act; BC Act)			●		●			●														
	Chelonia mydas	Green Turtle	VU/Mig.; VU (EPBC Act; BC Act)		●	●	●	●			●	●	●		●				●	●					
	Eretmochelys imbricata	Hawksbill Turtle	VU/Mig.; VU (EPBC Act; BC Act)		●	●	●	●			●														
	Natator depressus	Flatback Turtle	VU/Mig.; VU (EPBC Act; BC Act)		●	●	●	●			●								●						

Families	Species	Common name	Status	Introduced	Desktop sources																					PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon			●			●			●	●			●	●	●			●	●	●	●	●	●
	Ctenophorus isolepis	Military Dragon			●			●			●	●			●	●	●				●	●	●		●
	Ctenophorus nuchalis	Central Netted Dragon			●			●			●	●	●		●	●	●			●	●		●		●
	Ctenophorus reticulatus	Western Netted Dragon						●			●					●									
	Diporiphora valens	Southern Pilbara Tree Dragon																●							
	Gowidon longirostris (ex Amphibolurus)	Long-nosed Dragon			●			●			●	●			●	●	●			●		●			
	Lophognathus horneri (ex A. gilberti)	Horner's Dragon			●			●			●	●			●										
	Pogona minor minor	Western Bearded Dragon			●			●			●					●	●						●		●
	Pogona minor mitchelli	Northwestern Bearded Dragon			●							●			●		●			●	●				
	Tympanocryptis cephalus	Pebble Dragon			●						●	●			●		●			●			●		●
Gekkonidae	*Gehyra crypta*	Western Cryptic Gehyra									●														
	Gehyra peninsularis	Burrup Peninsula Rock Gehyra									●														
	Gehyra pilbara	Pilbara Dtella			●			●			●	●	●		●	●	●			●	●				
	Gehyra polka	Large-spotted Midwest Gehyra														●	●								
	Gehyra punctata	Spotted Dtella			●			●			●	●			●	●	●				●				●
	Gehyra purpurascens	Purplish Dtella			●																				
	Gehyra variegata	Tree Dtella			●			●			●	●	●		●	●	●	●		●					●
	Hemidactylus frenatus	Asian House Gecko		●	●	●					●														
	Heteronotia binoei	Bynoe's Gecko			●			●			●	●	●		●	●	●	●							●
	Heteronotia spelea	Desert Cave Gecko						●																	
Carphodactylidae	*Nephrurus levis occidentalis*	W Smooth Knob-tailed Gecko						●					●		●	●				●					
	Nephrurus levis pilbarensis	Pilbara Smooth Knob-tailed Gecko			●										●		●								
	Nephrurus cinctus (ex wheeleri)	Pilbara Banded Knob-tailed Gecko			●			●			●	●			●	●	●								
Diplodactylidae	*Crenadactylus ocellatus*	Southwestern Clawless Gecko									●														
	Diplodactylus bilybara (ex conspic.)	Pilbara Fat-tailed Gecko			●			●			●	●	●		●	●	●			●					●
	Diplodactylus galaxias	Northern Pilbara Beak-faced Gecko			●						●					●	●								●
	Diplodactylus laevis (ex conspic.)	Desert Fat-tailed Gecko									●														
	Diplodactylus mitchelli	Pilbara Stone Gecko			●						●	●			●	●									

Families	Species	Common name	Status	Introduced	Desktop sources																				PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
	Diplodactylus savagei	Southern Pilbara Beak-faced Gecko			●							●			●	●				●					
	Lucasium woodwardi (ex stenodactylum)	Pilbara Sandplain Gecko			●			●			●		●		●	●	●						●		●
	Lucasium wombeyi	Pilbara Ground Gecko			●											●	●								
	Oedura fimbria (ex *marmorata*)	Western Marbled Velvet Gecko						●																	
	Rhynchoedura ornata	Western Beaked Gecko			●			●								●	●								
	Strophurus ciliaris	Northern Spiny-tail Gecko															●								
	Strophurus elderi	Jewelled Gecko			●			●			●					●	●								
	Strophurus jeanae	Southern Phasmid Gecko						●									●								
	Strophurus strophurus	Western Spiny-tail gecko			●			●			●		●		●		●								
Pygopodidae	*Delma butleri (ex haroldi)*	Unbanded Delma											●												
	Delma nasuta	Sharp-snouted Delma			●			●			●	●			●										
	Delma pax	Peace Delma			●						●	●			●										●
	Delma tincta	Excitable Delma			●			●																	
	Lialis burtonis	Burton's Legless Lizard			●			●			●	●	●		●					●					●
	Pygopus nigriceps	Western Hooded Scaly-foot			●			●				●			●					●					
Scincidae	*Carlia munda*	Shaded-litter Rainbow Skink			●							●			●	●	●								●
	Carlia triacantha	Desert Rainbow Skink			●			●			●	●			●	●	●								●
	Cryptoblepharus buchananii	Buchanan's Snake-eyed Skink									●														
	Cryptoblepharus ustulatus	Russet Snake-eyed Skink													●										
	Ctenotus angusticeps	Airlie Island Ctenotus	P3 (DBCA) [previously EPBC]			●															●				
	Ctenotus grandis titan	Grand Ctenotus			●			●			●	●			●	●	●						●		●
	Ctenotus hanloni	Nimble Ctenotus						●					●			●	●								●
	Ctenotus helenae	Clay-soil Ctenotus			●			●			●	●			●	●	●			●					
	Ctenotus inornatus	Bar-shouldered Ctenotus									●													●	
	Ctenotus leonhardii	Leonhard's Ctenotus															●								
	Ctenotus pallasotus (ex *duricola*)	Western Pilbara Lined Ctenotus			●			●				●			●	●				●					
	Ctenotus pantherinus ocellifer	Leopard Ctenotus			●			●			●	●	●		●	●	●			●					●
	Ctenotus robustus	Eastern Striped Skink			●							●			●					●					●
	Ctenotus rubicundus	Ruddy Ctenotus			●										●	●	●								

Families	Species	Common name	Status	Introduced	Desktop sources																					PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
	Ctenotus rufescens	Rufous Finesnout Ctenotus						●					●		●					●						
	Ctenotus saxatilis	Rock Ctenotus			●			●				●	●		●	●	●			●						
	Ctenotus schomburgkii	Barred Wedge-snout Ctenotus			●										●					●						●
	Ctenotus serventyi	NW Sandy-loam Ctenotus			●			●			●	●			●		●									
	Ctenotus superciliaris	Sharp-browed Ctenotus			●																					
	Ctenotus u. uber	Spotted Ctenotus			●			●							●											●
	Cyclodomorphus melanops	Slender Blue-tongue			●			●			●	●			●	●	●	●								●
	Egernia cygnitos (ex depressa)	Western Pilbara Spiny-tailed Skink			●			●			●	●			●	●	●									●
	Egernia pilbarensis	Pilbara Skink			●						●						●									●
	Eremiascincus isolepis	Northern Bar-lipped Skink			●			●			●	●	●		●	●	●			●						●
	Eremiascincus musivus	Mosaic Desert Skink			●																					
	Eremiascincus pallidus	Western Narrow-banded Skink						●					●			●	●									
	Eremiascincus richardsonii	Broad-banded Sandswimmer						●																		
	Lerista bipes	NW Sandslider			●			●			●	●	●		●	●	●			●						●
	Lerista clara	Sharp-blazed 3-toed Slider			●						●					●	●									●
	Lerista flammicauda	Pilbara Firetail Slider														●										
	Lerista labialis	Southern Sandslider															●									
	Lerista muelleri	Wood Mulch-slider			●			●				●	●		●		●			●						●
	Lerista quadrivincula	Dark-streaked Slider	P1 (DBCA)								●															
	Lerista timida	Timid Slider															●									
	Lerista vehrmens	Powerful 3-toed Slider			●						●					●	●									
	Liopholis striata	Night Skink			●																					
	Menetia greyii	Common Dwarf Skink			●			●			●	●	●		●	●	●			●			●		●	
	Menetia surda surda	Western Dwarf Skink			●						●	●			●	●	●									
	Morethia ruficauda exquisita	Firetail Morethia			●			●			●				●	●	●			●						
	Notoscincus butleri	Lined soil-crevice skink (Dampier)	P4 (DBCA)		●		●								●	●	●									●
	Notoscincus ornatus	Ornate Soil-crevice Skink			●			●			●		●				●			●						
	Proablepharus reginae	Western Soil-crevice Skink			●			●				●			●		●									
	Tiliqua multifasciata	Central Blue-tongue			●			●			●	●			●								●			●

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Varanidae	*Varanus acanthurus*	Spiny-tailed Monitor			●			●			●	●			●	●	●			●					●
	Varanus brevicauda	Short-tailed Pygmy Monitor			●			●			●		●		●	●	●			●			●		●
	Varanus caudolineatus	Stripe-tailed Pygmy Monitor														●									
	Varanus eremius	Pygmy Desert Monitor			●			●					●		●	●	●						●		●
	Varanus giganteus	Perentie						●			●				●					●			●		
	Varanus gouldii	Bungarra or Sand Monitor			●			●			●		●		●					●					●
	Varanus panoptes rubidus	Yellow-spotted Monitor			●			●			●	●			●					●			●	●	
	Varanus pilbarensis	Pilbara Rock Monitor			●											●	●								
	Varanus tristis	Racehorse Monitor			●																		●		
Typhlopidae	*Anilios ammodytes*	Sand-diving Blindsnake						●			●	●			●	●	●								●
	Anilios grypus	Long-beaked Blindsnake						●			●	●	●		●	●	●			●					
	Anilios hamatus	Pale-headed Blindsnake										●			●										
	Anilios pilbarensis	Pilbara Blindsnake															●								
	Indotyphlops braminus	Flowerpot Blindsnake		●		●					●														
Pythonidae	*Antaresia perthensis*	Pygmy Python									●	●			●					●					●
	Antaresia childreni	Children's Python			●			●				●			●										●
	Aspidites melanocephalus	Black-headed Python			●						●	●			●										
	Liasis olivaceus barroni	Pilbara Olive Python	VU (EPBC & BC Acts)		●	●	●	●																	
Elapidae	*Acanthophis wellsi*	Pilbara Death Adder			●						●	●			●					●					
	Aipysurus apraefrontalis	Short-nosed Seasnake	CR (EPBC & BC Acts)			●																			
	Aipysurus duboisii	Dubois' Seasnake				●		●																	
	Aipysurus eydouxii	Spine-tailed Seasnake				●																			
	Aipysurus laevis	Olive Seasnake			●	●		●			●														
	Aipysurus tenuis	Brown-lined Seasnake				●																			
	Brachyurophis approximans	Pilbara Shovel-nosed Snake			●			●							●										●
	Demansia psammophis cupreiceps	Yellow-faced Whipsnake			●			●			●	●	●		●								●		●
	Demansia rufescens	Rufous Whipsnake						●			●				●										●
	Emydocephalus orarius (ex annulatus)	Western Turtle-headed Seasnake				●		●																	
	Ephalophis greyae	Mangrove Seasnake				●					●		●		●										

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	Furina ornata	Moon Snake			●			●			●				●					●						
	Hydrelaps darwiniensis	Black-ringed Mangrove Snake			●	●					●	●	●		●											
	Hydrophis czeblukovi	Fine-spined Seasnake				●									●											
	Hydrophis elegans	Elegant Seasnake				●		●																		
	Hydrophis kingii	Spectacled Seasnake				●		●																		
	Hydrophis major	Olive-headed Seasnake			●	●		●			●															
	Hydrophis macdowelli	Small-headed Seasnake				●																				
	Hydrophis ocellatus (ex *ornatus*)	Spotted Seasnake				●		●																		
	Hydrophis peronii	Spiny-headed Seasnake				●		●																		
	Hydrophis platurus	Yellow-bellied Seasnake				●																				
	Hydrophis stokesii	Stokes' Seasnake			●	●		●			●															
	Pseudechis australis	Mulga Snake			●			●			●	●			●					●						●
	Pseudonaja mengdeni (ex nuchalis)	Western Brown Snake			●			●			●	●			●					●						●
	Pseudonaja modesta	Ringed Brown Snake			●			●			●		●		●											
	Suta fasciata	Rosen's Snake						●			●				●											
	Suta monachus	Monk Snake			●						●	●			●											
	Suta punctata	Spotted Snake			●			●				●			●											●
Birds																										
Casuariidae	*Dromaius novaehollandiae*	Emu			●				●	●	●	●	●		●					●			●	●		
Anatidae	*Anas castanea*	Chestnut Teal									●															
Anatidae	*Anas gracilis*	Grey Teal			●				●	●	●				●			●		●	●					●
	Anas rhynchotis	Australasian Shoveler							●																	
	Anas superciliosa	Pacific Black Duck			●				●	●	●	●			●			●		●						
	Aythya australis	Hardhead			●				●	●	●															
	Chenonetta jubata	Australian Wood Duck			●				●	●	●															
	Cygnus atratus	Black Swan			●				●	●	●															
	Dendrocygna arcuata	Wandering Whistling-Duck								●	●															
	Dendrocygna eytoni	Plumed Whistling-Duck			●				●	●	●															
	Malacorhynchus membranaceus	Pink-eared Duck							●	●	●															
	Nettapus pulchellus	Green Pygmy-goose								●	●															

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					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
	Oxyura australis	Blue-billed Duck	P4 (DBCA)		●					●	●															
	Stictonetta naevosa	Freckled Duck			●					●	●															
	Tadorna tadornoides	Australian Shelduck									●															
Phasianidae	*Coturnix pectoralis*	Stubble Quail							●									●								
	Coturnix ypsilophora	Brown Quail			●				●	●	●	●			●			●		●						
Hydrobatidae	*Oceanites oceanicus*	Wilson's Storm-petrel	Mig. (EPBC & BC Acts)		●		●				●															
Procellariidae	*Ardenna carneipes*	Flesh-footed Shearwater	Mig. (EPBC & BC Acts), VU (BC Act)								●															
	Ardenna pacifica	Wedge-tailed Shearwater	Mig. (EPBC & BC Acts)		●	●	●		●	●																
	Calonectris leucomelas	Streaked Shearwater	Mig. (EPBC & BC Acts)			●																				
	Macronectes giganteus	Southern Giant Petrel	EN (EPBC Act), Mig. (EPBC & BC Acts)			●																				
	Puffinus huttoni	Hutton's Shearwater	EN (BC Act)							●	●															
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe			●				●	●	●															●
	Tachybaptus novaehollandiae	Australasian Grebe			●				●	●	●	●			●											
Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork			●				●	●	●		●	●	●											●
Threskiornithidae	*Platalea regia*	Royal Spoonbill			●					●	●															
	Plegadis falcinellus	Glossy Ibis	Mig. (EPBC & BC Acts)				●			●	●															
	Threskiornis moluccus	Australian White Ibis							●	●	●															●
	Threskiornis spinicollis	Straw-necked Ibis			●				●	●	●				●					●						
Ardeidae	*Ardea garzetta*	Little Egret			●				●	●	●	●	●		●					●						●
	Ardea ibis	Cattle Egret				●																				
	Ardea intermedia	Intermediate Egret			●				●	●	●															
	Ardea modesta	Great Egret			●	●			●		●		●													●
	Ardea novaehollandiae	White-faced Heron			●				●	●	●	●	●		●					●			●			●
	Ardea pacifica	White-necked Heron			●				●	●	●	●			●					●						
	Ardea sacra	Eastern Reef Egret			●				●		●	●	●	●	●			●			●		●			●
	Butorides striata	Striated Heron			●				●	●	●	●	●		●											●
	Ixobrychus flavicollis	Black Bittern			●				●	●	●															
	Nycticorax caledonicus	Rufous Night Heron			●				●	●	●	●	●		●											●
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican			●				●	●	●		●							●			●			●

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Fregatidae	*Fregata ariel*	Lesser Frigatebird	Mig. (EPBC & BC Acts)		●	●	●		●	●	●														
Sulidae	*Sula leucogaster*	Brown Booby	Mig. (EPBC & BC Acts)		●		●			●	●														
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant			●					●	●														●
	Phalacrocorax melanoleucos	Little Pied Cormorant			●				●	●	●		●												●
	Phalacrocorax sulcirostris	Little Black Cormorant			●				●	●	●		●	●	●					●					●
	Phalacrocorax varius	Pied Cormorant			●				●	●	●		●		●										●
Anhingidae	*Anhinga novaehollandiae*	Australasian Darter			●				●	●	●		●										●		
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk			●				●	●	●														●
	Accipiter fasciatus	Brown Goshawk			●				●	●	●	●			●			●		●					
	Aquila audax	Wedge-tailed Eagle			●				●	●	●	●	●		●					●	●	●	●		●
	Circus approximans	Swamp Harrier			●					●	●														
	Circus assimilis	Spotted Harrier			●				●	●	●	●	●		●								●		●
	Elanus caeruleus axillaris	Australian Black-shouldered Kite			●				●		●		●		●							●			●
	Haliaeetus leucogaster	White-bellied Sea-Eagle			●	●			●	●	●	●	●		●					●	●				●
	Haliastur indus	Brahminy Kite			●				●	●	●	●	●		●			●			●	●	●		●
	Haliastur sphenurus	Whistling Kite			●				●	●	●	●	●		●					●		●			●
	Hamirostra melanosternon	Black-breasted Buzzard			●				●	●	●														
	Hieraaetus morphnoides	Little Eagle			●				●	●	●				●					●	●				●
	Milvus migrans	Black Kite			●				●	●	●				●					●					
Pandionidae	*Pandion cristatus*	Osprey	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●	●	●						●		●	●	●
Otididae	*Ardeotis australis*	Australian Bustard			●				●	●	●	●	●		●					●	●		●	●	●
Gruidae	*Grus rubicunda*	Brolga			●					●	●				●					●					
Rallidae	*Fulica atra*	Eurasian Coot			●				●	●	●														
	Gallinula tenebrosa	Dusky Moorhen								●	●														
	Gallirallus philippensis	Buff-banded Rail							●	●	●														
	Porphyrio porphyrio	Purple Swamphen			●				●	●	●														
	Porzana fluminea	Australian Spotted Crake									●														
	Porzana pusilla	Baillon's Crake			●					●															
	Porzana tabuensis	Spotless Crake			●					●															
	Tribonyx ventralis	Black-tailed Native Hen									●														

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Turnicidae	*Turnix velox*	Little Button-quail			●				●	●	●	●	●		●			●		●	●			●	●
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew			●				●	●	●	●			●					●					
	Esacus magnirostris	Beach Stone-curlew			●				●	●	●	●	●	●	●					●	●				●
Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher			●				●	●	●		●	●							●				●
	Haematopus longirostris	Pied Oystercatcher			●				●	●	●	●	●	●	●			●							●
Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt			●					●	●														●
	Himantopus himantopus	Black-winged Stilt			●	●			●	●	●							●			●				●
	Recurvirostra novaehollandiae	Red-necked Avocet				●			●	●	●														●
Charadriidae	*Charadrius leschenaultii*	Greater Sand Plover	VU/Mig./VU (EPBC Act; BC Act)		●	●	●		●	●	●	●	●	●	●										●
	Charadrius mongolus	Lesser Sand Plover	EN/Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●										●
	Charadrius ruficapillus	Red-capped Plover			●	●			●	●	●	●	●	●	●			●			●				●
	Charadrius veredus	Oriental Plover	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●		●										●
	Elseyornis melanops	Black-fronted Dotterel			●				●	●	●	●			●					●	●				●
	Erythrogonys cinctus	Red-kneed Dotterel							●	●	●														●
	Pluvialis fulva	Pacific Golden Plover	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●												●
	Pluvialis squatarola	Grey Plover	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●										●
	Vanellus miles	Masked Lapwing							●		●														
	Vanellus tricolor	Banded Lapwing			●				●	●	●	●			●					●					●
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	EN (EPBC & BC Acts)			●																			
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●										●
	Arenaria interpres	Ruddy Turnstone	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●	●	●										●
	Calidris acuminata	Sharp-tailed Sandpiper	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●								●				●
	Calidris alba	Sanderling	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●										●
	Calidris canutus	Red Knot	EN/Mig./EN (EPBC Act; BC Act)		●	●	●		●	●	●		●												●
	Calidris ferruginea	Curlew Sandpiper	CR/Mig./CR (EPBC Act; BC Act)		●	●	●		●	●	●		●	●											●
	Calidris melanotos	Pectoral Sandpiper	Mig. (EPBC & BC Acts)			●			●		●														
	Calidris minuta	Little Stint	Mig. (EPBC Act)						●	●	●														
	Calidris ruficollis	Red-necked Stint	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●	●	●										●
	Calidris subminuta	Long-toed Stint	Mig. (EPBC & BC Acts)			●	●		●	●	●														
	Calidris tenuirostris	Great Knot	CR/Mig./CR (EPBC Act; BC Act)		●	●	●		●	●	●		●	●	●						●				●

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	Gallinago stenura	Pin-tailed Snipe	Mig. (EPBC & BC Acts)		●		●				●														
	Limicola falcinellus	Broad-billed Sandpiper	Mig. (EPBC & BC Acts)			●			●	●	●														
	Limosa lapponica	Bar-tailed Godwit	Mig. (EPBC & BC Acts)		●	●	●			●	●		●	●	●								●		●
	Limosa lapponica baueri	Bar-tailed Godwit (W. Alaska)	VU/Mig. (EPBC & BC Acts)			●																			
	Limosa lapponica menzbieri	Bar-tailed Godwit (N. Siberia)	CR/Mig. (EPBC & BC Acts)			●			●																
	Limosa limosa	Black-tailed Godwit	Mig. (EPBC & BC Acts)			●	●		●	●															●
	Numenius arquata	Eurasian Curlew																							●
	Numenius madagascariensis	Eastern Curlew	CR/Mig./CR (EPBC Act; BC Act)		●	●	●		●	●	●	●	●	●	●								●		●
	Numenius minutus	Little Curlew	Mig. (EPBC & BC Acts)		●		●		●	●	●													●	
	Numenius phaeopus	Whimbrel	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●								●	●	●
	Phalaropus lobatus	Red-necked Phalarope	Mig. (EPBC & BC Acts)			●				●	●														
	Tringa brevipes	Grey-tailed Tattler	(Mig. EPBC & BC Acts; P4 DBCA)		●	●	●		●	●	●	●	●	●	●										●
	Tringa glareola	Wood Sandpiper	Mig. (EPBC & BC Acts)		●		●		●	●	●														
	Tringa nebularia	Common Greenshank	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●	●	●								●	●	●
	Tringa stagnatilis	Marsh Sandpiper	Mig. (EPBC & BC Acts)		●	●	●		●	●	●			●	●										
	Tringa totanus	Common Redshank	Mig. (EPBC & BC Acts)			●			●	●	●														
	Xenus cinereus	Terek Sandpiper	Mig. (EPBC & BC Acts)		●	●	●		●	●	●		●		●										●
Glareolidae	*Glareola maldivarum*	Oriental Pratincole	Mig. (EPBC & BC Acts)		●	●	●		●	●	●														●
	Stiltia Isabella	Australian Pratincole				●			●	●	●														
Laridae	*Anous stolidus*	Common Noddy	Mig. (EPBC & BC Acts)		●	●																			
	Chlidonias leucopterus	White-winged Black Tern	Mig. (EPBC & BC Acts)		●		●		●	●															●
	Larus novaehollandiae	Silver Gull			●				●	●	●	●	●	●	●			●				●			●
	Larus pacificus	Pacific Gull									●														
	Onychoprion anaethetus	Bridled Tern	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●	●	●										
	Sterna albifrons	Little Tern	Mig. (EPBC & BC Acts)		●		●			●	●		●												●
	Sterna bengalensis	Lesser Crested Tern			●				●	●	●	●	●		●							●			●
	Sterna bergii	Crested Tern	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●	●	●										●
	Sterna caspia	Caspian Tern	Mig. (EPBC & BC Acts)		●	●	●		●	●	●	●	●		●			●			●	●			●
	Sterna dougallii	Roseate Tern	Mig. (EPBC & BC Acts)		●	●	●		●		●														●
	Sterna fuscata	Sooty Tern				●																			

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					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
	Sterna hirundo	Common Tern	Mig. (EPBC & BC Acts)		●		●		●	●	●		●												●
	Sterna hybrida	Whiskered Tern			●				●	●	●		●												●
	Sterna nereis nereis	Fairy Tern	VU (BC Act)			●	●		●	●	●		●												●
	Sterna nilotica	Gull-billed Tern	Mig. (EPBC & BC Acts)		●		●		●	●			●		●										●
Columbidae	*Columba livia*	Domestic Pigeon		●		●					●														
	Geopelia cuneata	Diamond Dove			●				●	●	●	●			●					●	●	●	●		●
	Geopelia humeralis	Bar-shouldered Dove			●				●	●	●	●			●			●							
	Geopelia striata	Peaceful Dove			●				●		●	●			●			●		●			●		●
	Geophaps plumifera	Spinifex Pigeon			●				●	●	●	●			●					●		●		●	●
	Ocyphaps lophotes	Crested Pigeon			●				●	●	●	●			●					●	●		●	●	●
	Phaps chalcoptera	Common Bronzewing			●				●	●	●														
	Phaps histrionica	Flock Bronzewing			●				●	●	●														
	Streptopelia chinensis	Spotted Turtle-dove		●					●	●	●														
Cuculidae	*Cacomantis pallidus*	Pallid Cuckoo			●				●		●	●			●			●		●			●		
	Chrysococcyx basalis	Horsfield's Bronze Cuckoo			●				●	●	●	●	●		●			●							●
	Chrysococcyx osculans	Black-eared Cuckoo							●	●	●	●			●										
Centropodidae	*Centropus phasianinus*	Pheasant Coucal			●				●	●	●	●			●						●				
Strigidae	*Ninox boobook*	Southern Boobook							●	●	●	●			●										●
	Ninox connivens	Barking Owl			●				●	●	●														
Tytonidae	*Tyto alba*	Barn Owl							●	●	●														
Podargidae	*Podargus strigoides*	Tawny Frogmouth			●				●	●	●	●			●					●					●
Eurostopodidae	*Eurostopodus argus*	Spotted Nightjar			●				●		●	●			●					●		●			●
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar			●				●	●	●				●									●	
Apodidae	*Apus pacificus*	Fork-tailed Swift	Mig. (EPBC & BC Acts)		●	●	●		●	●															●
Alcedinidae	*Dacelo leachii*	Blue-winged Kookaburra			●				●	●	●	●			●					●			●		
	Todiramphus chloris pilbara	Collared Kingfisher			●				●	●	●	●			●										
	Todiramphus pyrrhopygius	Red-backed Kingfisher			●				●	●	●	●			●										
	Todiramphus sanctus	Sacred Kingfisher			●				●	●	●	●	●		●			●		●	●				●
Meropidae	*Merops ornatus*	Rainbow Bee-eater			●	●			●	●	●	●	●		●			●		●	●	●		●	●
Falconidae	*Falco berigora*	Brown Falcon			●				●	●	●	●			●					●					●

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	Falco cenchroides	Australian Kestrel			●				●	●	●	●	●		●			●		●	●	●	●		●
	Falco hypoleucos	Grey Falcon	VU (EPBC Act, BC Act)						●															●	(●)
	Falco longipennis	Australian Hobby			●				●	●	●	●			●										
	Falco peregrinus	Peregrine Falcon	OS (BC Act)		●		●			●	●										●				●
	Falco subniger	Black Falcon							●	●															
Cacatuidae	*Cacatua roseicapilla*	Galah			●				●	●	●	●	●		●					●	●	●	●		●
	Cacatua sanguinea	Little Corella			●				●	●	●	●	●		●					●	●	●			●
	Calyptorhynchus banksii escondidus	Red-tailed Black Cockatoo							●																
	Nymphicus hollandicus	Cockatiel			●				●	●	●	●			●			●		●	●		●		●
Psittacidae	*Melopsittacus undulatus*	Budgerigar			●				●	●	●				●					●	●	●			
	Neophema bourkii	Bourke's Parrot								●	●														
	Pezoporus occidentalis	Night Parrot	EN/CR (EPBC Act; BC Act)			●																			
	Platycercus zonarius	Australian Ringneck							●	●	●	●			●						●				
Ptilonorhynchidae	*Ptilonorhynchus guttatus*	Western Bowerbird							●	●	●											●			
Climacteridae	*Climacteris melanurus*	Black-tailed Treecreeper							●		●														●
Maluridae	*Amytornis striatus whitei*	Rufous Grasswren							●		●	●			●										
	Malurus assimilis (ex *lamberti*)	Purple-backed Fairy-wren			●				●	●	●	●			●			●		●			●		
	Malurus leucopterus	White-winged Fairy-wren			●				●	●	●	●	●		●			●		●	●		●		●
	Malurus melanocephalus	Red-backed Fairy-wren								●															
	Stipiturus ruficeps	Rufous-crowned Emu-wren							●		●	●			●										
Meliphagidae	*Acanthagenys rufogularis*	Spiny-cheeked Honeyeater							●						●										
	Certhionyx variegatus	Pied Honeyeater							●																
	Epthianura aurifrons	Orange Chat							●	●	●														
	Epthianura crocea	Yellow Chat									●														
	Epthianura tricolor	Crimson Chat			●				●	●	●		●												
	Gavicalis virescens	Singing Honeyeater			●				●	●	●	●	●		●			●		●	●	●	●	●	●
	Lacustroica whitei	Grey Honeyeater								●	●														
	Lichmera indistincta	Brown Honeyeater			●				●	●	●	●	●		●			●		●	●				●
	Manorina flavigula	Yellow-throated Miner			●				●	●	●	●			●					●	●	●			●
	Melithreptus gularis	Black-chinned Honeyeater			●				●		●														

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	Ptilotula flavescens	Yellow-tinted Honeyeater								●															
	Ptilotula keartlandi	Grey-headed Honeyeater							●		●														
	Ptilotula penicillata	White-plumed Honeyeater							●	●	●	●			●			●			●				
	Ptilotula plumula	Grey-fronted Honeyeater								●	●														
	Purnella albifrons	White-fronted Honeyeater									●														
	Sugomel niger	Black Honeyeater							●	●															
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote			●				●	●	●	●			●										●
	Pardalotus striatus	Striated Pardalote			●				●	●	●														
Acanthizidae	*Calamanthus campestris*	Rufous Fieldwren							●																
	Gerygone fusca	Western Gerygone			●					●	●														
	Gerygone levigaster	Mangrove Gerygone													●										●
	Gerygone tenebrosa	Dusky Gerygone			●					●	●	●			●					●					●
	Pyrrholaemus brunneus	Redthroat			●				●		●	●			●										●
	Smicrornis brevirostris	Weebill			●				●	●	●														
Pomatostomidae	*Pomatostomus superciliosus*	White-browed Babbler			●					●															
	Pomatostomus temporalis	Grey-crowned Babbler			●				●	●	●	●			●			●							
Cinclosomatidae	*Cinclosoma marginatum (ex castaneothorax)*	Western Quail-thrush																							
Artamidae	*Artamus cinereus*	Black-faced Woodswallow			●				●	●	●	●			●			●		●	●		●		●
	Artamus leucorynchus	White-breasted Woodswallow			●				●	●	●	●	●		●			●					●		●
	Artamus minor	Little Woodswallow							●		●				●					●					
	Artamus personatus	Masked Woodswallow			●				●	●	●				●					●		●			●
Cracticidae	*Cracticus nigrogularis*	Pied Butcherbird			●				●	●	●	●	●		●					●	●	●		●	●
	Cracticus tibicen	Australian Magpie			●				●	●	●	●			●					●	●				●
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			●				●	●	●	●	●		●			●		●	●	●			●
	Lalage tricolor	White-winged Triller			●				●	●	●		●		●			●			●				
Oreoicidae	*Oreoica gutturalis*	Crested Bellbird			●				●	●	●	●			●								●		●
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush			●				●	●	●				●										●
	Pachycephala lanioides	White-breasted Whistler			●				●	●	●	●			●										
	Pachycephala melanura	Mangrove Golden Whistler			●				●	●	●	●			●										●
	Pachycephala rufiventris	Rufous Whistler			●				●	●	●				●			●					●		

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Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			●				●	●	●														
	Rhipidura leucophrys	Willie Wagtail			●				●	●	●	●	●		●			●		●	●	●		●	●
	Rhipidura phasiana	Mangrove Grey Fantail			●				●	●	●	●			●								●		●
Monarchidae	*Grallina cyanoleuca*	Magpie-lark			●				●	●	●	●			●			●		●	●			●	●
	Myiagra alecto	Shining Flycatcher	range extension																						●
	Myiagra rubecula	Leaden Flycatcher	(ID uncertain, possible vagrant)																						
Corvidae	*Corvus bennetti*	Little Crow			●				●	●	●	●	●		●							●			
	Corvus orru	Torresian Crow			●				●	●	●	●	●		●					●	●		●	●	●
Petroicidae	*Eopsaltria pulverulenta*	Mangrove Robin			●				●																●
	Melanodryas cucullatus	Hooded Robin							●		●	●			●								●		
	Petroica goodenovii	Red-capped Robin							●																
Alaudidae	*Mirafra javanica*	Horsfield's Bushlark			●				●	●	●	●	●		●			●			●		●		●
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow							●				●												
	Hirundo neoxena	Welcome Swallow			●				●	●	●	●	●		●			●		●	●				
	Hirundo rustica	Barn Swallow	Mig. (EPBC & BC Acts)			●			●	●	●														
	Petrochelidon ariel	Fairy Martin			●				●	●	●	●	●		●										
	Petrochelidon nigricans	Tree Martin			●				●	●	●	●	●		●			●		●	●				●
Acrocephalidae	*Acrocephalus australis*	Australian Reed-warbler			●				●	●	●														
Locustellidae	*Eremiornis carteri*	Spinifex-bird			●				●	●	●	●	●		●							●	●		●
	Megalurus cruralis	Brown Songlark			●				●	●	●	●	●		●						●				●
	Megalurus mathewsi	Rufous Songlark			●				●	●	●				●			●			●		●		●
	Megalurus timoriensis	Tawny Grassbird			●						●														
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola									●														
Zosteropidae	*Zosterops lateralis*	Grey-breasted White-eye								●	●														
	Zosterops luteus	Yellow White-eye			●				●	●	●	●			●			●							●
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird			●				●	●	●														
Passeridae	*Passer domesticus*	House Sparrow		●		●					●														
	Passer montanus	Eurasian Tree Sparrow		●		●																			
Estrildiidae	*Emblema pictum*	Painted Finch			●				●	●	●	●			●							●	●		●
	Heteromunia pectoralis	Pictorella Mannikin			●					●	●														

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	Neochmia ruficauda	Star Finch			●				●	●	●							●								
	Taeniopygia guttata	Zebra Finch			●				●	●	●	●	●		●			●		●	●	●	●		●	●
Motacillidae	*Anthus australis*	Australian Pipit			●				●	●	●	●	●		●			●		●	●		●		●	●
	Motacilla cinerea	Grey Wagtail	Mig. (EPBC & BC Acts)			●																				
	Motacilla flava	Yellow Wagtail	Mig. (EPBC & BC Acts)			●																				
Mammals																										
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna			●							●	●		●					●				●		
Dasyuridae	*Dasykaluta rosamondae*	Little Red Kaluta			●						●	●	●		●									●	●
	Dasyurus hallucatus	Northern Quoll	EN (EPBC & BC Acts)		●	●	●				●											●		●	●
	Ningaui timealeyi	Pilbara Ningaui			●						●	●			●											
	Planigale maculata	Common Planigale									●	●			●											
	Pseudantechinus woolleyae	Woolley's Pseudantechinus									●															
	Sminthopsis macroura	Stripe-faced Dunnart			●						●	●	●		●					●						●
	Sminthopsis youngsoni	Lesser Hairy-footed Dunnart	Range extension										●													●
Thylacomyidae	*Macrotis lagotis*	Bilby	VU (EPBC & BC Acts)			●																				
Macropodidae	*Lagorchestes conspicillatus leichardti*	Spectacled Hare-wallaby	P3 (BC Act)		●		●																			
	Macropus robustus	Euro			●						●	●	●		●			●		●	●	●		●	●
	Macropus rufus	Red Kangaroo			●							●			●					●	●		●		
	Petrogale rothschildi	Rothschild's Rock-wallaby			●						●													●	●
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	Range extension																							●
Dugongidae	*Dugong dugon*	Dugong	Mig. (EPBC Act), OS (BC Act)			●	●				●															●
Muridae	*Hydromys chrysogaster*	Water-rat	P4 (DBCA)		●		●																			
	Leggadina lakedownensis	Northern short-tailed Mouse	P4 (DBCA)		●		●				●	●	●		●					●						
	Mus musculus	House Mouse		●	●	●					●	●	●		●					●				●		
	Notomys alexis	Spinifex Hopping-mouse			●						●		●													
	Pseudomys chapmani	Western Pebble-mound Mouse	P4 (DBCA)		●		●			●	●	●	●		●									●		
	Pseudomys delicatulus	Delicate Mouse			●						●	●			●											
	Pseudomys desertor	Desert Mouse													●											
	Pseudomys hermannsburgensis	Sandy Inland Mouse			●						●	●	●		●					●						
	Pseudomys nanus	Western Chestnut Mouse			●						●															

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	Pseudomys sp. "hamersley"											●			●					●					
	Rattus rattus	Black Rat		●	●	●					●													●	
	Rattus tunneyi	Pale Field-rat			●						●														
	Zyzomys argurus	Common Rock-rat			●						●				●									●	
Leporidae	*Oryctolagus cuniculus*	Rabbit		●		●																			-
Pteropodidae	*Pteropus alecto*	Black Flying-fox			●						●													●	
	Pteropus scapulatus	Little Red Flying-fox			●						●														
Hipposideridae	*Rhinonicteris aurantia* (Pilbara)	Pilbara Leaf-nosed Bat	VU (EPBC & BC Acts)		●	●	●				●														●
Megadaermatidae	*Macroderma gigas*	Ghost Bat	VU (EPBC & BC Acts)		●	●	●																		
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheath-tailed Bat													●										●
	Taphozous georgianus	Common Sheath-tailed Bat			●						●				●							●			●
Molossidae	*Chaerephon jobensis*	Greater Northern Freetail-bat									●				●							●			●
	Ozimops cobourgianus (ex loriae)	Northern Coastal Freetail-Bat	P1 (DBCA)		●		●				●	●	●		●					●					●
	Ozimops lumsdenae	Northern Freetail-bat																				●			
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat													●							●			●
	Nyctophilus arnhemensis	Arnhem Land Long-eared Bat			●						●	●			●										
	Nyctophilus daedalus	Northwestern Long-eared Bat			●																				
	Nyctophilus geoffroyi	Lesser Long-eared Bat			●						●														
	Nyctophilus sp.	Unidentified Long-eared Bat													●										●
	Scotorepens greyii	Little Broad-nosed Bat			●						●				●							●			●
	Vespadelus finlaysoni	Finlayson's Cave Bat			●						●				●							●			●
Canidae	*Canis lupus dingo / familiaris*	Dingo/Dog		●		●						●			●					●	●				●
	Vulpes vulpes	Red Fox		●	●	●					●	●	●		●				●		●		●		
Felidae	*Felis catus*	Cat		●	●	●					●	●	●		●			●		●	●			●	●
Equidae	*Equus asinus*	Donkey		●		●																			
	Equus caballus	Horse		●		●																			
Camelidae	*Camelus dromedarius*	Arabian Camel		●																					
Bovidae	*Bos taurus*	European Cattle		●	●																			●	●
	Ovis aries	Sheep		●							●	●			●										
Balaenidae	*Eubalaena australis*	Southern Right Whale	EN/MI (EPBC Act), VU (BC Act)			●																			

Families	Species	Common name	Status	Introduced	Desktop sources																						PES 1320 Eramurra Level 2, 2020
					NatureMap (DBCA 2018a)	EPBC (DoEE 2018)	TPFA Eramurra (DBCA 2018b)	Storr & Harold (1985)	Johnstone *et al.* (2013)	Birdlife (2018)	ALA (2020)	Halpern Glick Maunsell *et al.* (2001)	Biota (2005a,b)	Bennelongia (2008)	Phoenix (2009)	Doughty *et al.* (2011) OY	Doughty *et al.* (2011) DR	ENV (2011)	Pendoley (2009)	Maunsell AECOM (2008a, 2008b)	GHD (GHD 2013)	360 Environmental (2014)	Chevron (2014)	Ecoscape (2016a, b)	
Balaenopteridae	*Balaenoptera acutorostrata*	Minke Whale				●																				●
	Balaenoptera edeni	Bryde's Whale	MI (EPBC Act)			●																				
	Balaenoptera musculus	Blue Whale	EN/MI (EPBC & BC Acts)			●																				
	Megaptera novaeangliae	Humpback Whale	VU/CD (EPBC Act; BC Act)			●	●				●															
Kogiidae	*Kogia sima*	Dwarf Sperm Whale	(new regional record)																							●
Delphinidae	*Delphinus delphis*	Common Dolphin				●																				
	Grampus griseus	Risso's Dolphin				●																				
	Lagenodelphis hosei	Fraser's Dolphin			●																					
	Orcaella heinsohni	Australian Snubfin Dolphin	P4 (DBCA)																							
	Orcinus orca	Orca	Mig. (EPBC Act)			●					●															
	Sousa sahulensis (ex *chinensis*)	Australian humpback dolphin	Mig. (EPBC Act); P4 (DBCA)			●																				
	Stenella attenuata	Spotted Dolphin				●																				
	Stenella longirostris longirostris	Spinner Dolphin									●															
	Tursiops aduncus	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	Mig. (EPBC Act)			●																				
	Tursiops truncatus s. str.	Bottlenose Dolphin				●																				

Appendix 4 Site by species matrix for systematic survey sites

Family	Scientific name	Common name	Site01	Site02	Site03	Site04	Site05	Site06	Site07	Site08
Amphibians										
Limnodynastidae	*Notaden nichollsi*	Desert Spadefoot				1				
Reptiles										
Agamidae	*Ctenophorus caudicinctus*	Ring-tailed Dragon				1				
Agamidae	*Ctenophorus isolepis*	Central Military Dragon				1				
Agamidae	*Ctenophorus nuchalis*	Central Netted Dragon	1		1					
Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon			1					
Agamidae	*Pogona minor*	Dwarf Bearded Dragon				1				
Agamidae	*Tympanocryptis cephalus*	Pebble Dragon					1	1	1	
Diplodactylidae	*Diplodactylus bilybara*	Western Fat-tailed Gecko								1
Diplodactylidae	*Diplodactylus conspicillatus*	Fat-tailed Gecko						1		
Diplodactylidae	*Diplodactylus galaxias*	Northern Pilbara Beak-faced Gecko	1	1			1	1		1
Elapidae	*Demansia psammophis*	Yellow-faced Whipsnake	1				1			
Elapidae	*Demansia rufescens*	Rufous Whipsnake						1		1
Elapidae	*Pseudechis australis*	Mulga Snake	1						1	
Elapidae	*Pseudonaja mengdeni*	Western Brown Snake				1				
Elapidae	*Suta punctata*	Spotted Snake			1					1
Gekkonidae	*Gehyra variegata*	Variegated Dtella	1	1		1	1			
Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko	1	1			1	1	1	1
Pygopodidae	*Delma tincta*	Excitable Delma								1
Pygopodidae	*Lialis burtonis*	Burton's Legless Lizard								1
Pythonidae	*Antaresia perthensis*	Pygmy Python					1			
Pythonidae	*Antaresia stimsoni*	Stimson's Python							1	
Scincidae	*Carlia munda*	Shaded-litter Rainbow Skink	1					1		1
Scincidae	*Ctenotus grandis*	Grand Ctenotus			1					
Scincidae	*Ctenotus hanloni*	Nimble Ctenotus	1	1				1		1

Family	Scientific name	Common name	Site01	Site02	Site03	Site04	Site05	Site06	Site07	Site08
Scincidae	*Ctenotus pantherinus*	Leopard Ctenotus	1	1	1		1	1		1
Scincidae	*Ctenotus robustus*		1		1		1	1	1	1
Scincidae	*Ctenotus schomburgkii*	Barred Wedge-snout Ctenotus	1							
Scincidae	*Ctenotus uber*	Spotted Ctenotus			1			1		
Scincidae	*Cyclodomorphus melanops*	Slender Blue-tongue					1			
Scincidae	*Eremiascincus isolepis*	Northern Bar-lipped Skink	1							
Scincidae	*Lerista bipes*	Northwestern Sandslider			1	1				
Scincidae	*Lerista clara*	Sharp-blazed Three-toed Slider	1		2	1	1	1		1
Scincidae	*Lerista muelleri*	Wood Mulch-slider	1							
Scincidae	*Menetia greyii*	Common Dwarf Skink	1		1		1		1	1
Scincidae	*Notoscincus butleri*	lined soil-crevice skink (Dampier)	1							
Scincidae	*Tiliqua multifasciata*	Central Blue-tongue			1					
Typhlopidae	*Anilios ammodytes*	Sand-diving Blind Snake		1		1	1			
Varanidae	*Varanus acanthurus*	Spiny-tailed Monitor		1			1			
Varanidae	*Varanus brevicauda*	Short-tailed Pygmy Monitor			1		1	1		1
Varanidae	*Varanus eremius*	Pygmy Desert Monitor			1					
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor				1				
Birds										
Accipitridae	*Circus assimilis*	Spotted Harrier			1		1		1	
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle			1	1		1		
Accipitridae	*Haliastur indus*	Brahminy Kite				1				
Accipitridae	*Haliastur sphenurus*	Whistling Kite	1				1			
Accipitridae	*Pandion cristatus*	Osprey			2					
Artamidae	*Artamus cinereus*	Black-faced Woodswallow				3				
Cacatuidae	*Cacatua roseicapilla*	Galah		1						
Cacatuidae	*Nymphicus hollandicus*	Cockatiel		1						
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		1		1		1		

Family	Scientific name	Common name	Site01	Site02	Site03	Site04	Site05	Site06	Site07	Site08
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar	2							1
Columbidae	*Geopelia striata*	Zebra Dove				1				
Columbidae	*Ocyphaps lophotes*	Crested Pigeon								2
Corvidae	*Corvus orru*	Torresian Crow						2		
Cracticidae	*Cracticus nigrogularis*	Pied Butcherbird	1	1						
Cuculidae	*Chrysococcyx basalis*	Horsfield's Bronze Cuckoo			1					
Estrildidae	*Emblema pictum*	Painted Finch	3	1		1				
Estrildidae	*Taeniopygia guttata*	Zebra Finch	5			1		1		
Falconidae	*Falco cenchroides*	Australian Kestrel		1	1	1			1	
Hirundinidae	*Petrochelidon ariel*	Fairy Martin				50				
Hirundinidae	*Petrochelidon nigricans*	Tree Martin			20					
Maluridae	*Malurus leucopterus*	White-winged Fairy-wren		1			1			1
Meliphagidae	*Gavicalis virescens*	Singing Honeyeater		1		1				1
Meliphagidae	*Lichmera indistincta*	Brown Honeyeater		1						
Meliphagidae	*Manorina flavigula*	Yellow-throated Miner		1						
Meropidae	*Merops ornatus*	Rainbow Bee-eater				1				
Motacillidae	*Anthus australis*	Australian Pipit						1		
Otididae	*Ardeotis australis*	Australian Bustard	1							
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	1	1						
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird		1						
Pardalotidae	*Pardalotus rubricatus*	Red-browed Pardalote	1	1						
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	1	1						
Sylviidae	*Eremiornis carteri*	Spinifex-bird			1					
Sylviidae	*Megalurus cruralis*	Brown Songlark			1					
Turnicidae	*Turnix velox*	Little Button-quail	4		1	2	1			5
Mammals										
Bovidae	*Bos taurus*	European Cattle	1		1	1		1	1	

Family	Scientific name	Common name	Site01	Site02	Site03	Site04	Site05	Site06	Site07	Site08
Dasyuridae	*Sminthopsis macroura*	Stripe-faced Dunnart		1			1	1	1	
Felidae	*Felis catus*	Cat				1				
Macropodidae	*Macropus robustus*	Euro	1			1	1	1		
Total			**28**	**22**	**23**	**25**	**20**	**20**	**10**	**19**

Appendix 5 Dasyurid Specimen from Eramurra, Western Australia - Brief report to Phoenix Environmental Sciences (K. Travouillon, WAM Mammalogy)

Dasyurid Specimen from Eramurra, Western Australia

Brief report to Phoenix Environmental Sciences

25 September 2020

Kenny Travouillon

Department of Terrestrial Zoology, Western Australian Museum,
Locked Bag 49, Welshpool DC, Western Australia 6986, Australia

GOVERNMENT OF WESTERN AUSTRALIA

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Although identifications in this report were consistent with the best available information and current scientific thinking at the time of identification the use of this report is at the risk of the user. Any liability to users of this report for loss of any kind arising out of the use of this report or the information and identifications it contains is expressly disclaimed.

Summary:

WAM registration number	M64321
Specimen identification: Order Family Genus Species Common name	 Diprotodontia Dasyuridae *Sminthopsis* *youngsoni* Lesser Hairy-footed Dunnart
BWI specimen status	Not listed
Identified by	Travouillon, K.
Number of specimens	1
Collector	John Scanlon, Phoenix Environmental Sciences
Specimen collection date	21/04/2020
Date specimen received at WAM	18/09/2020
Date specimen processed at WAM	25/09/2020
Location	Eramurra, S.R.E. -20.84328, 116.43273
Specimen found	Propylene glycol trap.
Condition of specimen on arrival at WAM	Alcohol specimen, broken into two parts, with skull removed.
Specimen preservation	Wet and dry specimen.
Tissue taken	No
Other comments	No comment.

Taxonomists:

Name	Affiliation	Specialty/Task	Hours
Travouillon	WA Museum	Mammalogy/IDs & curation	1