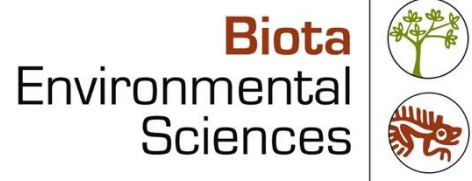


Ashburton Salt Project Migratory Shorebird Assessment



Prepared for K+S Salt Australia

October 2022



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Ashburton Salt Migratory Shorebird Assessment

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1.0 Executive Summary

Biota Environmental Sciences was commissioned by K+S Salt Australia Pty Ltd to undertake a five-phase assessment of the migratory shorebird assemblage and habitat usage for the proposed Ashburton Salt Project, located approximately 40 km southwest of Onslow. The five phases of survey were carried out in November and December (2018), and March, April and late May (2019), in accordance with EPBC Act Policy Statement 3.21 "Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species" (Commonwealth of Australia 2017).

The study area is partly located within the Exmouth Gulf and Onslow shorebird areas identified in the Australian National Directory of Important Shorebird Habitat (Weller et al. 2020). For the purposes of applying the criteria for important shorebird habitat, the shorebird habitat within the study area was separated into two discrete shorebird areas approximately aligned to these broader areas:

- Western shorebird area in the west, encompassing the majority of shorebird habitat in the study area; and
- Ashburton River shorebird area in the east, covering a small area of suitable habitat where the study area intersects the Ashburton River.

For the purposes of counting, the study area was further divided into six smaller shorebird count areas, five within the Western shorebird area and one covering the Ashburton River shorebird survey area. These areas were defined following the first phase of field survey based on expected shorebird usage (e.g. low tide foraging or high-tide roosting), counting methodology employed, and ability to complete a count of the area within the optimal part of the tidal cycle. A combination of ground counts and aerial counts were used to cover the extent of available shorebird habitat within the study area. Some count data from the study area were also available from BirdLife Australia's migratory shorebird count program (BirdLife Australia 2020).

Thirty-eight shorebird species (25 migratory) were assessed as potentially occurring within the study area based on a desktop study. Eight of the listed migratory species are also listed as conservation significant under State and/or Commonwealth legislation or policy, in addition to their listing as migratory species. These are:

- Eastern Curlew *Numenius madagascariensis* (Critically Endangered);
- Great Knot *Calidris tenuirostris* (Critically Endangered);
- Curlew Sandpiper *Calidris ferruginea* (Critically Endangered);
- Bar-tailed Godwit *Limosa lapponica* (ssp. *menzbieri* Critically Endangered/ssp. *baueri* Vulnerable);
- Lesser Sand Plover *Charadrius mongolus* (Endangered);
- Red Knot *Calidris canutus* (Endangered);
- Greater Sand Plover *Charadrius leschenaultii* (Vulnerable); and
- Grey-tailed Tattler (Department of Biodiversity, Conservation and Attractions (DBCA) Priority 4).

Twenty-eight species of shorebird were recorded from within the study area across the five phases of survey effort. Nineteen of these are migratory shorebirds and classified as such under State and Commonwealth legislation. All eight species additionally listed as threatened (listed above) were also recorded from the study area. An additional five migratory shorebird species were recorded from the surrounding area during the current survey, but not from within the study area.

Six broad shorebird habitats were identified within the study area, comprising:

- Bare intertidal flats;

- Sandy beaches;
- Mangroves;
- Algal mats;
- Supratidal salt flats (sabkhas); and
- Freshwater claypans.

During the current survey, the largest number of shorebirds were observed using the bare intertidal flats habitat type, particularly the intertidal mudflats in the north arm of Urala Creek, followed by the sandy beaches, while small numbers were observed in the mangroves (likely roosting). The majority of the algal mat areas were dry during all phases of the current survey, which meant direct assessment of usage was limited, but shorebirds were observed using areas of algal mats that were inundated, particularly adjacent to the intertidal mudflats near Urala Creek (North). The supratidal salt flats and freshwater claypans were dry during all phases of the current survey and no previous count data exists for these areas, so their usage when inundated could not be assessed directly. These habitats are of low suitability for shorebirds when dry, but may be used when inundated. However, it is expected that the salt flats in particular are unlikely to represent preferred foraging habitat for most shorebird species as high salinity levels in the substrate are not suitable for supporting most invertebrate fauna.

The Western shorebird area met all three criteria for a shorebird area of national significance under EPBC Act Policy Statement 3.2.1 (Commonwealth of Australia 2017):

- The abundance criterion (2,000 or more individual migratory shorebirds) was met during the March phase of the current survey and on a 2018 BirdLife Australia survey.
- The diversity criterion (15 or more migratory shorebird species) was met during the November, December, March and April surveys.
- The individual species criterion (greater than 0.1% of the flyway population of a species) was also met for 10 migratory shorebird species. These were:
 - Grey-tailed Tattler (*Tringa brevipes*) – current survey and 2018 BirdLife Australia counts;
 - Sanderling (*Calidris alba*) – current survey and 2018 BirdLife Australia counts;
 - Red-necked Stint (*Calidris ruficollis*) – current survey and 2018 BirdLife Australia counts;
 - Ruddy Turnstone (*Arenaria interpres*) – current survey;
 - Curlew Sandpiper (*Calidris ferruginea*) – current survey;
 - Broad-billed Sandpiper (*Limicola falcinellus*) – current survey;
 - Lesser Sand Plover (*Charadrius mongolus*) – 2018 BirdLife Australia counts;
 - Greater Sand Plover (*Charadrius leschenaultii*) – 2018 BirdLife Australia counts;
 - Eastern Curlew (*Numenius madagascariensis*) – 2018 BirdLife Australia counts; and
 - Common Greenshank (*Tringa nebularia*) – 2018 BirdLife Australia counts.

Neither of the two shorebird areas within the study area met the criteria for internationally important migratory shorebird habitat. However, most of the Western shorebird area is included within the broader Exmouth Gulf shorebird area, which has been identified as an area of international importance for migratory shorebirds as it regularly supports more than 1% of the flyway population of Eastern Curlew, Grey-tailed Tattler, and Ruddy Turnstone (Weller et al. 2020).

2.0 Introduction

2.1 Project Background

K+S Salt Australia Pty Ltd (K+S) is evaluating the possibility of developing a greenfield solar salt project (the proposed Ashburton Salt Project), located on the Western Australian coast approximately 40 km southwest of Onslow. A study area was identified for the salt production facilities, including solar salt evaporation and crystallisation ponds and associated infrastructure. This area, combined with an associated access road area, is hereafter referred to as the study area, delineated in Figure 2.1.

Biota was commissioned by K+S to undertake a five-phase assessment of the migratory shorebird assemblage and usage of the study area.

2.2 Study Objectives and Scope

The scope of this study was to undertake an assessment of the migratory shorebird usage of the study area in accordance with the guidelines set out in EPBC Act Policy Statement 3.21 on assessment of impacts to migratory shorebird species (Commonwealth of Australia 2017). This included:

- A desktop study of potential shorebird species previously recorded within the region;
- Five phases of field surveys, including four undertaken during the austral summer when most shorebirds are present in Australia and one during the austral winter for overwintering individuals;
- A complete shorebird count of the study area on each of the five field surveys (as far as practical); and
- An assessment of important foraging and roosting habitat for migratory shorebirds within the study area.

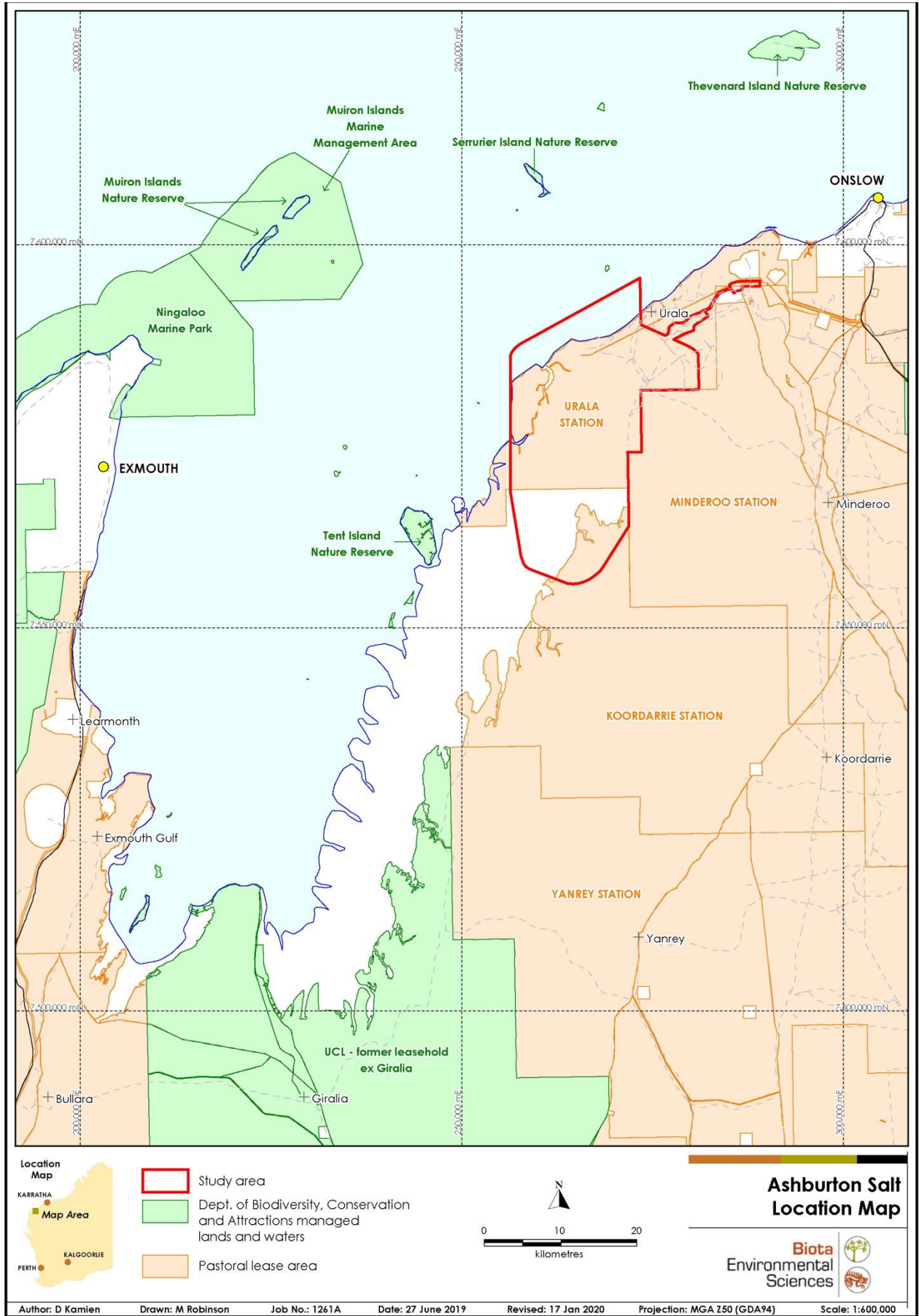


Figure 2.1: Location of the study area within the Onslow locality.

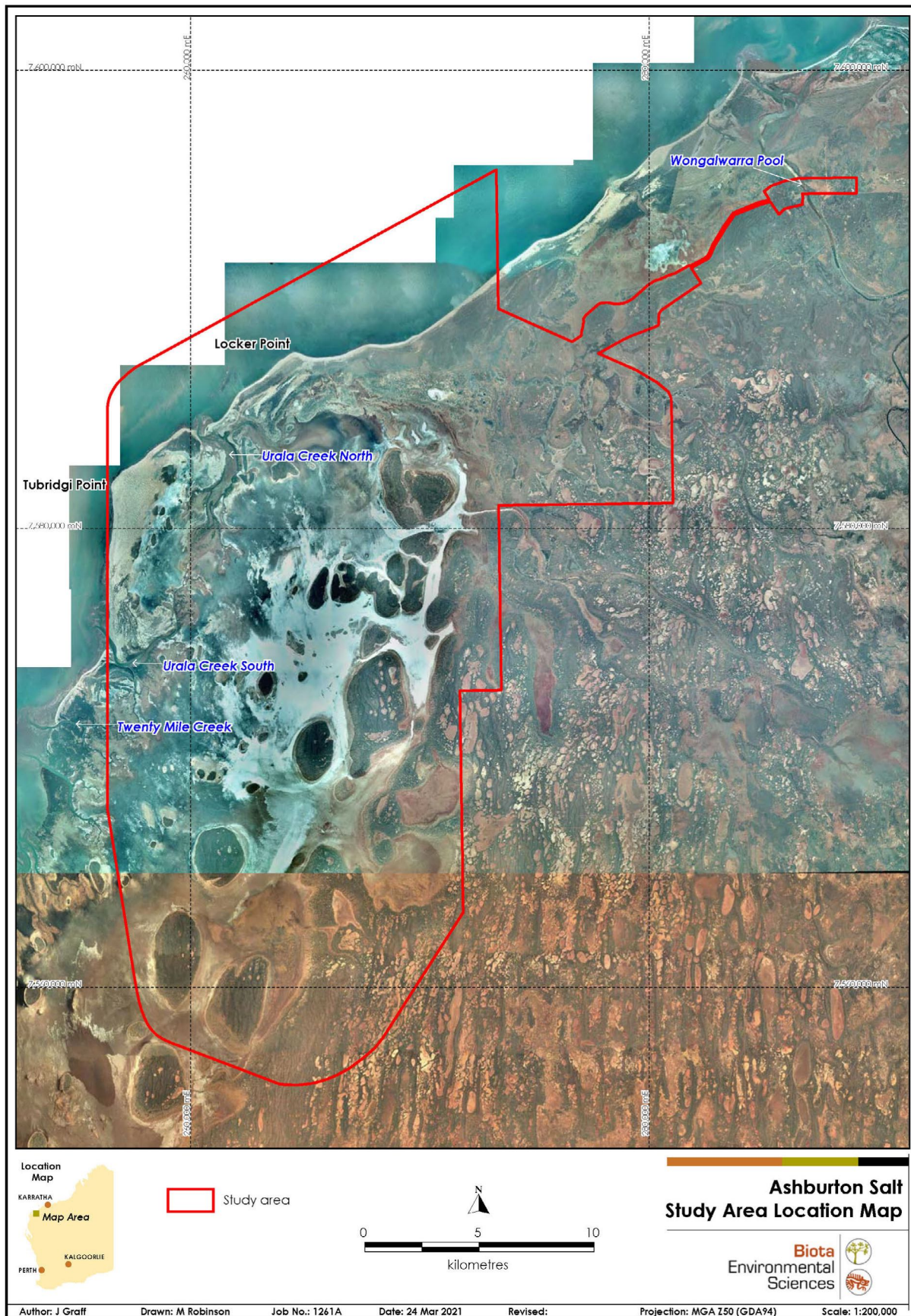


Figure 2.2: Locations referenced within report.

2.3 Shorebirds

2.3.1 Definition

Shorebirds are a group of birds that occur along shorelines and mudflats of coastal and inland waterbodies (Commonwealth of Australia 2017). The majority of species belong to the families Charadriidae (plovers) and Scolopacidae (sandpipers). In particular, the migratory shorebird policy statement and assessment guidelines are concerned with the 37 shorebird species listed as migratory species under the *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999*. For the purposes of this assessment, we also collected count data for non-migratory listed shorebird species to provide a more complete picture of the shorebird assemblage of the study area.

2.3.2 Shorebird Ecology

Most shorebird species in Australia are trans-equatorial migrants, breeding in the high latitudes of the northern hemisphere during the austral winter (boreal summer) and migrating to spend the non-breeding season in Australia during the austral summer. Australia is located within the East Asian-Australasian Flyway (EAAF); shorebirds that use the EAAF breed predominantly in the Siberian Arctic and migrate through eastern Asia. Most of the shorebirds that travel to Australia begin to arrive in early September, and by December, almost all have reached their final 'wintering' destinations here (Geering et al. 2007).

While in Australia, migratory shorebirds spend the majority of their time feeding. They exhibit localised movements as they seek out rich foraging areas that provide the food resources to enable them to recover from their southward migration, and to build up their body fat reserves in preparation for their return northward migration. Intertidal mudflats and shallow muddy fringes of wetlands are usually the primary foraging areas for most shorebird species in Australia, though other habitats such as sandy beaches, exposed reef flats, and rocky shorelines can also be important.

Shorebirds usually begin to leave northern Australia to return to their northern hemisphere breeding grounds in early March, with departures continuing until mid-May (Geering et al. 2007, Minton et al. 2013, Broome Bird Observatory unpublished data). The precise timing of departures varies by species, with Eastern Curlews (*Numenius madagascariensis*) and Greater Sand Plovers (*Charadrius leschenaultii*) usually the first species recorded departing Australia, and Red Knots (*Calidris canutus piersmai*) usually the last in mid-May (Broome Bird Observatory, unpublished data).

2.4 Legislation and Guidance

The following guidance statements were referenced during the planning and completion of this study:

- *EPBC Act Policy Statement 3.21: Industry Guidelines for Avoiding, Assessing and Mitigating impacts on EPBC Act listed Migratory Shorebird Species* (Commonwealth of Australia 2017);
- *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE 2013);
- *Survey Guidelines for Australia's Threatened Birds* (DEWHA 2010); and
- *Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna for Environmental Impact Assessment* (EPA 2016).

3.0 Methodology

3.1 Important Shorebird Habitat

The EPBC Act Policy Statement 3.2.1 (Commonwealth of Australia 2017) outlines criteria for determining whether areas constitute nationally or internationally important habitat for migratory shorebirds. Criteria for identifying migratory shorebird habitat of international importance follow those adopted under the Ramsar Convention on Wetlands. In particular, an area should be considered internationally important migratory shorebird habitat if it regularly supports:

- 1% of the individuals in a population of one species or subspecies of migratory shorebird; or
- a total abundance of at least 20,000 waterbirds.

Nationally important migratory shorebird habitat is defined following a similar approach. In particular, habitat should be considered nationally important migratory shorebird habitat if it regularly supports:

- 2,000 or more individuals;
- 15 or more migratory shorebird species; or
- 0.1% or more of the flyway population of a single species.

Population estimates for shorebird populations on the East Asian-Australasian Flyway, and the associated 1% and 0.1% thresholds, have been taken from the most recently revised estimates prepared by Hansen et al. (2016). These estimates and thresholds are included in Appendix 6.

A shorebird area is defined as a geographic area that is used by the same group of shorebirds over the main non-breeding period, or effectively the home range of the local population when present, and may include multiple roosting and feeding habitats (Commonwealth of Australia 2017). The application of this definition with respect to the study area is outlined below in Section 3.2.

3.2 Study Area

The study area is located within the Exmouth Gulf and Onslow shorebird areas as identified in the Australian National Directory of Important Shorebird Habitat (Weller et al. 2020; see Section 4.1.1). These shorebird areas extend significantly beyond the extent of the study area and full survey of these regions was not practical for the purposes of this study. Data on the significance of these broader areas to migratory shorebirds with respect to the criteria for important shorebird habitat outlined above is available from the directory and from BirdLife Australia's shorebirds program (BirdLife Australia 2020, Weller et al. 2020).

The study area was divided into two smaller shorebird areas to allow assessment against the criteria for important shorebird habitat at the scale of the study area. This division approximately followed the division of shorebird areas in the directory of important shorebird habitat (Weller et al. 2020), and resulted in two discrete shorebird areas within the study area as follows:

- Western shorebird area in the west, encompassing the majority of shorebird habitat in the study area; and
- Ashburton River shorebird area in the east, covering a small area of suitable habitat where the study area intersects the Ashburton River.

The guidelines for assessment of important shorebird habitat also acknowledge that within larger and more complex shorebird areas there is likely to be variation in the quality and importance of

different sites or habitats. As such, we have also mapped distinct shorebird habitats within the study area and provided an assessment of their observed and/or inferred usage by shorebirds.

3.3 Survey Team

The study team for this assessment is outlined below in Table 3.1. Field surveys were undertaken by Stewart Ford and John Graff, with the exceptions of the March 2019 survey, which was undertaken by John Graff and Jacinta King, and the May 2019 survey undertaken by Stewart Ford and Joshua Keen.

Table 3.1: Survey team and relevant qualifications and expertise.

Name	Position at Biota	Qualification	Years of experience	Survey Role
Garth Humphreys	Director/Principal Ecologist	BSc (Hons)	30	Project Director Project coordination Final report review
Stewart Ford	Senior Zoologist	BSc (Hons); PhD	12	Field survey (4 phases) Report review
John Graff	Zoologist	BSc (Hons)	12	Field survey (4 phases) Data analysis and reporting
Jacinta King	Zoologist	BSc (Hons)	8	Field survey (1 phase)
Joshua Keen	Graduate Zoologist	BSc (Hons)	3	Field survey (1 phase)

3.4 Desktop study

3.4.1 Databases

The following databases were searched as part of the desktop study:

- NatureMap (<https://naturemap.dpaw.wa.gov.au>) is a joint project of the Department of Biodiversity, Conservation and Attractions (DBCA) and the Western Australian Museum (WAM). This database represents the most comprehensive source of information on the distribution of Western Australia's flora and fauna, comprising records from the WA Threatened Fauna Database, Fauna Survey Returns Database (managed by the DBCA), the WAM Specimen Database, and the BirdLife Australia Atlas of Australian Birds. NatureMap was searched primarily to identify records of conservation significant fauna known from the locality of the study area.
- The Commonwealth *EPBC Act 1999* Protected Matters Search Tool was searched to identify listed shorebird species that were known to or may occur in the locality.
- Biota's internal database from the locality.

Due to the size of the study area, two separate searches were conducted for the NatureMap and Protected Matters databases, using a buffer of 40 km centred at two different points within the study area: 22.0116° S, 114.7108° E and 21.8700° S, 114.7997° E.

3.4.2 Previous Surveys

Data from five previous fauna surveys undertaken in the vicinity of the study area were reviewed (Table 3.2), and records collated to provide a preliminary assessment of shorebird species likely to

be present in the study area. A general assessment of the previous surveys undertaken is included within the terrestrial vertebrate fauna assessment (Biota 2020), and a brief summary is included below (Table 3.2). The majority of regional surveys undertaken previously did not undertake detailed shorebird counts, primarily because most of the relevant study areas did not incorporate extensive shorebird habitat. However, count data do exist from the Yannarie Salt Project Mangrove and Coastal Ecosystems Study (Biota 2005a) and the Wheatstone Project migratory waterbird assessment (Bamford Consulting Ecologists 2009). Count data also exist from the BirdLife Australia shorebirds counts conducted in the region (BirdLife Australia 2020).

Table 3.2: Previous surveys in the region of study area.

Report (Author)	Timing	Survey type	Proximity to study area
Yannarie Salt Project Fauna Survey (Biota 2005b)	Aug 2004	Level 2, 1 phase	0 km (overlaps)
Yannarie Salt Project Mangrove and Coastal Ecosystems Study (Biota 2005a)	Sep 2004	Targeted mangrove and shorebird	0 km (overlaps)
West Pilbara Iron Ore Project Onslow Rail Corridor Terrestrial Fauna Survey (Biota 2009)	Oct – Nov 2009	Level 2, 1 phase	0 km (overlaps)
Wheatstone Project Terrestrial Fauna Survey (Biota 2010)	Apr 2009	Level 2, 1 phase	1 km E
Survey for Migratory Waterbirds in the Wheatstone LNG Area, November 2008 and April 2009 (Bamford Consulting Ecologists 2009)	Nov 2008, Mar 2009	Targeted waterbird and shorebird	1 km E
Chevron Domgas Project Onslow Fauna Assessment (Validus 2008)	May – Jun 2008	Level 2, 1 phase	12 km NE

3.5 Survey Timing

Surveys were timed to coincide with a range of stages in the annual cycle of movements of migratory shorebirds within Australia (Table 3.3; Appendix 4), and with reference to the guidelines for conducting migratory shorebird surveys outlined by the Commonwealth government (Commonwealth of Australia 2017).

Table 3.3: Survey timing.

Survey Phase	Dates	Notes
Phase 1	6 – 12 November 2018	Summer count. Majority of migratory shorebirds expected to have returned, possibility of birds staging prior to continuing further south.
Phase 2	6 – 10 December 2018	Summer count. All migratory shorebirds expected to have returned. Prior to onset of wet season in northern Australia, so inland and freshwater species less likely to have dispersed.
Phase 3	5 – 9 March 2019	Summer count. Approximate commencement of northbound migration period in northern Australia. Majority of shorebirds expected to still be present, possibility of pre-migration staging.
Phase 4	7 – 11 April 2019	Summer count. Northbound migration period underway with possibility of passage birds staging.
Phase 5	23 – 26 May 2019	Winter count. Northern hemisphere breeders expected to have departed, leaving overwintering birds (primarily young birds yet to reach breeding age) and non-migratory species

3.6 Shorebird Counts

3.6.1 Count Areas

For the purposes of counting, the study area was further divided into six shorebird count areas (Figure 3.1), five making up the Western shorebird area and one covering the Ashburton River shorebird survey area. These areas were defined following the first phase of field survey based on expected shorebird usage (e.g. low tide foraging or high-tide roosting), counting methodology employed, and ability to complete a count of the area within the optimal part of the tidal cycle. The count areas were named as follows:

- Tubridgi Coast;
- Urala Creek (North and Overflow) - note overflow refers to the mudflat area surrounding the creek which becomes inundated at high tide;
- Urala Creek (South);
- Inland Creeks and Flats;
- Northern Coast; and
- Wongalwqrra Pool.

3.6.2 Contextual Counts

Guidelines for migratory shorebird surveys also recommend counting additional areas outside of assessment areas that may be used by the same group of shorebirds. Hence, additional contextual counts were conducted at the following sites in proximity to but not within the study area (Appendix 3):

- Urala Causeway;
- Locker Island;
- Fly Island;
- Observation Island; and
- Brown Island.

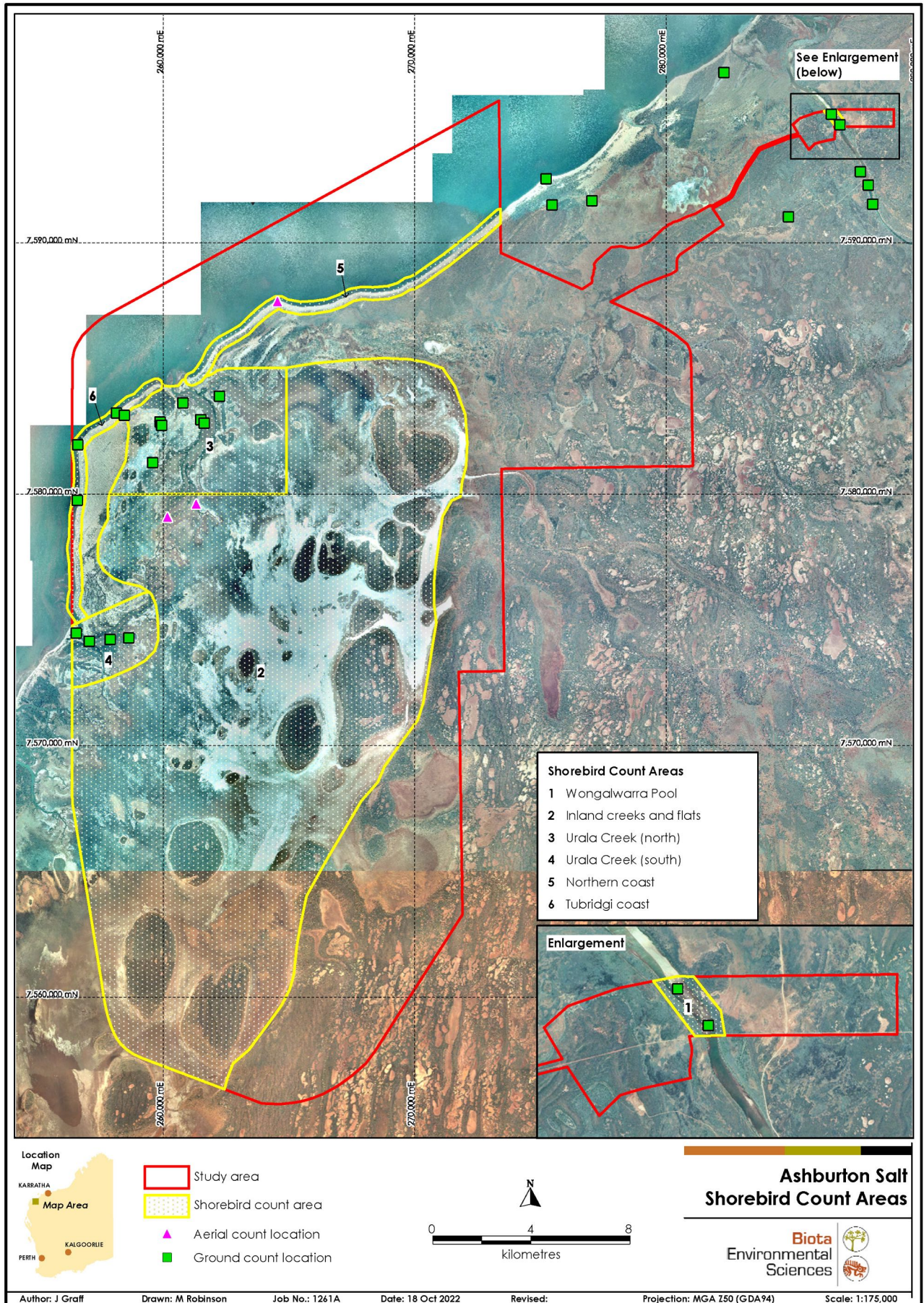


Figure 3.1: Shorebird count areas.

Note: Western Shorebird Area includes count areas 2 to 6, whilst Ashburton Shorebird Area includes count area 1.

3.6.3 Ground Counts

Ground counts were undertaken by observers on foot, using binoculars and telescopes to aid in observation and identification of the shorebirds. Ground counts were the preferred method for counting as they allowed for more time and the use of better optical aids for more accurate species identification and counts.

Most locations were accessible by helicopter. In order to minimise disturbance to the shorebirds and reduce the likelihood of birds leaving count areas prior to the count, personnel disembarked some distance from the count area, and helicopters did not overfly the count area during the drop-off process or during the counts.

Ground counts were conducted either as stationary counts or transect counts, depending on the dimensions and nature of the count area. Stationary counts were conducted at locations where the entirety of the count area could be observed from one location. Transect counts were used at larger and linear sites where the entirety of the count area was not visible from one location. During transect counts, observers walked the length of the count area ("transect") and birds were counted as the observers passed them, to prevent double-counting of birds moving ahead of the observers.

3.6.4 Aerial Counts

Aerial counts were used primarily to survey large areas with smaller numbers of birds, where ground-based counts were logistically impractical. Most surveys of the Inland Claypans and Northern Coast count areas were undertaken from the air (Table 3.4).

Table 3.4: Count areas and survey methods used during current survey.

Shorebird area (this study)	Count area (No. refers to Figure 3.1)	Tide	Survey method	No. Sites (total duration over 5 phases)
Ashburton	1. Wongalwarra Pool	High tide; low tide	Stationary ground counts	2 (10 person-hrs)
Western	2. Inland Creeks and Flats	High tide	Aerial counts	2 (10 person-hrs)
	3. Urala Creek (North and Overflow)	Low tide (creek); high tide (overflow)	Stationary ground counts	2 (10 person-hrs)
	4. Urala Creek (South)	Low tide	Stationary ground counts	4 (20 person-hrs)
	5. Northern Coast	High tide; low tide	Aerial counts	2 (10 person-hrs)
	6. Tubridgi Coast	High tide	Transect ground counts; aerial counts	4 (20 person-hrs)

3.6.5 Opportunistic Records

Additional opportunistic observations of shorebirds within the study area were also noted.

3.7 Survey Limitations

We consider that the overall level of survey was adequate and in accordance with the relevant guidelines. However, the results of this assessment should be considered in light of the following limitations:

- Complexity of the system: The north-western sector of the study area is a complex system of tidal creeks, mudflats, claypans and mangroves, with birds moving between different areas depending on tidal conditions. As such, determining the best areas for shorebirds and the best count strategies was challenging.

- Counts: Full counts of the mudflat system in Urala Creek North were not obtained on the November or April counts. In November, this was because the best areas for shorebirds and the best count strategies for each area were still being determined due to the complex nature of the tidal system. In April, the low tides were not sufficiently low for the mudflats in the creek to be exposed at low tide.
- Claypans, supratidal flats and algal mats: The majority of the algal mats, and all of the supratidal salt flats and freshwater claypans were not inundated during any of the five phases of the current survey, so the extent of shorebird usage of these habitats when inundated could not be accurately assessed during this survey. Available information regarding potential usage of these areas by shorebirds has been discussed in Sections 5.3.4 to 5.3.6.

3.8 Reference to Guidelines

All surveys conducted during this assessment were carried out with reference to the appropriate guidelines (see Section 2.4). In particular, in accordance with EPBC Act guidelines for conducting migratory shorebird surveys (Commonwealth of Australia 2017):

- five phases of survey were undertaken, with four phases undertaken during periods when large numbers of shorebirds were expected to be present over the austral summer, and the fifth survey undertaken during the austral winter to assess overwintering shorebird abundance;
- all counts were conducted by two experienced ornithologists with previous experience of counting shorebirds; and
- surveys at roost sites were conducted as far as practicable within the two hours either side of high tide, and foraging areas were surveyed as far practicable within two hours either side of low tide.

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4.0 Desktop study

4.1 Regional Context of the Study Area

General contextual information regarding land systems, geology and vegetation of the study area can be found in the terrestrial vertebrate fauna report prepared concurrently with this report (Biota 2020).

4.1.1 Regional Shorebird Areas

The study area overlaps two broader areas identified as important shorebird habitat in the Australian National Directory of Important Migratory Shorebird Habitat (Weller et al. 2020). The Western shorebird area is included within the Exmouth Gulf shorebird area, with the exception of some of the freshwater claypans inland of the salt flats (Figure 4.1). The Ashburton River shorebird area is included within the Onslow shorebird area, which encompasses the Onslow Salt Ponds (Figure 4.1).

The Exmouth Gulf shorebird area has been identified as internationally important habitat for migratory shorebirds as it supports internationally significant numbers of Eastern Curlew (*Numenius madagascariensis*), Grey-tailed Tattler (*Tringa brevipes*), and Ruddy Turnstone (*Arenaria interpres*) (Biota 2005a, Weller et al. 2020). It is also a nationally important site based on both migratory shorebird abundance (counts up to 11,864 individuals) and diversity (up to 18 species), and supports nationally important numbers of Greater Sand Plover (*Charadrius leschenaultii*), Lesser Sand Plover (*Charadrius mongolus*), Whimbrel (*Numenius phaeopus*), Bar-tailed Godwit (*Limosa lapponica*), Red-necked Stint (*Calidris ruficollis*), Great Knot (*Calidris tenuirostris*), Sanderling (*Calidris alba*), Common Greenshank (*Tringa nebularia*), Terek Sandpiper (*Xenus cinereus*), and Curlew Sandpiper (*Calidris ferruginea*) (Weller et al. 2020). The Exmouth Gulf shorebird area is described as follows (Weller et al. 2020):

“The Exmouth Gulf shorebird area is located adjacent to the township of Exmouth situated on the North West Cape. The shorebird area takes in the entire Exmouth Gulf coastline, the islands within the Exmouth Gulf and just outside, namely Muiron Islands and Sunday Island. It also includes the Indian Ocean coastline running down from North West Cape to Point Billie. The shorebird area is dominated on the east side of the Exmouth Gulf which has mudflats that are typically 1 kilometre wide (but up to 4 kilometres wide in some places, for example Giralia Bay). The mangroves are mostly 1 kilometre wide and the saline coastal flats 5-15 kilometres wide. Several islands are subject to complete inundation. The mangroves buffer the coast from erosion, especially during cyclones, which occur in most years. The whole coast site is subject to tidal inundation and the coastal plain may also be inundated by major rain events. The south end of the Gulf has similar characteristics, with a large-scale coastal plain which includes several estuaries, namely Turtle Creek Estuary, Gale Bay and Bay of Rest, and is dominated by intertidal mudflats, extensive mangrove areas and saline coastal flats.”

Available count data indicates that the Onslow shorebird area supports fewer shorebirds than Exmouth Gulf, and does not meet the criteria for a site of international importance. However, it does support nationally significant numbers of Red-necked Stint (Weller et al. 2020). The Onslow shorebird area is described as follows (Weller et al. 2020):

“Onslow is located in the southern extent of the Pilbara region in Western Australia, approximately 1,386 kilometres north of Perth. There is one major salt production facility in Onslow. The surrounding coastal environment is characterised by extensive areas of coastal intertidal sand flats and tidal creeks and inlets. There are several high tide roosting areas for shorebirds utilising the area, as well as significant areas of supratidal claypan. Most of these systems have been modified to control tidal inundation for the production of salt. The saltfield was built by enclosing a vast natural flat area facing the Indian Ocean with sea wall levees. The saltfield encompasses an area of 220 square kilometres, of which 87 square kilometres are occupied by operational ponds.

The saltfield's operational ponds are closely interconnected. They consist of six evaporation ponds of 77 square kilometres and 15 crystalliser ponds of 10 square kilometres. Sea water is pumped into the first evaporation pond, and brine flows through most of the evaporation ponds by gravity. Like other expansive salt evaporation facilities in the Pilbara region, the site continues to be a major migration stop-over area for shorebirds in the East Asia-Australasian Flyway. Despite the size of the site, and prevalence of a range of habitats for shorebirds, there is not much structured monitoring data available for the general area. With more data available the area would most likely identify as international significance for several species of migratory shorebird."

4.2 Regional Shorebird Records

The desktop study identified 38 shorebird species as having been previously recorded from within the region (Table 4.1). Of these, 25 species are considered migratory shorebirds, and listed as such under state and Commonwealth legislation (Table 4.1).

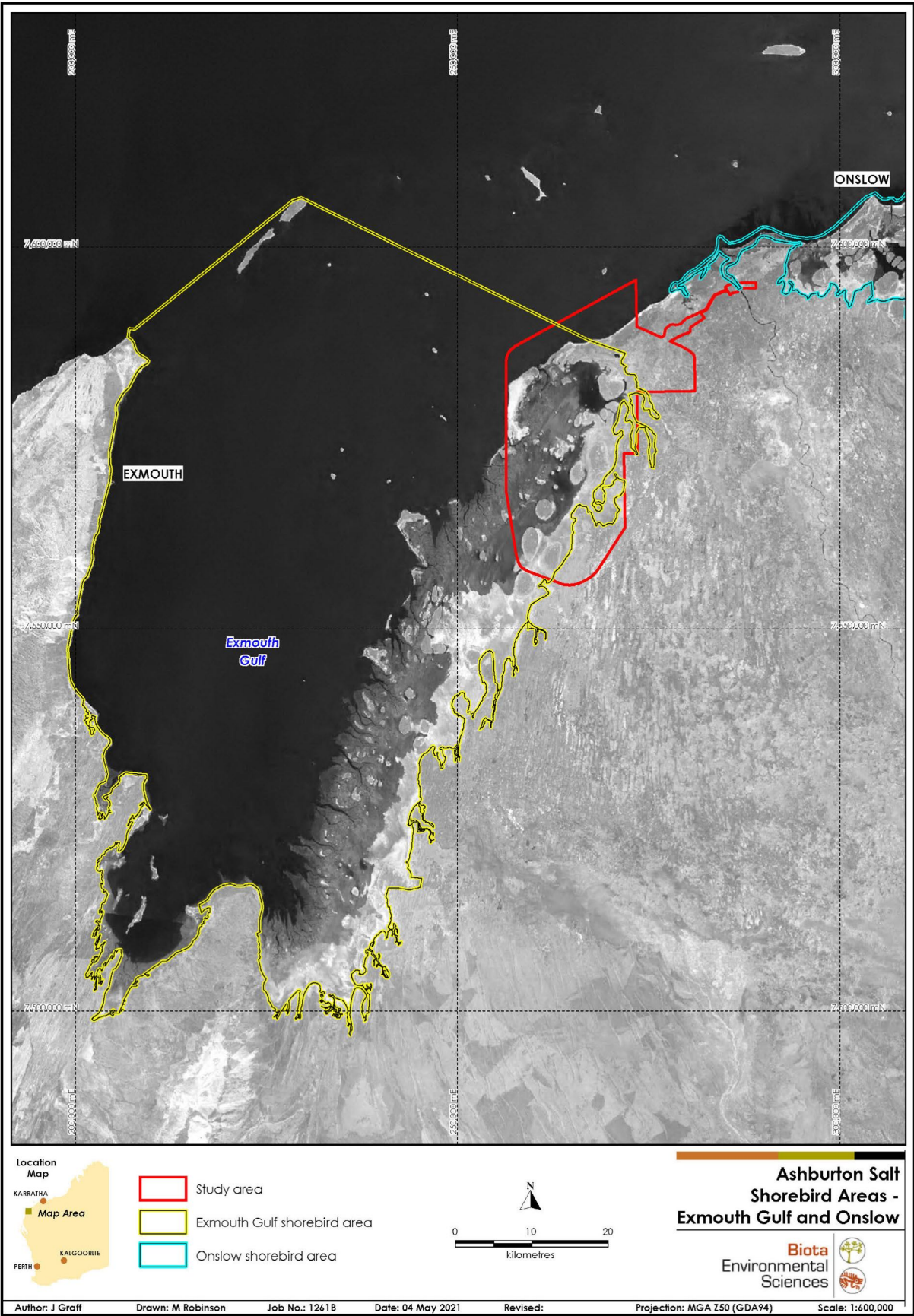


Figure 4.1: Exmouth Gulf and Onslow important shorebird areas (from Weller et al. 2020).

Table 4.1: Shorebirds previously recorded in the region.

Species	Common name	Conservation status ¹	
		State	Commonwealth
Burhinidae			
<i>Burhinus grallarius</i>	Bush Stone-curlew		
<i>Esacus magnirostris</i>	Beach Stone-curlew		
Haematopodidae			
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher		
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher		
Recurvirostridae			
<i>Himantopus leucocephalus</i>	Pied Stilt		
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet		
<i>Cladorhynchus leucocephalus</i>	Banded Stilt		
Charadriidae			
<i>Pluvialis fulva</i>	Pacific Golden Plover	MI	MI
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI
<i>Charadrius ruficapillus</i>	Red-capped Plover		
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN, MI	EN, MI
<i>Charadrius leschenaultia</i>	Greater Sand Plover	VU, MI	VU, MI
<i>Charadrius veredus</i>	Oriental Plover	MI	MI
<i>Euseyonis melanops</i>	Black-fronted Dotterel		
<i>Erythronyx cinctus</i>	Red-kneed Dotterel		
<i>Vanellus tricolor</i>	Banded Lapwing		
<i>Vanellus miles</i>	Masked Lapwing		
Scolopacidae			
<i>Limosa limosa</i>	Black-tailed Godwit	MI	MI
<i>Limosa lapponica</i>	Bar-tailed Godwit	CR/VU ² , MI	CR/VU ² , MI
<i>Numenius phaeopus</i>	Whimbrel	MI	MI
<i>Numenius madagascariensis</i>	Eastern Curlew	CR, MI	CR, MI
<i>Xenus cinereus</i>	Terek Sandpiper	MI	MI
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI	MI
<i>Tringa nebularia</i>	Common Greenshank	MI	MI
<i>Tringa stagnatilis</i>	Marsh Sandpiper	MI	MI
<i>Tringa glareola</i>	Wood Sandpiper	MI	MI
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI
<i>Calidris tenuirostris</i>	Great Knot	CR, MI	CR, MI
<i>Calidris canutus</i>	Red Knot	EN, MI	EN, MI
<i>Calidris alba</i>	Sanderling	MI	MI
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI
<i>Calidris subminuta</i>	Long-toed Stint	MI	MI
<i>Calidris melanotos</i>	Pectoral Sandpiper	MI	MI
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR, MI	CR, MI
Glareolidae			
<i>Glareola maldivarum</i>	Oriental Pratincole	MI	MI
<i>Stiltia isabella</i>	Australian Pratincole		

¹ See Appendix 5 for conservation status definitions

² At both state and Commonwealth level, Bar-tailed Godwit ssp. *menzbieri* is listed as Critically Endangered, and ssp. *baueri* listed as Vulnerable – field identification with certainty is challenging, but most birds in northwest Australia belong to ssp. *menzbieri*.

4.3 Local Shorebird Counts

Detailed shorebird count data are available from one previous survey in the region (Biota 2005a), and from BirdLife Australia's ongoing shorebirds project (BirdLife Australia 2020). The BirdLife Australia count data include two counts undertaken within the study area on the 5th January 2018, one covering the Tubridgi Coast and one covering a flooded area inland of Twenty Mile Creek, erroneously referred to as Twenty Mile Creek Claypan (Table 4.2, see also Figure 5.5).

Table 4.2: Previous shorebird count data from the study area (BirdLife Australia 2020).

Species	Common name	Tubridgi Coast	Twenty Mile Creek Claypan ¹	Total
Haematopodidae				
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	3	-	3
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	2	-	2
Charadriidae				
<i>Pluvialis squatarola</i>	Grey Plover*	12	-	12
<i>Charadrius mongolus</i>	Lesser Sand Plover*	111	70	181
<i>Charadrius leschenaultia</i>	Greater Sand Plover*	314	440	754
Scolopacidae				
<i>Limosa lapponica</i>	Bar-tailed Godwit*	143	180	323
<i>Numenius phaeopus</i>	Whimbrel*	22	40	62
<i>Numenius madagascariensis</i>	Eastern Curlew*	64	82	146
<i>Tringa brevipes</i>	Grey-tailed Tattler*	-	400	400
<i>Tringa nebularia</i>	Common Greenshank*	11	120	131
<i>Tringa stagnatilis</i>	Marsh Sandpiper*	3	-	3
<i>Calidris tenuirostris</i>	Great Knot*	55	200	255
<i>Calidris alba</i>	Sanderling*	114	-	114
<i>Calidris ruficollis</i>	Red-necked Stint*	-	900	900
	TOTAL	854	2,432	3,286
	Migratory	849	2,432	2,281
	No. species	12	9	14
	No. migratory species	10	9	12

* denotes Migratory-listed species

¹ Site is named Twenty Mile Creek Claypan but location shows it covers primarily high intertidal mudflats east of Twenty Mile Creek

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5.0 Survey Results

5.1 Shorebird Count Data

A total of 28 species of shorebird were recorded within the study area during the current surveys. Nineteen of these are migratory shorebirds and listed as such under State and Commonwealth legislation. An additional five migratory shorebird species were recorded from the vicinity of the study area during the current survey, but from outside the study area (Appendix 3).

Shorebird numbers were highest in the March counts, which were conducted at the commencement of the northward migration period. Several species, most notably Grey-tailed Tattler and Curlew Sandpiper, were recorded in particularly high numbers in March compared to the other four surveys, suggesting that the area may be used as a staging area for these species on northward migration. The lowest numbers of shorebirds were recorded during the May count, as would be expected since most adult migratory shorebirds have left Australia to breed at that time of year. The migratory shorebirds present at this time of year are predominantly young birds (usually in their first year) that have not reached breeding age and remain in non-breeding areas.

The study area was broken up into two shorebird areas and six count areas, as outlined in Section 3.2; count data for the two shorebird areas are presented below in Sections 5.1.1 and 5.1.2, and counts for individual count areas in Appendix 1. Raw count data for all counts are included in Appendix 2.

5.1.1 Western Shorebird Area

Across the five phases of survey, 27 species of shorebird were recorded from the Western shorebird area, of which 19 are migratory shorebirds and classified as such under State and Commonwealth legislation (Table 5.1; Table 5.3). Collated count data is provided in Table 5.3.

Table 5.1: Shorebird species diversity in Western shorebird area during each phase of the current survey.

Survey Phase	Dates	Shorebird Species	Migratory Shorebird Species
Phase 1	6 – 12 November 2018	23	18
Phase 2	6 – 10 December 2018	22	19
Phase 3	5 – 9 March 2019	24	19
Phase 4	7 – 11 April 2019	18	15
Phase 5	23 – 26 May 2019	13	10
Total		27	19

5.1.2 Ashburton River Shorebird Area

Across the five phases of survey, 14 species of shorebird were recorded from the Ashburton River shorebird area, of which nine are migratory shorebirds and classified as such under State and Commonwealth legislation (Table 5.2).

Table 5.2: Shorebird species diversity in Ashburton River shorebird area during each phase of the current survey.

Survey Phase	Dates	Shorebird Species	Migratory Shorebird Species
Phase 1	6 – 12 November 2018	8	6
Phase 2	6 – 10 December 2018	7	5
Phase 3	5 – 9 March 2019	13	9
Phase 4	7 – 11 April 2019	4	3
Phase 5	23 – 26 May 2019	3	1
Total		14	9

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Table 5.3: Total shorebird counts for the Western shorebird area during the current survey.

Species	Common name	Conservation Status (see Appendix 5)		Total count						
		State	Commonwealth	Nov	Dec	Mar	Apr	May	Maximum	
Burhinidae										
<i>Esacus magnirostris</i>	Beach Stone-curlew	-	-	2	-	-	-	-	2	
Haematopodidae										
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	-	14	7	6	7	10	14	
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	-	-	-	-	3	3	3	
Recurvirostridae										
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	2	2	8	-	-	8	
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	-	-	3	-	-	3	
Charadriidae										
<i>Pluvialis fulva</i>	Pacific Golden Plover	MI	MI	4	2	1	-	-	4	
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI	13	23	24	20	-	24	
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-	174	459	319	662	31	662	
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN; MI	EN; MI	9	48	86	100	-	100	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU; MI	VU; MI	90	124	189	11	-	189	
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	-	-	3	-	-	-	-	3	
<i>Vanellus tricolor</i>	Banded Lapwing	-	-	-	-	22	-	-	22	
Scolopacidae										
<i>Limosa lapponica</i>	Bar-tailed Godwit	*CR/VU; MI	*CR/VU; MI	61	99	137	101	4	137	
<i>Numenius phaeopus</i>	Whimbrel	MI	MI	10	7	23	8	6	23	
<i>Numenius madagascariensis</i>	Eastern Curlew	CR; MI	CR; MI	10	1	13	3	4	13	
<i>Xenus cinereus</i>	Terek Sandpiper	MI	MI	-	5	26	-	-	26	
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	10	1	1	-	-	10	
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI; P4	MI	54	59	228	13	20	228	
<i>Tringa nebularia</i>	Common Greenshank	MI	MI	21	27	93	7	-	93	
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI	74	43	83	95	3	95	
<i>Calidris tenuirostris</i>	Great Knot	CR; MI	CR; MI	42	45	126	5	30	126	
<i>Calidris canutus</i>	Red Knot	EN; MI	EN; MI	12	50	89	29	25	89	
<i>Calidris alba</i>	Sanderling	MI	MI	44	43	51	27	35	51	
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI	89	680	590	130	8	680	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI	1	4	1	-	-	4	
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR; MI	CR; MI	12	45	355	11	7	355	
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	MI	MI	4	175	129	19	-	175	
-	unidentified shorebird sp.	-	-	479	-	155	3	-	479	
				TOTAL	1,231	1,949	2,758	1,254	186	3,618
				Migratory[^]	706	1,682	2,245	579	142	2,422

* At both state and Commonwealth level, Bar-tailed Godwit ssp. *menzbieri* is listed as Critically Endangered, and ssp. *baueri* listed as Vulnerable – field identification with certainty is challenging, but most birds in NW Australia belong to ssp. *menzbieri*.

[^] Does not include unidentified shorebirds which may or may not have been migratory species.

Table 5.4: Total shorebird counts for the Ashburton River shorebird area during the current survey.

Species	Common name	Conservation Status (see Appendix 5)		Total count					
		State	Commonwealth	Nov	Dec	Mar	Apr	May	Maximum
Recurvirostridae									
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	-	-	6	-	-	6
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	-	-	1	-	-	1
Charadriidae									
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-	71	43	58	2	7	71
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU; MI	VU; MI	1	-	1	-	-	1
<i>Eseyornis melanops</i>	Black-fronted Dotterel	-	-	-	-	-	-	4	4
<i>Erythrogonyx cinctus</i>	Red-kneed Dotterel	-	-	-	1	7	-	-	7
Scolopacidae									
<i>Limosa lapponica</i>	Bar-tailed Godwit	*CR/VU; MI	*CR/VU; MI	-	-	2	-	-	2
<i>Numenius phaeopus</i>	Whimbrel	MI	MI	1	1	1	1	-	1
<i>Numenius madagascariensis</i>	Eastern Curlew	CR; MI	CR; MI	1	1	2	-	-	2
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	1	1	3	-	-	3
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI; P4	MI	-	-	1	1	-	1
<i>Tringa nebularia</i>	Common Greenshank	MI	MI	3	3	4	5	6	6
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI	6	1	45	-	-	45
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR; MI	CR; MI	-	-	6	-	-	6
TOTAL				87	51	137	9	17	156
Migratory[^]				13	7	65	7	6	67

* At both state and Commonwealth level, Bar-tailed Godwit *ssp. menzibieri* is listed as Critically Endangered, and *ssp. baueri* listed as Vulnerable – field identification with certainty is challenging, but most birds in NW Australia belong to *ssp. menzibieri*.

[^] Does not include unidentified shorebirds which may or may not have been migratory species.

5.2 Shorebird Occurrence

The largest concentrations of migratory shorebirds observed within the study area during the current survey were observed on the mudflats within Urala Creek (North) and the surrounding flats, followed by the western coastline between Tubridgi Point and the mouth of Urala Creek (South). Smaller numbers were observed along the northern shoreline of the study area, on the mudflats in Urala Creek (South), in the mangroves lining the Urala Creek system, and on the flats in the Ashburton River at Wongalwarra Pool. The locations where migratory shorebirds were recorded during the current survey are mapped in Figure 5.1 and Figure 5.2.

It should be noted that the extensive flats inland of the Urala Creek system were dry on all phases of the current survey, with the exception of the basin in the northeast. In addition, detailed counts were targeted around high and low tides in accordance with guidelines and because these periods were when shorebirds were most concentrated, allowing for more reliable counts.

Shorebirds will utilise a range of foraging and roosting areas depending on tidal cycle and food availability, so it is important to note that the locations mapped here reflect the distribution of shorebirds under the conditions of the 2018-19 season, and are somewhat biased away from areas used on mid-tides, so these observations should be used in conjunction with habitat mapping to determine likely shorebird occurrence within the study area.

For example, in early 2018 over 2,000 shorebirds were recorded on the flats inland of Twenty Mile Creek, whereas we did not record any shorebirds in this area during the current surveys.

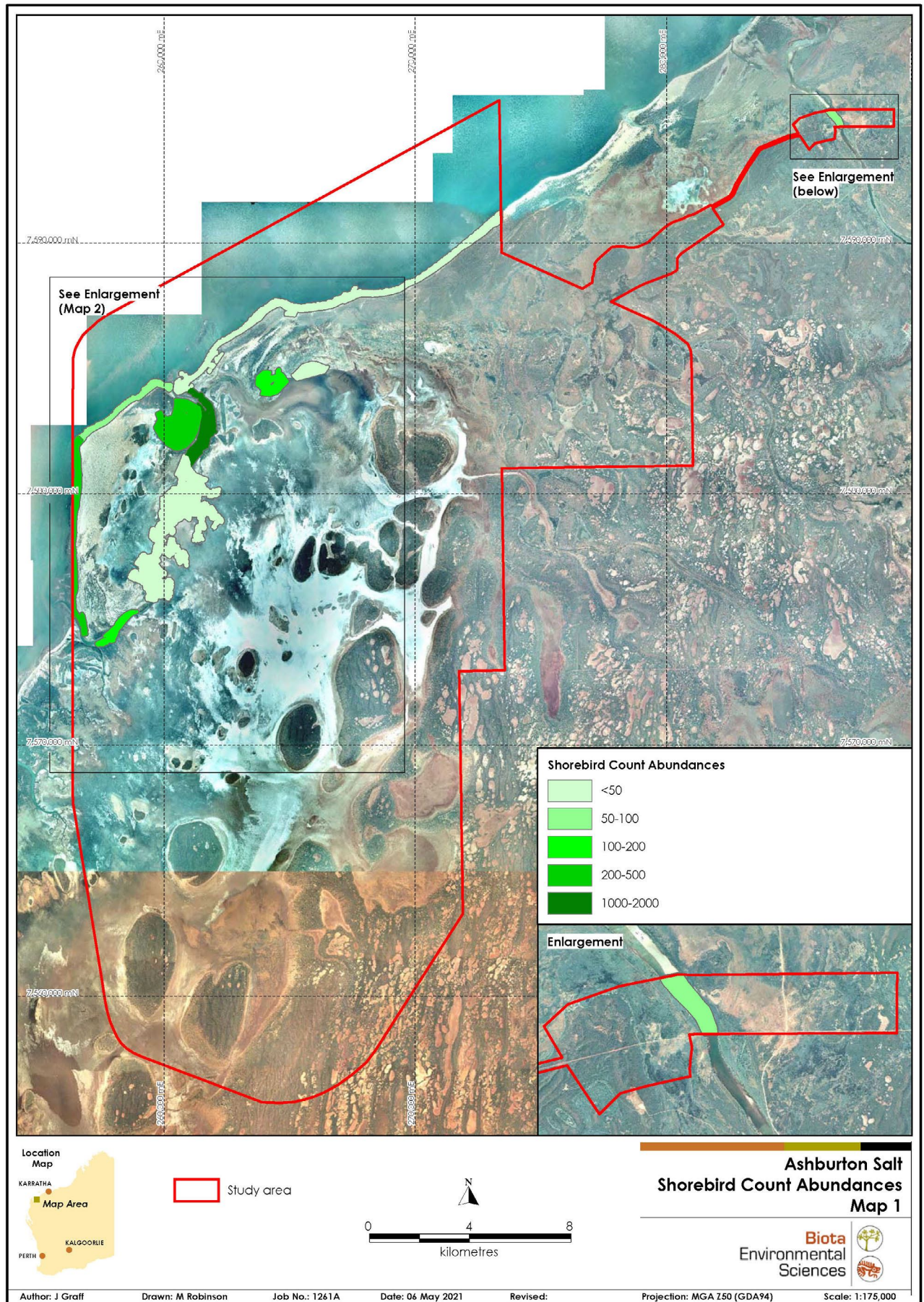


Figure 5.1: Migratory shorebird occurrence within the study area during the current survey.

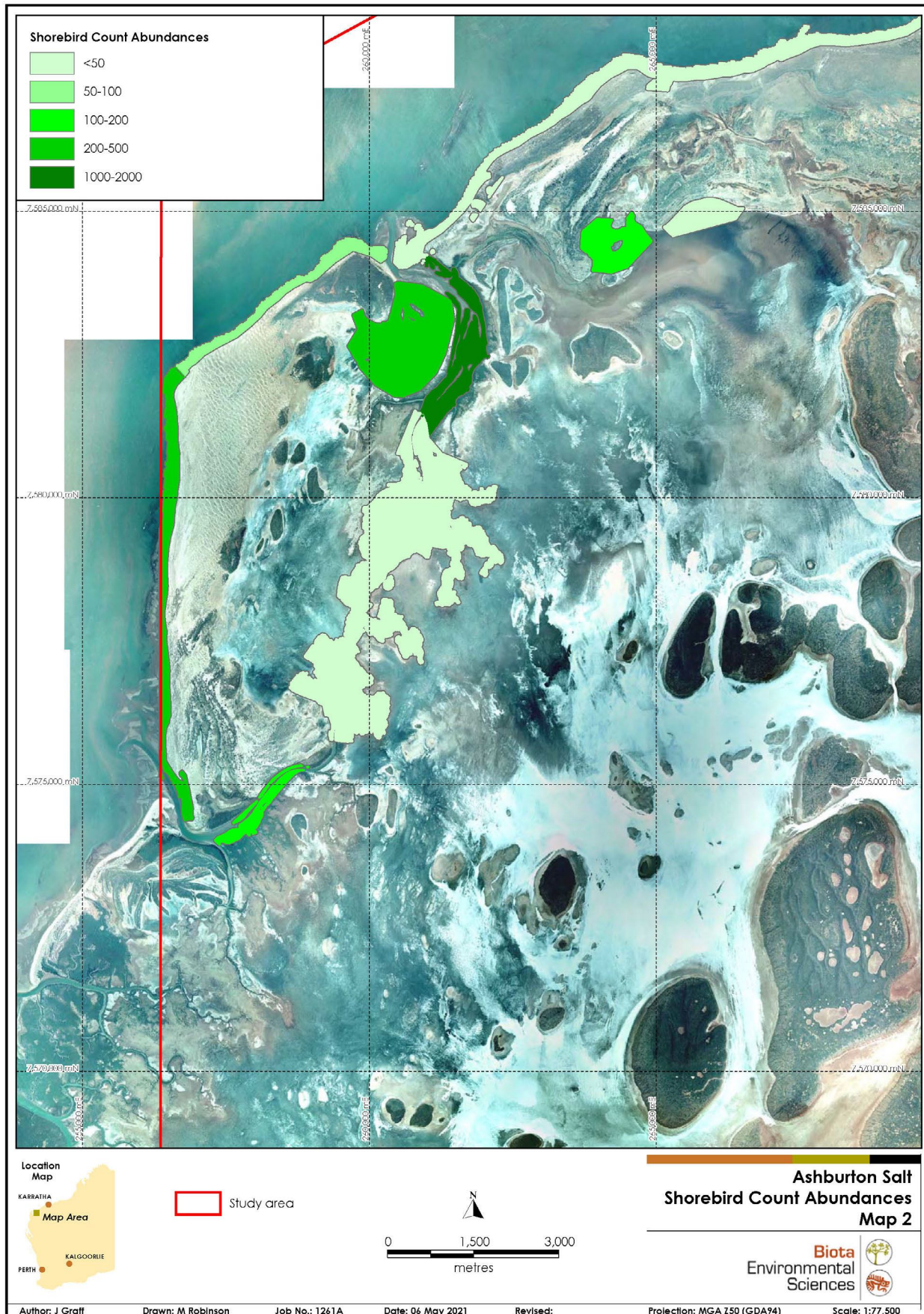


Figure 5.2: Enlarged view of migratory shorebird occurrence within the north-western study area during the current survey.

5.3 Shorebird Habitats

Six broad shorebird habitats were identified within the study area during the current survey. The abundance and diversity of shorebirds recorded in each habitat type is summarised in Table 5.5, and likely shorebird usage summarised in Table 5.6. The habitats are mapped in Figure 5.3 and Figure 5.4 and discussed in more detail in Sections 5.3.1 to 5.3.6.

During the current survey, the highest shorebird diversity and abundance was recorded on the bare intertidal flats habitat type (Table 5.5), particularly intertidal mudflats in association with the northern arm of Urala Creek. Data from previous surveys also show that large numbers of migratory shorebirds use intertidal mudflats and algal mats inland of Twelve Mile Creek at times. No data could be found on shorebird usage of the supratidal salt flats and freshwater claypans in the study area when inundated, so usage of these areas can only be inferred based on a review of the literature.

BirdLife Australia counts undertaken in the study area in January 2018 included the Tubridgi Coast and Twelve Mile Creek Claypan count areas, during flooding conditions with “*supratidal claypans [sic] all inundated down the eastern side of the [Exmouth] Gulf*”. It should be noted that areas described in these counts as “claypans” refer to the algal mats and supratidal flats, rather than the true claypans further inland, though these may also have inundated. The Tubridgi Coast count area includes predominantly sandy beaches, with smaller areas of bare intertidal flats, mangroves and supratidal mudflats (Figure 5.5), but given the flooding conditions it is reasonably expected that shorebirds would have primarily been using the sandy beaches. Similarly, the Twelve Mile Creek Claypan count area does not include freshwater claypans as defined in this report, but is made up of high intertidal mudflats, algal mats and some mangroves (Figure 5.5).

Table 5.5: Migratory shorebird diversity and abundance within the study area by habitat.

Habitat		Total Diversity (all surveys combined)	Max. Diversity (single survey)	Max. Abundance
Bare Intertidal flats	Urala Creek	19 spp.	17 spp. (Mar)	1,735 (Mar)
	Tubridgi Coast	12 spp. ¹	11 spp. (Nov, Dec, Mar) ¹	485 (Mar) ¹
	Wongalwarra	9 spp.	9 spp. (Mar)	65 (Mar)
	Habitat combined	20 spp.	20 spp. (Mar)	2,285 (Mar)
Sandy beaches	Tubridgi Coast	12 spp.	11 spp. (Nov, Dec, Mar)	849 (Jan 2018)
	Northern Coast	5 spp. ²	3 spp. (May) ²	41 (May)
	Habitat combined	12 spp.	11 spp. (Nov, Dec, Mar)	485 (Mar)
Mangroves		3 spp. ²	3 spp. (Nov) ²	25 (Mar) ²
Algal mats		12 spp.	12 spp. (Apr)	308 (Apr) ³
Supratidal salt flats ⁴		No data ⁴	No data ⁴	No data ⁴
Freshwater claypans ⁴		No data ⁴	No data ⁴	No data ⁴

¹ Estimate based on high tide counts, may be an overestimate as some birds observed moving to Urala Creek system to forage; however, birds may also have moved in from other roosting areas (e.g. offshore islands)

² Based on aerial counts only so may underestimate diversity and abundance of migratory shorebirds as small shorebirds often not identifiable to species level during aerial counts, and are not counted as migratory species unless definitely identified as such.

³ Counted in area west of Urala Creek (North) mapped primarily as algal mats, but small areas of high intertidal mudflats also in this area, so count is likely a slight overestimate.

⁴ No count data available for these habitats as habitats not inundated during current survey and no previous count data were available for these areas.

Table 5.6: Summary of extent and usage of shorebird habitats within study area.

Habitat	Extent (ha)	Foraging	Roosting
Bare Intertidal flats	2,012	Preferred foraging habitat for many shorebird species.	Roosting observed on higher mudflats in overflow areas when flooded at high tide. Lower mudflats not preferred roosting habitat as most areas are underwater at high tide.
Sandy beaches	272	Some foraging observed from mouth of Urala Creek South to Locker Point, but not preferred foraging habitat for most species. Preferred foraging habitat for a few species such as Sanderling.	Preferred shorebird roosting habitat from mouth of Urala Creek South to Locker Point. Small numbers roosting west of Locker Point
Mangroves	555	Not preferred foraging habitat for most species, except on fringes. Less dense areas may be used by a few species (e.g. Whimbrel, Common Sandpiper)	Favoured roosting habitat for some species such as Whimbrel, Common Greenshank and Grey-tailed Tattler.
Algal mats	4,157	Suitable foraging habitat when inundated, particularly for smaller species such as Red-necked Stint, but extent of usage difficult to assess due to limited inundation. Unlikely to be used when dry.	Suitable roosting habitat when inundated, particularly if other roost sites are unavailable due to higher than usual water levels. Unlikely to be used when dry.
Supratidal salt flats ²	20,443	Possible foraging habitat when inundated, though unlikely to represent high value foraging habitat as high salinity levels in substrate are not suitable for supporting most invertebrate fauna. Unlikely to be used when dry.	Potential roosting habitat when inundated, particularly if other roost sites are unavailable due to higher than usual water levels. Unlikely to be used when dry.
Freshwater claypans ²	1,416	Potential foraging habitat when inundated. Unlikely to be used when dry.	Potential roosting habitat when inundated, particularly if other roost sites are unavailable due to higher than usual water levels. Unlikely to be used when dry.

¹ Inferred based on literature only, as areas not inundated during current survey.

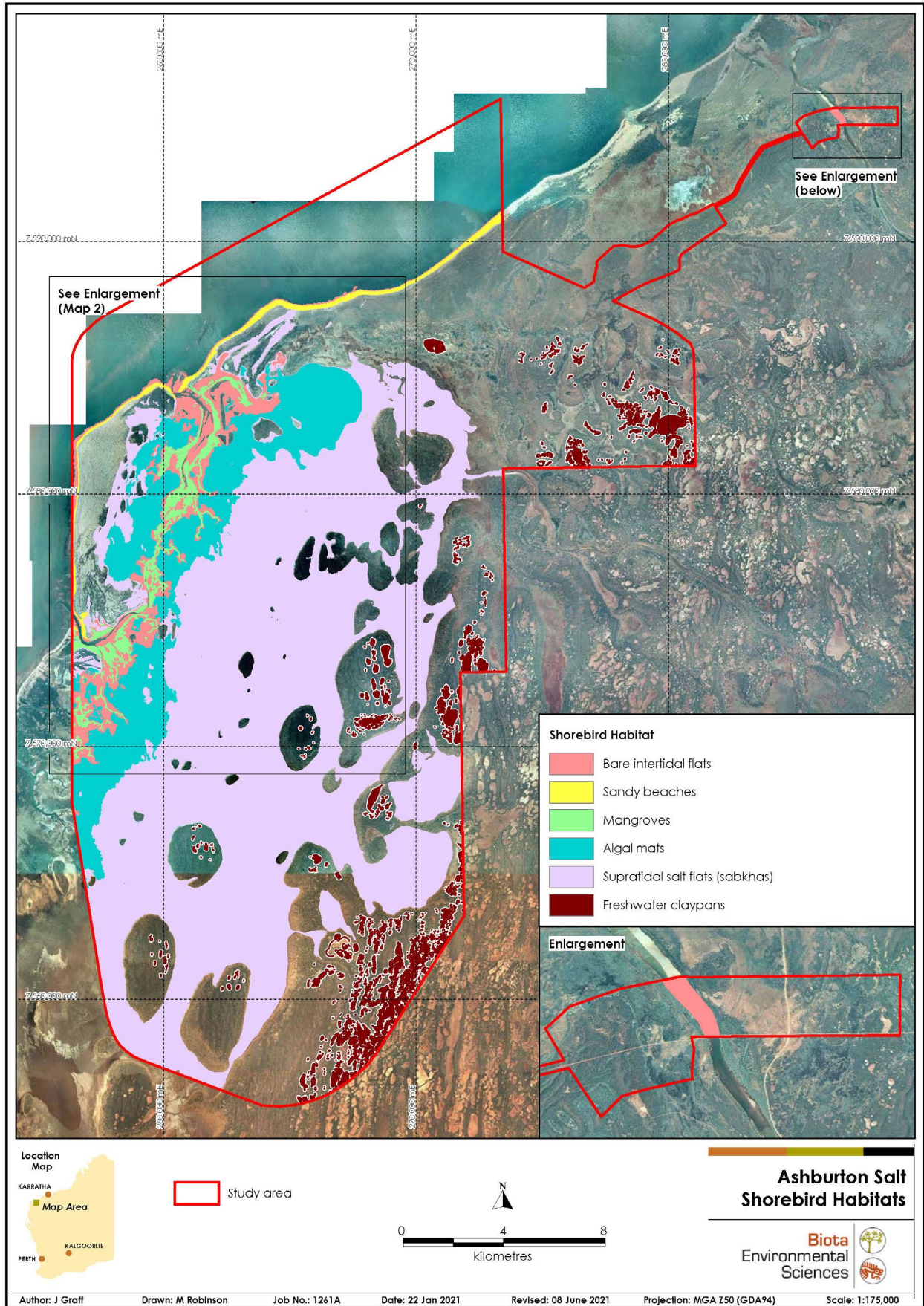


Figure 5.3: Shorebird habitats of the study area.

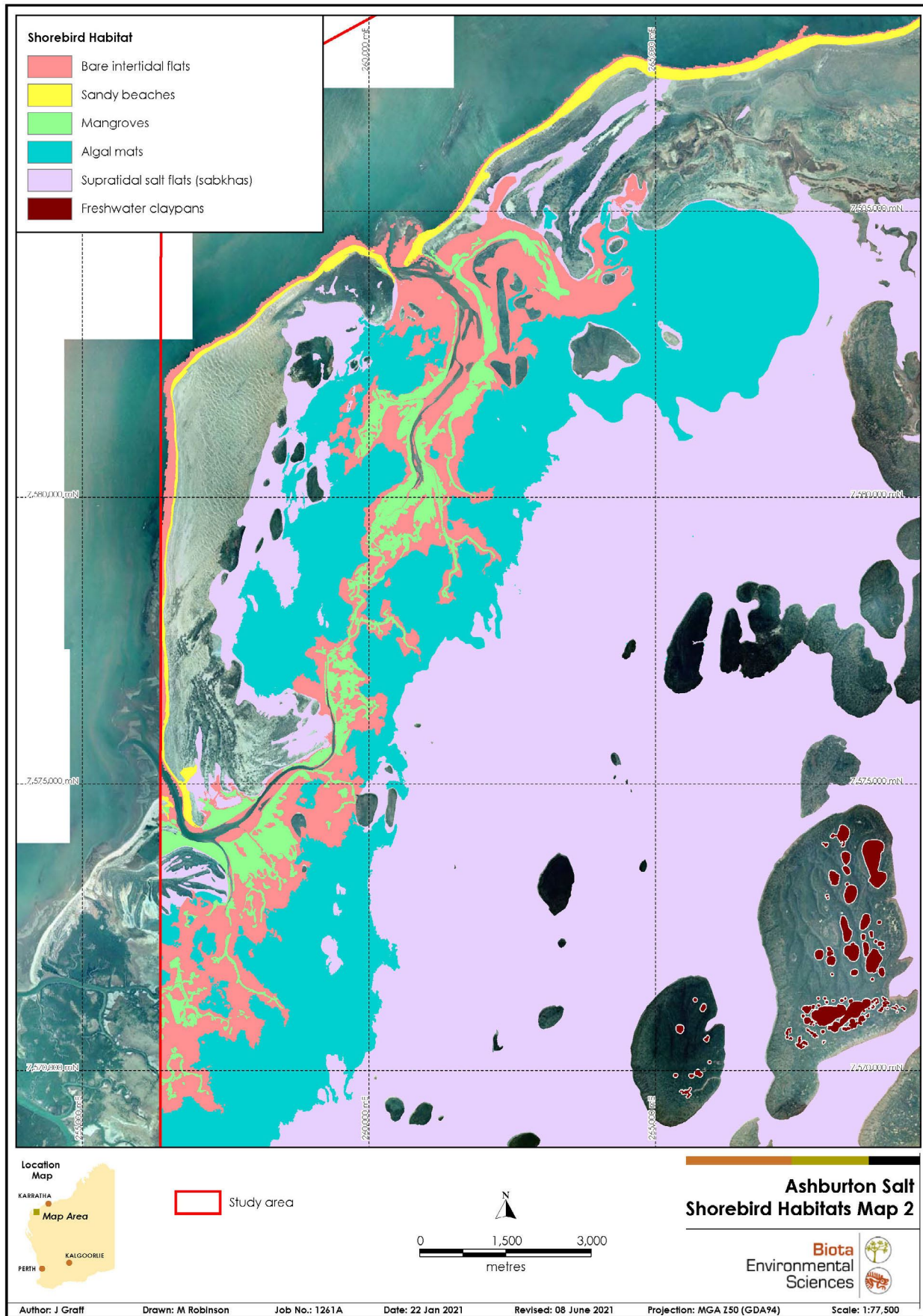


Figure 5.4: Enlarged view of shorebird habitats of the north-western study area.

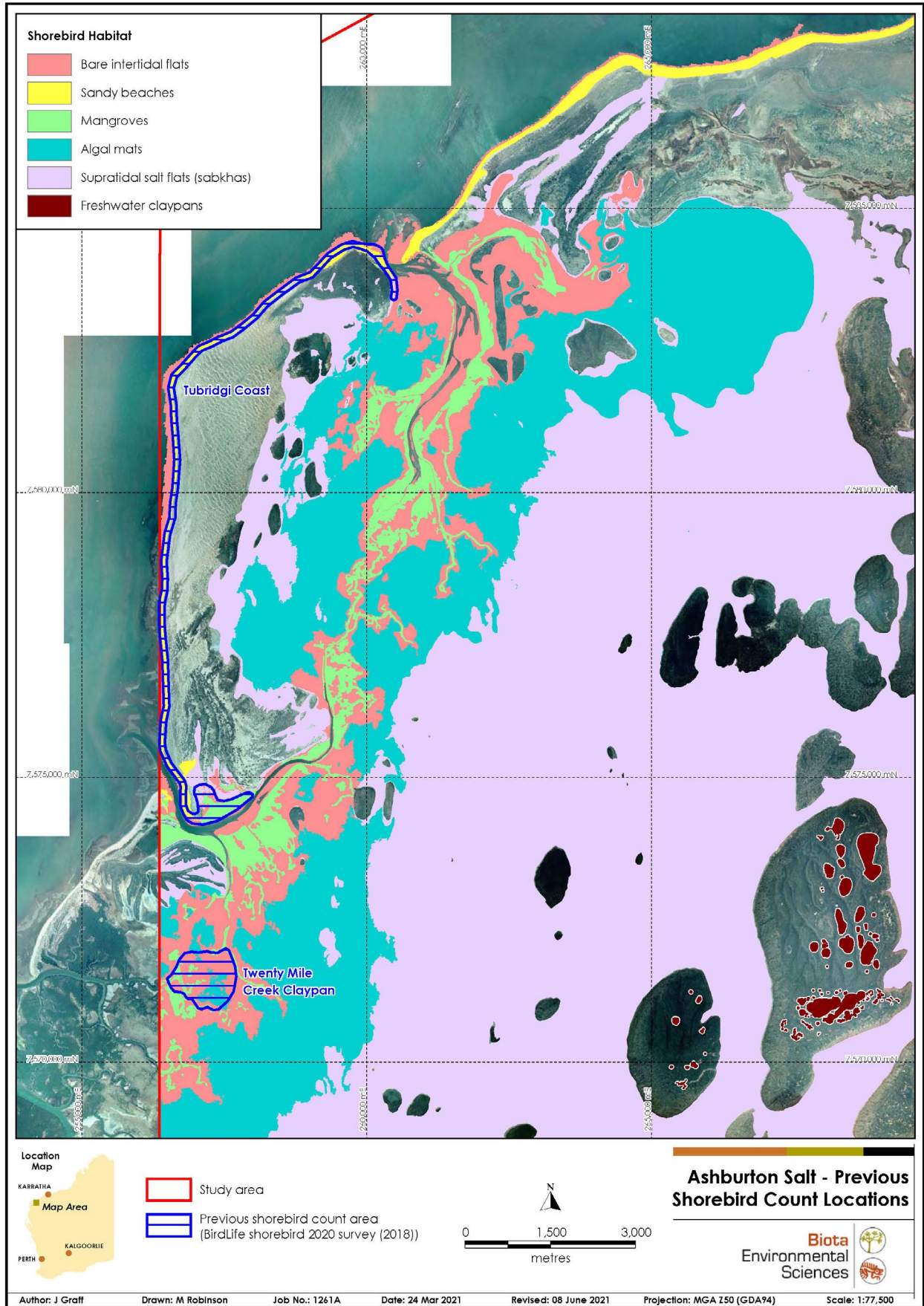


Figure 5.5: Previous survey locations within the study area and habitat.

5.3.1 Bare Intertidal Flats

Low intertidal mudflats occur within the main creek channels in both Urala Creek North and South, with higher mudflats occupying the surrounding areas adjacent to the creeks. A mix of intertidal reef flats and sand flats also occur along the western coast, extending south from Tubridgi Point, and a mix of mudflats, sand flats and rock flats occur at Wongalwarra Pool. These areas are exposed during most tidal cycles (Geoscience Australia 2021), though the lower elevation mudflats may remain inundated throughout the tidal cycle during neap tides or storm surges, while the higher level mudflats may not be inundated during lower high tides. Overall inundation of the intertidal mudflats ranges from 10 to 80%. These areas are distinct from other intertidal areas as they are largely 'bare' and do not support mangroves or algal mats.

Bare intertidal flats are preferred foraging habitat for many migratory shorebird species and are generally regarded as one of the most important habitats for migratory shorebirds (e.g. Rogers et al. 2011, Commonwealth of Australia 2017). Mudflats typically support a higher number and diversity of shorebirds than sand, reef, or rock flats (e.g. Pandiyan and Asokan 2016). This is consistent with our observations within the study area, where the highest numbers and diversity of shorebirds were observed on the intertidal mudflats in and around Urala Creek, particularly Urala Creek North where the most extensive areas of intertidal mudflats within the study area are located. The reef and sand flats south of Tubridgi Point were also used extensively by shorebirds, but in lower numbers than the mudflats nearby. Only small numbers of migratory shorebirds were observed foraging on the exposed intertidal flats at Wongalwarra Pool, which comprised a mix of mud, rocky and sand flats.

Exposed intertidal flats were used primarily for foraging, though some roosting was observed on higher intertidal mudflat areas adjacent to Urala Creek when these were inundated at high tide. During the current survey, migratory shorebirds using the extensive intertidal mudflats in the Urala Creek system followed the tidal movements across the mudflats, foraging on the low intertidal mudflats within the creeks when these were exposed at low tide, then moving to the higher intertidal mudflats nearby as the tide rose. Observations indicated that during the day they foraged throughout the tidal cycle, roosting or loafing opportunistically, rather than gathering in large flocks to roost at high tide. Conversely, most of the shorebirds foraging on exposed tidal flats along the Tubridgi Coast then roosted in small flocks around high tide on the adjacent beach when these flats were inundated.

5.3.2 Sandy Beaches

Sandy beaches are found along the coastline between the north and south arms of Urala Creek, and to the east of Urala Creek. Relatively high numbers of shorebirds were observed during the current survey along the coastline between the two arms of Urala Creek, particularly around Tubridgi Point and south to Urala Creek (South). The majority of birds observed on the beach were roosting in small flocks at high tide, though some foraging was also observed, particularly at the tideline and in the tide wrack (marine organic material and other debris deposited on the beach by tidal movement).

Fewer shorebirds were observed using the sandy beaches along the northern coast of the study area, particularly east of the north arm of Urala Creek. We hypothesise that these areas are less preferred for roosting by most species due to the greater distance to high-quality intertidal foraging habitat such as mudflats (as are present at Urala Creek) or reef platforms (as along the Tubridgi coast). Proximity to foraging areas has regularly been shown to be an important factor in shorebird roost site selection (e.g. Rogers et al. 2006, Zharikov and Milton 2009). Nevertheless, 33 Sanderling were recorded in this area during the May survey, which exceeds the 0.1% criterion for that species, and indicates that there is occasional usage of the area by larger numbers of shorebirds. Sanderling are also one of the few shorebirds that prefer sandy beaches for foraging, so proximity to tidal flats is likely to be less important for that species.

5.3.3 Mangroves

Mangroves fringe large sections of the north and south arms of Urala Creek, and their smaller tributaries. Mangroves provide favoured roosting habitat for several migratory shorebird species, including Whimbrel, Common Greenshank and Grey-tailed Tattler (Zharikov and Milton 2009, Johnston-Gonzalez and Abril 2018). Mangroves have also been shown to be strong predictors of high shorebird densities globally (Butler et al. 2001); however, few shorebirds forage within tall or dense mangrove areas. One exception is the Whimbrel, which is one of the few migratory shorebirds to regularly forage amongst mangroves (Bamford Consulting Ecologists 2009)

During the current survey, small numbers of shorebirds were observed foraging on mudflats and muddy creek banks on the margins of mangrove areas during low tide counts of the Urala Creek, but not within mangrove stands themselves. Small numbers of shorebirds were recorded from the mangrove-lined upper reaches of Urala Creek. Shorebirds were likely roosting in these areas, but as counts were undertaken from the helicopter in these areas and birds were typically observed only when disturbed by the helicopter, it was not possible to determine with certainty whether they had been foraging or roosting prior to observation.

5.3.4 Algal Mats

Algal mats occur above the elevation of the bare intertidal mudflats, where the substrate is covered by extensive cyanobacterial mats. These areas flood on high spring tides or after heavy rainfall or storm surges. The algal mats are inundated for between 1 and 3% of the time due to spring tides (Biota, 2005b). Remote-sensed “water observations from space” data indicates combined inundation from tides and/or rainfall events ranging from approximately 5% to 20% of the time, although this data may have limitations as it is compiled from images taken at intervals dictated by satellite coverage (Geoscience Australia 2021).

The majority of the algal mats were not inundated during any of the current surveys, so shorebird usage was difficult to assess directly. The algal mats in the northeast of the study area occur in a shallow basin that holds water between tide cycles and was inundated during the current survey (Geoscience Australia 2021). A small number (<50) of small shorebirds, likely comprising Red-necked Stints and Red-capped Plovers, were observed incidentally on several occasions in the north of this basin while overflying, but their occurrence was erratic. It is considered that these were likely birds using Urala Creek (North) at low tide that sometimes used this area on higher tides. During the April surveys, when tides were higher than normal (likely due to the influence of Tropical Cyclone Wallace offshore to the north), smaller areas of algal mat habitat to the west of Urala Creek were inundated around high tide and were regularly used by moderate numbers of shorebirds (up to approximately 300) for foraging and roosting. Foraging was largely restricted to small species, particularly Red-necked Stints, though species up to the size of Red Knot were observed foraging in small numbers. Larger species including Bar-tailed Godwit and Whimbrel were observed using the area for roosting close to high tide.

Regionally, large numbers of Red-necked Stint (c. 1,000) were also observed east of the study area in 2015 (Cornell Lab of Ornithology 2020) on flats adjacent to the Wheatstone access road that have been mapped as algal mats (URS Australia 2011). Large numbers (2,000) of small shorebirds were also recorded from the same area in March 2009 on “near-coastal claypans and flats” which were flooded due to recent rains and very high tides (Bamford Consulting Ecologists 2009), though the area mapped for this record also extends over large areas of salt flat and smaller areas of high intertidal mudflat (URS Australia 2011) and the exact distribution of birds over the area is uncertain (M. Bamford, pers. comm.). Conversely, surveys further east of Onslow recorded few shorebirds using algal mat and supratidal salt flat areas (these habitats are treated together), even when inundated on very high tides (Phoenix 2020). The exceptions were Oriental Plovers, Oriental Pratincoles, and non-migratory Red-capped Plovers. Oriental Plovers and Oriental Pratincoles forage primarily over open plains and were likely primarily using the area for roosting, though foraging and roosting use is noted (Phoenix 2020).

These observations suggest that algal mat areas can provide suitable foraging habitat for shorebirds, particularly small species, when wet or inundated. However, usage levels appear to vary. Recent research indicates that some small shorebird species, including Red-necked Stint, forage extensively by grazing on microbial mats and epibenthic biofilms (Kuwae et al. 2012, Beninger and Elnor 2020) which may explain what food source these birds are using on the algal mats. The infrequent inundation and relatively high salinity levels in the underlying substrate are not conducive to supporting high densities of invertebrate prey, so the algal mats are less likely to be preferred foraging habitat for larger shorebirds that prefer these food sources.

5.3.5 Supratidal Salt Flats (Sabkhas)

Hypersaline supratidal flats (salt flats or sabkhas) occur in the Western shorebird area, inland of the bare intertidal mudflats and algal mats. These areas are largely unsuitable for shorebirds when dry, but may be used when inundated, which occurs only during extreme tides (e.g. king tides and cyclonic storm surges) or following heavy rainfall. Tidal inundation occurs less than 1% of the time, while past data indicates that combined inundation from tides or rainfall was approximately 10% of the time for most areas (Geoscience Australia 2021). These areas were not inundated during the current survey, so shorebird usage could not be assessed directly, and no previous count data for supratidal salt flats within the survey area was available.

Shorebirds are known to forage in hypersaline habitats, but most examples in the literature focus on salt lakes or salt pans, and man-made salinas not connected to the ocean (e.g. Masero 2003, Andrei et al. 2008). There is little published literature on shorebird usage of natural supratidal salt flats (also known as sabkhas). Shorebird usage levels have been shown to decrease with increasing salinity in studies in Europe and North America (Andrei et al. 2008, Dias 2009). Salinity levels in salt lakes in the southern Great Plains used by shorebirds averaged 30.87 g/L, while those not used had salinity levels averaging 82.56 g/L (Andrei et al. 2008). Though increasing salinity also reduced the numbers of most species of shorebirds using salt ponds in Portugal, mean salinities of ponds used by shorebirds were higher, ranging from 60 g/L to 90 g/L depending on species, with at least one species regularly occurring on ponds with salinities up to 200 g/L (Dias 2009). Opportunistic water quality measurements for six locations within the supratidal salt flat habitat in the study area indicated that the salinity levels when inundated varied significantly, with measures ranging from 0.73 g/L (1.5 mS/cm) up to 172.9 g/L (230 mS/cm) (Biota, unpublished data). There was a broad trend towards higher salinities in shallower water, as would be expected, but the limited sampling means identifying other potentially relevant factors is problematic. This does indicate that salinity levels can be higher than preferred by most shorebird species even when the salt flats are inundated. The high salinity levels and infrequent inundation also mean that the salt flats support very little invertebrate biomass. As discussed in Section 5.3.4, a recent shorebird survey undertaken east of Onslow assessed supratidal salt flats (in combination with algal mats) as being of relatively low value for migratory shorebirds, with two migratory shorebird species recorded (Phoenix 2020).

The salt flats may provide suitable foraging and roosting habitat for shorebirds when inundated, but are not expected to be preferred habitat, particularly for foraging, due to the high salinity levels and relative lack of food sources. Shorebird usage of these areas is considered most likely to occur when usual foraging and roosting areas are too heavily inundated to provide suitable habitat.

5.3.6 Freshwater Claypans

Ephemeral freshwater claypans occur in the Western shorebird area, in the sandy country inland of the supratidal salt flats and on islands within the salt flats. These claypans were not inundated during any phases of the current surveys, so direct assessment of shorebird usage was not possible. However, it is likely that the claypans in the study area would be used by shorebirds for foraging and roosting when inundated, which past data indicates is about 10% of the time for most claypan areas, though some are inundated less frequently than this (Geoscience Australia 2021).

Claypans are known to provide high quality habitat for shorebirds when inundated, and may be used for both foraging and roosting (e.g. Collins et al. 2001, Zharikov and Milton 2009). In many areas, they are used primarily when nearby intertidal mudflats are inundated, during both the normal tidal cycle and exceptional high tides caused by extreme weather conditions (Jessop and Collins 2000, Collins et al. 2001). However, a few shorebird species such as Wood Sandpiper (*Tringa glareola*) show a strong preference for freshwater habitats and may use freshwater claypans but avoid adjacent intertidal mudflats.

There is little data available on shorebird usage of the freshwater claypans in the region of the study area. Claypans to the west of the study area have been shown to contain a range of aquatic invertebrates when inundated (Biota and Timms 2010) which provide a potential food source for shorebirds. Seven migratory shorebird species have also been recorded using a claypan area along the road into Onslow, though the total numbers of shorebirds recorded were low (Cornell Lab of Ornithology 2020). Fifty small shorebirds were also observed on an inundated claypan east of the project area during an aerial count, but were not identified to species level (Bamford Consulting Ecologists 2009).

5.4 Anthropogenic Disturbance

The majority of the Western shorebird area is undeveloped and is currently not readily accessible by land, so anthropogenic disturbance levels are very low. No anthropogenic disturbance was observed during the current survey aside from that related to the survey work itself (e.g. helicopter flyovers, disturbance by counting personnel). Vehicle tracks were observed on the beach along the northern coastline in the area to the east of the Urala Creek (North) mouth, and a small recreational vessel travelled past the Tubridgi Coast count area on one occasion but was not observed to disturb shorebirds.

The Ashburton River shorebird area is more readily accessible, with vehicle track access in close proximity, so is likely exposed to higher levels of disturbance than the Western shorebird area. However, no disturbance was observed during the current surveys.

6.0 Conservation Significance

6.1 Threatened Species

Eight shorebird species recorded from the study area are also listed as conservation significant at state and/or Commonwealth level, in addition to their Migratory listings (except in the case of Grey-tailed Tattler, the category of listing was the same at both state and Commonwealth levels). These were:

- Eastern Curlew *Numenius madagascariensis* (Critically Endangered);
- Great Knot *Calidris tenuirostris* (Critically Endangered);
- Curlew Sandpiper *Calidris ferruginea* (Critically Endangered);
- Bar-tailed Godwit *Limosa lapponica* (ssp. *menzbieri* Critically Endangered/ssp. *baueri* Vulnerable);
- Lesser Sand Plover *Charadrius mongolus* (Endangered);
- Red Knot *Calidris canutus* (Endangered);
- Greater Sand Plover *Charadrius leschenaultii* (Vulnerable); and
- Grey-tailed Tattler (DBCA Priority 4).

6.2 Assessment Against Criteria for Significant Shorebird Habitat

6.2.1 National Significance

The Western shorebird area meets all three criteria (Section 3.1) for an area of national importance for migratory shorebirds based on both shorebird diversity and overall shorebird abundance recorded during the current counts. The Ashburton River shorebird area did not meet any of the three criteria for an area of national importance for migratory shorebirds.

6.2.1.1 Shorebird Abundance ($\geq 2,000$ individuals)

The Western shorebird area met the criterion for abundance during one of the five phases of the current survey and based on previous count data from 2018:

- The March phase of the current survey (2,245 migratory shorebirds); and
- The 2018 BirdLife Australia survey (2,432 migratory shorebirds).

The Ashburton River shorebird area did not meet the abundance criterion for any of the five phases of the current survey, or based on any previous survey data.

6.2.1.2 Shorebird Diversity (≥ 15 migratory shorebird species)

The Western shorebird area met the criterion for diversity (15 or more species) during four of the five phases of the current survey:

- November (18 migratory shorebird species);
- December (19 migratory shorebird species);
- March (19 migratory shorebird species); and
- April (15 migratory shorebird species).

The Ashburton River shorebird area did not meet the diversity criterion for any of the five phases of the current survey, or based on any previous survey data.

6.2.1.3 Individual Species ($\geq 0.1\%$ of the estimated flyway population for a species)

The Western shorebird area also meets the criterion for national importance for 10 individual migratory shorebird species; that is, 0.1% of the estimated flyway population for that species. There are six species for which the study area met this criterion during the current survey, which are outlined below (Table 6.1). In addition, a further four species met this criterion during the BirdLife Australia counts conducted within the study area in January 2018 (Table 6.2).

Table 6.1: Nationally important shorebird species counts for the study area during current counts

Species	Common name	0.1% Criterion (individuals)	No. of surveys criterion met	High count (individuals)
<i>Tringa brevipes</i>	Grey-tailed Tattler	70	1	229 (March)
<i>Arenaria interpres</i>	Ruddy Turnstone	30	4	95 (April)
<i>Calidris alba</i>	Sanderling	30	4	51 (March)
<i>Calidris ruficollis</i>	Red-necked Stint	475	2	681 (December)
<i>Calidris ferruginea</i>	Curlew Sandpiper	90	1	361 (March)
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	30	2	175 (December)

Table 6.2: Nationally important shorebird species counts for the study area during January 2018 counts

Species	Common name	0.1% Criterion (individuals)	January 2018 count (individuals)
<i>Charadrius mongolus</i>	Lesser Sand Plover	180	181
<i>Charadrius leschenaultii</i>	Greater Sand Plover	200	754
<i>Numenius madagascariensis</i>	Eastern Curlew	35	146
<i>Tringa brevipes</i>	Grey-tailed Tattler	70	400
<i>Tringa nebularia</i>	Common Greenshank	110	131
<i>Calidris alba</i>	Sanderling	30	114
<i>Calidris ruficollis</i>	Red-necked Stint	475	900

The Ashburton River shorebird area did not meet the diversity criterion for any of the five phases of the current survey, or based on any previous survey data. However, it is included within the broader Onslow shorebird area which meets this criterion for Red-necked Stint (Weller et al. 2020).

6.2.2 International Significance

The Western shorebird area and the Ashburton River shorebird area did not meet any of the criteria for international significance at the scale of the study area (Section 3.1).

The Western shorebird area is included within the broader Exmouth Gulf shorebird area, which has been identified as internationally significant based on counts exceeding 1% of the estimated flyway population for Grey-tailed Tattler (*Tringa brevipes*) (Biota 2005a, BirdLife Australia 2020).

The Ashburton River shorebird area is included within the broader Onslow shorebird area. This broader count area also has not met any of the criteria for an area of international significance (Weller et al. 2020).

6.3 Regional Significance

A complete shorebird survey of the eastern Exmouth Gulf was not feasible during this study. However, several previous large scale shorebird surveys have been undertaken in the Exmouth Gulf (Biota 2005a, BirdLife Australia 2020), which provide some broader context for the counts obtained during this survey. An indication of the coverage of the each of the surveys is included in Figure 6.1, and total counts for the three surveys are included in Table 6.3

The most extensive coverage was provided by Biota's shorebird survey for the proposed Yannarie Salt Project (Biota 2005a), with surveys covering the majority of the eastern and southern Exmouth Gulf, but with little overlap of the current study area. Hence, an approximation for the number of shorebirds using the eastern and southern Exmouth Gulf can be obtained by combining these two counts (Table 6.4). It should be noted that these surveys were undertaken in different years, and as such these data do not reflect a true census of shorebird populations using Exmouth Gulf, and provide an indicative estimate of the Gulf population only.

Using this method, the proportion of total shorebirds recorded in the study area (28% of shorebird total and 23% of migratory shorebird total; Table 6.4) is approximately equivalent to the proportion of the eastern Exmouth Gulf occupied by the study area.

However, small species appeared to be proportionally more abundant in the study area, with species such as Broad-billed Sandpiper, Curlew Sandpiper, Lesser Sand Plover and Red-capped Plover proportionally over-represented in the study area compared to overall counts (Table 6.4). The most notable of these were Broad-billed Sandpiper and Curlew Sandpiper. Broad-billed Sandpipers were recorded on all four 'summer' surveys during the current study (Plate 6.1, Plate 6.2), with high counts in December (175) and March (129), with all records from Urala Creek North and surrounding overflow areas, but was not recorded on any of the previous Exmouth Gulf surveys. It is possible that the numbers observed during the current survey represent an unusual influx to the area, or they may favour the Urala Creek North area, which was not surveyed on the three previous surveys. Alternatively, they are a small species and may be overlooked amongst Red-necked Stints or Red-capped Plovers from a distance, particularly in roosting flocks, or from aerial surveys. Curlew Sandpipers are listed as critically endangered and were recorded on all five of the surveys during the current study with a high count of 355 in March, though the remaining counts were significantly lower (≤ 45). Total counts from previous surveys in the broader Exmouth Gulf region ranged from 0 to 35. The high count in March may indicate that the study area is used as a migratory staging point for birds migrating north from further south. It is possible that this usage extends more broadly within Exmouth Gulf but was missed on previous surveys which were not conducted during northward migration.

Conversely, large species such as Eastern Curlew, Whimbrel and Bar-tailed Godwit were proportionally under-represented in the study area. Again, this may partly reflect variation in populations using Exmouth Gulf between years, particularly given that 200 Eastern Curlew were counted within the study area in 2018 (BirdLife Australia 2020). However, all three previous counts recorded over 1,000 Bar-tailed Godwits in the eastern Exmouth Gulf, compared to a high count of 137 for the study area during the current surveys.



Plate 6.1: Broad-billed Sandpiper in the survey area during March counts.



Plate 6.2: Broad-billed Sandpipers foraging on mudflats in Urala Creek North during March counts.

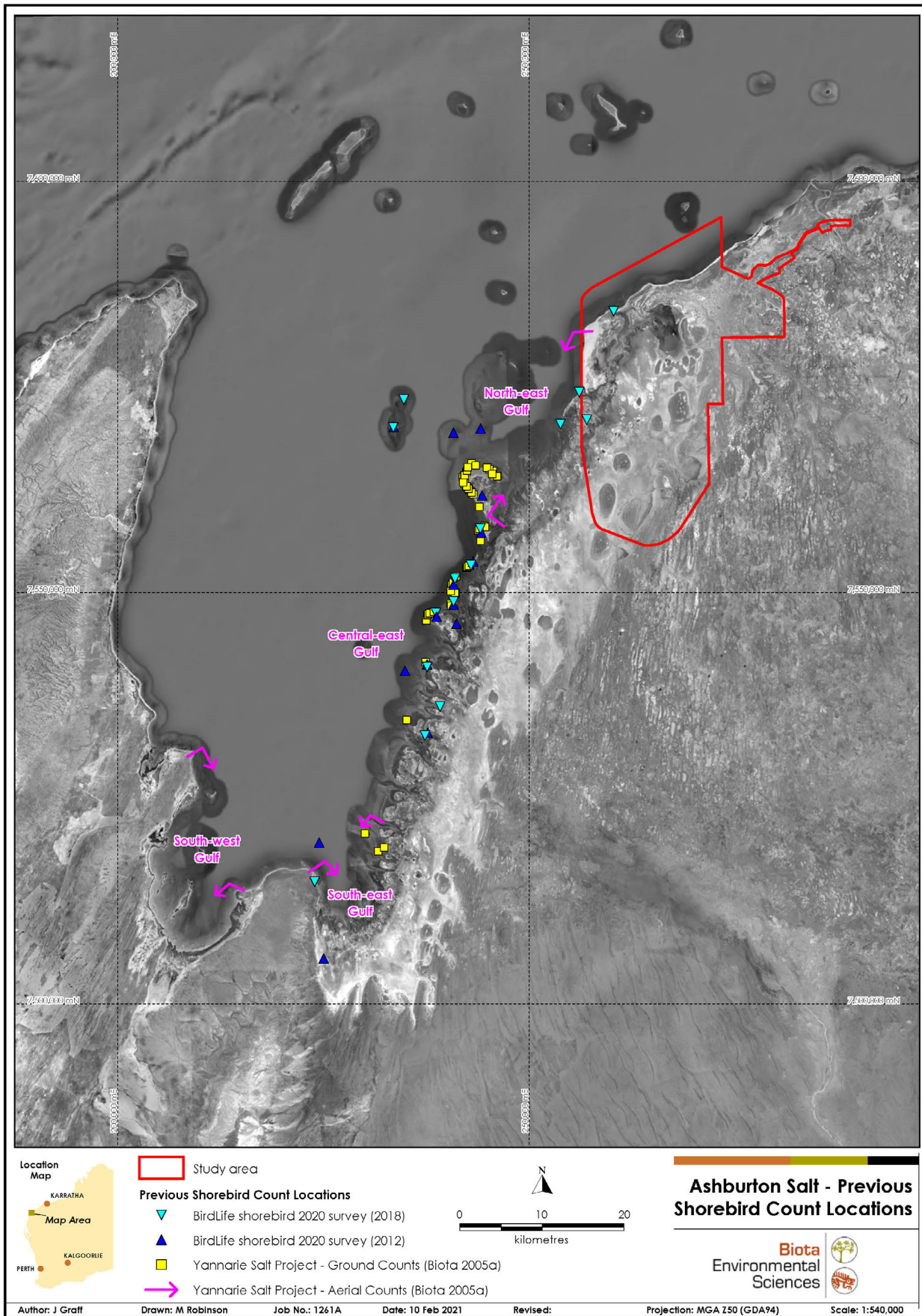


Figure 6.1: Previous eastern Exmouth Gulf survey locations.

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Table 6.3: Previous shorebird counts of eastern Exmouth Gulf

Species	Common name	Conservation Status		Current survey	Biota (2005a)	S2020 Jan 2012 (BirdLife Australia 2020)	S2020 Jan 2018 (BirdLife Australia 2020)
		State	Commonwealth				
Burhinidae							
<i>Esacus magnirostris</i>	Beach Stone-curlew	-	-	2	5	6	2
Haematopodidae							
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	-	14	196	107	20
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	-	3	17	32	9
Recurvirostridae							
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	8	-	-	-
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	3	-	-	-
Charadriidae							
<i>Pluvialis fulva</i>	Pacific Golden Plover	MI	MI	4	7	8	30
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI	24	32	30	12
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-	662	249	204	74
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN; MI	EN; MI	100	76	35	201
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU; MI	VU; MI	189	1,036	1,129	843
<i>Charadrius veredus</i>	Oriental Plover	MI	MI	-	15	-	-
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	-	-	3	-	-	-
<i>Vanellus tricolor</i>	Banded Lapwing	-	-	22	-	-	-
Scolopacidae							
<i>Limosa lapponica</i>	Bar-tailed Godwit	*CR/VU; MI	*CR/VU; MI	137	1,253	1,715	1,037
<i>Numenius phaeopus</i>	Whimbrel	MI	MI	23	192	85	186
<i>Numenius madagascariensis</i>	Eastern Curlew	CR; MI	CR; MI	13	189	56	335
<i>Xenus cinereus</i>	Terek Sandpiper	MI	MI	26	53	22	-
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	10	17	31	5
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI; P4	MI	228	3,184	771	1,422
<i>Tringa nebularia</i>	Common Greenshank	MI	MI	93	109	81	180
<i>Tringa stagnatilis</i>	Marsh Sandpiper	MI	MI	-	-	-	4
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI	95	185	446	36
<i>Calidris tenuirostris</i>	Great Knot	CR; MI	CR; MI	126	434	1,008	426
<i>Calidris canutus</i>	Red Knot	EN; MI	EN; MI	89	1	-	-
<i>Calidris alba</i>	Sanderling	MI	MI	51	112	95	189
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI	680	1,133	1,413	1,783
<i>Calidris subminuta</i>	Long-toed Stint	MI	MI	-	-	2	-
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI	4	5	2	-
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR; MI	CR; MI	355	34	26	-
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	MI	MI	175	-	-	-
-	unidentified shorebird sp.	-	-	479	660	126	550
TOTAL				3,618	9,194	7,430	7,344
Migratory[^]				2,422	8,067	6,955	6,689

[^] Does not include unidentified shorebirds which may or may not have been migratory species.

Table 6.4: Estimated abundance of shorebirds species in eastern Exmouth Gulf

Species	Common name	Conservation Status		Current survey	Biota (2005a)	Eastern Gulf estimate	Proportion in study area (%)	
		State	Commonwealth					
Burhinidae								
<i>Esacus magnirostris</i>	Beach Stone-curlew	-	-	2	5	7	28.6	
Haematopodidae								
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	-	14	196	210	6.7	
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	-	3	17	20	15.0	
Recurvirostridae								
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	8	-	8	100	
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	3	-	3	100	
Charadriidae								
<i>Pluvialis fulva</i>	Pacific Golden Plover	MI	MI	4	7	11	36.4	
<i>Pluvialis squatarola</i>	Grey Plover	MI	MI	24	32	56	42.9	
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-	662	249	911	72.7	
<i>Charadrius mongolus</i>	Lesser Sand Plover	EN; MI	EN; MI	100	76	176	56.8	
<i>Charadrius leschenaultii</i>	Greater Sand Plover	VU; MI	VU; MI	189	1,036	1,225	15.4	
<i>Charadrius veredus</i>	Oriental Plover	MI	MI	-	15	15	0.0	
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	-	-	3	-	3	100	
<i>Vanellus tricolor</i>	Banded Lapwing	-	-	22	-	22	100	
Scolopacidae								
<i>Limosa lapponica</i>	Bar-tailed Godwit	*CR/VU; MI	*CR/VU; MI	137	1,253	1,390	9.9	
<i>Numenius phaeopus</i>	Whimbrel	MI	MI	23	192	215	10.7	
<i>Numenius madagascariensis</i>	Eastern Curlew	CR; MI	CR; MI	13	189	202	6.4	
<i>Xenus cinereus</i>	Terek Sandpiper	MI	MI	26	53	79	32.9	
<i>Actitis hypoleucos</i>	Common Sandpiper	MI	MI	10	17	27	37.0	
<i>Tringa brevipes</i>	Grey-tailed Tattler	MI; P4	MI	228	3,184	3,412	6.7	
<i>Tringa nebularia</i>	Common Greenshank	MI	MI	93	109	202	46.0	
<i>Arenaria interpres</i>	Ruddy Turnstone	MI	MI	95	185	280	33.9	
<i>Calidris tenuirostris</i>	Great Knot	CR; MI	CR; MI	126	434	560	22.5	
<i>Calidris canutus</i>	Red Knot	EN; MI	EN; MI	89	1	90	98.9	
<i>Calidris alba</i>	Sanderling	MI	MI	51	112	163	31.3	
<i>Calidris ruficollis</i>	Red-necked Stint	MI	MI	680	1,133	1,813	37.5	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	MI	MI	4	5	9	44.4	
<i>Calidris ferruginea</i>	Curlew Sandpiper	CR; MI	CR; MI	355	34	389	91.3	
<i>Limicola falcinellus</i>	Broad-billed Sandpiper	MI	MI	175	-	175	100	
-	unidentified shorebird sp.	-	-	479	660	1,139	-	
				TOTAL	3,618	9,194	12,812	28.2
				Migratory[^]	2,422	8,067	10,489	23.1

[^] Does not include unidentified shorebirds which may or may not have been migratory species.

7.0 Conclusions

Thirty-eight shorebird species (25 migratory) were assessed as potentially occurring within the study area based on a desktop study. Eight of these species are also listed as conservation significant under State and/or Commonwealth legislation or policy, in addition to their listing as migratory species. These are:

- Eastern Curlew *Numenius madagascariensis* (Critically Endangered);
- Great Knot *Calidris tenuirostris* (Critically Endangered);
- Curlew Sandpiper *Calidris ferruginea* (Critically Endangered);
- Bar-tailed Godwit *Limosa lapponica* (ssp. *menzbieri* Critically Endangered/ssp. *baueri* Vulnerable);
- Lesser Sand Plover *Charadrius mongolus* (Endangered);
- Red Knot *Calidris canutus* (Endangered);
- Greater Sand Plover *Charadrius leschenaultii* (Vulnerable); and
- Grey-tailed Tattler (DBCA Priority 4).

Twenty-eight species of shorebird were recorded from within the study area across the five phases of survey effort. Nineteen of these are migratory shorebirds and classified as such under State and Commonwealth legislation, and all eight species additionally listed as threatened (see above) were recorded from the study area. An additional five migratory shorebird species were recorded from the vicinity of the study area during the current survey, but from outside the study area.

Six distinct shorebird habitats were identified within the study area, comprising:

- Bare intertidal flats;
- Sandy beaches;
- Mangroves;
- Algal mats;
- Supratidal salt flats (sabkhas); and
- Freshwater claypans.

During the current survey, the largest number of shorebirds were observed using the bare intertidal flats habitat type, particularly the intertidal mudflats in the north arm of Urala Creek, followed by the sandy beaches, while small numbers were observed in the mangroves (likely roosting). The majority of the algal mat areas were dry during all phases of the current survey, which meant direct assessment of usage was limited, but shorebirds were observed using areas of algal mats that were inundated, particularly adjacent to the intertidal mudflats near Urala Creek (North). The supratidal salt flats and freshwater claypans were dry during all phases of the current survey and no previous count data exists for these areas, so their usage when inundated could not be assessed directly. These habitats are of low suitability for shorebirds when dry, but may be used when inundated, though it is expected that the salt flats in particular are unlikely to represent preferred foraging habitat because of high salinity levels in the substrate are not suitable for supporting most invertebrate fauna.

The study area was divided into two shorebird areas for assessment against the criteria for important shorebird habitat, the Western shorebird area (included within the BirdLife Australia Exmouth Gulf shorebird area) and the Ashburton River shorebird area (included within the BirdLife Australia Onslow shorebird area). The Western shorebird area met all three criteria for a shorebird area of national significance under EPBC Act Policy Statement 3.2.1 (Commonwealth of Australia 2017).

- The abundance criterion (2,000 or more individual migratory shorebirds) was met during the March phase of the current survey and on a 2018 BirdLife Australia survey.

- The diversity criterion (15 or more migratory shorebird species) was met during the November, December, March and April surveys.
- The individual species criterion (greater than 0.1% of the flyway population of a species) was also met for 10 migratory shorebird species. These were:
 - Grey-tailed Tattler (*Tringa brevipes*) – current survey and 2018 BirdLife Australia counts;
 - Sanderling (*Calidris alba*) – current survey and 2018 BirdLife Australia counts;
 - Red-necked Stint (*Calidris ruficollis*) – current survey and 2018 BirdLife Australia counts;
 - Ruddy Turnstone (*Arenaria interpres*) – current survey;
 - Curlew Sandpiper (*Calidris ferruginea*) – current survey;
 - Broad-billed Sandpiper (*Limicola falcinellus*) – current survey;
 - Lesser Sand Plover (*Charadrius mongolus*) – 2018 BirdLife Australia counts;
 - Greater Sand Plover (*Charadrius leschenaultii*) – 2018 BirdLife Australia counts;
 - Eastern Curlew (*Numenius madagascariensis*) – 2018 BirdLife Australia counts; and
 - Common Greenshank (*Tringa nebularia*) – 2018 BirdLife Australia counts.

Neither of the two shorebird areas within the study area met the criteria for internationally important migratory shorebird habitat. However, the Western shorebird area is included within the broader Exmouth Gulf shorebird area, which has been identified as an area of international importance for migratory shorebirds as it regularly supports more than 1% of the flyway population of Eastern Curlew, Grey-tailed Tattler and Ruddy Turnstone (Weller et al. 2020)

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Appendix 1

Shorebird Counts by Count Area



Shorebird counts for Urala Creek (North and Overflow) count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Burhinidae						
<i>Esacus magnirostris</i>	Beach Stone-curlew	1	-	-	-	-
Haematopodidae						
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	1	-	-	1	2
Recurvirostridae						
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	3	-	-
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	3	-	-
Charadriidae						
<i>Pluvialis fulva</i>	Pacific Golden Plover*	1	-	-	-	-
<i>Pluvialis squatarola</i>	Grey Plover*	1	6	10	6	-
<i>Charadrius ruficapillus</i>	Red-capped Plover	116	351	205	590	30
<i>Charadrius mongolus</i>	Lesser Sand Plover*	1	3	12	39	-
<i>Charadrius leschenaultii</i>	Greater Sand Plover*	24	44	88	10	-
Scolopacidae						
<i>Limosa lapponica</i>	Bar-tailed Godwit*	15	45	69	57	1
<i>Numenius phaeopus</i>	Whimbrel*	-	2	4	7	5
<i>Numenius madagascariensis</i>	Eastern Curlew*	4	1	4	3	4
<i>Xenus cinereus</i>	Terek Sandpiper*	-	2	21	-	-
<i>Actitis hypoleucos</i>	Common Sandpiper*	7	1	1	-	-
<i>Tringa brevipes</i>	Grey-tailed Tattler*	2	5	180	10	20
<i>Tringa nebularia</i>	Common Greenshank*	11	27	93	7	-
<i>Arenaria interpres</i>	Ruddy Turnstone*	-	-	-	16	-
<i>Calidris tenuirostris</i>	Great Knot*	34	37	89	5	25
<i>Calidris canutus</i>	Red Knot*	12	50	89	29	25
<i>Calidris ruficollis</i>	Red-necked Stint*	41	577	481	129	1
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper*	-	4	1	-	-
<i>Calidris ferruginea</i>	Curlew Sandpiper*	12	45	354	11	7
<i>Limicola falcinellus</i>	Broad-billed Sandpiper*	4	175	129	19	-
-	unidentified shorebird sp.	450	-	100	-	-
TOTAL		737	1,375	1,936	939	120
Migratory		169	1,024	1,625	348	88
No. species		17	17	19	16	10
No. migratory species		14	16	16	14	8

* denotes Migratory-listed species

Shorebird counts for Inland Creeks and Flats count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Recurvirostridae						
<i>Himantopus leucocephalus</i>	Pied Stilt	2	n/d	-	n/d	n/d
Scolopacidae						
<i>Numenius phaeopus</i>	Whimbrel*	5	n/d	17	n/d	n/d
<i>Numenius madagascariensis</i>	Eastern Curlew*	4	n/d	8	n/d	n/d
<i>Tringa nebularia</i>	Common Greenshank*	7	n/d	-	n/d	n/d
-	unidentified shorebird sp.	15	n/d	40	n/d	n/d
	TOTAL	33	n/d	65	n/d	n/d
	Migratory	16	n/d	25	n/d	n/d
	No. species	4	n/d	2	n/d	n/d
	No. migratory species	3	n/d	2	n/d	n/d

* denotes Migratory-listed species

n/d denotes no data

Shorebird counts for Urala Creek (South) count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Haematopodidae						
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	6	2	-	n/d	n/d
Recurvirostridae						
<i>Himantopus leucocephalus</i>	Pied Stilt	-	2	5	n/d	n/d
Charadriidae						
<i>Charadrius ruficapillus</i>	Red-capped Plover	9	47	20	n/d	n/d
<i>Charadrius mongolus</i>	Lesser Sand Plover*	1	-	1	n/d	n/d
<i>Charadrius leschenaultii</i>	Greater Sand Plover*	5	12	19	n/d	n/d
Scolopacidae						
<i>Limosa lapponica</i>	Bar-tailed Godwit*	2	12	23	n/d	n/d
<i>Numenius phaeopus</i>	Whimbrel*	5	4	-	n/d	n/d
<i>Numenius madagascariensis</i>	Eastern Curlew*	2	-	1	n/d	n/d
<i>Xenus cinereus</i>	Terek Sandpiper*	-	3	5	n/d	n/d
<i>Actitis hypoleucos</i>	Common Sandpiper*	3	-	-	n/d	n/d
<i>Tringa brevipes</i>	Grey-tailed Tattler*	1	-	12	n/d	n/d
<i>Tringa nebularia</i>	Common Greenshank*	2	-	-	n/d	n/d
<i>Arenaria interpres</i>	Ruddy Turnstone*	2	-	1	n/d	n/d
<i>Calidris tenuirostris</i>	Great Knot*	3	5	15	n/d	n/d
<i>Calidris alba</i>	Sanderling*	1	-	-	n/d	n/d
<i>Calidris ruficollis</i>	Red-necked Stint*	14	14	32	n/d	n/d
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper*	1	-	-	n/d	n/d
<i>Calidris ferruginea</i>	Curlew Sandpiper*	-	-	1	n/d	n/d
	TOTAL	57	101	135	n/d	n/d
	Migratory	42	50	110	n/d	n/d
	No. species	15	9	12	n/d	n/d
	No. migratory species	13	6	10	n/d	n/d

* denotes Migratory-listed species

n/d denotes no data

Shorebird counts for Northern Coast count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Haematopodidae						
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	-	-	-	2	2
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	-	-	-	1
Charadriidae						
<i>Charadrius ruficapillus</i>	Red-capped Plover	-	-	-	-	1
<i>Vanellus tricolor</i>	Banded Lapwing	-	-	22	-	-
Scolopacidae						
<i>Numenius phaeopus</i>	Whimbrel*	-	-	-	1	-
<i>Tringa brevipes</i>	Grey-tailed Tattler*	-	1	-	1	-
<i>Arenaria interpres</i>	Ruddy Turnstone*	-	-	-	-	1
<i>Calidris alba</i>	Sanderling*	-	8	-	-	33
<i>Calidris ruficollis</i>	Red-necked Stint*	-	-	-	-	7
-	unidentified shorebird sp.	6	-	15	3	-
	TOTAL	6	9	37	7	45
	Migratory	-	9	-	2	41
	No. species	n/a	2	1	3	6
	No. migratory species	n/a	2	-	2	3

* denotes Migratory-listed species

Shorebird counts for Tubridigi Coast count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Burhinidae						
<i>Esacus magnirostris</i>	Beach Stone-curlew	1	-	-	-	-
Haematopodidae						
<i>Haematopus longirostris</i>	Australian Pied Oystercatcher	7	5	6	4	6
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher	-	-	-	3	2
Charadriidae						
<i>Pluvialis fulva</i>	Pacific Golden Plover*	3	2	1	-	-
<i>Pluvialis squatarola</i>	Grey Plover*	12	17	14	14	-
<i>Charadrius ruficapillus</i>	Red-capped Plover	49	61	94	72	-
<i>Charadrius mongolus</i>	Lesser Sand Plover*	7	45	73	61	-
<i>Charadrius leschenaultii</i>	Greater Sand Plover*	61	68	82	1	-
Scolopacidae						
<i>Limosa lapponica</i>	Bar-tailed Godwit*	44	42	45	44	3
<i>Numenius phaeopus</i>	Whimbrel*	-	1	2		1
<i>Tringa brevipes</i>	Grey-tailed Tattler*	51	53	36	2	-
<i>Tringa nebularia</i>	Common Greenshank*	1	-	-	-	-
<i>Arenaria interpres</i>	Ruddy Turnstone*	72	43	82	79	2
<i>Calidris tenuirostris</i>	Great Knot*	5	3	22	-	5
<i>Calidris alba</i>	Sanderling*	43	35	51	27	2
<i>Calidris ruficollis</i>	Red-necked Stint*	34	89	77	1	-
-	unidentified shorebird sp.	8	-	-	-	-
	TOTAL	491	464	585	308	21
	Migratory	334	398	485	229	13
	No. species	14	13	13	11	7
	No. migratory species	11	11	11	8	5

* denotes Migratory-listed species

Shorebird counts for Wongalwarra Pool count area.

Species	Common name	Count				
		Nov	Dec	Mar	Apr	May
Recurvirostridae						
<i>Himantopus leucocephalus</i>	Pied Stilt	-	-	6	-	-
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	-	-	1	-	-
Charadriidae						
<i>Charadrius ruficapillus</i>	Red-capped Plover	71	43	58	2	7
<i>Charadrius leschenaultii</i>	Greater Sand Plover*	1	-	1	-	-
<i>Euseyonis melanops</i>	Black-fronted Dotterel	-	-	-	-	4
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	-	1	7	-	-
Scolopacidae						
<i>Limosa lapponica</i>	Bar-tailed Godwit*	-	-	2	-	-
<i>Numenius phaeopus</i>	Whimbrel*	1	1	1	1	-
<i>Numenius madagascariensis</i>	Eastern Curlew*	1	1	2	-	-
<i>Actitis hypoleucos</i>	Common Sandpiper*	1	1	3	-	-
<i>Tringa brevipes</i>	Grey-tailed Tattler*	-	-	1	1	-
<i>Tringa nebularia</i>	Common Greenshank*	3	3	4	5	6
<i>Calidris ruficollis</i>	Red-necked Stint*	6	1	45	-	-
<i>Calidris ferruginea</i>	Curlew Sandpiper*	-	-	6	-	-
	TOTAL	87	51	137	9	17
	Migratory	13	7	65	7	6
	No. species	8	7	13	4	3
	No. migratory species	6	5	9	3	1

* denotes Migratory-listed species

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Appendix 2

Raw Count Data – Study Area



Raw count data for Urala Creek(North and Overflow) and Urala Creek (South) count areas

Location	Urala Creek (North Overflow)					Urala Creek (North)								Urala Creek (South)			
Date	10/11/18	11/11/18	8/04/19	10/04/19	24/05/19	10/11/18	11/11/18	9/12/18	7/03/19	8/03/19	10/04/19	24/05/19	26/05/19	8/11/18	10/11/18	9/12/18	8/03/19
Start time	6:50	9:43	14:37	11:35	13:55	7:17	8:00	6:08	6:31	6:35	8:05	7:15	9:35	13:42	9:38	9:00	9:00
Finish time	7:03	10:37	14:56	14:17	14:45	7:55	9:19	8:32	8:53	8:37	8:50	8:55	9:35	14:44	10:17	9:32	9:23
Survey type	Aerial	Transect	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Incidental	Stationary	Stationary	Stationary	Stationary
SPECIES																	
Burhinidae																	
Beach Stone-curlew						1											
Haematopodidae																	
Australian Pied Oystercatcher					2		1				1			2	6	2	
Sooty Oystercatcher																	
Recurvirostridae																	
Pied Stilt									3	3						2	5
Banded Stilt									3	2							
Charadriidae																	
Pacific Golden-Plover						1											
Grey Plover				5		1		6	10	6	1						
Red-capped Plover		16	40	580	29	8	100	351	130	205	10	1		5	9	47	20
Greater Sand-Plover		4	2	3		7	20	44	74	88	7			5	5	12	19
Lesser Sand-Plover		1	2	38				3	12	11	1				1		1
unidentified sand-plover sp.																	
Oriental Plover																	
Black-fronted Dotterel																	
Red-kneed Dotterel																	
Banded Lapwing																	
Scolopacidae																	
Bar-tailed Godwit				49		14	15	45	51	69	8	1		1	2	12	23
Whimbrel				4				2	4	2	3	5			5	4	
Eastern Curlew	1			2		3	2	1	1	4	1		4		2		1
Terek Sandpiper								2	21	14						3	5
Common Sandpiper						7		1		1				1	3		
Grey-tailed Tattler			1	5			2	5	168	180	5	20		1	1		12
Common Greenshank	2			4			9	27	93	63	3				2		
Marsh Sandpiper																	
Wood Sandpiper																	
Ruddy Turnstone			9	14							2			2			1
Great Knot				5	1	34	23	37	60	89		24		3		5	15
Red Knot			1	29		8	12	50	56	89		25					
Sanderling														1			
Red-necked Stint		11	50	124	1	30	25	577	396	481	5			14	1	14	32
Long-toed Stint																	
Sharp-tailed Sandpiper								4		1				1			
Curlew Sandpiper			11	7	7	12	9	45	354	255							1
Pectoral Sandpiper																	
Broad-billed Sandpiper		1	1	19		3		175	129	86							

Location	Urala Creek (North Overflow)					Urala Creek (North)							Urala Creek (South)				
	10/11/18	11/11/18	8/04/19	10/04/19	24/05/19	10/11/18	11/11/18	9/12/18	7/03/19	8/03/19	10/04/19	24/05/19	26/05/19	8/11/18	10/11/18	9/12/18	8/03/19
Date	6:50	9:43	14:37	11:35	13:55	7:17	8:00	6:08	6:31	6:35	8:05	7:15	9:35	13:42	9:38	9:00	9:00
Start time	7:03	10:37	14:56	14:17	14:45	7:55	9:19	8:32	8:53	8:37	8:50	8:55	9:35	14:44	10:17	9:32	9:23
Finish time	Aerial	Transect	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Incidental	Stationary	Stationary	Stationary	Stationary
Survey type	SPECIES																
shorebird sp.							450		50	100							
small shorebird sp.																	
TOTAL SHOREBIRDS	3	33	117	888	40	129	668	1375	1615	1749	47	76	4	36	37	101	135
Laridae																	
Silver Gull		1		2			1	8	5		3	3		1	1	2	3
Bridled Tern																	
Little Tern				2		2		5	10	7					2		
Little/Fairy Tern																	
Gull-billed Tern (Australian)				26	6	3		2	1		14	3		1	2	1	
Gull-billed Tern (Gull-billed)	1			7					2	1	3			1		2	
Gull-billed Tern			2									11					
Caspian Tern								2	3	1	3	6		1		1	2
Whiskered Tern			1	9			2	25	13	18	1	41					3
White-winged Black Tern				7													
Roseate Tern																	
Common Tern				3													
Lesser Crested Tern											10						
Crested Tern											5						
Crested/Lesser Crested Tern																	
tern sp.																	
TOTAL GULLS AND TERNS	1	1	3	56	6	5	3	42	34	27	39	64	0	4	5	6	8

Raw count data for Tubridgi Coast, Northern Coast count areas, and additional opportunistic surveys

Location	Tubridgi Coast (North)				Tubridgi Coast (West)				Tubridgi Point		Tubridgi Coast (Combined)		Northern Coast					Upper Urula Creek		Incidental
Date	9/11/18	9/12/18	8/03/19	9/04/19	9/11/18	8/12/18	6/03/19	9/04/19	11/11/18	8/12/18	8/11/18	26/05/19	9/11/18	7/12/18	6/03/19	8/04/19	24/05/19	9/11/18	8/03/19	8/04/19
Start time	High tide	11:15	11:41	14:07	High tide	11:37	10:14	11:48	6:57	14:25	9:21	9:11	High tide	10:20	14:30	15:05	13:36	High tide	9:30	13:30
Finish time		12:28	13:33	15:20		14:25	13:56	14:05	7:50	15:09	13:36	9:35		10:30	14:45	15:15	13:45		9:45	13:35
Survey type	Aerial	Transect	Transect	Transect	Aerial	Transect	Transect	Transect	Stationary	Stationary	Transect	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Incidental
SPECIES																				
Burhinidae																				
Beach Stone-curlew											1									
Haematopodidae																				
Australian Pied Oystercatcher	1	1	2	2		1	4	2		3	6	6				2	2			
Sooty Oystercatcher								3				2					1			
Recurvirostridae																				
Pied Stilt																		2		
Banded Stilt																				
Charadriidae																				
Pacific Golden-Plover		2	1								3									
Grey Plover		4	3	9		9	11	5	1	4	11									
Red-capped Plover		11	5	9		44	89	63	1	6	48						1			
Greater Sand-Plover		6	4			41	78	1	4	21	57									
Lesser Sand-Plover		2	11	15		29	62	46		14	7									
unidentified sand-plover sp.											1									
Oriental Plover																				
Black-fronted Dotterel																				
Red-kneed Dotterel																				
Banded Lapwing															22					
Scolopacidae																				
Bar-tailed Godwit		4	9	12		34	36	32		4	44	3								
Whimbrel			2							1		1				1		5	17	
Eastern Curlew																		4	8	
Terek Sandpiper																				
Common Sandpiper																				
Grey-tailed Tattler		2				23	36	2		28	51			1		1				
Common Greenshank											1							7		
Marsh Sandpiper																				
Wood Sandpiper																				
Ruddy Turnstone			1	24		35	81	55	1	8	71	2					1			
Great Knot						3	22				5	5								
Red Knot																				
Sanderling		8	5	9		27	46	18	3		40	2		8					33	
Red-necked Stint			1			46	76	1	20	43	14								7	
Long-toed Stint																				
Sharp-tailed Sandpiper																				
Curlew Sandpiper																				
Pectoral Sandpiper																				
Broad-billed Sandpiper																				

Location	Tubridgi Coast (North)				Tubridgi Coast (West)				Tubridgi Point		Tubridgi Coast (Combined)		Northern Coast					Upper Urala Creek		Incidental
Date	9/11/18	9/12/18	8/03/19	9/04/19	9/11/18	8/12/18	6/03/19	9/04/19	11/11/18	8/12/18	8/11/18	26/05/19	9/11/18	7/12/18	6/03/19	8/04/19	24/05/19	9/11/18	8/03/19	8/04/19
Start time	High tide	11:15	11:41	14:07	High tide	11:37	10:14	11:48	6:57	14:25	9:21	9:11	High tide	10:20	14:30	15:05	13:36	High tide	9:30	13:30
Finish time		12:28	13:33	15:20		14:25	13:56	14:05	7:50	15:09	13:36	9:35		10:30	14:45	15:15	13:45		9:45	13:35
Survey type	Aerial	Transect	Transect	Transect	Aerial	Transect	Transect	Transect	Stationary	Stationary	Transect	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Aerial	Incidental
SPECIES																				
shorebird sp.	7				93								6					15		
small shorebird sp.															15	3			40	
TOTAL SHOREBIRDS	8	40	44	80	93	292	541	228	30	132	360	21	6	9	37	7	45	33	65	0
Laridae																				
Silver Gull			2			2	2	1	1	2	20			1		8				
Bridled Tern																				
Little Tern		4	5	22		2	39	10	4	19	8			8						
Little/Fairy Tern				1				1												
Gull-billed Tern (Australian)								1	1	1										
Gull-billed Tern (Gull-billed)						1			1	1										
Gull-billed Tern											7									
Caspian Tern			1	1		2	3	3	2	1	2	5			3		8			
Whiskered Tern																				1
White-winged Black Tern							12													
Roseate Tern																				
Common Tern							1			1										
Lesser Crested Tern								1		10	7	1								
Crested Tern			2				2				2									
Crested/Lesser Crested Tern												20								
tern sp.															40		35			
TOTAL GULLS AND TERNS	0	4	10	24	0	5	59	17	8	34	23	53	0	0	52	0	51	0	0	1

Raw count data for Wongalwarra Pool count area

Location	Wongalwarra Pool (North)									Wongalwarra Pool (South)				
Date	7/11/18	9/11/18	7/12/18	8/12/18	5/03/19	6/03/19	9/04/19	23/05/19	25/05/19	7/11/18	8/12/18	5/03/19	6/03/19	9/04/19
Start time	13:58	8:17	16:02	8:22	16:16	7:36	8:19	17:07	9:16	13:36	8:15	16:03	7:23	8:03
Finish time	14:12	8:27	16:14	8:37	16:39	7:49	8:38	17:18	9:26	13:48	8:20	16:09	7:29	8:15
Survey type	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary
SPECIES														
Burhinidae														
Beach Stone-curlew														
Haematopodidae														
Australian Pied Oystercatcher														
Sooty Oystercatcher														
Recurvirostridae														
Pied Stilt					4	4						2		
Banded Stilt												1		
Charadriidae														
Pacific Golden-Plover														
Grey Plover														
Red-capped Plover	70		42	1	39	56	2		7	1	1	2		
Greater Sand-Plover	1				1	1								
Lesser Sand-Plover														
unidentified sand-plover sp.														
Oriental Plover														
Black-fronted Dotterel								4						
Red-kneed Dotterel	3		1		1	1						6		
Banded Lapwing														
Scolopacidae														
Bar-tailed Godwit					2	1								
Whimbrel	1		1		1	1	1							
Eastern Curlew	1	1	1	1		2								
Terek Sandpiper														
Common Sandpiper			1	1	1					1		2		
Grey-tailed Tattler					1		1							
Common Greenshank		1	2	1	1	3	3	6	5	2	1	1	1	2
Marsh Sandpiper														
Wood Sandpiper														
Ruddy Turnstone														
Great Knot														
Red Knot														
Sanderling														
Red-necked Stint	6		1		45	29								
Long-toed Stint														
Sharp-tailed Sandpiper														
Curlew Sandpiper					6									
Pectoral Sandpiper														
Broad-billed Sandpiper														

Location	Wongalwarra Pool (North)									Wongalwarra Pool (South)				
Date	7/11/18	9/11/18	7/12/18	8/12/18	5/03/19	6/03/19	9/04/19	23/05/19	25/05/19	7/11/18	8/12/18	5/03/19	6/03/19	9/04/19
Start time	13:58	8:17	16:02	8:22	16:16	7:36	8:19	17:07	9:16	13:36	8:15	16:03	7:23	8:03
Finish time	14:12	8:27	16:14	8:37	16:39	7:49	8:38	17:18	9:26	13:48	8:20	16:09	7:29	8:15
Survey type	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary
SPECIES														
shorebird sp.														
small shorebird sp.														
TOTAL SHOREBIRDS	82	2	49	4	102	98	7	10	12	4	2	14	1	2
Laridae														
Silver Gull			1	1	1		3				1			
Bridled Tern														
Little Tern														
Little/Fairy Tern														
Gull-billed Tern (Australian)			2				5							
Gull-billed Tern (Gull-billed)	2									1				
Gull-billed Tern				1										
Caspian Tern														
Whiskered Tern				1	2	4						2		
White-winged Black Tern														
Roseate Tern														
Common Tern														
Lesser Crested Tern														
Crested Tern														
Crested/Lesser Crested Tern														
tern sp.														
TOTAL GULLS AND TERNS	2	0	3	3	3	4	8	0	0	1	1	2	0	0

Appendix 3

Raw Count Data – Regional



Raw count data for regional count areas

Location	Ashburton River at Urala Causeway													Secret Creek	Three Mile Pool	Four Mile Creek	Northern Coast (outside area)
	Date	6/11/18	7/11/18	8/11/18	8/11/18	10/11/18	7/12/18	8/12/18	5/03/19	6/03/19	9/04/19	11/04/19	23/05/19				
Date	6/11/18	7/11/18	8/11/18	8/11/18	10/11/18	7/12/18	8/12/18	5/03/19	6/03/19	9/04/19	11/04/19	23/05/19	25/05/19	9/11/18	9/11/18	25/05/19	7/12/18
Start time	16:42	14:25	7:14	15:26	13:56	16:24	7:30	16:49	8:05	7:37	8:28	17:30	8:06	9:32	7:16	16:23	
Finish time	17:27	14:58	8:02	15:40	14:12	16:36	8:01	17:01	8:11	7:50	8:35	17:42	8:32	9:54	7:21	16:53	
Survey type	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Transect	Aerial
SPECIES																	
Burhinidae																	
Beach Stone-curlew																	
Haematopodidae																	
Australian Pied Oystercatcher																	2
Sooty Oystercatcher																	
Recurvirostridae																	
Pied Stilt	5	4	3	3	5	2		5		4	3						
Banded Stilt																	
Charadriidae																	
Pacific Golden-Plover																	
Grey Plover																	
Red-capped Plover														83			
Greater Sand-Plover																	
Lesser Sand-Plover																	
unidentified sand-plover sp.																	
Oriental Plover																	
Black-fronted Dotterel	10	8	4	10	4	9	4				2						
Red-kneed Dotterel	13	14	12	13	9	10	8	2		1							
Banded Lapwing		10															
Scolopacidae																	
Bar-tailed Godwit																	
Whimbrel																	
Eastern Curlew																	
Terek Sandpiper																	
Common Sandpiper	4	4	3	4	2			1							1		
Grey-tailed Tattler																	
Common Greenshank	3	4	1	4	4		1	3	2	8	1			1			
Marsh Sandpiper	1	1															
Wood Sandpiper	1	1	3	2							1						
Ruddy Turnstone																	
Great Knot																	
Red Knot																	
Sanderling																	
Red-necked Stint	1	1	1	1										12			
Long-toed Stint	3	3	3	3		1											
Sharp-tailed Sandpiper																	

Location	Ashburton River at Urala Causeway														Secret Creek	Three Mile Pool	Four Mile Creek	Northern Coast (outside area)
	Date	6/11/18	7/11/18	8/11/18	8/11/18	10/11/18	7/12/18	8/12/18	5/03/19	6/03/19	9/04/19	11/04/19	23/05/19	25/05/19				
Start time	16:42	14:25	7:14	15:26	13:56	16:24	7:30	16:49	8:05	7:37	8:28	17:30	8:06	9:32	7:16	16:23		
Finish time	17:27	14:58	8:02	15:40	14:12	16:36	8:01	17:01	8:11	7:50	8:35	17:42	8:32	9:54	7:21	16:53		
Survey type	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Stationary	Transect	Aerial	
SPECIES																		
Curlew Sandpiper														1				
Pectoral Sandpiper	1	1	1	1														
Broad-billed Sandpiper																		
shorebird sp.																		50
small shorebird sp.																		
TOTAL SHOREBIRDS	42	51	31	41	24	22	13	11	2	13	7	0	0	97	1	0	52	
Laridae																		
Silver Gull	13	1	1	2	1	1							1	4				
Bridled Tern																		
Little Tern																		
Little/Fairy Tern																		
Gull-billed Tern (Australian)	5	2	1		10	6												
Gull-billed Tern (Gull-billed)			1		2	1												
Gull-billed Tern																	19	
Caspian Tern	1		1	1		1						1	2					
Whiskered Tern	1	3	1	2	5	3	1	14				1	1		1			
White-winged Black Tern								1										
Roseate Tern																		
Common Tern																		
Lesser Crested Tern																		
Crested Tern																		
Crested/Lesser Crested Tern																		
tern sp.																		
TOTAL GULLS AND TERNS	20	6	5	5	18	12	1	15	0	0	0	2	4	4	1	19	0	

Raw count data for regional count areas (continued)

Location	Islet north of Brown Island		Locker Island Conservation Reserve		Brown Island		Fly Island		Observation Island		Incidental (Regional)					
	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/11/18	9/11/18	12/11/18	8/12/18	8/12/18	9/04/19
Date	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/11/18	9/11/18	12/11/18	8/12/18	8/12/18	9/04/19
Start time	13:11	10:52	10:43	12:36	13:15	10:59	12:33	9:36	12:03	10:11	7:51	6:45	6:45	8:06	7:09	9:14
Finish time	13:16	10:54	11:32	13:26	14:09	12:10	13:02	10:00	12:17	10:44	7:51	6:45	6:45	8:06	7:09	9:25
Survey type	Aerial	Aerial	Transect	Transect	Transect	Transect	Transect	Transect	Transect	Transect	Incidental	Incidental	Incidental	Incidental	Incidental	Incidental
SPECIES																
Burhinidae																
Beach Stone-curlew	1															
Haematopodidae																
Australian Pied Oystercatcher					2											
Sooty Oystercatcher	2															
Recurvirostridae																
Pied Stilt																
Banded Stilt																
Charadriidae																
Pacific Golden-Plover																
Grey Plover						1										
Red-capped Plover							1	2								
Greater Sand-Plover			20	6	21	8	1	1	1							
Lesser Sand-Plover			14	3	28	23	1									
unidentified sand-plover sp.						1										
Oriental Plover										1	1	1	21	7		
Black-fronted Dotterel																12
Red-kneed Dotterel																
Banded Lapwing											10					2
Scolopacidae																
Bar-tailed Godwit			2													
Whimbrel			1			1		1								
Eastern Curlew																
Terek Sandpiper																
Common Sandpiper				2	1	1										
Grey-tailed Tattler			39	11	24	12	3									
Common Greenshank																
Marsh Sandpiper																
Wood Sandpiper																
Ruddy Turnstone	12		16	12	26	20	9	3	14	15						
Great Knot						1										
Red Knot																
Sanderling			2	2					2	2						
Red-necked Stint					5	10	8									
Long-toed Stint																
Sharp-tailed Sandpiper																
Curlew Sandpiper																

Location	Islet north of Brown Island		Locker Island Conservation Reserve		Brown Island		Fly Island		Observation Island		Incidental (Regional)					
	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/11/18	9/11/18	12/11/18	8/12/18	8/12/18	9/04/19
Date	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/12/18	7/03/19	7/11/18	9/11/18	12/11/18	8/12/18	8/12/18	9/04/19
Start time	13:11	10:52	10:43	12:36	13:15	10:59	12:33	9:36	12:03	10:11	7:51	6:45	6:45	8:06	7:09	9:14
Finish time	13:16	10:54	11:32	13:26	14:09	12:10	13:02	10:00	12:17	10:44	7:51	6:45	6:45	8:06	7:09	9:25
Survey type	Aerial	Aerial	Transect	Transect	Transect	Transect	Transect	Transect	Transect	Transect	Incidental	Incidental	Incidental	Incidental	Incidental	Incidental
SPECIES																
Pectoral Sandpiper																
Broad-billed Sandpiper					2											
shorebird sp.																
small shorebird sp.																
TOTAL SHOREBIRDS	15	0	94	36	109	78	23	7	17	17	11	1	1	21	7	14
Laridae																
Silver Gull			10	26	1		2	6	2							
Bridled Tern	100	20			21											
Little Tern		3		5		100	250	4	12							
Little/Fairy Tern																
Gull-billed Tern (Australian)				1												
Gull-billed Tern (Gull-billed)																
Gull-billed Tern																
Caspian Tern			1					2								
Whiskered Tern																
White-winged Black Tern																
Roseate Tern	20		33				500		90							
Common Tern	10			7			50		7							
Lesser Crested Tern																
Crested Tern		50	5	70		3		80	3	1						
Crested/Lesser Crested Tern																
tern sp.																
TOTAL GULLS AND TERNS	130	73	49	109	22	103	802	92	114	1	0	0	0	0	0	0

Appendix 4

Tidal Information



Tide predictions for the dates of all five surveys. Data are for Beadon Creek in Onslow, as tidal data for the study area itself was not available.

November 2018				
6 th November	Low 0.77m at 0353	High 2.24m at 1023	Low 0.93m at 1542	High 2.53m at 2230
7 th November	Low 0.57m at 0438	High 2.38m at 1108	Low 0.90 at 1617	High 2.65m at 2311
8 th November	Low 0.43m at 0517	High 2.46m at 1146	Low 0.89m at 1652	High 2.71m at 2346
9 th November	Low 0.35m at 0553	High 2.47m at 1221	Low 0.92m at 1727	
10 th November	High 2.71m at 0019	Low 0.34m at 0628	High 2.44m at 1255	Low 0.97m at 1759
11 th November	High 2.65m at 0049	Low 0.39m at 0701	High 2.36m at 1326	Low 1.03m at 1822
12 th November	High 2.55m at 0115	Low 0.47m at 0733	High 2.27m at 1357	Low 1.10m at 1837
December 2018				
6 th December	Low 0.65m at 0424	High 2.22m at 1051	Low 1.14m at 1543	High 2.59m at 2238
7 th December	Low 0.53m at 0504	High 2.31m at 1130	Low 1.13m at 1620	High 2.63m at 2317
8 th December	Low 0.46m at 0539	High 2.36m at 1206	Low 1.12m at 1656	High 2.63m at 2352
9 th December	Low 0.44m at 0613	High 2.37m at 1240	Low 1.13m at 1729	
10 th December	High 2.60m at 0022	Low 0.46m at 0539	High 2.35m at 1311	Low 1.15m at 1757
March 2019				
5 th March	Low 0.90 at 0508	High 2.33m at 1130	Low 1.30m at 1715	High 2.48m at 2322
6 th March	Low 0.83m at 1158	High 2.46m at 1158	Low 1.19m at 1744	High 2.58m at 2354
7 th March	Low 0.78m at 0602	High 2.56m at 1225	Low 1.08m at 1810	
8 th March	High 2.63m at 0024	Low 0.77m at 0625	High 2.64m at 1250	Low 1.00m at 1834
9 th March	High 2.65m at 0053	Low 0.78m at 0644	High 2.70m at 1315	Low 0.93m at 1901
April 2019				
7 th April	High 2.65m at 0032	Low 0.92m at 0602	High 2.80m at 1245	Low 0.78m at 1842
8 th April	High 2.64m at 0102	Low 0.94m at 0623	High 2.84m at 1310	Low 0.73m at 1913
9 th April	High 2.59m at 0132	Low 0.99m at 0646	High 2.83m at 1336	Low 0.72m at 1945
10 th April	High 2.50m at 0203	Low 1.06m at 0711	High 2.79m at 1401	Low 0.77m at 2020
11 th April	High 2.36m at 0235	Low 1.16m at 0730	High 2.70m at 1427	Low 0.87m at 2059
May 2019				
23 rd May	High 2.41m at 0147	Low 1.20m at 0639	High 2.69m at 1340	Low 0.73m at 2005
24 th May	High 2.31m at 0219	Low 1.28m at 0656	High 2.55m at 1405	Low 0.86m at 2038
25 th May	High 2.20m at 0251	Low 1.36m at 0723	High 2.40m at 1430	Low 1.00m at 2113
26 th May	High 2.09m at 0326	Low 1.47m at 0800	High 2.24m at 1500	Low 1.14m at 2153

Appendix 5

Commonwealth and State Conservation-Significant Species Listings Definitions



Commonwealth EPBC Act 1999

Fauna species of national environmental significance are listed under the Commonwealth *EPBC Act*, and may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', which are consistent with IUCN categories.

Critically Endangered (CR): a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Endangered (EN): a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Vulnerable (VU): a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

Lower Risk (LR): a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (CD).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
2. **Near Threatened (NT).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
3. **Least Concern (LC).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

Migratory species (MI) are also protected under the *EPBC Act* as species of national environmental significance. Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and,
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Marine species are also protected under the *EPBC Act*, and are listed to ensure the long-term conservation of the species. Marine species include all Australian sea snakes, seals, crocodiles, dugongs, marine turtles, seahorses and seabirds that naturally occur in the Commonwealth marine area.

Western Australian Biodiversity Conservation Act 2016

The Wildlife Conservation (Specially Protected Fauna) Notice 2018 has 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 Biodiversity Conservation Act 2016:

Threatened Species

- **Critically Endangered (CR):** Threatened species considered to be "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines.
- **Endangered (EN):** Threatened species considered to be "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines".

- **Vulnerable (VU):** Threatened species considered to be “facing a high risk of extinction in the wild in the medium term future, as determined in accordance with criteria set out in the ministerial guidelines”.

Extinct Species

- **Extinct Species (EX):** Species where “there is no reasonable doubt that the last member of the species has died”
- **Extinct in the wild (EW):** Species that “is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form”

Specially Protected Species

- **Migratory (MI):** Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth.
- Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program
- **Species of special conservation interest (conservation dependent fauna) (CD):** Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
- **Other specially protected fauna (OS):** Fauna otherwise in need of special protection to ensure their conservation

Department of Biodiversity, Conservation and Attractions Priority Listing

In addition, the DBCA maintains a list of Priority species that have not been assigned statutory protection under the *Biodiversity Conservation Act 2016*. Species on this list are considered to be of conservation priority because there is insufficient information to make an assessment of their conservation status or they are considered to be rare but not threatened and are in need of monitoring. Under this list, species are classified according to five Priority categories:

Priority 1: Poorly known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority 2: Poorly known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority 3: Poorly known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy. conservation lands.

Appendix 6

East Asian-Australasian Flyway Population Estimates and Significance Thresholds



Flyway population estimates and 1 % and 0.1 % criteria (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	3,250	325
Black-tailed Godwit	160,000	1,600	160
Broad-billed Sandpiper	30,000	300	30
Common Greenshank	110,000	1,100	110
Common Redshank	75,000-150,000	750	75
Common Sandpiper	190,000	1,900	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	4,250	425
Greater Sand Plover	200,000-300,000	2,000	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	1,800	180
Little Curlew	110,000	1,100	110
Little Ringed Plover	150,000	1,500	150
Long-toed Stint	230,000	2,300	230
Marsh Sandpiper	130,000	1,300	130
Oriental Plover	230,000	2,300	230
Oriental Pratincole	2,880,000	28,800	2,880
Pacific Golden Plover	120,000	1,200	120
Pectoral Sandpiper	1,220,000-1,930,000	12,200	1220
Pin-tailed Snipe	170,000	1,700	170
Red Knot	110,000	1,100	110
Red-necked Phalarope	250,000	2,500	250
Red-necked Stint	475,000	4,750	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	1,300	130