Gladstone Ports Corporation
Report for Migratory Shorebird Monitoring
Port Curtis and the Curtis Coast
Annual Report – 2019

Report Prepared for Gladstone Ports Corporation

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List of Acronyms / Abbreviations

DoAWE	Department of Agriculture, Water and the Environment
DEH	Department of Environment and Heritage
DEWHA	Department of Water, Heritage and the Arts
DoE	Department of Environment
DoEE	Department of Environment and Energy
EAAF	East-Asian Australasian Flyway
EIS	Environmental Impact Statement
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ERMP	Ecosystem Research and Monitoring Program
ERMPAP	Ecosystem Research and Monitoring Program Advisory Panel
GPC	Gladstone Ports Corporation
GPS	Global Positioning System
LNG	Liquefied Natural Gas
MCR	Mundoolin – Colosseum – Rodds management area
WBDDP	Western Basin Dredging and Disposal Project
WBRA	Western Basin Reclamation Area

Executive Summary

- Wildlife Unlimited conducted five surveys of the migratory shorebirds on the Curtis Coast in 2019, in January, February, March, August and October. This was the first year of comprehensive surveys since 2012, one year after the start of the Port Curtis and Port Alma Ecosystem Research and Monitoring Program (ERMP).
- In 2019, counts were conducted at each traditional survey location on the Curtis Coast in each survey month. These locations included (from north to south): the Fitzroy Estuary, North Curtis Island, Port Curtis, the Mainland Shoreline and the Western Basin Reclamation Area, Colosseum Inlet, Mundoolin and Rodds Peninsula.

January

- 198 surveys were conducted in January, with most surveys conducted in good counting conditions.
- 10,301 migratory shorebirds were recorded on the Curtis Coast in January – approximately the same number as that recorded in January 2012 (10,308) but significantly less than the number recorded in January 2011 (13,172). There were 18 species of migratory shorebird recorded during surveys in January.
- Important roost sites in January 2019 included the Yellow Patch Entrance Sandbar (North Curtis Island), which supported over 1,000 birds; between 500 and 999 birds were found at the Curlew Spit Claypan and Cattle Point (Fitzroy Estuary), the west side of the Entrance Sandbar (North Curtis Island) and the south-east end of Curtis Island (Port Curtis).
- The foraging density of migratory shorebirds on the Curtis Coast in January was 1.02 birds/ha, slightly less than that recorded in January 2011 (1.31 birds/ha) but the same density as was recorded in January 2012. The highest density of birds recorded in January 2019 was at North Curtis Island (1.65 birds/ha).

February

- 161 surveys were conducted in February, in variable counting conditions.
- 9,388 migratory shorebirds were recorded on the Curtis Coast in February – the lowest number recorded in this month for the survey to date. There were 19 species of migratory shorebird recorded during surveys in February.
- Important roost sites in February 2019 included the Yellow Patch Entrance Sandbar at North Curtis Island, which again supported over 1,000 birds; between 500 and 999 birds were found at North East Shell Point (Fitzroy Estuary), the Yellow Patch Entrance Sandbar mangrove roost (North Curtis Island), the south end claypan (Port Curtis) and the Mundoolin Rocks east claypan and Central Mangrove Island (Mundoolin – Colosseum – Rodds Peninsula) (MCR).

- The foraging density of migratory shorebirds on the Curtis Coast in February was 0.93 birds/ha, the lowest density recorded in February to date. The highest density of birds recorded in February 2019 was at North Curtis Island (2 birds/ha).

March

- 176 surveys were conducted in March, in variable counting conditions.
- 10,103 migratory shorebirds were recorded on the Curtis Coast in March – the lowest number recorded in this month for the survey to date. There were 19 species of migratory shorebird recorded during surveys in March.
- Important roost sites in March 2019 included the Yellow Patch Entrance Sandbar at North Curtis Island, which again supported over 1,000 birds; between 500 and 999 birds were found at Cattle Point (Fitzroy Estuary), the west side of the Entrance Sandbar (North Curtis Island), the south-east end of Curtis Island (Port Curtis) and the Mundoolin Rocks east claypan and Central Mangrove Island (MCR).
- The foraging density of migratory shorebirds on the Curtis Coast in March was 1 bird/ha, the lowest density recorded in March to date. The highest density of birds recorded in March 2019 was at North Curtis Island (1.65 birds/ha).

August

- 190 surveys were conducted in August, in variable counting conditions.
- 2,407 migratory shorebirds were recorded on the Curtis Coast in August – the lowest number recorded in this month for the survey to date. There were 15 species of migratory shorebird recorded during surveys in August.
- There were no roost sites in August that supported more than 500 birds.
- The foraging density of migratory shorebirds on the Curtis Coast in August was 0.24 birds/ha, the lowest density recorded in August to date. The highest density of birds recorded in August 2019 was in the Fitzroy Estuary (0.52 birds/ha).

October

- 197 surveys were conducted in October, in variable counting conditions.
- 9,029 migratory shorebirds were recorded on the Curtis Coast in October – the lowest number recorded in this month for the survey to date. There were 19 species of migratory shorebird recorded during surveys in October.
- Important roost sites in October 2019 included the Curlew Spit Claypan, in the Fitzroy Estuary, and the South Cheetham Salt Fields, in Cheetham Salt Works – both sites supported more than 1,000 birds. The Yellow Patch Entrance Sandbar and the south spit of Note Creek (North Curtis Island) and the Mundoolin Rocks east claypan (MCR) each supported between 500 and 999 birds.
- The foraging density of migratory shorebirds on the Curtis Coast in October was 0.24 birds/ha, the lowest density recorded in October to date. The highest density of birds recorded in October 2019 was at North Curtis Island (1.3 birds/ha).

- Human disturbance of migratory shorebirds on the Curtis Coast seems to have returned to levels common to much of the populated east coast of Australia following the cessation of large-scale construction activities in Port Curtis.
- The Curtis Coast as a whole supported ***internationally significant*** numbers of migratory shorebirds in 2019, and a large number of individual sites supported *nationally significant* numbers. The shorebird habitat present on the Curtis Coast is of great conservation value, and provides an extremely important refuge to multiple critically endangered, endangered and vulnerable shorebird species.
- As a whole, migratory shorebirds in the East Asian-Australasian Flyway (EAAF) are facing significant threats and challenges to their survival.
- Some species on the Curtis Coast appear to be declining (e.g. Eastern Curlew), while others appear to be increasing in abundance (e.g. Grey Plover). Several species were present in the highest abundance recorded during the project to date in 2019. Further statistical analysis is required before these trends can be properly evaluated.
- The data recorded during this project is of great conservation value, and will hopefully inform effective migratory shorebird conservation on the Curtis Coast in the years to come.

Pied Oystercatcher nest with eggs, near Williams Bay (Alice Ewing, Wildlife Unlimited)

1 Introduction

1.1 The Project

The development and expansion of port facilities in the Western Basin of the Port of Gladstone is required for the ongoing growth and operation of the Gladstone Ports Corporation (GPC) (GPC, 2016). The facilities recently developed or expanded are a key component of the import/export chain for coal and also support emerging industries in the Gladstone region such as liquified natural gas (LNG). Dredging of the Western Basin of Port Curtis was required to provide safe, efficient access to the new port facilities. The aim was to increase the depth and width of existing channels and swing basins in the harbour, as well as construct new channels, swing basins and berth pockets. Stage 1A of the Western Basin Dredging and Disposal Project (WBDDP) required the removal of 22.5 million m^3 of material; 17.6M m^3 was then deposited in a 265ha land reclamation at Fisherman's Landing that is now known as the Western Basin Reclamation Area (WBRA).

1.2 Environmental Approvals

The Queensland Coordinator-General declared the WBDDP to be a 'significant project' for which an Environmental Impact Statement (EIS) was required under the *State Development and Public Works Organisation Act 1971* (Gladstone Ports Corporation, 2016). The EIS was approved with conditions by the Queensland Coordinator-General on 23 July 2010. The project was also determined to be a 'controlled action' by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (now the Department of Agriculture, Water and the Environment: DoAWE) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 18 June 2009 (EPBC 2009/4904). EPBC Act approval was granted on 22 October 2010, subject to conditions.

1.3 Ecosystem Research and Monitoring Program

Conditions 25 to 37 of the EPBC Act approval (GPC, 2016) required GPC to develop and implement the 'Port Curtis and Port Alma Ecosystem Research and Monitoring Program' (ERMP). The aim of the ERMP is to develop a detailed understanding of the marine ecology and environment of Port Curtis and Port Alma. This information can then be used to monitor, manage and/or improve the regional marine environment and to offset potential impacts of the project on listed threatened and migratory species and values of the Great Barrier Reef World Heritage Area and National Heritage Place. The results of the ERMP are to be used to inform adaptive management response to observed impacts or potential impacts. Condition 33 of the EPBC Act approval required a study to be conducted to determine the effect of port development activities on migratory shorebirds. During years one and two of the study (in 2011 and 2012) a comprehensive set of five surveys were to be conducted each year. Following this, single annual summer surveys, conducted between October and March, were required to be completed for six years (2013 to 2018). Section 33 (i) of the condition stated that the comprehensive surveys from years one and two were to be repeated in the last two years of

the study (i.e. in 2019 and 2020). This report details the results of the third comprehensive year of surveys, completed in the ninth year (2019) of the study.

The objectives of the program are:

- population censuses of species present;
- mapping of feeding and roosting sites;
- investigation of habitat utilisation relative to the lunar/tide cycles and season; and
- identification of critical characteristics of important habitat.

Port development activities that should be addressed include, but are not limited to:

- dredge vessel movement;
- pile driving;
- construction dredging;
- bund wall construction during dredging;
- construction of the bund wall; and
- filling of the reclamation area.

Aspects of construction that should be addressed are:

- noise and associated pressure impacts;
- light spill;
- water quality reduction;
- decreased access to intertidal foreshore habitat;
- increased sedimentation; and
- displacement.

The design of the shorebird monitoring program was developed by GHD and described in the reports covering surveys one to four, which took place in January, February, March and August 2011 (GHD, 2011a; 2011b; 2011c; 2011d). The method was reviewed and endorsed by the Ecosystem Research and Monitoring Program Advisory Panel (ERMPAP), which was established to oversee the work. This report details the results of the comprehensive surveys conducted in 2019 following the established methods.

2 Migratory Shorebirds in Australia

2.1 EPBC Act Listing

The Commonwealth Government has listed 37 species of migratory shorebirds under the EPBC Act (DoEE, 2017) (Appendix 1). These species regularly visit Australia, traversing the East Asian-Australasian Flyway (EAAF) from their northern hemisphere breeding grounds in northern Asia and North America to the over-wintering

grounds which encompass the region between India, Australia, New Zealand and the Western Pacific (Bamford et al., 2008). Conservation of migratory species is difficult because their ecology is often poorly understood, and they require resources that are distributed throughout a number of jurisdictions and countries. Migratory shorebirds are of particular concern because populations are declining both worldwide (Hansen et al., 2016) and in Australia (Clemens et al., 2016).

Listing under the EPBC Act signifies that migratory shorebirds are a 'matter of national environmental significance' and any action that may have a 'significant impact' on a 'matter of national environmental significance' requires the approval of the Commonwealth Environment Minister to proceed.

"A 'significant impact' is an impact that is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is affected; and upon the intensity, duration, magnitude and geographic extent of the impacts. You should consider all these factors when determining whether an action is likely to have a significant impact on matters of national environmental significance" (DEWHA, 2009a).

Australia has signed a number of international agreements relating to migratory shorebird conservation, including the Convention on Wetlands of International Importance (Ramsar), the Convention on Conservation of Migratory Species of Wild Animals (Bonn Convention), the Japan-Australia Migratory Bird Agreement, the China-Australia Migratory Bird Agreement and the Republic of Korea Migratory Bird Agreement. The EPBC Act is the key mechanism for meeting Australia's responsibilities under these agreements (DEWHA, 2009b; DoE, 2015). Under the EPBC Act, the Australian Government may prepare wildlife conservation plans for listed species. The first conservation management plan for migratory shorebirds was published in February 2006 and, following review, the second plan was published in August 2015 (DEH, 2006; DoE, 2015). The review of the first plan found that it had "failed to meet its objectives because it had apparently not reduced the rate of decrease of any of the listed species, nor did it have any measurable influence on the known core impacts in East Asia." The review recommended that: 1) the Little Ringed Plover be added to the EPBC Act list of migratory shorebirds bringing the total number to 37; and 2) the plan be updated to include new, focused conservation priorities.

The new plan lists 11 threats to migratory shorebird populations including three for which 'immediate mitigation action is required'. The most serious threat has been identified as coastal development outside Australia, including land reclamation in the Yellow Sea. The threat was expected to occur annually or more frequently and has the potential to cause population extinctions. The second most serious threat was climate variability and change. The threat was expected to occur five-yearly and has the potential to cause population decreases. The third most serious threat was coastal development in Australia. The threat was expected to occur annually or more frequently and had the potential to stall or reduce population recovery (DoE, 2015).

Seven EPBC Act listed migratory shorebird species are included on the threatened species list in Australia. Curlew Sandpiper, Eastern Curlew, Great Knot and the Siberian sub-species of the Bar-tailed Godwit (*menzbieri*) are listed as critically endangered. Red Knot and Greater Sand Plover are listed as endangered; Lesser Sand Plover and the Alaskan sub-species of the Bar-tailed Godwit (*baueri*) are listed as vulnerable. The scientific committee determined that individual recovery plans were not required because the needs of all species were adequately addressed by the migratory shorebird conservation plan (DoE, 2015).

2.2 EPBC Act Listed Shorebird Species

The 37 species of migratory shorebirds listed under the EPBC Act exhibit a variety of life history attributes (Marchant & Higgins, 1993). These attributes influence the likelihood of their presence in Port Curtis and the Curtis Coast. They also influence the likelihood of detection during survey, so it is important to match the survey method to the attributes of the target species (Bamford et al., 2008). Key life history attributes from this perspective include the species range in Australia, preferred habitat, roost selection and behaviour and migration timing.

Of the 37 listed species, six (Swinhoe's Snipe, Pin-tailed Snipe, Asian Dowitcher, Common Redshank, Red-necked Phalarope and Little Ringed Plover) are extremely rare in central Queensland (Marchant & Higgins, 1993; Menkhorst et al., 2017). Another eight (Latham's Snipe, Little Curlew, Wood Sandpiper, Ruff, Pectoral Sandpiper, Long-toed Stint, Oriental Plover and Oriental Pratincole) rarely utilise marine environments (Marchant & Higgins, 1993; Menkhorst et al., 2017) so are unlikely to be present in large numbers in marine ecosystems on the Curtis Coast. The remaining 23 species frequent marine environments, are present on the central Queensland coast (Marchant & Higgins, 1993; Menkhorst et al., 2017) and have been recorded in previous surveys (GHD, 2011a; 2011b; 2011c; 2011d; Sandpiper Ecological Surveys, 2012a; 2012b; 2012c; Wildlife Unlimited, 2012; 2013a; 2013b; 2014; 2015; 2016; 2017; 2018).

Of these 23 species, most will roost in aggregations at high tide (Marchant & Higgins, 1993). Such roosts can be classified into three broad groups: 1) raised high points such as sand banks, mud banks, sand/shell/gravel bars, sand spits, beaches and islets; 2) mangroves and other vegetation; and 3) rocks, ledges, reefs and shipwrecks. Most of the shorebird species on the Curtis Coast use banks, bars, spits and beaches, while some species use trees (e.g. Whimbrel, Terek Sandpiper, Grey-tailed Tattler and Common Sandpiper) and others use rocks (e.g. Ruddy Turnstone, Wandering Tattler and Common Sandpiper). It is therefore important to survey all three types of roosts in order to get an accurate estimate of abundance for all species. A further complication is that some species, notably the Red-necked Stint, are known to move to coastal wetlands during the high tide and continue feeding (Higgins & Davies, 1996; Minton et al., 2012). Notwithstanding this possibility, roost counts in marine ecosystems at high tide appear to the best method for obtaining an accurate count of shorebirds on the Curtis Coast (Bamford et al., 2008; GHD, 2011c). Work in locating such

roosts for this project was completed by GHD and is described in previous reports (GHD, 2011a; 2011b; 2011c; 2011d).

A migratory shorebird site in the EAAF is considered of ***international significance*** if it supports >1 percent of the population estimate for the flyway (DEWHA, 2009a; Hansen et al., 2016). A site is considered of *national significance* if it supports >0.1 percent of the flyway estimate. The Australian Government accepts the recently revised EAAF population estimates of Hansen et al. (2016) (Appendix 1). In this report, we also use the population estimates of Hansen et al. (2016) when discussing the significance of roosts, and also include EAAF population estimates produced by Wetlands International (2019) in species' accounts for comparison.

2.3 Migratory Shorebirds on the Curtis Coast

A thorough investigation of migratory shorebird habitat and patterns of use on the Curtis Coast conducted under the auspices of the ERMPAP has markedly increased understanding of the carrying capacity of the study area and the patterns of use by migratory shorebirds (Choi et al., 2017). The study combined bird counts, prey sampling and radio tracking of birds. The total number of migratory shorebirds that use the Curtis Coast annually was found to be about 20,000. Of these, 44 percent stopover in the area on their journey to foraging grounds further south. For species such as Curlew Sandpiper, Red Knot, Broad-billed Sandpiper, Sharp-tailed Sandpiper and Ruddy Turnstone, which have been consistently recorded in low numbers over summer, the Curtis Coast is more important as a staging area.

Radio tracking indicated that birds have high site fidelity, returning to the same roosts and foraging grounds each year and remaining mostly at those sites throughout the Austral summer. There are three key ramifications associated with this finding. 1) It provides support for a key assumption of the five-day survey method because the likelihood of double counting of birds in different regions of the Curtis Coast on different days is low. 2) The movement patterns suggest that the region be divided into four migratory shorebird management units, viz. the Fitzroy Estuary, North Curtis Island, Port Curtis and MCR. 3) The small amount of movement that does occur within the region means that loss or degradation of habitat affects more animals than may be typically present at a site and this needs to be taken into account when development decisions are made. This issue is even more important when considering the needs of the birds which stopover on migration. A related finding was that the diurnal and nocturnal movement patterns were strikingly different. This means that daytime surveys are not sufficient to understand all the habitat requirements of the birds, but for practical reasons, the current sampling methodology is appropriate.

Choi et al. (2017) found that migratory shorebird food is present on the Curtis Coast at low density by international standards. In addition, the prey has low digestible content and is patchy across the tidal flats and across the tidal cycle. Many of the best foraging areas are only exposed at the lowest tides for a short period of time. Taking these factors into account, it appears that the Curtis Coast is close to carrying capacity; the

number of birds present in the region is close to the maximum number that can be supported by the amount of food available.

The overall conclusion of Choi et al. (2017) was that the migratory shorebird ecosystems on the Curtis Coast were healthy, but vulnerable to further loss of habitat or a reduction in habitat quality. The appropriate scale for shorebird management is smaller than the study area (the Curtis Coast), but point locations are too small. Hence the recommendation of management units at a scale commensurate with the observed movement of birds and defined by breaks in contiguous habitat.

Some other findings from the study are relevant to the annual shorebird counts and this report:

- The study produced estimates of the migration timing for 16 migratory shorebird species. This is important information for understanding the data collected during this project. It can also be used to determine the best timing for surveys.
- The estimated daily mean tidal flat exposure on the Curtis Coast varied from 8,900ha to 12,400ha. This compares with an estimate of 10,067ha produced by GHD (2011c).

3 Methods

3.1 Study Area

The study area is centred on Port Curtis and extends north to Cattle Point in the Fitzroy Estuary and south to Rodds Peninsula as defined in the ERMP (Gladstone Ports Corporation, 2016). Henceforth, we refer to the study area as the 'Curtis Coast'. The Curtis Coast is divided into seven locations following the method of GHD (2011c):

- North Curtis Island,
- Fitzroy Estuary,
- Port Curtis,
- Mundoolin Rocks and Colosseum Inlet,
- Rodds Peninsula,
- Cheetham Salt Works, and
- Mainland foreshore

For the purposes of analysis, the locations have been further classified into four management units following the method of Choi et al. (2017). The management units are defined as follows: Port Curtis incorporating the mainland foreshore (Figure 3.1.1); the Fitzroy Estuary and North Curtis Island (Figure 3.1.2); and MCR (Figure 3.1.3). Data from the Cheetham Salt Works at Bajool (located in the Fitzroy Estuary) has been excluded from analyses using the putative management units because of discontinuity of access to the site. However, important data from the salt works is discussed in Section 4.5.16 below.

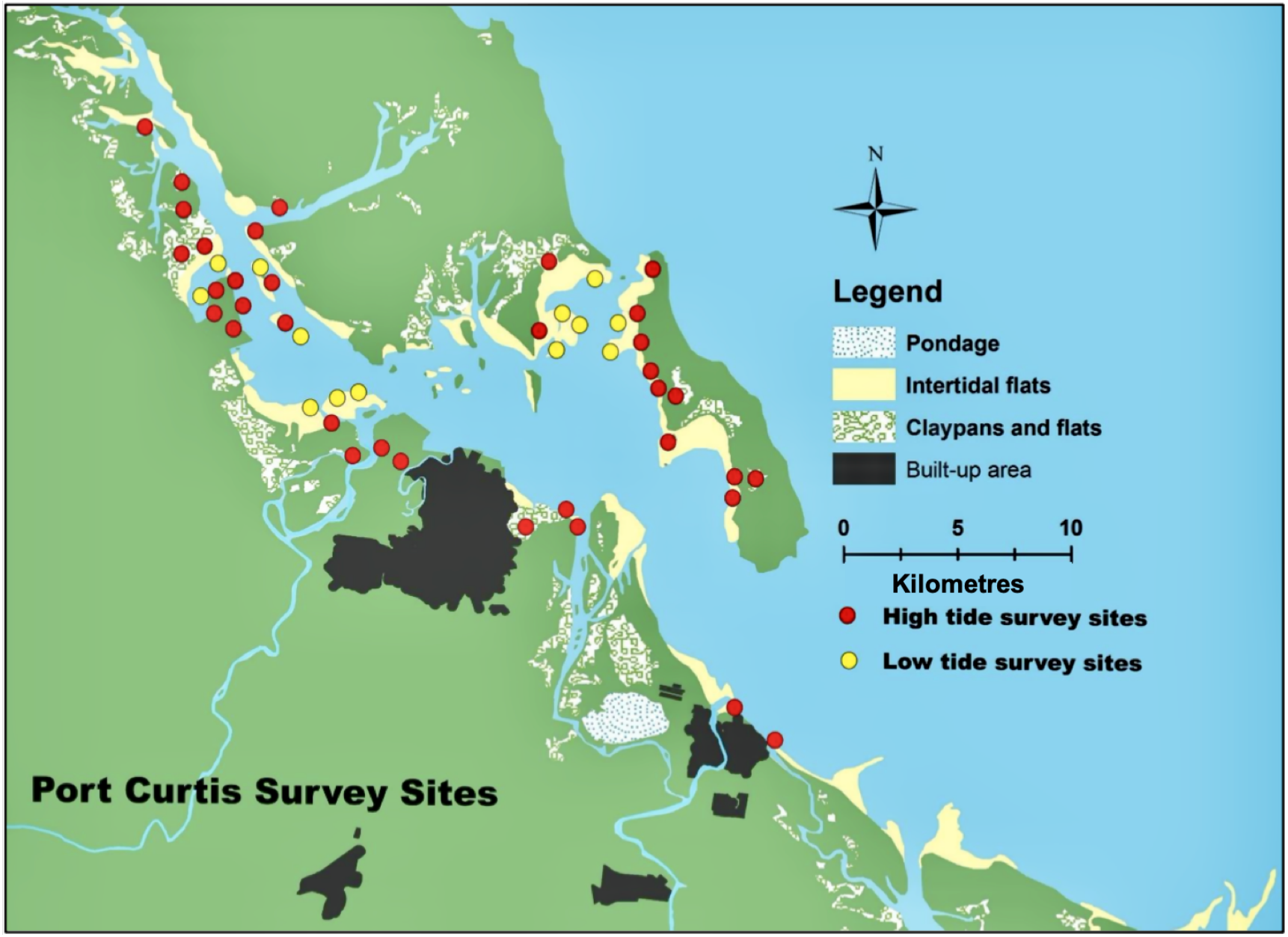

Figure 3.1.1 Migratory shorebird survey sites in the Port Curtis management unit

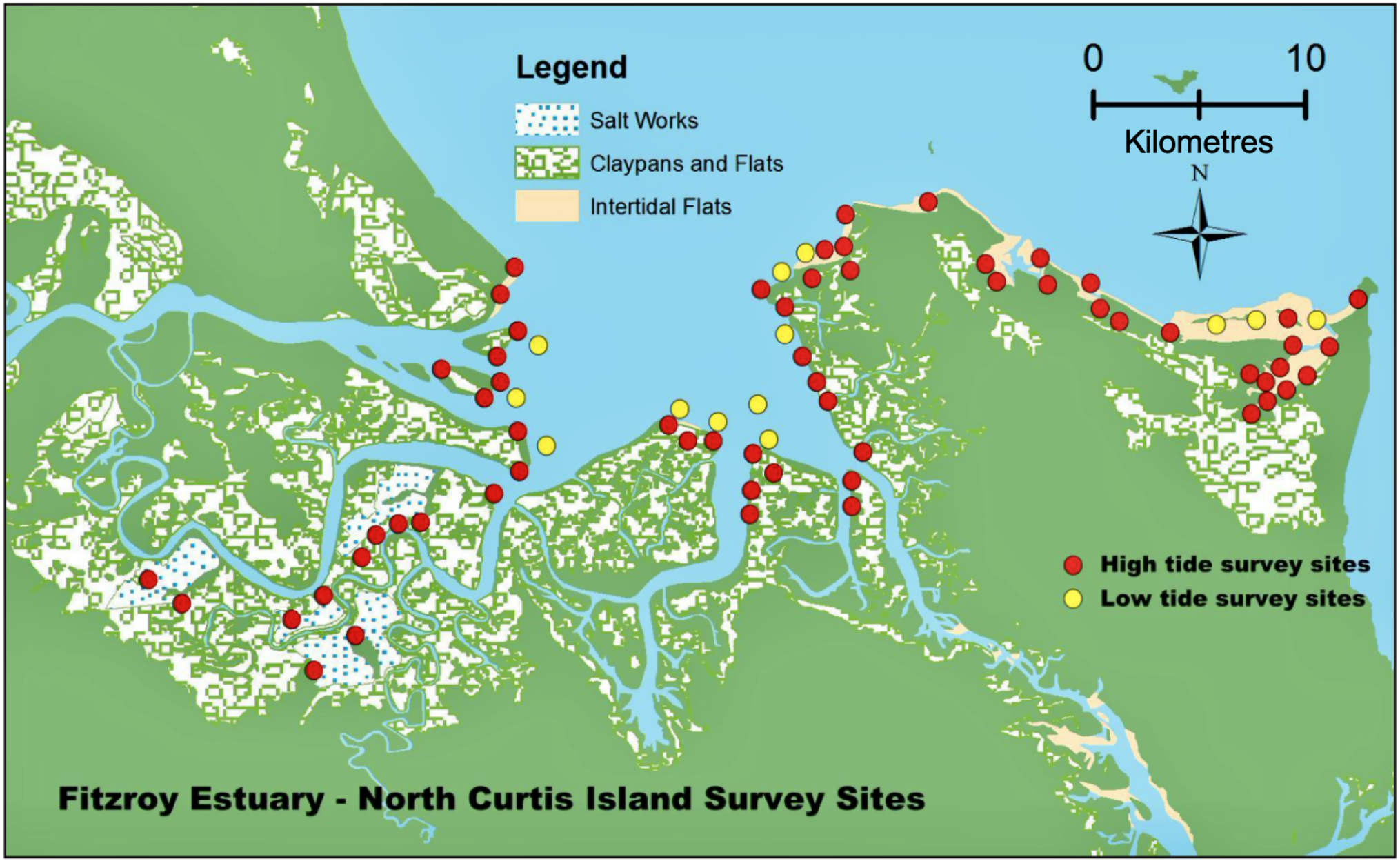

Figure 3.1.2 Migratory shorebird survey sites in the Fitzroy Estuary and North Curtis Island management units

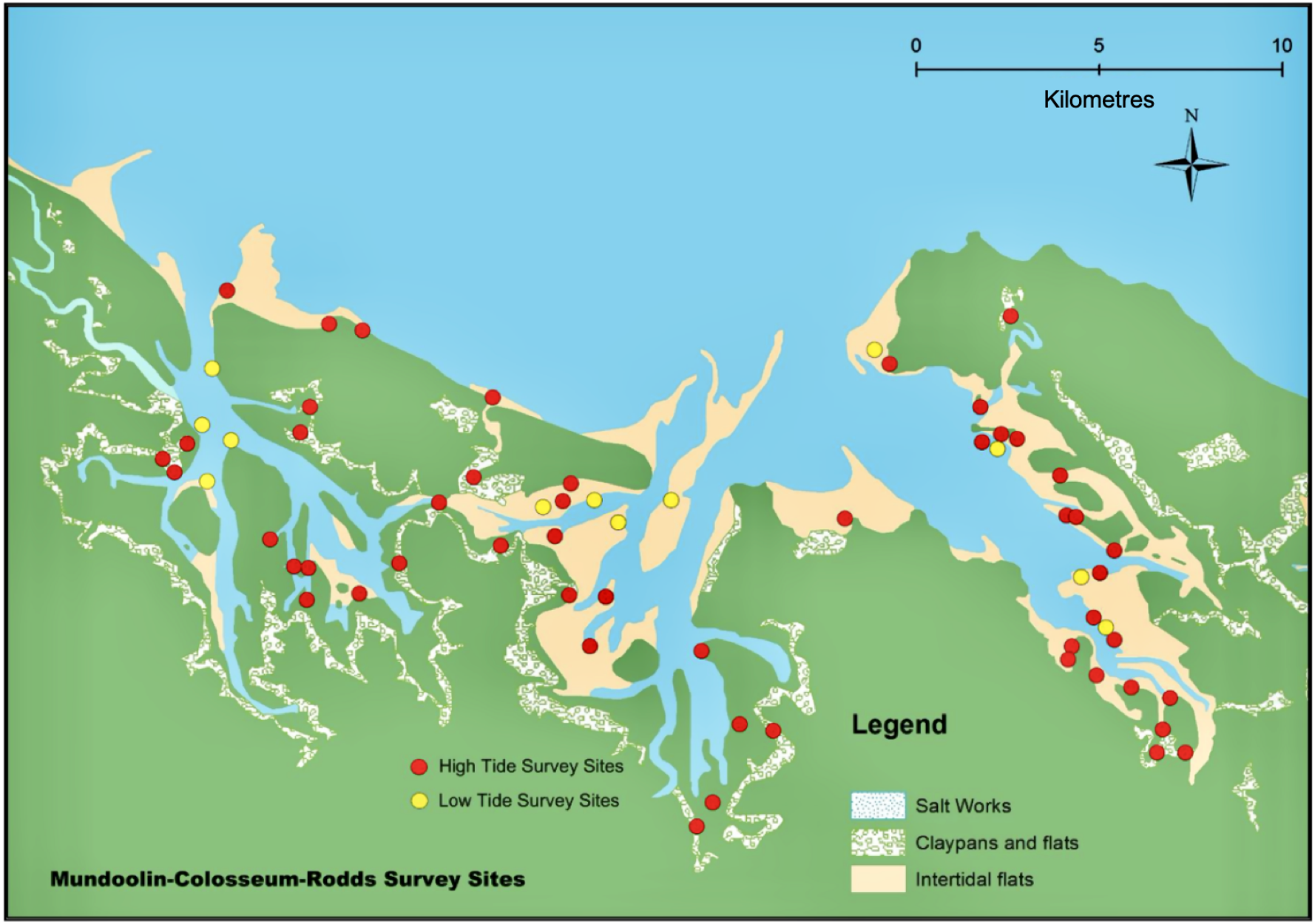

Figure 3.1.3 Migratory shorebird survey sites in the Mundoolin – Colosseum – Rodds Peninsula (MCR) management unit

3.2 Shorebird Survey Guidelines

The DoAWE (formerly DEWHA) has published guidelines detailing the recommended survey coverage, timing, effort and minimum data requirements for conducting migratory shorebird surveys (DEWHA, 2009b). Survey coverage and effort for this project was determined by DoAWE in the approval conditions and ERMP for the project (Gladstone Ports Corporation, 2016). DoAWE has helped fund the *Shorebird 2020* program via the Natural Heritage Trust and there is considerable agreement between the DoAWE survey guidelines and the *Shorebird 2020* procedures (DEWHA, 2009b; http://www.birdlife.org.au/projects/shorebirds-2020). Use of the *Shorebird 2020* procedure is desirable for this study because most shorebird observers in Australia are familiar with it. Consequently, training requirements for observers will be minimised and the pool of skilled and experienced observers will be maximised. Over the life of the study this will increase the comparability of the data and minimise difficulty in finding suitably experienced survey staff.

Timing for the survey was determined using Australian Government guidelines (DEWHA, 2009b), recommendations from previous surveys (GHD, 2011a; 2011b; 2011c; 2011d) and advice from the ERMPAP. Criteria and recommendations for the timing of shorebird surveys are:

- at a suitable time in relation to the seasonal movements of the species known to be present at the study site,
- for surveys of roosting sites, no more than two hours either side of high tide,
- for foraging surveys, no more than two hours either side of low tide,
- high rainfall and strong wind to be avoided, and
- periods when disturbance is occurring to be avoided.

3.3 Survey Timing

Recent work by Choi et al. (2017) determined that summer surveys miss about 44% of the migratory shorebirds present in the study area, as these individuals are in transit during migration, and only stop over briefly to feed before moving on. The aim of the comprehensive surveys is to count the populations of migratory shorebirds that are present on the Curtis Coast throughout the year. To this end, in 2019 we followed the comprehensive survey procedure developed by GHD in 2011, and conducted shorebird surveys in January, February, March, August and October. Migratory shorebirds present on the Curtis Coast can be grouped into three classes relating to the timing of their migration (Table 3.1.1). The classes are: 1) summer resident; 2) summer resident, with some individuals migrating; and 3) non-resident (present mainly during migration stop-over). The timing of the surveys in 2019 was designed to capture population information on birds in each migration class throughout the year; further information on migration timing (based on the work of Marchant and Higgins (1993), Higgins and Davies (1996) and Choi et al. (2017) is available in Table 3.3.2 below.

Table 3.3.1 The migration status of migratory shorebird species on the Curtis Coast

This table was compiled following the data presented in Choi et al. (2017).

Resident during summer (Curtis Coast is final non-breeding destination)	Eastern Curlew, Bar-tailed Godwit, Whimbrel, Great Knot, Greater Sand Plover, Grey Plover and Grey-tailed Tattler
Resident in summer, with stopover individuals present during migration	Lesser Sand Plover, Red-necked Stint, Terek Sandpiper
Non-resident during summer, individuals present during migration	Broad-billed Sandpiper (northward), Curlew Sandpiper (both), Red Knot (southward), Ruddy Turnstone (northward) and Sharp-tailed Sandpiper (both)

Other considerations for the survey timing, in order of importance, are tide heights, weather, and predictable disturbance. Spring tides are essential to concentrate birds at roosts and tide heights of >3.6m but <4.4m are desirable. At lower tides, some of the large, important roosts present difficulties when counting. Some roosts are difficult to reach by boat (e.g. the Yellow Patch entrance sandbar), flocks may be dispersed over large areas (e.g. at Deception Point), and in some cases birds hide in foliage and walk away from surveyors (e.g. at Curlew Spit). At the highest tides (and especially after rain when the rivers run high) some large, important roosts are inundated and cannot be occupied. Some examples include the Yellow Patch entrance sandbar, the northern end of Mackenzie Island and Rundle Beach. Stable weather is desirable because surveys cannot be conducted in strong wind or rain. This is particularly important in summer because of the possibility of prolonged bad weather associated with tropical cyclones. Major causes of predictable anthropogenic disturbance such as public holidays and fishing competitions should also be avoided if possible. In winter, the longer daylight hours of August are more desirable than June and July because a five-day survey program causes time constraints during the low tide surveys on the fifth day.

Black-winged Stilts roosting near the Cheetham Salt Works in March (Alice Ewing, Wildlife Unlimited)

Table 3.3.2 The timing of migration for 23 species of migratory shorebirds on the Curtis Coast. Yellow cells indicate periods when the population is believed to be in flux, red cells indicate periods when the majority of the population is present and a question mark in cells indicates that migration behaviour is uncertain at that time.

Species	Jul			Aug			Sep			Oct			Nov			Dec			Jan			Feb			Mar			Apr			May			Jun		
Black-tailed Godwit																																				
Bar-tailed Godwit																																				
Whimbrel																																				
Eastern Curlew																																				
Marsh Sandpiper																																				
Common Greenshank																																				
Terek Sandpiper																																				
Common Sandpiper							?	?	?																											
Ruddy Turnstone																																				
Grey-tailed Tattler																																				
Wandering Tattler																																				
Great Knot																																				
Red Knot																																				
Sanderling																																				
Red-necked Stint																																				
Sharp-tailed Sandpiper																																				
Curlew Sandpiper																																				
Broad-billed Sandpiper																																				
Pacific Golden Plover																																				
Grey Plover																																				
Lesser Sand Plover																																				
Greater Sand Plover																																				
Double-banded Plover																																				

3.4 Survey Schedule

There were five migratory shorebird surveys conducted by Wildlife Unlimited along the Curtis Coast in 2019. Each survey was timed such that field work was conducted for five consecutive days coinciding with a full moon spring tide (see Table 3.4.1 below for timing of each monthly survey in 2019). In the case of inclement weather, which affected the March and October surveys, the daily schedule of sites visited was adjusted following the advice of the boat operators. Surveys commenced two hours before high tide and were usually completed within four hours; any counts that took place after this period were included in the dataset provided there was no evidence of birds moving between roosts or to the foraging grounds. All sites with a history of supporting large numbers of birds were surveyed within the prescribed four-hour period.

Table 3.4.1 Timing of migratory shorebird surveys conducted in 2019

Survey month	Survey timing
January	Sunday the 6th to Thursday the 10th
February	Tuesday the 5th to Saturday the 9th
March	Thursday the 7th to Monday the 11th
August	Thursday the 1st to Tuesday the 6th
October	Monday the 14th to Friday the 18th

3.5 Count Procedure

Shorebirds were counted following the *Shorebirds 2020* procedure (described below), and recorded on a modified version of the *Shorebirds 2020* datasheet (Table 3.5.1). The procedure largely follows Australian Government guidelines (DEWHA, 2009b) and is commonly used around Australia. Each location was surveyed in a single day by two pairs of observers working simultaneously (GHD, 2011c). This was done to minimise the possibility that birds would move during the survey, confounding the count. The teams consisted of two experienced shorebird observers equipped with binoculars, a spotting scope with a 20x-60x magnifying lens, a map and a GPS containing the coordinates of all the survey sites.

Table 3.5.1 Data collected on each survey

Number of observers and their names	Date
Start and finish time	Shorebird area (Curtis Coast)
Count area	Site number and name
Survey type (land, boat or air)	Tide height (rising, high or falling)
Wind direction and speed	Human Activity
Threats	Species and abundance
Location using GPS (datum WGS84)	Notes

In fulfilment of the conditions of the EPBC Act approval, the shorebird species for which data were collected were the 37 migratory species listed in the Migratory Shorebird Conservation Plan (DoE, 2015). The addition of the Little Ringed Plover to the migratory shorebird list is unlikely to affect the project because it only occurs as a vagrant in Queensland and has never been recorded on the Curtis Coast. In addition, abundances were collected for ten species of non-migratory shorebirds (Appendix 2) that are also part of the *Shorebirds 2020* program.

3.5.1 Roost surveys

Roost surveys were conducted two hours either side of the high tide (see the Results section for each months' tide times during the survey period). The roosts were accessed by boat and the count was preferentially conducted by wading ashore to a suitable location. Where it was not possible to reach the shore, counting was undertaken from the boat. Both observers confirmed species identification. If birds were flushed, care was taken to avoid double counting within the roost or at succeeding roosts. Surveys on the mainland shoreline including the Western Basin Reclamation Area (WBRA) were accessed by vehicle.

3.5.2 Foraging surveys

Foraging surveys were planned to be conducted at low tide at each location on the same day as the roost surveys. Surveys commenced no earlier than two hours before the low tide and finished at low tide. The surveys were conducted in one of two ways depending on the shape of the intertidal area: large intertidal flats were surveyed by wading ashore to reach the survey point and long, linear flats were surveyed from a slow-moving boat.

3.5.3 Western Basin Reclamation Area high tide surveys

Potential shorebird roosting sites on the WBRA were thoroughly investigated at high tide during the mainland shoreline surveys. The survey was conducted in two ways: 1) survey of all sites at the WBRA; and 2) vehicle traverse of the major roads and investigation of all likely roost sites.

3.5.4 Cheetham Salt Works surveys

Cheetham Salt Works at Bajool is in the Fitzroy Estuary management unit within the study area of the ERMP (Gladstone Ports Corporation, 2016). The salt works were surveyed over the first 18 months of the project (GHD, 2011a; 2011b; 2011c; 2011d; Sandpiper Ecological Surveys, 2012a; 2012b). During this period, surveys were conducted at five sites within the salt works and at six sites from the Port Alma Road adjacent to the salt works. At the five internal sites, relatively high counts of a suite of migratory and non-migratory shorebirds that were rare elsewhere on the Curtis Coast were regularly obtained from concentration ponds where the salinity and water height generated suitable foraging conditions (Houston et al., 2012). Records from the six sites along the road were unpredictable and usually of species that were commonly recorded during the rest of the Curtis Coast survey. Permission to survey the internal salt works sites could not be obtained for the

August 2012 survey or subsequent surveys (Wildlife Unlimited, 2012; 2013a; 2013b; 2014; Sandpiper Ecological Surveys, 2012c) until permission was renewed in February 2015 (Wildlife Unlimited, 2015; 2016; 2017). Despite permission to access the salt works being granted, regular access during survey periods remains problematic. Often conducted on the fifth day of the field trip, the distances to be driven, the times that the salt works are open and road conditions within the salt works can all confound a regimented count procedure – particularly when other mainland sites must be surveyed on the same day. In 2019, the salt works were surveyed during each field trip, all surveys except the August and October trips were conducted from the road. A section discussing the results of the salt works surveys made in August and October has been prepared and included in the Results section for each of these months.

3.7 Mapping

Mapping was completed using ArcGIS 10. The base layers were obtained from the Geoscience Australia 1:250,000 series, via MapConnect. GPC supplied data for the WBRA and the built-up areas of Gladstone. The maps were generated using the mainland and islands layers to represent the area above high tide; to this was added the WBRA data supplied by GPC. Minor edits were made to the WBRA area data so that they fit seamlessly with the Geoscience Australia data. The area below high tide was represented by tidal foreshore, sea and waterways layers. The flats layer was included to represent the claypans; the pondage layer represented the Cheetham Salt Works. The built-up area shows the location of Gladstone and Tannum Sands to aid with orientation. A roost site layer was created from GPS coordinates obtained during the project.

3.8 Analysis

This report analyses data from the comprehensive migratory shorebird surveys conducted by Wildlife Unlimited in 2019. An overall summary of the results of the 2019 surveys is presented first, followed by a discussion of the results from each management unit (including comparisons with the historical data collected by GHD during the comprehensive surveys of 2011 and 2012). This report presents some single species comparisons between management units between years to examine long-term trends in the dataset. This approach has been adopted because: 1) it is a requirement of the ERMP; and 2) the overall number of migratory shorebirds – though an important tool for monitoring – may conceal the substitution of species within the study area. For example, a decline in the type and quantity of prey or a change in the physical properties of the substrate (Colwell, 2010) may lead to the abandonment of a foraging area by one species, but the change may facilitate greater use by another species with the result being no overall change in the number of shorebirds at the study site. To ensure continuity of reporting, the results from the February 2019 summer surveys (when the highest numbers of birds are typically recorded) are presented here in a similar way to earlier reports.

Migratory shorebird densities were calculated using the high tide roost data from each survey and the area of intertidal flat as determined by GHD (2011c). The GHD data have been superseded by Choi et al. (2017) who accounted for variation in the tidal range. However, the established method has been retained for this report because the GHD value falls within the range of values calculated by Choi et al. (2017), and by using the established method continuity between reports can be maintained. The established method is a blunt tool which does not take into account the tidal range or the foraging preferences of each species (Colwell, 2010). It does, however, serve two useful functions: it provides a standardised comparison between management units, and helps to contextualise the changes in shorebird community composition in Port Curtis through time.

4 Results

In 2019, Wildlife Unlimited staff undertook five surveys of the migratory shorebird populations of the Curtis Coast (see Table 3.4.1 for survey dates). The following results are presented in chronological order, with the results from each survey compared to historical data (when available) from 2011 and 2012 – the last time during the ERMP project that comprehensive surveys were conducted.

4.1 January

The surveys in January target the migratory shorebirds that are present on the Curtis Coast during the Austral summer. The vast majority of the migratory shorebirds present in the region in January will spend the whole summer foraging, laying down fat stores which will provide them with the massive amount of energy required for their eventual return to their breeding grounds (see Table 3.3.2 for a summary of the migration timing of each species present on the Curtis Coast). The results from the surveys completed in January 2019 are compared below to the results from the surveys conducted in January 2011 and January 2012.

4.1.2 Survey coverage

A total of 162 high tide surveys were completed in January, and the total survey time at high tide was 1,270 minutes (approximately 21 hours). A total of 36 low tide surveys were conducted, and the total survey time at low tide was 472 minutes (approximately 8 hours). The survey effort in January is presented in Table 4.1.1. The weather during the January field trip was variable, but most surveys were conducted in good counting conditions with winds below 20km/h.

4.1.3 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in January 2019 was 10,301 – approximately the same number as that recorded in January 2012 (10,308) but less than the number recorded in January 2011 (13,172) (see Figure 4.1.1). Only individuals identified to species level were included in this total; a further 417 migratory shorebirds could not be identified to species level. A total of 18 migratory shorebird species were identified during the high tide roost counts (the same as

that in January 2011 but less than that in January 2012; see Figure 4.1.2). The ten most abundant species, listed in descending order, were Bar-tailed Godwit, Lesser Sand Plover, Great Knot, Whimbrel, Eastern Curlew, Red-necked Stint, Grey-tailed Tattler, Terek Sandpiper, Greater Sand Plover and Curlew Sandpiper. The foraging density of migratory shorebirds across the Curtis Coast in January 2019 was 1.02 birds/ha; this is slightly less than the foraging density observed in January 2011 (total of 13,172 birds; 1.31 birds/ha) but the same as that observed in January 2012 (total of 10,308 birds; 1.02 birds/ha).

Table 4.1.1 Summary of survey effort in January 2019: number of sites and elapsed survey time at each location

Location	**High Tide**		**Low Tide**	
	Sites	**Duration (mins)**	**Sites**	**Duration (mins)**
Port Curtis	49	403*	17	129*
Fitzroy Estuary	23	297*	5	152
North Curtis Island	38	257*	3	18*
Mundoolin-Colosseum	27	204	9	107
Rodds Peninsula	19	90	2	66
Cheetham Salt Works	6	19	0	0
Total	**162**	**1,270***	**36**	**472***

**Some sites (8) did not have complete data on count duration; the total is therefore an underestimate of total survey time.*

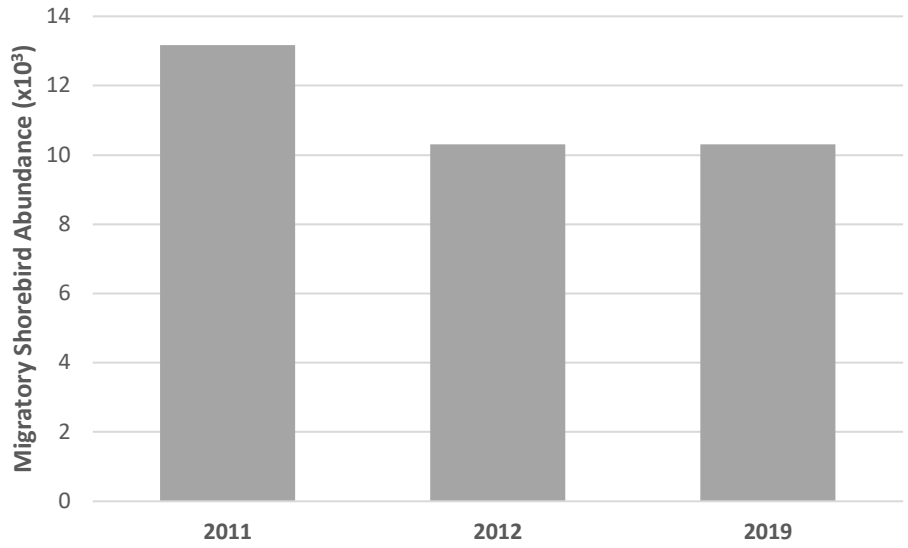

Figure 4.1.1 Abundance of migratory shorebirds on the Curtis Coast in January 2011, 2012 and 2019. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

The foraging density within the Fitzroy Estuary management unit was 1.15 birds/ha in 2019, compared to 0.51 birds/ha in 2011 and 1.72 birds/ha in 2012. The foraging density within the North Curtis Island management unit was 1.65 birds/ha in 2019, compared to 3.7 birds/ha in 2011 and 1.42 birds/ha in 2012. The foraging density within the MCR management unit was 0.76 birds/ha in 2019, compared to 0.72 birds/ha in 2011 and 0.86 birds/ha in 2012. The foraging density within the Port Curtis management unit was 0.75 birds/ha in 2019, compared to 0.97 birds/ha in 2011 and 0.69 birds/ha in 2012. It should be noted that the foraging densities were calculated using GHD's foraging habitat area calculation from 2011 (prior to the commencement of the WBDDP). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

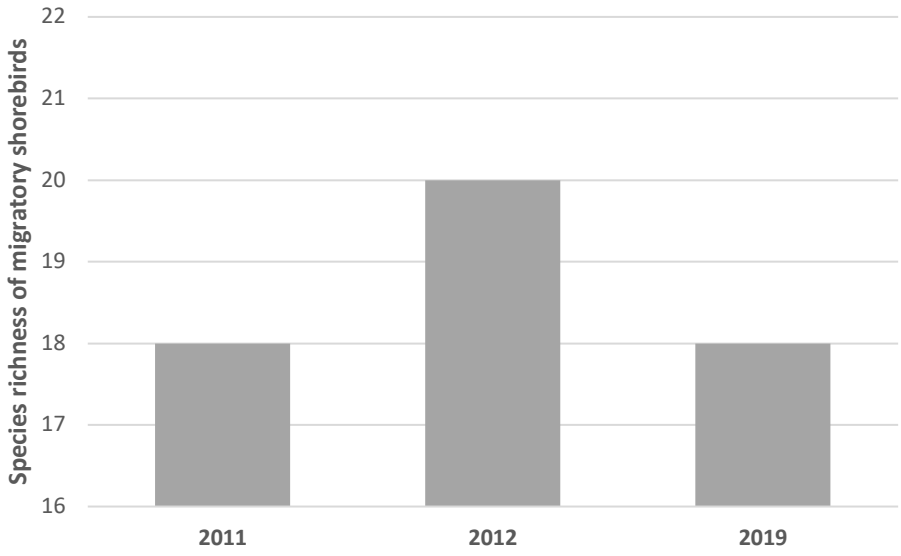

Figure 4.1.2 Species richness of migratory shorebirds on the Curtis Coast in January 2011, 2012 and 2019. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

In January 2019, most shorebirds were found in the north of the study area (i.e. the Fitzroy Estuary and North Curtis management units) (Table 4.1.2, Figure 4.1.3). There was one roost with >1000 birds: the Yellow Patch Entrance Sandbar, in North Curtis (1,937 birds). There were a further four roosts with between 500 and 1000 birds: the Curlew Spit claypan (566 birds) and Cattle Point (549 birds) in the Fitzroy Estuary, the west side of the Entrance Sandbar in North Curtis Island (631 birds), and the south-east end of Curtis Island, in Port Curtis (963 birds). There were 16 roosts with between 100 and 500 birds: six in the Fitzroy Estuary, two in North Curtis, three in Port Curtis, and five in MCR. The Cheetham Salt Works were only able to be surveyed from the road, and 13 Red-necked Stints were recorded in the roadside claypans.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in January 2019. The species accounts are given in descending order of abundance and are

followed by a discussion of the non-migratory shorebirds present during the survey. Note that the shorebird population estimations utilised in the last report (Wildlife Unlimited, 2018) have been replaced in the current report by the recent work of Hansen et al. (2016) and in some cases are significantly different. Where Hansen et al. (2016) give population estimates in the form of a range (e.g. the 180,000 to 275,000 given for Lesser Sand Plover), the lower values are adopted for calculating the significance of counts made during surveys.

Table 4.1.2 Place names of the roosts with the greatest abundance of migratory shorebirds in January 2019

Management Unit	**Abundance**	**Roost**
Fitzroy Estuary	>1000	Nil
	500-999	1. Curlew Spit claypan 2. Cattle Point
	100-499	1. West side of Deception Pt. Claypan 2. Rundle Beach 3. East Shore Connor Creek 4. Northern Side - Mackenzie Island 5. Mud Island claypan 6. North East Shell Point
North Curtis	>1000	1. Yellow Patch entrance sandbar
	500-999	1. Entrance Sandbar west side
	100-499	1. Keppell Creek Entrance 2. Creek Number 3
Port Curtis	>1000	Nil
	500-999	1. South-east end of Curtis Island
	100-499	1. Calliope 2 2. Facing Island Sandbar 3. Facing Island Claypan
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-999	Nil
	100-499	1. Colosseum Inlet Lagoon 2. Mundoolin Rocks east claypan 3. Williams Bay, Mangrove Bay 4. Central Mangrove Island 5. Spit End 6. Turkey Beach Mangrove Island

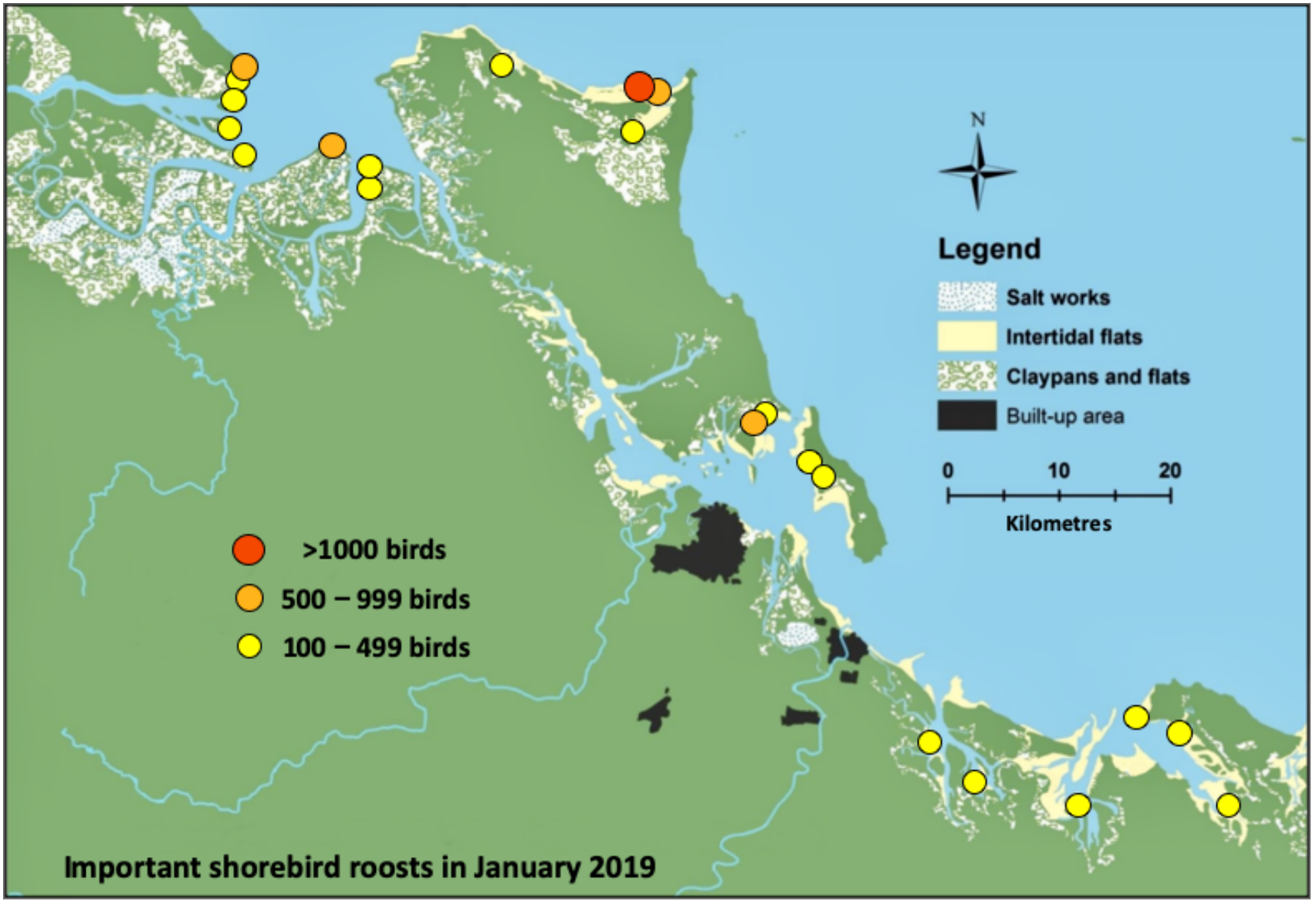

Figure 4.2.3 Important shorebird roosts on the Curtis Coast in January 2019

4.1.4 Bar-tailed Godwit (*Limosa lapponica*)

EAAF population estimate (Hansen, 2016): 325,000

1% population estimate for internationally significant sites: 3,250

0.1% population estimate for nationally significant sites: 325

EAAF population estimate (Wetlands International, 2019): 279,000

The Bar-tailed Godwit was the most abundant migratory shorebird on the Curtis Coast in January 2019, with 2,147 birds recorded at high tide roosts during the survey. This was 1,248 fewer birds than the number counted in January 2011 (3395) but 37 more birds than were counted in January 2012 (2,110). Bar-tailed Godwits were present at 25 sites, two of which were of *national significance*: the Yellow Patch Entrance Sandbar in the North Curtis management unit supported 382 birds, and the south-east end of Curtis Island in the Port Curtis management unit supported 580 birds. The foraging density was highest in these two management units. Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia. The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016).

Table 4.1.3 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Port Curtis	7	773	0.32
North Curtis	5	633	0.32
MCR	4	461	0.14
Fitzroy Estuary	9	280	0.19
Totals	***25***	***2,147***	***0.21***

4.1.5 Lesser Sand Plover (*Charadrius mongolus*)

EAAF population estimate (Hansen, 2016): 180,000 – 275,000

1% population estimate for internationally significant sites: 1,800

0.1% population estimate for nationally significant sites: 180

EAAF population estimate (Wetlands International, 2019): 140,000

The Lesser Sand Plover was the second most abundant migratory shorebird on the Curtis Coast in January 2019, with 2,141 birds recorded at high tide roosts during the survey. This was 1,144 more birds than the number counted in January 2011 (997) and 1,355 more birds than were counted in January 2012 (786). Lesser Sand Plovers were present at 18 sites, four of which were of *national significance*: the Yellow Patch Entrance Sandbar and the west side of the Entrance Sandbar in the North Curtis management unit (486 and 330 birds, respectively), and Cattle Point and the northern side of Mackenzie Island in the Fitzroy Estuary (461 and 211 birds, respectively). The foraging density was highest in these two management units. The population of Lesser Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019) and in Australia, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.1.4 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	7	946	0.40
North Curtis	4	909	0.46
MCR	5	211	0.06
Port Curtis	2	75	0.03
Totals	***18***	***2,141***	***0.21***

4.1.6 Great Knot (*Calidris tenuirostris*)

EAAF population estimate (Hansen, 2016): 425,000

1% population estimate for internationally significant sites: 4,250

0.1% population estimate for nationally significant sites: 425

EAAF population estimate (Wetlands International, 2019): 290,000

The Great Knot was the third most abundant migratory shorebird on the Curtis Coast in January 2019, with 933 birds recorded at high tide roosts during the survey. This was 147 more birds than the number counted in January 2011 (786) and 14 more birds than were counted in January 2012 (919). Great Knots were present at 13 sites. The foraging density was highest in the North Curtis and Fitzroy Estuary management units. The population of Great Knots in the EAAF seems to be relatively stable (Clemens et al., 2016).

Table 4.1.5 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	2	452	0.19
Fitzroy Estuary	5	322	0.14
Port Curtis	2	86	0.03
MCR	4	73	0.02
Totals	***13***	***933***	***0.09***

4.1.7 Whimbrel (*Numenius phaeopus*)

EAAF population estimate (Hansen, 2016): 65,000

1% population estimate for internationally significant sites: 650

0.1% population estimate for nationally significant sites: 65

EAAF population estimate (Wetlands International, 2019): 55,000

The Whimbrel was the fourth most abundant migratory shorebird on the Curtis Coast in January 2019, with 918 birds recorded at high tide roosts during the survey. This was 1,718 less birds than the number counted in January 2011 (2,636) and 29 less birds than were counted in January 2012 (947). Whimbrel were present at 57 sites, three of which were of *national significance*. These included the Colosseum Inlet Lagoon, in MCR (122 birds), and the Keppel Creek entrance and 'creek number 3' in the North Curtis management unit (201 and 105 birds respectively). The foraging density was highest in the North Curtis and MCR management units. The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but there is no evidence of this at a continental scale in Australia and the data suggest an increase in the population north of 27.8°S (Clemens et al., 2016).

Table 4.1.6 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	9	450	0.23
MCR	18	281	0.08
Port Curtis	18	118	0.05
Fitzroy Estuary	12	69	0.03
Totals	***57***	***918***	***0.09***

4.1.8 Eastern Curlew (*Numenius madagascariensis*)

EAAF population estimate (Hansen, 2016): 35,000

1% population estimate for internationally significant sites: 350

0.1% population estimate for nationally significant sites: 35

EAAF population estimate (Wetlands International, 2019): 32,000

The Eastern Curlew was the fifth most abundant migratory shorebird on the Curtis Coast in January 2019, with 898 birds recorded at high tide roosts during the survey. This was 708 less birds than the number counted in January 2011 (1,606) but 291 more birds than were counted in January 2012 (607). The number of Eastern Curlew present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the global population of this species was present during the survey). Eastern Curlew were present at 44 sites, seven of which were of *national significance*. These included Spit End (145 birds), the Mundoolin Rocks east claypan (92 birds) and Williams Bay in Mangrove Bay (74 birds) in the MCR management unit; the south-east end of Curtis Island, in Port Curtis (196 birds); the west side of the entrance sandbar and 'creek number 3' in the North Curtis management unit (55 and 37 birds respectively) and the Curlew Spit Claypan, in the Fitzroy Estuary (45 birds). The foraging density was highest in the MCR and Port Curtis management units. The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and also on the Australian continent particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.1.7 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	12	403	0.12
Port Curtis	9	253	0.1
North Curtis	7	135	0.07
Fitzroy Estuary	16	107	0.05
Totals	***44***	***898***	***0.09***

4.1.9 Red-necked Stint (*Calidris ruficollis*)

EAAF population estimate (Hansen, 2016): 475,000

1% population estimate for internationally significant sites: 4,750

0.1% population estimate for nationally significant sites: 475

EAAF population estimate (Wetlands International, 2019): 315,000

The Red-necked Stint was the sixth most abundant migratory shorebird on the Curtis Coast in January 2019, with 868 birds recorded at high tide roosts during the survey. This was 1,277 less birds than the number counted in January 2011 (2158) and 2,101 less birds than were counted in January 2012 (2982). Red-necked Stint were present at 21 sites. The foraging density was highest in the North Curtis management unit. Red-necked Stints present a particular problem when estimating numbers based on counts at high tide roosts. The species is flexible in its use of feeding habitat and is known to move to coastal wetlands during the high tide (Higgins & Davies, 1996; Minton et al., 2012). It has been postulated that stint distribution at the Curtis Coast may relate to the amount of moisture in the claypans and this in turn relates to tide height and recent rainfall (GHD, 2011d; Sandpiper Ecological Surveys, 2012a). It is unclear whether the population of Red-necked Stints in the EAAF is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly east of 129°E (Clemens et al., 2016).

Table 4.1.8 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	4	396	0.2
MCR	5	183	0.05
Fitzroy Estuary	8	178	0.08
Port Curtis	4	111	0.05
Totals	***21***	***868***	***0.09***

4.1.10 Grey-tailed Tattler (*Tringa brevipes*)

EAAF population estimate (Hansen, 2016): 70,000

1% population estimate for internationally significant sites: 700

0.1% population estimate for nationally significant sites: 70

EAAF population estimate (Wetlands International, 2019): 44,000

The Grey-tailed Tattler was the seventh most abundant migratory shorebird on the Curtis Coast in January 2019, with 725 birds recorded at high tide roosts during the survey. This was 139 more birds than the number counted in January 2011 (586), but 26 less birds than were counted in January 2012 (751). The number of Grey-tailed Tattler present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Grey-tailed Tattlers were present at 15 sites, three of which were of *national significance*. These included Central Mangrove Island and Turkey Beach Mangrove Island in the MCR management unit (325 and 115 birds respectively), as well as the south-east end of Curtis Island, in Port Curtis (100 birds). The foraging density was highest in the MCR and Port Curtis management units. The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia suggest it may be increasing, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.1.9 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	6	475	0.14
Port Curtis	6	226	0.09
Fitzroy Estuary	2	23	0.01
North Curtis	1	1	0.001
Totals	***15***	***725***	***0.07***

4.1.11 Terek Sandpiper (*Xenus cinereus*)

EAAF population estimate (Hansen, 2016): 50,000

1% population estimate for internationally significant sites: 500

0.1% population estimate for nationally significant sites: 50

EAAF population estimate (Wetlands International, 2019): 50,000

The Terek Sandpiper was the eighth most abundant migratory shorebird on the Curtis Coast in January 2019, with 529 birds recorded at high tide roosts during the survey. This was 4 more birds than the number counted in January 2011 (525), but 184 less birds than were counted in January 2012 (713). The number of Terek Sandpiper present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Terek Sandpipers were present at 19 sites, three of which were of *national significance*. These included Central Mangrove Island and 'Mangrove Island 2' in the MCR management unit (120 and 90 birds respectively), as well as the East Point of Mud Island, in the Fitzroy Estuary (50 birds). The foraging density was highest in the MCR management unit. It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.1.10 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	5	293	0.09
Port Curtis	7	110	0.05
Fitzroy Estuary	6	113	0.05
North Curtis	1	13	0.006
Totals	***19***	***529***	***0.05***

4.1.12 Greater Sand Plover (*Charadrius leschenaultia*)

EAAF population estimate (Hansen, 2016): 200,000 – 300,000

1% population estimate for internationally significant sites: 2,000

0.1% population estimate for nationally significant sites: 200

EAAF population estimate (Wetlands International, 2019): 79,000

The Greater Sand Plover was the ninth most abundant migratory shorebird on the Curtis Coast in January 2019, with 523 birds recorded at high tide roosts during the survey. This was 349 more birds than the number counted in January 2011 (174), and 368 more birds than were counted in January 2012 (155). Greater Sand Plovers were present at 12 sites, one of which was of *national significance*. This site was North East Shell Point in the Fitzroy Estuary, which supported 262 birds. The foraging density was highest in the MCR management unit. The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019) but there is no evidence of this at a continental scale in Australia though the data do suggest a decrease in the population south of 27.8°S and west of 129°E (Clemens et al., 2016).

Table 4.1.11 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	5	347	0.15
North Curtis	2	120	0.06
Port Curtis	2	35	0.01
MCR	3	21	0.006
Totals	***12***	***523***	***0.05***

4.1.13 Curlew Sandpiper (*Calidris ferruginea*)

EAAF population estimate (Hansen, 2016): 90,000

1% population estimate for internationally significant sites: 900

0.1% population estimate for nationally significant sites: 90

EAAF population estimate (Wetlands International, 2019): 135,000

The Curlew Sandpiper was the tenth most abundant migratory shorebird on the Curtis Coast in January 2019, with 237 birds recorded at high tide roosts during the survey. This was 161 more birds than the number counted in January 2011 (76), and 175 more birds than were counted in January 2012 (62). Curlew Sandpipers were present at eight sites. The foraging density was highest in the Fitzroy Estuary. Curlew Sandpiper are declining in the EAAF, though the decline is more rapid south of 27.8°S (Clemens et al., 2016).

Table 4.1.12 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	5	159	0.07
North Curtis	2	58	0.03
MCR	1	20	0.006
Port Curtis	0	Nil	Nil
Totals	***8***	***237***	***0.02***

4.1.14 Other migratory shorebirds

There were a further eight species of migratory shorebird recorded on the Curtis Coast in January 2019. They were (in order of descending abundance): Grey Plover (153 birds), Black-tailed Godwit (100 birds), Ruddy Turnstone (42 birds), Broad-billed Sandpiper and Pacific Golden Plover (20 birds each), Common Greenshank and Sanderling (19 birds each) and Sharp-tailed Sandpiper (9 birds). Together, these species made up approximately 4% of the total migratory shorebird count for the survey. The distribution of these species throughout the survey area did not follow any broad pattern.

4.1.15 Non-migratory shorebirds

There were 898 non-migratory shorebirds recorded on the Curtis Coast in January 2019, representing six species. They were (in order of descending abundance): Red-capped Plover (481 birds), Pied Oystercatcher (385 birds), Black-winged Stilt (ten birds), Sooty Oystercatcher (9 birds), Beach Stone-curlew (7 birds) and Masked Lapwing (6 birds). The key assumption making roost counting the preferred method for estimating migratory shorebird numbers – that the majority of birds congregate in communal roosts at high tide – does not hold for all non-migratory species. Consequently, the counts obtained during the survey were unlikely to give an accurate estimate of the populations of these species on the Curtis Coast. Nonetheless, collection of the data makes the survey comparable with the *Shorebird 2020* counts, helps to describe the distributions of the species, may be a valid index of the populations and has intrinsic value as a record of presence and abundance. No further analysis was conducted because non-migratory species are beyond the scope of the ERMP (Gladstone Ports Corporation, 2016).

4.1.16 Low tide surveys

There were 36 low tide surveys conducted on the Curtis Coast in January 2019. In total, 472 minutes (almost 8 hours) were spent surveying foraging migratory shorebirds (Table 4.1.1). A total of 1,265 birds were counted during the low tide surveys, representing 14 species. The species with over 50 individuals counted at low tide were (in order of descending abundance): Bar-tailed Godwit (350 birds), Red-necked Stint (241 birds), Great Knot (166 birds), Eastern Curlew (162 birds), Whimbrel (121 birds) and Lesser Sand Plover (75 birds). Red Knot (37 birds), Grey-tailed Tattler (28 birds), Terek Sandpiper (20), Greater Sand Plover (16), Curlew Sandpiper (4 birds), Grey Plover (4 birds), Common Greenshank (2 birds) and Common Sandpiper (1 bird) made up the remainder. The low tide counts are not strictly comparable with previous surveys because shorebirds move quickly around the intertidal zone in response to the movement of the tide. It is therefore difficult to replicate surveys even when they occur at the same location.

4.2 February

The surveys in February target the migratory shorebirds present on the Curtis Coast in the Austral summer (see Table 3.3.2). Unlike the results from the other surveys completed in 2019, results from the February survey can be compared to results from each year of the project thus far. This means that the data presented in this section of the report are more detailed than those in other sections, include maps of significant roosts (in Appendix 3) and present longer time series.

4.2.1 Survey Coverage

A total of 130 high tide surveys were completed in February, and the total survey time at high tide was 1,174 minutes (approximately 19.5 hours). A total of 31 low tide surveys were conducted, and the total survey time at low tide was 418 minutes (approximately seven hours). The survey effort in February is presented in Table 4.2.1. The weather during the February field trip was variable; 48% of high tide surveys were conducted in good counting conditions with winds below 20km/h, but only two of the 31 low tide surveys were conducted in these conditions. 53 high tide surveys were conducted with winds between 29 and 38km/h, and 14 were conducted in strong winds >39km/h. Twenty-six low tide surveys were conducted with winds between 20 and 38km/h, and three were conducted in winds above 39km/h.

Table 4.2.1 Summary of survey effort in February: number of sites and elapsed survey time at each location

Location	**High Tide**		**Low Tide**	
	Sites	**Duration (mins)**	**Sites**	**Duration (mins)**
Port Curtis	33	255	17	100
Fitzroy Estuary	19	262	6	106
North Curtis Island	34	401	3	115
Mundoolin-Colosseum	25	167	3	76
Rodd's Peninsula	19	89	2	21
Cheetham Salt Works*	Nil	Nil	Nil	Nil
Total	130	1,174	31	418

**The Cheetham Salt Works were not surveyed in February due to lack of access.*

4.2.2 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in February 2019 was 9,388 (see Figure 4.2.1), the lowest number recorded in February to date. Only individuals identified to species level were included in this total; a further 58 migratory shorebirds could not be identified to species level (unidentified large, medium and small waders). A total of 19 migratory shorebird species were identified during the high tide roost counts (Figure 4.2.2). Lesser Sand Plover, Bar-tailed Godwit, Red-necked Stint and Whimbrel were the most abundant species. The rest of the 'top ten' were (listed in

descending order): Terek Sandpiper, Great Knot, Eastern Curlew, Grey-tailed Tattler, Greater Sand Plover and Grey Plover. The foraging density of migratory shorebirds across the Curtis Coast in February 2019 was 0.93 bird/ha, the lowest density recorded in this month during the project to date.

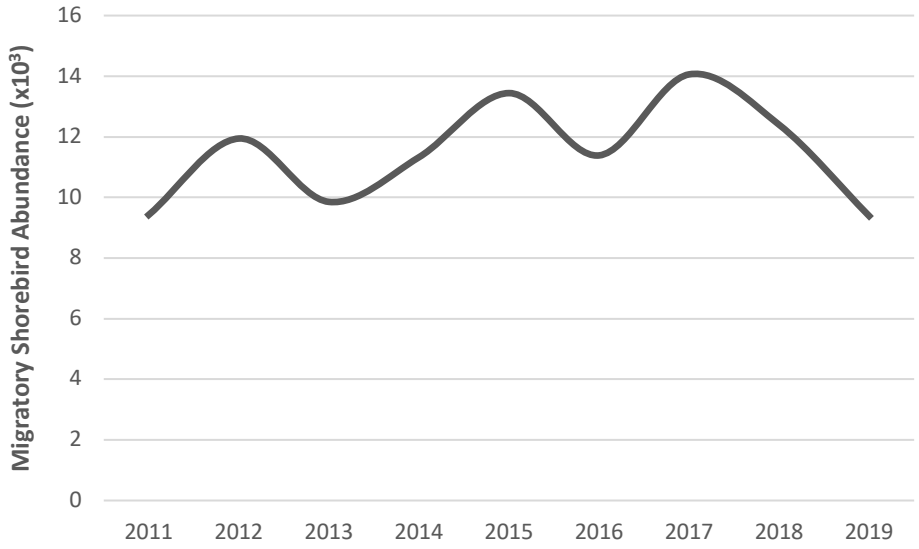

Figure 4.2.1 Abundance of migratory shorebirds on the Curtis Coast during February surveys over the life of the project to date. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

In 2019, the foraging density within each management unit was as follows. The Fitzroy Estuary supported 0.58 birds/ha, North Curtis supported two birds/ha, Mundoolin – Colosseum – Rodds Peninsula Peninsula (MCR) supported 0.81 birds/ha and Port Curtis supported 0.58 birds/ha. For a comparison between foraging densities in February in each management unit and year of the project, please see Table 4.2.2 below. It should be noted that the foraging densities were calculated using GHD's foraging habitat area calculation from 2011 (prior to the commencement of the WBDDP). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

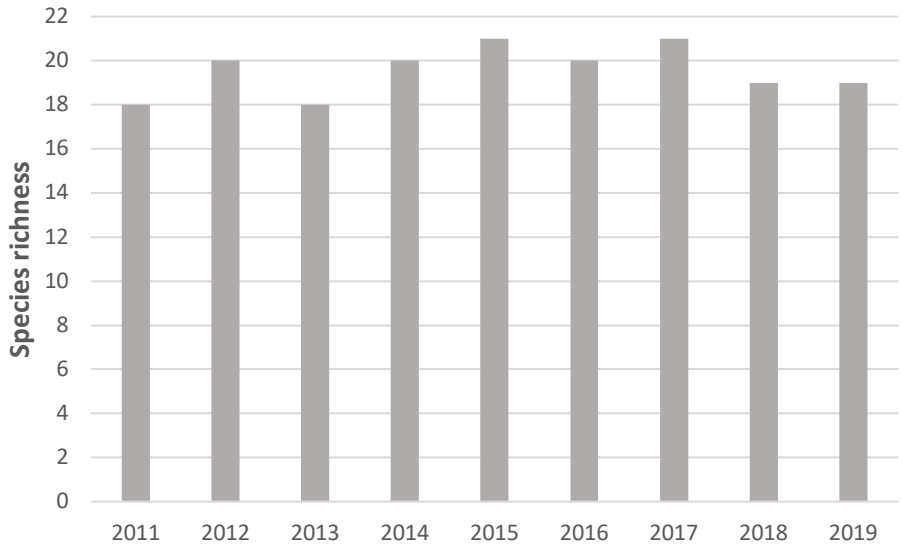

Figure 4.2.2 Species richness of migratory shorebirds on the Curtis Coast during February surveys over the life of the project to date. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

Table 4.2.2 Foraging density (in birds/ha) of migratory shorebirds in each of the management units on the Curtis Coast during February surveys over the life of the project to date

Management unit	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Fitzroy Estuary	0.67	1.09	0.85	1.20	2.28	1.16	1.68	1.39	0.58
MCR	0.73	1.19	0.66	0.92	1.01	1.12	0.89	0.85	0.81
North Curtis Island	1.63	1.91	1.74	1.91	1.49	1.08	2.28	1.60	2.00
Port Curtis	0.92	0.69	0.92	0.70	0.73	1.16	1.10	1.30	0.58
Curtis Coast overall	*0.94*	*1.19*	*0.98*	*1.12*	*1.34*	*1.13*	*1.40*	*1.23*	*0.93*

In February 2019, shorebird distribution was slightly skewed to the north (Table 4.2.3, Figure 4.2.3) There was one roost with >1000 birds: the Yellow Patch Entrance Sandbar, in the North Curtis Island management unit (1,852 birds). There were a further five roosts with between 500 and 1000 birds: the Mundoolin Rocks east claypan (930 birds) and Central Mangrove Island (520 birds) in the MCR management unit; the mangrove roost at the Yellow Patch Entrance Sandbar (593 birds) in North Curtis, the south-east end of Curtis Island, in Port Curtis and North East Shell Point (547 birds) in the Fitzroy Estuary. There were 14 roosts with between 100 and 500 birds: three in the Fitzroy Estuary, four in North Curtis, three in Port Curtis, and four in MCR.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in February 2019. The species accounts are given in descending order of abundance and are followed by a discussion of the non-migratory shorebirds present during the survey. No surveys were able to be conducted in the Cheetham Salt Works. Note that the shorebird population estimations utilised in the last report (Wildlife Unlimited, 2018) have been replaced by in the current report by the recent work of Hansen et

al. (2016) and in some cases are significantly different. Where Hansen et al. (2016) give population estimates in the form of a range (e.g. the 180,000 to 275,000 given for Lesser Sand Plover), the lower values are adopted for calculating the significance of counts made during surveys.

Table 4.2.3 Place names of the roosts with the greatest abundance of migratory shorebirds in February 2019

Management Unit	**Abundance**	**Roost**
Fitzroy Estuary	>1000	Nil
	500-999	1. North East Shell Point
	100-499	1. Curlew Spit Claypan 2. Cattle Point 3. Mackenzie Island – north side
North Curtis	>1000	1. Yellow Patch entrance sandbar
	500-999	2. YP Sandbar – Mangrove Roost
	100-499	1. West side of Entrance Sandbar 2. Keppell Creek Entrance 3. Station Point Ck Sandbar 4. Mud Bay, Cape Capricorn
Port Curtis	>1000	Nil
	500-999	1. South End Claypan
	100-499	1. Facing Island Claypan 2. Facing Island 4 3. Facing Island Sandbar
MCR	>1000	Nil
	500-999	1. Mundoolin Rocks east claypan 2. Central Mangrove Island
	100-499	1. Williams Bay, Mangrove Bay 2. Colosseum Inlet Lagoon 3. Col. Inlet Mangrove Ck Saltpan 4. Spit End

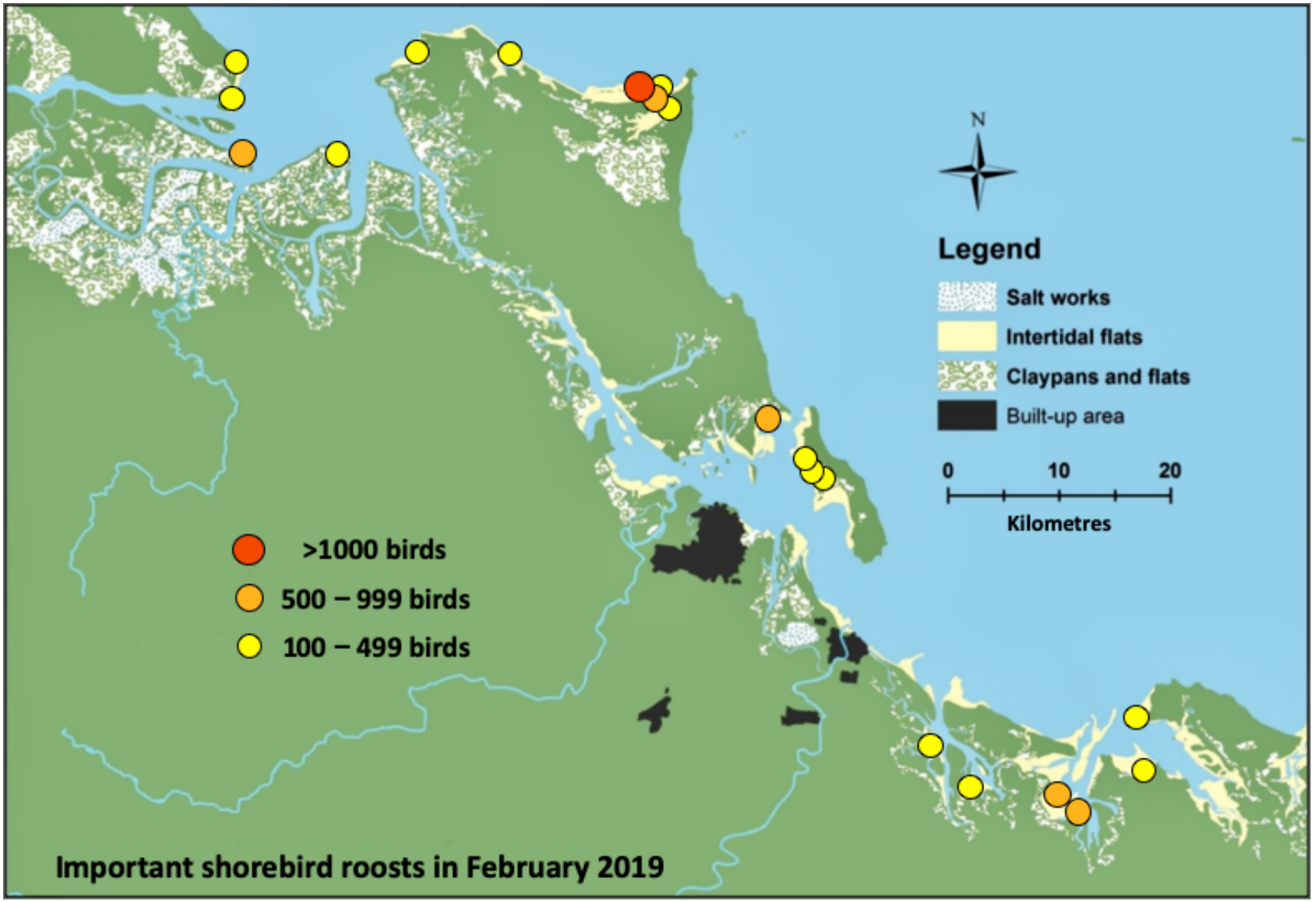

Figure 4.2.3 Important shorebird roosts on the Curtis Coast in February 2019

4.2.3 Lesser Sand Plover (*Charadrius mongolus*)

EAAF population estimate (Hansen, 2016): 180,000 – 275,000

1% population estimate for internationally significant sites: 1,800

0.1% population estimate for nationally significant sites: 180

EAAF population estimate (Wetlands International, 2019): 140,000

The Lesser Sand Plover was the most abundant migratory shorebird on the Curtis Coast in February 2019, with 1,889 birds recorded at high tide roosts during the survey. The number of Lesser Sand Plover present on the Curtis Coast in February 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Lesser Sand Plovers were present at 12 sites, three of which were of *national significance*: North East Shell Point (465 birds) in the Fitzroy Estuary, and the Yellow Patch Entrance Sandbar (700 birds) and the west side of the Entrance Sandbar (390) in the North Curtis Island management unit (see Figure A1 in Appendix 3). The foraging density was highest in the North Curtis and Fitzroy Estuary management units. The population of Lesser Sand Plovers is believed to be declining in the EAAF (Wetlands International, 2019) and in Australia, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016). On the Curtis Coast the population of Lesser Sand Plover is highly variable, but the population has increased each year since 2016, when it was the lowest during the project to date (Figure 4.2.3).

Table 4.2.4 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	4	1,172	0.59
Fitzroy Estuary	4	589	0.25
Port Curtis	2	126	0.05
MCR	2	2	<0.001
Totals	***12***	***1,889***	***0.19***

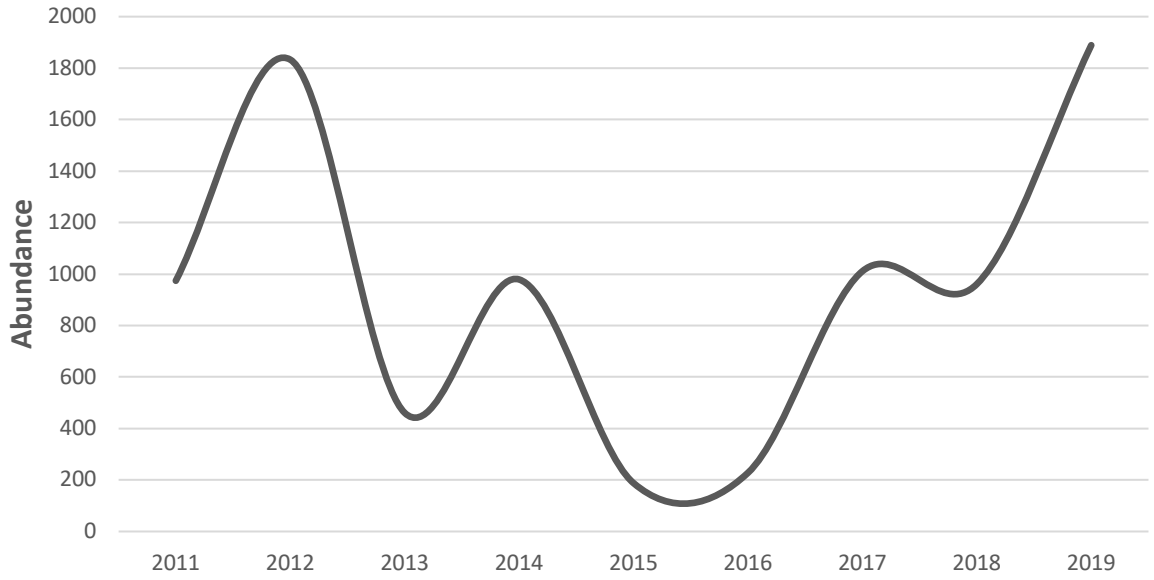

Figure 4.2.3 Abundance of Lesser Sand Plover on the Curtis Coast from February 2011 – 2019

4.2.4 Bar-tailed Godwit (*Limosa lapponica*)

EAAF population estimate (Hansen, 2016): 325,000

1% population estimate for internationally significant sites: 3,250

0.1% population estimate for nationally significant sites: 325

EAAF population estimate (Wetlands International, 2019): 279,000

The Bar-tailed Godwit was the second most abundant migratory shorebird on the Curtis Coast in February 2019, with 1,667 recorded at high tide roosts during the survey. Bar-tailed Godwits were present at 20 sites, one of which was of *national significance*: the Yellow Patch Entrance Sandbar (342 birds) in the North Curtis Island management unit (see Figure A2 in Appendix 3). The foraging density was highest in the North Curtis management unit. Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia. The decline is especially strong north of 27.8°S, which includes the study site (Clemens et al., 2016). On the Curtis Coast the population of Bar-tailed Godwit has declined slightly over the last five years (Figure 4.2.4).

Table 4.2.5 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	3	581	0.18
North Curtis	5	488	0.25
Port Curtis	5	479	0.20
Fitzroy Estuary	7	119	0.05
Totals	***20***	***1,667***	***0.17***

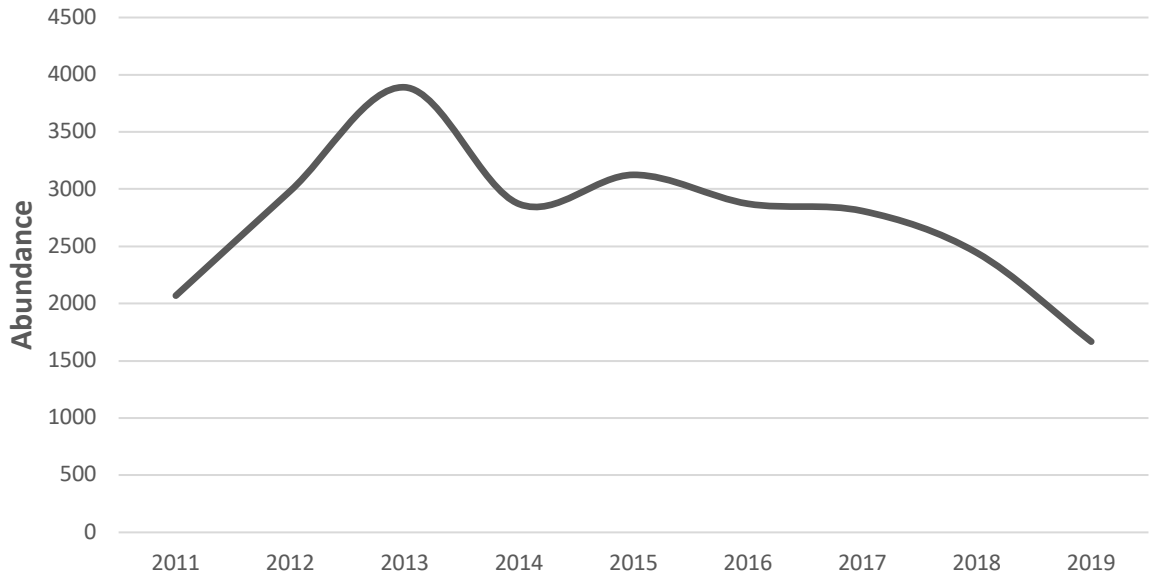

Figure 4.2.4 Abundance of Bar-tailed Godwit on the Curtis Coast from February 2011 – 2019

4.2.5 Red-necked Stint (*Calidris ruficollis*)

EAAF population estimate (Hansen, 2016): 475,000

1% population estimate for internationally significant sites: 4,750

0.1% population estimate for nationally significant sites: 475

EAAF population estimate (Wetlands International, 2019): 315,000

The Red-necked Stint was the third most abundant migratory shorebird on the Curtis Coast in February 2019, with 1,269 birds recorded at high tide roosts during the survey. Red-necked Stints were present at 20 sites, one of which was of *national significance*: the Yellow Patch Sandbar mangrove roost (500 birds) in the North Curtis Island management unit (see Figure A3 in Appendix 3). The foraging density was highest in the North Curtis management unit. Red-necked Stints present a particular problem when estimating numbers based on counts at high tide roosts. The species is flexible in its use of feeding habitat and is known to move to coastal wetlands during the high tide (Higgins & Davies, 1996; Hollands & Minton, 2012; Minton et al., 2012). It has

been postulated that stint distribution at the Curtis Coast may relate to the amount of moisture in the claypans and this in turn relates to tide height and recent rainfall (GHD, 2011d; Sandpiper Ecological Surveys, 2012a). It is unclear whether the population of Red-necked Stints in the EAAF is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly east of 129°E (Clemens et al., 2016). On the Curtis Coast, the population of Red-necked Stint is highly variable (Figure 4.2.5).

Table 4.2.6 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	6	716	0.4
MCR	6	261	0.07
Fitzroy Estuary	6	249	0.1
Port Curtis	2	43	0.02
Totals	***20***	***1,269***	***0.13***

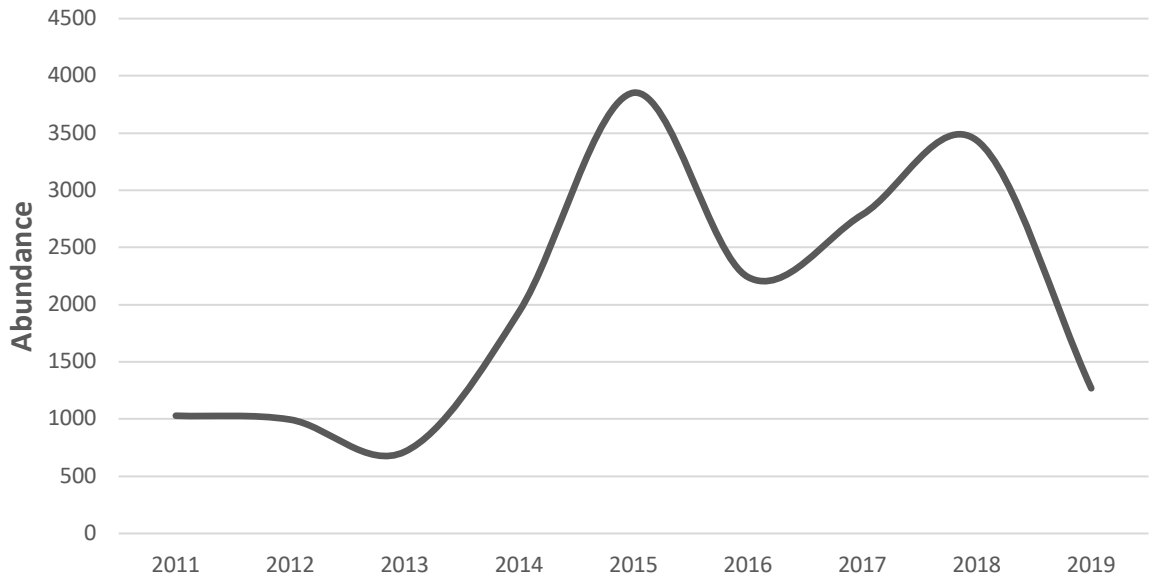

Figure 4.2.5 Abundance of Red-necked Stint on the Curtis Coast from February 2011 – 2019

4.2.6 Whimbrel (*Numenius phaeopus*)

EAAF population estimate (Hansen, 2016): 65,000

1% population estimate for internationally significant sites: 650

0.1% population estimate for nationally significant sites: 65

EAAF population estimate (Wetlands International, 2019): 55,000

The Whimbrel was the fourth most abundant migratory shorebird on the Curtis Coast in February 2019, with 1,173 birds recorded at high tide roosts during the survey. The number of Whimbrel present on the Curtis Coast in February 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 62 sites, six of which were of *national significance*. These included: the Keppel Creek Entrance (178 birds), the Yellow Patch Entrance Sandbar (128 birds) and Mud Bay, near Cape Capricorn in the North Curtis Island management unit; the Colosseum Inlet Lagoon (130 birds), in MCR; and the south-east end of Curtis Island (121 birds) as well as Facing Island 4 (89 birds) in Port Curtis (see Figure A4 in Appendix 3). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but there is no evidence of this at a continental scale in Australia and the data suggest an increase in the population north of 27.8°S (Clemens et al., 2016). On the Curtis Coast, the Whimbrel population seems to have stabilised around a mean of approximately 1,200 birds (Figure 4.2.6).

Table 4.2.7 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	15	497	0.25
MCR	19	356	0.1
Port Curtis	17	290	0.12
Fitzroy Estuary	11	30	0.01
Totals	***62***	***1,173***	***0.12***

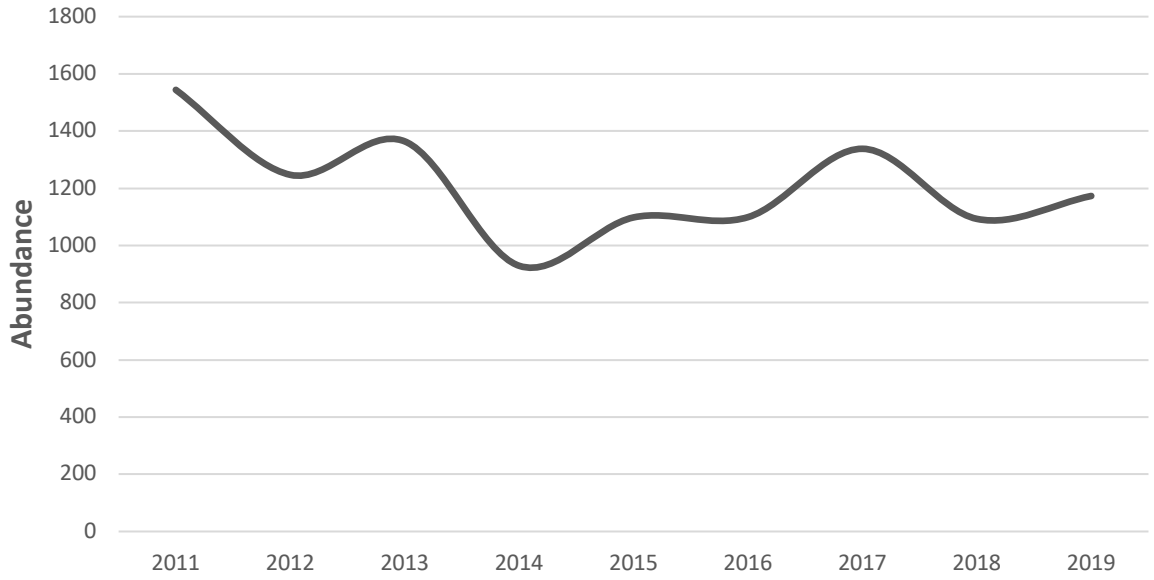

Figure 4.2.6 Abundance of Whimbrel on the Curtis Coast from February 2011 – 2019

4.2.7 Terek Sandpiper (*Xenus cinereus*)

EAAF population estimate (Hansen, 2016): 50,000

1% population estimate for internationally significant sites: 500

0.1% population estimate for nationally significant sites: 50

EAAF population estimate (Wetlands International, 2019): 50,000

The Terek Sandpiper was the fifth most abundant migratory shorebird on the Curtis Coast in February 2019, with 841 birds recorded at high tide roosts during the survey. The number of Terek Sandpiper present on the Curtis Coast in February 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Terek Sandpipers were present at 22 sites, five of which were of *national significance*. These included: Facing Island 4 (126 birds) in Port Curtis management unit, and Central Mangrove Island (260 birds) and Bird Island (55 birds), in the MCR; East Point at Mud Island (75 birds), in the Fitzroy Estuary; "Creek 5" (67 birds), on the North Curtis Island and Facing Island 4, in Port Curtis (see Figure A5 in Appendix 3). The foraging density was highest in the MCR management unit. It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly south of 27.8°S and east of 129°E (Clemens et al., 2016). On the Curtis Coast, with the exception of February 2017 (which had a count around 1,000 birds higher than normal), the mean population of Terek Sandpiper seems to be stable at approximately 1,000 birds (Figure 4.2.7).

Table 4.2.8 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	8	461	0.14
Fitzroy Estuary	6	147	0.06
Port Curtis	4	139	0.06
North Curtis	4	94	0.05
Totals	***22***	***841***	***0.08***

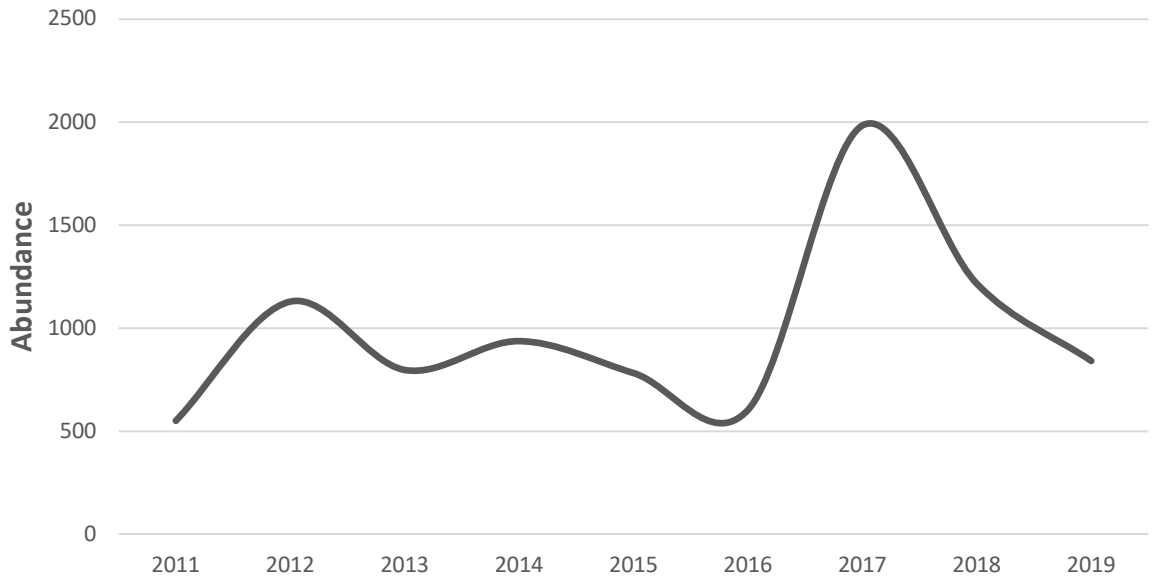

Figure 4.2.7 Abundance of Terek Sandpiper on the Curtis Coast from February 2011 – 2019

4.2.8 Great Knot (*Calidris tenuirostris*)

EAAF population estimate (Hansen, 2016): 425,000

1% population estimate for internationally significant sites: 4,250

0.1% population estimate for nationally significant sites: 425

EAAF population estimate (Wetlands International, 2019): 290,000

The Great Knot was the sixth most abundant migratory shorebird on the Curtis Coast in February 2019, with 733 birds recorded at high tide roosts during the survey. Great Knots were present at eight sites (see Figure A6 in Appendix 3). The foraging density was highest in the North Curtis management unit. The population of Great Knots in the EAAF seems to be relatively stable (Clemens et al., 2016), but is highly variable on the Curtis Coast in February (Figure 4.2.8).

Table 4.2.9 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	1	398	0.20
MCR	2	245	0.07
Port Curtis	3	74	0.03
Fitzroy Estuary	2	16	0.006
Totals	***8***	***733***	***0.07***

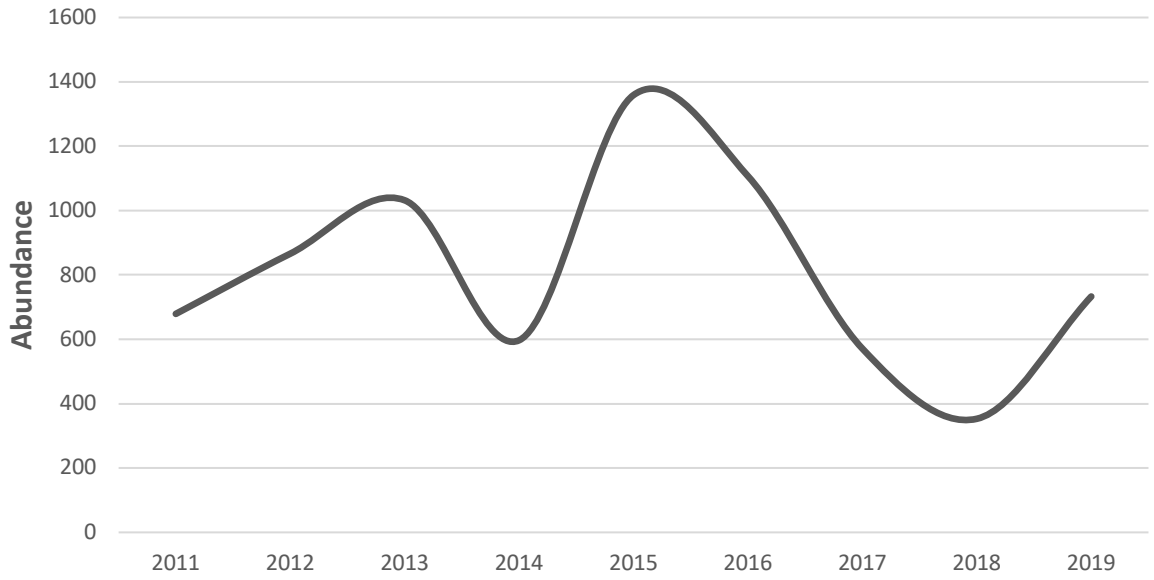

Figure 4.2.8 Abundance of Great Knot on the Curtis Coast from February 2011 – 2019

4.2.9 Eastern Curlew (*Numenius madagascariensis*)

EAAF population estimate (Hansen, 2016): 35,000

1% population estimate for internationally significant sites: 350

0.1% population estimate for nationally significant sites: 35

EAAF population estimate (Wetlands International, 2019): 32,000

The Eastern Curlew was the seventh most abundant migratory shorebird on the Curtis Coast in February 2019, with 526 birds recorded at high tide roosts during the survey. The number of Eastern Curlew present on the Curtis Coast in February 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Eastern Curlew were present at 32 sites, four of which were of *national significance* (see Figure A7 in Appendix 3). These included the Mundoolin Rocks east claypan (94 birds) in the MCR management unit, the South End Claypan (85 birds), in Port Curtis; and the Yellow Patch Entrance Sandbar (83 birds) and Keppel Creek entrance (35 birds), in the North Curtis management unit. The

foraging density was highest in the North Curtis management unit. The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and also on the Australian continent – particularly south of 27.8°S and east of 129°E (Clemens et al., 2016). On the Curtis Coast there has been a significant decline in the number of Eastern Curlews counted in February (Figure 4.2.8). The count made in 2019 was the lowest in the history of the project, representing a decline in abundance of almost 60% since February 2011.

Table 4.2.10 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	9	201	0.06
North Curtis	8	190	0.09
Port Curtis	11	125	0.05
Fitzroy Estuary	4	10	0.004
Totals	***32***	***526***	***0.05***

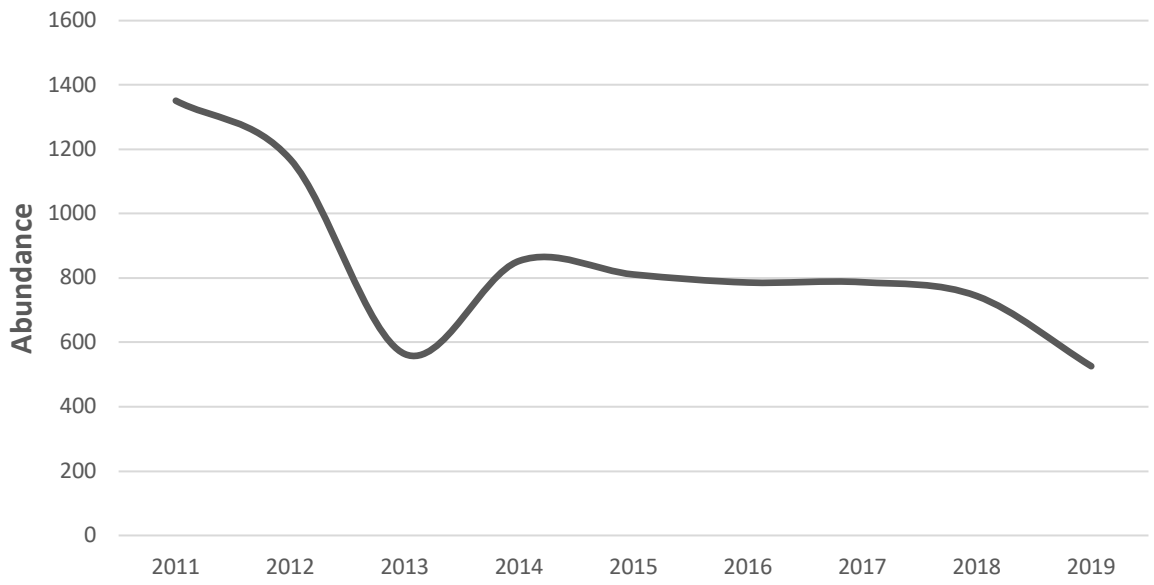

Figure 4.2.9 Abundance of Eastern Curlew on the Curtis Coast from February 2011 – 2019

4.2.10 Grey-tailed Tattler (*Tringa brevipes*)

EAAF population estimate (Hansen, 2016): 70,000

1% population estimate for internationally significant sites: 700

0.1% population estimate for nationally significant sites: 70

EAAF population estimate (Wetlands International, 2019): 44,000

The Grey-tailed Tattler was the eighth most abundant migratory shorebird on the Curtis Coast in February 2019, with 489 birds recorded at high tide roosts during the survey. Grey-tailed Tattlers were present at 21 sites, one of which was of *national significance*: Central Mangrove Island (260 birds) in the MCR management unit (see Figure A8 in Appendix 3). The foraging density was highest in the MCR. The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia suggest it may be increasing, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016). On the Curtis Coast, there was an increase in the counts of Grey-tailed Tattler from 2011-2018, followed by a precipitous decline in February 2019 (Figure 4.2.10).

Table 4.2.11 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in February 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	11	365	0.11
Port Curtis	3	59	0.02
North Curtis	3	39	0.01
Fitzroy Estuary	4	26	0.01
Totals	***21***	***489***	***0.05***

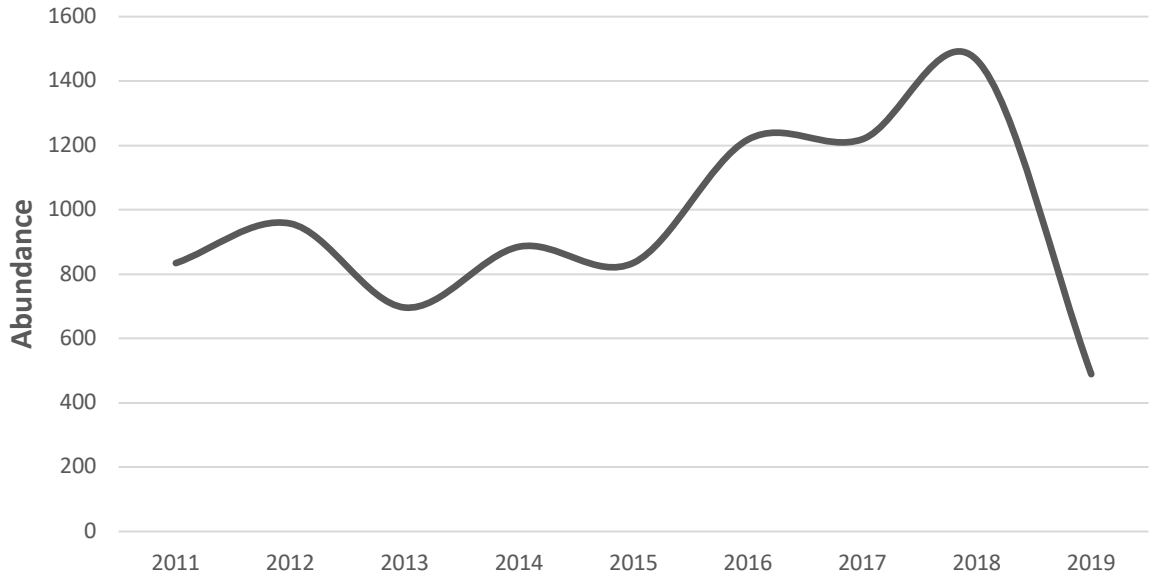

Figure 4.2.10 Abundance of Grey-tailed Tattler on the Curtis Coast from February 2011 – 2019

4.2.11 Greater Sand Plover (*Charadrius leschenaultia*)

EAAF population estimate (Hansen, 2016): 200,000 – 300,000

1% population estimate for internationally significant sites: 2,000

0.1% population estimate for nationally significant sites: 200

EAAF population estimate (Wetlands International, 2019): 79,000

The Greater Sand Plover was the ninth most abundant migratory shorebird on the Curtis Coast in February 2019, with 310 birds recorded at high tide roosts during the survey. Greater Sand Plovers were present at 11 sites (see Figure A9 in Appendix 3). No Greater Sand Plovers were recorded in the MCR management unit. The foraging density was highest in North Curtis. The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019) but there is no evidence of this at a continental scale in Australia – though the data do suggest a decrease in the population south of 27.8°S and west of 129°E (Clemens et al., 2016). On the Curtis Coast the population of Greater Sand Plover increased markedly between 2014 and 2017 but has since returned to numbers similar to that at the start of the project in 2011 (Figure 4.2.11).

Table 4.2.12 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	4	178	0.09
Fitzroy Estuary	6	107	0.05
Port Curtis	1	25	0.01
MCR	Nil	Nil	Nil
Totals	***11***	***310***	***0.03***

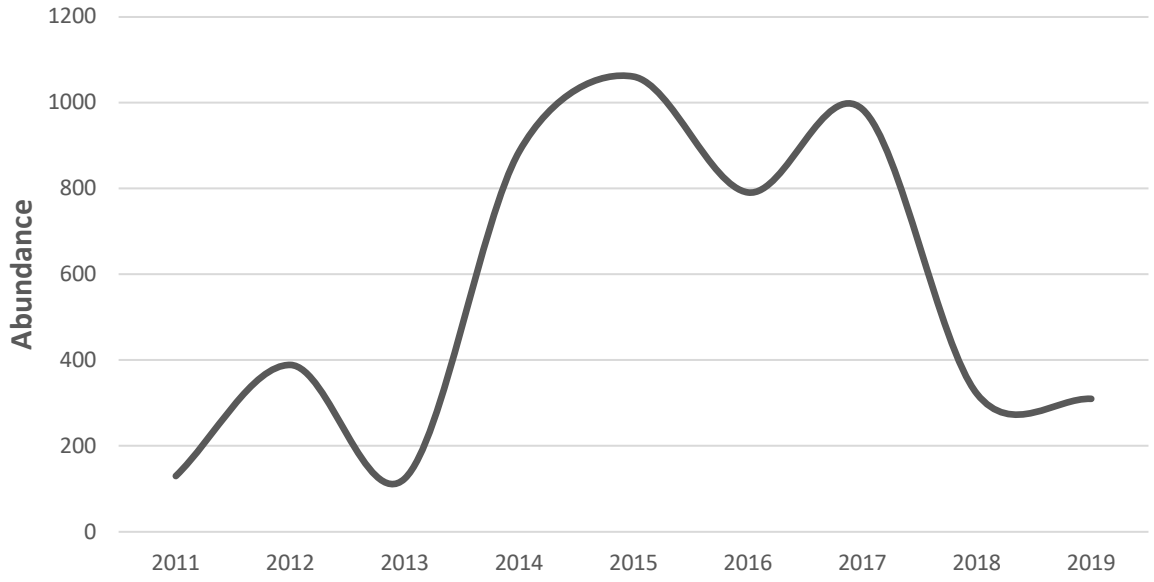

Figure 4.2.11 Abundance of Greater Sand Plover on the Curtis Coast from February 2011 – 2019

4.2.12 Grey Plover (*Pluvialis squatarola*)

EAAF population estimate (Hansen, 2016): 80,000

1% population estimate for internationally significant sites: 800

0.1% population estimate for nationally significant sites: 80

EAAF population estimate (Wetlands International, 2019): 104,000

The Grey Plover was the tenth most abundant migratory shorebird on the Curtis Coast in February 2019, with 229 birds recorded at high tide roosts during the survey. Grey Plovers were present at four sites, two of which were of *national significance*: the Mundoolin Rocks east claypan (110 birds), in the MCR management unit, and the Yellow Patch entrance sandbar (100 birds) at North Curtis (see Figure A10 in Appendix 3). The foraging density was highest in the North Curtis management unit. Grey Plovers are believed to be declining in the

EAAF (Wetlands International, 2019) and in Australia, particularly south of 27.8°S and west of 129°E (Clemens et al., 2016). On the Curtis Coast, the population of Grey Plover is, on average, around 150 birds; the count in 2019 is the highest recorded so far during the project (Figure 4.2.11).

Table 4.2.12 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	1	110	0.03
North Curtis	1	100	0.05
Fitzroy Estuary	1	11	0.004
Port Curtis	1	8	0.003
Totals	***4***	***229***	***0.02***

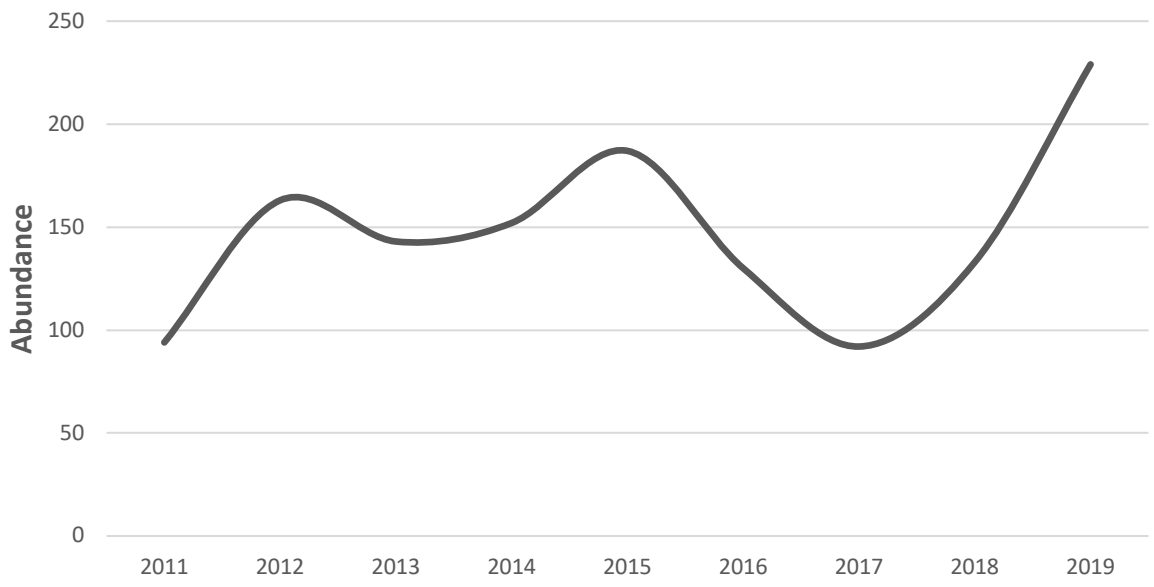

Figure 4.2.11 Abundance of Grey Plover on the Curtis Coast from February 2011 – 2019

4.2.13 Other migratory shorebirds

There were a further nine species of migratory shorebird recorded on the Curtis Coast in February 2019. They were (in order of descending abundance): Curlew Sandpiper (83 birds), Ruddy Turnstone (50 birds), Sharp-tailed Sandpiper (37 birds), Common Greenshank (32 birds), Sanderling (26 birds), Pacific Golden Plover (17 birds), Broad-billed Sandpiper (15 birds), Common Sandpiper (one bird) and Red Knot (one bird). Together, these species made up approximately 3% of the total migratory shorebird count for the survey. Most individuals representing these species were detected in the North Curtis Island and MCR management units.

4.2.14 Non-migratory shorebirds

There were 779 non-migratory shorebirds recorded on the Curtis Coast in January 2019, representing six species. They were (in order of descending abundance): Red-capped Plover (504 birds), Pied Oystercatcher (241 birds), Masked Lapwing (21 birds), Sooty Oystercatcher (seven birds), Black-winged Stilt (three birds) and Beach Stone-curlew (three birds). The key assumption making roost counting the preferred method for estimating migratory shorebird numbers – that the majority of birds congregate in communal roosts at high tide – does not hold for all non-migratory species. Consequently, the counts obtained during the survey were unlikely to give an accurate estimate of the populations of these species on the Curtis Coast. Nonetheless, collection of the data makes the survey comparable with the *Shorebird 2020* counts, helps to describe the distributions of the species, may be a valid index of the populations and has intrinsic value as a record of presence and abundance. No further analysis was conducted because non-migratory species are beyond the scope of the ERMP (Gladstone Ports Corporation, 2016).

4.2.15 Low tide surveys

There were 31 low tide surveys conducted on the Curtis Coast in January 2019. In total, 418 minutes (approximately seven hours) were spent surveying foraging migratory shorebirds (Table 4.2.1). A total of 1,668 birds were counted during the low tide surveys, representing 15 species. The species with over 50 individuals counted at low tide were (in order of descending abundance): Great Knot (330 birds), Red-necked Stint (234 birds), Bar-tailed Godwit (192 birds), Whimbrel (100 birds), Eastern Curlew (98 birds), and Lesser Sand Plover (62 birds). Grey-tailed Tattler (29 birds), Greater Sand Plover (26 birds), Terek Sandpiper (17 birds), Curlew Sandpiper (13 birds), Grey Plover (ten birds), Common Sandpiper (four birds), Sanderling (three birds), Sharp-tailed Sandpiper (two birds) and Common Greenshank (one bird) made up the remainder of the species recorded at low tide. The low tide counts are not strictly comparable with previous surveys because shorebirds move quickly around the intertidal zone in response to the movement of the tide. It is therefore difficult to replicate surveys even when they occur at the same location.

4.3 March

The surveys in March target migratory shorebirds present on the Curtis Coast in the Austral summer, as well as migrants using the Curtis Coast as a stopover site on their northward migration (Choi et al., 2017; Table A1). The results of the surveys conducted in March 2019 are compared below to the results of surveys conducted in March 2011 and March 2012.

4.3.1 Survey Coverage

A total of 138 high tide surveys were completed in March, and the total survey time at high tide was 1,199 minutes (approximately 20 hours). A total of 38 low tide surveys were conducted, and the total survey time at low tide was 788 minutes (approximately 13 hours). The survey effort in March is presented in Table 4.3.1. The weather during the March field trip was variable; 73% of high tide surveys and 44% of low tide surveys were conducted in good counting conditions with winds below 20km/h. 12 surveys were conducted with winds between 29 and 38km/h.

Table 4.3.1 Summary of survey effort in March: number of sites and elapsed survey time at each location

Location	**High Tide**		**Low Tide**	
	Sites	**Duration (mins)**	**Sites**	**Duration (mins)**
Port Curtis	42	306	17	152
Fitzroy Estuary	22	271	6	113
North Curtis Island	25	195	3	183
Mundoolin-Colosseum	28	209	9	133
Rodds Peninsula	20	128	3	207
Cheetham Salt Works	1	90	0	0
Total	**138**	**1,199**	**38**	**788**

4.3.2 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in March 2019 was 10,103 (see Figure 4.3.1). Only individuals identified to species level were included in this total; a further 1,023 migratory shorebirds could not be identified to species level (these were mostly unidentified small and medium waders). A total of 19 migratory shorebird species were identified during the high tide roost counts – the same as in March 2011 and March 2012. In each year, Red-necked Stint and Bar-tailed Godwit were the most and second most abundant species respectively. The composition of the rest of the 'top ten' changed between years; in 2019, the most abundant species, listed in descending order, were Red-necked Stint, Bar-tailed Godwit, Grey-tailed Tattler, Lesser Sand Plover, Great Knot, Terek Sandpiper, Whimbrel, Eastern Curlew, Greater Sand Plover and Curlew Sandpiper. The foraging density of migratory shorebirds across the Curtis Coast in March 2019 was 1 bird/ha; this is slightly less than the foraging density

observed in March 2011 (total of 13,400 birds; 1.33 birds/ha) and March 2012 (total of 11,239 birds; 1.12 birds/ha).

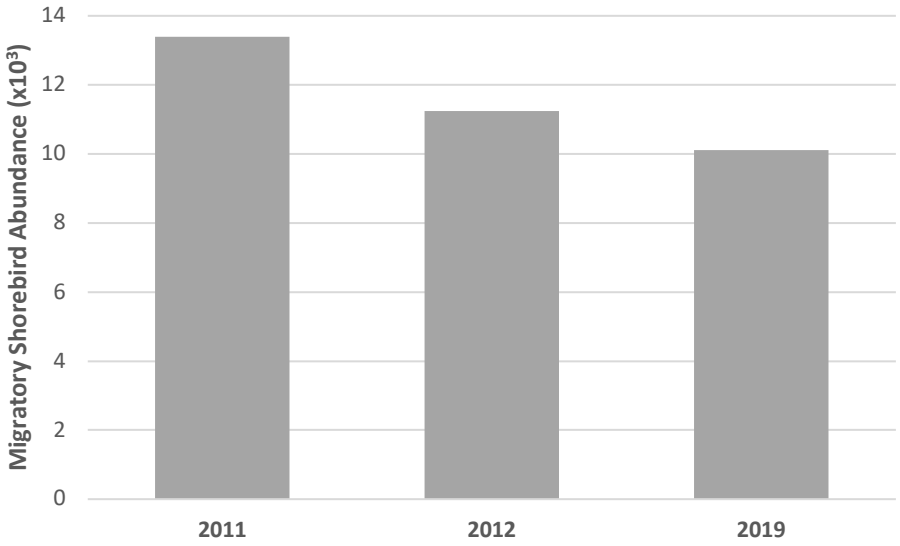

Figure 4.3.1 Abundance of migratory shorebirds on the Curtis Coast in March 2011, 2012 and 2019. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

The foraging density within the Fitzroy Estuary management unit was 0.9 birds/ha in 2019, compared to 2.6 birds/ha in 2011 and 2.3 birds/ha in 2012. The foraging density within the North Curtis Island management unit was 1.65 birds/ha in 2019, compared to 1.4 birds/ha in 2011 and 1.3 birds/ha in 2012. The foraging density within the MCR management unit was 0.85 birds/ha in 2019, compared to 0.6 birds/ha in 2011 and 0.5 birds/ha in 2012. The foraging density within the Port Curtis management unit was 0.74 birds/ha in 2019, compared to 0.73 birds/ha in 2011 and 0.65 birds/ha in 2012. It should be noted that the foraging densities were calculated using GHD's foraging habitat area calculation from 2011 (prior to the commencement of the WBDDP). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In March 2019, shorebird distribution was slightly skewed to the north (Table 4.3.2, Figure 4.3.2). There was one roost with >1000 birds; the Yellow Patch Entrance Sandbar, in North Curtis (1481 birds). There were a further five roosts with between 500 and 1000 birds: Cattle Point (847 birds) in the Fitzroy Estuary, the west side of the Entrance Sandbar (591 birds) in the North Curtis management unit, the south-east end of Curtis Island in Port Curtis (790 birds), and the Mundoolin Rocks east claypan (788 birds) and Central Mangrove Island (621) in the MCR management unit. There were 18 roosts with between 100 and 500 birds: five in the Fitzroy Estuary, three in North Curtis, four in Port Curtis, and six in MCR. One site at the Cheetham Salt Works (Port Alma Salt Works East #1) was surveyed from the road, and 480 birds were recorded at that site – 328 Sharp-tailed Sandpiper, 144 Red-necked Stint, six Common Greenshank and two Marsh Sandpiper.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in March 2019. The species accounts are given in descending order of abundance and are followed by a discussion of the non-migratory shorebirds present during the survey. Note that the shorebird population estimations utilised in the last report (Wildlife Unlimited, 2018) have been replaced in the current report by the recent work of Hansen et al. (2016) and in some cases are significantly different. Where Hansen et al. (2016) give population estimates in the form of a range (e.g. the 180,000 to 275,000 given for Lesser Sand Plover), the lower values are adopted for calculating the significance of counts made during surveys.

Red-necked Stint (*Calidris ruficollis*), the most abundant shorebird recorded in March (Louis Backstrom)

Table 4.3.2 Place names of the roosts with the greatest abundance of migratory shorebirds in March 2019

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-999	1. Cattle Point
	100-499	1. North East Shell Point 2. Curlew Spit Claypan 3. West side of Deception Pt. Claypan 4. Rundle Beach 3. Eupatoria Point
North Curtis	>1000	1. Yellow Patch entrance sandbar
	500-999	1. Entrance Sandbar west side
	100-499	1. YP Sandbar – Mangrove Roost 2. Keppell Creek Entrance 3. Mud Bay, Cape Capricorn
Port Curtis	>1000	Nil
	500-999	1. South-east end of Curtis Island
	100-499	1. Facing Island Sandbar 2. Bund 2 3. Facing Island 4 4. Facing Island Claypan
MCR	>1000	Nil
	500-999	1. Mundoolin Rocks east claypan 2. Central Mangrove Island
	100-499	1. Upper 7 Mile Creek Inlet 2. Williams Bay, Mangrove Bay 3. Spit End 4. Morris Creek Mouth 5. Rodds Harbour Sand Island 6. Mangrove Island 2

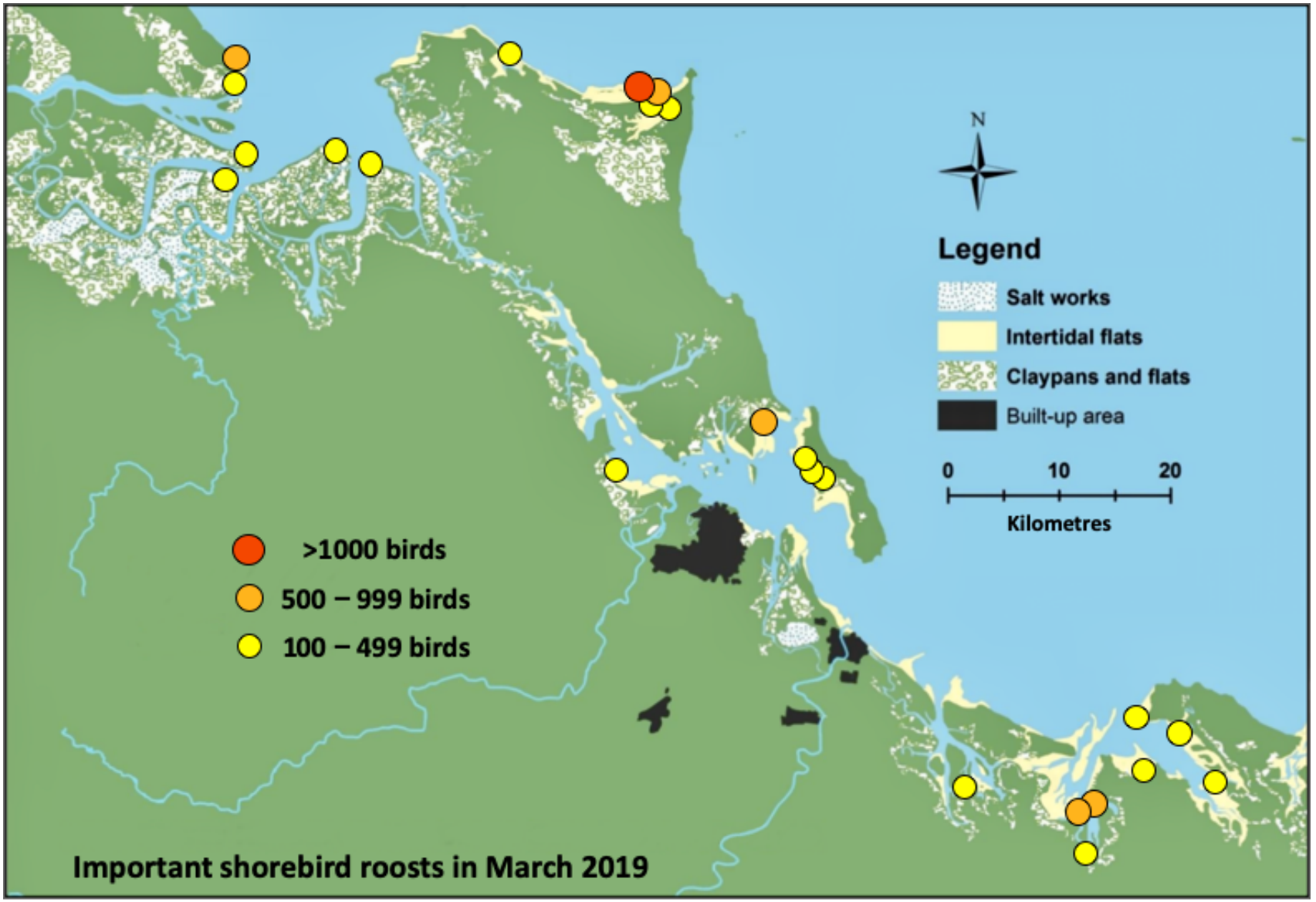

Figure 4.2.3 Important shorebird roosts on the Curtis Coast in March 2019

4.3.3 Red-necked Stint (*Calidris ruficollis*)

EAAF population estimate (Hansen, 2016): 475,000

1% population estimate for internationally significant sites: 4,750

0.1% population estimate for nationally significant sites: 475

EAAF population estimate (Wetlands International, 2019): 315,000

The Red-necked Stint was the most abundant migratory shorebird on the Curtis Coast in March 2019, with 1,881 birds recorded at high tide roosts during the survey. This was significantly (2,320) less birds than the number counted in March 2011 (4201) and 1,778 less birds than were counted in March 2012 (3,659). Red-necked Stint were present at 22 sites, one of which was of *national significance*: the Yellow Patch Entrance Sandbar, in the North Curtis management unit supported 480 birds. The foraging density was highest in the North Curtis management unit. Red-necked Stints present a particular problem when estimating numbers based on counts at high tide roosts. The species is flexible in its use of feeding habitat and is known to move to coastal wetlands during the high tide (Higgins & Davies, 1996; Hollands & Minton, 2012; Minton et al., 2012). It has been postulated that stint distribution at the Curtis Coast may relate to the amount of moisture in the claypans and this in turn relates to tide height and recent rainfall (GHD, 2011d; Sandpiper Ecological Surveys, 2012a). It is unclear whether the population of Red-necked Stints in the EAAF is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly east of 129°E (Clemens et al., 2016).

Table 4.3.3 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	4	714	0.36
Fitzroy Estuary	7	694	0.30
Port Curtis	5	259	0.11
MCR	6	214	0.05
Totals	***22***	***1,881***	***0.18***

4.3.4 Bar-tailed Godwit (*Limosa lapponica*)

EAAF population estimate (Hansen, 2016): 325,000

1% population estimate for internationally significant sites: 3,250

0.1% population estimate for nationally significant sites: 325

EAAF population estimate (Wetlands International, 2019): 279,000

The Bar-tailed Godwit was the second most abundant migratory shorebird on the Curtis Coast in March 2019, with 1,650 birds recorded at high tide roosts during the survey. This was 502 fewer birds than the number counted in March 2011 (2,157) and 922 less birds than were counted in March 2012 (2,572). Bar-tailed Godwits were present at 30 sites. The foraging density was highest in the North Curtis management unit. Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia. The decline is especially strong north of 27.8°S, which includes the study site (Clemens et al., 2016).

Table 4.3.4 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	6	555	0.17
North Curtis	6	499	0.25
Port Curtis	7	354	0.15
Fitzroy Estuary	11	242	0.10
Totals	***30***	***1,650***	***0.16***

4.3.5 Grey-tailed Tattler (*Tringa brevipes*)

EAAF population estimate (Hansen, 2016): 70,000

1% population estimate for internationally significant sites: 700

0.1% population estimate for nationally significant sites: 70

EAAF population estimate (Wetlands International, 2019): 44,000

The Grey-tailed Tattler was the third most abundant migratory shorebird on the Curtis Coast in March 2019, with 1,418 birds recorded at high tide roosts during the survey. This was 414 more birds than the number counted in March 2011 (1,004), and 495 more birds than were counted in March 2012 (923). The number of Grey-tailed Tattler present on the Curtis Coast in March 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Grey-tailed Tattlers were present at 35 sites, three of which were of *national significance*. These included Central Mangrove Island in the MCR management unit (537 birds), as well as the Yellow Patch Sandbar Mangrove Roost (240 birds) in North Curtis and the south-east end of Curtis Island, in Port Curtis (171 birds). The foraging density was highest in the MCR and North Curtis management units. The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia suggest it may be increasing, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.3.5 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	12	678	0.20
North Curtis	7	398	0.20
Port Curtis	11	286	0.12
Fitzroy Estuary	5	56	0.02
Totals	***35***	***1,418***	***0.14***

4.3.6 Lesser Sand Plover (*Charadrius mongolus*)

EAAF population estimate (Hansen, 2016): 180,000 – 275,000

1% population estimate for internationally significant sites: 1,800

0.1% population estimate for nationally significant sites: 180

EAAF population estimate (Wetlands International, 2019): 140,000

The Lesser Sand Plover was the fourth most abundant migratory shorebird on the Curtis Coast in March 2019, with 1,203 birds recorded at high tide roosts during the survey. This was 439 less birds than the number counted in March 2011 (1,642) but 246 more birds than were counted in March 2012 (957). Lesser Sand Plovers were present at 11 sites, three of which were of *national significance*: the Yellow Patch Entrance Sandbar (390 birds) at North Curtis, North East Shell Point in the Fitzroy Estuary (235 birds) and the Mundoolin Rocks east claypan (213 birds) in the MCR management unit. The foraging density was highest in the North Curtis and Fitzroy Estuary management units. The population of Lesser Sand Plovers is believed to be declining in the EAAF (Wetlands International, 2019) and in Australia, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.3.6 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	2	440	0.23
Fitzroy Estuary	3	379	0.16
MCR	4	299	0.09
Port Curtis	2	85	0.04
Totals	***11***	***1,203***	***0.12***

4.3.7 Great Knot (*Calidris tenuirostris*)

EAAF population estimate (Hansen, 2016): 425,000

1% population estimate for internationally significant sites: 4,250

0.1% population estimate for nationally significant sites: 425

EAAF population estimate (Wetlands International, 2019): 290,000

The Great Knot was the fifth most abundant migratory shorebird on the Curtis Coast in March 2019, with 920 birds recorded at high tide roosts during the survey. This was 468 more birds than the number counted in March 2011 (452) and 163 more birds than were counted in March 2012 (757). Great Knots were present at eight sites. The foraging density was highest in the North Curtis and Fitzroy Estuary management units. The population of Great Knots in the EAAF seems to be relatively stable (Clemens et al., 2016).

Table 4.3.7 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	2	347	0.18
Fitzroy Estuary	2	259	0.11
MCR	2	269	0.08
Port Curtis	2	45	0.02
Totals	***8***	***920***	***0.09***

4.3.8 Terek Sandpiper (*Xenus cinereus*)

EAAF population estimate (Hansen, 2016): 50,000

1% population estimate for internationally significant sites: 500

0.1% population estimate for nationally significant sites: 50

EAAF population estimate (Wetlands International, 2019): 50,000

The Terek Sandpiper was the sixth most abundant migratory shorebird on the Curtis Coast in March 2019, with 758 birds recorded at high tide roosts during the survey. This was 352 more birds than the number counted in March 2011 (406), and 506 more birds than were counted in March 2012 (252). The number of Terek Sandpiper present on the Curtis Coast in March 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Terek Sandpipers were present at 29 sites, seven of which were of *national significance*. These included: 'Mangrove Is 2' (84 birds), Dead Mangrove (79 birds), Central Mangrove Island (61 birds), and Bird Island (55 birds) in the MCR management unit, the Yellow Patch Sandbar Mangrove Roost (123) in North Curtis, Facing Island 4 (95 birds) and the Facing Island Sandbar (63 birds) in Port Curtis. The foraging density was highest in the MCR and North Curtis management units. It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). However, Australian data suggest the species is declining, particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.3.8 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	7	295	0.09
North Curtis	7	184	0.09
Port Curtis	7	193	0.08
Fitzroy Estuary	8	86	0.04
Totals	***29***	***758***	***0.08***

4.3.9 Whimbrel (*Numenius phaeopus*)

EAAF population estimate (Hansen, 2016): 65,000

1% population estimate for internationally significant sites: 650

0.1% population estimate for nationally significant sites: 65

EAAF population estimate (Wetlands International, 2019): 55,000

The Whimbrel was the seventh most abundant migratory shorebird on the Curtis Coast in March 2019, with 747 birds recorded at high tide roosts during the survey. This was 1,091 less birds than the number counted in March 2011 (1,838) and 515 less birds than were counted in March 2012 (1,262). The number of Whimbrel present on the Curtis Coast in March 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 67 sites, three of which were of *national significance*. These included the Keppel Creek entrance (167 birds) in the North Curtis management unit, the south east end of Curtis Island (107 birds) and the Colosseum Inlet Lagoon, in MCR (88 birds). The foraging density was highest in the North Curtis management unit. The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but there is no evidence of this at a continental scale in Australia and the data suggest an increase in the population north of 27.8°S (Clemens et al., 2016).

Table 4.3.9 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	13	306	0.20
Port Curtis	16	205	0.09
MCR	22	174	0.05
Fitzroy Estuary	16	62	0.03
Totals	***67***	***747***	***0.06***

4.3.10 Eastern Curlew (*Numenius madagascariensis*)

EAAF population estimate (Hansen, 2016): 35,000

1% population estimate for internationally significant sites: 350

0.1% population estimate for nationally significant sites: 35

EAAF population estimate (Wetlands International, 2019): 32,000

The Eastern Curlew was the eighth most abundant migratory shorebird on the Curtis Coast in March 2019, with 622 birds recorded at high tide roosts during the survey. This was 189 more birds than the number counted in March 2011 (433) and 259 more birds than were counted in March 2012 (363). The number of Eastern Curlew present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Eastern Curlew were present at 36 sites, three of which were of *national significance*. These included the south-east end of Curtis Island (213 birds) in the Port Curtis management unit, as well as Mundoolin Rocks opposite and the Mundoolin Rocks east claypan, both in the MCR management unit (50 and 99 birds respectively). The foraging density was highest in the Port Curtis management unit. The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and also on the Australian continent particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.3.10 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Port Curtis	9	268	0.10
MCR	11	263	0.08
North Curtis	9	77	0.04
Fitzroy Estuary	7	14	0.005
Totals	***36***	***622***	***0.06***

4.3.11 Greater Sand Plover (*Charadrius leschenaultia*)

EAAF population estimate (Hansen, 2016): 200,000 – 300,000

1% population estimate for internationally significant sites: 2,000

0.1% population estimate for nationally significant sites: 200

EAAF population estimate (Wetlands International, 2019): 79,000

The Greater Sand Plover was the ninth most abundant migratory shorebird on the Curtis Coast in March 2019, with 308 birds recorded at high tide roosts during the survey. This was 99 more birds than the number counted in March 2011 (209), and 52 more birds than were counted in March 2012 (256). Greater Sand Plovers were present at eight sites. The foraging density was highest in the Fitzroy Estuary and North Curtis management units. The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019) but there is no evidence of this at a continental scale in Australia though the data do suggest a decrease in the population south of 27.8°S and west of 129°E (Clemens et al., 2016).

Table 4.3.11 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	3	137	0.07
North Curtis	2	134	0.07
Port Curtis	1	29	0.01
MCR	2	8	0.002
Totals	***8***	***308***	***0.03***

4.3.12 Curlew Sandpiper (*Calidris ferruginea*)

EAAF population estimate (Hansen, 2016): 90,000

1% population estimate for internationally significant sites: 900

0.1% population estimate for nationally significant sites: 90

EAAF population estimate (Wetlands International, 2019): 135,000

The Curlew Sandpiper was the tenth most abundant migratory shorebird on the Curtis Coast in March 2019, with 201 birds recorded at high tide roosts during the survey. This was 96 more birds than the number counted in March 2011 (105), and 183 more birds than were counted in March 2012 (18). Curlew Sandpipers were present at eight sites, one of which was of *national significance*: Cattle Point, in the Fitzroy Estuary management unit, supported 106 birds. The foraging density was also highest in the Fitzroy Estuary. Curlew Sandpiper are declining in the EAAF, though the decline is more rapid south of 27.8°S (Clemens et al., 2016).

Table 4.3.12 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	3	113	0.05
North Curtis	2	56	0.03
Port Curtis	2	31	0.01
MCR	1	1	<0.001
Totals	***8***	***201***	***0.02***

4.3.13 Other migratory shorebirds

There were a further nine species of migratory shorebird recorded on the Curtis Coast in March 2019. They were (in order of descending abundance): Sharp-tailed Sandpiper (168 birds), Grey Plover (84 birds), Sanderling (44 birds), Ruddy Turnstone (39 birds), Broad-billed Sandpiper (21 birds), Common Greenshank (16 birds), Pacific Golden Plover (14 birds), Red Knot (8 birds) and Marsh Sandpiper (1 bird). Together, these species made up approximately 4% of the total migratory shorebird count for the survey. Most individuals representing these species were detected in the North Curtis Island management unit.

4.3.14 Non-migratory shorebirds

There were 807 non-migratory shorebirds recorded on the Curtis Coast in January 2019, representing eight species. They were (in order of descending abundance): Red-capped Plover (500 birds), Pied Oystercatcher (266 birds), Black-winged Stilt and Masked Lapwing (11 birds each), Red-necked Avocet (7 birds), Black-fronted Dotterel (5 birds), Beach Stone-curlew (4 birds) and Sooty Oystercatcher (3 birds). The key assumption making

roost counting the preferred method for estimating migratory shorebird numbers – that the majority of birds congregate in communal roosts at high tide – does not hold for all non-migratory species. Consequently, the counts obtained during the survey were unlikely to give an accurate estimate of the populations of these species on the Curtis Coast. Nonetheless, collection of the data makes the survey comparable with the *Shorebird 2020* counts, helps to describe the distributions of the species, may be a valid index of the populations and has intrinsic value as a record of presence and abundance. No further analysis was conducted because non-migratory species are beyond the scope of the ERMP (Gladstone Ports Corporation, 2016).

4.3.15 Low tide surveys

There were 38 low tide surveys conducted on the Curtis Coast in January 2019. In total, 788 minutes (approximately 13 hours) were spent surveying foraging migratory shorebirds (Table 4.3.1). A total of 4,057 birds were counted during the low tide surveys, representing 19 species. The species with over 50 individuals counted at low tide were (in order of descending abundance): Red-necked Stint (1,372 birds), Great Knot (726 birds), Lesser Sand Plover (633 birds), Bar-tailed Godwit (474 birds), Eastern Curlew (169 birds), Curlew Sandpiper (163 birds), Whimbrel (159 birds), Grey-tailed Tattler (80 birds), Greater Sand Plover (72 birds) and Terek Sandpiper (59 birds). Sharp-tailed Sandpiper (43 birds), Red Knot (26 birds), Sanderling (23 birds), Pacific Golden Plover (18 birds), Black-tailed Godwit (16 birds), Grey Plover (12 birds), Common Greenshank (6 birds), Broad-billed Sandpiper (4) and Common Sandpiper (2 birds) made up the remainder. The low tide counts are not strictly comparable with previous surveys because shorebirds move quickly around the intertidal zone in response to the movement of the tide. It is therefore difficult to replicate surveys even when they occur at the same location.

Pacific Golden Plover (*Pluvialis fulva*), a species commonly recorded during low tide surveys (Louis Backstrom)

4.4 August

The surveys in August target overwintering migratory shorebirds, as well as those individuals who are returning from migration early (Table 3.3.2). Birds may overwinter in the region for a number of reasons. A failure to generate adequate fat reserves in the summer to survive complete migration is probably the most common explanation. Birds which arrived in Australia for the first time earlier in the year may not have reached sexual maturity, and so have no need to undergo a complete return migration. Some of the migratory shorebirds overwintering on the Curtis Coast may have made a partial migration from their summer foraging habitat further south. Similarly, birds that left the country but did not reach the breeding grounds, or those who failed to reproduce successfully may return earlier than others. The results from the surveys conducted in August 2019 are compared below to the results of surveys conducted in August 2011 and August 2012.

4.4.1 Survey Coverage

A total of 153 high tide surveys were completed in August, and the total survey time at high tide was 966 minutes (approximately 16 hours). A total of 37 low tide surveys were conducted, and the total survey time at low tide was 649 minutes (approximately 11 hours). The survey effort during August is presented in Table 4.4.1. The weather during the August field trip was variable; 55% of all surveys were conducted in winds between 20 and 28 km/h, which is less than ideal. However, this was the strongest wind experienced during the survey period; 40% of the surveys occurred in light winds (12 to 19 km/h) and the remaining 5% were conducted in calm conditions.

Table 4.4.1 Summary of survey effort in August: number of sites and elapsed survey time at each location

Location	**High Tide**		**Low Tide**	
	Sites	**Duration (mins)**	**Sites**	**Duration (mins)**
Port Curtis	44	223	17	170
Fitzroy Estuary	23	233	6	107
North Curtis Island	37	142	3	119
Mundoolin-Colosseum	28	156	9	159
Rodd's Peninsula	17	149	2	94
Cheetham Salt Works	4	63	0	0
Total	**153**	**966**	**37**	**649**

4.4.2 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in August 2019 was 2,407 (see Figure 4.4.1). Only individuals identified to species level were included in this total; a further two migratory shorebird 'types' could not be identified to species level (unidentified small and medium waders). A total of 15 migratory shorebird species were identified during the high tide roost

counts – one more than in August 2011 and the same as that recorded in August 2012 (see Figure 4.4.2). In 2011, Eastern Curlew was the most abundant shorebird present on the Curtis Coast in August. In 2012, it was the Bar-tailed Godwit. Interestingly, these species were not present in large numbers in 2019. In 2019, the most abundant species, listed in descending order, were Red-necked Stint, Grey-tailed Tattler, Eastern Curlew, Lesser Sand Plover and Whimbrel. The foraging density of migratory shorebirds across the Curtis Coast in August 2019 was 0.24 birds/ha; this is slightly less than the foraging density observed in August 2011 (total of 3,185 birds; 0.32 birds/ha) and August 2012 (total of 4,120 birds; 0.41 birds/ha).

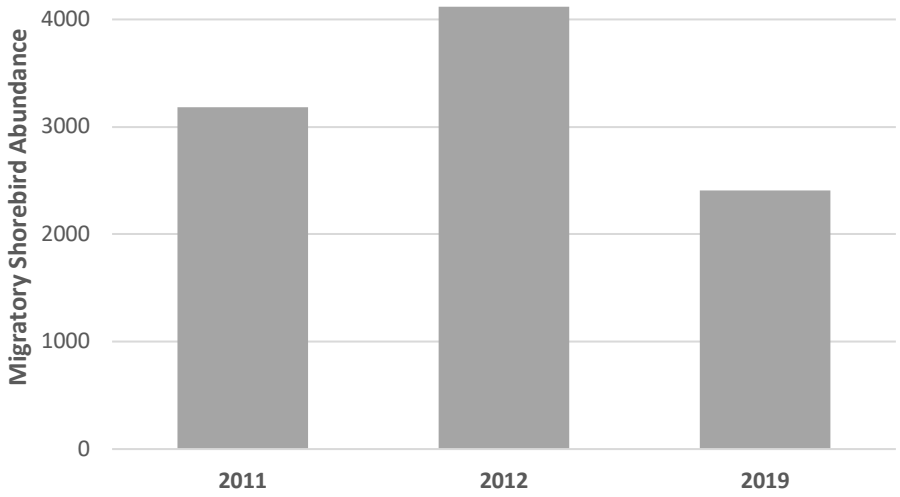

Figure 4.4.1 Abundance of migratory shorebirds on the Curtis Coast in August 2011, 2012 and 2019. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

The foraging density within the Fitzroy Estuary management unit was 0.52 birds/ha in 2019, compared to 0.61 birds/ha in 2011 and 0.67 birds/ha in 2012. The foraging density within the North Curtis Island management unit was 0.14 birds/ha in 2019, compared to 0.35 birds/ha in 2011 and 0.45 birds/ha in 2012. The foraging density within the MCR management unit was 0.24 birds/ha in 2019, compared to 0.2 birds/ha in 2011 and 0.4 birds/ha in 2012. The foraging density within the Port Curtis management unit was 0.03 birds/ha in 2019, compared to 0.16 birds/ha in 2011 and 0.14 birds/ha in 2012. It should be noted that the foraging densities were calculated using GHD's foraging habitat area calculation from 2011 (prior to the commencement of the WBDDP). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

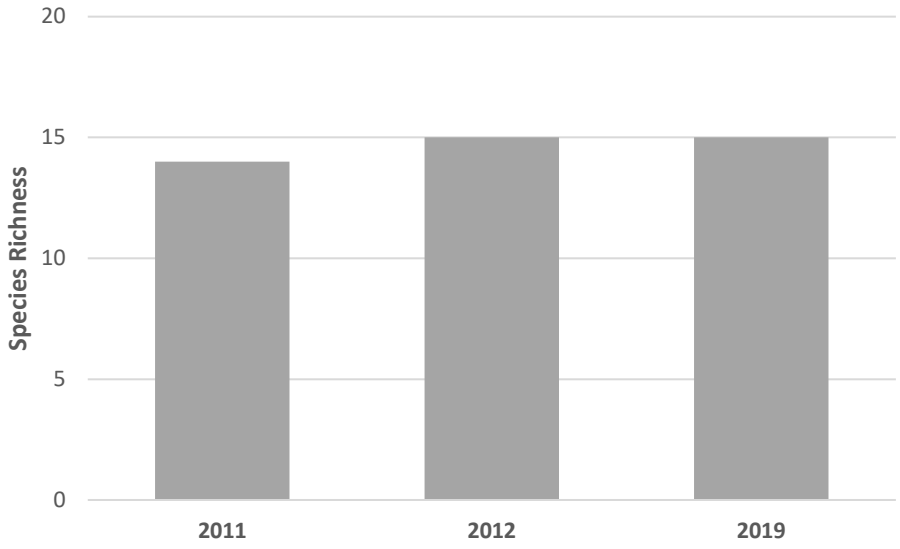

Figure 4.4.2 Species richness of migratory shorebirds on the Curtis Coast in August 2011, 2012 and 2019.

In August 2019, shorebird distribution was skewed to the north, with over half of the shorebirds counted located in the Fitzroy Estuary (Table 4.4.2). There were no roosts that supported more than 500 birds in August (Figure 4.4.2). There were seven roosts with between 100 and 500 birds: four in the Fitzroy Estuary and three in MCR. The two roosts with highest abundance were the 'Curlew Spit mangrove 2' site (389 birds) and Cattle Point (374 birds), both in the Fitzroy Estuary.

Due to the low numbers of shorebirds present on the Curtis Coast in August 2019, species accounts are given below for each of the five most abundant migratory shorebirds during the survey. The species accounts are given in descending order of abundance and are followed by a general discussion of the other migratory and non-migratory shorebirds present during the survey, as well as a brief discussion of the salt works surveys that were conducted. Note that the shorebird population estimations utilised in the last report (Wildlife Unlimited, 2018) have been replaced by in the current report by the recent work of Hansen et al. (2016) and in some cases are significantly different. Where Hansen et al. (2016) give population estimates in the form of a range (e.g. the 180,000 to 275,000 given for Lesser Sand Plover), the lower values are adopted for calculating the significance of counts made during surveys.

Table 4.4.2 Place names of the roosts with the greatest abundance of migratory shorebirds in August 2019

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-999	Nil
	100-499	1. Curlew Spit mangrove 2 2. Cattle Point 3. North East Shell Point 4. Curlew Spit Claypan
North Curtis	>1000	Nil
	500-999	Nil
	100-499	Nil
Port Curtis	>1000	Nil
	500-999	Nil
	100-499	Nil
MCR	>1000	Nil
	500-999	Nil
	100-499	1. Spit End 2. Central Mangrove Island 3. Mangrove Is 2

The alumina plant near Parsons Point on the first survey morning in August (Elliot Leach, Wildlife Unlimited)

4.4.3 Red-necked Stint (*Calidris ruficollis*)

EAAF population estimate (Hansen, 2016): 475,000

1% population estimate for internationally significant sites: 4,750

0.1% population estimate for nationally significant sites: 475

EAAF population estimate (Wetlands International, 2019): 315,000

The Red-necked Stint was the most abundant migratory shorebird on the Curtis Coast in August 2019, with 1,145 birds recorded at high tide roosts during the survey. This was 554 more birds than the number counted in August 2011 (591) and 512 more birds than were counted in August 2012 (633). Red-necked Stint were present at 16 sites. The foraging density was highest in the Fitzroy Estuary management unit. Red-necked Stints present a particular problem when estimating numbers based on counts at high tide roosts. The species is flexible in its use of feeding habitat and is known to move to coastal wetlands during the high tide (Higgins & Davies, 1996; Hollands & Minton, 2012; Minton et al., 2012). It has been postulated that stint distribution at the Curtis Coast may relate to the amount of moisture in the claypans and this in turn relates to tide height and recent rainfall (GHD, 2011d; Sandpiper Ecological Surveys, 2012a). It is unclear whether the population of Red-necked Stints in the EAAF is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly east of 129°E (Clemens et al., 2016).

Table 4.4.3 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	8	954	0.4
MCR	4	120	0.04
North Curtis	3	63	0.03
Port Curtis	1	8	0.003
Totals	***16***	***1,145***	***0.11***

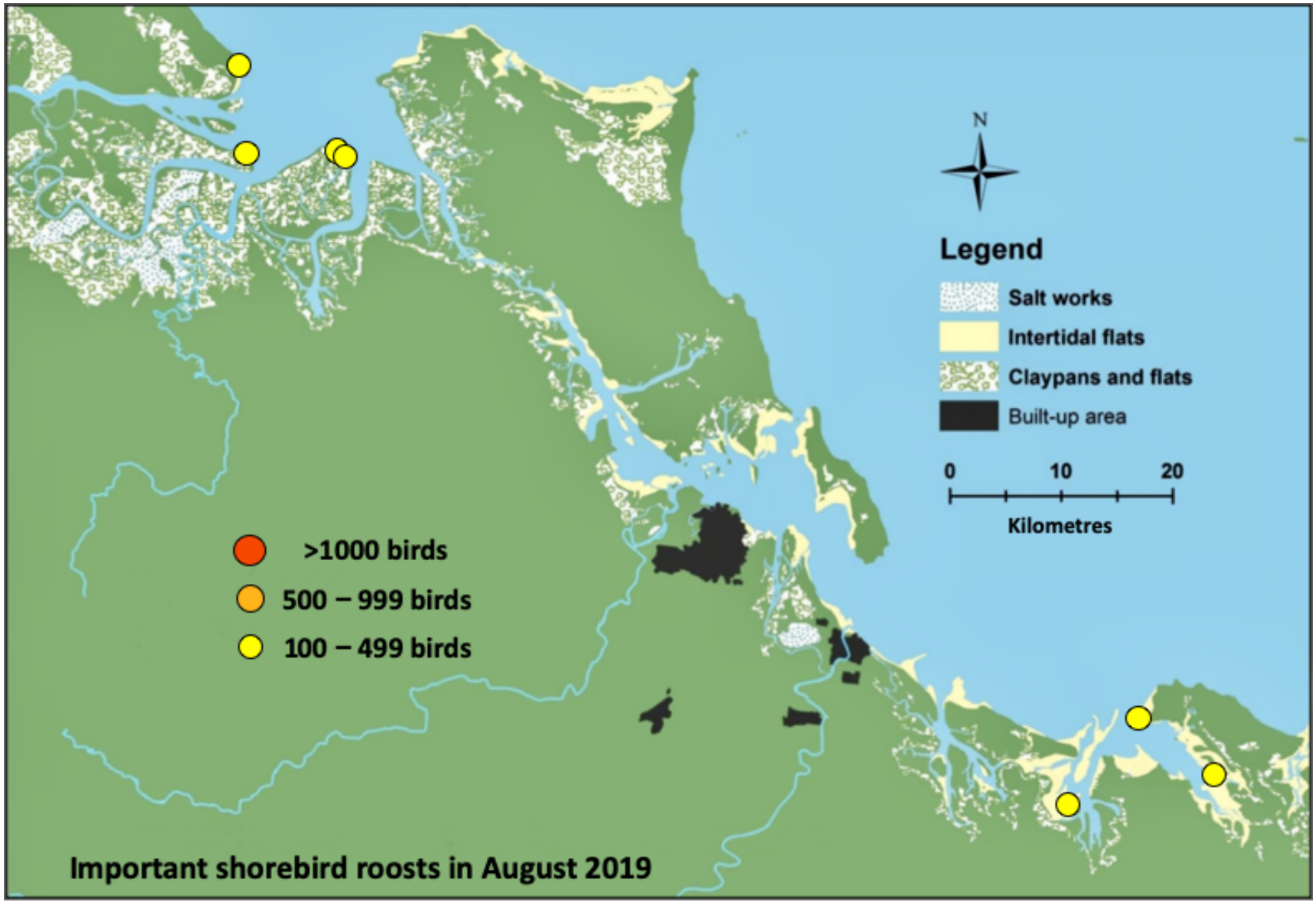

Figure 4.4.2 Important shorebird roosts on the Curtis Coast in August 2019

4.4.4 Grey-tailed Tattler (*Tringa brevipes*)

EAAF population estimate (Hansen, 2016): 70,000

1% population estimate for internationally significant sites: 700

0.1% population estimate for nationally significant sites: 70

EAAF population estimate (Wetlands International, 2019): 44,000

The Grey-tailed Tattler was the second most abundant migratory shorebird on the Curtis Coast in August 2019, with 383 birds recorded at high tide roosts during the survey. This was 15 more birds than the number counted in August 2011 (368), and 78 more birds than were counted in August 2012 (305). Grey-tailed Tattlers were present at ten sites, three of which were of *national significance*. These included Central Mangrove Island (125 birds), Mangrove Island 2 (100 birds) and the Morris Creek Mouth (78) in the MCR management unit. The foraging density was highest in the MCR. The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia suggest it may be increasing, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.4.4 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in August 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	3	303	0.09
North Curtis	3	36	0.02
Fitzroy Estuary	3	33	0.01
Port Curtis	1	11	0.004
Totals	***10***	***383***	***0.03***

4.4.5 Eastern Curlew (*Numenius madagascariensis*)

EAAF population estimate (Hansen, 2016): 35,000

1% population estimate for internationally significant sites: 350

0.1% population estimate for nationally significant sites: 35

EAAF population estimate (Wetlands International, 2019): 32,000

The Eastern Curlew was the third most abundant migratory shorebird on the Curtis Coast in August 2019, with 364 birds recorded at high tide roosts during the survey. This was 503 less birds than the number counted in August 2011 (867) and 548 less birds than were counted in August 2012 (912). The number of Eastern Curlew present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Eastern Curlew were present at 24 sites, three of which were of *national significance*. These included the Upper 7 Mile Creek Inlet (55 birds) and the Colosseum Inlet Mangrove Ck Saltpan (46 birds) in the MCR management unit; the Yellow Patch Entrance Sandbar, in North Curtis, supported 44 birds. The foraging density was highest in the North Curtis management unit. The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and also on the Australian continent – particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.4.5 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in August 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	8	137	0.07
MCR	5	170	0.05
Fitzroy Estuary	8	44	0.02
Port Curtis	3	13	0.005
Totals	***24***	***364***	***0.04***

4.4.6 Lesser Sand Plover (*Charadrius mongolus*)

EAAF population estimate (Hansen, 2016): 180,000 – 275,000

1% population estimate for internationally significant sites: 1,800

0.1% population estimate for nationally significant sites: 180

EAAF population estimate (Wetlands International, 2019): 140,000

The Lesser Sand Plover was the fourth most abundant migratory shorebird on the Curtis Coast in August 2019, with 172 birds recorded at high tide roosts during the survey. This was 198 less birds than the number counted in August 2011 (370) and 40 less birds than were counted in August 2012 (212). Lesser Sand Plovers were present at six sites. The foraging density was highest in the Fitzroy Estuary. The population of Lesser Sand Plovers is believed to be declining in the EAAF (Wetlands International, 2019) and in Australia, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.4.6 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in August 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	2	103	0.04
Port Curtis	1	29	0.01
North Curtis	1	16	0.008
MCR	2	24	0.007
Totals	***6***	***172***	***0.02***

4.4.7 Whimbrel (*Numenius phaeopus*)

EAAF population estimate (Hansen, 2016): 65,000

1% population estimate for internationally significant sites: 650

0.1% population estimate for nationally significant sites: 65

EAAF population estimate (Wetlands International, 2019): 55,000

The Whimbrel was the fifth most abundant migratory shorebird on the Curtis Coast in August 2019, with 100 birds recorded at high tide roosts during the survey. This was 270 less birds than the number counted in August 2011 (370) and 112 less birds than were counted in August 2012 (212). Whimbrel were present at 17 sites. The foraging density was highest in the North Curtis management unit. The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but there is no evidence of this at a continental scale in Australia and the data suggest an increase in the population north of 27.8°S (Clemens et al., 2016).

Table 4.4.7 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in August 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	7	55	0.02
North Curtis	5	28	0.01
Fitzroy Estuary	4	14	0.005
Port Curtis	1	3	0.001
Totals	***17***	***100***	***0.01***

4.4.8 Other migratory shorebirds

There were a further ten species of migratory shorebird recorded on the Curtis Coast in August 2019. The abundance of each species was less than 100 birds. They were (in order of descending abundance): Bar-tailed Godwit (69 birds), Curlew Sandpiper (56 birds), Great Knot (43 birds), Marsh Sandpiper (24 birds), Terek Sandpiper (ten birds), Red Knot and Ruddy Turnstone (nine birds each), Pacific Golden Plover and Common Greenshank (eight birds each), Double-banded Plover (five birds) and Grey Plover (two birds). Together, these species made up approximately 10% of the total migratory shorebird count for the survey. Most individuals representing these species were found in the Fitzroy Estuary management unit.

4.4.9 Non-migratory shorebirds

There were 630 non-migratory shorebirds recorded on the Curtis Coast in August 2019, representing seven species. They were (in order of descending abundance): Red-capped Plover (376 birds), Pied Oystercatcher (198 birds), Masked Lapwing (36 birds), Beach Stone-curlew (ten birds), Sooty Oystercatcher (six birds), Black-fronted Dotterel (three birds) and Black-winged Stilt (one bird). The key assumption making roost counting the preferred method for estimating migratory shorebird numbers – that the majority of birds congregate in communal roosts at high tide – does not hold for all non-migratory species. Consequently, the counts obtained during the survey were unlikely to give an accurate estimate of the populations of these species on the Curtis Coast. Nonetheless, collection of the data makes the survey comparable with the *Shorebird 2020* counts, helps to describe the distributions of the species, may be a valid index of the populations and has intrinsic value as a record of presence and abundance. No further analysis was conducted because non-migratory species are beyond the scope of the ERMP (Gladstone Ports Corporation, 2016).

4.4.10 Salt works surveys

Due to the timing of the tides on the last few days of the survey, it was not possible to access the salt works. Instead, two team members visited the salt works the day after the five-day survey period finished. They visited two sites within the salt works: Bajool NW (where only 29 Black-winged Stilts were counted) and the South Cheetham Salt Fields. At the latter site, 429 birds were counted, including 349 Black-winged Stilt, 57 Red-necked Avocet, 24 Marsh Sandpiper, 22 Curlew Sandpiper, five Bar-tailed Godwit and one Masked Lapwing.

4.4.11 Low tide surveys

There were 37 low tide surveys conducted on the Curtis Coast in August 2019. In total, 649 minutes (approximately 11 hours) were spent surveying foraging migratory shorebirds (Table 4.4.1). A total of 320 birds were counted during the low tide surveys, representing nine species. In order of descending abundance, these species were: Eastern Curlew (152 birds), Bar-tailed Godwit (59 birds), Red-necked Stint (38 birds), Lesser Sand

Plover (34 birds), Grey-tailed Tattler (18 birds), Whimbrel (13 birds), Double-banded Plover (four birds), Greater Sand Plover and Terek Sandpiper with one bird each. The low tide counts are not strictly comparable with previous surveys because shorebirds move quickly around the intertidal zone in response to the movement of the tide. It is therefore difficult to replicate surveys even when they occur at the same location.

Returning to the jetty after a day of shorebird surveys in the Colosseum Inlet and along Rodds Peninsula in August (Elliot Leach, Wildlife Unlimited)

4.5 October

The surveys in October target overwintering migratory shorebirds, as well as those migratory shorebirds that are beginning to return to the region following the Austral winter (Section 4.4, Table 3.3.2). An October survey was not completed in 2011; therefore, the results discussed below make comparisons only to the data that were collected in October 2012.

4.5.1 Survey Coverage

A total of 165 high tide surveys were completed in October, and the total survey time at high tide was 1,257 minutes (approximately 21 hours). A total of 32 low tide surveys were conducted, and the total survey time at low tide was 491 minutes (approximately eight hours). The survey effort in October is presented in Table 4.5.1. The weather during the October field trip was variable; 50% of high tide surveys were conducted in good counting conditions with winds below 20km/h, but only 12.5% of low tide surveys were conducted in good counting conditions. Thirty high tide surveys were conducted with winds between 29 and 38km/h. Eighteen low tide surveys were conducted with winds between 29 and 38km/h, and nine were conducted in winds above 39 km/h.

Table 4.5.1 Summary of survey effort in October: number of sites and elapsed survey time at each location

Location	**High Tide**		**Low Tide**	
	Sites	**Duration (mins)**	**Sites**	**Duration (mins)**
Port Curtis	48	295*	15	126
Fitzroy Estuary	23	264	6	112
North Curtis Island	39	244*	Nil	Nil
Mundoolin-Colosseum	28	274	8	188
Rodd's Peninsula	20	138	3	65
Cheetham Salt Works	7	60*	Nil	Nil
Total	**165**	**1,275**	**32**	**491**

**Some sites (15) did not have complete data on count duration; the total is therefore an underestimate of total survey time.*

4.5.2 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in October 2019 was 9,029 (see Figure 4.5.1). Only individuals identified to species level were included in this total; a further 260 birds could not be positively identified (160 of these were Sand Plover spp.; the rest were unidentified large, medium and small waders). A total of 19 migratory shorebird species were identified during the high tide roost counts, one more species than identified in 2012. The most abundant shorebirds on the Curtis Coast in October were the same in 2012 and 2019: Red-necked Stint, Bar-tailed Godwit and Eastern

Curlew. In 2019, the rest of the 'top ten' was (in descending order of abundance): Greater Sand Plover, Whimbrel, Grey-tailed Tattler, Lesser Sand Plover, Terek Sandpiper, Great Knot and Grey Plover. The foraging density of migratory shorebirds across the Curtis Coast in October 2019 was 0.9 bird/ha, slightly less than that observed in 2012 (total of 12,461 birds; 1.2 birds/ha).

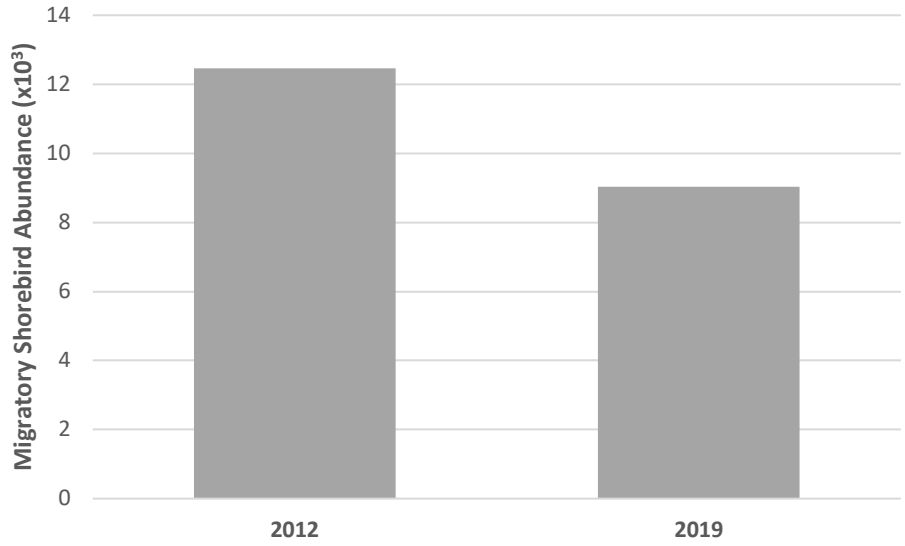

Figure 4.5.1 Abundance of migratory shorebirds on the Curtis Coast during October surveys over the life of the project to date. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the study.

The foraging density within the Fitzroy Estuary management unit was 0.99 birds/ha in 2019, compared to 2.2 birds/ha in 2012. The foraging density within the North Curtis Island management unit was 1.3 birds/ha in 2019, the same as that in 2012. The foraging density within the MCR management unit was 0.9 birds/ha in 2019, compared to 1 bird/ha in 2012. The foraging density within the Port Curtis management unit was 0.5 birds/ha in 2019, the same as that in 2012. It should be noted that the foraging densities were calculated using GHD's foraging habitat area calculation from 2011 (prior to the commencement of the WBDDP). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In October 2019, shorebird distribution was slightly skewed to the north (Table 4.5, Figure 4.5.2). There was one roost with >1000 birds: the Curlew Spit Claypan, in the Fitzroy Estuary (1,340 birds). There were a further four roosts with between 500 and 1000 birds: the Mundoolin Rocks east claypan (937 birds) in the MCR management unit; and Rundle Beach (581 birds), the Yellow Patch Entrance Sandbar (928 birds) and the south spit of Note Creek (536 birds) in the Fitzroy Estuary. There were 17 roosts with between 100 and 500 birds: three in the Fitzroy Estuary, three in North Curtis, five in Port Curtis, and six in MCR. The Cheetham Salt Works were surveyed in October, and a total of 3,111 birds were counted from three sites (3,058 from one site, the South Cheetham Salt Fields). These data are presented in Table 4.5 and Figure 4.5.2.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in October 2019. The species accounts are given in descending order of abundance and are followed by a discussion of the non-migratory shorebirds present during the survey, as well as the results of the surveys at the Cheetham Salt Works. Note that the shorebird population estimations utilised in the last report (Wildlife Unlimited, 2018) have been replaced by in the current report by the recent work of Hansen et al. (2016) and in some cases are significantly different. Where Hansen et al. (2016) give population estimates in the form of a range (e.g. the 180,000 to 275,000 given for Lesser Sand Plover), the lower values are adopted for calculating the significance of counts made during surveys.

Mt Larcom, photographed in October from the survey boat on the way to the Narrows, at the northern end of Port Curtis (Elliot Leach, Wildlife Unlimited)

Table 4.5.2 Place names of the roosts with the greatest abundance of migratory shorebirds in October 2019

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	1. Curlew Spit Claypan
	500-999	Nil
	100-499	1. Deception Pt Claypan west side 2. Cattle Point 3. Mackenzie Island – north side
North Curtis	>1000	Nil
	500-999	1. Yellow Patch entrance sandbar 2. Note Creek South Spit
	100-499	1. Little Barramundi Creek 2. Keppell Creek Entrance 3. Station Point Ck Sandbar
Port Curtis	>1000	Nil
	500-999	Nil
	100-499	1. Facing Island 4 2. Crab Point 3. Friend Point shoreline roost 4. Bund 3 5. South End Claypan
MCR	>1000	Nil
	500-999	1. Mundoolin Rocks east claypan
	100-499	1. Mangroves opposite Mund rocks 2. Williams Bay, Mangrove Bay 3. Central Mangrove Island 4. Spit End 5. Morris Creek Mouth 6. Bird Island
Cheetham Salt Works	>1000	1. South Cheetham Salt Fields
	500-999	Nil
	100-499	Nil

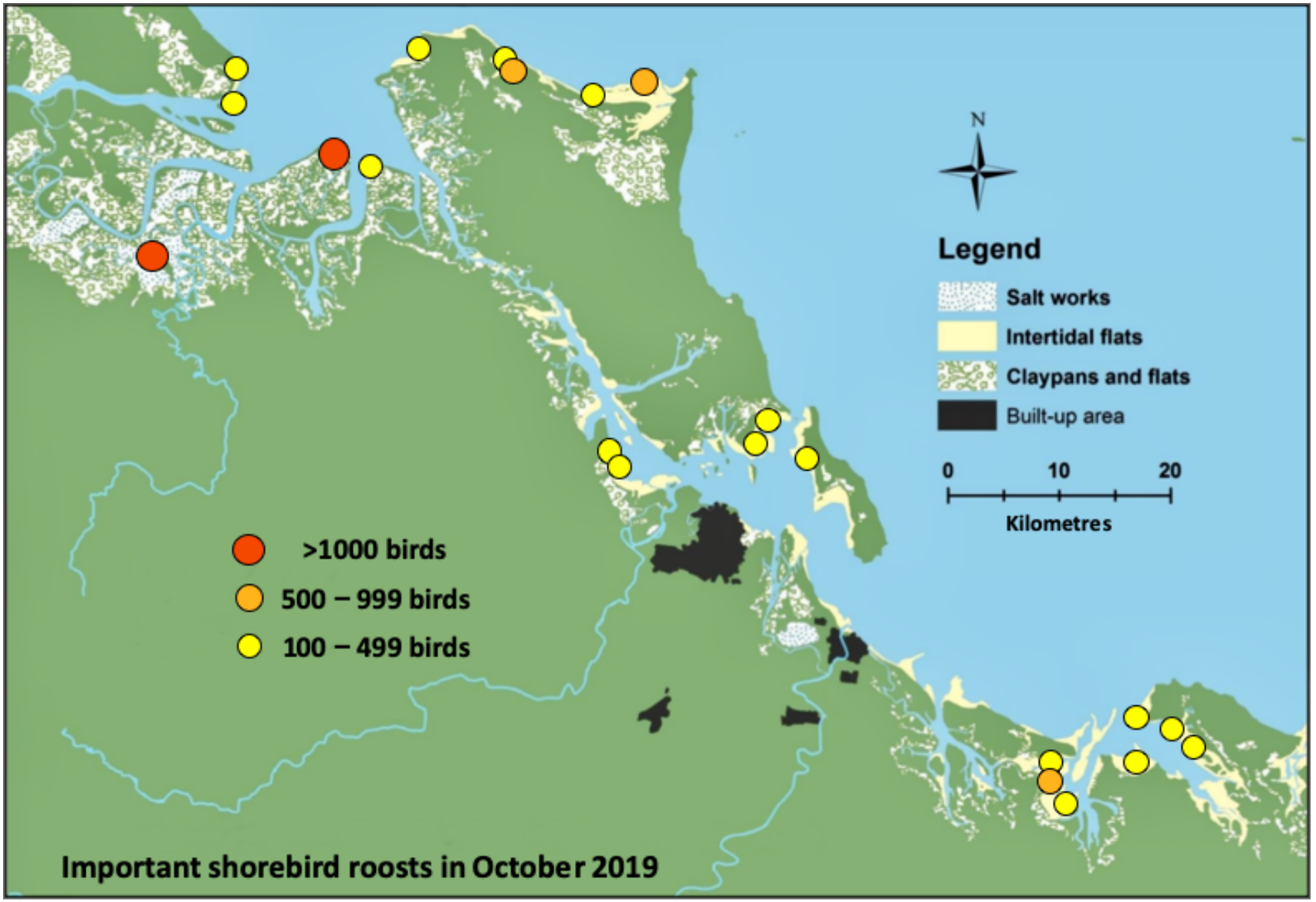

Figure 4.5.2 Important shorebird roosts on the Curtis Coast in October 2019

4.5.3 Red-necked Stint (*Calidris ruficollis*)

EAAF population estimate (Hansen, 2016): 475,000

1% population estimate for internationally significant sites: 4,750

0.1% population estimate for nationally significant sites: 475

EAAF population estimate (Wetlands International, 2019): 315,000

The Red-necked Stint was the most abundant migratory shorebird on the Curtis Coast in October 2019, with 2,388 birds recorded at high tide roosts during the survey. This was 847 less birds than the number counted in October 2012 (3,235). Red-necked Stint were present at 18 sites, one of which was of *national significance*: the Curlew Spit Claypan, in the Fitzroy Estuary, supported 777 birds. The foraging density was highest in the Fitzroy Estuary management unit. Red-necked Stints present a particular problem when estimating numbers based on counts at high tide roosts. The species is flexible in its use of feeding habitat and is known to move to coastal wetlands during the high tide (Higgins & Davies, 1996; Hollands & Minton, 2012; Minton et al., 2012). It has been postulated that stint distribution at the Curtis Coast may relate to the amount of moisture in the claypans and this in turn relates to tide height and recent rainfall (GHD, 2011d; Sandpiper Ecological Surveys, 2012a). It is unclear whether the population of Red-necked Stints in the EAAF is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly east of 129°E (Clemens et al., 2016).

Table 4.5.3 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	7	968	0.49
MCR	4	611	0.18
North Curtis	5	437	0.22
Port Curtis	2	372	0.15
Totals	***18***	***2,388***	***0.24***

4.5.4 Bar-tailed Godwit (*Limosa lapponica*)

EAAF population estimate (Hansen, 2016): 325,000

1% population estimate for internationally significant sites: 3,250

0.1% population estimate for nationally significant sites: 325

EAAF population estimate (Wetlands International, 2019): 279,000

The Bar-tailed Godwit was the second most abundant migratory shorebird on the Curtis Coast in October 2019, with 1,227 recorded at high tide roosts during the survey. This was 1,238 fewer birds than the number counted in October 2012 (2,465). Bar-tailed Godwits were present at 29 sites. The foraging density was highest in the North Curtis management unit. Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia. The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016).

Table 4.5.4 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	4	367	0.19
MCR	7	578	0.17
Fitzroy Estuary	10	196	0.08
Port Curtis	8	86	0.04
Totals	***29***	***1,227***	***0.12***

4.5.5 Eastern Curlew (*Numenius madagascariensis*)

EAAF population estimate (Hansen, 2016): 35,000

1% population estimate for internationally significant sites: 350

0.1% population estimate for nationally significant sites: 35

EAAF population estimate (Wetlands International, 2019): 32,000

The Eastern Curlew was the third most abundant migratory shorebird on the Curtis Coast in October 2019, with 1,098 birds recorded at high tide roosts during the survey. This was 373 less birds than were counted in October 2012 (1,471). The number of Eastern Curlew present on the Curtis Coast in January 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Eastern Curlew were present at 44 sites, eleven of which were of *national significance*. These included the South End Claypan (176 birds), in Port Curtis; the Yellow Patch Entrance Sandbar (96 birds), Mud Bay at Cape Capricorn (52 birds), the north spit of Note Creek (44 birds) and Little Barramundi Creek (41 birds) in the North Curtis management unit; the mangroves opposite Mund Rocks (80 birds), Williams Bay, Mangrove Bay (74 birds), Spit End (74 birds), Oaky Creek at Turkey Creek (64 birds), and the Mundoolin Rocks east claypan (62 birds) in the MCR management unit; and the Curlew Spit claypan (40 birds) in the Fitzroy Estuary. The foraging density was highest in the North Curtis management unit. The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and also on the Australian continent particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.5.5 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	9	327	0.17
MCR	11	397	0.12
Port Curtis	12	259	0.11
Fitzroy Estuary	12	115	0.05
Totals	***44***	***1,098***	***0.11***

4.5.6 Greater Sand Plover (*Charadrius leschenaultia*)

EAAF population estimate (Hansen, 2016): 200,000 – 300,000

1% population estimate for internationally significant sites: 2,000

0.1% population estimate for nationally significant sites: 200

EAAF population estimate (Wetlands International, 2019): 79,000

The Greater Sand Plover was the fourth most abundant migratory shorebird on the Curtis Coast in October 2019, with 931 birds recorded at high tide roosts during the survey. This was 599 more birds than were counted in October 2012 (342). Greater Sand Plovers were present at 11 sites, two of which were of *national significance*; the south spit of Note Creek (500 birds), in the North Curtis management unit, and the Mundoolin Rocks east claypan (200 birds) in the MCR management unit. No Greater Sand Plovers were recorded in Port Curtis. The foraging density was highest in North Curtis. The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019) but there is no evidence of this at a continental scale in Australia though the data do suggest a decrease in the population south of 27.8°S and west of 129°E (Clemens et al., 2016).

Table 4.5.6 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	5	563	0.29
Fitzroy Estuary	4	164	0.07
MCR	2	204	0.06
Port Curtis	Nil	Nil	Nil
Totals	***11***	***931***	***0.09***

4.5.7 Whimbrel (*Numenius phaeopus*)

EAAF population estimate (Hansen, 2016): 65,000

1% population estimate for internationally significant sites: 650

0.1% population estimate for nationally significant sites: 65

EAAF population estimate (Wetlands International, 2019): 55,000

The Whimbrel was the fifth most abundant migratory shorebird on the Curtis Coast in October 2019, with 806 birds recorded at high tide roosts during the survey. This was 299 less birds than were counted in October 2012 (1,262). The number of Whimbrel present on the Curtis Coast in October 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 72 sites, three of which were of *national significance*. These included the Yellow Patch Entrance Sandbar (106 birds) and the Station Point Creek Sandbar (67 birds) in the North Curtis Island management unit, as well as Facing Island 4 (68 birds) in Port Curtis. The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but there is no evidence of this at a continental scale in Australia and the data suggest an increase in the population north of 27.8°S (Clemens et al., 2016).

Table 4.5.7 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
North Curtis	17	306	0.16
Fitzroy Estuary	18	206	0.08
Port Curtis	20	180	0.07
MCR	17	114	0.03
Totals	***72***	***806***	***0.08***

4.5.8 Grey-tailed Tattler (*Tringa brevipes*)

EAAF population estimate (Hansen, 2016): 70,000

1% population estimate for internationally significant sites: 700

0.1% population estimate for nationally significant sites: 70

EAAF population estimate (Wetlands International, 2019): 44,000

The Grey-tailed Tattler was the sixth most abundant migratory shorebird on the Curtis Coast in October 2019, with 770 birds recorded at high tide roosts during the survey. This was 220 less birds than were counted in October 2012 (990). The number of Grey-tailed Tattler present on the Curtis Coast in October 2019 was of ***international significance*** (i.e. >1% of the total EAAF population of this species was present during the survey). Grey-tailed Tattlers were present at 24 sites, two of which were of *national significance*. These were Central Mangrove Island (222 birds) and Bird Island (72 birds) in the MCR management unit. The foraging density was highest in the MCR. The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia suggest it may be increasing, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.5.8 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	9	468	0.14
North Curtis	6	120	0.06
Port Curtis	6	114	0.05
Fitzroy Estuary	3	68	0.03
Totals	***24***	***770***	***0.08***

4.5.9 Lesser Sand Plover (*Charadrius mongolus*)

EAAF population estimate (Hansen, 2016): 180,000 – 275,000

1% population estimate for internationally significant sites: 1,800

0.1% population estimate for nationally significant sites: 180

EAAF population estimate (Wetlands International, 2019): 140,000

The Lesser Sand Plover was the seventh most abundant migratory shorebird on the Curtis Coast in October 2019, with 680 birds recorded at high tide roosts during the survey. This was 17 more birds than were counted in October 2012 (663). Lesser Sand Plovers were present at eight sites, two of which was of *national significance*: the Curlew Spit Claypan (259 birds), in the Fitzroy Estuary and the Yellow Patch Entrance Sandbar (190 birds) in the North Curtis Island management unit. The foraging density was highest in the Fitzroy Estuary and North Curtis management units. The population of Lesser Sand Plovers is believed to be declining in the EAAF (Wetlands International, 2019) and in Australia, particularly north of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.5.9 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	3	316	0.13
North Curtis	2	244	0.13
MCR	3	120	0.04
Port Curtis	Nil	Nil	Nil
Totals	***8***	***680***	***0.07***

4.5.10 Terek Sandpiper (*Xenus cinereus*)

EAAF population estimate (Hansen, 2016): 50,000

1% population estimate for internationally significant sites: 500

0.1% population estimate for nationally significant sites: 50

EAAF population estimate (Wetlands International, 2019): 50,000

The Terek Sandpiper was the eighth most abundant migratory shorebird on the Curtis Coast in October 2019, with 414 birds recorded at high tide roosts during the survey. This was 60 more birds than were counted in October 2012 (354). Terek Sandpipers were present at 16 sites, two of which were of *national significance*. These included: Facing Island 4 (126 birds) in Port Curtis management unit, and Central Mangrove Island (90 birds) in the MCR. The foraging density was highest in the Port Curtis and MCR management units. It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). However Australian data suggest the species is declining, particularly south of 27.8°S and east of 129°E (Clemens et al., 2016).

Table 4.5.10 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	6	168	0.05
Port Curtis	5	160	0.06
Fitzroy Estuary	3	60	0.02
North Curtis	2	26	0.01
Totals	***16***	***414***	***0.04***

4.5.11 Great Knot (*Calidris tenuirostris*)

EAAF population estimate (Hansen, 2016): 425,000

1% population estimate for internationally significant sites: 4,250

0.1% population estimate for nationally significant sites: 425

EAAF population estimate (Wetlands International, 2019): 290,000

The Great Knot was the ninth most abundant migratory shorebird on the Curtis Coast in October 2019, with 404 birds recorded at high tide roosts during the survey. This was 876 fewer birds than were counted in October 2012 (1,280). Great Knots were present at 11 sites. There were no Great Knots recorded in Port Curtis. The foraging density was highest in the North Curtis and Fitzroy Estuary management units. The population of Great Knots in the EAAF seems to be relatively stable (Clemens et al., 2016).

Table 4.5.11 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
MCR	4	229	0.07
Fitzroy Estuary	5	106	0.04
North Curtis	2	69	0.03
Port Curtis	Nil	Nil	Nil
Totals	***11***	***404***	***0.04***

4.5.12 Grey Plover (*Pluvialis squatarola*)

EAAF population estimate (Hansen, 2016): 80,000

1% population estimate for internationally significant sites: 800

0.1% population estimate for nationally significant sites: 80

EAAF population estimate (Wetlands International, 2019): 104,000

The Grey Plover was the tenth most abundant migratory shorebird on the Curtis Coast in October 2019, with 94 birds recorded at high tide roosts during the survey. This was two fewer birds than were counted in October 2012 (96). Grey Plovers were present at six sites; there were no Grey Plovers detected in Port Curtis. The foraging density was the same in each management unit that Grey Plover were present. Grey Plovers are believed to be declining in the EAAF (Wetlands International, 2019) and in Australia, particularly south of 27.8°S and west of 129°E (Clemens et al., 2016).

Table 4.5.12 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2019

Management Unit	**Roosts**	**Number of birds**	**Foraging Density (*birds / ha*)**
Fitzroy Estuary	2	31	0.01
North Curtis	2	25	0.01
MCR	2	38	0.01
Port Curtis	Nil	Nil	Nil
Totals	***6***	***94***	***0.02***

4.5.13 Other migratory shorebirds

There were a further seven species of migratory shorebird recorded on the Curtis Coast in October 2019. They were (in order of descending abundance): Curlew Sandpiper (88 birds), Red Knot (43 birds), Common Greenshank (28 birds), Common Sandpiper (15 birds), Broad-billed Sandpiper (14 birds), Sharp-tailed Sandpiper (12 birds), Ruddy Turnstone (8 birds), Pacific Golden Plover (7 birds), Marsh Sandpiper (1 bird) and Little Curlew (1 bird) – a vagrant to the region, and only the third recorded as a part of the ERMP so far. Together, these species made up approximately 2% of the total migratory shorebird count for the survey. Most individuals representing these species were detected in the Fitzroy Estuary management unit.

4.5.14 Non-migratory shorebirds

There were 678 non-migratory shorebirds recorded on the Curtis Coast in October 2019, representing five species. They were (in order of descending abundance): Red-capped Plover (433 birds), Pied Oystercatcher (221 birds), Beach Stone-curlew (ten birds), Masked Lapwing (8 birds) and Sooty Oystercatcher (6 birds). The key assumption making roost counting the preferred method for estimating migratory shorebird numbers –

that the majority of birds congregate in communal roosts at high tide – does not hold for all non-migratory species. Consequently, the counts obtained during the survey were unlikely to give an accurate estimate of the populations of these species on the Curtis Coast. Nonetheless, collection of the data makes the survey comparable with the *Shorebird 2020* counts, helps to describe the distributions of the species, may be a valid index of the populations and has intrinsic value as a record of presence and abundance. No further analysis was conducted because non-migratory species are beyond the scope of the ERMP (Gladstone Ports Corporation, 2016).

4.5.15 Low tide surveys

There were 32 low tide surveys conducted on the Curtis Coast in October 2019. In total, 491 minutes (approximately eight hours) were spent surveying foraging migratory shorebirds (Table 4.5.1). A total of 1,668 birds were counted during the low tide surveys, representing 16 species. The species with over 50 individuals counted at low tide were (in order of descending abundance): Red-necked Stint (527 birds), Bar-tailed Godwit (438 birds), Great Knot (190 birds), Eastern Curlew (169 birds), Whimbrel (146 birds) and Lesser Sand Plover (54 birds). Terek Sandpiper and Grey-tailed Tattler (both with 39 birds), Grey Plover (22 birds), Greater Sand Plover (20 birds), Common Greenshank (8 birds), Sanderling and Pacific Golden Plover (each with 5 birds), Ruddy Turnstone (4 birds) and Red Knot and Broad-billed Sandpiper (each with 1 bird) made up the remainder. The low tide counts are not strictly comparable with previous surveys because shorebirds move quickly around the intertidal zone in response to the movement of the tide. It is therefore difficult to replicate surveys even when they occur at the same location.

4.5.16 Cheetham Salt Works Surveys in October 2019

Access was gained to three sites within the salt works, including one site that supported ***internationally significant*** numbers of migratory shorebirds. This site, the South Cheetham Salt Fields, supported a total of 3,078 shorebirds. The majority were Sharp-tailed Sandpipers (2,002 birds), but there were also large numbers of Marsh Sandpiper (447 birds), Curlew Sandpiper (321 birds), Bar-tailed Godwit (270 birds) and smaller numbers of Red-necked Stint (20 birds) and Broad-billed Sandpiper (20 birds). The number of Sharp-tailed Sandpipers present at the site represents more than 2% of the entire EAAF population of that species – therefore, this is an ***internationally significant*** site for that species. Similarly, the numbers of Marsh and Curlew Sandpiper present were of *national significance*, representing more than 0.1% of the total EAAF populations of both species. It is strongly recommended that this site, and as many others within the salt works as possible, be checked on each remaining survey.

5 Discussion

In the East Asian-Australasian Flyway (EAAF), most migratory shorebird species are in peril, and habitat loss is the main threatening process (Choi et al., 2016, Hansen et al. 2016). Multiple species that occur annually on the Curtis Coast have recently been listed as Critically Endangered (e.g. Great Knot, Eastern Curlew, Curlew Sandpiper), Endangered (e.g. Red Knot, Lesser Sand Plover) or Vulnerable (e.g. Greater Sand Plover) under the EPBC Act (Hansen et al., 2016). A continental scale meta-analysis of Australian data demonstrated declines in 12 of the 19 migratory shorebirds that visit the country on an annual basis (Clemens et al., 2016), and suggested that these declines are primarily the result of factors outside Australia. Nevertheless, effective management of the remaining migratory shorebird habitat in Australia is important for future conservation.

5.1 Migratory Shorebirds on the Curtis Coast in 2019

In 2019, the Curtis Coast harboured internationally and nationally significant numbers of migratory shorebirds in every survey month, underlining the importance of the region for the migratory shorebirds of Australia and the EAAF. In the summer months (January, February and March), the Curtis Coast supported more than 1% of the total EAAF population of the following species: Eastern Curlew, Grey-tailed Tattler, Lesser Sand Plover, Terek Sandpiper and Whimbrel. These numbers were of ***international significance***. Individual sites on the Curtis Coast in summer supported more than 0.1% of the total EAAF population of the following species: Bar-tailed Godwit, Curlew Sandpiper, Eastern Curlew, Grey-tailed Tattler, Lesser Sand Plover, Red-necked Stint, Terek Sandpiper and Whimbrel. These sites, and the numbers of shorebirds they support, are of *national significance*, and every effort should be made to preserve them in their current condition.

In the other survey months (August and October), the numbers of migratory shorebirds present on the Curtis Coast were lower than those recorded during the summer survey months. However, the Curtis Coast proved to be an important overwintering site for several species, supporting more than 1% of the total EAAF population of Eastern Curlew, Grey-tailed Tattler, Sharp-tailed Sandpiper and Whimbrel. These numbers were of ***international significance*****.** Several individual sites on the Curtis Coast in August and October supported more than 0.1% of the total EAAF population of the following species: Eastern Curlew, Greater Sand Plover, Grey-tailed Tattler, Lesser Sand Plover, Red-necked Stint, Sharp-tailed Sandpiper, Terek Sandpiper and Whimbrel. These sites, and the numbers of shorebirds they support, are of *national significance*, and every effort should be made to preserve them in their current condition. It is important to note that certain roost sites (e.g. the Yellow Patch Entrance Sandbar) often supported *nationally significant* numbers of multiple species simultaneously. Occasionally, ***internationally significant*** numbers of single species could be found in one small area (e.g. two adjacent sites), or even at single sites (e.g. Lesser Sand Plover at the Yellow Patch Entrance Sandbar in February or Sharp-tailed Sandpiper at the South Cheetham Salt Fields in October). Figure 5.1.1 below shows the location of every individual site on the Curtis Coast where a *nationally significant* count of at least one species was made in 2019.

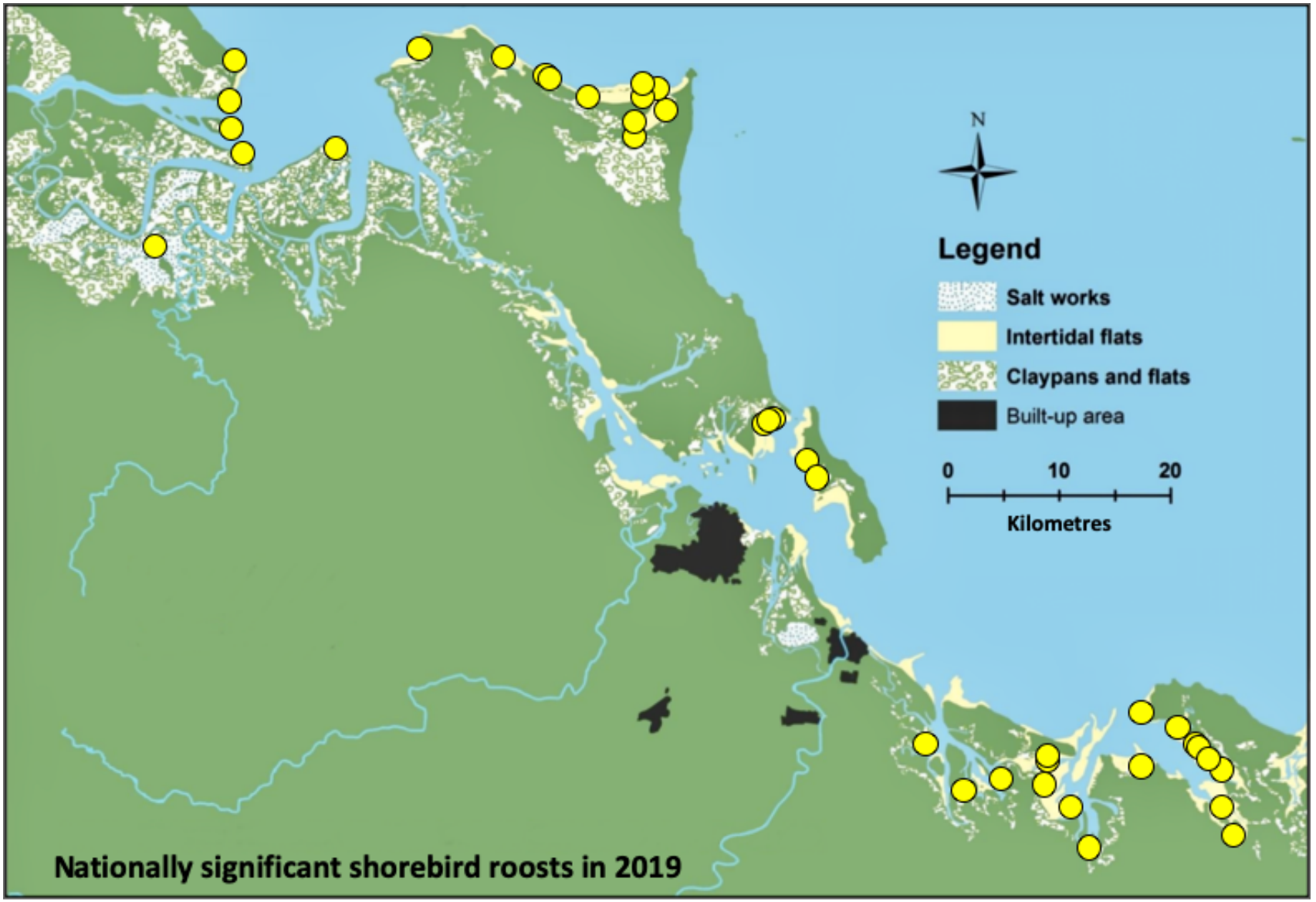

Figure 5.1.1 Migratory shorebird roosts that supported a nationally significant number (>0.01% of the total EAAF population of that species) of at least one species during 2019

5.2 Human Impact on the Migratory Shorebirds of the Curtis Coast in 2019

There was no major construction activity observed within Port Curtis in 2019. The cessation of construction works associated with the development of the LNG plants on Curtis Island and the WBRA has ensured that detectable human impacts on migratory shorebirds in the Curtis Coast region are those common to most populated areas of Australia. These include direct disturbance by people (e.g. birds flushing due to close approach by people on foot, in cars or in boats), animals (e.g. dogs off leash at beaches, feral horses on Curtis Island (Figure 5.2.1 below)), light pollution (which potentially alters nocturnal foraging behaviour), noise pollution and so on. More difficult to assess are the ongoing effects of habitat alteration and changes in water quality due to human activity. These impacts may lead to a change in the community composition of benthic organisms and have flow-on implications for prey availability – but assessing these impacts is beyond the scope of this report. For some discussion of prey abundance and availability on the Curtis Coast, see Choi et al. (2017); a discussion of possible impacts of human activity in Port Curtis on migratory shorebirds during earlier surveys is available in Wildlife Unlimited (2017; 2018).

Figure 5.2.1 Feral horses on Curtis Island in October 2019. The horses drink from claypans on the island; we found tracks in the mud while conducting shorebird surveys (Elliot Leach, Wildlife Unlimited).

5.3 Survey Timing, Conditions, Coverage, and Inference

There were five migratory shorebird surveys conducted by Wildlife Unlimited along the Curtis Coast in 2019. The timing of the surveys was determined by the tide heights in each month, as well as the availability of staff and boat operators. Counting conditions were good in January, March, and August, but were less than ideal in February and October. In the latter months, observers often encountered strong winds, which may have

affected the counts of species such as Greater and Lesser Sand Plover, which can be difficult to separate at a distance in poor conditions. Survey coverage was good in 2019 (for details, refer to the relevant section of each month's results, in Section 4). In general, the geographical coverage and duration of this project appears suitable to meet the primary aim of monitoring the migratory shorebird populations of the Curtis Coast during a major construction phase and in the period of increased human utilisation thereafter.

5.4 Conclusions

The abundance of migratory shorebirds on the Curtis Coast appears to be declining. By comparing the overall abundance in each month with the results of equivalent earlier surveys, we note that 2019 had the lowest migratory shorebird abundance in each month since the start of the project. Species richness, by comparison, appears to be fairly stable. It should be noted that variation in counting conditions and observer ability in each month (and year) in which surveys were conducted have the potential to skew these results significantly. As an example, in earlier surveys (conducted in 2011 and 2012), there were sometimes thousands of shorebirds counted but not identified. Excluding species which were not positively identified from the data presented in this report leads to lower counts in earlier years. Conversely, poor counting conditions experienced in some recent surveys precluded access to important roosts – which leads to lower counts in the later years of the project. It must also be noted that (with the exception of February), these conclusions are drawn from a maximum of three data points and should therefore be considered preliminary findings. The apparent decline of migratory shorebirds on the Curtis Coast is not surprising given the overall population trends for these species in the EAAF. These declines are likely driven largely by the influence of habitat loss outside Australia. Given the threats faced by migratory shorebirds on a global scale, the Curtis Coast is clearly an internationally significant refuge for the shorebirds of the EAAF and is of great conservation importance. Similarly, the data generated by the current project is extremely valuable from a conservation perspective. There will be five migratory shorebird surveys conducted by Wildlife Unlimited on the Curtis Coast in 2020; these will be the final surveys associated with the ERMP. The addition of this data to the overall dataset for the project will help to decipher the long-term trends in the populations of migratory shorebirds on the Curtis Coast.

5.5 Recommendations

The discontinuity of access to the Cheetham Salt Works over the course of the project may have obscured the importance of several sites within the salt works to migratory shorebirds. It is strongly recommended that each salt works site is visited during each survey in 2020.

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Mangroves such as these provide important roosting sites for a number of migratory shorebirds, including Grey-tailed Tattlers, Terek Sandpipers and Whimbrels (Elliot Leach, Wildlife Unlimited)

Appendix 1: EPBC Act Listed Migratory Shorebirds in Australia, including population estimates from Hansen et al. (2016).

Species in **bold** were recorded on the Curtis Coast during surveys in 2019.

Common Name	Scientific Name	Final Population Estimate	1% Flyway Population	0.1% Flyway Population
Asian Dowitcher	*Limnodromus semipalmatus*	14,000	140	14
Bar-tailed Godwit	*Limosa lapponica*	325,000	3,250	325
Black-tailed Godwit	*Limosa limosa*	160,000	1,600	160
Broad-billed Sandpiper	*Limocola falcinellus*	30,000	300	30
Common Greenshank	*Tringa nebularia*	110,000	1,100	110
Common Redshank	*Tringa tetanus*	75,000-150,000	750	75
Common Sandpiper	*Actitis hypoleucos*	190,000	1,900	190
Curlew Sandpiper	*Calidris ferruginea*	90,000	900	90
Double-banded Plover	*Charardrius bicinctus*	19,000	190	19
Eastern Curlew	*Numenius madagascariensis*	35,000	350	35
Great Knot	*Calidris tenuirostris*	425,000	4,250	425
Greater Sand Plover	*Charardrius veredus*	200,000-300,000	2,000	200
Grey Plover	*Pluvialus squatorola*	80,000	800	80
Grey-tailed Tattler	*Tringa brevipes*	70,000	700	70
Latham's Snipe	*Gallinago hardwickii*	30,000	300	30
Lesser Sand Plover	*Charardrius mongolus*	180,000-275,000	1,800	180
Little Curlew	*Numenius minutus*	110,000	1,100	110
Little Ringed Plover	*Charardrius dubius*	150,000	1,500	150
Long-toed Stint	*Calidris subminuta*	230,000	2,300	230
Marsh Sandpiper	*Tringa stagnatilis*	130,000	1,300	130
Oriental Plover	*Charardrius leschenaultii*	230,000	2,300	230
Oriental Pratincole	*Glareola maldivarum*	2,880,000	28,800	2880
Pacific Golden Plover	*Pluvialis fulva*	120,000	1,200	120
Pectoral Sandpiper	*Calidris melanotus*	1,220,000-1,930,000	12,200	1220
Pin-tailed Snipe	*Gallinago stenura*	170,000	1,700	170
Red Knot	*Calidris canutus*	110,000	1,100	110
Red-necked Phalarope	*Phalaropus lobatus*	250,000	2,500	250
Red-necked Stint	*Calidris ruficollis*	475,000	4,750	475
Ruddy Turnstone	*Arenaria interpres*	30,000	300	30
Ruff	*Philomachus pugnax*	25,000-100,000	250	25
Sanderling	*Calidris alba*	30,000	300	30
Sharp-tailed Sandpiper	*Calidris acuminata*	85,000	850	85
Swinhoe's Snipe	*Gallinago megala*	40,000	400	40
Terek Sandpiper	*Xenus cinereus*	50,000	500	50
Wandering Tattler	*Tringa incana*	10,000-25,000	100	10
Whimbrel	*Numenius phaeopus*	65,000	650	65
Wood Sandpiper	*Tringa glareola*	130,000	1,300	130

Appendix 2: Non-migratory Shorebirds on the Curtis Coast in 2019

Common Name	Scientific Name
Bush Stone Curlew	*Burhinus grallarius*
Beach Stone Curlew	*Esacus magnirostris*
Australian Pied Oystercatcher	*Haematopus longirostris*
Sooty Oystercatcher	*Haematopus himantopus*
Red-kneed Dotterel	*Erythrogobus cinctus*
Red-capper Plover	*Charadrius ruficapillus*
Black-fronted Dotterel	*Elseyornis melanops*
Masked Lapwing	*Vanellus miles*
Black-winged Stilt	*Himantopus himantopus*
Red-necked Avocet	*Recurvirostra novaehollandiae*

Appendix 3: High tide roost sites and abundance of the ten most common migratory shorebirds on the Curtis Coast in February 2019

The following ten figures depict, for the ten most abundant migratory shorebird species on the Curtis Coast in 2019, each high tide roost site that supported at least one individual of that species. *Nationally significant* counts (>0.01% of the total EAAF population of that species) are shown on the maps in red. The species for which roost maps are presented are listed below.

Common Name	Scientific Name	Abundance in February 2019	1% Flyway Population	0.1% Flyway Population
Lesser Sand Plover	*Charardrius mongolus*	1,889	1,800	180
Bar-tailed Godwit	*Limosa lapponica*	1,667	3,250	325
Red-necked Stint	*Calidris ruficollis*	1,269	4,750	475
Whimbrel	*Numenius phaeopus*	1,173	650	65
Terek Sandpiper	*Xenus cinereus*	841	500	50
Great Knot	*Calidris tenuirostris*	733	4,250	425
Eastern Curlew	*Numenius madagascariensis*	526	350	35
Grey-tailed Tattler	*Tringa brevipes*	489	700	70
Greater Sand Plover	*Charardrius veredus*	310	2,000	200
Grey Plover	*Pluvialus squatorola*	229	800	80

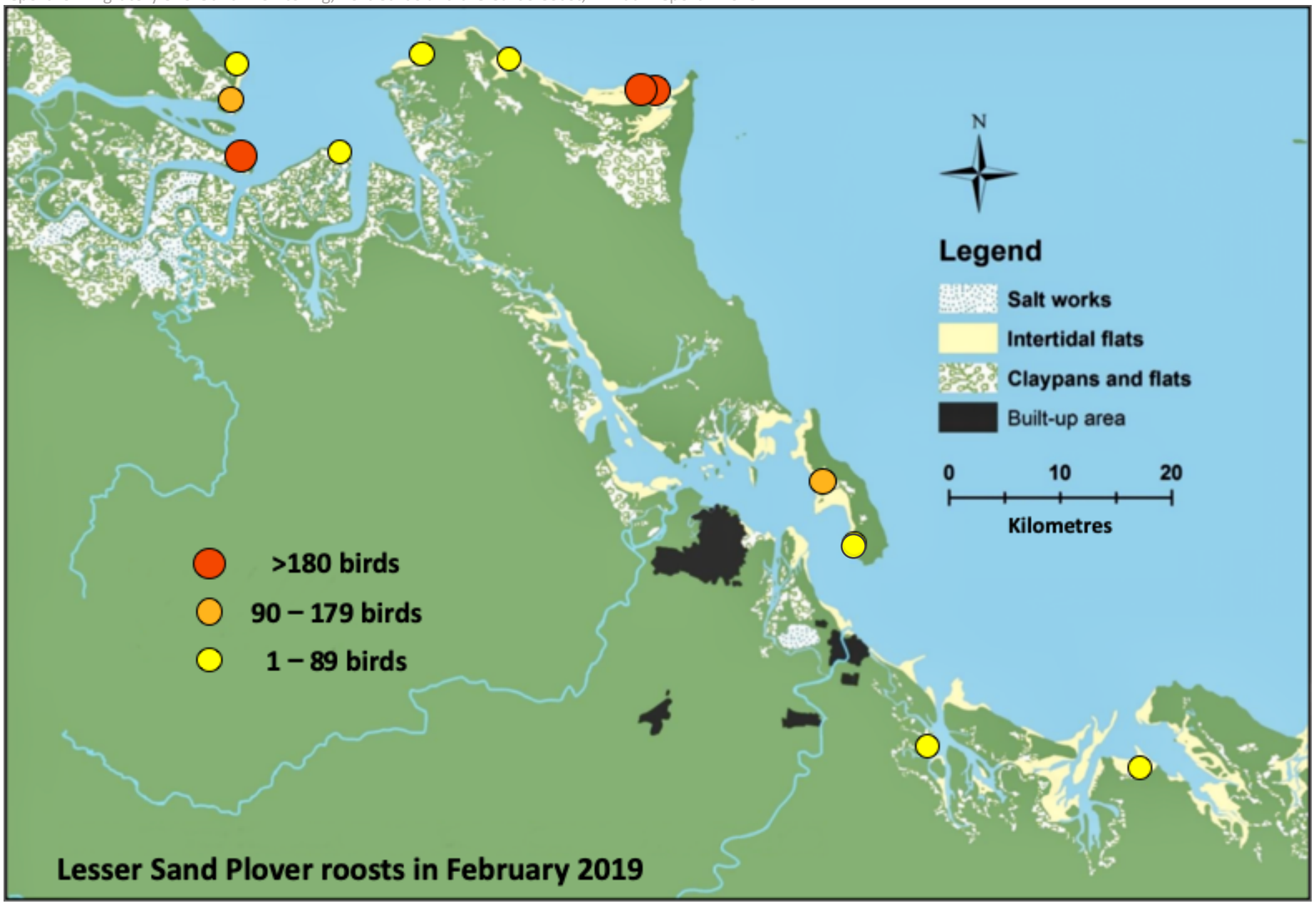

Figure A1 The high tide roost sites utilised by Lesser Sand Plovers on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

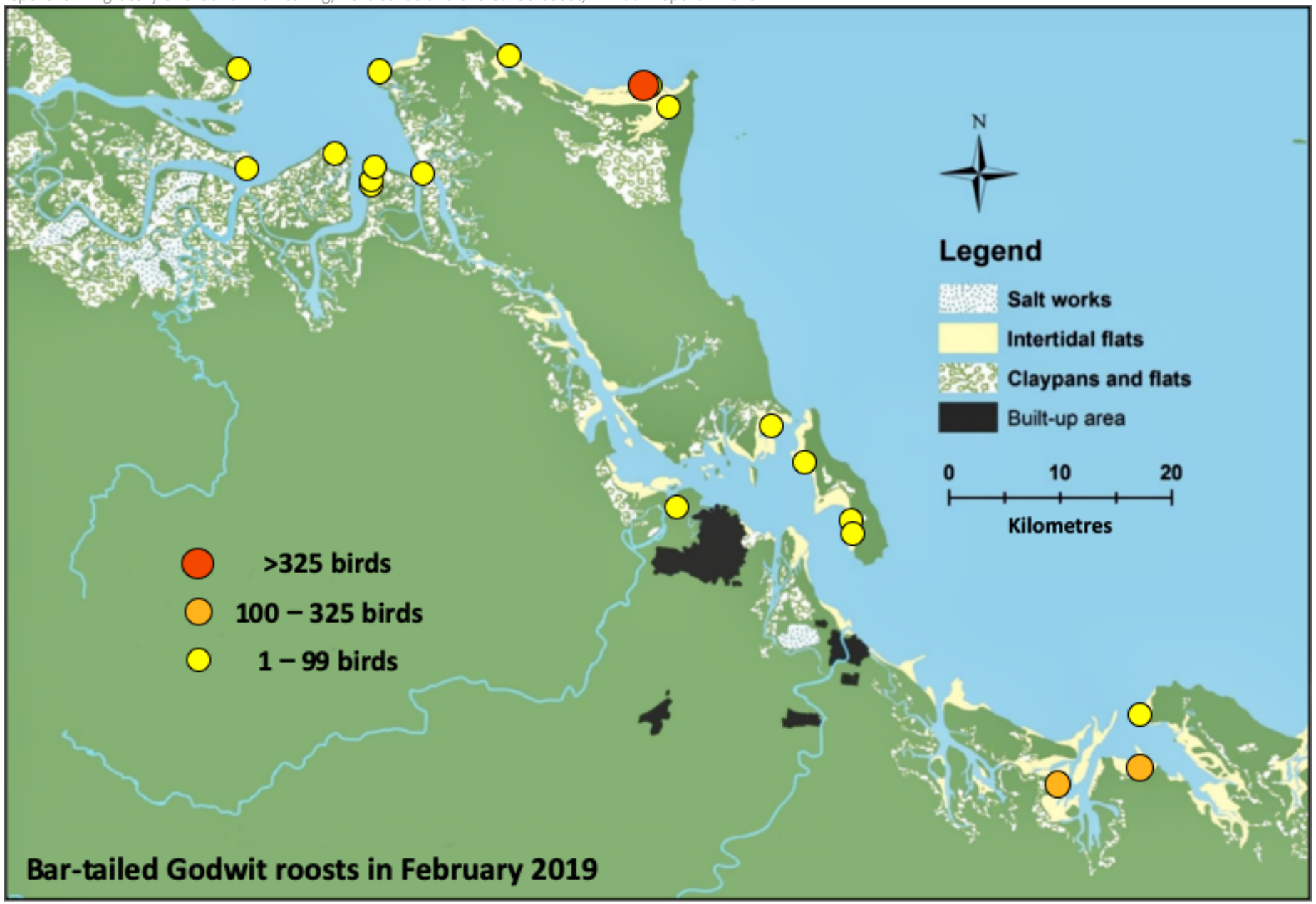

Figure A2 The high tide roost sites utilised by Bar-tailed Godwits on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

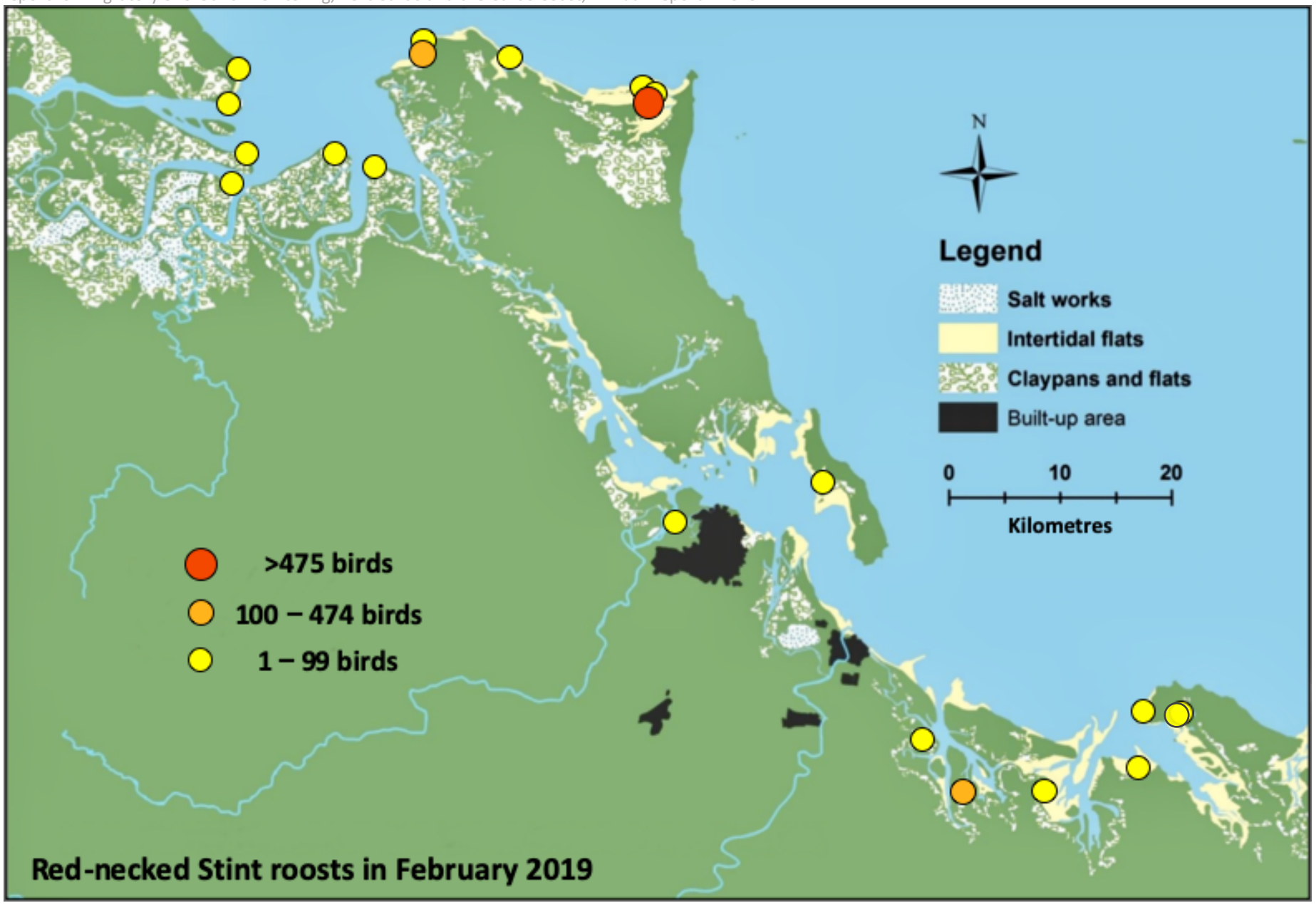

Figure A3 The high tide roost sites utilised by Red-necked Stints on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

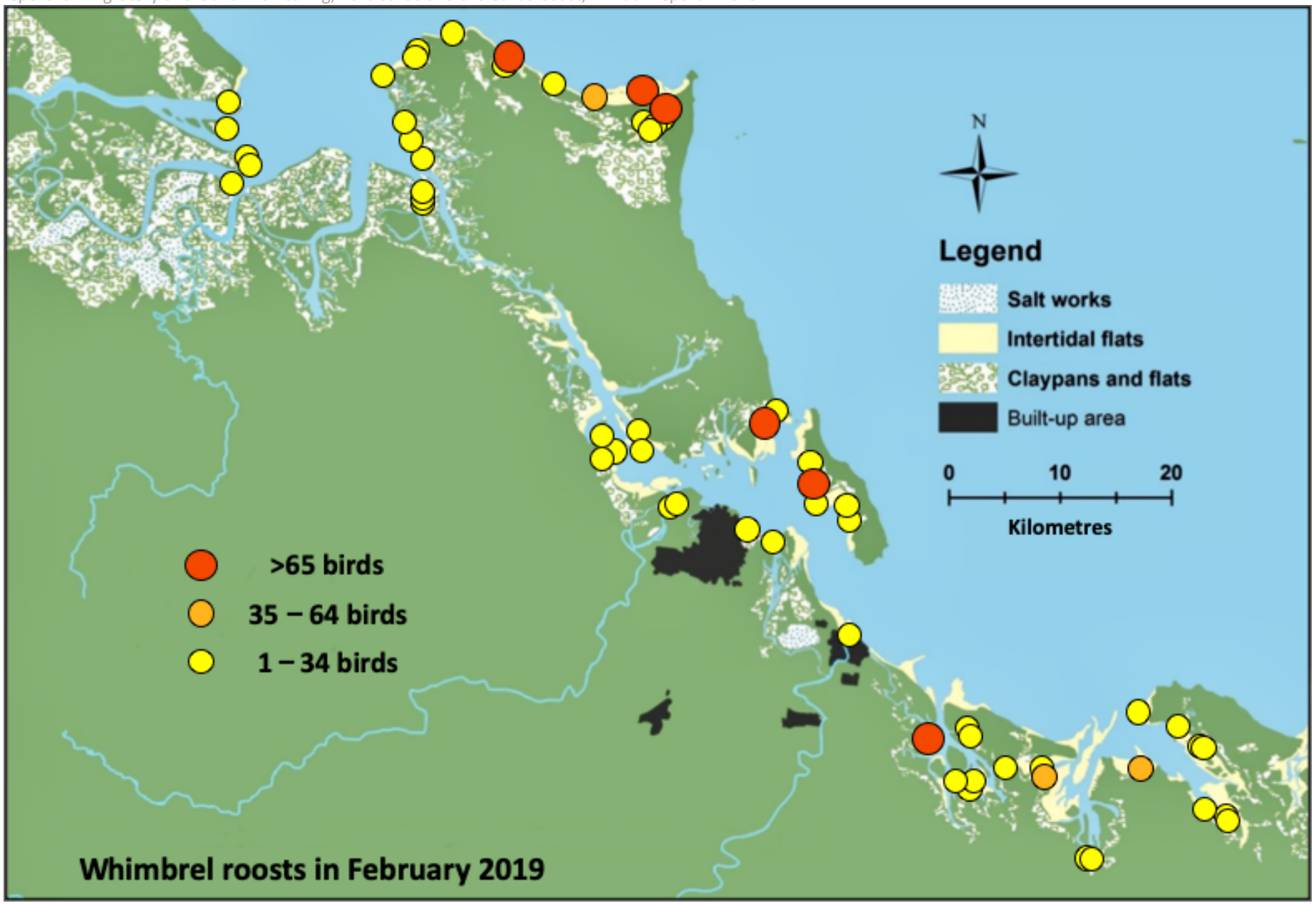

Figure A4 The high tide roost sites utilised by Whimbrel on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

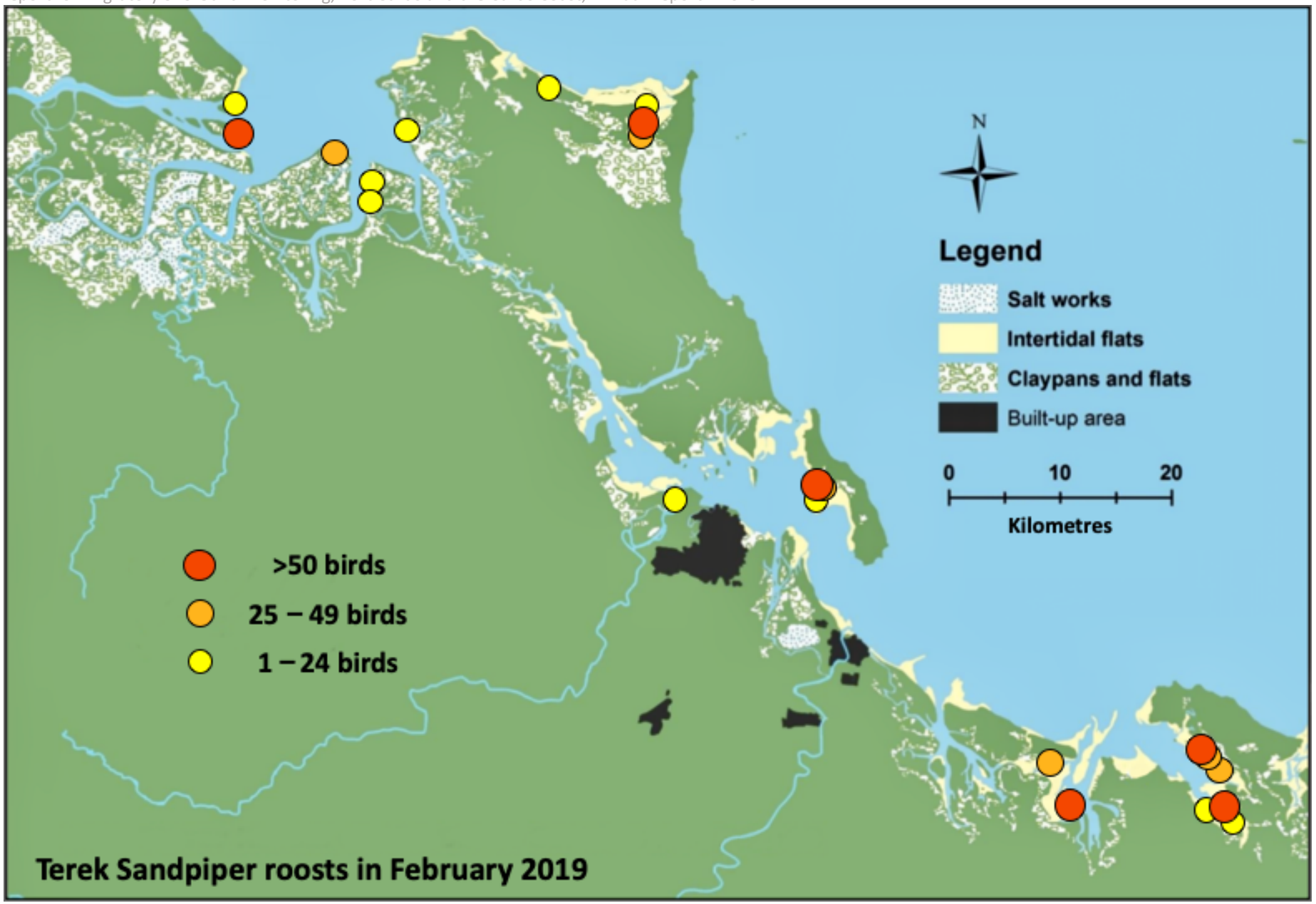

Figure A5 The high tide roost sites utilised by Terek Sandpiper on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

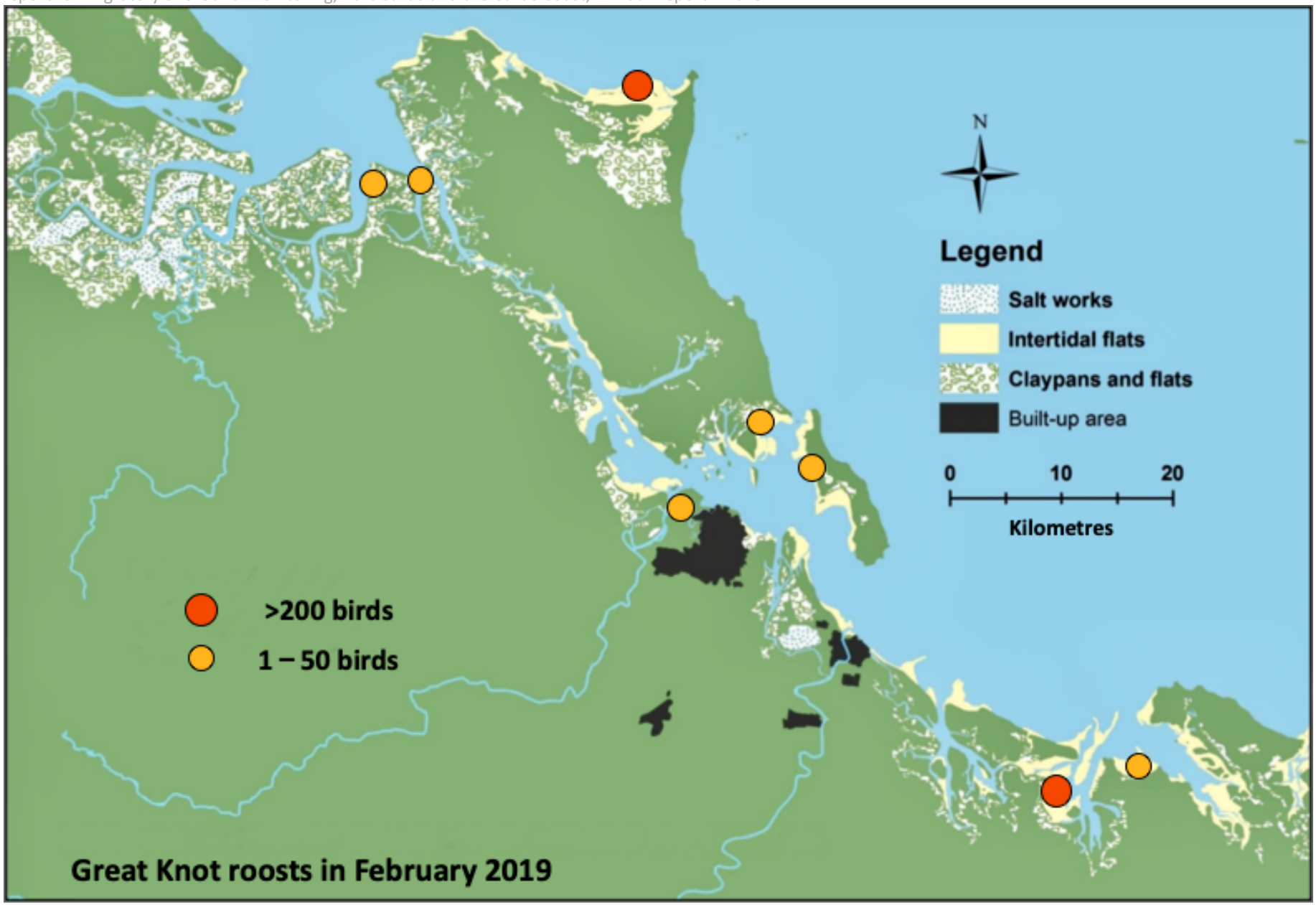

Figure A6 The high tide roost sites utilised by Great Knot on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

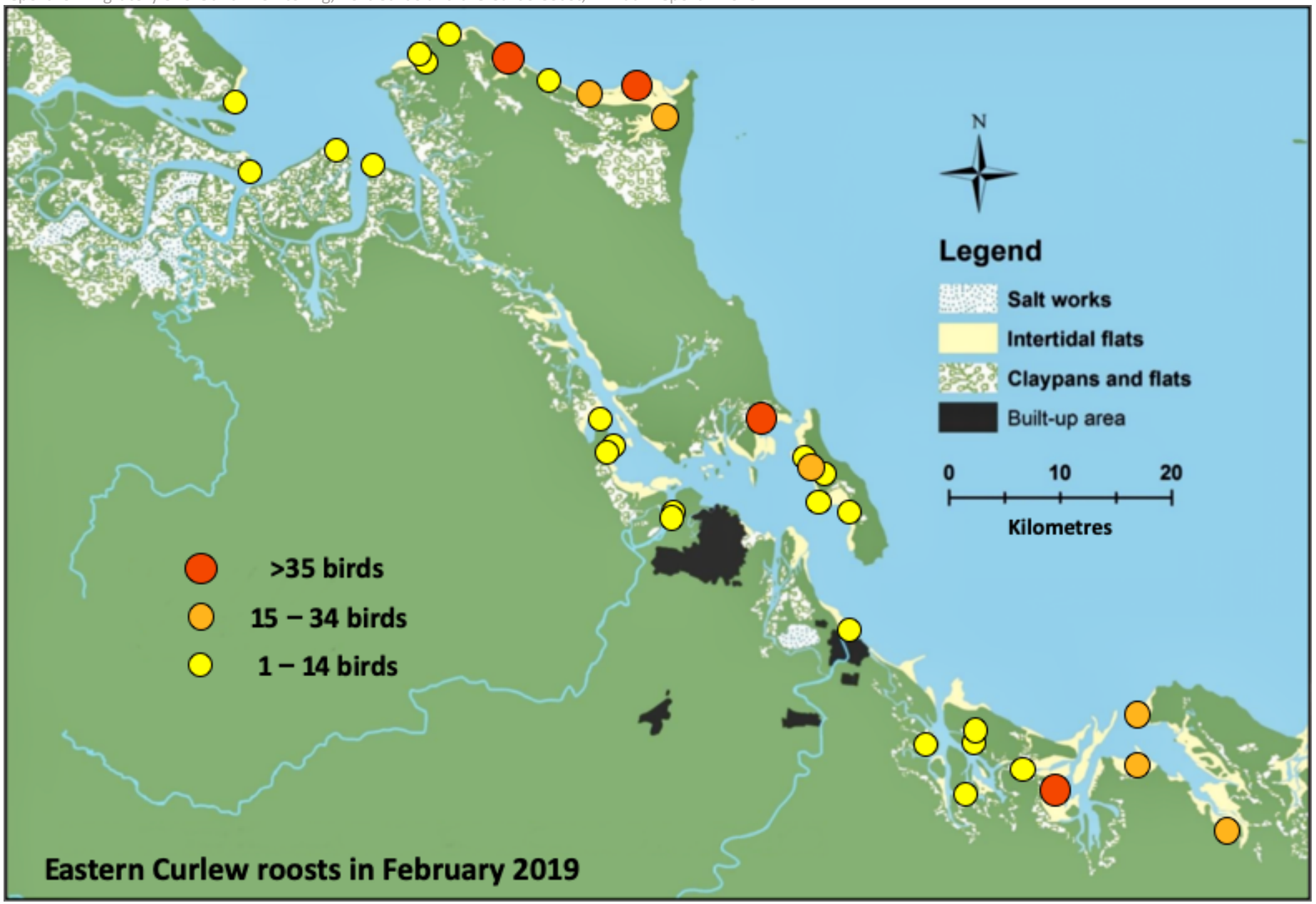

Figure A7 The high tide roost sites utilised by Eastern Curlew on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

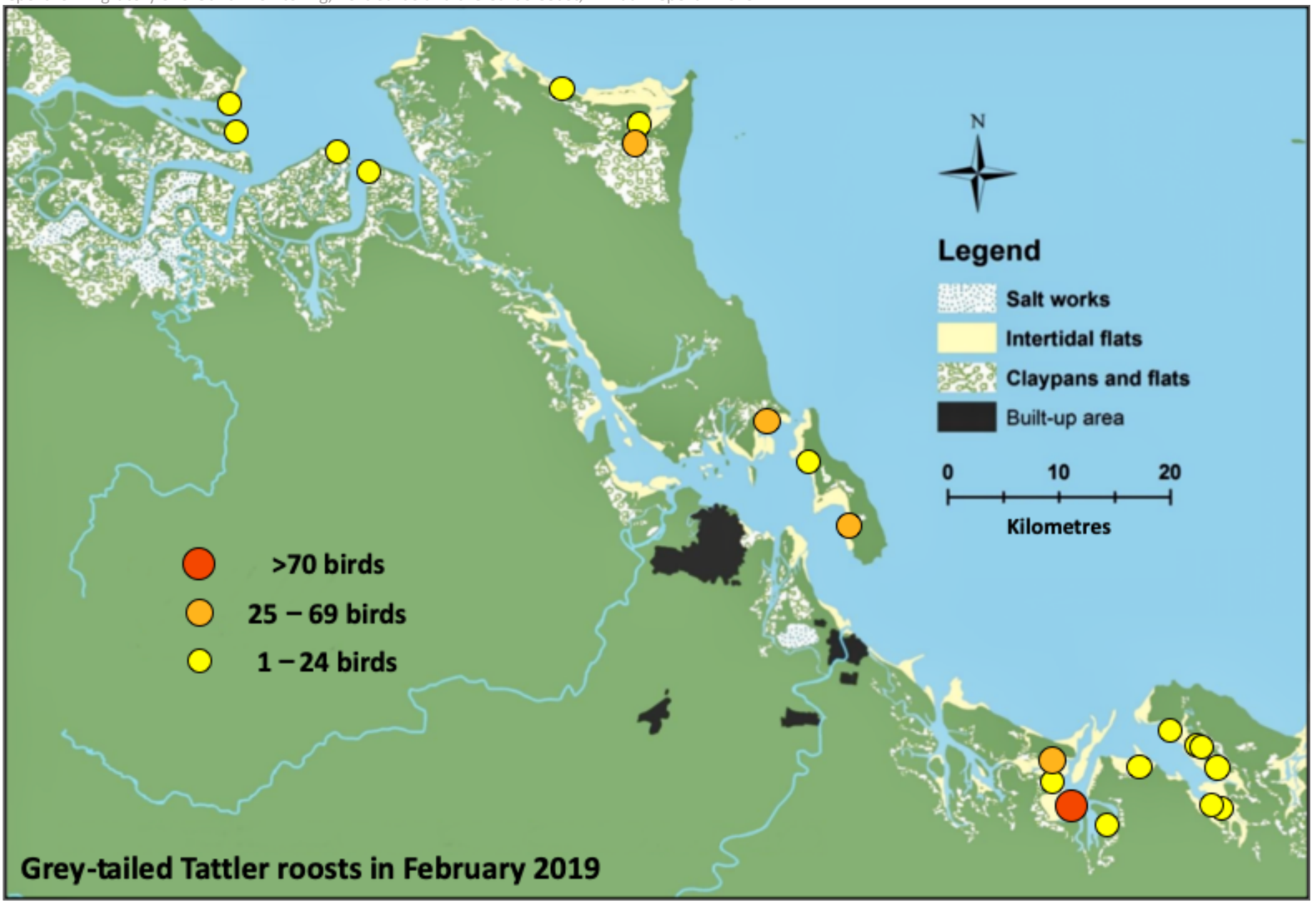

Figure A8 The high tide roost sites utilised by Grey-tailed Tattler on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

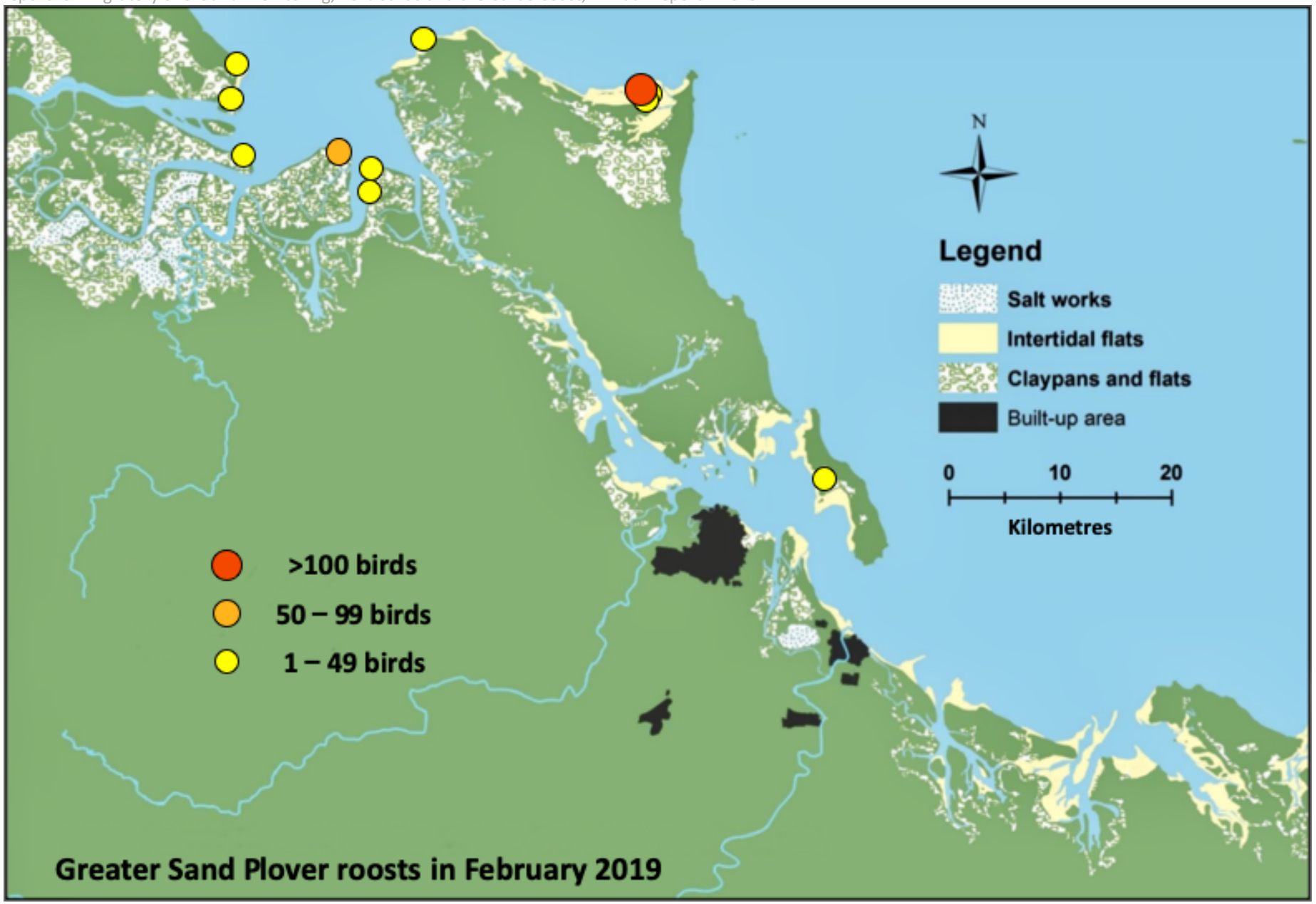

Figure A9 The high tide roost sites utilised by Greater Sand Plover on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.

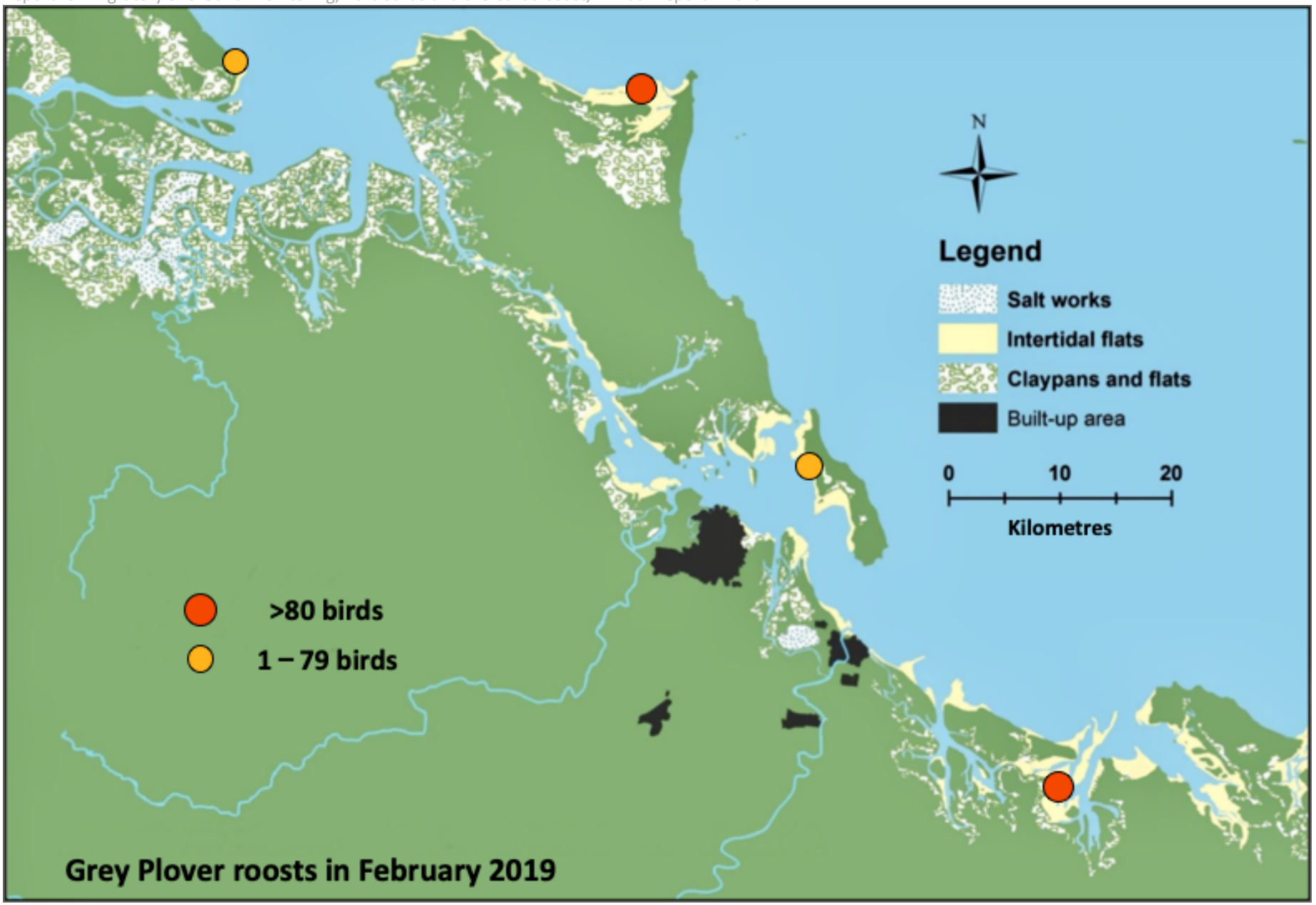

Figure A10 The high tide roost sites utilised by Grey Plover on the Curtis Coast in February 2019. Sites of *national significance* are depicted in red.