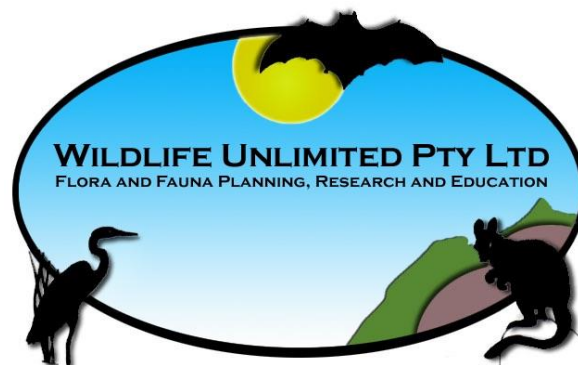


Gladstone Ports Corporation
Report for Migratory Shorebird Monitoring
Port Curtis and the Curtis Coast
Annual Report – 2020



Report Prepared for Gladstone Ports Corporation
Wildlife Unlimited Pty Ltd
ABN: 36 147 131 119
PO Box 255, Bairnsdale, VIC 3875
Ph: 03 5152 6367
Email: wildlifeunlimited@wideband.net.au



Document history and status

Version	Date	Sent to	Format	Quantity
Final	08-Jun-21	Anjana Singh GPC	Electronic	1

Document title: Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Project: Curtis Coast Shorebird Monitoring Project

Project manager: Jim Reside and Micha V Jackson

Author: Micha V Jackson

Client: Gladstone Ports Corporation

Document version: Final

Last saved: 08-Jun-21

File name: Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Cover photo: Grey-tailed Tattler *Tringa brevipes* and Pacific Golden Plover *Pluvialis fulva* (Micha V Jackson, Wildlife Unlimited).

©Gladstone Ports Corporation

This report has been prepared for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring program. The study was undertaken through a Consultancy Agreement (CA130030) between Gladstone Ports Corporation and Wildlife Unlimited Pty Ltd to monitor migratory shorebirds on the Curtis Coast.

This report has been prepared for Gladstone Ports Corporation in accordance with the agreed terms of the contract. Wildlife Unlimited Pty Ltd accepts no responsibility for use by any other parties.

Except as permitted by the Copyright Act 1968, no part of the work may in any form or by any electronic, mechanical, photocopying, recording, or any other means be reproduced, stored in a retrieval system or be broadcast or transmitted without prior written permission of Gladstone Ports Corporation. This document has been prepared with all due diligence and care, based on the best available information at the time of publication, without peer review, and the information herein is subject to change without notice. The copyright owner shall not be liable for technical or other errors or omissions contained within the document. The reader/user accepts all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using this information. Any decisions made by other parties based on this document are solely the responsibility of those parties. Information contained in this document is from a number of sources and, as such, does not necessarily represent the policies of GPC.

Enquiries about reproduction, including downloading or printing the web version, should be directed to ermp@westernbasinportdevelopment.com.au.

Citation

Wildlife Unlimited. 2021. Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. pp. 134.

Table of Contents

List of Figures	v
List of Tables	vii
List of Acronyms / Abbreviations	xi
Executive Summary	xii
1 Introduction	1
1.1 The Project	1
1.2 Environmental Approvals	1
1.3 Ecosystem Research and Monitoring Program	1
2 Migratory Shorebirds in Australia.....	3
2.1 EPBC Act Listing	3
2.2 EPBC Act Listed Shorebird Species.....	4
2.3 Migratory Shorebirds on the Curtis Coast	5
3 Methods.....	7
3.1 Study Area.....	7
3.2 Shorebird Survey Guidelines.....	11
3.3 Survey Timing.....	11
3.4 Survey Schedule.....	14
3.5 Count Procedure	14
3.5.1 Roost surveys	15
3.5.2 Foraging surveys	15
3.5.3 Western Basin Reclamation Area high tide surveys.....	15
3.5.4 Cheetham Salt Works surveys.....	15
3.7 Mapping.....	16
3.8 Analysis	16
4 Results	18
4.1 January	18
4.1.1 Survey coverage	18
4.1.2 Abundance estimates.....	18
4.1.3 Red-necked Stint (<i>Calidris ruficollis</i>).....	23
4.1.4 Bar-tailed Godwit (<i>Limosa lapponica</i>).....	24
4.1.5 Grey-tailed Tattler (<i>Tringa brevipes</i>).....	25
4.1.6 Whimbrel (<i>Numenius phaeopus</i>)	26
4.1.7 Terek Sandpiper (<i>Xenus cinereus</i>)	27
4.1.8 Greater Sand Plover (<i>Charadrius leschenaultia</i>)	28
4.1.9 Eastern Curlew (<i>Numenius madagascariensis</i>)	29
4.1.10 Lesser Sand Plover (<i>Charadrius mongolus</i>)	30
4.1.11 Great Knot (<i>Calidris tenuirostris</i>).....	31
4.1.12 Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	32
4.1.13 Other migratory shorebirds	33
4.1.14 Non-migratory shorebirds.....	33
4.1.15 Low tide surveys.....	33
4.1.16 Cheetham Salt Works Surveys in January 2020	35
4.2 February.....	38
4.2.1 Survey Coverage.....	38
4.2.2 Abundance estimates.....	38

4.2.3 Red-necked Stint (<i>Calidris ruficollis</i>).....	43
4.2.4 Bar-tailed Godwit (<i>Limosa lapponica</i>).....	44
4.2.5 Grey-tailed Tattler (<i>Tringa brevipes</i>).....	45
4.2.6 Terek Sandpiper (<i>Xenus cinereus</i>).....	46
4.2.7 Whimbrel (<i>Numenius phaeopus</i>).....	47
4.2.8 Great Knot (<i>Calidris tenuirostris</i>).....	48
4.2.9 Eastern Curlew (<i>Numenius madagascariensis</i>).....	49
4.2.10 Lesser Sand Plover (<i>Charadrius mongolus</i>).....	50
4.2.11 Curlew Sandpiper (<i>Calidris ferruginea</i>).....	51
4.2.12 Greater Sand Plover (<i>Charadrius leschenaultia</i>).....	52
4.2.13 Other migratory shorebirds.....	53
4.2.14 Non-migratory shorebirds.....	53
4.2.15 Low tide surveys.....	53
4.3 March.....	58
4.3.1 Survey Coverage.....	58
4.3.2 Abundance estimates.....	58
4.3.3 Red-necked Stint (<i>Calidris ruficollis</i>).....	63
4.3.4 Grey-tailed Tattler (<i>Tringa brevipes</i>).....	64
4.3.5 Bar-tailed Godwit (<i>Limosa lapponica</i>).....	65
4.3.6 Lesser Sand Plover (<i>Charadrius mongolus</i>).....	66
4.3.7 Eastern Curlew (<i>Numenius madagascariensis</i>).....	67
4.3.8 Terek Sandpiper (<i>Xenus cinereus</i>).....	68
4.3.9 Whimbrel (<i>Numenius phaeopus</i>).....	69
4.3.10 Great Knot (<i>Calidris tenuirostris</i>).....	70
4.3.11 Greater Sand Plover (<i>Charadrius leschenaultia</i>).....	71
4.3.12 Curlew Sandpiper (<i>Calidris ferruginea</i>).....	72
4.3.13 Other migratory shorebirds.....	73
4.3.14 Non-migratory shorebirds.....	73
4.3.15 Low tide surveys.....	73
4.3.16 Cheetham Salt Works Surveys in March 2021.....	74
4.4 August.....	78
4.4.1 Survey Coverage.....	78
4.4.2 Abundance estimates.....	79
4.4.3 Red-necked Stint (<i>Calidris ruficollis</i>).....	83
4.4.4 Eastern Curlew (<i>Numenius madagascariensis</i>).....	84
4.4.5 Lesser Sand Plover (<i>Charadrius mongolus</i>).....	85
4.4.6 Bar-tailed Godwit (<i>Limosa lapponica</i>).....	86
4.4.7 Whimbrel (<i>Numenius phaeopus</i>).....	87
4.4.8 Other migratory shorebirds.....	88
4.4.9 Non-migratory shorebirds.....	88
4.4.10 Low tide surveys.....	88
4.4.11 Cheetham Salt Works Surveys in August 2020.....	89
4.5 October.....	92
4.5.1 Survey Coverage.....	92
4.5.2 Abundance estimates.....	92
4.5.3 Bar-tailed Godwit (<i>Limosa lapponica</i>).....	97
4.5.4 Whimbrel (<i>Numenius phaeopus</i>).....	98
4.5.5 Red-necked Stint (<i>Calidris ruficollis</i>).....	99
4.5.6 Eastern Curlew (<i>Numenius madagascariensis</i>).....	100
4.5.7 Grey-tailed Tattler (<i>Tringa brevipes</i>).....	101
4.5.8 Great Knot (<i>Calidris tenuirostris</i>).....	102
4.5.9 Terek Sandpiper (<i>Xenus cinereus</i>).....	103
4.5.10 Lesser Sand Plover (<i>Charadrius mongolus</i>).....	104
4.5.11 Curlew Sandpiper (<i>Calidris ferruginea</i>).....	105
4.5.12 Grey Plover (<i>Pluvialis squatarola</i>).....	106
4.5.13 Other migratory shorebirds.....	107
4.5.14 Non-migratory shorebirds.....	107
4.5.15 Low tide surveys.....	107
4.5.16 Cheetham Salt Works Surveys in October 2020.....	108

5 Discussion	112
5.1 Migratory Shorebirds on the Curtis Coast in 2021	112
5.2 Human Impacts on the Migratory Shorebirds of the Curtis Coast	114
5.3 Survey Timing, Conditions, Coverage, and Inference	114
5.4 Conclusions	115
5.5 Recommendations	116
6 References	117
Appendix 1: EPBC Act Listed Migratory Shorebirds in Australia	121
Appendix 2: Non-migratory Shorebirds on the Curtis Coast in 2020.....	122
Appendix 3: High tide roost sites and abundance of the ten most common migratory shorebirds on the Curtis Coast in February 2020	123
Appendix 4: Map of ERMP Bioregion.....	134

List of Figures

Figure 1 Migratory shorebird survey sites in the Port Curtis management unit.	8
Figure 2 Migratory shorebird survey sites in the Fitzroy Estuary and North Curtis management units.	9
Figure 3 Migratory shorebird survey sites in the Mundoolin – Colosseum – Rodds Peninsula (MCR) management unit.	10
Figure 4 Abundance of migratory shorebirds on the Curtis Coast in January 2011, 2012, 2019 and 2020.	19
Figure 5 Species richness of migratory shorebirds on the Curtis Coast in January 2011, 2012, 2019 and 2020.	20
Figure 6 Important shorebird roosts on the Curtis Coast in January 2020.	22
Figure 7 Abundance of migratory shorebirds on the Curtis Coast during February surveys over the life of the project.	39
Figure 8 Species richness of migratory shorebirds on the Curtis Coast during February surveys over the life of the project.	40
Figure 9 Important shorebird roosts on the Curtis Coast in February 2020.	42
Figure 10 Abundance of Red-necked Stint on the Curtis Coast from February 2011 – 2020.	43
Figure 11 Abundance of Bar-tailed Godwit on the Curtis Coast from February 2011 – 2020.	44
Figure 12 Abundance of Grey-tailed Tattler on the Curtis Coast from February 2011 – 2020.	45
Figure 13 Abundance of Terek Sandpiper on the Curtis Coast from February 2011 – 2020.	46
Figure 14 Abundance of Whimbrel on the Curtis Coast from February 2011 – 2020.	47
Figure 15 Abundance of Great Knot on the Curtis Coast from February 2011 – 2020.	48
Figure 16 Abundance of Eastern Curlew on the Curtis Coast from February 2011 – 2020.	49
Figure 17 Abundance of Lesser Sand Plover on the Curtis Coast from February 2011 – 2020.	50
Figure 18 Abundance of Curlew Sandpiper on the Curtis Coast from February 2011 – 2020.	51
Figure 19 Abundance of Greater Sand Plover on the Curtis Coast from February 2011 – 2020.	52
Figure 20 Abundance of migratory shorebirds on the Curtis Coast in March 2011, 2012, 2019 and 2021.	59
Figure 22 Important shorebird roosts on the Curtis Coast in March 2021.	62
Figure 23 Abundance of migratory shorebirds on the Curtis Coast in August 2011, 2012, 2019 and 2020.	79
Figure 24 Species richness of migratory shorebirds on the Curtis Coast in August 2011, 2012, 2019 and 2020.	79
Figure 25 Important shorebird roosts on the Curtis Coast in August 2020.	82
Figure 26 Abundance of migratory shorebirds on the Curtis Coast made in October 2012, 2019 and 2020.	93
Figure 27 Species richness of migratory shorebirds on the Curtis Coast in October 2012, 2019 and 2020.	93
Figure 28 Important shorebird roosts on the Curtis Coast in October 2020.	96
Figure 29 Roosts that supported a nationally significant number (>0.01% of the total EAAF population of that species) of at least one migratory shorebird species during high tide surveys on the Curtis Coast (not including the Cheetham Salt Works) in 2020/2021.	113

Figure A1 The high tide roost sites utilised by Red-necked Stint on the Curtis Coast in February 2020.....	124
Figure A2 The high tide roost sites utilised by Bar-tailed Godwit on the Curtis Coast in February 2020.....	125
Figure A3 The high tide roost sites utilised by Grey-tailed Tattler on the Curtis Coast in February 2020.	126
Figure A4 The high tide roost sites utilised by Terek Sandpiper on the Curtis Coast in February 2020.....	127
Figure A5 The high tide roost sites utilised by Whimbrel on the Curtis Coast in February 2020.	128
Figure A6 The high tide roost sites utilised by Great Knot on the Curtis Coast in February 2020.....	129
Figure A7 The high tide roost sites utilised by Eastern Curlew on the Curtis Coast in February 2020.....	130
Figure A8 The high tide roost sites utilised by Lesser Sand Plover on the Curtis Coast in February 2020.	131
Figure A9 The high tide roost sites utilised by Curlew Sandpiper on the Curtis Coast in February 2020.....	132
Figure A10 The high tide roost sites utilised by Greater Sand Plover on the Curtis Coast in February 2020.....	133

List of Tables

Table 1 The migration status of migratory shorebird species on the Curtis Coast.....	12
Table 2 The timing of migration for 23 species of migratory shorebirds on the Curtis Coast.....	13
Table 3 Timing of migratory shorebird surveys conducted in 2020/2021.....	14
Table 4 Data collected on each survey.	14
Table 5 Intertidal flat area used to calculate migratory shorebird density.	17
Table 6 Summary of survey effort in January 2020: number of sites and elapsed survey time at each location.	19
Table 7 Summary of foraging density in January over time.....	20
Table 8 Place names of the roosts with the greatest abundance of migratory shorebirds in January 2020.	21
Table 9 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2020.	23
Table 10 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in January 2020.....	24
Table 11 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in January 2020.	25
Table 12 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in January 2020.	26
Table 13 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in January 2020.....	27
Table 14 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in January 2020.....	28
Table 15 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in January 2020.....	29
Table 16 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in January 2020.	30
Table 17 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in January 2020.....	31
Table 18 Comparison of the number of birds, number of roosts occupied and foraging density of Sharp-tailed Sandpiper between four management units in January 2020.....	32
Table 19 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in January 2020.	34
Table 20 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in January, 2020.	36
Table 21 Summary of survey effort in February: number of sites and elapsed survey time at each location.	38
Table 22 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.	40

Table 23 Place names of the roosts with the greatest abundance of migratory shorebirds in February 2020. ..	41
Table 24 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Red-necked Stint between four management units in January 2020.	43
Table 25 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Bar-tailed Godwits between four management units in February 2020.	44
Table 26 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Grey-tailed Tattler between four management units in February 2020.	45
Table 27 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Terek Sandpiper between four management units in February 2020.	46
Table 28 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Whimbrels between four management units in February 2020.	47
Table 29 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Great Knots between four management units in February 2020.	48
Table 30 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Eastern Curlew between four management units in February 2020.	49
Table 31 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Lesser Sand Plovers between four management units in February 2020.	50
Table 32 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Curlew Sandpiper between four management units in February 2020.	51
Table 33 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Greater Sand Plover between four management units in February 2020.	52
Table 34 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in February 2020.	54
Table 35 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in February, 2020.	56
Table 36 Summary of survey effort in March: number of sites and elapsed survey time at each location.	58
Table 37 Summary of foraging density in March over time.	60
Table 38 Place names of the roosts with the greatest abundance of migratory shorebirds in March 2021.	61
Table 39 Place names of the roosts with the greatest abundance of migratory shorebirds in March 2021.	63
Table 40 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2021.	64
Table 41 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in March 2021.	65
Table 42 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in March 2021.	66
Table 43 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in March 2021.	67

Table 44 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in March 2021.....	68
Table 45 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in March 2021.....	69
Table 46 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in March 2021.....	70
Table 47 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in March 2021.....	71
Table 48 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2021.	72
Table 49 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in March 2021.	74
Table 50 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in March, 2021.	76
Table 51 Summary of survey effort in August: number of sites and elapsed survey time at each location.	78
Table 52 Summary of foraging density in August over time.....	80
Table 53 Place names of the roosts with the greatest abundance of migratory shorebirds in August 2020.	81
Table 54 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in August 2020.....	83
Table 55 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in August 2020.	84
Table 56 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in August 2020.	85
Table 57 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in August 2020.	86
Table 58 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in August 2020.	87
Table 59 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in August, 2020.	90
Table 60 Summary of survey effort in October: number of sites and elapsed survey time at each location.	92
Table 61 Summary of foraging density in August over time.....	94
Table 62 Place names of the roosts with the greatest abundance of migratory shorebirds in October 2020.....	95
Table 63 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in October 2020.....	97
Table 64 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in October 2020.	98

Table 65 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in October 2020.....	99
Table 66 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in October 2020.	100
Table 67 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2020.	101
Table 68 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in October 2020.	102
Table 69 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in October 2020.	103
Table 70 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in October 2020.	104
Table 71 Comparison of the number of birds, number of roosts occupied and foraging density of Curlew Sandpipers between four management units in October 2020.	105
Table 72 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2020.	106
Table 73 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in October 2020.	108
Table 74 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in October, 2020.	110
Table 75 Number of roosts that supported a nationally significant number (>0.01% of the total EAAF population of that species) during high tide surveys on the Curtis Coast (not including the Cheetham Salt Works) in 2020/2021.....	114

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	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
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 2020/2021, in January, February, March (conducted in 2021 because poor weather and the Covid-19 pandemic prevented implementation of surveys in March 2020), August and October. This was the fourth year of comprehensive surveys since 2011, which was the start of the Port Curtis and Port Alma Ecosystem Research and Monitoring Program (ERMP).
- In 2020/2021, 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

- 156 high tide surveys and 38 low tide surveys were conducted in January 2020 including high tide surveys at the Cheetham Salt Works, in variable counting conditions.
- 8,618 migratory shorebirds were recorded on the Curtis Coast during high tide surveys in January 2020 (not including the Cheetham Salt Works) – less than were recorded in January 2019 (10,301), January 2012 (10,308) or January 2011 (13,172). There were 18 species of migratory shorebird recorded during surveys in January.
- Important roost sites in January 2020 included the Deception Point claypan west side site (Fitzroy Estuary) and the Yellow Patch Entrance Sandbar (North Curtis), which each supported over 1,000 birds; between 500 and 1,000 birds were found at the Keppell Creek Entrance (North Curtis), Central Mangrove Island (Mundoolin – Colosseum – Rodds Peninsula; MCR) and Williams Bay, Mangrove Bay (MCR).
- The overall foraging density of migratory shorebirds on the Curtis Coast in January 2020 was 0.86 birds/ha, the lowest density recorded in January. The highest density of birds recorded in January 2020 was at North Curtis Island (2.07 birds/ha).

February

- 150 high tide surveys and 39 low tide surveys were conducted in February 2020 (no surveys were completed at the Cheetham Salt Works), with most surveys conducted in good counting conditions.
- 9,441 migratory shorebirds were recorded on the Curtis Coast during high tide surveys in February 2020 – the third lowest number recorded in February between 2011 and 2020, and similar to the number recorded in February 2019. There were 18 species of migratory shorebird recorded during surveys in February.
- Important roost sites in February 2020 included the Mundoolin Rocks east claypan (MCR), which supported over 1,000 birds; between 500 and 1,000 birds were found at South End - West Claypan (Port Curtis), the Western Basin Reclamation Area (Port Curtis) and Central Mangrove Island (MCR).

- The foraging density of migratory shorebirds on the Curtis Coast in February 2020 was 0.94 birds/ha, the second lowest density recorded in February. The highest density of birds recorded in February 2020 was at Port Curtis (1.24 birds/ha).

March

- Note that the March surveys were completed in 2021 because poor weather and the Covid-19 pandemic prevented implementation of surveys in March 2020.
- 151 high tide surveys and 37 low tide surveys were conducted in March 2021, in variable counting conditions.
- 9,735 migratory shorebirds were recorded on the Curtis Coast in March 2021 (not including the Cheetham Salt Works) – 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 2021 included the Yellow Patch Entrance Sandbar (North Curtis) and the Curlew Spit claypan (Fitzroy Estuary), which each supported over 1,000 birds; between 500 and 1,000 birds were found at Central Mangrove Island, Spit End, and the Mundoolin Rocks east claypan (all MCR).
- The foraging density of migratory shorebirds on the Curtis Coast in March 2021 was 0.97 bird/ha, the lowest density recorded in March to date and approximately the same as March 2019. The highest density of birds recorded in March 2021 was in the Fitzroy Estuary (1.22 birds/ha).

August

- 143 high tide surveys and 30 low tide surveys were conducted in August 2020 including low tide surveys at the Cheetham salt works, with most surveys conducted in good counting conditions.
- 1,972 migratory shorebirds were recorded on the Curtis Coast in August 2020 – less than were recorded in August 2019 (2,407), and much less than were recorded in August 2011 (4,424) and August 2012 (4,120). 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 2020 was 0.20 birds/ha, the lowest density recorded in August. The highest density of birds recorded in August 2020 was in the Fitzroy Estuary (0.50 birds/ha).

October

- 157 high tide surveys and 27 low tide surveys were conducted in October 2020 including high tide surveys at the Cheetham salt works, in variable counting conditions.
- 7,193 migratory shorebirds were recorded on the Curtis Coast in October 2020 (not including the Cheetham Salt Works) – less than were recorded in 2019 (9,209) and much less than were recorded in 2012 (12,416). There were 18 species of migratory shorebird recorded during surveys in October.

- Important roost sites in October 2020 included Cattle Point (Fitzroy Estuary), Little Barramundi Creek (North Curtis), Mangroves Opposite Mund Rocks (MCR), Mundoolin Rocks east claypan (MCR) and Central Mangrove Island (MCR), which each supported between 500 and 1,000 birds.
- The foraging density of migratory shorebirds on the Curtis Coast in October 2020 was 0.72 birds/ha, the lowest density recorded in October. The highest density of birds recorded in October 2020 was at MCR (0.99 birds/ha).

General

- The Curtis Coast as a whole supported ***internationally significant*** numbers of migratory shorebirds in 2020/2021, 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, and many species are experiencing population declines.
- Overall migratory shorebird numbers on the Curtis Coast appear to be decreasing with counts from most months in 2020/2021 the lowest in the project, though patterns for individual species are variable (see species plots and summaries in section 4). However, formal statistical trend analyses have not been undertaken here, and are required before any apparent patterns can be considered as regional population “trends”.
- The data recorded during this project is of high conservation value, and can be used to inform effective migratory shorebird conservation on the Curtis Coast.



Migratory shorebirds in flight (Micha V Jackson, Wildlife Unlimited)

1 Introduction

1.1 The Project

Development and expansion of port facilities in the Western Basin of the Port of Gladstone have formed part of the ongoing operation of the Gladstone Ports Corporation (GPC; GPC, 2016). Expanded facilities are key components of the import/export chain for coal and support other 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 new port facilities, and aimed 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) was conducted between 2011 and 2013 and involved removal of 22.5 million m³ of material; 17.6M m³ 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 fourth comprehensive year of surveys, completed in the tenth year (2020) of the study.

The objectives of the study were to:

- conduct a population censuses of species present;
- map shorebird feeding and roosting sites;
- investigate habitat utilisation relative to the lunar/tide cycles and season; and
- identify 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.

To address the conditions of the EPBC Approval for the WBDDP, monitoring of shorebirds in the ERMP bioregion (Appendix 4) was conducted from 2011 to 2020. 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 methods used in 2011 were 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 2020/2021, which followed 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 non-breeding grounds which encompass parts of India, Southeast Asia, 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 worldwide (Hansen et al., 2016), in the EAAF (Studds et al., 2017) and in Australia (Clemens et al., 2016; Clemens et al., 2019).

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 Lesser Sand Plover are listed as Endangered; Greater Sand Plover and the Alaskan sub-species of the Bar-tailed Godwit (*baueri*) are listed as Vulnerable.

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; Menkhurst 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; Menkhurst 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; Menkhurst 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, 2019).

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 with good visibility and limited vegetation such as sand banks, mud banks (including upper tidal flats), sand/shell/gravel bars, sand spits, beaches, islets and man-made ponds such as dredge spoil ponds; 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 and Curlew Sandpiper 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 be 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 has accepted the recently revised EAAF population estimates of Hansen et al. (2016) (Appendix 1), so 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 undertake a 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 than a non-breeding (or 'overwintering') site.

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 Mundoolin – Colosseum – Rodds Peninsula (MCR); and, 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 that 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

Report prepared by Wildlife Unlimited for Gladstone Ports Corporation Ecosystem Research and Monitoring Program 5

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 prey (i.e. food) is present on the Curtis Coast at low density by international standards. In addition, the prey present on the Curtis Coast generally 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; i.e. 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 10,052ha produced by GHD (2011c).



Eastern Curlew is one of the species found along the Curtis Coast that is listed in a threatened category (Critically Endangered) under the EPBC Act (Micha V Jackson, Wildlife Unlimited)

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 1); the Fitzroy Estuary (Figure 2); North Curtis (Figure 2); and MCR (Figure 3). Data from the Cheetham Salt Works at Bajool (located in the Fitzroy Estuary) have 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 Sections 4.1.16, 4.3.16, 4.4.11 and 4.5.16 below.

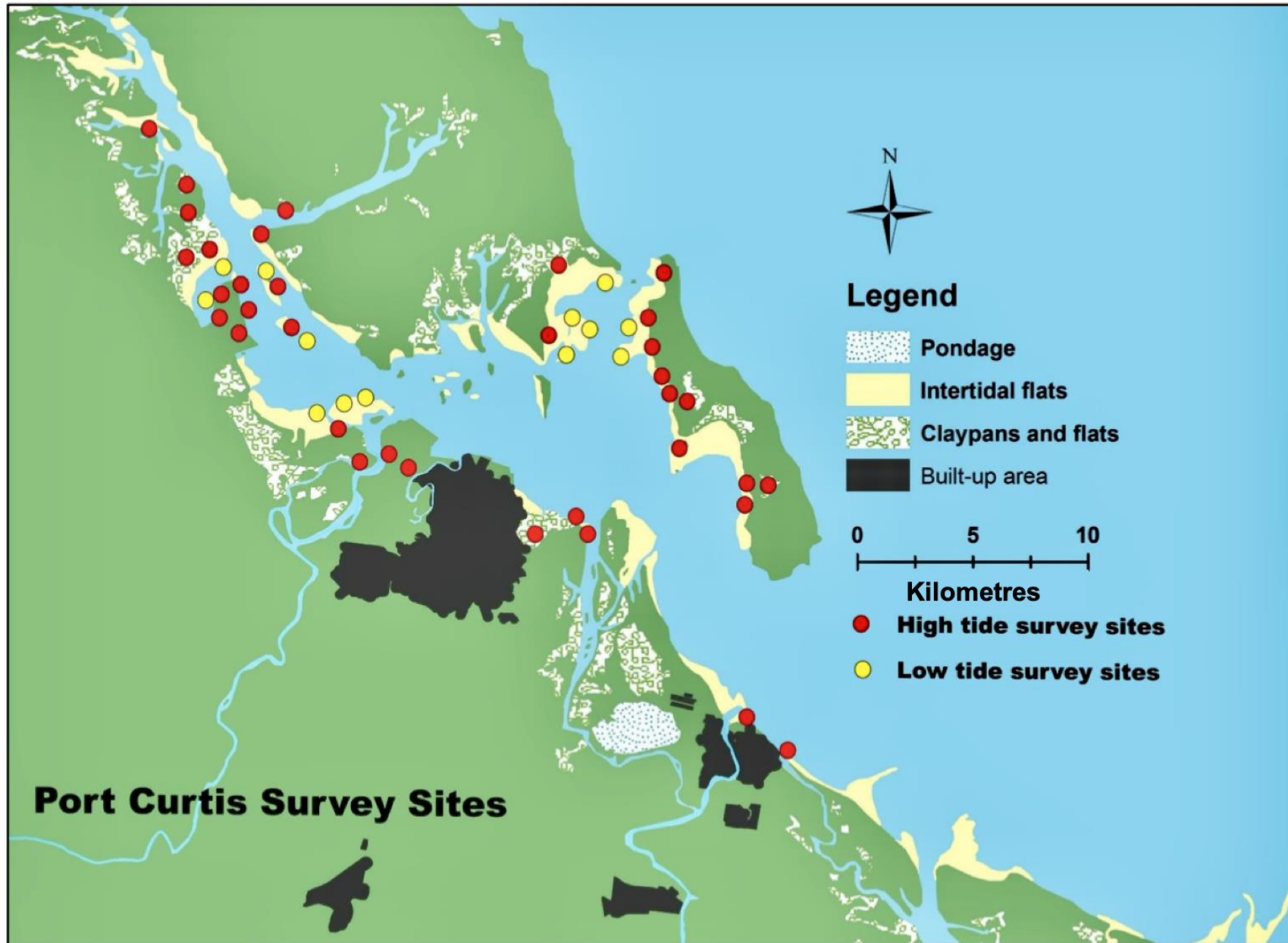


Figure 1 Migratory shorebird survey sites in the Port Curtis management unit.

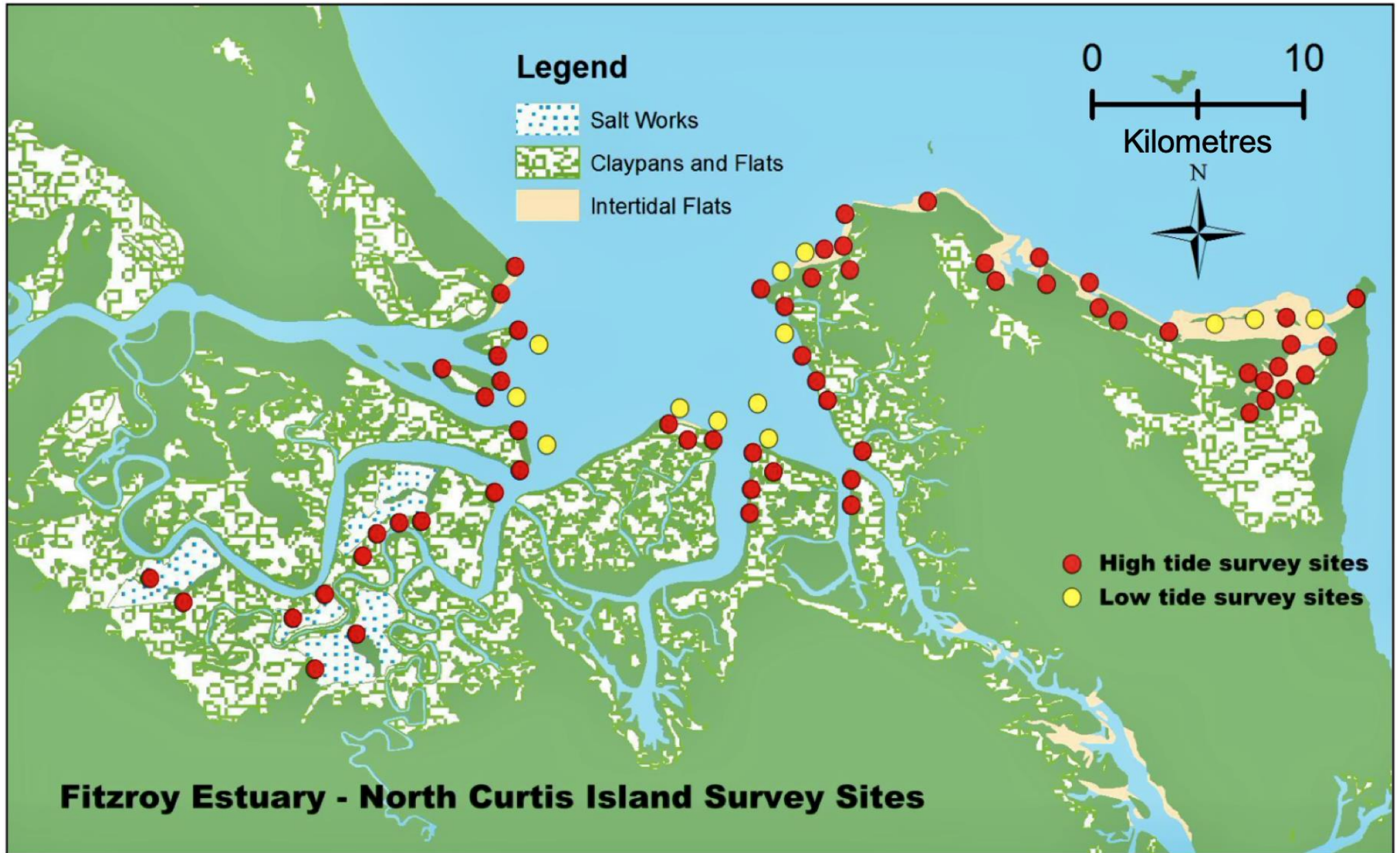


Figure 2 Migratory shorebird survey sites in the Fitzroy Estuary and North Curtis management units.

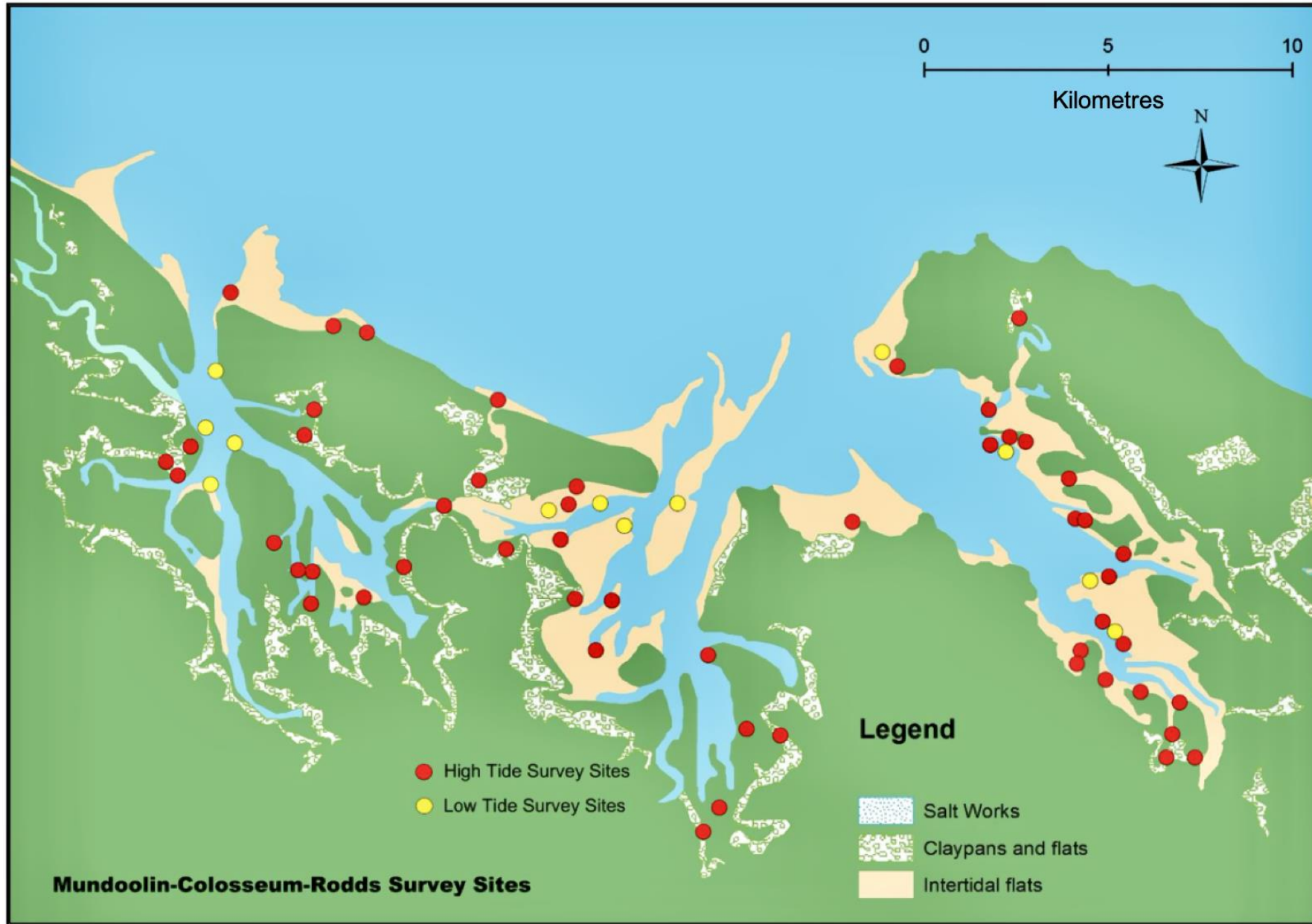


Figure 3 Migratory shorebird survey sites in the Mundoolin – Colosseum – Rodds Peninsula (MCR) management unit.

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 BirdLife Australia's *National Shorebird Monitoring Program* (formerly *Shorebirds 2020*) via the Natural Heritage Trust and there is considerable agreement between the DoAWE survey guidelines and the *Shorebirds 2020* procedures (DEWHA, 2009b; <http://www.birdlife.org.au/projects/shorebirds-2020>). Use of the *Shorebirds 2020* procedure was considered desirable for this study because most shorebird observers in Australia are familiar with it. Consequently, training requirements for observers was minimised and the pool of skilled and experienced observers maximised. Over the life of the study this increased comparability of the data and minimised 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

A study by Choi et al. (2017) estimated that conducting only a single shorebird count in the Curtis Coast region in February would miss about 44% of the total number of the total migratory shorebirds that use the area throughout the non-breed season because many individuals may transit through the area briefly to use it as a refuelling site during northward or southward migration and would not therefore be picked up during a single count. This finding highlights the value of repeated surveys throughout the non-breeding period, and is also a reminder that any particular count is a snapshot of the number of birds currently in the area, but this number will fluctuate throughout the non-breeding season. The aim of the comprehensive surveys is to count the populations of migratory shorebirds that are present on the Curtis Coast at different times throughout the year. To this end, in 2020 (as in 2019) we followed the comprehensive survey procedure developed by GHD in 2011, and planned to conduct shorebird surveys in January, February, March, August and October. Due to poor weather and the Covid-19 pandemic, however, the March 2020 survey had to be postponed and was completed in March 2021. Migratory shorebirds present on the Curtis Coast can be grouped into three classes

relating to the timing of their migration (Table 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 2020/2021 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 2 below.

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.

Table 1 The migration status of migratory shorebird species on the Curtis Coast.

Table compiled following 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)

Table 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 indicate 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 four migratory shorebird surveys conducted by Wildlife Unlimited along the Curtis Coast in 2020 and one in 2021. Each survey was timed such that field work was conducted for five consecutive days coinciding with a full moon spring tide (see Table 3 below for timing of each monthly survey in 2020/2021). In the case of inclement weather, 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 Timing of migratory shorebird surveys conducted in 2020/2021.

Survey month	Survey timing
January (2020)	Saturday the 11 th to Wednesday the 15 th
February (2020)	Sunday the 9 th to Thursday the 13 th
March (2021)	Wednesday the 10 th to Sunday the 14 th
August (2020)	Monday the 3 rd to Friday the 7 th
October (2020)	Friday the 2 nd to Tuesday the 6 th

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 4). 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 4 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).

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 conducted at low tide on the same day as 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 2020/2021, the salt works were surveyed comprehensively at high tide in January, March and October but not in February, when wet driving conditions precluded access, or August when they were only surveyed at low tide because of construction activity at the high tide roosts.

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 2020/2021. An overall summary of the results of the 2020/2021 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, 2012 and 2019). 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 2020 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) (Table 5). 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.

Table 5 Intertidal flat area used to calculate migratory shorebird density.

Management unit	Area (ha)
North Curtis	1,972
Fitzroy Estuary	2,366
Port Curtis	2,401
MCR	3,313
Total	10,052



Grey-tailed Tattler (left and cover) are common in the Curtis Coast region and are often found roosting in mangroves (right) at high tide (Micha V Jackson, Wildlife Unlimited).

4 Results

In 2020/2021, Wildlife Unlimited staff undertook five surveys of the migratory shorebird populations of the Curtis Coast (see Table 3 for survey dates). As noted above, all five surveys were originally planned for 2020 but due to bad weather conditions and the Covid-19 pandemic the March 2020 surveys had to be postponed until March 2021. Results from each survey are compared to historical data (when available) from 2011, 2012 and 2019 – the other years during the ERMP project that comprehensive surveys were conducted during the same five months of the year. Results from February are compared to historical data from all years between 2011 and 2019 when annual summer counts were conducted.

4.1 January

January surveys 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 that will provide them with the massive amount of energy required for their eventual return to their northern hemisphere breeding grounds (see Table 2 for a summary of the migration timing of each species present on the Curtis Coast). The results from the surveys completed in January 2020 are compared below to the results from the surveys conducted in January 2011, January 2012 and January 2019.

4.1.1 Survey coverage

156 high tide surveys were completed in January (including counts at the Cheetham Salt Works), with a total high tide survey time of 1,020 minutes (approximately 17 hours). There were eight sites that could not be surveyed at high tide due to site inundation or other factors. 38 low tide surveys were completed, with a total low tide survey time of 526 minutes (approximately 9 hours). The survey effort from January is presented in Table 6. The weather during the January field trip was variable, with 37 of the 194 total surveys completed when the wind speed was above 20km/h, which is not ideal for shorebird counting.

4.1.2 Abundance estimates

The total number of EPBC Act-listed migratory shorebirds recorded at high tide roost counts on the Curtis Coast in January 2020 was 8,618, which was less than in any other year of the project (see Figure 4). 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 and are presented separately at the end of this section. Only individuals identified to species level and “Sand Plover spp.” – which represents either Greater or Lesser Sand Plover (both migratory species) – are included in this total; a further 70 shorebirds could not be identified to species level. A total of 18 migratory shorebird species were identified during the high tide roost counts, which was the same as that in January 2011 and January 2019 but slightly less than that in January 2012 (see Figure 5). The ten most abundant species, listed in descending order, were Red-necked Stint, Bar-tailed Godwit, Grey-

tailed Tattler, Whimbrel, Terek Sandpiper, Greater Sand Plover, Eastern Curlew, Lesser Sand Plover, Great Knot and Sharp-tailed Sandpiper. This differs somewhat from the January 2019 counts, when Bar-tailed Godwit was the most numerous species and Red-necked Stint the sixth most numerous, while Curlew Sandpiper was among the ten most numerous species but Sharp-tailed Sandpiper was not. There were also hundreds more Grey-tailed Tattler (295 – 460 more individuals) and Greater Sand Plover (134 – 502 more individuals) counted in 2020 and hundreds less Eastern Curlew (124 – 1,123 fewer individuals) and Lesser Sand Plover (344 – 1,699 fewer individuals) counted in 2020 than in any of the other three years. These results underscore the importance of considering species-specific results as well as total numbers. The overall foraging density of migratory shorebirds across the Curtis Coast (excluding the salt works) in January 2020 was 0.86 birds/ha (8,618 migratory shorebirds ÷ 10,052 ha), less than the foraging density observed in January 2011 (13,172 birds; 1.31 birds/ha), January 2012 (10,308 birds; 1.02 birds/ha) and January 2019 (10,301 birds; 1.02 birds/ha).

Table 6 Summary of survey effort in January 2020: number of sites and elapsed survey time at each location.

Location	High Tide		Low Tide	
	Sites	Duration (mins)	Sites	Duration (mins)
Port Curtis	45	276	17	151
Fitzroy Estuary	22	220	7	114
North Curtis Island	38	210	3	87
Mundoolin-Colosseum	28	153	9	116
Rodds Peninsula	19	91	2	58
Cheetham Salt Works	4	70	0	0
Total	156	1,020	38	526

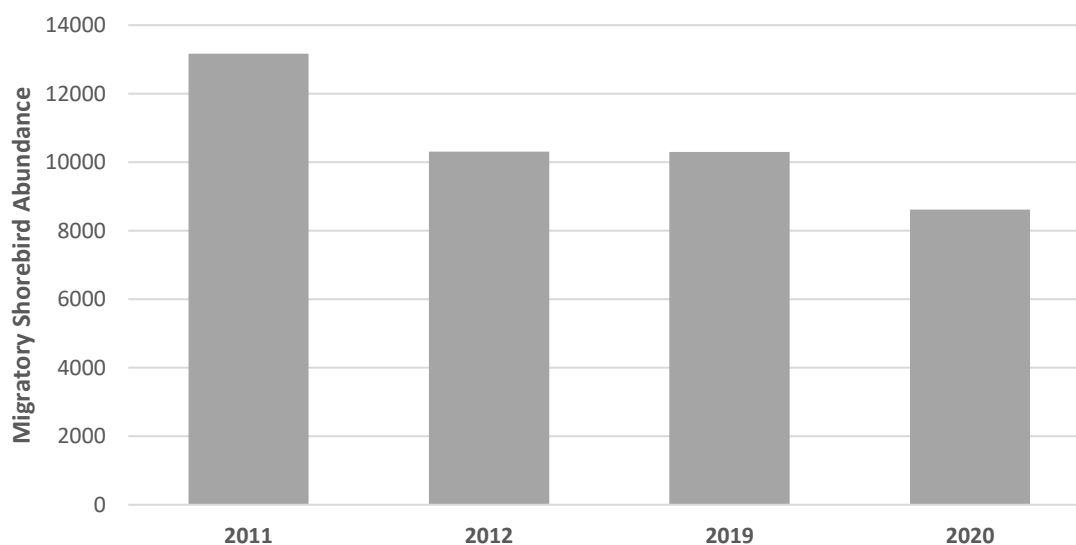


Figure 4 Abundance of migratory shorebirds on the Curtis Coast in January 2011, 2012, 2019 and 2020. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the project.

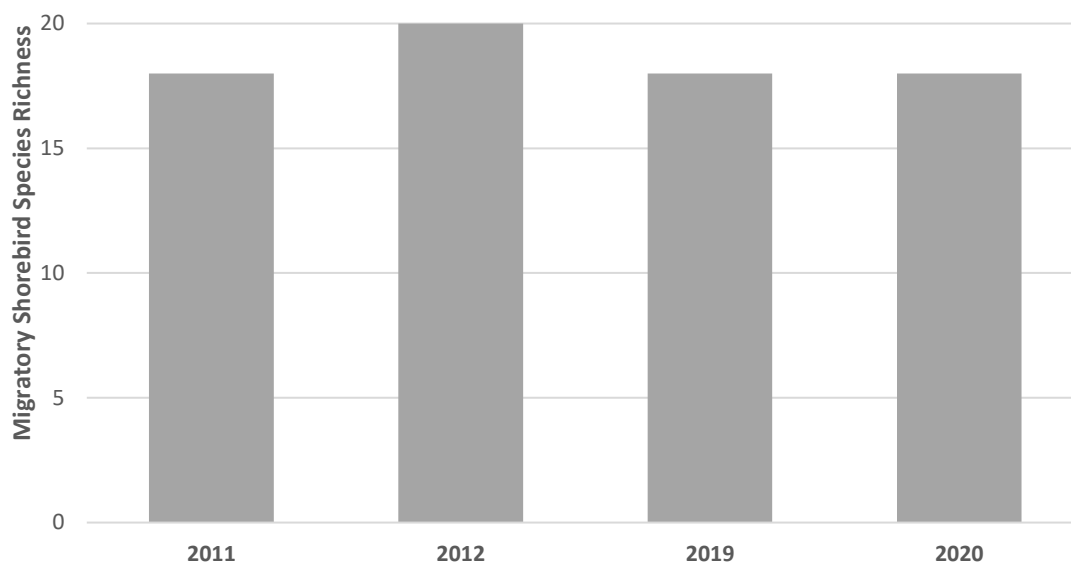


Figure 5 Species richness of migratory shorebirds on the Curtis Coast in January 2011, 2012, 2019 and 2020.

The foraging density of migratory shorebirds by management unit is summarised below (Table 7). 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; Table 5). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In January 2020, shorebirds were fairly evenly distributed across the study area with >1000 migratory shorebirds in each management unit and peak numbers (> 3300) in North Curtis (Table 8, Figure 6). There were two roosts with >1000 migratory shorebirds: the Yellow Patch Entrance Sandbar (1,636 birds) in North Curtis and the Deception Point claypan west site (1,038 birds) in the Fitzroy Estuary. There were a further three roosts with between 500 and 1000 migratory shorebirds: Central Mangrove Island (643 birds) and the Williams Bay, Mangrove Bay site (584 birds) in the MCR management unit, and Keppell Creek Entrance (566 birds) in North Curtis. There were 12 roosts with between 100 and 500 migratory shorebirds: four each in North Curtis and MCR, three in Port Curtis, and one in Fitzroy. Counts from the Cheetham Salt Works are discussed below in section 4.1.16.

Table 7 Summary of foraging density in January over time.

Location	Foraging density (birds/ha)			
	2011	2012	2019	2020
Fitzroy Estuary	0.5	1.7	1.2	0.9
North Curtis Island	3.7	1.4	1.7	2.1
MCR	0.7	0.9	0.8	1.0
Port Curtis	1.0	0.7	0.8	0.6

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in January 2020. These species accounts are given in descending order of abundance and are followed by a discussion of the non-migratory shorebirds present during the survey and the shorebirds observed at the Cheetham Salt Works. Note that the shorebird population estimations utilised in earlier reports (e.g. 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.

A summary of all shorebirds counted in January 2020 can be found in Table 20 at the end of this section.

Table 8 Place names of the roosts with the greatest abundance of migratory shorebirds in January 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	1. Deception Point claypan west side
	500-1000	Nil
	100-499	1. Curlew Spit claypan
North Curtis	>1000	1. Yellow Patch Entrance Sandbar
	500-1000	1. Keppell Creek Entrance
	100-499	1. Note Creek beach
		2. Creek 5
		3. Little Barramundi Creek
		4. Note Creek North Spit
Port Curtis	>1000	Nil
	500-1000	Nil
	100-499	1. Facing Island Claypan
		2. Facing Island 4
		3. Calliope 2
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-1000	1. Central Mangrove Island
		2. Williams Bay, Mangrove Bay
	100-499	1. Mundoolin Rocks east claypan
		2. Spit End
		3. Mangrove Island 2
		4. Colosseum Inlet Mangrove Creek Saltpan

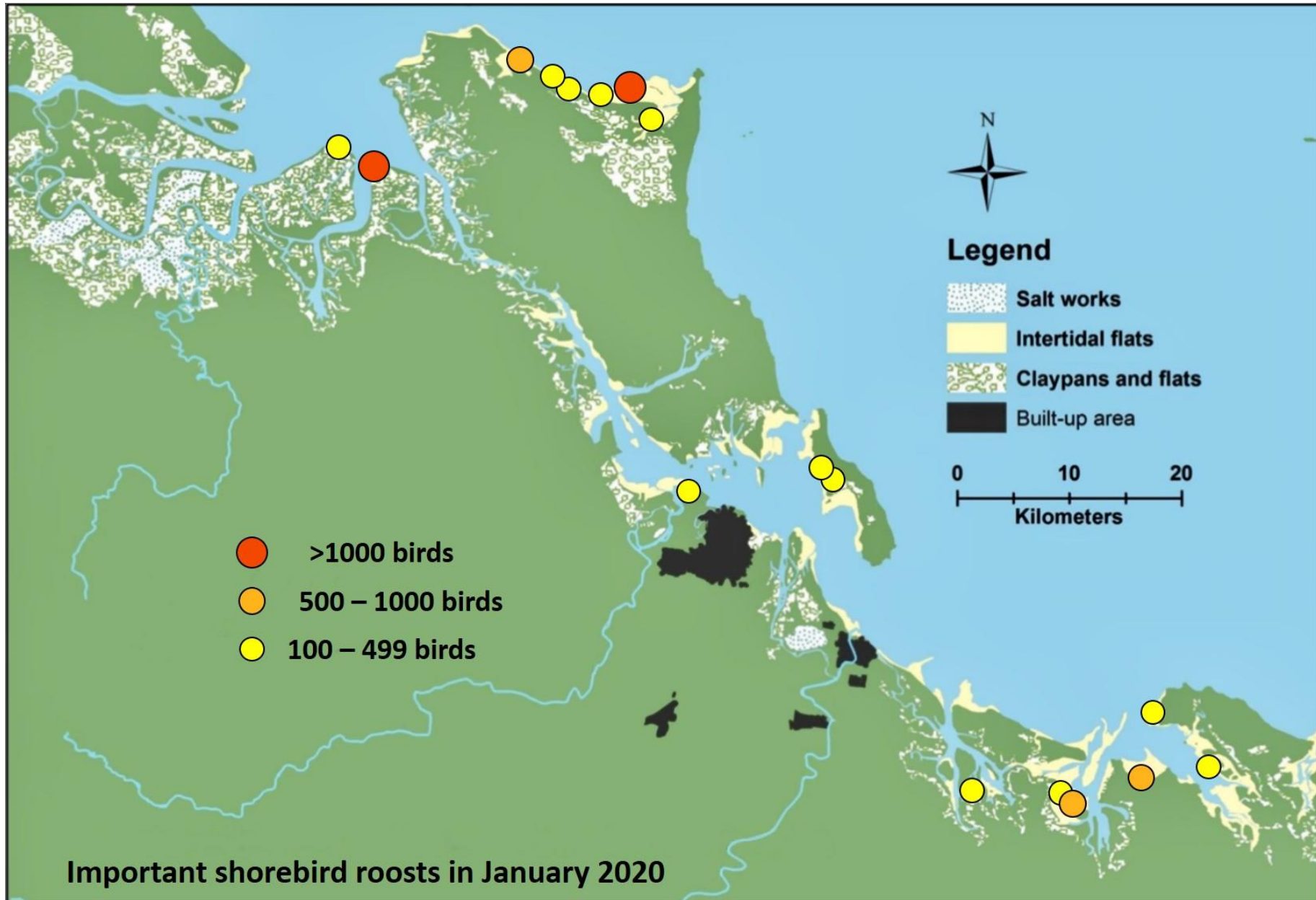


Figure 6 Important shorebird roosts on the Curtis Coast in January 2020.

4.1.3 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 January 2020, with 1,970 birds recorded at high tide roosts during the survey. This was 1,102 more birds than the number counted in January 2019 (868), comparable to the numbers counted in January 2011 (2,158) but 1,012 less birds than the number counted in January 2012 (2,982). Red-necked Stint were present at 14 sites (excluding the salt works), one of which was of *national significance*: the Deception Point claypan west side site in the Fitzroy Estuary management unit supported 820 birds. The foraging density was also highest in the Fitzroy Estuary management unit (Table 9). 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 show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019).

Table 9 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	2	890	0.38
North Curtis	6	602	0.31
MCR	3	387	0.12
Port Curtis	3	91	0.04
Totals	14	1970	0.20

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 second most abundant migratory shorebird on the Curtis Coast in January 2020, with 1,385 birds recorded at high tide roosts during the survey. This was the lowest number counted in January during the project, with 2,010 fewer birds than the number counted in January 2011 (3,395), 762 fewer birds than the number counted in January 2019 (2,147) and 725 fewer birds than the number counted in January 2012 (2,110). Bar-tailed Godwits were present at 19 sites, two of which were of *national significance*: the Yellow Patch Entrance Sandbar in the North Curtis management unit supported 651 birds, and the Williams Bay, Mangrove Bay site in the MCR management unit supported 414 birds. The foraging density was by far highest in the North Curtis management unit (Table 10). Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016). The Siberian sub-species of this species (*menzbieri*) is listed as Critically Endangered and the Alaskan sub-species (*baueri*) as Vulnerable under the EPBC Act; *menzbieri* is the sub-species predominantly found in eastern Australia.

Table 10 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	4	703	0.36
MCR	4	431	0.13
Fitzroy Estuary	6	149	0.06
Port Curtis	5	102	0.04
Totals	19	1,385	0.14

4.1.5 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 January 2020, with 1,046 birds recorded at high tide roosts during the survey. This was the highest number counted in January during the project, with 460 more birds than the number counted in January 2011 (586), 321 more birds than the number counted in January 2019 (725) and 295 more birds than the number counted in January 2012 (751). The total number of Grey-tailed Tattler present on the Curtis Coast in January 2020 was of **international significance** (i.e. >1% of the total estimated EAAF population of this species was present during the survey). Grey-tailed Tattlers were present at 31 sites, two of which were of *national significance*: Central Mangrove Island in the MCR management unit supported 400 birds, and the Creek 5 site in the North Curtis management unit supported 100 birds. The foraging density was highest in the MCR management unit (Table 11). The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 11 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	8	567	0.17
North Curtis	13	253	0.13
Port Curtis	6	253	0.06
Fitzroy Estuary	4	87	0.04
Totals	31	1,046	0.10

4.1.6 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 January 2020, with 872 birds recorded at high tide roosts during the survey. This was the lowest number counted in January during the project, with 1,764 less birds than the number counted in January 2011 (2,636), 75 less birds than the number counted in January 2012 (947) and 46 less birds than the number counted in January 2019 (918). The total number of Whimbrel present on the Curtis Coast in January 2020 was of **international significance** (i.e. >1% of the total estimated EAAF population of this species was present during the survey). Whimbrel were present at 57 sites, one of which was of *national significance*: the Keppell Creek Entrance in the North Curtis management unit supported 205 birds. The foraging density was also by far highest in the North Curtis management unit (Table 12). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 12 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	22	489	0.25
MCR	15	190	0.06
Port Curtis	11	144	0.06
Fitzroy Estuary	9	49	0.02
Totals	57	872	0.09

4.1.7 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 January 2020, with 757 birds recorded at high tide roosts during the survey. This was the highest number counted in January during the project, with 232 more birds than the number counted in January 2011 (525), 228 more birds than the number counted in January 2019 (529) and 44 more birds than the number counted in January 2012 (713). The number of Terek Sandpiper present on the Curtis Coast in January 2020 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 27 sites, four of which were of *national significance*: the Central Mangrove Island and the Mangrove Island 2 site in the MCR management unit supported 156 birds and 80 birds respectively, the Facing Island 4 site in the Port Curtis management unit supported 105 birds, and the East Shore Connor Creek in the Fitzroy Estuary management unit supported 68 birds. The foraging density was highest in the MCR management unit (Table 13). It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). There are currently insufficient data to assess long-term trends in Australia, and data do not show a significant trend in Australia over the medium term (Clemens et al., 2019).

Table 13 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	7	329	0.10
Port Curtis	4	175	0.07
North Curtis	11	138	0.07
Fitzroy Estuary	5	115	0.05
Totals	27	757	0.08

4.1.8 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 sixth most abundant migratory shorebird on the Curtis Coast in January 2020, with 657 birds recorded at high tide roosts during the survey. This was the highest number counted in January during the project, with 502 more birds than the number counted in January 2012 (155), 483 more birds than the number counted in January 2011 (174) and 134 more birds than the number counted in January 2019 (523). Greater Sand Plovers were present at 9 sites, one of which was of *national significance*: the Yellow Patch Entrance Sandbar in the North Curtis management unit supported 421 birds. The foraging density was highest in the North Curtis management unit (Table 14). The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019). Data from Australia do not show a significant trend over the long term, but do show a medium-term decline in abundance in Australia (Clemens et al., 2019). This species is listed as Vulnerable under the EPBC Act.

Table 14 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	4	475	0.24
Port Curtis	1	163	0.07
Fitzroy Estuary	2	10	0.004
MCR	2	9	0.003
Totals	9	657	0.07

4.1.9 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 January 2020, with 483 birds recorded at high tide roosts during the survey. This was the lowest number counted in January during the project, with 1,123 fewer birds than the number counted in January 2011 (1606), 415 fewer birds than the number counted in January 2019 (898) and 124 fewer birds than the number counted in January 2012 (607). The number of Eastern Curlew present on the Curtis Coast in January 2020 was of **international significance** (i.e. >1% of the global population of this species was present during the survey). Eastern Curlew were present at 22 sites, five of which were of *national significance*: the Mundoolin Rocks east claypan, Spit End, the Williams Bay, Mangrove Bay site, and the Colosseum Inlet Mangrove Creek Saltpan in the MCR management unit supported 199, 75, 61 and 39 birds respectively, and the Keppell Creek Entrance in the North Curtis management unit supported 37 birds. The foraging density was highest in the MCR management unit (Table 15). The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 15 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	7	377	0.11
North Curtis	5	76	0.04
Port Curtis	6	24	0.01
Fitzroy Estuary	4	6	0.003
Totals	22	483	0.05

4.1.10 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 eighth most abundant migratory shorebird on the Curtis Coast in January 2020, with 442 birds recorded at high tide roosts during the survey. This was the lowest number counted in January during the project, with 1,699 fewer birds than the number counted in January 2019 (2,141), 555 fewer birds than the number counted in January 2011 (997) and 344 fewer birds than the number counted in January 2012 (786). Lesser Sand Plovers were present at 10 sites, none of which reached the threshold for national significance. The foraging density was highest in the North Curtis management unit (Table 16). The Lesser Sand Plover is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Endangered under the EPBC Act.

Table 16 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	5	220	0.11
Fitzroy Estuary	2	164	0.07
Port Curtis	1	50	0.02
MCR	2	8	0.002
Totals	10	442	0.04

4.1.11 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 January 2020, with 406 birds recorded at high tide roosts during the survey. This was the lowest number counted in January during the project, with 527 fewer birds than the number counted in January 2019 (933), 513 fewer birds than the number counted in January 2012 (919) and 380 fewer birds than the number counted in January 2011 (786). Great Knots were present at 7 sites, none of which reached the threshold for national significance. The foraging density was highest in the North Curtis management unit (Table 17). Data from Australia do not show a significant trend in Great Knot over the long term but do show a decline in abundance over the medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 17 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	2	150	0.05
North Curtis	1	122	0.06
Fitzroy Estuary	2	71	0.03
Port Curtis	2	63	0.03
Totals	7	406	0.04

4.1.12 Sharp-tailed Sandpiper (*Calidris acuminata*)**EAAF population estimate (Hansen, 2016): 85,000****1% population estimate for internationally significant sites: 850****0.1% population estimate for nationally significant sites: 85****EAAF population estimate (Wetlands International, 2019): 160,000**

The Sharp-tailed Sandpiper was the tenth most abundant migratory shorebird on the Curtis Coast in January 2020, with 164 birds recorded at high tide roosts during the survey. This was the highest number counted in January during the project, with 164 more birds than the number counted in January 2011 (0), 159 more birds than the number counted in January 2012 (5) and 155 more birds than the number counted in January 2019 (9). Sharp-tailed Sandpipers were present at 14 sites, one of which was of *national significance*: the Keppell Creek Entrance in the North Curtis management unit supported 119 birds. The foraging density was highest in the North Curtis management unit (Table 18). Australian data show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019).

Table 18 Comparison of the number of birds, number of roosts occupied and foraging density of Sharp-tailed Sandpiper between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	4	143	0.07
Fitzroy Estuary	4	10	0.004
Port Curtis	4	8	0.003
MCR	2	3	0.0009
Totals	14	164	0.02

4.1.13 Other migratory shorebirds

There were a further eight species of migratory shorebird recorded on the Curtis Coast in January 2020. They were (in order of descending abundance): Curlew Sandpiper (115 birds), Broad-billed Sandpiper (97 birds), Grey Plover (72 birds), Common Greenshank (69 birds), Ruddy Turnstone (48 birds), Red Knot (23 birds), Pacific Golden Plover (10 birds) and Marsh Sandpiper (2 birds). Together, these species made up approximately 5% of the total migratory shorebird count for the survey.

4.1.14 Non-migratory shorebirds

There were 708 non-migratory shorebirds of nine species recorded during high tide counts on the Curtis Coast in January 2020. They were (in order of descending abundance): Red-capped Plover (364 birds), Australian Pied Oystercatcher (240 birds), Pied Stilt (48 birds), Masked Lapwing (33 birds), Beach Stone-curlew (eight birds), Sooty Oystercatcher (eight birds), Red-necked Avocet (three birds), Red-kneed Dotterel (three birds), and Bush Stone-curlew (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).

4.1.15 Low tide surveys

There were 38 low tide surveys conducted on the Curtis Coast in January 2020. In total, 526 minutes (almost 9 hours) were spent surveying shorebirds at low tide (Table 6). A total of 3,061 birds of 22 species (2,380 migratory, 253 non-migratory and some individuals that could not be identified to species level) were counted during the low tide surveys. The species with over 50 individuals counted at low tide were (in order of descending abundance): Great Knot (638 birds), Bar-tailed Godwit (554 birds), Red-necked Stint (347 birds), Lesser Sand Plover (216 birds), Eastern Curlew (133 birds), Pied Oystercatcher (133 birds), Whimbrel (129 birds), Greater Sand Plover (119 birds), Red-capped Plover (94 birds) and Terek Sandpiper (67 birds). Grey-tailed Tattler (33 birds), Curlew Sandpiper (19 birds), Grey Plover (15 birds), Masked Lapwing (15 birds), Red Knot (10 birds), Ruddy Turnstone (10 birds), Pied Stilt (six birds), Common Greenshank (four birds), Beach Stone-curlew (three birds), Sharp-tailed Sandpiper (three birds), Red-necked Avocet (two birds), Marsh Sandpiper (one bird) and unidentified shorebirds or sand plovers (510 birds total) 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.

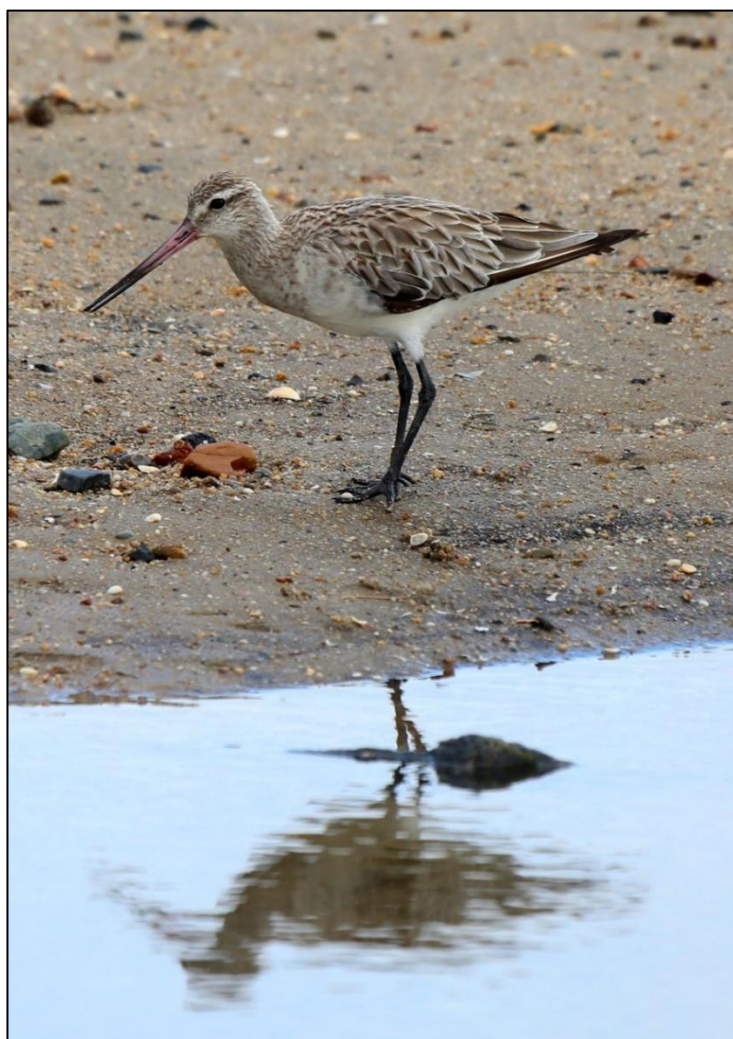
In January 2020, there was one site counted at low tide with between 500 and 1000 migratory shorebirds (Table 19): Yellow Patch Sandbar (627 birds) in North Curtis. There were four sites counted at low tide with between 100 and 500 migratory shorebirds (Table 19): Mundoolin North (464 birds) in the MCR management unit, Cattle Point (215 birds) in the Fitzroy Estuary, and Friend Point (170 birds) and Pelican Banks (143 birds) in Port Curtis.

Table 19 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in January 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-1000	Nil
	100-499	1. Cattle Point
North Curtis	>1000	Nil
	500-1000	1. Yellow Patch Sandbar
	100-499	Nil
Port Curtis	>1000	Nil
	500-1000	Nil
	100-499	1. Friend Point 2. Pelican Banks
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-1000	Nil
	100-499	1. Mundoolin North

4.1.16 Cheetham Salt Works Surveys in January 2020

Access was gained to eight sites within the salt works, which were surveyed on 15 January. In addition to the shorebirds reported above, a total of 2,901 shorebirds of 10 species were recorded at the salt works, including 2,806 at the South Cheetham Salt Fields site. The majority of shorebirds found within the salt works were Sharp-tailed Sandpiper (675 birds), Red-necked Avocet (631 birds), Black-tailed Godwit (503 birds; also note this species was not recorded elsewhere on the Curtis Coast in January 2020), Pied Stilt (317 birds), Curlew Sandpiper (302 birds), Marsh Sandpiper (231 birds), Common Greenshank (188 birds), along with smaller numbers of Bar-tailed Godwit (30 birds), Red-necked Stint (20 birds) and Masked Lapwing (four birds). The number of Sharp-tailed Sandpiper, Black-tailed Godwit, Curlew Sandpiper, Marsh Sandpiper and Common Greenshank present at the site were all of *national significance*, representing more than 0.1% of the total estimated EAAF populations of each species. Given previous recommendations, the importance of this site, and the difference in community structure at this site compared with the rest of the Curtis Coast, it is unfortunate that access to the salt works was patchy throughout the ten-year project, including in 2020, but nonetheless positive that high tide surveys at the salt works were possible during three of five survey periods in 2020/21.



Bar-tailed Godwit was the second-most numerous migratory shorebird species counted in the Gladstone region in January, 2020 (Micha V Jackson, Wildlife Unlimited).

Table 20 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in January, 2020.

Species	North Curtis		Fitzroy Estuary		Port Curtis		MCR		Cheetham Salt Works		Total	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
<i>Migratory</i>												
Bar-tailed Godwit	703	184	149	97	102	100	431	173	30	-	1415	554
Black-tailed Godwit	0	0	0	0	0	0	0	0	503	-	503	0
Broad-billed Sandpiper	11	0	86	0	0	0	0	0	0	-	97	0
Common Greenshank	29	0	1	1	12	1	27	2	188	-	257	4
Curlew Sandpiper	47	16	49	0	14	0	5	3	302	-	417	19
Eastern Curlew	76	17	6	11	24	46	377	59	0	-	483	133
Great Knot	122	165	71	151	63	49	150	273	0	-	406	638
Greater Sand Plover	475	92	10	8	163	3	9	16	0	-	657	119
Grey Plover	26	0	3	3	7	0	36	12	0	-	72	15
Grey-tailed Tattler	253	0	87	3	139	4	567	26	0	-	1046	33
Lesser Sand Plover	220	81	164	82	50	0	8	53	0	-	442	216
Marsh Sandpiper	0	1	0	0	2	0	0	0	231	-	233	1
Pacific Golden Plover	10	0	0	0	0	0	0	0	0	-	10	0
Red Knot	8	10	0	0	15	0	0	0	0	-	23	10
Red-necked Stint	602	51	890	46	91	202	387	48	20	-	1990	347
Ruddy Turnstone	0	0	2	0	4	0	42	10	0	-	48	10
Sand Plover spp.	0	80	0	2	0	0	0	0	0	-	0	82
Sharp-tailed Sandpiper	143	1	10	0	8	2	3	0	675	-	839	3
Terek Sandpiper	138	44	115	0	175	9	329	14	0	-	757	67
Whimbrel	489	34	49	9	144	55	190	31	0	-	872	129
Total migratory	3352	732	1692	457	1013	471	2561	720	1949	-	10567	2380
<i>Non-migratory</i>												
Beach Stone-curlew	2	0	1	0	2	0	3	0	0	-	8	0
Bush Stone-curlew	1	0	0	0	0	0	0	0	0	-	1	0
Masked Lapwing	21	15	2	0	10	0	0	74	4	-	37	89
Pied Oystercatcher	40	0	17	7	8	52	175	41	0	-	240	100
Pied Stilt	0	0	0	0	48	6	0	0	317	-	365	6
Red-capped Plover	100	12	70	36	8	5	186	118	0	-	364	171

Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Red-kneed Dotterel	0	0	0	0	3	0	0	0	0	-	3	0
Red-necked Avocet	0	0	0	0	3	2	0	3	631	-	634	5
Sooty Oystercatcher	0	0	0	0	6	0	2	0	0	-	8	0
Total non-migratory	164	27	90	43	88	65	366	236	952	-	1660	371
Unidentified small shorebird	0	290	0	80	0	0	0	30	0	-	0	400
Unidentified medium shorebird	0	0	0	0	70	0	0	8	0	-	70	8
Grand total	3516	1049	1782	580	1171	536	2927	994	2901	-	12297	3159

4.2 February

February surveys target the migratory shorebirds present on the Curtis Coast in the Austral summer (see Table 2). Unlike the results from the other surveys completed in 2020/2021, 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

150 high tide surveys were completed in February, with a total high tide survey time of 854 minutes (approximately 14 hours). 39 low tide surveys were completed, with a total low tide survey time of 521 minutes (a bit under nine hours). There were seven sites that could not be surveyed at high tide and one that could not be surveyed at low tide due to site inundation or other factors. The survey effort from February is presented in Table 21. The weather during the February field trip was generally good, with only four of the 189 total surveys completed when the wind speed was above 20km/h, which is not ideal for shorebird counting.

Table 21 Summary of survey effort in February: number of sites and elapsed survey time at each location.

Management Unit	High Tide		Low Tide	
	Sites	Duration (mins)	Sites	Duration (mins)
Port Curtis	40	308	17	129
Fitzroy Estuary	22	138	6	96
North Curtis Island	40	170	4	96
Mundoolin-Colosseum	28	144	9	142
Rodd's Peninsula	20	94	3	58
Cheetham Salt Works*	Nil	Nil	Nil	Nil
Total	150	854	39	521

*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 2020 was 9,441 (see Figure 7), the third lowest number recorded in February and similar to the number recorded in February 2019. Only individuals identified to species level and "Sand Plover spp." – which represents either Greater or Lesser Sand Plover (both migratory species) – are included in this total; a further 279 shorebirds could not be identified to species level. A total of 17 migratory shorebird species were identified during the high tide roost counts, which was less than in some other years but there was only small variation during the project (see Figure 8). Red-necked Stint, Bar-tailed Godwit, Grey-tailed Tattler, Terek Sandpiper and Whimbrel were the most abundant species. The rest of the 'top ten' were (listed in descending

order): Great Knot, Eastern Curlew, Lesser Sand Plover, Curlew Sandpiper and Greater Sand Plover. The overall foraging density of migratory shorebirds across the Curtis Coast in February 2020 was 0.94 bird/ha, similar to the foraging density observed in February 2019 and one of the lowest February densities recorded during the project.

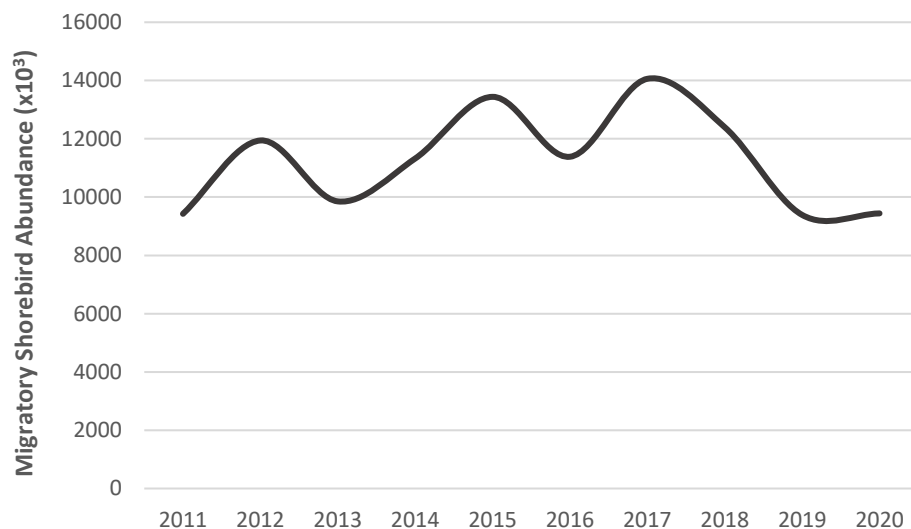


Figure 7 Abundance of migratory shorebirds on the Curtis Coast during February surveys over the life of the project. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the project.

In 2020, the foraging density of migratory shorebirds within each management unit was as follows: the Fitzroy Estuary supported 0.55 birds/ha, North Curtis supported 0.89 birds/ha, Mundoolin – Colosseum – Rodds Peninsula Peninsula (MCR) supported 1.03 birds/ha and Port Curtis supported 1.24 birds/ha. For a comparison between foraging densities in February in each management unit and year of the project, see Table 22 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; Table 5). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In February 2020, shorebirds were fairly evenly distributed across the study area with >3000 migratory shorebirds in the MCR, nearly 3000 in Port Curtis and >1000 in the Fitzroy Estuary and North Curtis (Table 23, Figure 9) There was one roost with >1000 migratory shorebirds, the Mundoolin Rocks east claypan site (1,323 birds) in the MCR management unit. There were a further three roosts with between 500 and 1000 migratory shorebirds: the South End - West Claypan (743 birds) and Western Basin Reclamation Area (550 birds) in Port Curtis and the Central Mangrove Island (652 birds) in the MCR management unit. There were 20 roosts with between 100 and 500 migratory shorebirds: six in the Fitzroy Estuary, five in North Curtis and Port Curtis, and four in MCR.

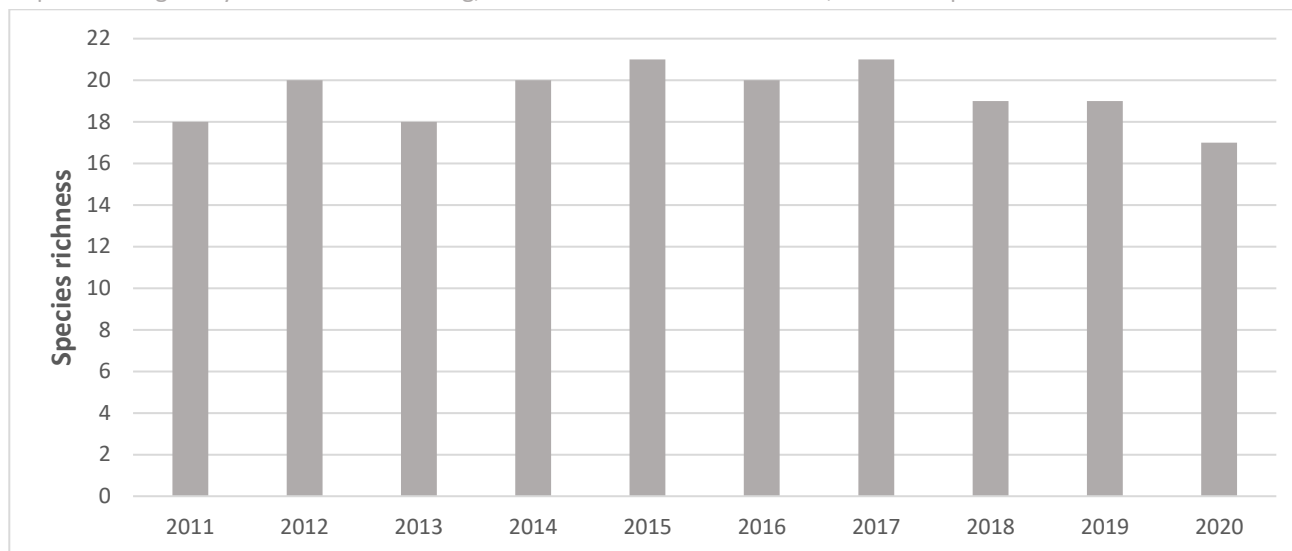


Figure 8 Species richness of migratory shorebirds on the Curtis Coast during February surveys over the life of the project.

Table 22 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.

Management unit	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Fitzroy Estuary	0.67	1.09	0.85	1.20	2.28	1.16	1.68	1.39	0.58	0.55
MCR	0.73	1.19	0.66	0.92	1.01	1.12	0.89	0.85	0.81	1.03
North Curtis Island	1.63	1.91	1.74	1.91	1.49	1.08	2.28	1.60	2.00	0.89
Port Curtis	0.92	0.69	0.92	0.70	0.73	1.16	1.10	1.30	0.58	1.24
<i>Curtis Coast overall</i>	<i>0.94</i>	<i>1.19</i>	<i>0.98</i>	<i>1.12</i>	<i>1.34</i>	<i>1.13</i>	<i>1.40</i>	<i>1.23</i>	<i>0.93</i>	<i>0.94</i>

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in February 2020. 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.

A summary of all shorebirds counted in February 2020 can be found in Table 35 at the end of this section.

Table 23 Place names of the roosts with the greatest abundance of migratory shorebirds in February 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-999	Nil
	100-499	1. Deception Point claypan west side 2. North East Shell Point 3. Curlew Spit mangrove 2 4. Curlew Spit claypan 5. Eupatoria Point 6. Rundle Beach
North Curtis	>1000	1. Nil
	500-999	2. Nil
	100-499	1. Yellow Patch Entrance Sandbar 2. Little Keppel Creek Sandbar 3. Yellow Patch Sandbar - Mangrove Roost 4. Keppell Creek Entrance 5. Creek 5
Port Curtis	>1000	Nil
	500-999	1. South End - West Claypan 2. Western Basin Reclamation Area
	100-499	1. Bund 8 2. Facing Island Claypan 3. South-east end of Curtis Island 4. Facing Island Sandbar 5. Facing Island 4
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	1. Mundoolin Rocks east claypan
	500-999	1. Central Mangrove Island
	100-499	1. Spit End 2. Williams Bay, Mangrove Bay 3. Bird Island 4. Mangrove Island 2

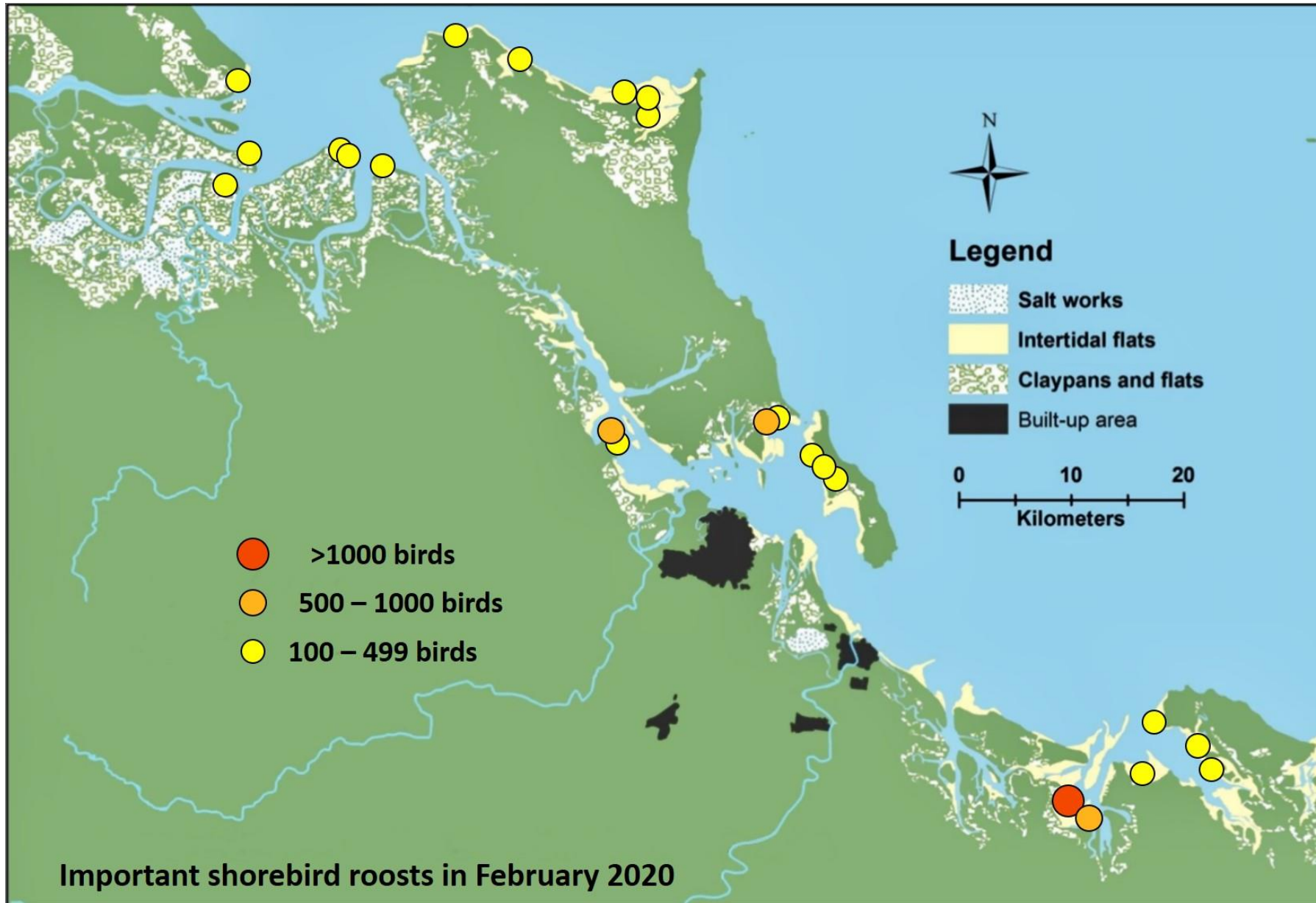


Figure 9 Important shorebird roosts on the Curtis Coast in February 2020.

4.2.3 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 February 2020, with 1,951 birds recorded at high tide roosts during the survey. Red-necked Stints were present at 19 sites, one of which was of *national significance*: the Western Basin Reclamation Area in the Port Curtis management unit supported 519 birds (see Figure A1 in Appendix 3). The foraging density was highest in the Port Curtis management unit (Table 24). 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 show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019). The number of Red-necked Stint counted on the Curtis Coast in February was quite variable over the years of the project, with the highest numbers of birds counted between 2015 and 2018 (Figure 10).

Table 24 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Red-necked Stint between four management units in January 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	7	945	0.40
Fitzroy Estuary	6	775	0.33
MCR	5	230	0.07
North Curtis	1	1	0.0005
Totals	19	1,951	0.19

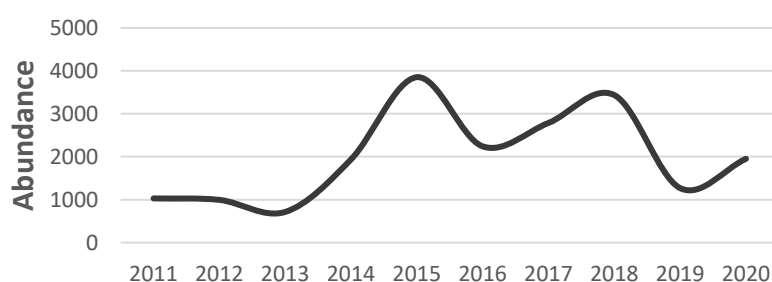


Figure 10 Abundance of Red-necked Stint on the Curtis Coast from February 2011 – 2020.

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 2020, with 1,883 recorded at high tide roosts during the survey. Bar-tailed Godwits were present at 23 sites, one of which was of *national significance*: the Mundoolin Rocks east claypan in the MCR management unit supported 520 birds (see Figure A2 in Appendix 3). The foraging density was highest in the North Curtis management unit (Table 25). Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The decline is especially strong north of 27.8°S, which includes the study site (Clemens et al., 2016). The Siberian sub-species of this species (*menzbieri*) is listed as Critically Endangered and the Alaskan sub-species (*baueri*) as Vulnerable under the EPBC Act; *menzbieri* is the sub-species predominantly found in eastern Australia. The number of Bar-tailed Godwit counted on the Curtis Coast in February was somewhat variable over the years of the project, with a peak count 2013 that was not matched in other years and the lowest numbers counted in the last two years of the project (Figure 11).

Table 25 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Bar-tailed Godwits between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (birds / ha)
MCR	6	812	0.19
North Curtis	5	601	0.31
Port Curtis	4	289	0.12
Fitzroy Estuary	8	181	0.08
Totals	23	1,883	0.19

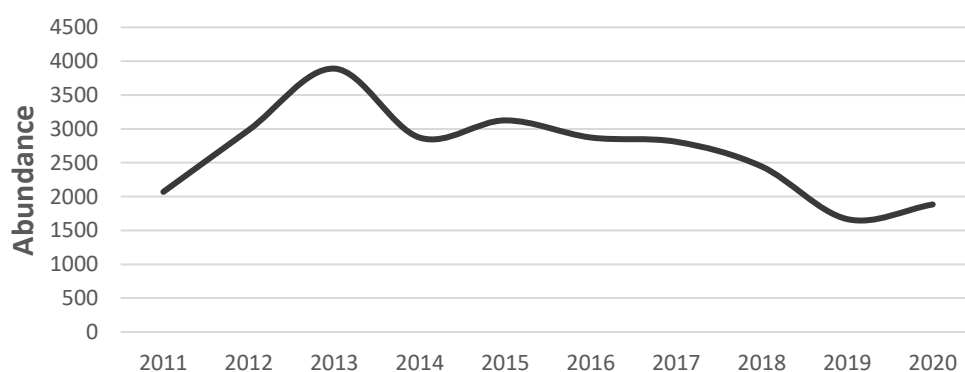


Figure 11 Abundance of Bar-tailed Godwit on the Curtis Coast from February 2011 – 2020.

4.2.5 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 February 2020, with 1,501 birds recorded at high tide roosts during the survey. The total number of Grey-tailed Tattler present on the Curtis Coast in February 2020 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 33 sites, five of which were of **national significance**: the Central Mangrove Island in the MCR management unit supported 400 birds, the Yellow Patch Sandbar - Mangrove Roost and the Creek 5 site in the North Curtis management unit supported 212 and 130 birds respectively, and the South End - West Claypan site and the South-east end of Curtis Island in the Port Curtis management unit both supported 130 birds (see Figure A3 in Appendix 3). The foraging density was highest in the North Curtis management unit (Table 26). The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019). A similar number of Grey-tailed Tattler were counted on the Curtis Coast in February 2020 as in 2018, and these peaks were higher than any other counts during the project (Figure 12).

Table 26 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Grey-tailed Tattler between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	10	572	0.17
Port Curtis	9	434	0.18
North Curtis	11	425	0.22
Fitzroy Estuary	3	70	0.03
Totals	33	1,501	0.15

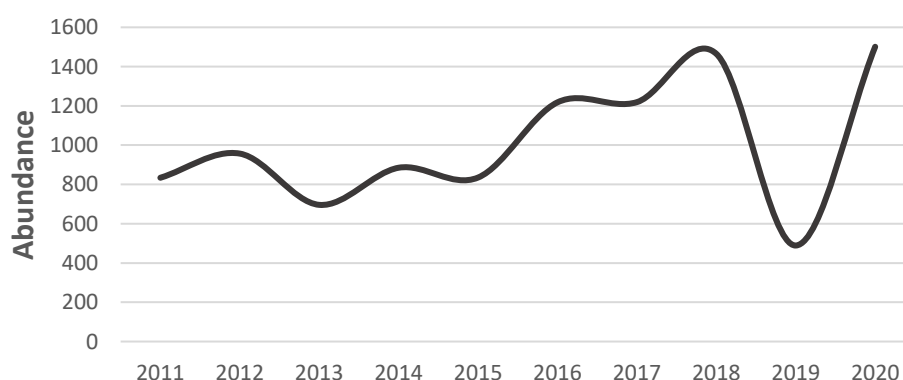


Figure 12 Abundance of Grey-tailed Tattler on the Curtis Coast from February 2011 – 2020.

4.2.6 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 fourth most abundant migratory shorebird on the Curtis Coast in February 2020, with 923 birds recorded at high tide roosts during the survey. The total number of Terek Sandpiper present on the Curtis Coast in February 2020 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 24 sites, five of which were of **national significance**: Central Mangrove Island, Bird Island, the Mundoolin Rocks Mangrove 2 site and the Mangrove Island 2 site in the MCR management unit supported 200 birds, 140 birds, 78 birds and 65 birds respectively, and the Facing Island Sandbar in the Port Curtis management unit supported 117 birds (see Figure A4 in Appendix 3). The foraging density was by far highest in the MCR management unit (Table 27). It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). There are currently insufficient data to assess long-term trends in Australia, and data do not show a significant trend in Australia over the medium term (Clemens et al., 2019). A similar number of Terek Sandpiper were counted on the Curtis Coast in February across the years of the project, with the exception of February 2017, which had a higher than usual count (Figure 13).

Table 27 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Terek Sandpiper between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (birds / ha)
MCR	8	557	0.17
Port Curtis	6	217	0.09
North Curtis	6	115	0.06
Fitzroy Estuary	4	34	0.01
Totals	24	923	0.09

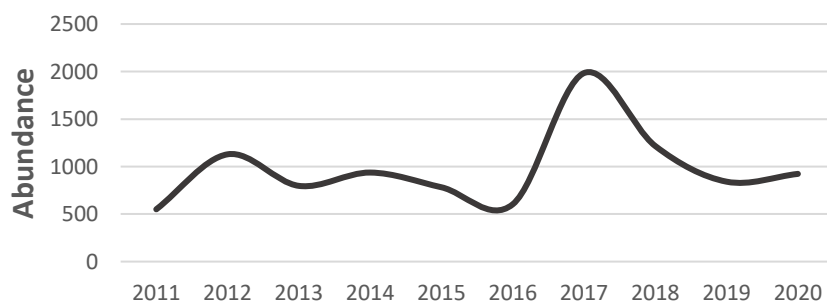


Figure 13 Abundance of Terek Sandpiper on the Curtis Coast from February 2011 – 2020.

4.2.7 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 February 2020, with 886 birds recorded at high tide roosts during the survey. The number of Whimbrel present on the Curtis Coast in February 2020 was of **international significance** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 61 sites, three of which were of **national significance**: the South End - West Claypan in the Port Curtis management unit supported 163 birds, and the Keppell Creek Entrance and Mud Bay, Cape Capricorn site in the North Curtis management unit supported 87 birds and 71 birds respectively (see Figure A5 in Appendix 3). The foraging density was highest in the Port Curtis management unit (Table 28). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019). The number of Whimbrel counted on the Curtis Coast in February 2020 was the lowest recorded across the years of the project and similar to February 2014, while the highest number was counted in the first year of the project (Figure 14).

Table 28 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Whimbrels between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (birds / ha)
Port Curtis	19	376	0.16
North Curtis	19	277	0.14
MCR	20	229	0.07
Fitzroy Estuary	3	4	0.002
Totals	61	886	0.09

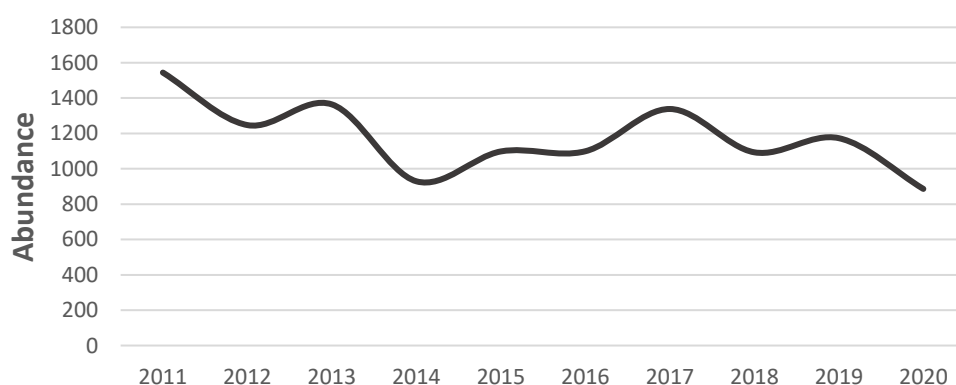


Figure 14 Abundance of Whimbrel on the Curtis Coast from February 2011 – 2020.

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 2020, with 686 birds recorded at high tide roosts during the survey. Great Knots were present at nine sites, one of which was of *national significance*: the Mundoolin Rocks east claypan in the MCR management unit supported 485 birds (see Figure A6 in Appendix 3). The foraging density was highest in the North Curtis management unit (Table 29). Data from Australia do not show a significant trend in Great Knot over the long term but do show a decline in abundance over the medium term (Clemens et al., 2019), and it is listed as Critically Endangered under the EPBC Act. The number of Great Knot counted on the Curtis Coast in February was quite variable over the years of the project, with a peak count in February 2015 and the lowest number counted in February 2018 (Figure 15).

Table 29 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Great Knots between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	3	141	0.07
MCR	3	488	0.15
Port Curtis	2	42	0.02
Fitzroy Estuary	1	15	0.006
Totals	9	686	0.07

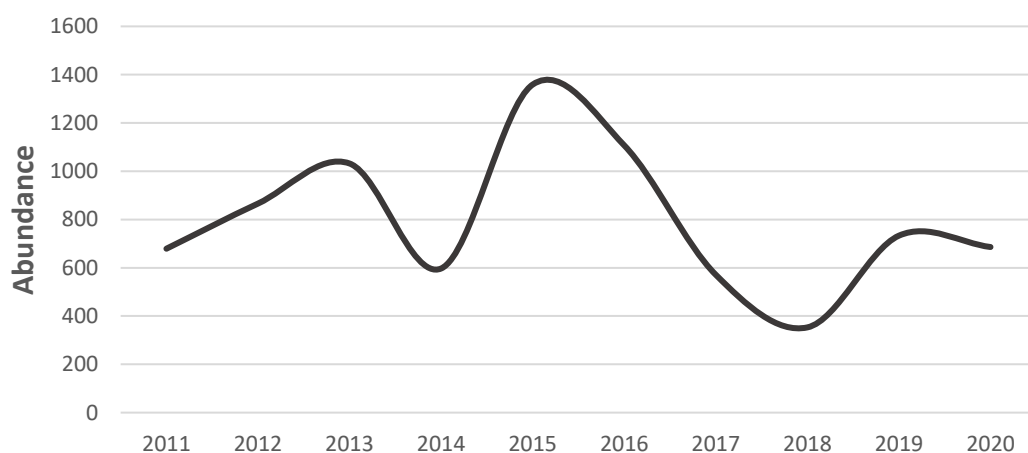


Figure 15 Abundance of Great Knot on the Curtis Coast from February 2011 – 2020.

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 2020, with 496 birds recorded at high tide roosts during the survey. The number of Eastern Curlew present on the Curtis Coast in February 2020 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 30 sites, five of which were of *national significance*: the South End - West Claypan, the Bund 8 site and the Facing Island Claypan in the Port Curtis management unit support 97, 74 and 66 birds respectively, and the Williams Bay, Mangrove Bay site and the Spit End in the MCR management unit supported 45 birds and 38 birds respectively (see Figure A7 in Appendix 3). The foraging density was by far highest in the Port Curtis management unit (Table 30). The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act. Fewer Eastern Curlews were counted on the Curtis Coast in February in the later years of the project than the earlier years; about 60% fewer were counted in 2019 and 2020 than in 2011 (Figure 16).

Table 30 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Eastern Curlew between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	10	299	0.13
MCR	14	175	0.05
North Curtis	5	21	0.01
Fitzroy Estuary	1	1	0.0004
Totals	30	496	0.05

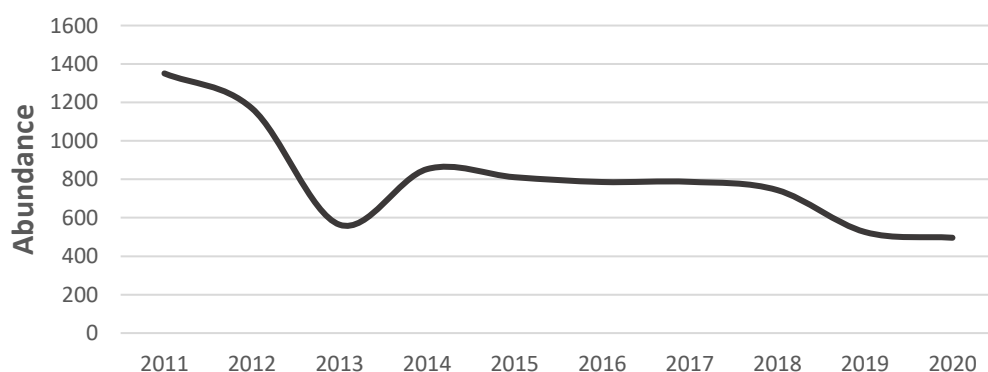


Figure 16 Abundance of Eastern Curlew on the Curtis Coast from February 2011 – 2020.

4.2.10 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 eighth most abundant migratory shorebird on the Curtis Coast in February 2020, with 458 birds recorded at high tide roosts during the survey. Lesser Sand Plovers were present at 12 sites, none of which reached the threshold for national significance (see Figure A8 in Appendix 3). The foraging density was highest in the Port Curtis management unit (Table 31). The Lesser Sand Plover is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Endangered under the EPBC Act. The number of Lesser Sand Plover counted on the Curtis Coast in February was quite variable during the project, with peak counts in 2019 and 2012 and the lowest number counted in 2015 (Figure 17).

Table 31 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Lesser Sand Plovers between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (birds / ha)
MCR	4	174	0.05
Port Curtis	4	171	0.07
Fitzroy Estuary	2	100	0.04
North Curtis	2	13	0.007
Totals	12	458	0.05

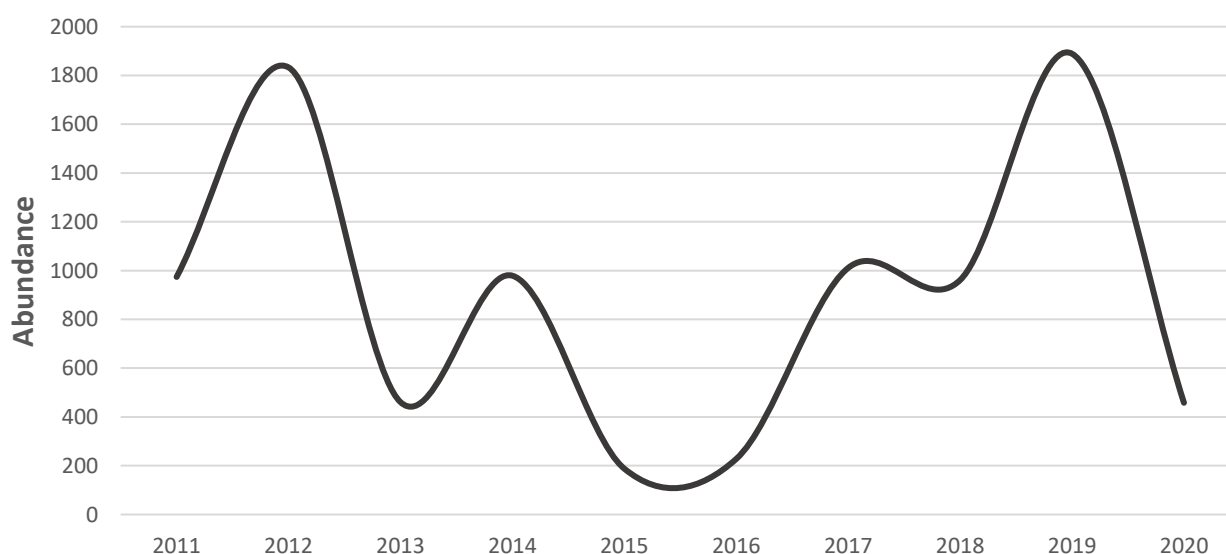


Figure 17 Abundance of Lesser Sand Plover on the Curtis Coast from February 2011 – 2020.

4.2.11 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 ninth most abundant migratory shorebird on the Curtis Coast in February 2020, with 122 birds recorded at high tide roosts during the survey. Curlew Sandpiper were present at three sites, none of which reached the threshold for national significance (see Figure A9 in Appendix 3). The foraging density was highest in the Port Curtis management unit (Table 32). Curlew Sandpiper are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act. The number of Curlew Sandpiper counted on the Curtis Coast in February has been small and rather variable across the years of the project, with a peak count in 2020 and the lowest number counted in 2013 (Figure 18).

Table 32 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Curlew Sandpiper between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	2	92	0.04
MCR	1	30	0.009
North Curtis	Nil	Nil	Nil
Fitzroy Estuary	Nil	Nil	Nil
Totals	3	122	0.01

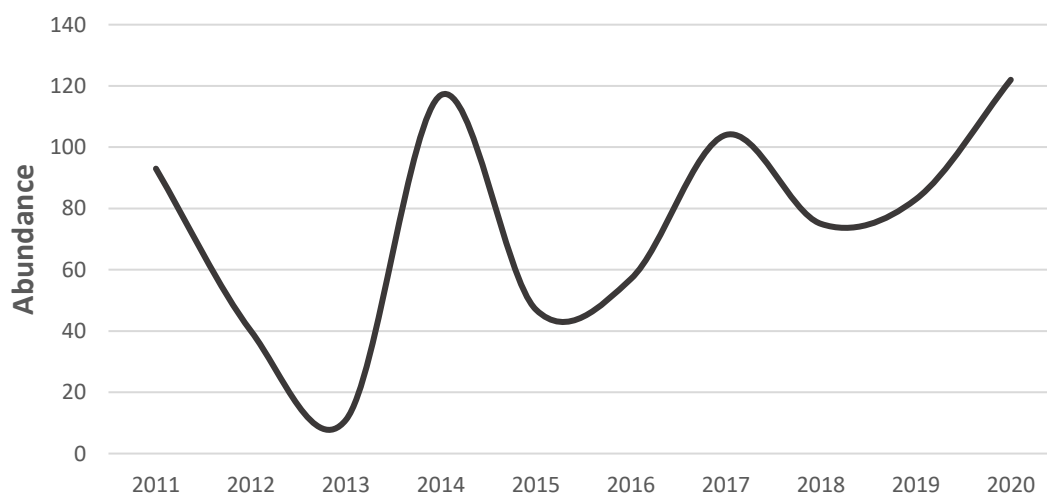


Figure 18 Abundance of Curlew Sandpiper on the Curtis Coast from February 2011 – 2020.

4.2.12 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 tenth most abundant migratory shorebird on the Curtis Coast in February 2020, with 91 birds recorded at high tide roosts during the survey. Greater Sand Plovers were present at six sites, none of which reached the threshold for national significance (see Figure A10 in Appendix 3). The foraging density was highest in Port Curtis (Table 33). The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019). Data from Australia do not show a significant trend over the long term, but do show a medium-term decline in abundance in Australia (Clemens et al., 2019). This species is listed as Vulnerable under the EPBC Act. The number of Greater Sand Plover counted in on the Curtis Coast in February was greater between 2014 and 2017 than in the early years of the project but has since returned to numbers similar to that at the start of the project, with the lowest count in 2020 (Figure 19).

Table 33 Comparison of the number of roosts occupied, number of birds counted, and foraging density of Greater Sand Plover between four management units in February 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	3	58	0.02
MCR	2	23	0.007
Fitzroy Estuary	1	10	0.004
North Curtis	Nil	Nil	Nil
Totals	6	91	0.009

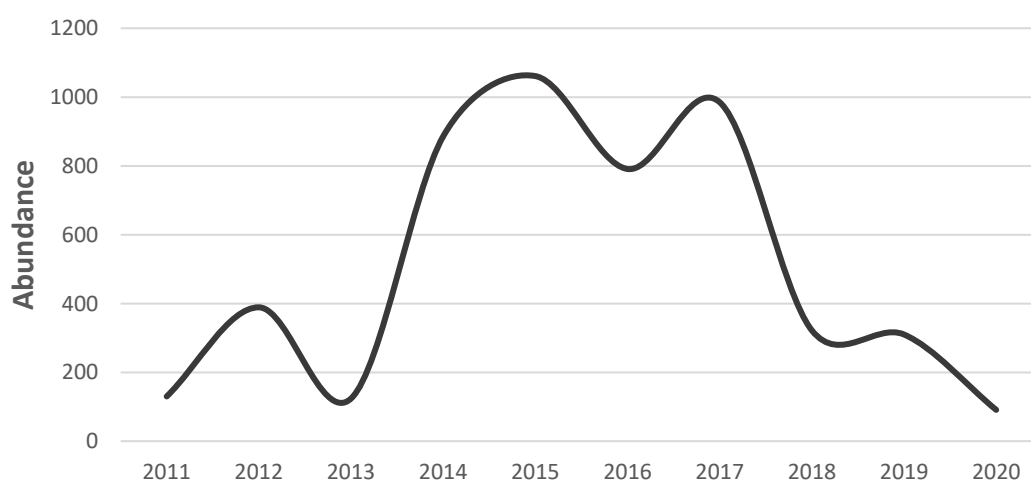


Figure 19 Abundance of Greater Sand Plover on the Curtis Coast from February 2011 – 2020.

4.2.13 Other migratory shorebirds

There were a further seven species of migratory shorebird recorded on the Curtis Coast in February 2020. They were (in order of descending abundance): Grey Plover (87 birds), Common Greenshank (80 birds), Ruddy Turnstone (30 birds), Sharp-tailed Sandpiper (30 birds), Pacific Golden Plover (27 birds), Sanderling (25 birds) and Red Knot (15 birds). Together, these species made up approximately 3.5% of the total migratory shorebird count for the survey.

4.2.14 Non-migratory shorebirds

There were 688 non-migratory shorebirds of seven species recorded during high tide counts on the Curtis Coast in February 2020. They were (in order of descending abundance): Red-capped Plover (339 birds), Pied Oystercatcher (316 birds), Beach Stone-curlew (13 birds), Masked Lapwing (8 birds), Red-necked Avocet (5 birds), Sooty Oystercatcher (5 birds) and Bush Stone-curlew (2 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 39 low tide surveys conducted on the Curtis Coast in February 2020. In total, 521 minutes (approximately eight-and-a-half hours) were spent surveying shorebirds at low tide (Table 21). A total of 3,342 birds of 21 species (3,011 migratory, 285 non-migratory, and some individuals that could not be identified to species level) were counted during the low tide surveys. The species with over 50 individuals counted at low tide were (in order of descending abundance): Bar-tailed Godwit (575 birds), Red-necked Stint (549 birds), Lesser Sand Plover (397 birds), Curlew Sandpiper (318 birds), Great Knot (303 birds), Greater Sand Plover (236 birds), Eastern Curlew (204 birds), Pied Oystercatcher (191 birds), Whimbrel (153 birds), Red-capped Plover (88 birds), Grey-tailed Tattler (82 birds) and Terek Sandpiper (67 birds). Broad-billed Sandpiper (30 birds), Grey Plover (29 birds), Common Greenshank (11 birds), Sharp-tailed Sandpiper (eight birds), Red Knot (six birds), Ruddy Turnstone (six birds), Red-necked Avocet (four birds), Sanderling (two birds) Sooty Oystercatcher (two birds) and unidentified shorebirds or sand plovers (81 birds total) 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.

In February 2020, there were two sites counted at low tide with between 500 and 1000 migratory shorebirds (Table 34): Yellow Patch Sandbar (798 birds) in North Curtis and Mundoolin North (555 birds) in the MCR management unit. There were six sites counted at low tide with between 100 and 500 migratory shorebirds (Table 34): Friend Point (261 birds) in Port Curtis, Mud Bay (187 birds) and Station Point (114 birds) in North Curtis, Mundoolin South (167 birds) and Upper Colosseum (135 birds) in the MCR management unit, and Mackenzie Island (108 birds) in the Fitzroy Estuary.

Table 34 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in February 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-1000	Nil
	100-499	1. Cattle Point
North Curtis	>1000	Nil
	500-1000	1. Yellow Patch Sandbar
	100-499	1. Mud Bay 2. Station Point
Port Curtis	>1000	Nil
	500-1000	Nil
	100-499	1. Friend Point
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-1000	1. Mundoolin North
	100-499	1. Mundoolin South 2. Upper Colosseum



The Western Basin Reclamation Area sometimes provides good roosting habitat for migratory shorebirds like Red-necked Stint (Micha V Jackson, Wildlife Unlimited)

Table 35 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in February, 2020.

Species	North Curtis		Fitzroy Estuary		Port Curtis		MCR		Total	
	High	Low	High	Low	High	Low	High	Low	High	Low
<i>Migratory</i>										
Bar-tailed Godwit	601	192	181	83	289	79	812	221	1883	575
Broad-billed Sandpiper	0	30	0	0	0	0	0	0	0	30
Common Greenshank	0	0	0	0	15	0	65	11	80	11
Curlew Sandpiper	0	313	0	2	92	3	30	0	122	318
Eastern Curlew	21	28	1	13	299	98	175	65	496	204
Great Knot	141	40	15	32	42	8	488	223	686	303
Greater Sand Plover	0	160	10	61	58	8	23	7	91	236
Grey Plover	52	0	0	4	18	0	17	25	87	29
Grey-tailed Tattler	425	3	70	1	434	6	572	72	1501	82
Lesser Sand Plover	13	252	100	63	171	2	174	80	458	397
Pacific Golden Plover	11	0	0	0	6	0	10	0	27	0
Red Knot	11	6	0	0	0	0	4	0	15	6
Red-necked Stint	1	47	775	44	945	259	230	199	1951	549
Ruddy Turnstone	0	0	0	0	0	0	30	6	30	6
Sand Plover spp.	47	0	103	25	0	0	0	10	150	35
Sanderling	25	2	0	0	0	0	0	0	25	2
Sharp-tailed Sandpiper	23	4	0	0	6	4	1	0	30	8
Terek Sandpiper	115	1	34	28	217	8	557	30	923	67
Whimbrel	277	0	4	13	376	39	229	80	886	153
Total migratory	1763	1078	1293	369	2968	514	3417	1029	9441	3011
<i>Non-migratory</i>										
Beach Stone-curlew	0	0	6	0	4	0	3	0	13	0
Bush Stone-curlew	2	0	0	0	0	0	0	0	2	0
Masked Lapwing	0	0	0	0	8	0	0	0	8	0
Pied Oystercatcher	22	3	8	7	47	55	239	126	316	191
Red-capped Plover	38	9	53	32	119	23	129	24	339	88
Red-necked Avocet	0	0	0	0	5	4	0	0	5	4

Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Sooty Oystercatcher	0	0	0	0	0	1	5	1	5	2
Total non-migratory	62	12	67	39	183	83	376	151	688	285
Unidentified small shorebird	0	0	16	22	251	2	12	0	279	24
Unidentified medium shorebird	0	0	0	3	0	0	0	19	0	22
Grand total	1825	1090	1376	433	3402	599	3805	1199	10408	3342

4.3 March

March surveys 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). Due to bad weather conditions and the Covid-19 pandemic the March 2020 surveys had to be postponed until March 2021. The results of the surveys conducted in March 2021 are compared below to the results of surveys conducted in March 2011, March 2012 and March 2019.

4.3.1 Survey Coverage

151 high tide surveys were completed in March (including counts at the Cheetham Salt Works), with a total high tide survey time of 1,149 minutes (approximately 19 hours). 37 low tide surveys were completed, with a total low tide survey time of 472 minutes (approximately 8 hours). The survey effort from February is presented in Table 36. The weather during the March field trip was variable, with 47 of the 188 total surveys completed when the wind speed was above 20km/h, which is not ideal for shorebird counting.

Table 36 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	37	228	18	175
Fitzroy Estuary	25	247	6	129
North Curtis Island	39	235	4	66
Mundoolin-Colosseum	28	230	7	66
Rodds Peninsula	19	97	2	36
Cheetham Salt Works	3	112	Nil	Nil
Total	151	1,149	37	472

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 2021 was 9,735, which was less than in any other year of the project (see Figure 20). Most of the reduction in numbers compared with previous years was from lower numbers of Red-necked Stint, Great Knot and Whimbrel counted in 2021. 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 and are presented separately at the end of this section. Only individuals identified to species level were included in this total; a further 35 shorebirds could not be identified to species level (these were mostly unidentified small and medium waders). A total of 20 migratory shorebird species were identified during the high tide roost counts, which was one more than the number recorded in all other years (see Figure 21). In all other years, Red-necked Stint and Bar-tailed Godwit were the most and second most abundant species respectively, but in 2021 Grey-tailed Tattler

was the second most abundant and Bar-tailed Godwit the third. The composition of the rest of the ‘top ten’ changed between years; in 2021, the most abundant species, listed in descending order, were Red-necked Stint, Grey-tailed Tattler, Bar-tailed Godwit, Lesser Sand Plover, Eastern Curlew, Whimbrel, Great Knot, Terek Sandpiper, Greater Sand Plover, and Curlew Sandpiper. The foraging density of migratory shorebirds across the Curtis Coast in March 2021 was 0.97 birds/ha, less than the foraging density observed in March 2019 (10,103 birds; 1 bird/ha), March 2012 (11,239 birds; 1.12 birds/ha), and March 2011 (13,400 birds; 1.33 birds/ha).

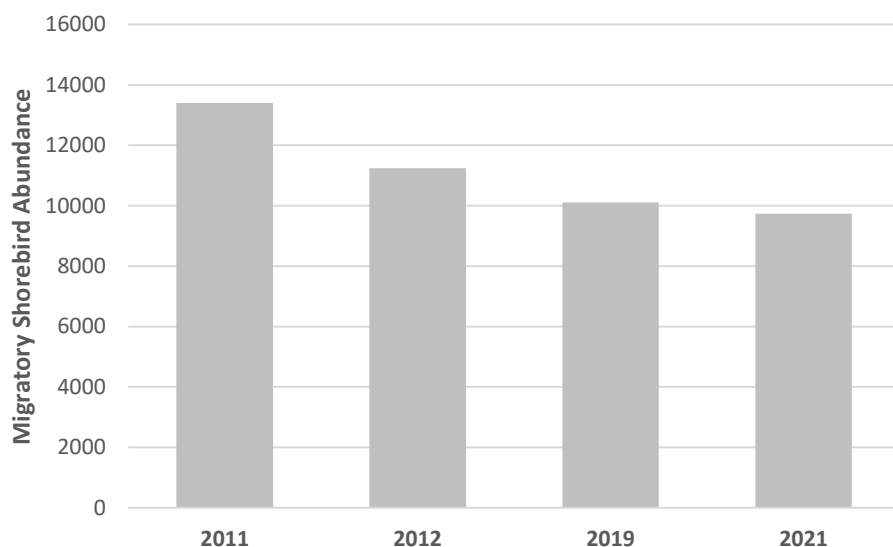


Figure 20 Abundance of migratory shorebirds on the Curtis Coast in March 2011, 2012, 2019 and 2021. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the project.

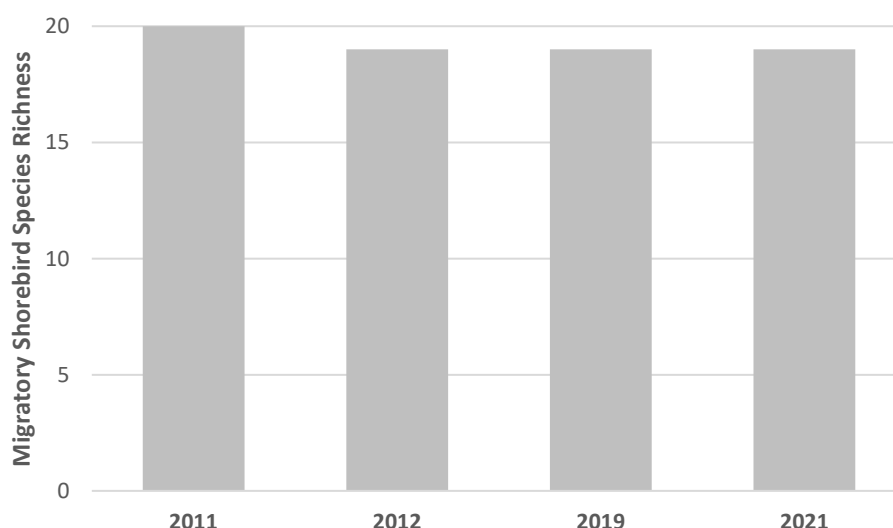


Figure 21 Species richness of migratory shorebirds on the Curtis Coast in March 2011, 2012, 2019 and 2021.

The foraging density of migratory shorebirds by management unit is summarised below (Table 37). 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; Table 5). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In March 2021, shorebird distribution was somewhat skewed to the north (Table 38, Figure 22). There were two roosts with >1000 birds; the Curlew Spit claypan (1,110 birds) in the Fitzroy Estuary and the Yellow Patch Entrance Sandbar (1,097 birds) in North Curtis. There were a further three roosts with between 500 and 1000 birds: Central Mangrove Island (670 birds), Spit End (565 birds), and the Mundoolin Rocks east claypan (563 birds), all in the MCR management unit. There were 20 roosts with between 100 and 500 birds: six in the Fitzroy Estuary, five in North Curtis, three in Port Curtis, and six in MCR. Counts from the Cheetham Salt Works are discussed below in section 4.3.16.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in March 2021. 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.

A summary of all shorebirds counted in March 2021 can be found in Table 50 at the end of this section.

Table 37 Summary of foraging density in March over time.

Location	Foraging density (birds/ha)			
	2011	2012	2019	2021
Fitzroy Estuary	2.6	2.3	0.9	1.2
North Curtis Island	1.4	1.3	1.7	1.2
MCR	0.6	0.5	0.9	1.0
Port Curtis	0.7	0.7	0.8	0.5

Table 38 Place names of the roosts with the greatest abundance of migratory shorebirds in March 2021.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	1. Curlew Spit claypan
	500-999	Nil
	100-499	1. Deception Point claypan west side 2. Northern Side - Mackenzie Island 3. Curlew Spit mangrove 2 4. Division Point 5. Cattle Point 6. Claypan east side Connor Creek #2
North Curtis	>1000	1. Yellow Patch entrance sandbar
	500-999	Nil
	100-499	1. Keppell Creek Entrance 2. Yellow Patch Sandbar - Mangrove Roost 3. Creek 5 4. Little Keppel Creek Sandbar 5. Mud Bay, Cape Capricorn
Port Curtis	>1000	Nil
	500-999	Nil
	100-499	1. Bund 6 2. Facing Island Sandbar 3. South-east end of Curtis Island
MCR	>1000	Nil
	500-999	1. Central Mangrove Island 2. Spit End 3. Mundoolin Rocks east claypan
	100-499	1. Williams Bay, Mangrove Bay 2. Mangrove Island 2 3. Mundoolin Rocks opposite 4. Bird Island 5. Turkey Beach Sand Island 6. Turkey Beach Mangrove Island

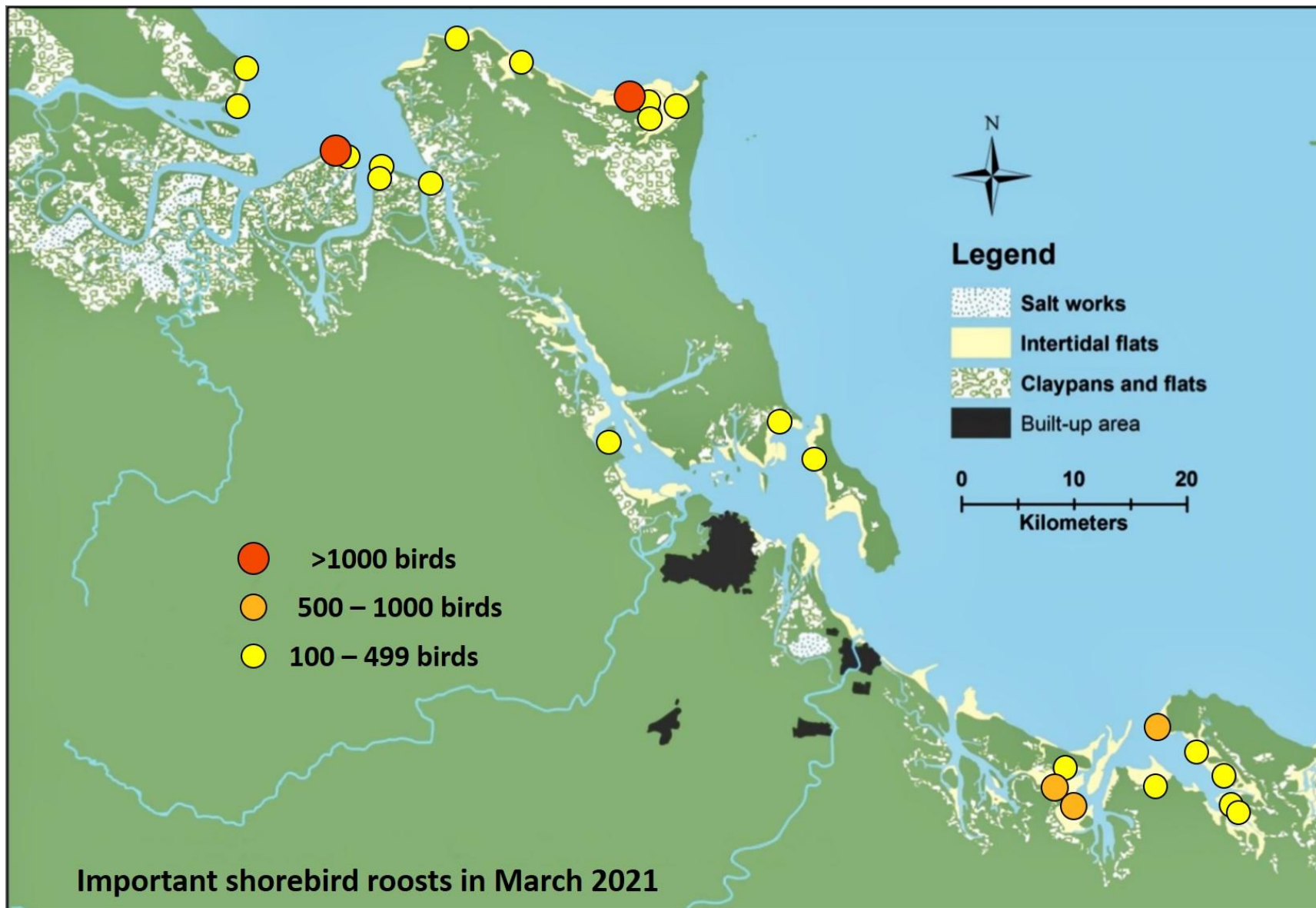


Figure 212 Important shorebird roosts on the Curtis Coast in March 2021.

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 2021, with 2,514 birds recorded at high tide roosts during the survey. This was significantly (1,687) less birds than the number counted in March 2011 (4,201) and 1,145 less birds than were counted in March 2012 (3,659), but 633 more birds than the number counted in March 2019 (1,881). Red-necked Stint were present at 23 sites, one of which was of *national significance*: the Curlew Spit claypan in the Fitzroy Estuary management unit supported 900 birds. The foraging density was highest in the Fitzroy Estuary management unit (Table 39). 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 show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019).

Table 39 Place names of the roosts with the greatest abundance of migratory shorebirds in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	11	1,870	0.79
Port Curtis	4	374	0.16
North Curtis	1	150	0.08
MCR	7	120	0.04
Totals	23	2,514	0.25

4.3.4 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 March 2021, with 1,939 birds recorded at high tide roosts during the survey. This was 521 more birds than the number counted in March 2019 (1,418), 935 more birds than the number counted in March 2011 (1,004), and 1,016 more birds than the number counted in March 2012 (923). The number of Grey-tailed Tattler present on the Curtis Coast in March 2021 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, seven of which were of **national significance**: Central Mangrove Island, Mangrove Island 2, Bird Island, Turkey Beach Mangrove Island, and Mundoolin Rocks east claypan in the MCR management unit supported 600, 222, 130, 120 and 70 and birds respectively, the Yellow Patch Sandbar Mangrove Roost in the North Curtis management unit supported 131 birds, and Facing Island Sandbar in the Port Curtis management unit support 110 birds. The foraging density was highest in the MCR management unit (Table 40). The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 40 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	15	1,325	0.40
North Curtis	12	402	0.20
Port Curtis	7	211	0.19
Fitzroy Estuary	1	1	<.001
Totals	35	1,939	0.19

4.3.5 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 third most abundant migratory shorebird on the Curtis Coast in March 2021, with 1,848 birds recorded at high tide roosts during the survey. This was 724 less birds than the number counted in March 2012 (2,572) and 309 less birds than the number counted in March 2011 (2,157), but 198 more birds than the number counted in March 2019 (1,650). Bar-tailed Godwits were present at 28 sites, one of which was of *national significance*: the Mundoolin Rocks east claypan in the MCR management unit supported 400 birds. The foraging density was highest in the MCR management unit (Table 41). Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016). The Siberian sub-species of this species (*menzbieri*) is listed as Critically Endangered and the Alaskan sub-species (*baueri*) as Vulnerable under the EPBC Act; *menzbieri* is the sub-species predominantly found in eastern Australia.

Table 41 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	7	999	0.30
North Curtis	7	443	0.22
Port Curtis	5	126	0.05
Fitzroy Estuary	9	280	0.12
Totals	28	1,848	0.18

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 2021, with 978 birds recorded at high tide roosts during the survey. This was 664 less birds than the number counted March 2011 (1,642) and 225 less birds than the number counted in March 2019 (1,203), but 21 more birds than were counted in March 2012 (957). Lesser Sand Plovers were present at 11 sites, one of which was of *national significance*: the Yellow Patch Entrance Sandbar in the North Curtis management unit support 350 birds. The foraging density was highest in the North Curtis and Fitzroy Estuary management units (Table 42). The Lesser Sand Plover is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Endangered under the EPBC Act.

Table 42 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	4	378	0.16
North Curtis	3	370	0.19
MCR	3	225	0.07
Port Curtis	1	5	0.002
Totals	11	978	0.10

4.3.7 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 March 2021, with 674 birds recorded at high tide roosts during the survey. This was 52 more birds than the number counted in March 2019 (622), 241 more birds than the number counted in March 2011 (433), and 311 more birds than the number counted in March 2012 (363). The number of Eastern Curlew present on the Curtis Coast in March 2021 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 38 sites, nine of which were of *national significance*: the Keppell Creek Entrance, Station Point Creek Sandbar, Little Keppell Creek Sandbar, and Yellow Patch Entrance Sandbar in the North Curtis management unit supported 140, 56, 44 and 38 birds respectively, the Facing Island Sandbar in the Port Curtis management unit supported 64 birds, and the Williams Bay, Mangrove Bay site, Mundoolin Rocks east claypan, Turkey Beach Sand Island and Spit End in the MCR management unit supported 56, 52, 40 and 36 birds respectively. The foraging density was highest in the North Curtis management unit (Table 43). The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 43 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	6	284	0.14
MCR	15	259	0.08
Port Curtis	8	110	0.05
Fitzroy Estuary	9	21	0.009
Totals	38	674	0.07

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 2021, with 346 birds recorded at high tide roosts during the survey. This was 412 less birds than the number counted in March 2019 (758) and 60 less birds than the number counted in March 2011 (406), but 94 more birds than the number counted in March 2012 (252). Terek Sandpipers were present at 21 sites, three of which were of *national significance*: Facing Island Sandbar in the Port Curtis management unit supported 85 birds, Creek 5 in the North Curtis management unit supported 60 birds, and the Northern Side - Mackenzie Island site in the Fitzroy Estuary management unit supported 52 birds. The foraging density was highest in the North Curtis management unit (Table 44). It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). There are currently insufficient data to assess long-term trends in Australia, and data do not show a significant trend in Australia over the medium term (Clemens et al., 2019).

Table 44 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	8	168	0.09
Port Curtis	4	88	0.04
Fitzroy Estuary	3	71	0.03
MCR	6	19	0.006
Totals	21	346	0.03

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 2021, with 656 birds recorded at high tide roosts during the survey. This was 1,182 less birds than the number counted in March 2011 (1,838), 606 less birds than the number counted in March 2012 (1,262) and 91 less birds than the number counted in March 2019 (747). The number of Whimbrel present on the Curtis Coast in March 2021 was of **international significance** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 70 sites, one of which were of **national significance**: the Mud Bay, Cape Capricorn site in the North Curtis management unit supported 68 birds. The foraging density was highest in the North Curtis management unit (Table 45). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 45 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	20	230	0.12
Port Curtis	12	141	0.06
MCR	24	228	0.07
Fitzroy Estuary	14	57	0.02
Totals	70	656	0.07

4.3.10 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 eighth most abundant migratory shorebird on the Curtis Coast in March 2021, with 348 birds recorded at high tide roosts during the survey. This was 572 less birds than the number counted in March 2019 (920), 409 less birds than the number counted in March 2012 (757), and 104 less birds than the number counted in March 2011 (452). Great Knots were present at seven sites, none of which reached the threshold for national significance. The foraging density was highest in the North Curtis management unit (Table 46). Data from Australia do not show a significant trend in Great Knot over the long term but do show a decline in abundance over the medium term (Clemens et al., 2019), and it is listed as Critically Endangered under the EPBC Act.

Table 46 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	1	231	0.12
Fitzroy Estuary	1	20	0.008
MCR	4	92	0.03
Port Curtis	1	5	0.002
Totals	7	348	0.03

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 2021, with 167 birds recorded at high tide roosts during the survey. This was 141 less birds than the number counted in March 2019 (308), 89 less birds than the number recorded in March 2012 (256), and 42 less birds than the number counted in March 2011 (209). Greater Sand Plovers were present at eight sites, none of which reached the threshold for national significance. The foraging density was highest in the Fitzroy Estuary management unit, but low all across the survey area (Table 47). There were no Greater Sand Plovers recorded in Port Curtis. The population of Greater Sand Plovers in the EAAF is believed to be declining (Wetlands International, 2019). Data from Australia do not show a significant trend over the long term, but do show a medium-term decline in abundance in Australia (Clemens et al., 2019). This species is listed as Vulnerable under the EPBC Act.

Table 47 Comparison of the number of birds, number of roosts occupied and foraging density of Greater Sand Plover between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	4	103	0.04
North Curtis	1	50	0.03
MCR	3	14	0.004
Port Curtis	Nil	Nil	Nil
Totals	8	167	0.02

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 2021, with 82 birds recorded at high tide roosts during the survey. This was 119 less birds than the number counted in March 2019 (201) and 23 less birds than the number counted in March 2011 (105), but 64 more birds than the number counted in March 2012 (18). Curlew Sandpipers were present at five sites, none of which reached the threshold for national significance. The foraging density was highest in the Port Curtis management unit, but low all across the survey area (Table 48). Curlew Sandpiper are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 48 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in March 2021.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	1	58	0.02
North Curtis	1	13	0.007
Fitzroy Estuary	2	10	0.004
MCR	1	1	<0.001
Totals	5	82	0.008

4.3.13 Other migratory shorebirds

There were a further nine species of migratory shorebird recorded on the Curtis Coast in March 2021. They were (in order of descending abundance): Pacific Golden Plover (47 birds), Grey Plover (42 birds), Common Greenshank (23 birds), Ruddy Turnstone (23 birds), Broad-billed Sandpiper (20 birds), Sharp-tailed Sandpiper (10 birds), Black-tailed godwit (nine birds), Red Knot (eight birds) and Common Sandpiper (one bird).

Together, these species made up approximately 2% of the total migratory shorebird count for the survey.

These species were fairly evenly distributed across the management units.

4.3.14 Non-migratory shorebirds

There were 1,244 non-migratory shorebirds of eight species recorded during high tide counts on the Curtis Coast in March 2021. They were (in order of descending abundance): Pied Oystercatcher (374 birds), Red-capped Plover (372 birds), Red-necked Avocet (215 birds), Black-winged Stilt (212 birds), Masked Lapwing (42 birds), Beach Stone-curlew (19 birds), Sooty Oystercatcher (eight birds), and Bush stone curlew (two 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 37 low tide surveys conducted on the Curtis Coast in March 2021. In total, 472 minutes (approximately 8 hours) were spent surveying shorebirds at low tide (Table 36). A total of 2,090 birds of 21 species (1,921 migratory, 155 non-migratory and some individuals that could not be identified to species level) were counted during the low tide surveys. The species with over 50 individuals counted at low tide were (in order of descending abundance): Bar-tailed Godwit (585 birds), Lesser Sand Plover (479 birds), Red-necked Stint (404 birds), Eastern Curlew (143 birds), Pied Oystercatcher (115 birds), Whimbrel (114 birds), Greater Sand Plover (78 birds) and Great Knot (59 birds). Red-capped Plover (36 birds), Pacific Golden Plover (16 birds), Terek Sandpiper (12 birds), Grey Plover (11 birds), Grey-tailed Tattler (eight birds), Common Greenshank (four birds), Masked Lapwing (three birds), Ruddy Turnstone (three birds), Sanderling (three birds), Marsh Sandpiper (two birds), Beach Stone-curlew (one bird) and unidentified shorebirds (14 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.

In March 2021, there were six sites counted at low tide with between 100 and 500 migratory shorebirds (Table 49): Deception Point (316 birds), Cattle Point (190 birds) and Curlew Spit (119 birds) in the Fitzroy Estuary, Yellow Patch Sandbar (286 birds) in North Curtis, and Mundoolin North (217 birds) and Upper Colosseum (153 birds) in the MCR management unit.

Table 49 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in March 2021.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-1000	Nil
	100-499	1. Deception Point 2. Cattle Point 3. Curlew Spit
North Curtis	>1000	Nil
	500-1000	Nil
	100-499	1. Yellow Patch Sandbar
Port Curtis	>1000	Nil
	500-1000	Nil
	100-499	Nil
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-1000	Nil
	100-499	1. Mundoolin North 2. Upper Colosseum

4.3.16 Cheetham Salt Works Surveys in March 2021

Access was gained to three sites within the salt works, which were surveyed on 11 March. In addition to the shorebirds reported above, total of 1,735 shorebirds of 11 species were recorded at the salt works, including 1,377 at the South Cheetham Salt Fields site. The majority of shorebirds found within the salt works were Sharp-tailed Sandpiper (577 birds), Black-tailed godwit (257 birds), Marsh Sandpiper (242 birds, also note this species was not recorded elsewhere on the Curtis Coast at high tide in March 2021), Curlew Sandpiper (221 birds), Red-necked Avocet (215 birds), also note this species was not recorded elsewhere on the Curtis Coast at high tide in March 2021), Black-winged Stilt (202 birds), along with much smaller numbers of Red-necked Stint (10 birds), Common Greenshank (five birds), Broad-billed Sandpiper (three birds), Masked Lapwing (two birds), and Red-capped Plover (one bird). The number of Sharp-tailed Sandpiper, Black-tailed Godwit, Marsh Sandpiper, and Curlew Sandpiper present at the site were all of *national significance*, representing more than 0.1% of the total estimated EAAF populations of each species. Given previous recommendations, the importance of this site, and the difference in community structure at this site compared with the rest of the

Curtis Coast, it is unfortunate that access to the salt works was patchy throughout the ten-year project, including in 2020, but nonetheless positive that high tide surveys at the salt works were possible during three of five survey periods in 2020/2021.



Pacific Golden Plover is one migratory shorebird species regularly seen during low tide counts (Micha V Jackson, Wildlife Unlimited).

Table 50 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in March, 2021.

Species	North Curtis		Fitzroy Estuary		Port Curtis		MCR		Cheetham Salt Works		Total	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
<i>Migratory</i>												
Bar-tailed Godwit	443	108	280	163	126	112	999	202	0	-	1848	585
Black-tailed godwit	0	0	2	0	0	0	7	0	257	-	266	0
Broad-billed Sandpiper	2	0	18	0	0	0	0	0	3	-	23	0
Common Greenshank	7	0	3	0	4	0	9	4	5	-	28	4
Common Sandpiper	0	0	0	0	0	0	1	0	0	-	1	0
Curlew Sandpiper	13	0	10	0	58	0	1	0	221	-	303	0
Eastern Curlew	284	34	21	18	110	35	259	56	0	-	674	143
Great Knot	231	0	20	0	5	9	92	50	0	-	348	59
Greater Sand Plover	50	31	103	25	0	11	14	11	0	-	167	78
Grey Plover	28	8	6	3	3	0	5	0	0	-	42	11
Grey-tailed Tattler	402	0	1	2	211	0	1325	6	0	-	1939	8
Lesser Sand Plover	370	222	378	186	5	17	225	54	0	-	978	479
Marsh Sandpiper	0	0	0	0	0	0	0	2	242	-	242	2
Pacific Golden Plover	1	0	38	15	2	1	6	0	0	-	47	16
Red Knot	7	0	0	0	0	0	1	0	0	-	8	0
Red-necked Stint	150	25	1870	363	374	10	120	6	10	-	2524	404
Ruddy Turnstone	0	0	0	0	5	0	18	3	0	-	23	3
Sanderling	0	3	0	0	0	0	0	0	0	-	0	3
Sharp-tailed Sandpiper	0	0	1	0	9	0	0	0	577	-	587	0
Terek Sandpiper	168	2	71	7	88	3	19	0	0	-	346	12
Whimbrel	230	3	57	20	141	40	228	51	0	-	656	114
Total migratory	2386	436	2879	802	1141	238	3329	445	1315	-	11050	1921
<i>Non-migratory</i>												
Beach Stone-curlew	7	0	4	0	2	1	6	0	0	-	19	1
Black-winged Stilt	0	0	0	0	10	0	0	0	202	-	212	0
Bush stone curlew	0	0	0	0	0	0	2	0	0	-	2	0
Masked Lapwing	22	0	4	0	10	3	4	0	2	-	42	3
Pied Oystercatcher	84	5	56	25	5	33	229	52	0	-	374	115
Red-capped Plover	13	0	59	6	113	9	186	21	1	-	372	36

Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Red-necked Avocet	0	0	0	0	0	0	0	0	215	-	215	0
Sooty Oystercatcher	2	0	0	0	4	0	2	0	0	-	8	0
Total non-migratory	128	5	123	31	144	46	429	73	420	-	1244	155
Unidentified small shorebird	0	0	35	11	0	3	0	0	0	-	35	14
Grand total	2514	441	3037	844	1285	287	3758	518	1735	0	12329	2090

4.4 August

August surveys target overwintering migratory shorebirds, as well as those individuals returning from migration early (see Table 2). Birds may overwinter in Australia for a number of reasons. In some species, birds do not reach sexual maturity in the first year of life, so some birds that arrived in Australia for the first time earlier in the year will have no reason to undergo a complete return migration. In addition, some young birds complete only “exploratory” (i.e. partial) migrations in their first few years of life, so 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. Finally, failure to generate adequate fat reserves in the summer to survive complete migration may mean that some birds decided not to depart for the breeding grounds in autumn. The results from the surveys conducted in August 2020 are compared below to the results of surveys conducted in August 2011, August 2012 and August 2019.

4.4.1 Survey Coverage

143 high tide surveys were completed in August, with a total high tide survey time of 949 minutes (approximately 16 hours). 30 low tide surveys were completed (including counts at the Cheetham Salt Works), with a total low tide survey time of 457 minutes (approximately seven-and-a-half hours). There were 15 sites that could not be surveyed at high tide and 11 that could not be surveyed at low tide due to site inundation or other factors. The survey effort from August is presented in Table 51. The weather during the August field trip was generally good, with only 15 of the 173 surveys completed when the wind speed was above 20km/h, which is not ideal for shorebird counting.

Table 51 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	235	7	79
Fitzroy Estuary	23	233	6	127
North Curtis Island	32	194	3	102
Mundoolin-Colosseum	24	213	8	56
Rodd's Peninsula	20	74	2	56
Cheetham Salt Works*	Nil	Nil	4	37
Total	143	949	30	457

**The Cheetham Salt Works were only surveyed at low tide because of construction activity at the high tide roosts*

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 2020 was 1,972 (see Figure 22), which was less than in any other year of the project. The difference between 2020 and 2019 was mostly due to the smaller number of Red-necked Stint counted in 2020. Only individuals identified to species level are included in this total; a further 150 shorebirds could not be identified to species level. A total of 15 migratory shorebird species were identified during the high tide roost counts, which was one more than in August 2011 and the same number as August 2012 and 2019 (see Figure 23). Eastern Curlew, Bar-tailed Godwit and Red-necked Stint were the most abundant shorebirds present on the Curtis Coast in 2011, 2012 and 2019 respectively. In 2020 Red-necked Stint was again the most abundant shorebird (583 individuals) followed by Eastern Curlew (334), Lesser Sand Plover (314), Bar-tailed Godwit (296) and Whimbrel (169). The overall foraging density of migratory shorebirds across the Curtis Coast (excluding the salt works) in August 2020 was 0.20 birds/ha, less than the foraging density observed in August 2011 (4,424 birds; 0.44 birds/ha), August 2012 (4,120 birds; 0.41 birds/ha) and August 2019 (2,407 birds; 0.24 birds/ha).

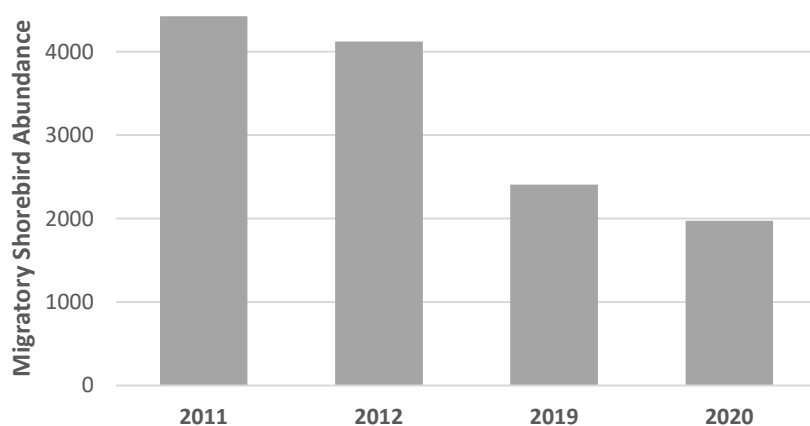


Figure 223 Abundance of migratory shorebirds on the Curtis Coast in August 2011, 2012, 2019 and 2020. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the project.

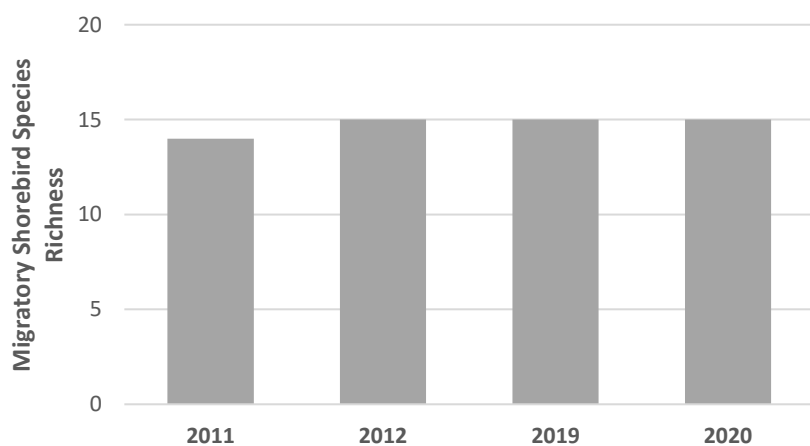


Figure 234 Species richness of migratory shorebirds on the Curtis Coast in August 2011, 2012, 2019 and 2020.

The foraging density of migratory shorebirds by management unit is summarised below (Table 52). 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; Table 5). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

As in August 2019, in August 2020 shorebird distribution was skewed to the north, with over half of the migratory shorebirds counted at high tide located in the Fitzroy Estuary (Table 53). There were no roosts that supported more than 500 migratory shorebirds in August (Figure 24). There were six roosts with between 100 and 500 migratory shorebirds: five in the Fitzroy Estuary and one in North Curtis. The two roosts with highest abundance of migratory shorebirds were the 'Curlew Spit Claypan' site (456 birds) and Cattle Point (233 birds), both in the Fitzroy Estuary.

Due to the low numbers of shorebirds present on the Curtis Coast in August 2020, 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 low tide surveys (including 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.

A summary of all shorebirds counted in August 2020 can be found in Table 59 at the end of this section.

Table 52 Summary of foraging density in August over time.

Location	Foraging density (birds/ha)			
	2011	2012	2019	2020
Fitzroy Estuary	0.6	0.7	0.5	0.5
North Curtis Island	0.1	0.4	0.5	0.2
MCR	0.2	0.2	0.4	0.1
Port Curtis	0.2	0.1	0.03	0.08

Table 53 Place names of the roosts with the greatest abundance of migratory shorebirds in August 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-999	Nil
	100-499	1. Curlew Spit Claypan 2. Cattle Point 3. Curlew Spit mangrove 2 4. Deception Point claypan west side 5. North East Shell Point
North Curtis	>1000	Nil
	500-999	Nil
	100-499	1. Yellow Patch Entrance Sandbar
Port Curtis	>1000	Nil
	500-999	Nil
	100-499	Nil
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-999	Nil
	100-499	Nil

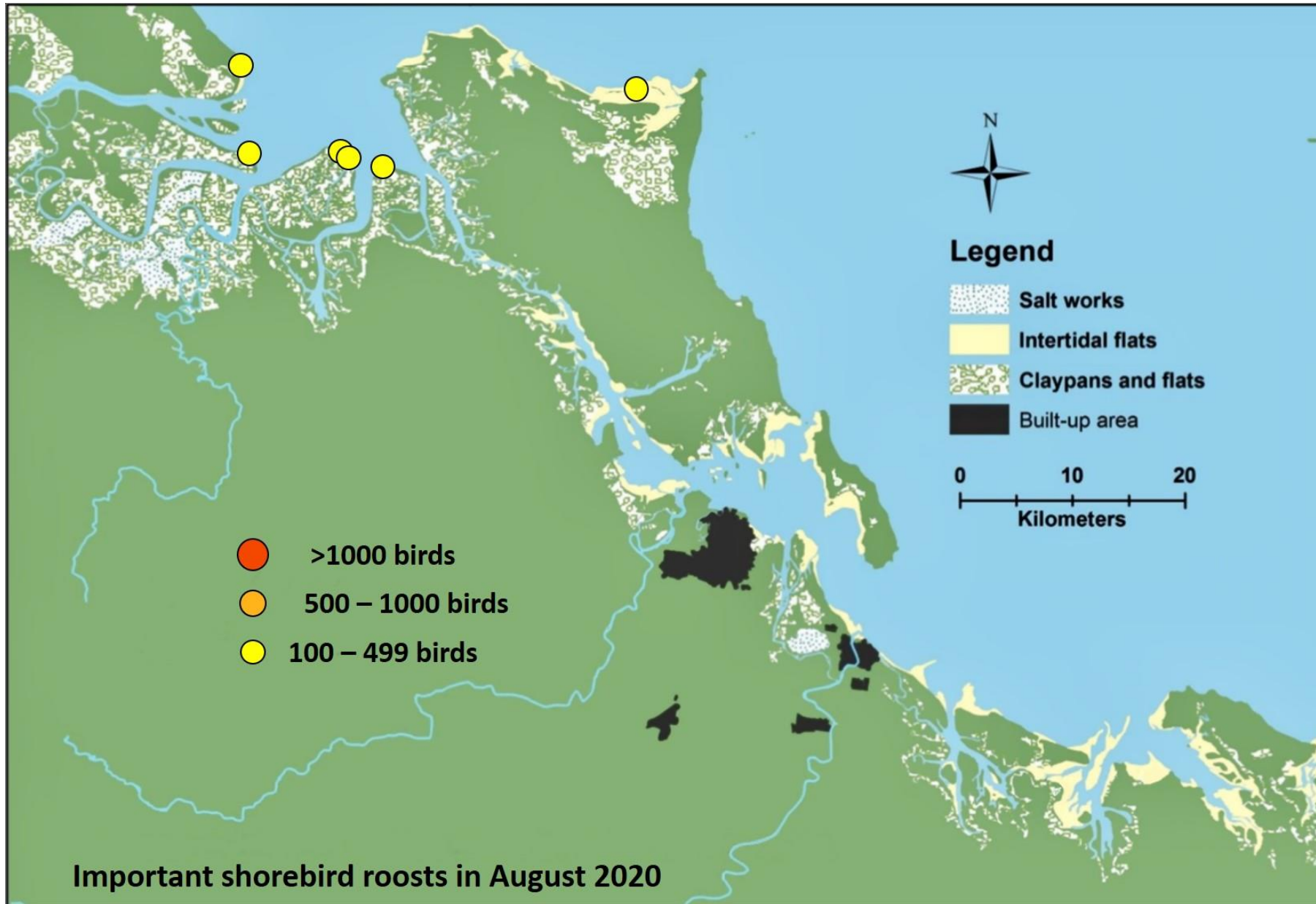


Figure 245 Important shorebird roosts on the Curtis Coast in August 2020.

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 2020, with 583 birds recorded at high tide roosts during the survey. This was 562 fewer birds than the number counted in August 2020 (1,145), 50 fewer birds than the number counted in August 2012 (633) and eight fewer birds than the number counted in August 2011 (591). Red-necked Stint were present at eight sites (half as many as in 2019), none of which reached the threshold for national significance. As in 2019, the foraging density was by far highest in the Fitzroy Estuary management unit (Table 54). 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 show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019).

Table 54 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in August 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	4	536	0.23
MCR	2	28	0.008
North Curtis	2	19	0.009
Port Curtis	Nil	Nil	0
Totals	8	583	0.11

4.4.4 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 second most abundant migratory shorebird on the Curtis Coast in August 2020, with 334 birds recorded at high tide roosts during the survey. This was 578 less birds than were counted in August 2012 (912) and 533 less birds than the number counted in August 2011 (867) but similar (30 less) than the number counted in August 2019 (364). The number of Eastern Curlew present on the Curtis Coast in January 2020 nearly reached the threshold for international significance (i.e. >1% of the total EAAF population of this species was present during the survey). Eastern Curlew were present at 26 sites, two of which were of *national significance*: the aptly named Curlew Spit claypan in the Fitzroy management unit supported 40 birds and the Rodds Harbour Sand Island site in the MCR management unit supported 39 birds. The foraging density was similar across the management units (Table 55). The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 55 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in August 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	10	124	0.04
Fitzroy Estuary	9	102	0.04
North Curtis	4	87	0.04
Port Curtis	3	21	0.009
Totals	26	334	0.03

4.4.5 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 third most abundant migratory shorebird on the Curtis Coast in August 2020, with 314 birds recorded at high tide roosts during the survey. This was 56 less birds than the number counted in August 2011 (370) but 142 more birds than were counted in August 2019 (172) and 102 more birds than were counted in August 2012 (212). Lesser Sand Plovers were present at six sites, none of which reached the threshold for national significance. The foraging density was highest in the Fitzroy Estuary (Table 56). There were no Lesser Sand Plovers recorded in the MCR management unit. The Lesser Sand Plover is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Endangered under the EPBC Act.

Table 56 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in August 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	2	248	0.11
North Curtis	3	36	0.02
Port Curtis	1	30	0.01
MCR	Nil	Nil	0
Totals	6	314	0.03

4.4.6 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 Tattler was the fourth most abundant migratory shorebird on the Curtis Coast in August 2020, with 296 birds recorded at high tide roosts during the survey. This was 1,199 less birds than the number counted in August 2012 (1,495) and 293 less birds than the number counted in August 2011 (589), but 227 more than the number counted in August 2019 (69). Bar-tailed Godwit were present at 13 sites, none of which reached the threshold for national significance. The foraging density was similar across the management units (Table 57). Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016). The Siberian sub-species of this species (*menzbieri*) is listed as Critically Endangered and the Alaskan sub-species (*baueri*) as Vulnerable under the EPBC Act; *menzbieri* is the sub-species predominantly found in eastern Australia.

Table 57 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in August 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	3	113	0.05
North Curtis	3	80	0.04
MCR	4	70	0.02
Port Curtis	3	33	0.01
Totals	13	296	0.03

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 2020, with 169 birds recorded at high tide roosts during the survey. This was 201 less birds than the number counted in August 2011 (370) and 43 less birds than the number counted in August 2012 (212), but 69 more birds than the number counted in August 2019 (100). Whimbrel were present at 34 sites, none of which reached the threshold for national significance. The foraging density was highest in the Port Curtis management unit (Table 58). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 58 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in August 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Port Curtis	10	63	0.03
MCR	8	46	0.01
North Curtis	7	35	0.02
Fitzroy Estuary	9	25	0.01
Totals	34	169	0.02

4.4.8 Other migratory shorebirds

There were a further ten species of migratory shorebird recorded on the Curtis Coast in August 2020. The abundance of each species was less than 100 birds. They were (in order of descending abundance): Terek Sandpiper (87 birds), Grey-tailed Tattler (75 birds), Greater Sand Plover (40 birds), Curlew Sandpiper (26 birds), Grey Plover (26 birds), Great Knot (nine birds), Ruddy Turnstone (five birds), Golden Plover (four birds), Double-banded Plover (three birds), Common Greenshank (one bird). Together, these species made up approximately 14% of the total migratory shorebird count for the survey. Most individuals of these species were found in the Fitzroy Estuary and Port Curtis management units.

4.4.9 Non-migratory shorebirds

There were 694 non-migratory shorebirds of seven species recorded during high tide counts on the Curtis Coast in August 2020. They were (in order of descending abundance): Red-capped Plover (443 birds), Pied Oystercatcher (193 birds), Masked Lapwing (33 birds), Beach Stone-curlew (18 birds), Pied Stilt (three birds), Sooty Oystercatcher (three birds), and Black-fronted Dotterel (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 Low tide surveys

There were 30 low tide surveys conducted on the Curtis Coast in August 2020 (excluding the salt works survey discussed below). In total, 457 minutes (approximately seven-and-a-half hours) were spent surveying shorebirds at low tide (Table 51). A total of 1,122 birds of 14 species (493 migratory, 345 non-migratory and 284 individuals that could not be identified to species level) were counted during the low tide surveys. The species with over 50 individuals counted at low tide were (in order of descending abundance): Pied Oystercatcher (241 birds), Bar-tailed Godwit (182 birds), Eastern Curlew (143 birds), Red-capped Plover (90 birds), Whimbrel (69 birds) and Red-necked Stint (51 birds). Lesser Sand Plover (19 birds), Great Knot (nine birds), Masked Lapwing (eight birds), Grey-tailed Tattler (seven birds), Beach Stone-curlew (six birds), Double-banded Plover (six birds), Greater Sand Plover (five birds), Ruddy Turnstone (two birds) and unidentified shorebirds (284 birds total) 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. Only the Yellow Patch Sand Bar (134 birds) in North Curtis had >100 birds counted at low tide.

4.4.11 Cheetham Salt Works Surveys in August 2020

It was only possible to visit the saltworks at low tide during this survey period because of construction activity at the high tide roosts. Five sites within the salt works were visited: the claypan opposite the Salt Works Plant, the Port Alma Salt Works West #1 site, the Bajool NW site, the South Cheetham Salt Fields, and the pond overflow in the Southwest corner of the Salt Works. A total of 227 shorebirds were counted including (in descending order) Pied Stilt (167 birds), Red-necked Avocet (43 birds), Masked Lapwing (six birds), Sharp-tailed Sandpiper (three birds) and Red-capped Plover (three birds), Curlew Sandpiper (two birds) and Marsh Sandpiper (two birds), and Common Greenshank (one bird). Almost all birds (218 of 227) were counted at the South Cheetham Salt Fields site.



At low tide shorebirds spread out onto large expanses of exposed tidal flat (Micha V Jackson, Wildlife Unlimited)

Table 59 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in August, 2020.

Species	North Curtis		Fitzroy Estuary		Port Curtis		MCR		Cheetham Salt Works		Total	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
<i>Migratory</i>												
Bar-tailed Godwit	80	88	113	74	33	0	70	20	-	0	296	182
Common Greenshank	0	0	0	0	1	0	0	0	-	1	1	1
Curlew Sandpiper	0	0	25	0	1	0	0	0	-	2	26	2
Double-banded Plover	0	6	1	0	2	0	0	0	-	0	3	6
Eastern Curlew	87	32	102	46	21	24	124	41	-	0	334	143
Great Knot	0	0	5	6	0	0	4	3	-	0	9	9
Greater Sand Plover	9	0	31	1	0	2	0	2	-	0	40	5
Grey Plover	15	0	8	0	0	0	3	0	-	0	26	0
Grey-tailed Tattler	8	0	27	1	17	0	23	6	-	0	75	7
Lesser Sand Plover	36	1	248	1	30	5	0	12	-	0	314	19
Marsh Sandpiper	0	0	0	0	0	0	0	0	-	2	0	2
Pacific Golden Plover	0	0	0	0	0	0	4	0	-	0	4	0
Red-necked Stint	19	0	536	20	0	0	28	31	-	0	583	51
Ruddy Turnstone	0	0	0	0	0	0	5	2	-	0	5	2
Sharp-tailed Sandpiper	0	0	0	0	0	0	0	0	-	3	0	3
Terek Sandpiper	1	0	53	0	20	0	13	0	-	0	87	0
Whimbrel	35	32	25	19	63	13	46	5	-	0	169	69
Total migratory	290	159	1174	168	188	44	320	122	-	8	1972	501
<i>Non-migratory</i>											0	0
Beach Stone-curlew	2	0	7	0	3	1	6	5	-	0	18	6
Black-fronted Dotterel	0	0	0	0	1	0	0	0	-	0	1	0
Black-winged Stilt	0	0	0	0	3	0	0	0	-	167	3	167
Masked Lapwing	19	4	1	0	11	4	2	0	-	6	33	14
Pied Oystercatcher	44	31	24	42	29	46	96	122	-	0	193	241
Red-capped Plover	174	30	104	21	76	5	89	34	-	3	443	93
Red-necked Avocet	0	0	0	0	0	0	0	0	-	43	0	43
Sooty Oystercatcher	0	0	0	0	1	0	2	0	-	0	3	0

Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Total non-migratory	239	65	136	63	124	56	195	161	-	219	694	564
Unidentified small shorebird	0	0	0	228	0	0	120	4	-	0	120	232
Unidentified medium shorebird	0	0	0	2	0	1	30	8	-	0	30	11
Unidentified large shorebird	0	0	0	40	0	0	0	1	-	0	0	41
Grand total	529	224	1310	501	312	101	665	296	-	227	2816	1349

4.5 October

October surveys target overwintering migratory shorebirds, as well as those migratory shorebirds that are beginning to return to the region following the Austral winter (see Table 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 and October 2019.

4.5.1 Survey Coverage

157 high tide surveys were completed in October (including counts at the Cheetham Salt Works), with a total high tide survey time of 1,359 minutes (approximately 23 hours). 27 low tide surveys were completed, with a total low tide survey time of 407 minutes (approximately seven hours). There were five sites that could not be surveyed at high tide and one at low tide due to site inundation or other factors. The survey effort from October is presented in Table 60. The weather during the October field trip was variable; just over 50% of high tide surveys were conducted in good counting conditions with winds below 20km/h, but only 37% of low tide surveys were conducted in good counting conditions with winds below 20km/h.

Table 60 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	46	349	7	68
Fitzroy Estuary	23	282	6	106
North Curtis Island	38	238	3	44
Mundoolin-Colosseum	26	273	8	148
Rodd's Peninsula	19	132	3	41
Cheetham Salt Works	5	85	Nil	Nil
Total	157	1,359	27	407

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 2020 was 7,193, which was less than in any other year of the project (see Figure 26). Only individuals identified to species level and "Sand Plover spp." – which represents either Greater or Lesser Sand Plover (both migratory species) – are included in this total; a further 98 birds 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 number identified in 2012 and one less than 2019 (Figure 27). The most abundant shorebirds on the Curtis Coast in October in 2020 (in descending order) were Bar-tailed Godwit (1,101 individuals), Whimbrel (1,206) and Red-necked Stint (928), which was different to 2012 and 2019 when the most numerous were Red-necked Stint (much higher counts of 3,235 in 2012 and 2,388 in 2019), Bar-tailed Godwit (similar count of

1,227 in 2019 but a higher count of 2,465 in 2012) and Eastern Curlew (1,098 counted in 2019 and 1,471 counted in 2012 compared with just 325 in 2020). The foraging density of migratory shorebirds across the Curtis Coast in October 2020 was 0.72 bird/ha, less than that observed in 2012 and 2019 (12,461 and 9,029 birds, respectively; 1.2 birds/ha and 0.90 birds/ha, respectively).

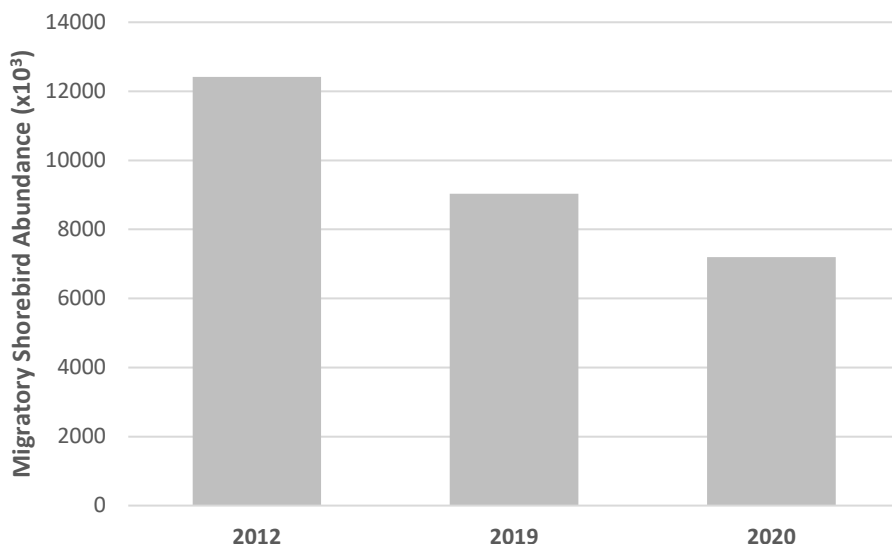


Figure 256 Abundance of migratory shorebirds on the Curtis Coast made in October 2012, 2019 and 2020. Counts made at Cheetham Salt Works have been excluded from these totals due to the variability of access to that site over the course of the project.

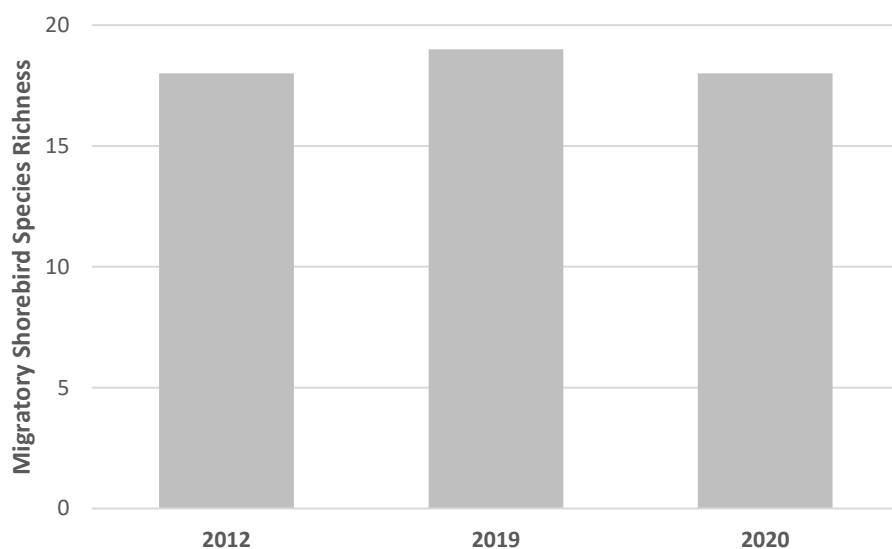


Figure 267 Species richness of migratory shorebirds on the Curtis Coast in October 2012, 2019 and 2020.

The foraging density of migratory shorebirds by management unit is summarised below (Table 61). 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; Table 5). The area of foraging habitat may have changed since that time, and this may affect any comparisons made.

In October 2020, shorebird distribution was fairly even across the survey area (Table 62, Figure 28). There were no roosts with >1000 migratory shorebirds. There were five roosts with between 500 and 1000 migratory shorebirds: the mangroves opposite Mund Rocks (706 birds), Mundoolin Rocks east claypan (701 birds) and Central Mangrove Island (672 birds) sites in the MCR management unit; Cattle Point (511 birds) in the Fitzroy Estuary; and, Little Barramundi Creek (508 birds) in North Curtis. There were an additional 13 roosts with between 100 and 500 migratory shorebirds: five in the MCR, four in the Fitzroy Estuary, and two each in North Curtis and Port Curtis. Counts from the Cheetham Salt Works are discussed below in section 4.5.16.

Species accounts are given below for each of the ten most abundant migratory shorebirds present on the Curtis Coast in October 2020. 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 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.

A summary of all shorebirds counted in October 2020 can be found in Table 74 at the end of this section.

Table 61 Summary of foraging density in August over time.

Location	Foraging density (birds/ha)		
	2012	2019	2020
Fitzroy Estuary	2.2	1.0	0.7
North Curtis Island	1.3	1.3	0.7
MCR	1.0	0.9	1.0
Port Curtis	0.5	0.5	0.4

Table 62 Place names of the roosts with the greatest abundance of migratory shorebirds in October 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-999	1. Cattle Point
	100-499	1. Curlew Spit claypan 2. Rundle Beach 3. Deception Point claypan west side 4. Mud Island claypan
North Curtis	>1000	Nil
	500-999	1. Little Barramundi Creek
	100-499	1. Yellow Patch Entrance Sandbar 2. Station Point Creek Sandbar
Port Curtis	>1000	Nil
	500-999	Nil
	100-499	1. South End Claypan 2. Facing Island 4
Mundoolin – Colosseum – Rodds Peninsula (MCR)	>1000	Nil
	500-999	1. Mangroves Opposite Mund Rocks 2. Mundoolin Rocks east claypan 3. Central Mangrove Island
	100-499	1. Williams Bay, Mangrove Bay 2. Morris Creek Mouth 3. Bird Island 4. Rodds Harbour Sand Island 5. Spit End

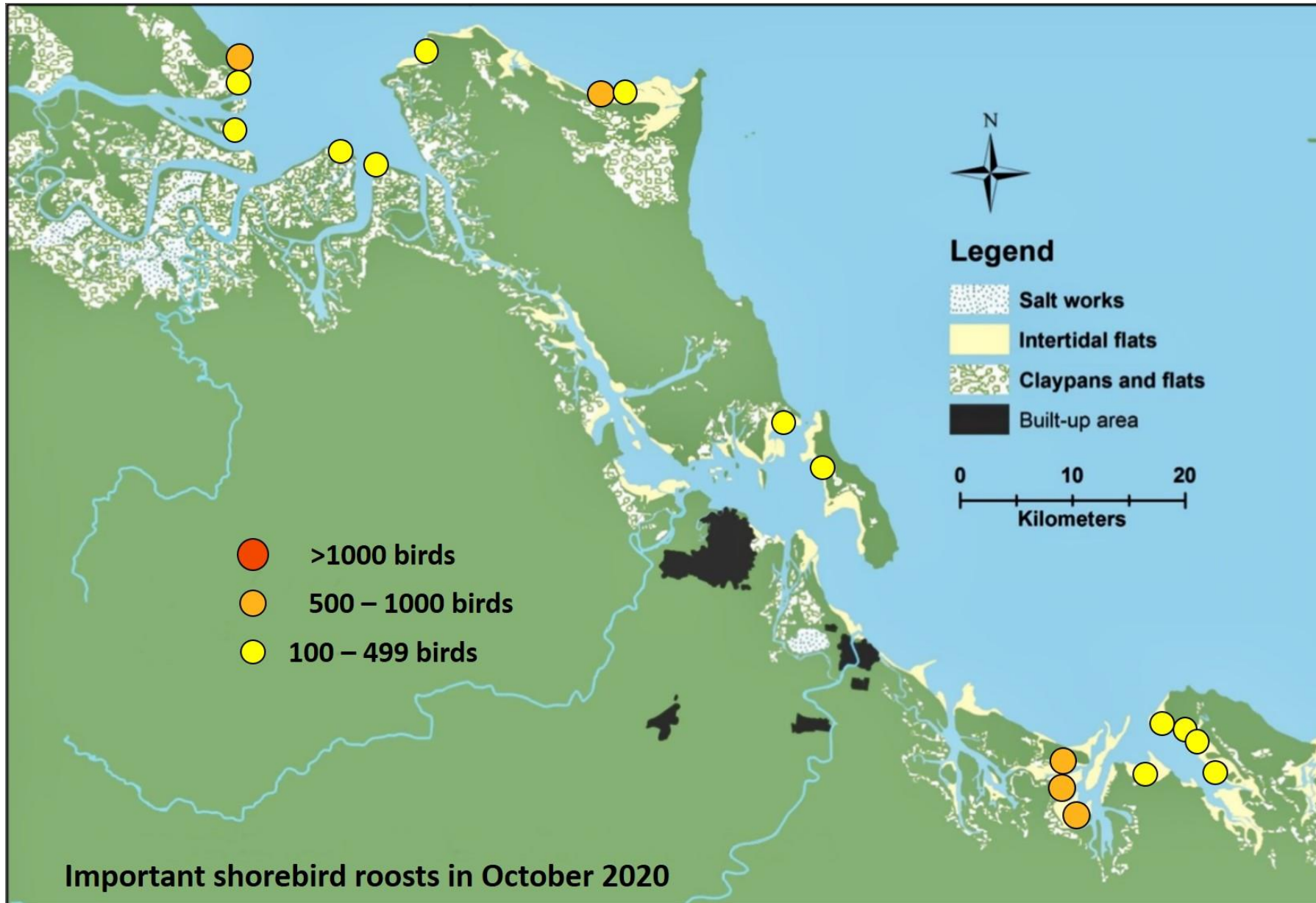


Figure 278 Important shorebird roosts on the Curtis Coast in October 2020.

4.5.3 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 October 2020, with 1,919 recorded at high tide roosts during the survey. This was 692 more birds than the number counted in 2019 (1,227) but 546 fewer birds than the number counted in October 2012 (2,465). Bar-tailed Godwits were present at 23 sites, two of which were of *national significance*: the Mangroves Opposite Mund Rocks in the MCR management unit supported 440 birds and Little Barramundi Creek in the North Curtis management unit supported 420 birds. The foraging density was highest in the MCR and North Curtis management units (Table 63). Bar-tailed Godwits are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The decline is especially strong north of 27.8°S which includes the study site (Clemens et al., 2016). The Siberian sub-species of this species (*menzbieri*) is listed as Critically Endangered and the Alaskan sub-species (*baueri*) as Vulnerable under the EPBC Act; *menzbieri* is the sub-species predominantly found in eastern Australia.

Table 63 Comparison of the number of birds, number of roosts occupied and foraging density of Bar-tailed Godwits between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	7	1,101	0.33
North Curtis	6	530	0.27
Fitzroy Estuary	6	233	0.10
Port Curtis	4	55	0.02
Totals	23	1,919	0.19

4.5.4 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 second most abundant migratory shorebird on the Curtis Coast in October 2020, with 1,206 birds recorded at high tide roosts during the survey. This was 400 more birds than were counted in October 2019 (806) but 56 birds less than were counted in 2012 (1,262). The number of Whimbrel present on the Curtis Coast in October 2020 was of **international significance** (i.e. >1% of the total EAAF population of this species was present during the survey). Whimbrel were present at 83 sites, five of which were of **national significance**: Central Mangrove Island in the MCR management unit supported 331 birds, the South End Claypan site and the Facing Island 4 site in the Port Curtis management unit supported 210 and 79 birds respectively, the Station Point Creek Sandbar in the North Curtis management unit supported 66 birds, and the Mud Island claypan in the Fitzroy Estuary supported 65 birds. The foraging density was highest in the Port Curtis management unit (Table 64). The Whimbrel population in the EAAF is believed to be declining (Wetlands International, 2019), but data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 64 Comparison of the number of birds, number of roosts occupied and foraging density of Whimbrels between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	19	463	0.14
Port Curtis	18	404	0.17
North Curtis	25	215	0.11
Fitzroy Estuary	21	124	0.05
Totals	83	1,206	0.12

4.4.5 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 October 2020, with 928 birds recorded at high tide roosts during the survey. This was 2,307 less birds than the number counted in October 2012 (3,235) and 1,460 less birds than the number counted in October 2019 (2,388). Red-necked Stint were present at 14 sites, none of which reached the threshold for national significance. The foraging density was highest in the Fitzroy Estuary management unit (Table 65). 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 show that there has been a long-term decline in the abundance of this species in Australia (Clemens et al., 2019).

Table 65 Comparison of the number of birds, number of roosts occupied and foraging density of Red-necked Stint between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	4	529	0.22
MCR	6	356	0.11
North Curtis	1	32	0.02
Port Curtis	3	11	0.004
Totals	14	928	0.09

4.5.6 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 fourth most abundant migratory shorebird on the Curtis Coast in October 2020, with 839 birds recorded at high tide roosts during the survey. This was 632 less birds than the number counted in October 2012 (1,471) and 259 less birds than the number counted in October 2019 (1,098). The number of Eastern Curlew present on the Curtis Coast in October 2020 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 33 sites, seven of which were of **national significance**: the mangroves opposite Mund Rocks, Rodds Harbour Sand Island and Spit End sites in the MCR management unit supported 119, 87 and 65 birds respectively, the Bund 6 site in Port Curtis management unit supported 71 birds, the Curlew Spit claypan in the Fitzroy Estuary management unit supported 70 birds, and the Mud Bay, Cape Capricorn and Yellow Patch Entrance Sandbar sites in the North Curtis management unit supported 51 and 46 birds respectively. The foraging density was highest in the North Curtis management unit (Table 66). The Eastern Curlew is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 66 Comparison of the number of birds, number of roosts occupied and foraging density of Eastern Curlew between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	8	325	0.10
North Curtis	10	227	0.12
Port Curtis	7	143	0.06
Fitzroy Estuary	8	144	0.06
Totals	33	839	0.11

4.5.7 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 fifth most abundant migratory shorebird on the Curtis Coast in October 2020, with 789 birds recorded at high tide roosts during the survey. This was 18 birds more than the number counted in October 2019 (770), but 201 less birds than the number 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 31 sites, three of which were of *national significance*: Central Mangrove Island, Bird Island and the Mundoolin Rocks east claypan in the MCR management unit supported 200, 125 and 81 birds respectively. The foraging density was highest in the MCR management unit (Table 67). The Grey-tailed Tattler is believed to be declining in the EAAF (Wetlands International, 2019). However, data from Australia do not show a significant trend over the long or medium term (Clemens et al., 2019).

Table 67 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	9	436	0.13
North Curtis	10	176	0.09
Port Curtis	8	146	0.06
Fitzroy Estuary	4	31	0.01
Totals	31	789	0.08

4.5.8 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 October 2020, with 497 birds recorded at high tide roosts during the survey. This was 93 more birds than the number counted in October 2019 (404), but 783 less birds than the number counted in October 2012 (1,280). Great Knots were present at 10 sites, none of which reached the threshold for national significance. There were no Great Knots recorded in Port Curtis. The foraging density was highest Fitzroy Estuary management unit (Table 68). Data from Australia do not show a significant trend in Great Knot over the long term but do show a decline in abundance over the medium term (Clemens et al., 2019), and it is listed as Critically Endangered under the EPBC Act.

Table 68 Comparison of the number of birds, number of roosts occupied and foraging density of Great Knots between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	3	262	0.11
MCR	5	230	0.07
North Curtis	2	5	0.003
Port Curtis	Nil	Nil	Nil
Totals	10	497	0.04

4.5.9 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 seventh most abundant migratory shorebird on the Curtis Coast in October 2020, with 400 birds recorded at high tide roosts during the survey. This was 48 birds more than the number counted in October 2012 (352), but 14 less birds than the number counted in October 2019 (414).

Terek Sandpipers were present at 17 sites, two of which were of *national significance*: Central Mangrove Island and Bird Island in the MCR management unit supported 140 and 55 birds respectively. The foraging density was highest in the MCR management unit (Table 69). It is unclear whether the number of Terek Sandpipers in the EAAF population is changing (Wetlands International, 2019). There are currently insufficient data to assess long-term trends in Australia, and data do not show a significant trend in Australia over the medium term (Clemens et al., 2019).

Table 69 Comparison of the number of birds, number of roosts occupied and foraging density of Terek Sandpiper between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
MCR	4	199	0.06
Port Curtis	4	88	0.04
North Curtis	5	60	0.03
Fitzroy Estuary	4	53	0.02
Totals	17	400	0.04

4.5.10 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 eighth most abundant migratory shorebird on the Curtis Coast in October 2020, with 167 birds recorded at high tide roosts during the survey. This was 513 less birds than the number counted in October 2019 (680) and 496 less birds than the number counted in October 2012 (663). Lesser Sand Plovers were present at four sites, none of which reached the threshold for national significance. There were no Lesser Sand Plovers recorded in Port Curtis. The foraging density was highest in the North Curtis Estuary management unit, but low all across the survey area (Table 70). The Lesser Sand Plover is considered to be in decline across the EAAF (Wetlands International, 2019) and in Australia over both the long and medium term (Clemens et al., 2019). The species is listed as Endangered under the EPBC Act.

Table 70 Comparison of the number of birds, number of roosts occupied and foraging density of Lesser Sand Plovers between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	1	58	0.03
MCR	1	80	0.02
Fitzroy Estuary	2	29	0.01
Port Curtis	Nil	Nil	Nil
Totals	4	167	0.02

4.5.11 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 ninth most abundant migratory shorebird on the Curtis Coast in October 2020, with 157 birds recorded at high tide roosts during the survey. This was 69 more birds than the number counted in October 2019 (88) and 20 more birds than the number counted in October 2012 (137). Curlew Sandpiper were present at four sites, one of which was of *national significance*: Cattle Point in the Fitzroy Estuary management unit supported 121 birds. There were no Curlew Sandpipers recorded in Port Curtis. The foraging density was highest in the Fitzroy Estuary management unit (Table 71). Curlew Sandpiper are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019). The species is listed as Critically Endangered under the EPBC Act.

Table 71 Comparison of the number of birds, number of roosts occupied and foraging density of Curlew Sandpipers between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
Fitzroy Estuary	2	155	0.07
North Curtis	1	1	0.0005
MCR	1	1	0.0003
Port Curtis	Nil	Nil	Nil
Totals	4	157	0.02

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 2020, with 104 birds recorded at high tide roosts during the survey. This was 10 more birds than the number counted in October 2019 (94) and eight more birds than the number counted in October 2012 (96). Grey Plovers were present at five sites, none of which reached the threshold for national significance. There were no Grey Plovers recorded in Port Curtis. The foraging density was highest in the North Curtis management unit (Table 72). Grey Plovers are believed to be declining across the EAAF (Wetlands International, 2019) and in Australia over the long and medium term (Clemens et al., 2019).

Table 72 Comparison of the number of birds, number of roosts occupied and foraging density of Grey-tailed Tattler between four management units in October 2020.

Management Unit	Roosts	Number of birds	Foraging Density (<i>birds / ha</i>)
North Curtis	2	65	0.03
Fitzroy Estuary	2	20	0.008
MCR	1	19	0.006
Port Curtis	Nil	Nil	Nil
Totals	5	104	0.01

4.5.13 Other migratory shorebirds

There were a further eight species of migratory shorebird recorded on the Curtis Coast in October 2020. They were (in order of descending abundance): Common Greenshank (74 birds), Greater Sand Plover (51 birds), Pacific Golden Plover (24 birds), Sharp-tailed Sandpiper (11 birds), Ruddy Turnstone (seven birds), Broad-billed Sandpiper (one bird), 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 Fitzroy Estuary and MCR management units.

4.5.14 Non-migratory shorebirds

There were 652 non-migratory shorebirds of five species recorded during high tide counts on the Curtis Coast in October 2020. They were (in order of descending abundance): Red-capped Plover (424 birds), Pied Oystercatcher (182 birds), Masked Lapwing (36 birds), Beach Stone-curlew (seven birds), Sooty Oystercatcher (two birds), and Black-fronted Dotterel (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).

4.5.15 Low tide surveys

There were 28 low tide surveys conducted on the Curtis Coast in October 2020. In total, 407 minutes (approximately seven hours) were spent surveying foraging migratory shorebirds (Table 60). A total of 2,032 birds of 20 species (1,459 migratory, 354 non-migratory and 219 individuals that could not be identified to species level) were counted during the low tide surveys. The species with over 50 individuals counted at low tide were (in order of descending abundance): Bar-tailed Godwit (494 birds), Red-necked Stint (250 birds), Eastern Curlew (232 birds), Red-capped Plover (212 birds), Great Knot (200 birds), Whimbrel (145 birds), and Pied Oystercatcher (129 birds). Black-tailed Godwit (35 birds), Grey-tailed Tattler (26 birds), Grey Plover (22 birds), Lesser Sand Plover (20 birds), Terek Sandpiper (20 birds), Beach Stone-curlew (seven birds), Greater Sand Plover (seven birds), Common Greenshank (five birds), Masked Lapwing (five birds), Curlew Sandpiper (one bird), Golden Plover (one bird), Marsh Sandpiper (one bird), Sooty Oystercatcher (one bird), and unidentified shorebirds (219) 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.

In October 2020, there were five sites counted at low tide with between 100 and 500 migratory shorebirds (Table 73): Mundoolin North (250 birds), Mundoolin South (179 birds) and Rodd's Main Tidal Flat (166 birds) in the MCR management unit, and Yellow Patch Sandbar (180 birds) and Station Point (117 birds) in North Curtis.

Table 73 Place names of the sites with the greatest abundance of migratory shorebirds at low tide in October 2020.

Management Unit	Abundance	Roost
Fitzroy Estuary	>1000	Nil
	500-1000	Nil
	100-499	Nil
North Curtis	>1000	Nil
	500-1000	Nil
	100-499	1. Yellow Patch Sandbar 2. Station Point
Port Curtis	>1000	Nil
	500-1000	Nil
	100-499	Nil
Mundoolin – Colosseum – Rodd's Peninsula (MCR)	>1000	Nil
	500-1000	Nil
	100-499	1. Mundoolin North 2. Mundoolin South 3. Station Point

4.5.16 Cheetham Salt Works Surveys in October 2020

Access was gained to five sites within the salt works, which were surveyed on 6 October. In addition to the shorebirds reported above, total of 1,748 shorebirds of 12 species were recorded at the salt works, including 1,718 at the South Cheetham Salt Fields site. The majority of shorebirds found within the salt works were Sharp-tailed Sandpiper (952 birds), Red-necked Avocet (354 birds), Curlew Sandpiper (183 birds), Black-tailed Godwit (94 birds; also note this species was not recorded elsewhere on the Curtis Coast in October 2020), and Marsh Sandpiper (85 birds), along with smaller numbers of Black-winged Stilt (37 birds), Common Greenshank (19 birds), Masked Lapwing (15 birds), Red-capped Plover (two birds), Bar-tailed Godwit (one bird), Common Sandpiper (one bird), Pacific Golden Plover (one bird) and four unidentified shorebirds. The number of Sharp-tailed Sandpipers was of *international significance*, representing more than 1% of the total estimated EAAF population, and the number of Curlew Sandpiper was of *national significance*, representing more than 0.1% of the total estimated EAAF population. Given previous recommendations, the importance of this site, and the difference in community structure at this site compared with the rest of the Curtis Coast, it is unfortunate that

access to the salt works was patchy throughout the ten-year project, including in 2020, but nonetheless positive that high tide surveys at the salt works were possible during three of five survey periods in 2020/2021.



The Black-tailed Godwit is one species that is regularly observed at the Cheetham Saltworks but not elsewhere during Curtis Coast region shorebird surveys (Micha V Jackson, Wildlife Unlimited).

Table 74 Total number of birds counted at high and low tide in each management unit of the Curtis Coast in October, 2020.

Species	North Curtis		Fitzroy Estuary		Port Curtis		MCR		Cheetham Salt Works		Total	
	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low
<i>Migratory</i>												
Bar-tailed Godwit	530	108	233	77	55	47	1101	262	1	-	1920	494
Black-tailed Godwit	0	0	0	35	0	0	0	0	94	-	94	35
Broad-billed Sandpiper	0	0	1	0	0	0	0	0	0	-	1	0
Common Greenshank	7	1	4	0	11	0	52	4	19	-	93	5
Common Sandpiper	0	0	0	0	0	0	1	0	1	-	2	0
Curlew Sandpiper	1	0	155	0	0	0	1	1	183	-	340	1
Eastern Curlew	227	28	144	69	143	55	325	80	0	-	839	232
Great Knot	5	84	262	7	0	0	230	109	0	-	497	200
Greater Sand Plover	0	0	51	4	0	0	0	3	0	-	51	7
Grey Plover	65	5	20	4	0	0	19	13	0	-	104	22
Grey-tailed Tattler	176	2	31	2	146	4	436	18	0	-	789	26
Lesser Sand Plover	58	0	29	0	0	0	80	20	0	-	167	20
Marsh Sandpiper	0	0	0	1	0	0	0	0	85	-	85	1
Pacific Golden Plover	1	0	9	0	1	0	13	1	1	-	25	1
Red Knot	0	0	0	0	0	0	1	0	0	-	1	0
Red-necked Stint	32	54	529	0	11	1	356	195	0	-	928	250
Ruddy Turnstone	2	0	1	0	0	0	4	0	0	-	7	0
Sand Plover spp.	8	0	0	0	9	0	0	0	0	-	17	0
Sharp-tailed Sandpiper	6	0	5	0	0	0	0	0	952	-	963	0
Terek Sandpiper	60	0	53	17	88	2	199	1	0	-	400	20
Whimbrel	215	24	124	38	404	39	463	44	0	-	1206	145
Total migratory	1393	306	1651	254	868	148	3281	751	1336	-	8529	1459
<i>Non-migratory</i>												
Beach Stone-curlew	0	0	3	1	0	4	4	2	0	-	7	7
Black-fronted Dotterel	0	0	1	0	0	0	0	0	0	-	1	0
Black-winged Stilt	0	0	0	0	0	0	0	0	37	-	37	0

Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast, Annual Report – 2020

Masked Lapwing	21	5	0	0	15	0	0	0	15	-	51	5
Pied Oystercatcher	17	6	23	11	47	28	95	84	0	-	182	129
Red-capped Plover	130	49	144	122	63	11	87	30	2	-	426	212
Red-necked Avocet	0	0	0	0	0	0	0	0	354	-	354	0
Sooty Oystercatcher	0	0	0	0	1	1	1	0	0	-	2	1
Total non-migratory	168	60	171	134	126	44	187	116	408	-	1060	354
Unidentified small shorebird	0	0	1	0	0	0	53	0	4	-	58	0
Unidentified medium shorebird	42	0	0	206	0	0	2	4	0	-	44	210
Unidentified large shorebird	0	0	0	9	0	0	0	0	0	-	0	9
Grand total	1603	366	1823	603	994	192	3523	871	1748	-	9691	2032

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, Clemens et al., 2016). Multiple species that occur annually on the Curtis Coast are listed as Critically Endangered (i.e. Great Knot, Eastern Curlew and Curlew Sandpiper), Endangered (i.e. Red Knot and Lesser Sand Plover) or Vulnerable (i.e. Greater Sand Plover) under the EPBC Act. A continental scale meta-analysis of Australian data showed long-term declines in 13 of the 20 migratory shorebirds that visit the country on an annual basis (Clemens et al., 2019), and suggested that these declines are primarily the result of factors outside Australia but that effective management of the remaining migratory shorebird habitat in Australia is nonetheless very important for future conservation.

5.1 Migratory Shorebirds on the Curtis Coast in 2021

In 2021, 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. Across the core non-breeding season, which roughly corresponds with the Australian summer (including October, January, February and March), the Curtis Coast supported more than 1% of the total EAAF population of the following species on multiple occasions: Eastern Curlew, Grey-tailed Tattler, 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, 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.

In August, which is the breeding season or early southward migration period for migratory shorebirds and the Australian winter, the numbers of migratory shorebirds present on the Curtis Coast were predictably lower than those recorded during the summer survey months. Still, the Curtis Coast proved to be an important overwintering site for several species, and two individual sites on the Curtis Coast supported more than 0.1% of the total EAAF population of the Critically Endangered Eastern Curlew in August, 2020.

It is important to note that certain individual 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). Figure 29 below shows the location of each of the 34 individual sites on the Curtis Coast (not including the Cheetham Salt Works) where a *nationally significant* count of at least one migratory shorebird species was made during high tide counts in 2020/2021. Table 75 shows the number of roost sites in each month that each shorebird species was counted in *nationally significant* numbers.

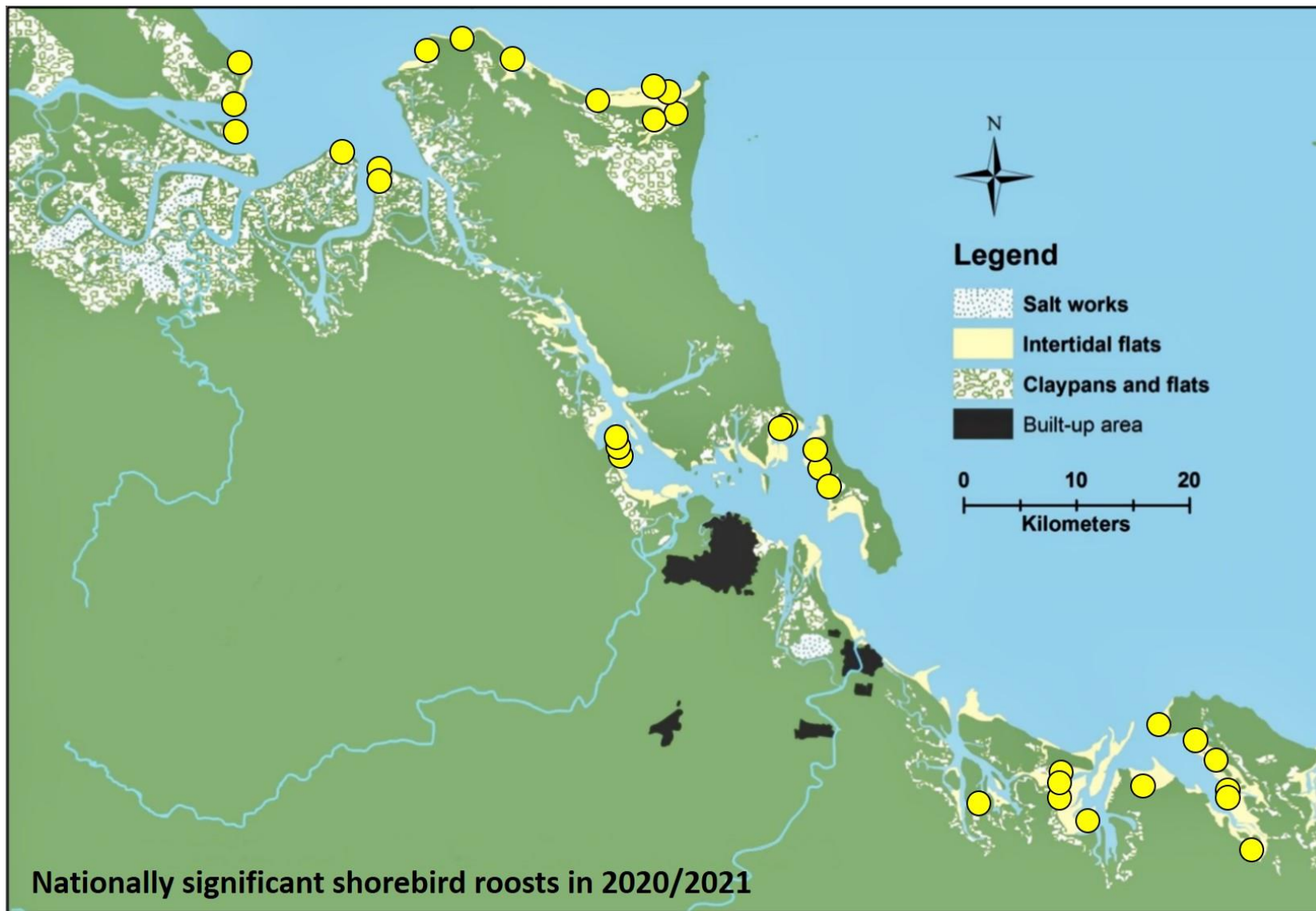


Figure 289 Roosts that supported a nationally significant number ($>0.01\%$ of the total EAAF population of that species) of at least one migratory shorebird species during high tide surveys on the Curtis Coast (not including the Cheetham Salt Works) in 2020/2021.

Table 75 Number of roosts that supported a nationally significant number (>0.01% of the total EAAF population of that species) during high tide surveys on the Curtis Coast (not including the Cheetham Salt Works) in 2020/2021.

Migratory Shorebird Species	# roosts - Jan	# roosts - Feb	# roosts - Mar	# roosts - Aug	# roosts - Oct
<i>Bar-tailed Godwit</i>	2	1	1	0	2
<i>Black-tailed godwit</i>	0	0	0	0	0
<i>Broad-billed Sandpiper</i>	1	0	0	0	0
<i>Common Greenshank</i>	0	0	0	0	0
<i>Common Sandpiper</i>	0	0	0	0	0
<i>Curlew Sandpiper</i>	0	0	0	0	1
<i>Eastern Curlew</i>	5	5	8	2	7
<i>Great Knot</i>	0	1	0	0	0
<i>Greater Sand Plover</i>	1	0	0	0	0
<i>Grey Plover</i>	0	0	0	0	0
<i>Grey-tailed Tattler</i>	2	5	7	0	3
<i>Lesser Sand Plover</i>	0	0	1	0	0
<i>Marsh Sandpiper</i>	0	0	0	0	0
<i>Pacific Golden Plover</i>	0	0	0	0	0
<i>Red Knot</i>	0	0	0	0	0
<i>Red-necked Stint</i>	1	1	1	0	0
<i>Ruddy Turnstone</i>	1	0	0	0	0
<i>Sanderling</i>	0	0	0	0	0
<i>Sharp-tailed Sandpiper</i>	1	0	0	0	0
<i>Terek Sandpiper</i>	4	5	3	0	3
<i>Whimbrel</i>	1	3	1	0	5

5.2 Human Impacts on the Migratory Shorebirds of the Curtis Coast

Common human disturbance impacts on shorebirds 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, 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).

5.3 Survey Timing, Conditions, Coverage, and Inference

There were five migratory shorebird surveys conducted by Wildlife Unlimited along the Curtis Coast in 2020/2021 (the March survey was conducted in 2021 because poor weather and the Covid-19 pandemic prevented implementation of surveys in March 2020; the four other surveys were all conducted in 2020). 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 February and August, but somewhat less than ideal in

January, March and October. Particularly in October, observers more often encountered strong winds, which may have affected the counts of species such as Greater versus Lesser Sand Plover, which can be difficult to separate at a distance in poor conditions. Survey coverage was good in 2021/2021 (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

Overall, 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 2020/2021 had the lowest migratory shorebird abundance in each month since the start of the project except February, when the 2020 count was still among the lowest in the ten years of February surveys conducted. 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 somewhat. 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 there are only a small number of data points for each month (10 in February, four in January, March and August and three in October). Nonetheless, the 2020/2021 results show a continuation of the consistently lower numbers that were recorded in 2019 compared with earlier survey years, which increases confidence in this result. Importantly, readers should be aware that no statistical trend analyses have been performed on shorebird counts presented in this report. Such analyses are highly recommended to determine whether apparent declines in overall shorebird numbers and specific species are statistically significant. Trend analysis is likely to be most feasible for February, which is considered to have peak non-breeding counts for most species, and for which ten continuous years of data are available on the Curtis Coast.

A decline in migratory shorebird abundance on the Curtis Coast would not be particularly 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. Nonetheless, 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. The surveys conducted in 2020/2021 were the final surveys on the Curtis Coast to be associated with the ERMP.

5.5 Recommendations

As noted above, a trend analysis of overall and individual shorebird species abundance to determine if observed patterns are statistically significant is highly recommended. If any declining trends on the Curtis Coast are more pronounced than documented Australia-wide trends over a comparable period, any potential local factors that could be leading to a reduced local shorebird population should be investigated as a priority. In addition, ongoing monitoring of shorebird abundance and habitat quality is recommended for all important shorebird areas in Australia, with the Curtis Coast being no exception. Without long-term monitoring, it is impossible to know how Australia's shorebirds, many of which are threatened and declining, are faring over time, or to assess whether local management interventions are needed.

6 References

- Bamford, M., Watkins, D., Bancroft, W., Tischler, G. & Wahl, J. 2008. Migratory shorebirds of the East-Asian Australasian flyway: Population Estimates and Internationally Important Sites. Canberra, Australia: Wetlands International - Oceania.
- Choi C.-Y., Moffitt D.J., Fuller, R.A., Skilleter, G., Rogers, D., Coleman, J. & Klaassen, M. 2016. Annual Report: Migratory Shorebird Monitoring – Understanding Ecological Impact (CA130019). Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 49 pp.
- Choi C.-Y., Coleman, J., Klaassen, M., Moffitt D.J., Rogers, D., Skilleter, G. & Fuller, R.A. 2017. Final Report: Migratory Shorebird Monitoring – Understanding Ecological Impact (CA12000284). Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 133 pp.
- Clemens, R. S., Rogers, D. I., Hansen, B. D., Gosbell, K., Minton, C. D. T., Straw, P., Bamford, M., Woehler, E. J., Milton, D. A., Weston, M. A., Venables, W., Weller, D., Hassell, C. J., Rutherford, W., Onton, K., Herrod, A., Studds, C. E., Choi, C.-Y., Dhanjal-Adams, K. L., Murray, N. J., Skilleter, G. A. & Fuller, R. A. 2016. Continental-scale decreases in shorebird populations in Australia. *Emu*, 116, 119-135.
- Clemens, R., Driessen, J. and Ehmke, G. 2019. Australian Bird Index Phase 2 – Developing Waterbird Indices for National Reporting. Unpublished report for the Department of the Environment. BirdLife Australia, Melbourne.
- Colwell, M. A. 2010. *Shorebird Ecology, Conservation and Management*. Los Angeles: University of California Press.
- DEH. 2006. *Wildlife Conservation Plan for Migratory Shorebirds*. Canberra: Commonwealth of Australia. 24 pp.
- DEWHA. 2009a. *Significant impact guidelines for 36 migratory shorebird species - EPBC Act policy statement 3.21*. pp. 17. Canberra: Commonwealth of Australia. 17 pp.
- DEWHA. 2009b. *Significant impact guidelines for 36 migratory shorebird species - Background paper to EPBC Act policy statement 3.21*. pp. 35. Canberra: Commonwealth of Australia
- DoE. 2015. *Wildlife Conservation Plan for Migratory Shorebirds*. Canberra: Commonwealth of Australia. 24 pp.

DoEE. 2017. *EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Canberra: Commonwealth of Australia. 24 pp.

GHD. 2011a. *Report for Migratory Shorebird Monitoring - Port Curtis to Port Alma, Survey 1 January 2011*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 39 pp.

GHD. 2011b. *Report for Migratory Shorebird Monitoring - Port Curtis to Port Alma, Survey 2, February 2011*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 14 pp.

GHD. 2011c. *Report for Migratory Shorebird Monitoring - Port Curtis to Port Alma, Survey 3, March 2011*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 71 pp.

GHD. 2011d. *Report for Migratory Shorebird Monitoring - Port Curtis to Port Alma, Survey 4, November 2011*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 32 pp.

Gladstone Ports Corporation. 2016. *Port Curtis and Port Alma Ecosystem Research and Monitoring Program*. 17 pp. Gladstone: Gladstone Ports Corporation.

Hansen, B.D., Fuller, R.A., Watkins, D., Rogers, D.I., Clemens, R.S., Newman, M., Woehler, E.J. & Weller, D.R. 2016. *Revision of the East Asian-Australasian Flyway Population Estimates for 37 listed Migratory Shorebird Species*. Unpublished report for the Department of the Environment. Melbourne: BirdLife Australia.

Higgins, P. J. & Davies, S. J. J. F. (eds). 1996. *Handbook of Australian, New Zealand and Antarctic Birds, Vol. 3: Snipe to Pigeons*. Melbourne: Oxford University Press.

Houston, W., Black, R., Elder, R., Black, L. & Segal, R. 2012. Conservation value of solar salt ponds in coastal tropical eastern Australia to waterbirds and migratory shorebirds. *Pacific Conservation Biology*, 18, 100-122.

Marchant, S. & Higgins, P. J. (eds). 1993. *Handbook of Australian, New Zealand and Antarctic Birds, Vol 2. Raptors to Lapwings*. Melbourne: Oxford University Press.

Menkhorst, P., Rogers, D., Clarke, R., Davies, J. N., Marsack, P. & Franklin, K. 2017. *The Australian Bird Guide*. Melbourne: CSIRO Publishing.

Minton, C., Dann, P., Ewing, A., Taylor, S., Jessop, R., Anton, P. & Clemens, R. S. 2012. Trends of Shorebirds in Corner Inlet, Victoria, 1982–2011. *Stilt*, 61, 3-18.

Sandpiper Ecological Surveys. 2012a. *Migratory Shorebird Monitoring - Survey 1 and 2, Year 2 (Jan/Feb 2012)*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 61 pp.

Sandpiper Ecological Surveys. 2012b. *Migratory Shorebird Monitoring - Survey 3, Year 2, March 2012*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 41 pp.

Sandpiper Ecological Surveys. 2012c. *Migratory Shorebird Monitoring - Survey 5, Year 2, October 2012*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 55 pp.

Studds, C.E., Kendall, B.E., Murray, N.J., Wilson, H.B., Rogers, D.I., Clemens, R.S., Gosbell, K., Hassell, C.J., Jessop, R., Melville, D.S., Milton, D.A., Minton, C.D., Possingham, H.P., Riegen, A.C., Straw, P., Woehler, E.J. & Fuller, R.A. (2017). Rapid population decline in migratory shorebirds relying on Yellow Sea tidal mudflats as stopover sites. *Nature Communications*, 8, 14895.

Wetlands International. 2019. *Waterbird Population Estimates for the East Asian-Australasian Flyway*. Retrieved 7 November 2019. Available: <http://wpe.wetlands.org>.

Wildlife Unlimited. 2012. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast – August 2012*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 40 pp.

Wildlife Unlimited. 2013a. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast – Annual Summer Survey – 2013*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 70 pp.

Wildlife Unlimited. 2013b. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast – October 2013*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 63 pp.

Wildlife Unlimited. 2014. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast – Annual Summer Survey – 2014*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 70 pp.

Wildlife Unlimited. 2015. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast Annual Summer Survey – 2015*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 78 pp.

Wildlife Unlimited. 2016. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast Annual Summer Survey – 2016*. Report produced for the Ecosystem Research and Monitoring Program Advisory Panel as part of Gladstone Ports Corporation's Ecosystem Research and Monitoring Program. 81 pp.

Wildlife Unlimited. 2017. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast Annual Summer Survey – 2017*. Report produced for the Ecosystem Research and Monitoring program Advisory panel as part of Gladstone Ports Corporation's Ecosystem Research and monitoring program. 90 pp.

Wildlife Unlimited. 2018. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast Annual Summer Survey – 2018*. Report produced for the Ecosystem Research and Monitoring program Advisory panel as part of Gladstone Ports Corporation's Ecosystem Research and monitoring program. 74 pp.

Wildlife Unlimited. 2019. *Gladstone Ports Corporation Report for Migratory Shorebird Monitoring, Port Curtis and the Curtis Coast Annual Summer Survey – 2019*. Report produced for the Ecosystem Research and Monitoring program Advisory panel as part of Gladstone Ports Corporation's Ecosystem Research and monitoring program. 115 pp.

Appendix 1: EPBC Act Listed Migratory Shorebirds in Australia

Species in **bold** were recorded on the Curtis Coast in 2020. Population estimates are from Hansen et al. (2016).

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

Appendix 2: Non-migratory Shorebirds on the Curtis Coast in 2020

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

Appendix 3: High tide roost sites and abundance of the ten most common migratory shorebirds on the Curtis Coast in February 2020

The following ten figures depict, for the ten most abundant migratory shorebird species on the Curtis Coast in 2020, 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 2020	1% Flyway Population	0.1% Flyway Population
Red-necked Stint	<i>Calidris ruficollis</i>	1,951	4,750	475
Bar-tailed Godwit	<i>Limosa lapponica</i>	1,883	3,250	325
Grey-tailed Tattler	<i>Tringa brevipes</i>	1,501	700	70
Terek Sandpiper	<i>Xenus cinereus</i>	923	500	50
Whimbrel	<i>Numenius phaeopus</i>	886	650	65
Great Knot	<i>Calidris tenuirostris</i>	686	4,250	425
Eastern Curlew	<i>Numenius madagascariensis</i>	496	350	35
Lesser Sand Plover	<i>Charadrius mongolus</i>	458	1,800	180
Curlew Sandpiper	<i>Calidris ferruginea</i>	122	900	90
Greater Sand Plover	<i>Charadrius veredus</i>	91	2,000	200

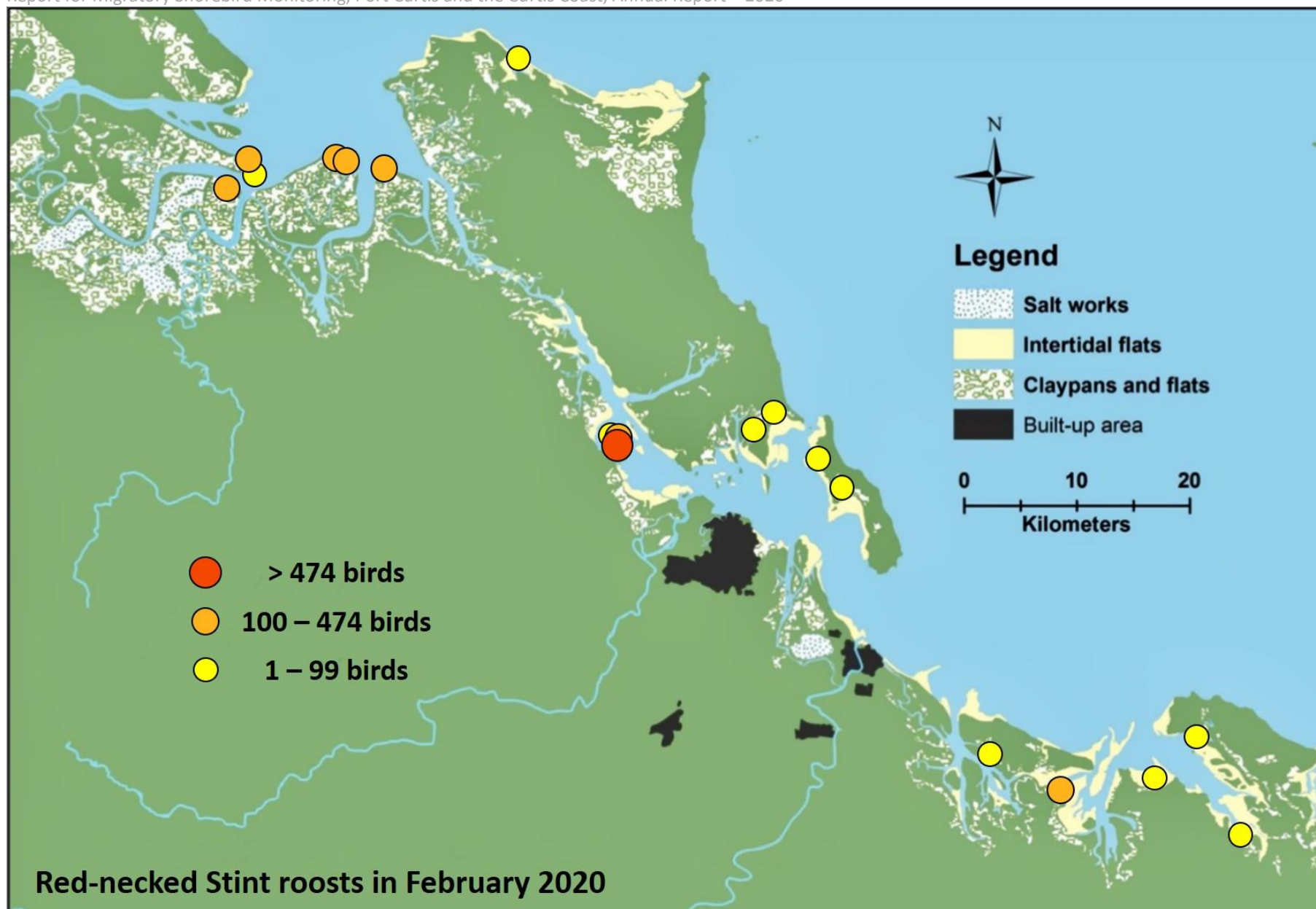


Figure A1 The high tide roost sites utilised by Red-necked Stint on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

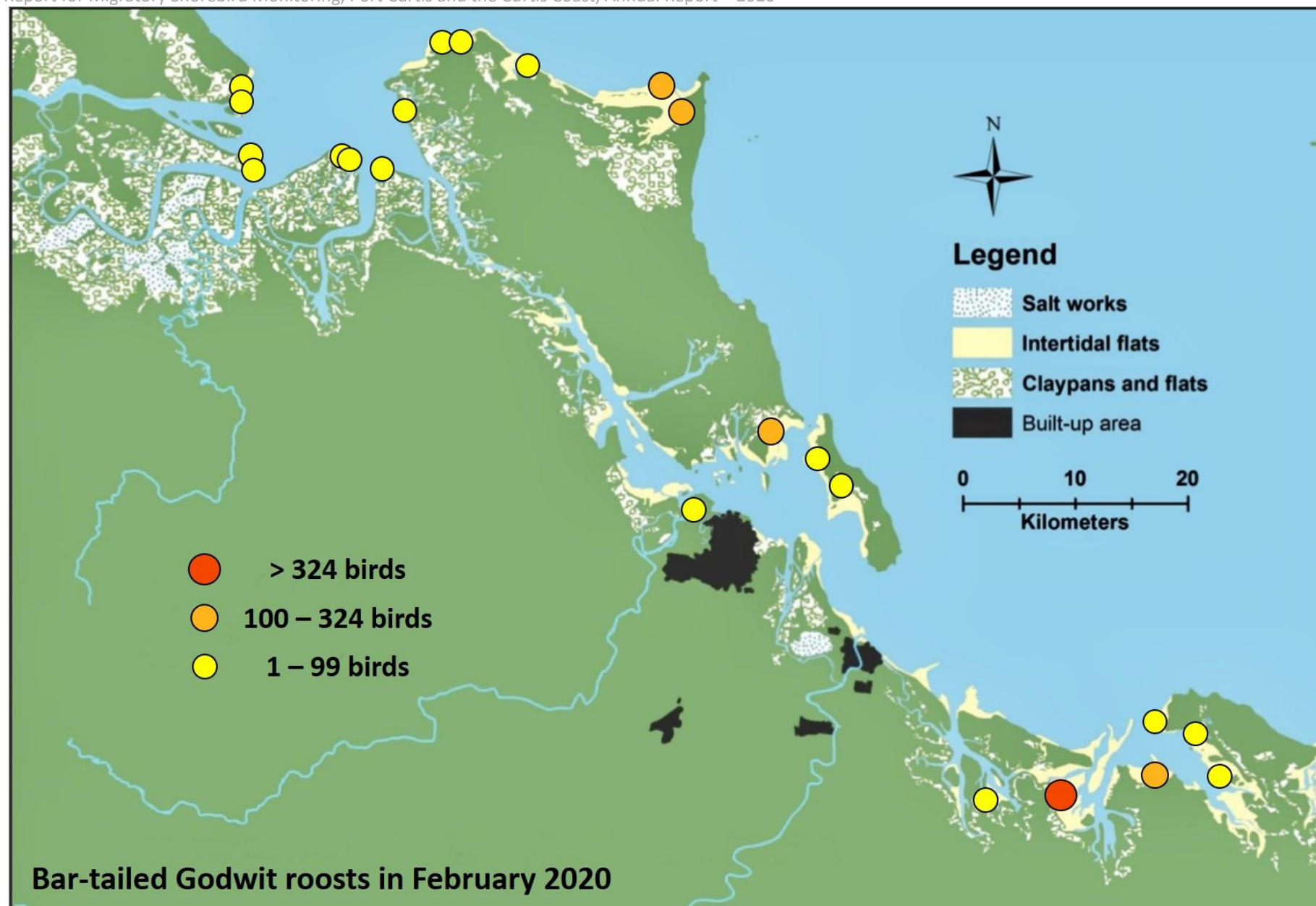


Figure A2 The high tide roost sites utilised by Bar-tailed Godwit on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

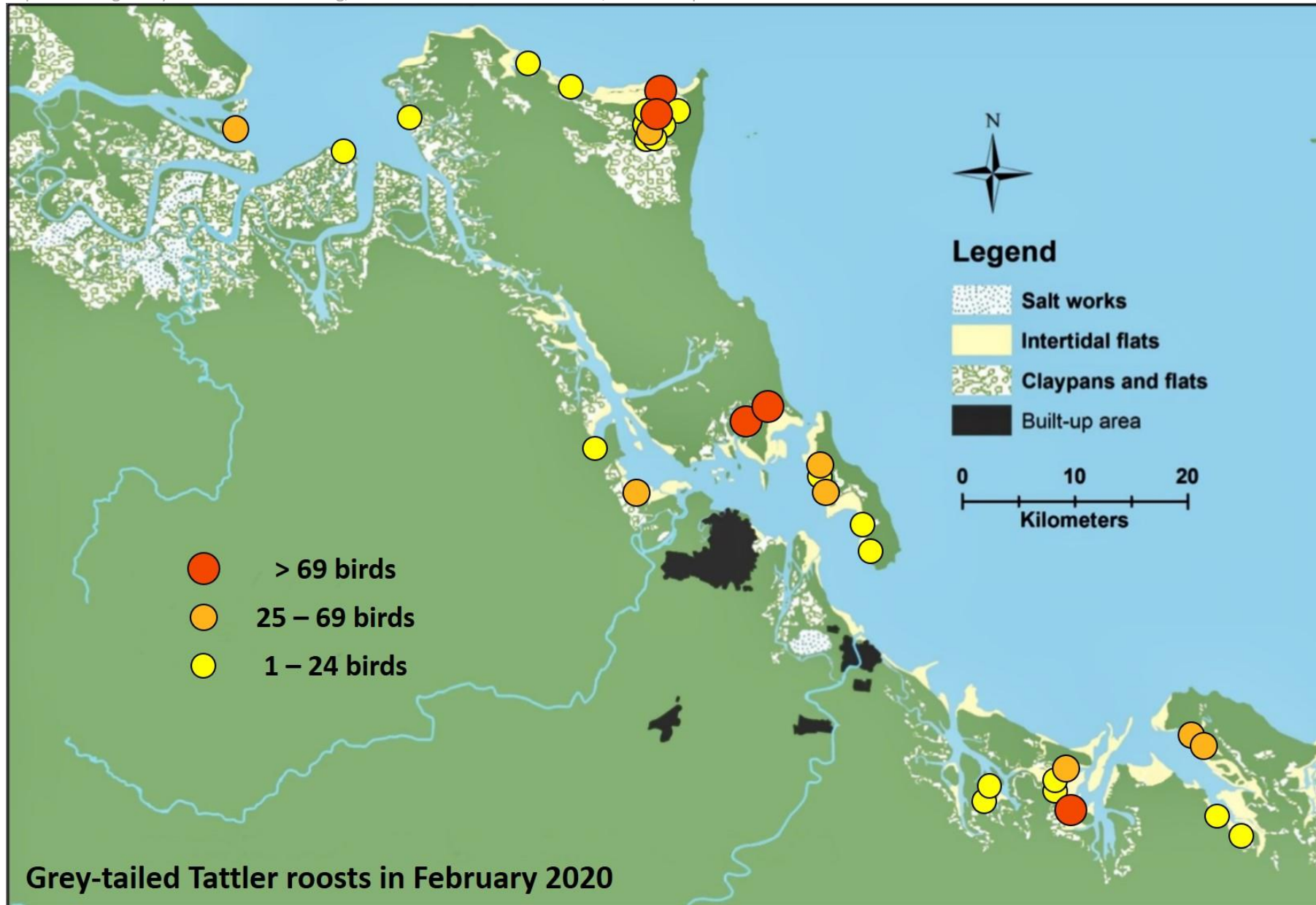


Figure A3 The high tide roost sites utilised by Grey-tailed Tattler on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

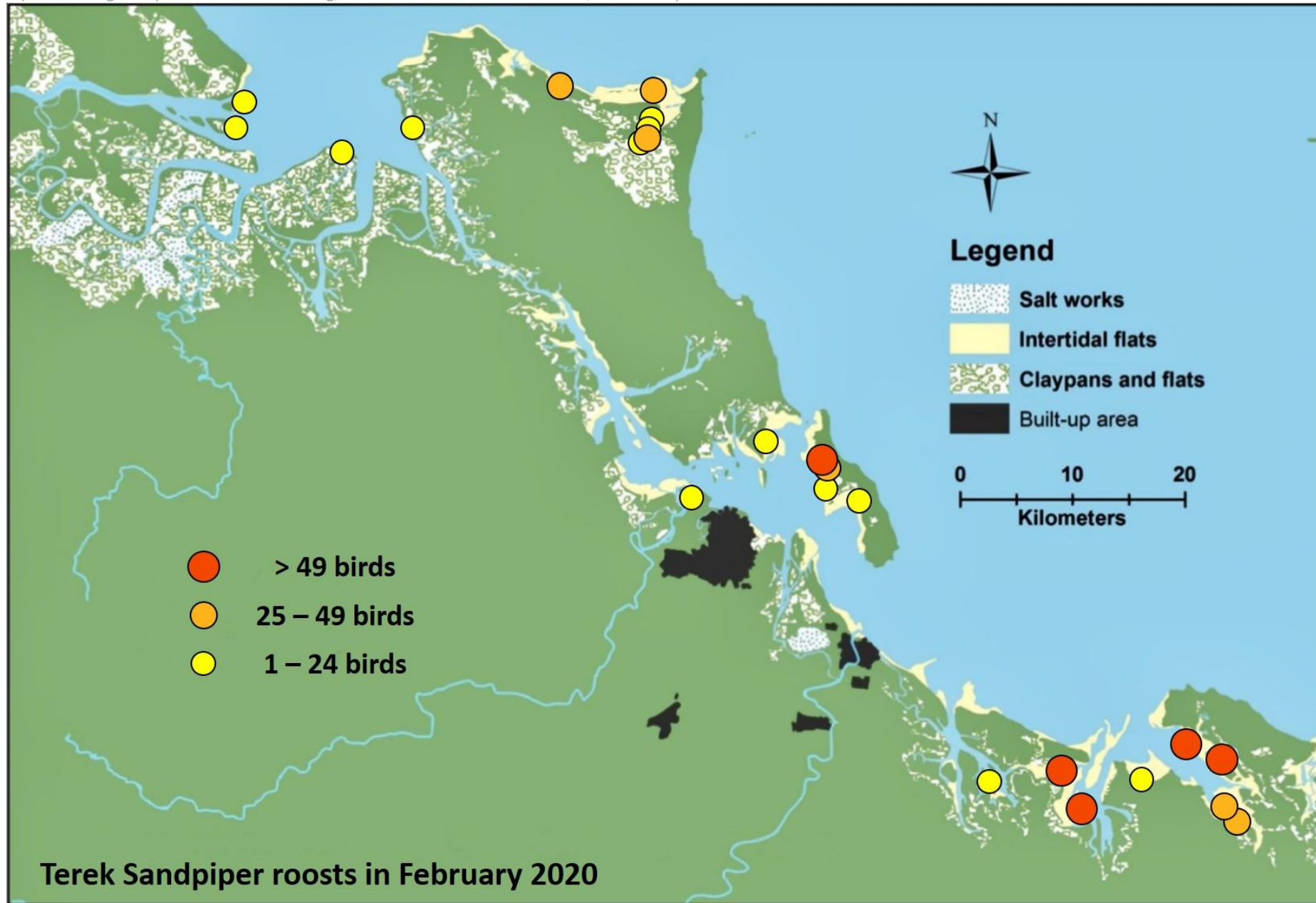


Figure A4 The high tide roost sites utilised by Terek Sandpiper on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

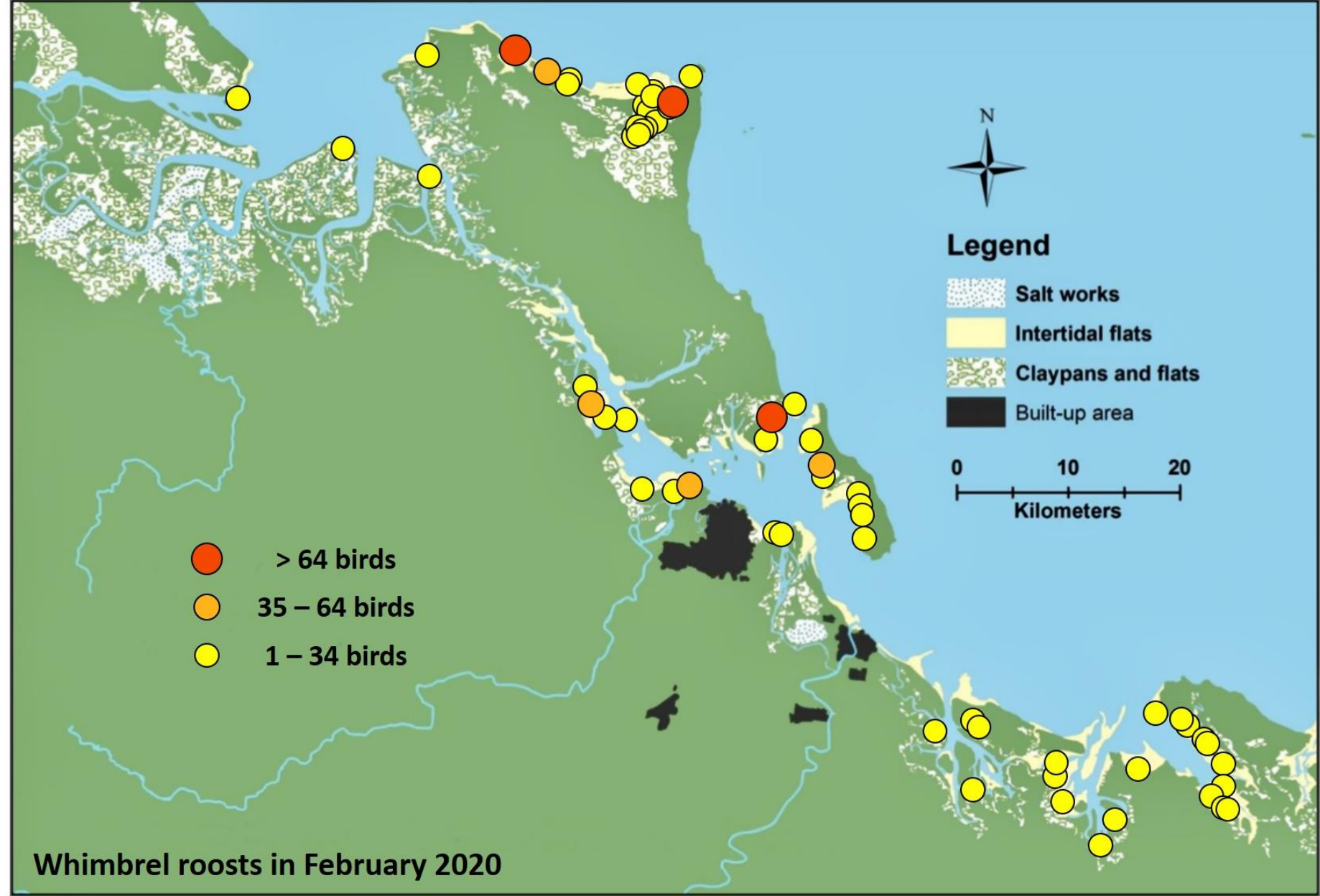


Figure A5 The high tide roost sites utilised by Whimbrel on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

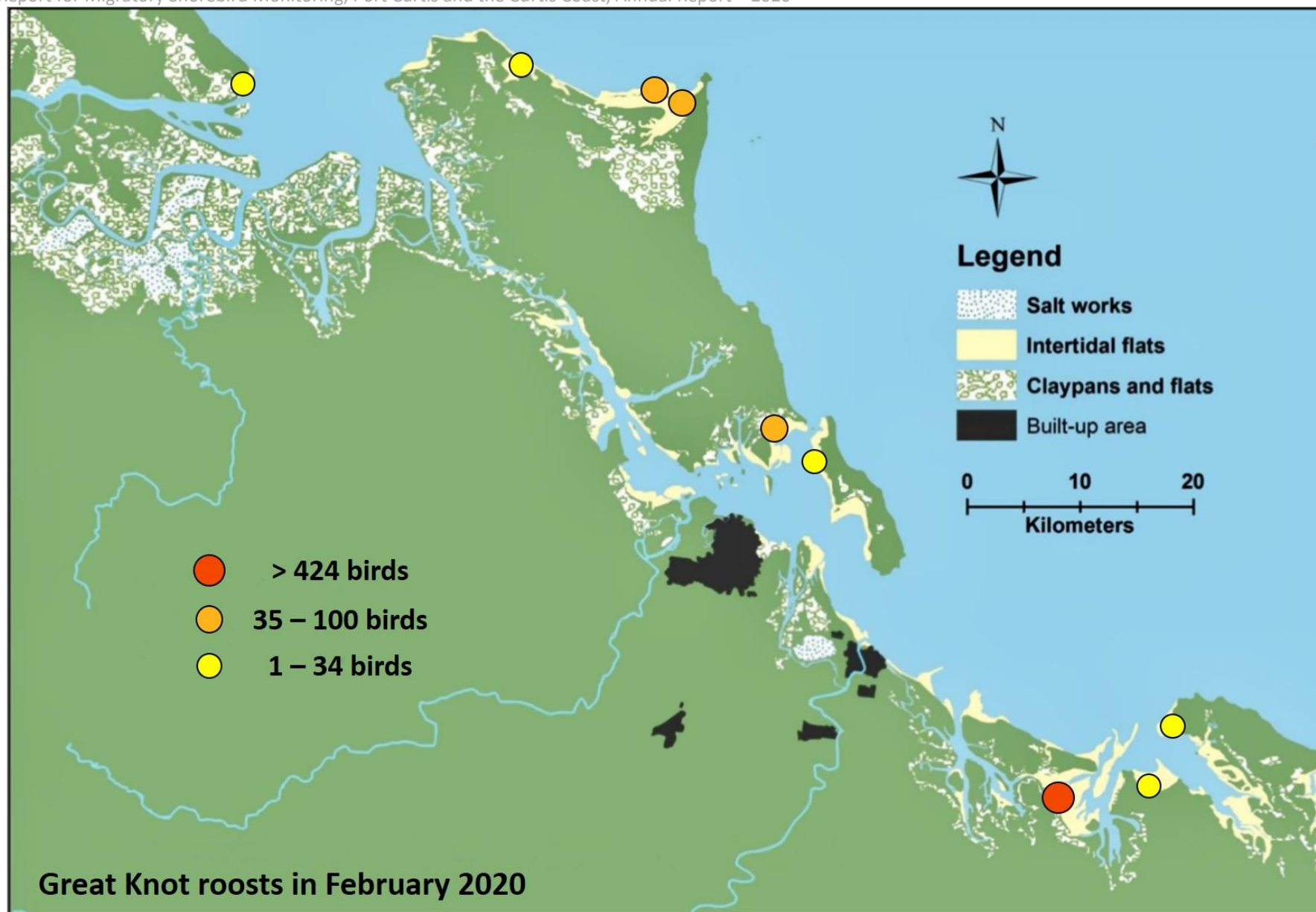


Figure A6 The high tide roost sites utilised by Great Knot on the Curtis Coast in February 2020. Sites of national significance are depicted in red. There were no counts between 100 and 424 birds.

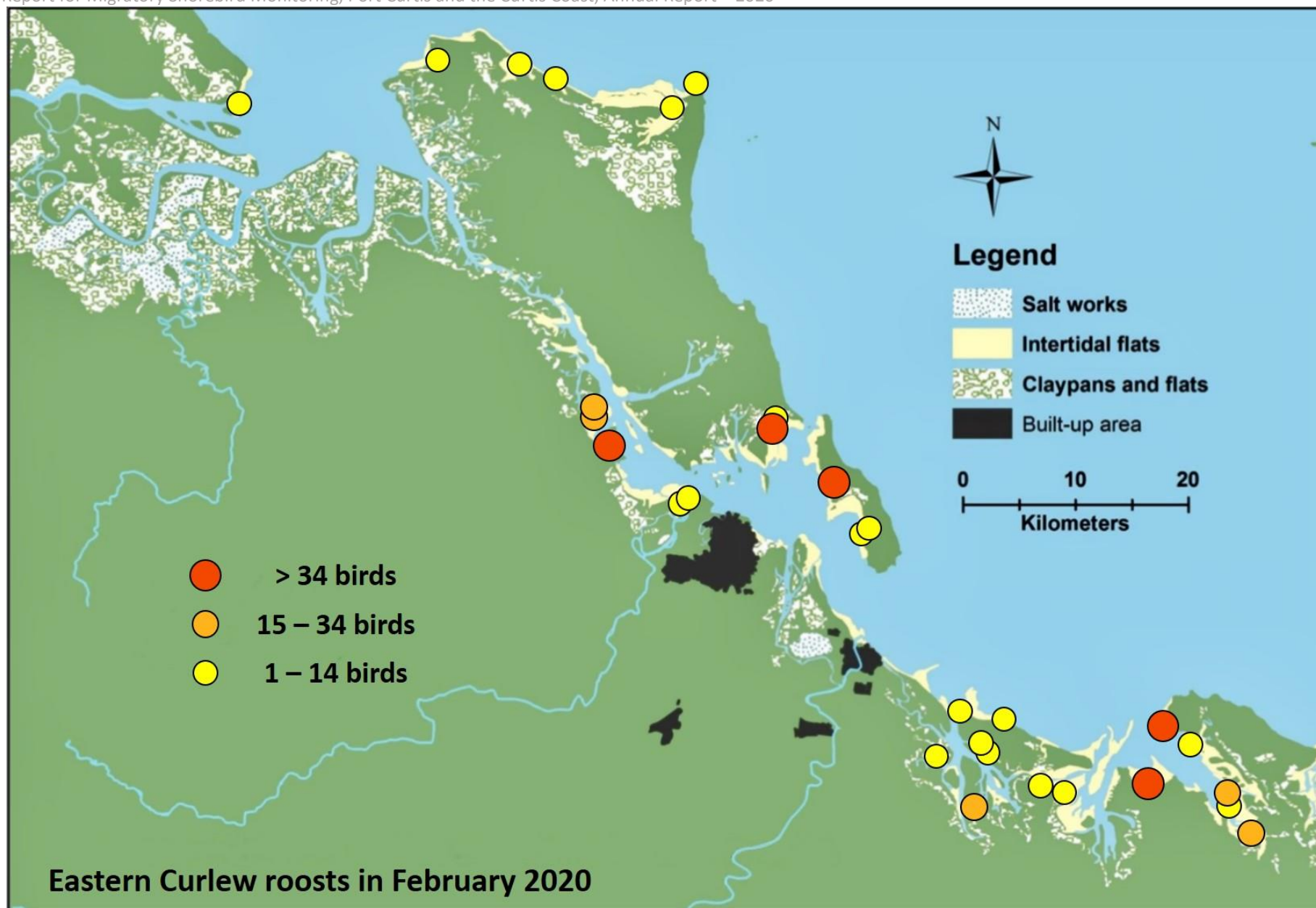


Figure A7 The high tide roost sites utilised by Eastern Curlew on the Curtis Coast in February 2020. Sites of national significance are depicted in red.

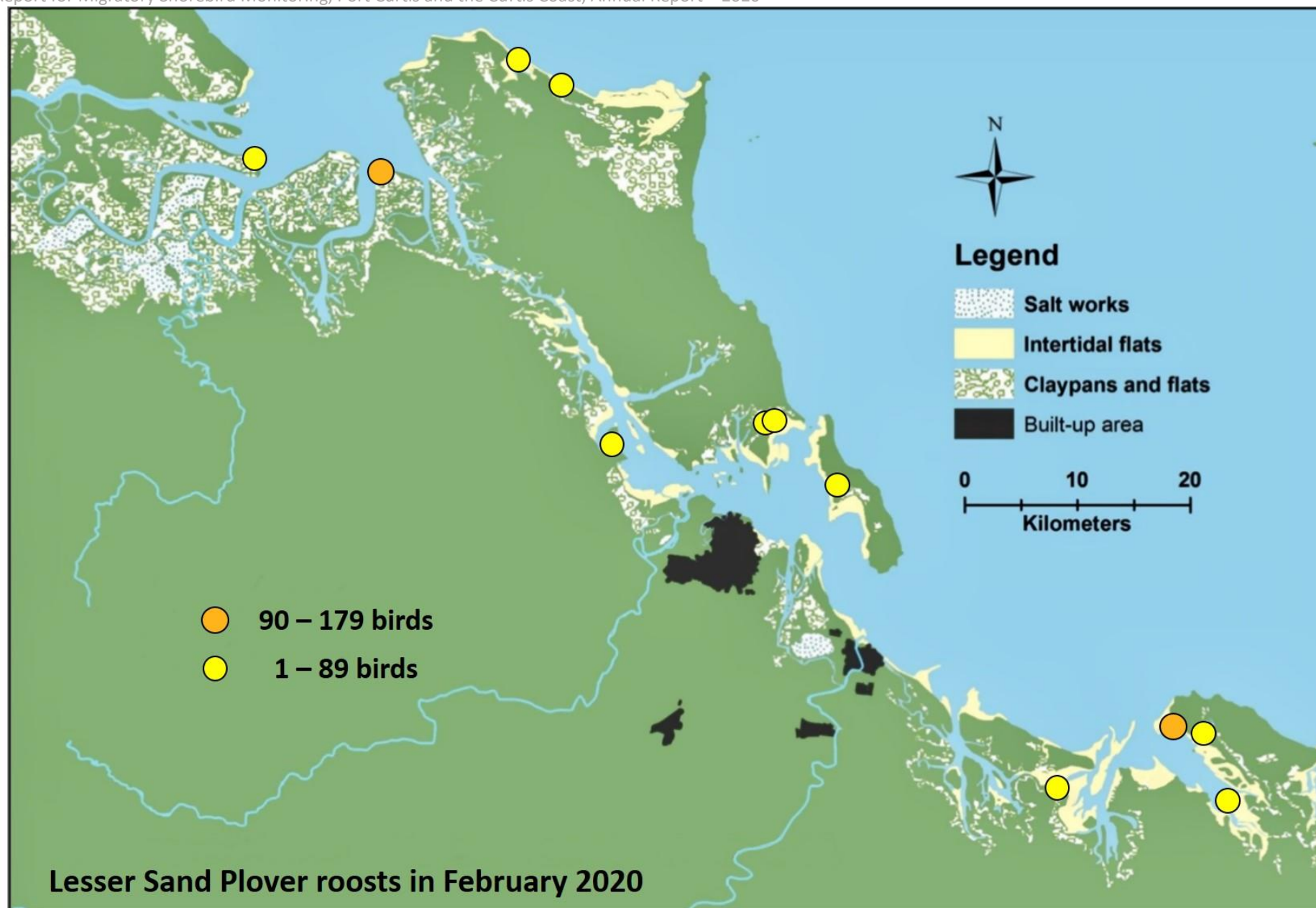


Figure A8 The high tide roost sites utilised by Lesser Sand Plover on the Curtis Coast in February 2020.

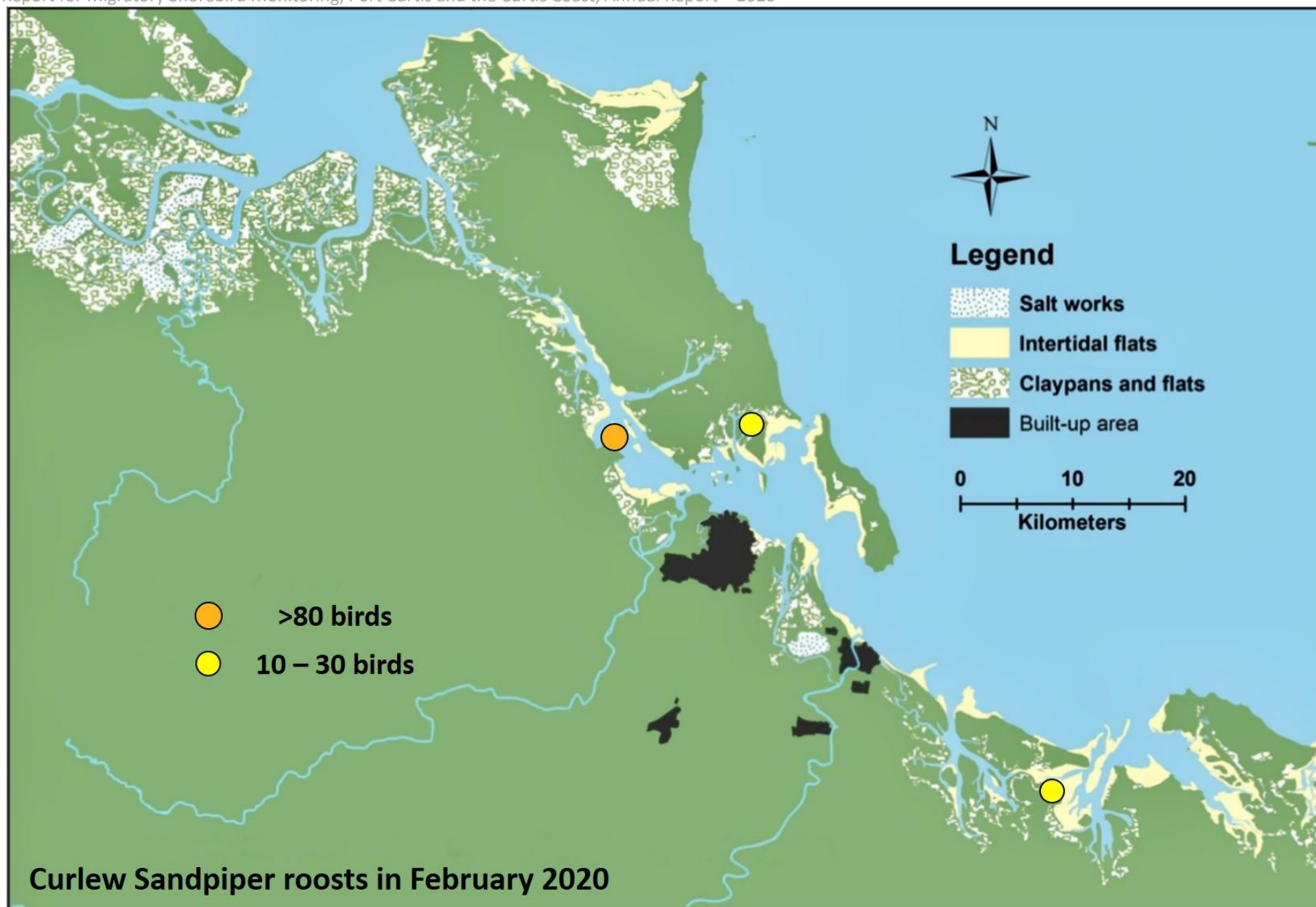


Figure A9 The high tide roost sites utilised by Curlew Sandpiper on the Curtis Coast in February 2020.

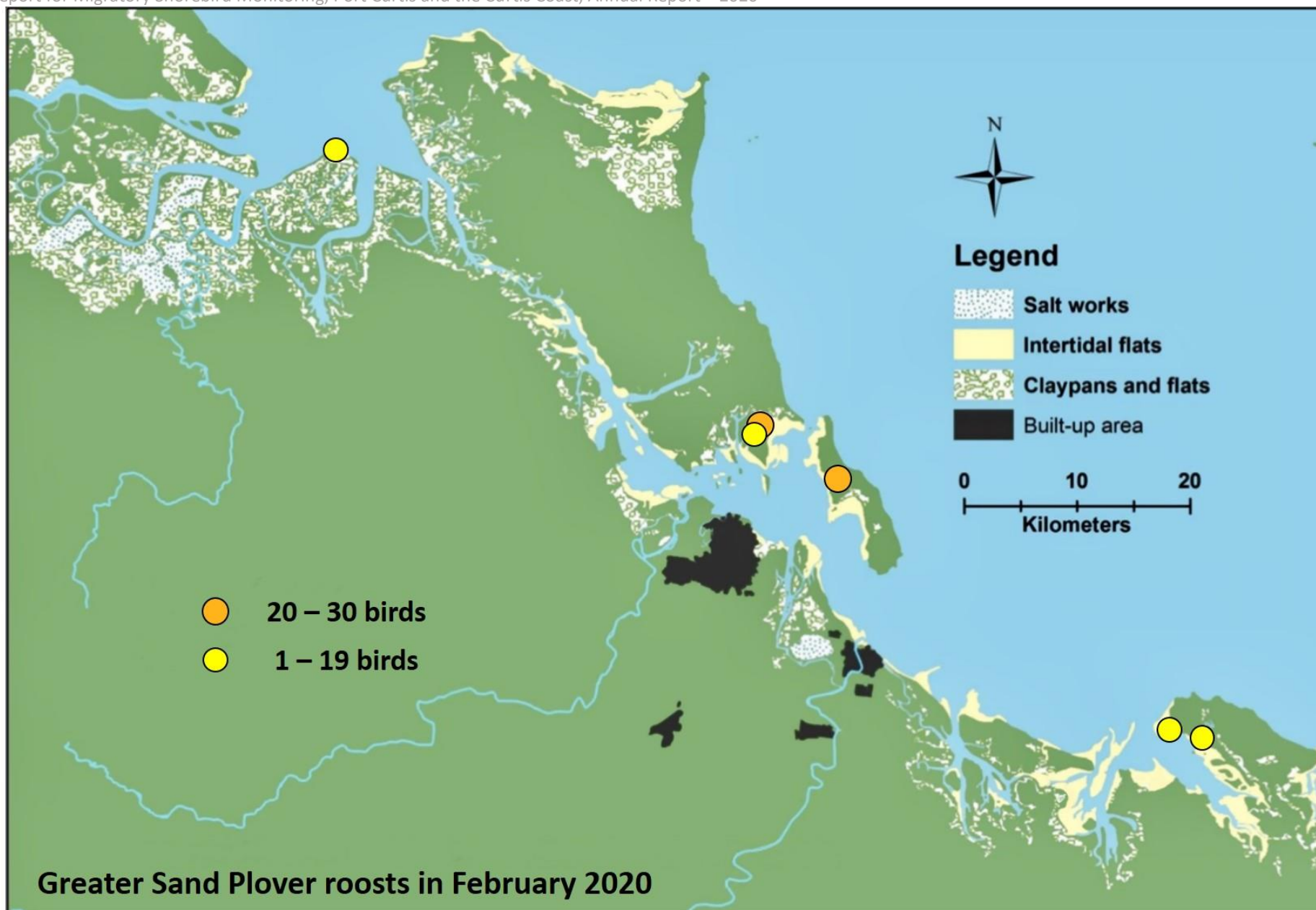


Figure A10 The high tide roost sites utilised by Greater Sand Plover on the Curtis Coast in February 2020.

Appendix 4: Map of ERMP Bioregion

