QLD WADER STUDY GROUP

2020/21

Port of Brisbane shorebird monitoring

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Queensland Wader Study Group

Port of Brisbane shorebird monitoring annual report 2020/21

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Cover image:

Mixed flock of nine shorebird species feeding and roosting in Port of Brisbane reclamation area pond: Eva Plaganyi-Lloyd, QWSG.

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EXECUTIVE SUMMARY

BACKGROUND

For over 30 years, Port of Brisbane (Port) lands on Fisherman Island have been used as high tide roosting habitat by large numbers of shorebirds, mostly migratory shorebirds but also resident shorebirds. Since 2003, the QWSG has been commissioned by Port of Brisbane Pty Ltd to undertake regular (typically monthly) counts of birds at roost sites on Fisherman Island. This is the eighth annual report since 2013 to present the results of the shorebird monitoring activities of the QWSG at the Port of Brisbane and covers the period September 2020 to August 2021.

OBJECTIVES

The specific objectives of this report are to:

- Provide a summary of bird numbers by species and site (individually and overall) at the Port for 2020/21, presented as a table of raw numbers and suitable graph(s).
- Quantify the relative importance of the Port for supporting roosting shorebirds in Moreton Bay by comparing total Port counts with the total Moreton Bay count.
- Present annual changes in shorebird numbers by species for each roost site within the Port.
- Analyse longer-term trends of shorebird numbers at the Port by species.
- Provide a summary of shorebird banding activities at the Port.

STUDY APPROACH

Ten counts were conducted over the period September 2020 to August 2021 at eleven roost sites on Fisherman Island that were used by shorebirds. During each count, QWSG volunteers recorded the total number of individuals for each species observed at each site within a 2-hour period, approximately an hour either side of high tide. Birds were observed through high-powered spotting telescopes mounted on sturdy tripods. Any movement of birds between count sites during the count were noted and communicated between counting teams to avoid double-counting. Two visits to capture and band shorebirds were made.

KEY RESULTS

Monthly shorebird counts

The total migratory shorebird count ranged between 4330 and 6577 birds during the south migration period (September to mid-November), between 4360 and 8884 birds during the non-breeding period (mid-November to mid-March), between 1205 and 1480 during the north migration period (mid-March to May) and 1085 during a single count in July during the northern hemisphere breeding period (June to August). The total resident shorebird count ranged between 87 and 1289 birds. Five of the eleven Port sites supported 95% of the total migratory shorebirds overall: reclamation area ponds C3, R3, BS3, FPE and the claypan, with ponds C3 and R3 being the two most important, supporting 59% of migratory shorebirds. The claypan was the most important site for resident shorebirds, supporting 45% of the total resident shorebirds overall, with reclamation area ponds C4 and BS3 the next most important. The artificial roost supported 1.7% of migratory shorebirds and 5.4% of resident shorebirds overall. A total of 21 migratory shorebird species and seven resident shorebird species were recorded at the Port.

Annual variation in shorebird counts

There is no evidence of a substantive change in either overall migratory shorebird numbers or resident shorebird numbers roosting at the Port over the 18-year period 2003-2020. Similarly, the average counts through the austral summer non-breeding period (mid-November to mid-March) for each of the 12 most important species have been variable between 2003 and 2020, with little evidence of any long-term increase or decline. Yet, three of the four Red-necked Stint

non-breeding period counts in 2020 were below the critical threshold, suggesting numbers of this species may have declined significantly in recent years, particularly since the average non-breeding period counts over the past three years have been amongst the lowest recorded for the species.

Roost site rankings

The relative rankings of the eleven Port roost sites have not varied appreciably over the past four years. In 2020, reclamation pond C3 (PBC3) overtook pond R3 (PBR3) as the highest-ranked site supporting the most migratory shorebirds through the shorebird year. Reclamation pond BS3 (PBS3) also became substantially more important than it has been in previous years as fresh dredge spoil was pumped into this pond. By contrast, reclamation pond BS2 (PBS2) became substantially less important as this area was filled in with dry sand during this count period.

Comparison with Moreton Bay as a whole

During 2020/21, the Index of Relative Importance (IRI) for the Port was highest for Curlew Sandpiper, with an average of 79% of the Moreton Bay total numbers of this species using the Port, and lowest for Bar-tailed Godwit, with an average of 12% of the Moreton Bay total using the Port. Relative to 2019, the IRI increased for seven species, decreased for four species and remained unchanged for one species in 2020/21, with a slight increase from 0.44 to 0.46 in the average across all 12 important species.

Shorebird banding

Two visits to band shorebirds resulted in a total of 49 birds of eight different species being caught and banded for the first time as well as three recaptures. Two Bar-tailed Godwits fitted with Platform Terminal Transmitter (PTT) satellite tracking devices provided a wealth of data on local movements between roosting and feeding sites in the vicinity of the Port as well as the full migration track of one bird from its location at the Port to its breeding grounds in northern Alaska and back again. There were 26 shorebird flag re-sightings at the Port, including two birds banded in China, two birds banded in Japan and one bird banded in Victoria.

RECOMMENDATIONS

Port of Brisbane Pty Ltd is encouraged to continue to prioritise the management and monitoring of shorebirds at the Port. Satellite tracking of birds using the Port should be continued in tandem with the ongoing monthly count monitoring of the Port roost sites and the alternative roosts in the local region to develop a better understanding of the movement of birds between the Port and alternative roost sites in the local region and potential constraints, for example temporal variation in roost suitability due to tide cycles and disturbance. Such information is important for predicting the impacts on shorebirds of the eventual loss of the Port reclamation area for roosting once the area becomes fully reclaimed.

There is also a need to continue to explore opportunities to provision habitat for shorebirds within or adjacent to Port lands to compensate for the expected future loss of roosting habitat in the reclamation area. In this regard, Port of Brisbane Pty Ltd could advocate for such an outcome together with other interested and relevant stakeholders and regulators. Planning to provide adequate shorebird habitat in Moreton Bay into the future is required to manage the increasing pressures on shorebirds from the continued growth and development of Brisbane and the anticipated future loss of roosting habitat in the Port reclamation area.

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Glossary of Terms and Abbreviations

EAAF	East Asian Australasian Flyway
Port	Port of Brisbane
QWSG	Queensland Wader Study Group

1.0 INTRODUCTION

1.1 BACKGROUND

For over 30 years, Port of Brisbane (Port) lands on Fisherman Island have been used as high tide roosting habitat by large numbers of shorebirds, mostly migratory shorebirds but also resident (non-migratory) shorebirds. The birds roost mostly along the edges of shallow ponds or adjacent open expanses of drying mud that have been created by pumping of dredge material as infill for ongoing reclamation. Fewer birds roost on the crest or inside of the outer rock bund wall. The birds respond dynamically to changing configurations of suitable habitat as the reclamation has progressed.

The Queensland Wader Study Group (QWSG) has monitored shorebirds at the Port from as early as 1991, when three consecutive years of monitoring were commissioned by the Port of Brisbane Corporation during the initial major development works that led to the creation of the current dredge reclamation area (Driscoll 1992, 1993, 1994). Since 2003, the QWSG has been commissioned by Port of Brisbane Pty Ltd to undertake regular (typically monthly) counts of birds on Port lands within the reclamation area, a purpose-built shorebird roost site (PBAR) and a nearby claypan (FICP) on Fisherman Island (**Figure 1.1**). At the same time, QWSG members have also regularly counted between 50 and 65 other high tide roosts in Moreton Bay, to monitor shorebird numbers throughout Moreton Bay more broadly (Fuller *et al.* 2019).

Starting in 2007, the QWSG has included the Port of Brisbane in a network of locations around Moreton Bay where shorebirds are captured to be fitted with numbered metal bands and engraved green leg flags. The leg flags are engraved with a unique combination of letters and numbers that can be read from a distance and allows each bird to be individually identified without the need to re-capture it. Furthermore, some birds have been fitted with small Platform Terminal Transmitter (PTT) satellite tracking devices to track their local and migratory movements. This contributes to a national and global programme that seeks to better understand the annual survival and movements of shorebirds both within Moreton Bay and on their migration through the East Asian Australasian Flyway (EAAF, or Flyway) to their breeding grounds in the northern hemisphere.

This is the eighth annual report since 2013 to present the results of the shorebird monitoring activities of the QWSG at the Port of Brisbane and covers the period September 2020 to August 2021.

1.2 OBJECTIVES

The specific objectives of this report are to:

- Provide a summary of bird numbers by species and site (individually and overall) at the Port for 2020/21, presented as a table of raw numbers and suitable graph(s).
- Quantify the relative importance of the Port for supporting roosting shorebirds in Moreton Bay by comparing total Port counts with the total Moreton Bay count.
- Present annual changes in shorebird numbers by species for each roost site within the Port.
- Analyse longer-term trends of shorebird numbers at the Port by species.
- Provide a summary of shorebird banding activities at the Port.

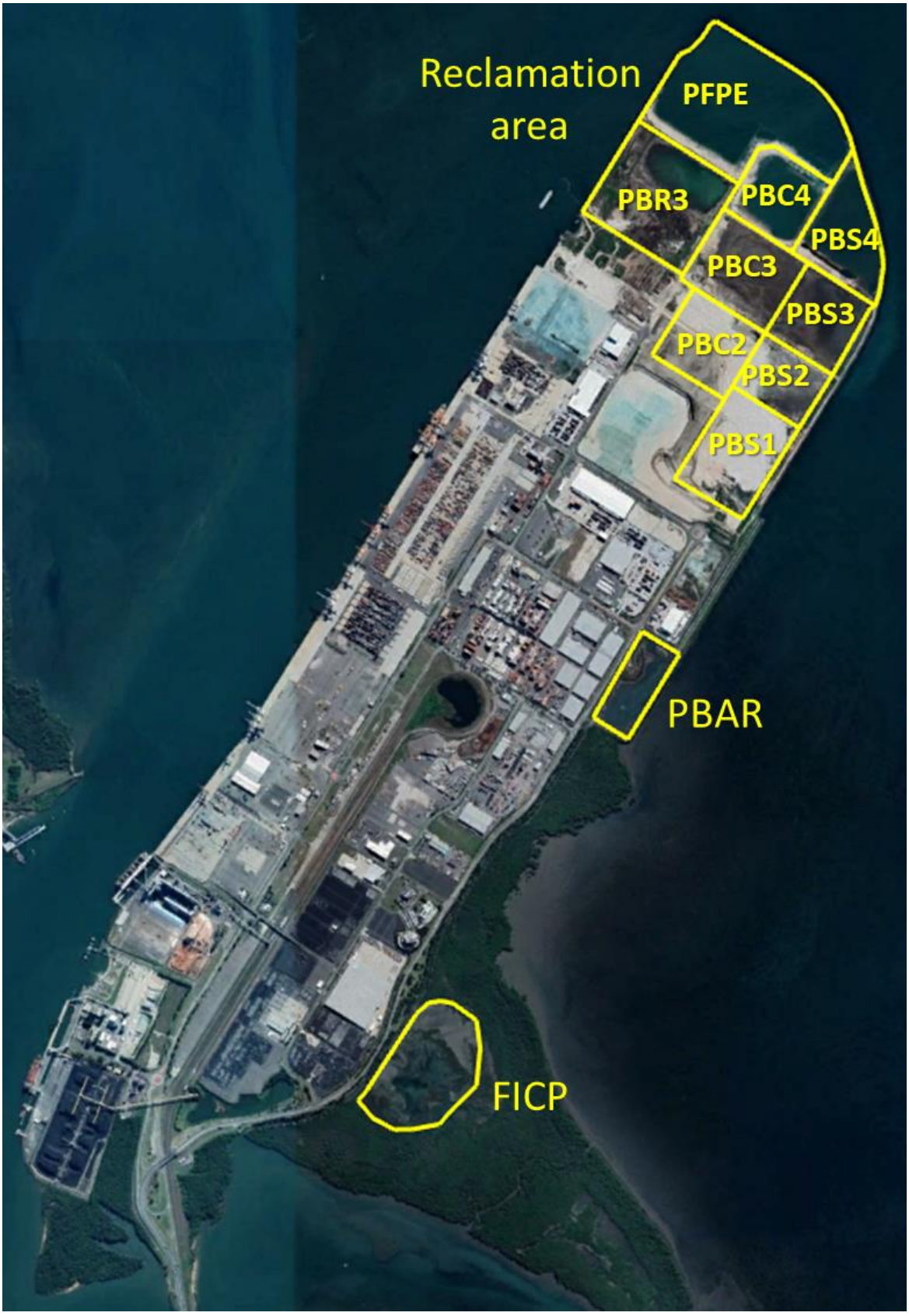

Figure 1.1. *Locations of shorebird count sites on Fisherman Island at Port of Brisbane in 2020/21, including nine sites within the reclamation area, a purpose-built shorebird roost site (PBAR) and a nearby claypan (FICP).*

2.0 MONITORING APPROACH

The annual monitoring involved two main activities: monthly counts; and irregular shorebird banding.

2.1 MONTHLY SHOREBIRD COUNTS

Ten counts were conducted within the reporting period (**Table 2.1**); no counts were done in June and August 2021 due to Covid restrictions. During 2020/21, eleven roost sites on Fisherman Island were used by shorebirds: nine within the reclamation area; a purpose-built shorebird roost site (PBAR); and a nearby claypan (FICP; **Figure 1.1**). QWSG count volunteers generally met on site 1.5 hours before high tide to be briefed and assigned to one or more count sites in teams of at least two members. Each team then proceeded to record the total number of individuals for each species observed within their assigned sites within a 2-hour period, approximately an hour either side of high tide. Birds were observed through high-powered spotting telescopes mounted on sturdy tripods. Any movement of birds between count sites during the count were noted and communicated between teams to avoid double-counting.

Monthly counts were also conducted at Lytton Claypan No. 1, a roost site on land managed by Port of Brisbane Pty Ltd just south of Fisherman Island. However, the results for this site are not included in the total Port counts and analyses reported in the following sections.

Counts were allocated to one of four periods that characterise the annual cycle of a typical migratory shorebird as follows:

- Breeding (the northern hemisphere breeding season or austral winter months June to August);
- South Migration (September to mid-November);
- Non-breeding (the austral summer months mid-November to mid-March); and
- North Migration (mid-March to May).

Table 2.1. *Count dates and high tide (HT) details during the September 2020 to August 2021 reporting period.*

Shorebird activity period	Date	HT height (m)	HT time
South migration	20/09/2020	2.30	11:36
South migration	18/10/2020	2.46	10:30
South migration	08/11/2020	2.11	14:52
Non-breeding	06/12/2020	2.28	13:28
Non-breeding	17/01/2021	2.38	12:25
Non-breeding	14/02/2021	2.43	11:19
Non-breeding	14/03/2021	2.38	10:16
North migration	11/04/2021	2.27	09:12
North migration	09/05/2021	2.13	07:59
Breeding	18/07/2021	2.03	16:24

2.2 SHOREBIRD BANDING AND FLAG RESIGHTING

Shorebirds were captured using mist nets at night or cannon-nets during the day. Trapped birds were removed, placed in a cloth bag and taken to a banding station out of sight of the nets, for processing. Each bird was fitted with an engraved metal band (supplied by the Australian Bird and Bat Banding Scheme) on the left tarsus and an engraved green leg flag on the right tibia. All flags

used were dark green and engraved with a combination of 2-3 letters or numbers, stained white to contrast with the green background. Birds were also measured and weighed to assist with ageing and sexing. During the monthly counts, the details of any birds carrying engraved leg flags were recorded opportunistically when the flag combinations were able to be read.

2.3 IMPORTANT MIGRATORY SHOREBIRD SPECIES AT THE PORT OF BRISBANE

Twelve migratory shorebird species are a particular focus of the monitoring at the Port of Brisbane (**Table 2.2**). The 12 species have all been recorded at some time or another on Fisherman Island in numbers exceeding 0.2 % of the total Flyway population size, and often in numbers exceeding 1% of the Flyway population (**Table 2.1**). Note that a site is considered internationally or nationally significant for a species if the population at the site exceeds >1% or > 0.1% of the total Flyway population size respectively (Bamford *et al.* 2008).

Table 2.2. *Maximum summer counts of 12 important species at the Port of Brisbane on Fisherman Island also expressed as the percentage of the total population size in the EAAF (Hansen et al. 2016) and their frequency of occurrence in all counts between September 2003 and August 2020, including all seasons not just summer.*

Species	Maximum count since 2003 (% flyway population)	Year of maximum	Frequency (% of all surveys)
Grey-tailed Tattler	1434 (2.0)	2019	91
Red-necked Stint	6803 (1.4)	2003	100
Lesser Sand Plover	2433 (1.4)	2003	91
Curlew Sandpiper	2607 (2.9)	2017	99
Sharp-tailed Sandpiper	2078 (2.4)	2005	87
Far Eastern Curlew	670 (1.2)	2006	91
Pacific Golden Plover	1219 (1.0)	2019	88
Great Knot	708 (0.2)	2013	74
Greater Sand Plover	441 (0.2)	2006	74
Ruddy Turnstone	213 (0.7)	2016	89
Bar-tailed Godwit	1572 (0.5)	2019	96
Grey Plover	145 (0.2)	2007	68

2.4 ANALYSIS

To determine the relative importance of the different sites within the Port to migratory shorebirds, each of the 11 sites (PBAR, FICP and nine sites within the reclamation area) were ranked (1 to 11, from highest to lowest values) for each of:

- the total number of migratory shorebirds recorded for the shorebird year (September to August);
- the average number of migratory shorebird species recorded for the shorebird year; and
- an average rank for each site based upon individual site rankings for the total birds counted throughout the shorebird year for each of the 12 important species (**Appendix A**).

The average of these three rankings was used as a measure of the relative importance of the site to migratory shorebirds during the shorebird year. The lower the ranking the higher the importance of the site for migratory shorebirds.

To assess the relative importance of the Port to the 12 important migratory shorebird species listed in **Table 2.1**, an Index of Relative Importance (IRI) was calculated for each species as the ratio of the total Port count to the whole of Moreton Bay count (refer to **Appendix E** for a list of sites used) averaged across all counts from September to April inclusive using the equation:

$$\mathrm{IRI} = \frac{1}{n}\sum_{i=1}^{n}\frac{PortofBrisbaneCount_i}{MoretonBayCount_i}$$

Where *n* = the total number of counts and *i* = the *i* th count.

2.5 PERMITS AND APPROVALS

All QWSG field activities were carried out in accordance with scientific purposes permits WISP16744415 and WA0032220, Moreton Bay Marine Park Permit QS2007/CVL1337A and Animal Ethics Approvals CA 2018-02-1159 and CA 2020-11-1435.

3.0 RESULTS AND DISCUSSION

3.1 MONTHLY SHOREBIRD COUNTS 2020/21

The total counts of both migratory and resident (non-migratory) shorebirds at each site each month between September 2020 and August 2021 are summarised in **Table 3.1**. The total migratory shorebird count ranged between 4330 and 6577 birds during the south migration period (September to mid-November), between 4360 and 8884 birds during the non-breeding period (mid-November to mid-March), between 1205 and 1480 during the north migration period (mid-March to May) and 1085 during a single count in July during the northern hemisphere breeding period (June to August). The total resident shorebird count ranged between 87 and 1289 birds (**Table 3.1**).

Five of the eleven Port sites supported 95% of the total migratory shorebirds overall: reclamation area ponds C3, R3, BS3, FPE and the claypan, with ponds C3 and R3 being the two most important, supporting 59% of migratory shorebirds (**Table 3.1**). The claypan was the most important site for resident shorebirds, supporting 45% of the total resident shorebirds overall, with reclamation area ponds C4 and BS3 the next most important. The artificial roost supported 1.7% of migratory shorebirds and 5.4% of resident shorebirds overall.

A total of 21 migratory shorebird species and seven resident shorebird species were recorded at the Port (**Appendix B**). The number of migratory and resident shorebird species recorded at each of the eleven Port roost sites on each count are summarised in **Table 3.2**.

Counts for each of the 12 important species for each site and month during the past year are given in **Appendix A**. **Appendix B** outlines the monthly totals across all Port sites for all shorebird species, not just the twelve important species.

The results of the monthly counts at Lytton Claypan No. 1 are summarised in **Appendix F**.

Table 3.1. *Total counts of both migratory and resident shorebirds at each site each month between September 2020 and August 2021. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Total migratory shorebirds													
Pond C3	PBC3	85	1250	1368	4999	1663	2298	4314	476		540	**16993**	35.9%
Pond R3	PBR3	3378	1640	1448	1842	1331	770	260	23	1	3	**10696**	22.6%
Pond BS3	PBS3		169	56	1052	1215	974	2450		2	15	**5933**	12.5%
Pond FPE	PFPE	210	760	2129	917	1279	1	8	372	103		**5779**	12.2%
Claypan	FICP	511	1	875	4	209	139	1459	319	1356	501	**5374**	11.4%
Artificial roost	PBAR	10	136	544	9	48	37	24	3			**811**	1.7%
Pond BS2	PBS2	13		2	33	425	97		10	18	20	**618**	1.3%
Pond C2	PBC2			41		480			2			**523**	1.1%
Pond BS4	PBS4	116	129	69	28	16	43	43			2	**446**	0.9%
Pond C4	PBC4	7		45		2		38			4	**96**	0.2%
Pond BS1	PBS1		8			10						**18**	0.0%
	Total	**4330**	**4093**	**6577**	**8884**	**6678**	**4360***	**8596**	**1205**	**1480**	**1085**	**47288**	
Total resident shorebirds													
Claypan	FICP	9	5	10	7	14	6	18	14	1086	634	**1803**	44.8%
Pond C4	PBC4			1	73	165	166	102	82		7	**596**	14.8%
Pond BS3	PBS3	1		6	13	2	1		7	2	389	**421**	10.5%
Pond BS2	PBS2	27	35	1	9	19	21	1	48	72	6	**239**	5.9%
Pond C3	PBC3	4	14	11		9	22	19	31	1	126	**237**	5.9%
Artificial roost	PBAR	8	32	20	53	23	12	8	13	4	46	**219**	5.4%
Pond FPE	PFPE	37	25	11	4	3	2	15		71	34	**202**	5.0%
Pond R3	PBR3	24	4	6	12	12	12	15	7	5	43	**140**	3.5%
Pond BS4	PBS4	5	7	12			18	58	3	1	4	**108**	2.7%
Pond C2	PBC2	1	1	8	2	3	5	4	7	3		**34**	0.8%
Pond BS1	PBS1	1	6	1	4	3	3		4	4		**26**	0.6%
	Total	**117**	**129**	**87**	**177**	**253**	**268**	**240**	**216**	**1249**	**1289**	**4025**	

* Includes one Ruddy Turnstone recorded at the Lucinda Drive drain.

Table 3.2. *Total number of species of both migratory and resident shorebirds at each site each month between September 2020 and August 2021.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding
Total migratory shorebird species											
Claypan	**FICP**	8	1	4	1	6	5	6	5	8	4
Artificial roost	**PBAR**	3	9	8	5	6	4	2	1		
Pond C2	**PBC2**			4		6			1		
Pond C3	**PBC3**	5	6	8	7	9	11	12	5		6
Pond C4	**PBC4**	1		3		1		3			2
Pond R3	**PBR3**	7	12	9	8	10	4	5	1	1	1
Pond BS1	**PBS1**		3			3					
Pond BS2	**PBS2**	1		1	1	5	2		2	3	1
Pond BS3	**PBS3**		5	4	6	12	11	12		1	1
Pond BS4	**PBS4**	2	4	6	3	4	6	6			1
Pond FPE	**PFPE**	4	5	5	2	2	1	1	2	2	
Total resident shorebird species											
Claypan	**FICP**	3	1	1	2	2	2	2	4	4	4
Artificial roost	**PBAR**	2	6	4	4	3	2	2	4	2	3
Pond C2	**PBC2**	1	1	2	1	1	1	1	1	1	
Pond C3	**PBC3**	1	2	1		1	1	1	1	1	2
Pond C4	**PBC4**			1	1	2	1	1	1		1
Pond R3	**PBR3**	2	1	2	1	1	1	1	1	2	3
Pond BS1	**PBS1**	1	1	1	1	1	1		1	3	
Pond BS2	**PBS2**	1	1	1	1	1	1	1	1	1	2
Pond BS3	**PBS3**	1		1	1	1	1		3	1	2
Pond BS4	**PBS4**	2	1	3			2	1	2	1	2
Pond FPE	**PFPE**	2	1	1	1	1	1	2		2	2

A record high count for one species was recorded during the 2020 shorebird year, namely a count of 248 Ruddy Turnstone, corresponding to 0.8% of the species' total Flyway population (**Table 3.3**). The previous highest total count of Ruddy Turnstone at the Port was a count of 213 in 2016 (**Table 2.1**).

Table 3.3. *Maximum summer counts of 12 important species at the Port of Brisbane also expressed as the percentage of the total population size in the EAAF (Hansen et al. 2016) and their frequency of occurrence in all counts between September 2003 and August 2021, including all seasons not just summer.*

Species	Maximum count for 2020	Maximum count since 2003 (% flyway population)	Year of maximum	Frequency (% of all surveys)
Grey-tailed Tattler	1167	1434 (2.0)	2019	91
Red-necked Stint	2843	6803 (1.4)	2003	100
Lesser Sand Plover	2053	2433 (1.4)	2003	92
Curlew Sandpiper	2041	2607 (2.9)	2017	100
Sharp-tailed Sandpiper	506	2078 (2.4)	2005	87
Far Eastern Curlew	246	670 (1.2)	2006	91
Pacific Golden Plover	792	1219 (1.0)	2019	88
Great Knot	406	708 (0.2)	2013	74
Greater Sand Plover	305	441 (0.2)	2006	74
Ruddy Turnstone	248	248 (0.8)	2020	89
Bar-tailed Godwit	1075	1572 (0.5)	2019	97
Grey Plover	37	145 (0.2)	2007	68

3.2 ANNUAL VARIATION IN SHOREBIRD COUNTS AT THE PORT OF BRISBANE

Total migratory shorebird numbers roosting at the Port have shown the expected cyclical pattern of increasing during the south migration period (September to mid-November, generally reaching peak numbers in the late south migration period or through the non-breeding period (mid-November to mid-March), before decreasing again during the north migration period (mid-March to May) to relatively low numbers during the northern hemisphere breeding period (**Figure 3.1**). Total resident shorebird numbers have been variable, both seasonally and inter-annually, but were generally higher at times when inland areas are dry, particularly through the winter months, when some resident shorebird species such as Pied Stilt and Red-necked Avocet appear in larger numbers along the coast (**Figure 3.1**). The counts for these two species increased substantially in May and July 2021 (**Appendix B**).

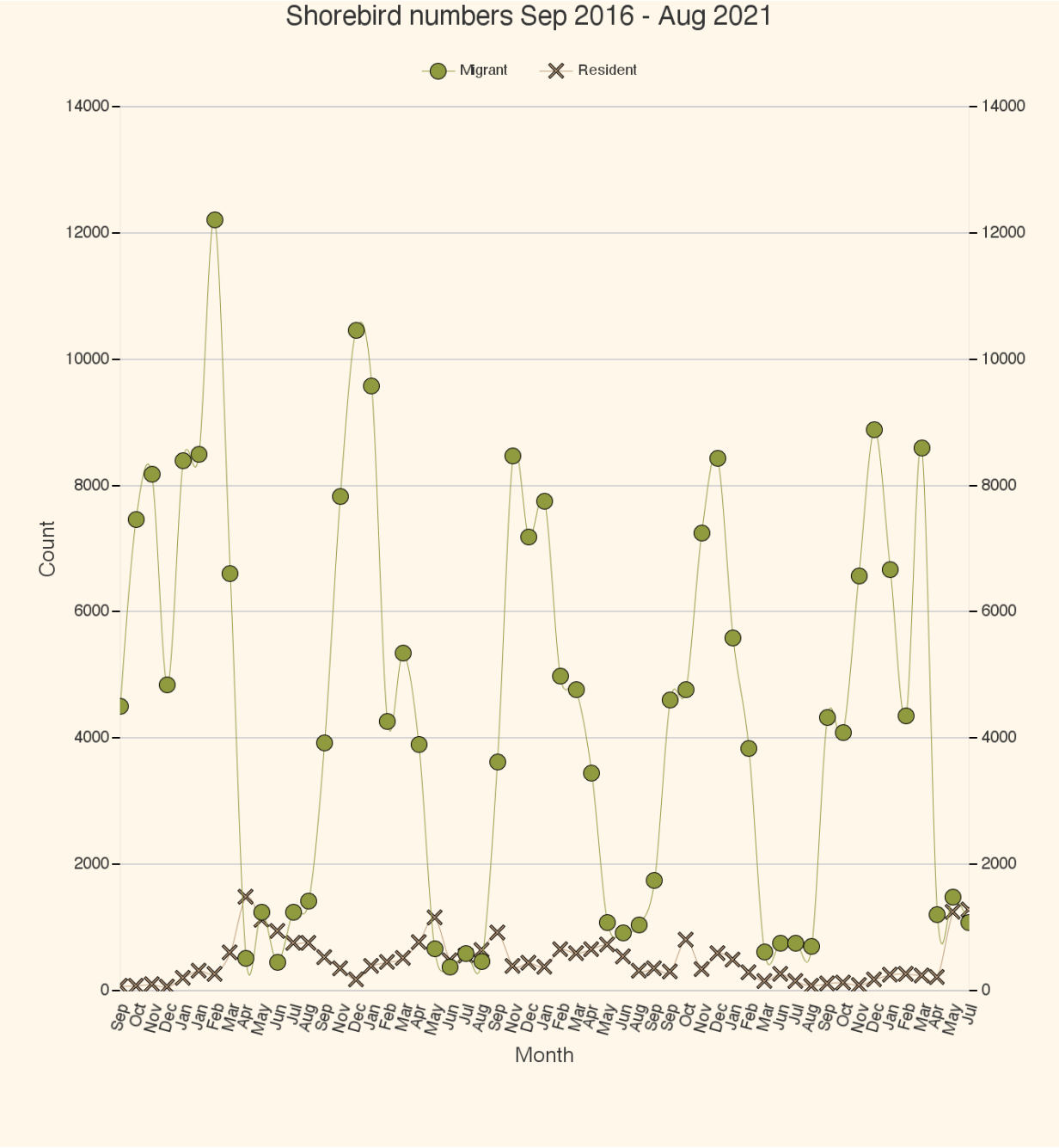

Figure 3.1. *Total migratory and total resident shorebird numbers by month between September 2016 and August 2021 (total monthly Port counts).*

The average total migratory shorebird counts during each of the breeding (June to August), non-breeding (mid-November to mid-March) and migration (September to mid-November and mid-March to May) periods have been variable between years, with no evidence of a temporal trend over the 18-year period 2003-2020 (**Figure 3.2**). The same appears to be the case for the maximum migratory shorebird count during the non-breeding period (**Figure 3.2**). Thus, there is no evidence of a substantive change in overall migratory shorebird numbers roosting at the Port over the 18-year period 2003-2020.

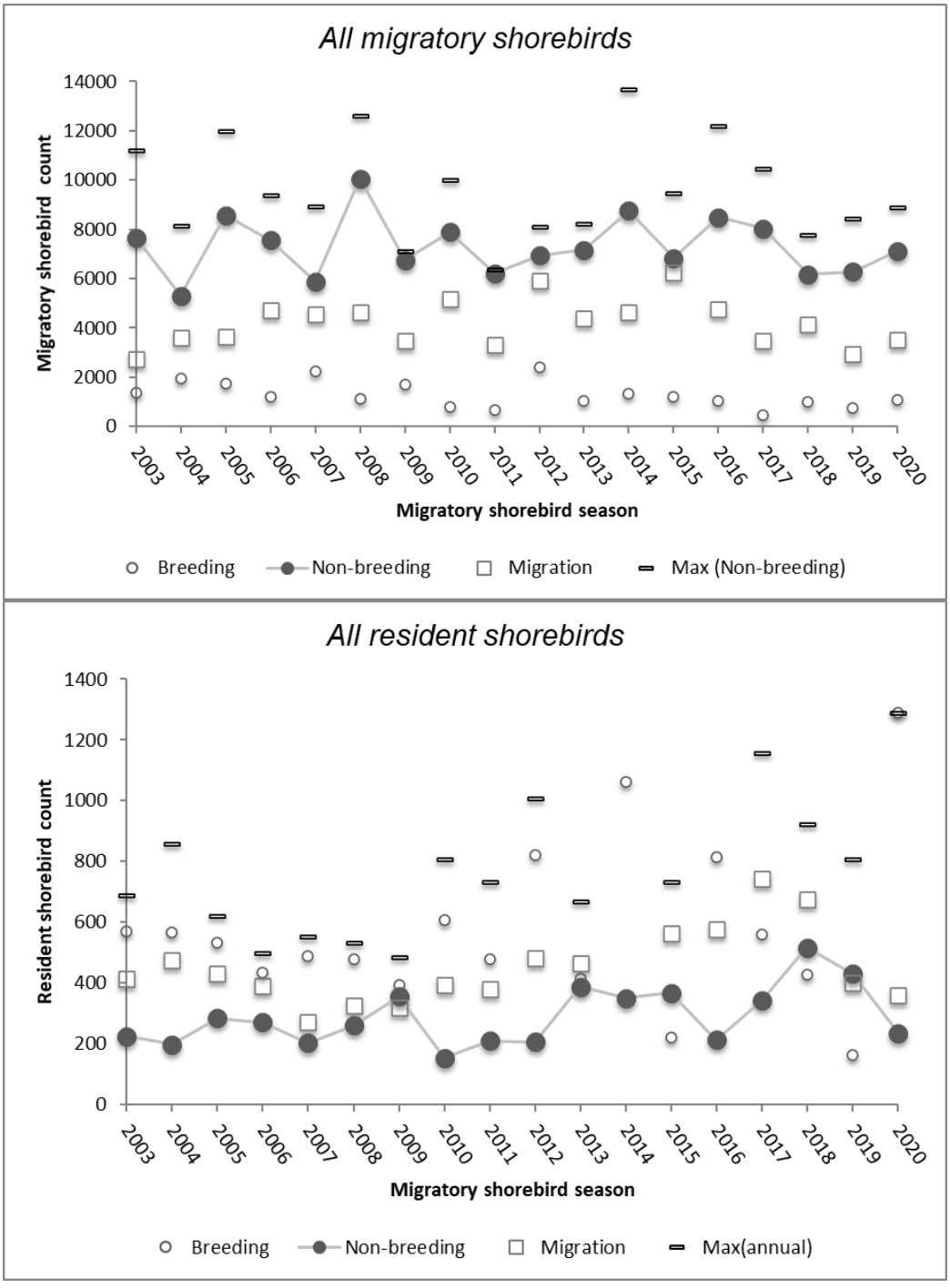

Figure 3.2. Average total Port counts for each migratory shorebird period and maximum (max) counts for each year (September to August) since 2003 for migratory shorebirds (top panel) and resident shorebirds (bottom panel). Migratory shorebird periods: breeding (June to August); non-breeding (mid-November to mid-March); and during migration (south: September to mid-November; north: mid-March to May).

Similarly, there was no evidence of a temporal trend in the average and maximum counts of resident shorebirds at the Port over the same 18-year period (**Figure 3.2**).

The average counts through the austral summer non-breeding period (mid-November to mid-March) for each of the 12 most important species have been variable between 2003 and 2020, with no clear evidence of a temporal trend in the average count for any species over this 18-year period (**Figures 3.3a** and **3.3b**).

Five of 48 (10%) non-breeding period counts across the 12 important species in 2020 were below the critical threshold values for the respective species that might indicate a significant decrease in the number of birds using the Port (**Table 3.4**); however, this frequency is within that expected by the 90% confidence intervals (see **Appendix D**). Three of the four Red-necked Stint counts were below the critical threshold, suggesting numbers of this species may have declined significantly in recent years, particularly since the average non-breeding period counts over the past three years have been amongst the lowest recorded for the species (**Figure 3.3b**). Similarly, three of the four Red-necked Stint counts were below the critical threshold in 2019 (Driscoll 2021). There is no evidence that the population of Red-necked Stint using Moreton Bay has declined; while one study reported a significant decline in the population visiting Australia (Clemens *et al.* 2016), another found no significant decline (Studds *et al.* 2016), and a third found a significant increase in the population within Moreton Bay (Wilson *et al.* 2011). This species commonly uses high-tide roosting habitats as feeding areas at high tide; consequently, the decrease in numbers using the Port may reflect a reduction in the suitability of the reclamation area ponds for Red-necked Stint foraging in recent years.

Table 3.4. *Comparison of summer counts for the 12 most important species with the lower 90% confidence limit threshold (in red; threshold values derived from either of two successive 8-year sampling blocks between 2003 and 2018; see **Appendix D**). The coloured cells indicate counts that fall below the threshold for that species.*

Species	Threshold	06-Dec-20	17-Jan-21	14-Feb-21	14-Mar-21	2020 mean	2013-2020 mean
Bar-tailed Godwit	*469*	1075	888	711	692	842	756
Curlew Sandpiper	*505*	1991	1057	840	2041	1482	1140
Far Eastern Curlew	*61*	246	65	174	117	151	134
Great Knot	*64*	406	156	54	126	186	185
Greater Sand Plover	*13*	305	32	68	166	143	114
Grey Plover	*15*	15	37	32	17	25	31
Grey-tailed Tattler	*291*	900	1167	0	499	642	623
Lesser Sand Plover	*673*	2053	974	722	856	1151	935
Pacific Golden Plover	*202*	359	546	361	792	515	389
Red-necked Stint	*1373*	1296	1115	612	2843	1467	2427
Ruddy Turnstone	*27*	46	248	214	205	178	82
Sharp-tailed Sandpiper	*137*	182	316	506	131	284	422

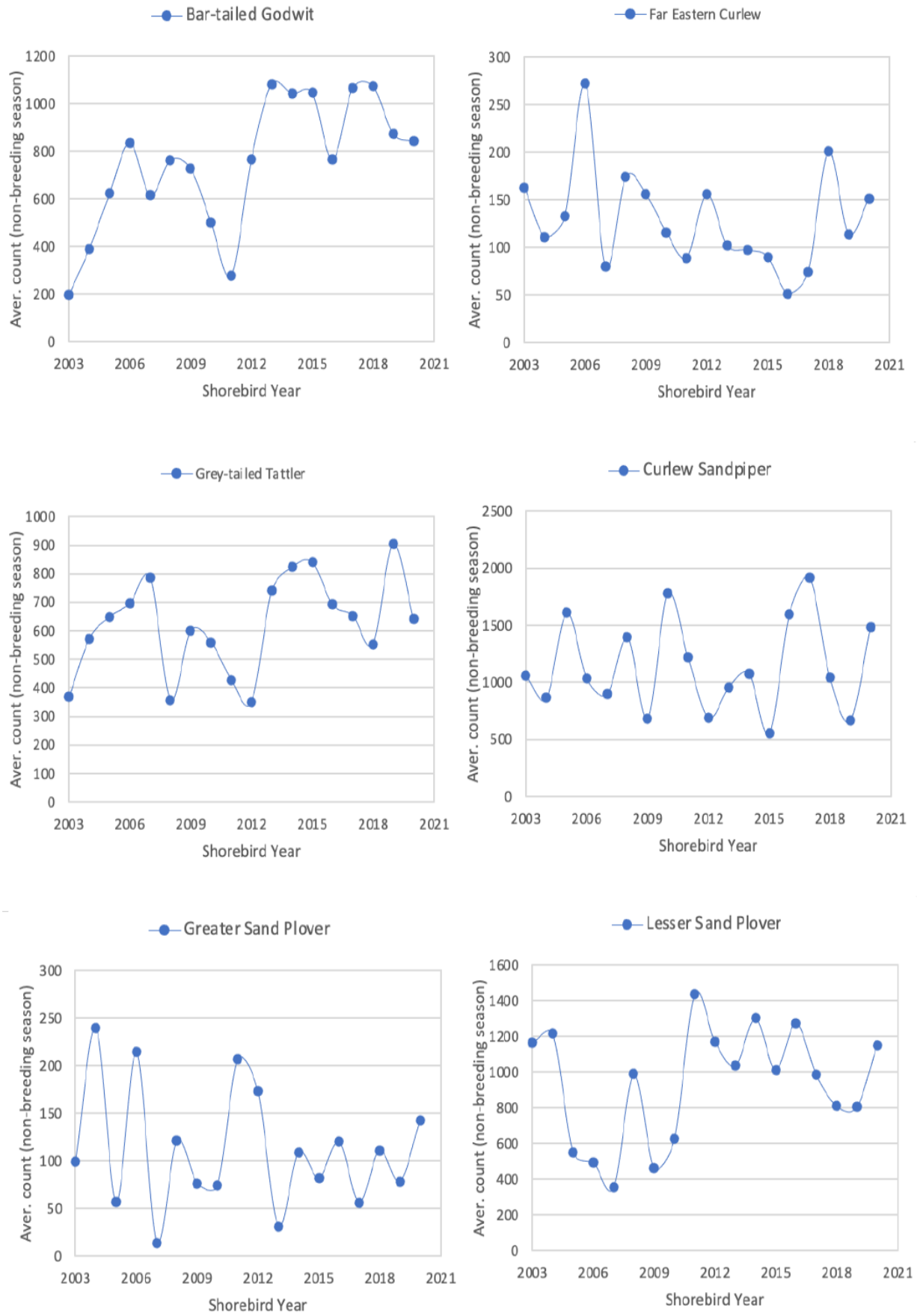

Figure 3.3a. *Average non-breeding period (mid-November to mid-March) counts of migratory shorebird species at the Port of Brisbane from 2003 to 2020.*

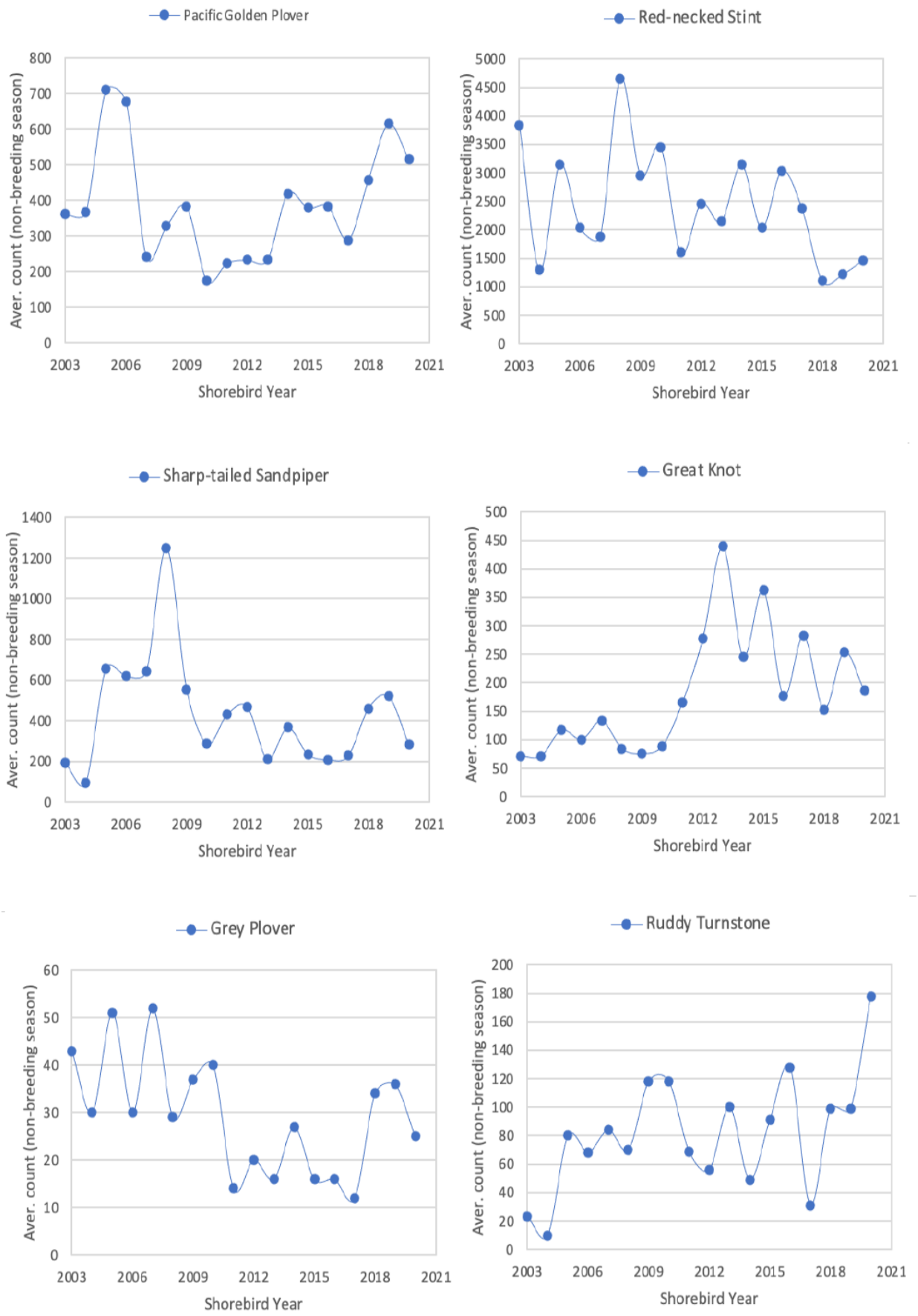

Figure 3.3b. *Average non-breeding period (mid-November to mid-March) counts of migratory shorebird species at the Port of Brisbane from 2003 to 2020.*

3.3 ROOST SITE RANKINGS

The relative rankings of the eleven Port roost sites have not varied appreciably over the past four years (**Table 3.5**). In 2020, reclamation pond C3 (PBC3) overtook pond R3 (PBR3) as the highest-ranked site supporting the most migratory shorebirds through the shorebird year. Reclamation pond BS3 (PBS3) also became substantially more important than it has been in previous years as fresh dredge spoil was pumped into this pond. By contrast, reclamation pond BS2 (PBS2) became substantially less important as this area was filled in with dry sand. Reclamation pond C4 (PBC4) is a new site that was created in March 2020 when it was excised from pond FPE (PFPE).

Table 3.5. *Derived rank of relative importance of the 11 sites currently in use at the Port based on data from **Table 3.1** and **Appendix A**. The rankings are for each of the past four shorebird years. The data for earlier years can be found in previous reports. The site rankings within years are colour graduated from light green (high rank or low numeric value) to dark green (low rank or high numeric value). The last column indicates the extent of change in ranking between 2017 and 2020; a negative value indicates the ranking has improved*.

Site	Site code	Rank 2017	Rank 2018	Rank 2019	Rank 2020	Change since 2017
Pond C3	PBC3	3.2	3	2.3	1.5	-1.7
Pond R3	PBR3	1.7	1.4	1.8	2.7	1
Pond BS3	PBS3	6.2	7.7	6.7	2.8	-3.4
Claypan	FICP	3.3	6.1	4	4.7	1.4
Artificial roost	PBAR	6.9	3.9	6.9	6.0	-0.9
Pond FPE	PFPE	3.8	4.1	4.9	6.3	2.5
Pond BS4	PBS4	5.5	4.3	5	7.1	1.6
Pond C2	PBC2	8.6	9.4	9.7	7.5	-1.1
Pond BS2	PBS2	6.8	6.6	4.9	8.4	1.6
Pond BS1	PBS1	9	8.5	8.8	9.3	0.3
Pond C4	PBC4				9.7	

3.4 COMPARISONS WITH MORETON BAY AS A WHOLE

During 2020/21, the Index of Relative Importance (IRI) for the Port was highest for Curlew Sandpiper, with an average of 79% of the Moreton Bay total numbers of this species using the Port, and lowest for Bar-tailed Godwit, with an average of 12% of the Moreton Bay total using the Port (**Table 3.6**). Relative to 2019, the IRI increased for seven species, decreased for four species and remained unchanged for one species in 2020, with a slight increase from 0.44 to 0.46 in the average across all 12 species. Relative to 2016, which had the highest overall IRI over the past five years, the IRI in 2020 increased for two species and decreased for the remaining ten species. The overall average IRI has remained relatively unchanged over the past four years 2017-2020, within the range 0.44 to 0.46. Continued use of this index of relative importance will help to monitor the changes in shorebird numbers at the Port compared to elsewhere throughout Moreton Bay.

Table 3.6. *Index of Relative Importance (IRI) for the Port, for each of the last five shorebird years for each of the 12 most important species at the Port of Brisbane. Colour coding between years, not between species: yellow (lowest) to green (highest).*

Species	2016	2017	2018	2019	2020
Curlew Sandpiper	0.68	0.84	0.71	0.56	0.79
Grey Plover	0.85	0.70	0.79	0.90	0.75
Greater Sand Plover	0.72	0.63	0.61	0.53	0.60
Lesser Sand Plover	0.71	0.76	0.67	0.67	0.53
Pacific Golden Plover	0.57	0.44	0.49	0.63	0.53
Ruddy Turnstone	0.66	0.36	0.54	0.37	0.50
Red-necked Stint	0.51	0.51	0.40	0.37	0.47
Sharp-tailed Sandpiper	0.40	0.25	0.42	0.39	0.42
Grey-tailed Tattler	0.43	0.31	0.36	0.34	0.40
Great Knot	0.36	0.35	0.31	0.39	0.26
Far Eastern Curlew	0.16	0.07	0.12	0.07	0.13
Bar-tailed Godwit	0.21	0.16	0.15	0.12	0.12
Average across all 12 species	0.52	0.45	0.46	0.44	0.46

3.5 SHOREBIRD BANDING ACTIVITIES

Two visits to band shorebirds were made to Port lands during the 2020/21 reporting period: a visit in January 2021 to cannon net smaller birds in the outer FPE area and a visit in February 2021 to Lytton Claypan No. 1 (just south of Fisherman Island) to mist-net larger species. A total of 49 birds of eight different species were caught and banded for the first time as well as 3 recaptures (**Table 3.7**). The three birds recaptured had all originally been banded at the same location in prior years.

Table 3.7. *Summary of birds banded at the Port of Brisbane in 2020/21 as well the cumulative totals since the project began, listing first-time captures and recaptures (in brackets). Not all banded birds were leg-flagged.*

Species	2020/21	All years
Broad-billed Sandpiper		4
Bar-tailed Godwit	6	68 (1)
Caspian Tern		1
Crested Tern		2
Curlew Sandpiper	4	19 (1)
Great Knot		93 (9)
Greater Sand Plover	1	4
Grey-tailed Tattler	0 (1)	5 (1)
Lesser Sand Plover	27 (2)	163 (6)
Pacific Golden Plover	1	60 (1)
Red Knot		5
Red-capped Plover		5
Red-kneed Dotterel		23
Red-necked Stint	8	64 (1)
Ruddy Turnstone	2	18
Sharp-tailed Sandpiper		3
Sooty Tern		4
Black-winged stilt		2
Total	**49 (3)**	**543 (20)**

Two of the Bar-tailed Godwit captured at Lytton Claypan on 27th February 2021 were fitted with small Platform Terminal Transmitter (PTT) satellite tracking devices to track their local and migratory movements.

An adult male fitted with PTT 207722 and engraved leg flag BYX provided a full migration trace from its location at the Port, to its northern breeding grounds in Alaska and back again (**Figure 3.4**). The bird left Brisbane in late March 2021, migrating to Alaska via staging grounds in the Yellow Sea where it held a breeding territory on the North Slope. It departed Alaska in early September arriving back in the Brisbane area on 23rd September after a non-stop flight across the Pacific Ocean. This provided invaluable information on this individual's migratory strategy and local movements on the non-breeding, staging and breeding grounds.

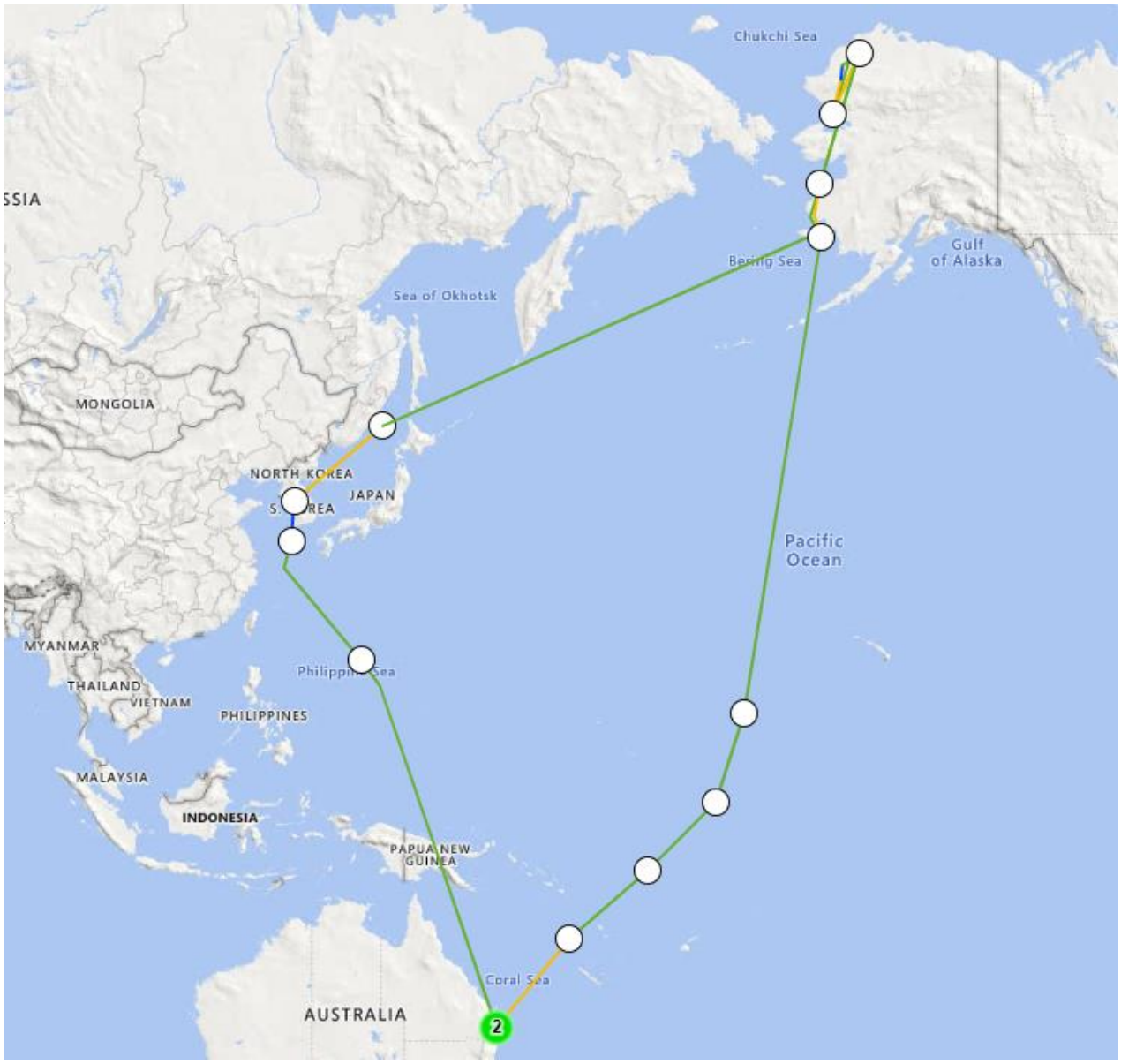

Figure 3.4. *Migratory track of Bar-tailed Godwit BYX in 2021.*

A second adult male fitted with PTT 207724 and leg flag BYZ did not migrate in 2021. Instead, it provided a wealth of data on local movements as the bird foraged in Moreton Bay in-between roosting at various high tide roost sites. The local movements of both BYZ and BYX are shown in **Figure 3.5**. These birds confined their foraging and roosting activities to an area extending south from the Port to as far as Lota.

Work will continue on tracking shorebirds and will involve continuation of leg flagging a range of species at multiple sites in Moreton Bay, including the Port. This will allow QWSG to monitor changes over time in different cohorts. Work will also continue in satellite tracking of a range of species to obtain fine-scale spatial and temporal data on the local movements of birds in Moreton Bay and establish foraging ranges and important feeding areas. As devices become smaller and lighter, these technologies provide access to smaller species and QWSG is monitoring these advances keenly for further opportunities to extend knowledge in other species.

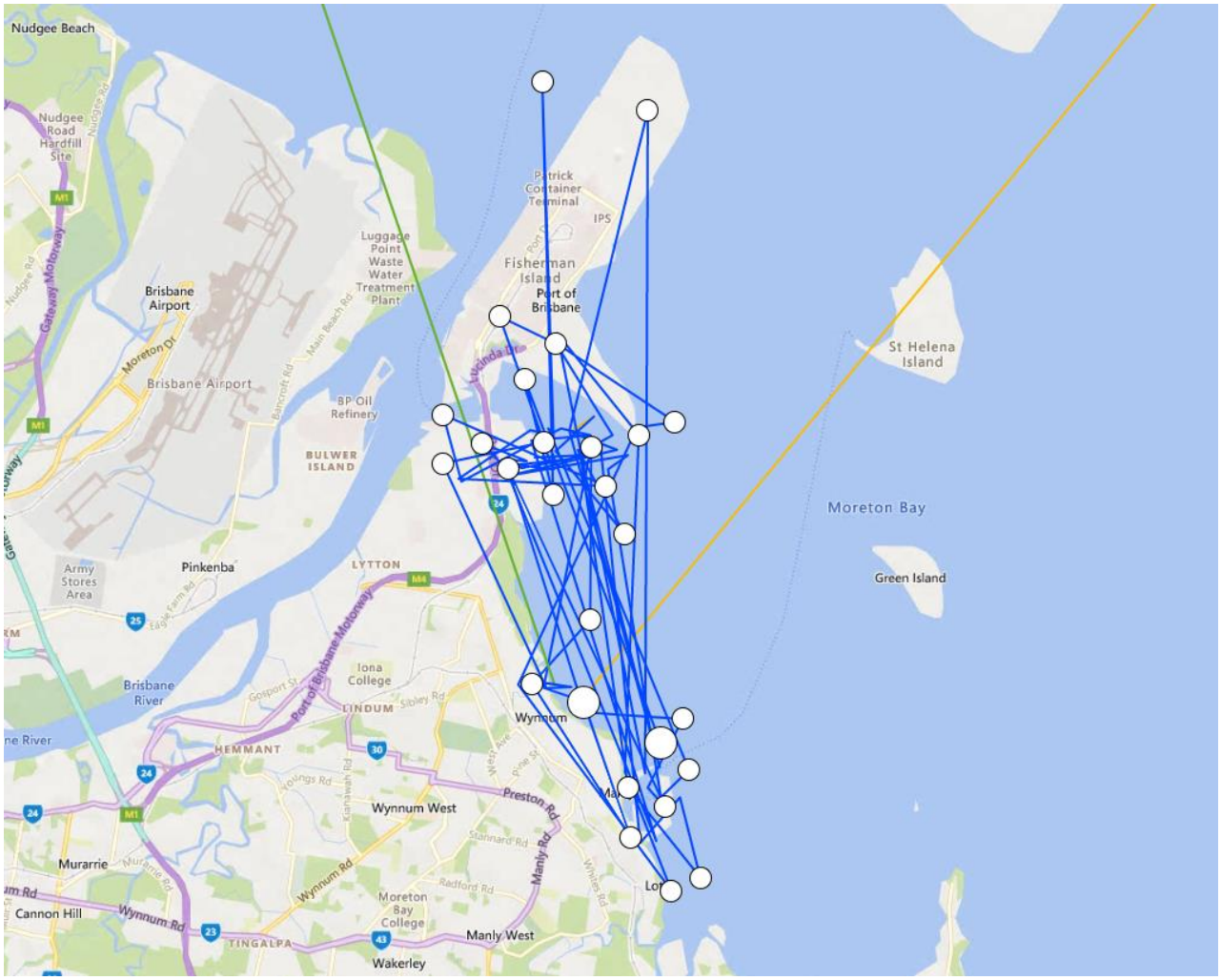

Figure 3.5. *Local movements of Bar-tailed Godwits BYX and BYZ in 2021.*

There were 26 shorebird flag re-sightings on Port lands (including roost sites on Fisherman Island and Lytton Claypan No. 1) during the 2020/21 reporting period, including:

- 21 green flags on birds banded in Moreton Bay;
- one orange flag on a Curlew Sandpiper banded in Victoria;
- two white flags, one on a Red Knot and the other on a Great Knot banded at Chongming Dao Shanghai, China; and
- two blue flags, one on a Red Knot and the other on a Bar-tailed Godwit banded at Tori-no-Umi, Watari, Miyagi, Japan in 2014.

Among 14 green-flagged birds where the engraved alpha-numeric code could be read, the sites where the birds were originally banded were:

- Manly Harbour: 4 Bar-tailed Godwit, 2 Great Knot, 1 Curlew Sandpiper, 2 Pied Oystercatcher, 2 Pied Stilt, all banded within the period 2010 to 2020;
- Lytton Claypan No. 1: 1 Bar-tailed Godwit banded in 2021;
- Toorbul: 1 Bar-tailed Godwit banded in 2019; and
- West Geoff Skinner: 1 Bar-tailed Godwit banded in 2008.

4.0 RECOMMENDATIONS

Two major shorebird roost sites on the western shoreline of Moreton Bay are located relatively close to the Port of Brisbane roosts on Fisherman Island:

- Lytton Claypan No. 1, located 2 km south of FICP and 6 km south of the reclamation area; and
- Luggage Point Claypan, located 4 km south-west of the reclamation area on the northern side of the Brisbane River mouth.

These two roosts cover relatively large areas that support suitable roosting habitat for most of the migratory shorebird species that roost at the Port roost sites, and, for many individuals may be located closer to feeding habitat areas along the mainland shoreline to the north and south of the Port. However, since they are subject to natural tidal cycles, their suitability for roosting changes dynamically with tide height, whereas the suitability of the Port reclamation area roosts remains mostly independent of tidal cycles. The preliminary satellite tracking results reported in **Section 3.4** also indicate that Bar-tailed Godwits that use Port roosting sites also roost as far south as the Manly Harbour roost that is located 11 km south of the Port reclamation area.

The proximity of alternative roosts to the Port means that temporal variability and trends in the numbers of shorebirds roosting at the Port cannot be properly understood without considering the potential movement of shorebirds between the Port and these alternative roost sites. A better understanding of these linkages, and potential constraints to the movement of shorebirds between roosts, for example temporal variation in roost suitability due to tide cycles and disturbance will be important for predicting the impacts on shorebirds of the eventual loss of the Port reclamation area for roosting once the area becomes fully reclaimed. Satellite tracking has the potential to provide detailed information on the movements of birds between roost sites to better understand these local dynamics. Therefore, it is recommended that satellite tracking of birds using the Port be continued in tandem with the ongoing monthly count monitoring of the Port roost sites and the alternative roosts in the local region.

Port of Brisbane Pty Ltd is encouraged to continue to prioritise the management and monitoring of shorebirds at the Port. There is a need to continue to explore opportunities to provision habitat for shorebirds within or adjacent to Port lands to compensate for the expected future loss of roosting habitat in the reclamation area. In this regard, Port of Brisbane Pty Ltd could advocate for such an outcome together with other interested and relevant stakeholders and regulators. Planning to provide adequate shorebird habitat in Moreton Bay into the future is required to manage the increasing pressures on shorebirds from the continued growth and development of Brisbane and the anticipated future loss of roosting habitat in the Port reclamation area (Fuller *et al.* 2019).

5.0 REFERENCES

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APPENDIX A: Monthly count data for the 12 most important migratory shorebird species by site in 2020/21

Table A1. *Monthly counts of Grey-tailed Tattler by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond FPE	PFPE	5	742	1050	900	1124			351	1		**4173**	84.2%
Pond BS3	PBS3					36		479				**515**	10.4%
Pond BS4	PBS4	115	108									**223**	4.5%
Pond R3	PBR3	1	17			7						**25**	0.5%
Pond C3	PBC3							20				**20**	0.4%
Claypan	FICP											**0**	
Artificial roost	PBAR											**0**	
Pond C2	PBC2											**0**	
Pond C4	PBC4											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
	Total	**121**	**867**	**1050**	**900**	**1167**	**0**	**499**	**351**	**1**	**0**	**4956**	

Table A2. *Monthly counts of Red-necked Stint by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond C3	PBC3		932	326	719	268	60	912	141		293	**3651**	32.3%
Claypan	FICP	74		743	4	84	6	1350		380		**2641**	23.4%
Pond R3	PBR3	1490	30	249	3	152	198	63		1		**2186**	19.4%
Pond BS3	PBS3		162	47	510	206	236	500		2	15	**1678**	14.9%
Pond BS2	PBS2	13			33	367	96		3	15	20	**547**	4.8%
Pond FPE	PFPE		3	256						102		**361**	3.2%
Pond BS4	PBS4		12	44	24	9	7	18			2	**116**	1.0%
Artificial roost	PBAR		42		3	16	9					**70**	0.6%
Pond C2	PBC2			14		5			2			**21**	0.2%
Pond BS1	PBS1		5			8						**13**	0.1%
Pond C4	PBC4			2							1	**3**	<0.1%
	Total	**1577**	**1186**	**1681**	**1296**	**1115**	**612**	**2843**	**146**	**500**	**331**	**11287**	

Table A3. *Monthly counts of Curlew Sandpiper by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond C3	PBC3		61	445	1953	714	758	1404			121	**5456**	56.2%
Pond R3	PBR3	1790	295	62		263	68	44				**2522**	26.0%
Pond FPE	PFPE			801								**801**	8.3%
Pond BS3	PBS3		3	1	35	62	12	591				**704**	7.3%
Claypan	FICP	32		88				1	38	8		**167**	1.7%
Artificial roost	PBAR		10	5		5						**20**	0.2%
Pond BS4	PBS4			11	3	4	1	1				**20**	0.2%
Pond C2	PBC2			2		5						**7**	0.1%
Pond BS2	PBS2					3	1					**4**	<0.1%
Pond BS1	PBS1					1						**1**	<0.1%
Pond C4	PBC4											**0**	
	Total	**1822**	**369**	**1415**	**1991**	**1057**	**840**	**2041**	**38**	**8**	**121**	**9702**	

Table A4. *Monthly counts of Sharp-tailed Sandpiper by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3	59	8	183	80	187	422	1				**940**	48.8%
Pond C3	PBC3		57	101	55	50	51	54				**368**	19.1%
Claypan	FICP	27		36		2	1		215	44		**325**	16.9%
Pond BS3	PBS3		1	7	46	10	4	57				**125**	6.5%
Artificial roost	PBAR	7	11	6	1	21	24	19				**89**	4.6%
Pond BS2	PBS2			2		38						**40**	2.1%
Pond C2	PBC2			24		3						**27**	1.4%
Pond BS4	PBS4			2		2	4					**8**	0.4%
Pond BS1	PBS1		2			1						**3**	0.2%
Pond C4	PBC4					2						**2**	0.1%
Pond FPE	PFPE											**0**	
	Total	**93**	**79**	**361**	**182**	**316**	**506**	**131**	**215**	**44**	**0**	**1927**	

Table A5. *Monthly counts of Bar-tailed Godwit by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3		1064	640	1075	575						**3354**	46.5%
Claypan	FICP	254				11			17	768	445	**1495**	20.7%
Pond C3	PBC3			1		12	525	528				**1066**	14.8%
Pond BS3	PBS3					290	186	129				**605**	8.4%
Artificial roost	PBAR	1		435								**436**	6.0%
Pond FPE	PFPE	188										**188**	2.6%
Pond C4	PBC4	7		33				32				**72**	1.0%
Pond BS4	PBS4							3				**3**	<0.1%
Pond C2	PBC2											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
	Total	**450**	**1064**	**1109**	**1075**	**888**	**711**	**692**	**17**	**768**	**445**	**7219**	

Table A6. *Monthly counts of Great Knot by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3		54	257	406	52						**769**	64.2%
Claypan	FICP						21	71		32	52	**176**	14.7%
Pond BS3	PBS3					104	23	6				**133**	11.1%
Pond C3	PBC3						10	49				**59**	4.9%
Artificial roost	PBAR			48								**48**	4.0%
Pond C4	PBC4			10								**10**	0.8%
Pond BS4	PBS4			2								**2**	0.2%
Pond C2	PBC2											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
Pond FPE	PFPE											**0**	
	Total	**0**	**54**	**317**	**406**	**156**	**54**	**126**	**0**	**32**	**52**	**1197**	

Table A7. *Monthly counts of Far Eastern Curlew by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3		77		244	2		6				**329**	36.6%
Claypan	FICP	59				42	51	2	36	116	3	**309**	34.4%
Pond BS3	PBS3					15	120	108				**243**	27.1%
Artificial roost	PBAR	2	3		2	3	3					**13**	1.4%
Pond C3	PBC3					3		1				**4**	0.4%
Pond C2	PBC2											**0**	
Pond C4	PBC4											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
Pond BS4	PBS4											**0**	
Pond FPE	PFPE											**0**	
	Total	**61**	**80**	**0**	**246**	**65**	**174**	**117**	**36**	**116**	**3**	**898**	

Table A8. *Monthly counts of Ruddy Turnstone by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3		6		17	55	82	146	23			**329**	40.9%
Pond FPE	PFPE		12	4	17	155	1		21			**210**	26.1%
Pond C3	PBC3	1	4	10	12	32	68	3	1			**131**	16.3%
Pond BS3	PBS3						34	42				**76**	9.5%
Pond BS4	PBS4		4				29	14				**47**	5.8%
Pond C2	PBC2					6						**6**	0.7%
Claypan	FICP									4		**4**	0.5%
Pond BS2	PBS2									1		**1**	0.1%
Artificial roost	PBAR											**0**	
Pond C4	PBC4											**0**	
Pond BS1	PBS1											**0**	
	Total	**1**	**26**	**14**	**46**	**248**	**215***	**205**	**45**	**5**	**0**	**805**	

* Includes one Ruddy Turnstone recorded at the Lucinda Drive drain.

Table A9. *Monthly counts of Lesser Sand Plover by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond C3	PBC3	4	67	305	1948	552	656	808	289		60	**4689**	87.6%
Pond BS3	PBS3		1		105	406	65	43				**620**	11.6%
Pond FPE	PFPE			18								**18**	0.3%
Pond BS2	PBS2					15				2		**17**	0.3%
Pond BS4	PBS4			1			1	5				**7**	0.1%
Pond C2	PBC2			1		1						**2**	<0.1%
Pond R3	PBR3			1								**1**	<0.1%
Pond BS1	PBS1		1									**1**	<0.1%
Claypan	FICP											**0**	
Artificial roost	PBAR											**0**	
Pond C4	PBC4											**0**	
	Total	**4**	**69**	**326**	**2053**	**974**	**722**	**856**	**289**	**2**	**60**	**5355**	

Table A10. *Monthly counts of Greater Sand Plover by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond C3	PBC3	1		32	305	30	68	165	32		4	**637**	99.5%
Pond BS3	PBS3					2		1				**3**	0.5%
Claypan	FICP											**0**	
Artificial roost	PBAR											**0**	
Pond C2	PBC2											**0**	
Pond C4	PBC4											**0**	
Pond R3	PBR3											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
Pond BS4	PBS4											**0**	
Pond FPE	PFPE											**0**	
	Total	**1**	**0**	**32**	**305**	**32**	**68**	**166**	**32**	**0**	**4**	**640**	

Table A11. *Monthly counts of Pacific Golden Plover by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond BS3	PBS3				350	80	290	418				**1138**	45.7%
Pond C3	PBC3	75	129	148	7	2	69	365			34	**829**	33.3%
Pond C2	PBC2					460						**460**	18.5%
Pond BS4	PBS4	1	5	9			1	2				**18**	0.7%
Claypan	FICP	8	1	8								**17**	0.7%
Artificial roost	PBAR		5			1	1	5	3			**15**	0.6%
Pond R3	PBR3	6			2	1						**9**	0.4%
Pond C4	PBC4							2				**2**	0.1%
Pond BS2	PBS2					2						**2**	0.1%
Pond BS1	PBS1											**0**	
Pond FPE	PFPE											**0**	
	Total	**90**	**140**	**165**	**359**	**546**	**361**	**792**	**3**	**0**	**34**	**2490**	

Table A12. *Monthly counts of Grey Plover by site in 2020/21. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	20-Sep-2020 S Migration	18-Oct-2020 S Migration	08-Nov-2020 S Migration	06-Dec-2020 Non-breeding	17-Jan-2021 Non-breeding	14/-Feb-2021 Non-breeding	14/-Mar-2021 Non-breeding	11-Apr-2021 N Migration	09-May-2021 N Migration	18-Jul-2021 Breeding	**Total**	% total
Pond R3	PBR3	24	48	14	15	37						**138**	71.1%
Pond C3	PBC3	4					32	5				**41**	21.1%
Pond FPE	PFPE	2	1					8				**11**	5.7%
Pond C4	PBC4							4				**4**	2.1%
Claypan	FICP											**0**	
Artificial roost	PBAR											**0**	
Pond C2	PBC2											**0**	
Pond BS1	PBS1											**0**	
Pond BS2	PBS2											**0**	
Pond BS3	PBS3											**0**	
Pond BS4	PBS4											**0**	
	Total	**30**	**49**	**14**	**15**	**37**	**32**	**17**	**0**	**0**	**0**	**194**	

APPENDIX B: Monthly Port of Brisbane total count data for all shorebird species in 2020/21

Date	20-Sep-20	18-Oct-20	08-Nov-20	06-Dec-20	17-Jan-21	14-Feb-21	14-Mar-21	11-Apr-21	09-May-21	18-Jul-21	
Migratory species	13	16	16	15	16	14	15	12	10	10	
Resident species	4	6	4	4	5	5	5	5	6	6	
Total shorebirds	4447	4222	6664	9061	6931	4628	8836	1421	2729	2374	**Total**
Migratory shorebirds											
Bar-tailed Godwit	450	1064	1109	1075	888	711	692	17	768	445	**7219**
Black-tailed Godwit			2								**2**
Broad-billed Sandpiper		8	1	7	4	2	76				**98**
Common Greenshank		1	2	2	37						**42**
Curlew Sandpiper	1822	369	1415	1991	1057	840	2041	38	8	121	**9702**
Double-banded Plover								20		31	**51**
Eurasian Whimbrel	49	43	45	1	35	60	33	13	4		**283**
Far Eastern Curlew	61	80		246	65	174	117	36	116	3	**898**
Great Knot		54	317	406	156	54	126		32	52	**1197**
Greater Sand Plover	1		32	305	32	68	166	32		4	**640**
Grey Plover	30	49	14	15	37	32	17				**194**
Grey-tailed Tattler	121	867	1050	900	1167		499	351	1		**4956**
Lesser Sand Plover	4	69	326	2053	974	722	856	289	2	60	**5355**
Marsh Sandpiper						3	2			1	**6**
Pacific Golden Plover	90	140	165	359	546	361	792	3		34	**2490**
Red Knot	31	26	43								**100**
Red-necked Stint	1577	1186	1681	1296	1115	612	2843	146	500	331	**11287**
Ruddy Turnstone	1	26	14	46	248	215	205	45	5		**805**
Sanderling					1						**1**
Sharp-tailed Sandpiper	93	79	361	182	316	506	131	215	44		**1927**
Terek Sandpiper		2									**2**
unidentified shorebird		30								3	**33**
Resident shorebirds											
Black-fronted Dotterel		2						3	9	2	**16**
Masked Lapwing	2	3	2	7	8	4	2	9	10	13	**60**
Pied Oystercatcher	36	29	15	78	161	180	172	84	69	36	**860**
Pied Stilt	6	21	24	47	17	12	18	13	1070	561	**1789**
Red-capped Plover	73	72	46	45	64	70	45	107	90	154	**766**
Red-necked Avocet		2							1	523	**526**
Sooty Oystercatcher					3	2	3				**8**

APPENDIX C: Average and maximum non-breeding season (austral summer) counts, average breeding season (austral winter) counts, and average migration (north and south) counts for the 12 important species each year since 2003

Species	Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Bar-tailed Godwit	Non-br	198	391	623	968	615	764	718	500	272	768	1084	1042	1047	766	1067	1074	875	842
	Maximum	461	401	874	1235	657	913	942	577	344	1283	1481	1185	1356	1066	1529	1499	1572	1075
	Migration	518	260	464	669	547	597	384	511	130	499	742	594	801	581	425	344	411	682
	Breeding	435	397	557	395	342	326	573	88	37	53	292	146	28	132	32	47	21	445
Curlew Sandpiper	Non-br	1062	865	1612	1037	899	1387	667	1784	1218	691	956	1078	553	1599	1914	1045	665	1482
	Maximum	1418	2298	2289	1813	1855	2007	768	2086	1746	697	2040	1671	849	2443	2607	2192	1455	2041
	Migration	184	676	530	481	527	620	324	1043	660	880	462	477	937	806	712	1082	901	730
	Breeding	50	160	58	28	244	63	185	96	62	50	101	188	70	477	32	58	187	121
Far Eastern Curlew	Non-br	163	111	133	355	80	173	155	114	87	156	102	97	90	51	74	201	114	151
	Maximum	244	186	280	670	164	212	227	128	105	259	119	165	122	133	117	291	207	246
	Migration	38	88	83	63	69	105	83	74	100	153	140	106	91	62	17	79	25	59
	Breeding	134	32	34	67	43	56	59	41	67	107	29	49	34	35	14	169	23	3
Great Knot	Non-br	71	95	117	117	133	84	74	89	166	277	439	246	363	177	283	153	254	186
	Maximum	123	221	210	185	183	111	112	160	180	515	708	534	596	379	580	186	389	406
	Migration	304	104	99	115	87	53	103	98	358	203	261	449	156	175	148	71	67	81
	Breeding	1		1		20	10	5	1	3	2	33	86			1	0	0	52
Greater Sand Plover	Non-br	99	240	71	215	28	121	102	74	207	173	31	109	82	120	56	111	78	143
	Maximum	404	415	158	441	42	185	216	146	432	336	80	226	133	287	103	223	147	305
	Migration	1	40	37	19	83	129	26	27	82	129	5	64	61	43	48	14	11	13
	Breeding	1	61	1		1		6	50	23	4		1				2	10	4
Grey Plover	Non-br	43	30	51	30	52	29	37	40	14	20	32	34	16	21	16	34	36	25
	Maximum	55	51	59	45	145	32	45	45	23	33	40	38	52	38	33	44	41	37
	Migration	21	17	11	13	35	27	23	19	30	10	19	21	12	11	16	16	18	19
	Breeding	5	1	7		9		5					3		4		5	0	0

Species	Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Grey-tailed Tattler	Non-br	368	572	649	696	786	356	599	560	428	349	740	824	841	692	653	553	905	642
	Maximum	496	890	801	960	1288	584	1105	568	478	413	803	1230	1175	1296	1259	710	1434	1167
	Migration	288	476	415	488	509	527	491	455	271	441	532	577	550	250	89	629	0	478
	Breeding	232	419	360	149	197	362	22	15	33	254	375	357	265	55	11	5	35	0
Lesser Sand Plover	Non-br	1164	1216	549	493	353	989	461	625	1438	1173	1036	1303	1013	1275	986	812	804	1151
	Maximum	2433	1664	823	605	954	1256	643	833	1458	1856	1424	1929	1409	1804	1138	1140	1672	2053
	Migration	294	277	212	345	390	479	276	485	550	640	462	543	322	577	553	222	259	138
	Breeding	101	65	37	49	85	12	46	123	19	15	21	41	28	36	3	83	101	60
Pacific Golden Plover	Non-br	363	367	711	682	242	327	381	175	223	233	233	419	379	384	289	458	616	515
	Maximum	455	755	902	1090	303	372	546	201	298	418	301	664	575	464	399	836	1219	792
	Migration	118	183	276	265	167	117	113	137	148	112	159	175	208	157	117	191	179	80
	Breeding	18	46	20	11	18	9	15	3	6	2	22			4		52	8	34
Red-necked Stint	Non-br	3841	1294	3153	2043	1882	4525	2914	3451	1602	2463	2151	3145	2033	3040	2369	1103	1220	1467
	Maximum	6803	2383	5239	2978	2623	5586	3547	4791	2015	3323	3143	6669	4111	4666	3902	1505	2218	2843
	Migration	1072	1292	1236	1964	1366	1513	1401	1887	1112	2381	1270	1183	2207	2022	1246	1576	792	1018
	Breeding	525	735	591	460	1176	527	709	349	441	1933	153	432	817	332	393	525	317	331
Ruddy Turnstone	Non-br	23	10	80	68	84	70	118	118	69	56	100	49	91	128	31	99	99	178
	Maximum	46	22	207	134	113	104	166	136	104	91	131	75	127	213	37	156	190	248
	Migration	5	12	63	47	80	112	55	76	80	28	55	33	56	27	14	32	3	18
	Breeding		31	75	31	108	15	55	28	27	6	11	2	4	19	6	14	3	0
Sharp-tailed Sandpiper	Non-br	193	97	658	622	641	1208	485	286	421	469	211	367	235	209	228	460	519	284
	Maximum	454	226	2078	1082	1201	1680	774	446	610	476	258	832	504	304	434	569	808	506
	Migration	90	227	175	217	868	283	279	218	167	388	129	606	465	184	196	181	230	158
	Breeding	4		1	4	14	64	3	1	8	3	7	78	5	1	1	1	6	0

APPENDIX D: Non-breeding period (mid-November to mid-March) means and lower 90% confidence limits for the 12 most important migratory shorebird species at the Port

The results (derived from log transformed counts) are for successive 8-year sampling blocks since 2003. Colour coding indicates for each species the higher (green) and lower (yellow) means for the different time periods. Red font indicates the critical count that can serve as a trigger to suggest the relevant species may be exhibiting a real decline in numbers at the Port.

The table uses two periods of sampling, that is, 2010 and earlier, and after 2010. Both sets of data incorporate eight years of sampling. For some species the sample mean for the earlier sampling is higher and for some it is lower than for sampling after 2010. Colour coding is used to indicate whether the mean is higher (green) or lower (yellow) than the alternative mean for each species. Each mean has an associated threshold value that can serve as a trigger for response if any future count is lower than this figure. For each species there are two choices of threshold value, one for each of the sampling periods. A conservative approach would be to use the higher of these two values for each species. These are the choices of threshold values that have been highlighted in red lettering. Future counts of each species can be evaluated.

The 90% lower confidence limit represents a threshold value, below which only 1 in 10 sample means will occur. Hence a single count below this value is likely to be an indication of a real change in the population mean, that is, an actual change in the numbers of birds (refer to the 2019 report for details of derivation of this table).

Period	2003-2010		2011-2018	
Species	Mean	Threshold	Mean	Threshold
Bar-tailed Godwit	418	*114*	818	*469*
Curlew Sandpiper	954	*505*	911	*439*
Far Eastern Curlew	129	*61*	75	*27*
Great Knot	64	*18*	182	*64*
Greater Sand Plover	35	*4*	53	*13*
Grey Plover	33	*15*	10	*2*
Grey-tailed Tattler	507	*291*	558	*259*
Lesser Sand Plover	524	*163*	1033	*673*
Pacific Golden Plover	367	*202*	295	*164*
Red-necked Stint	2457	*1373*	1853	*936*
Ruddy Turnstone	44	*14*	61	*27*
Sharp-tailed Sandpiper	307	*100*	260	*137*

APPENDIX E: List of QWSG monthly roost monitoring sites in Moreton Bay used to calculate the Moreton Bay count

Table E1. *List of QWSG monthly roost monitoring sites in Moreton Bay used to calculate the Moreton Bay total count that is an input to calculating the Index of Relative Importance; the list does not include the Port of Brisbane roost sites that are also included in the Moreton Bay total count.*

Site code	Site name	Latitude	Longitude
ACAC	Acacia St Wellington Pt	-27.48	153.23
AMSB	Amity Point sandbank	-27.39	153.43
BECK	Bell's Creek Caloundra	-26.85	153.11
BHBI	Buckleys Hole sandbar Bribie Is	-27.10	153.16
BHMS	Bishop's Marsh	-27.04	153.06
BSVP	Base Street, Victoria Point	-27.59	153.31
CABO	Caboolture River mouth	-27.15	153.04
DAYS	Day's Gutter Moreton Island	-27.37	153.41
DBBA	Deception Bay claypan	-27.17	153.02
DBMN	Deception Bay south	-27.20	153.04
DOHL	Dohle's vic. Pine River nth side	-27.28	153.04
DTMI	Dead Tree Beach, Moreton Is	-27.34	153.43
DUNW	Dunwich Nth Straddie (One Mile)	-27.49	153.40
EAGS	East Geoff Skinner Reserve	-27.49	153.25
GOBC	Godwin Beach	-27.09	153.11
GOSE	Goat Is SE	-27.52	153.38
GRHI	Gregory Rd, Hays Inlet	-27.25	153.06
KBWL	Kedron Brook Wetlands	-27.36	153.08
KIAN	Kianawah Road Wetland	-27.45	153.14
KKBC	Kakadu Beach Bribie Is	-27.05	153.14
KSMF	King Street Mudflat - Thornlands	-27.56	153.28
LUPO	Luggage Point	-27.38	153.15
LYTT	Lytton	-27.42	153.16
MAHA	Manly Harbour	-27.46	153.19
MIPB	Mirapool beach, Moreton Is	-27.32	153.44
MIPO	Mirapool Moreton Island	-27.34	153.44
NAPK	Nandeebie Park Cleveland	-27.53	153.28
NARD	Nathan Rd Redcliffe	-27.21	153.07
OYPO	Oyster Point	-27.54	153.28
PEWA	Pelican Waters Lamerough Ck	-26.83	153.12
PRNS	Pine Rivers north	-27.29	153.03
PRWR	Pine Rivers Wetland Res	-27.29	153.04
PTHR	Pt Halloran reserve	-27.57	153.29
RANS	Redcliffe airport north side	-27.20	153.06
REPO	Reeders Point Moreton Is	-27.36	153.42
SBN1	Sandbank No 1 Caloundra	-26.81	153.13

Site code	Site name	Latitude	Longitude
SBN2	Sandbank No 2 Caloundra	-26.82	153.12
SBTH	Sandy Bank, Toondah Harbour	-27.53	153.31
SHIH	St Helena Is homestead	-27.39	153.23
SHIN	St Helena Is north	-27.38	153.23
SHIP	St Helena Is pier	-27.39	153.22
SHIS	St Helena Is south east	-27.40	153.24
TGBC	Toorbul George Bishop causeway claypan	-27.04	153.09
THLD	Thornlands Rd Thornlands	-27.56	153.28
THQE	Thorneside Queens Esp.	-27.48	153.21
TOOR	Toorbul	-27.05	153.11
TRNT	Toorbul north	-27.04	153.11
TRSF	Toorbul sandfly	-27.04	153.11
TRSS	Toorbul sandspit	-27.03	153.09
WEGS	West Geoff Skinner Reserve	-27.49	153.24

APPENDIX F: Summary of 2020/21 monthly count data for Lytton Claypan No. 1.

Table F1. *Maximum count for each migratory and resident shorebird species each month from September 2020 to August 2021 at Lytton Claypan No. 1 (LYN1) roost site.*

Species / Month	Sep	Oct	Nov	Dec*	Jan	Feb	Mar	Apr	May	Jul	Aug
Number of counts	1	1	1	1	1	1	1	2	1	2	1
Bar-tailed Godwit	864	300	611		634	453	525	274			272
Black-tailed Godwit								7	15	19	25
Common Greenshank								5			
Curlew Sandpiper	21		78		11	47	10	48			
Eurasian Whimbrel	66		26		49	63	147	287	2		
Far Eastern Curlew	121		288		229	260	46	17	1	27	97
Great Knot	25		12		2	1	1	6			
Marsh Sandpiper								1	4	1	1
Pacific Golden Plover			1								
Red Knot	24		1					1			
Red-necked Stint	1		169		58	5	15	1			
Sharp-tailed Sandpiper	2		15			73	11	770			
Total migratory	**1124**	**300**	**1201**	**0**	**983**	**902**	**755**	**1417**	**22**	**47**	**395**
Black-fronted Dotterel								2			
Masked Lapwing	8	1	3		1	2	11	10	19	28	29
Pied Oystercatcher					2	1			3	8	11
Pied Stilt	4					31	56	716	922	380	168
Red-capped Plover	4	4	2		5	1	2			2	
Red-kneed Dotterel										2	
Red-necked Avocet										205	119
Total resident	**16**	**5**	**5**	**0**	**8**	**35**	**69**	**728**	**944**	**625**	**327**

* Claypan was dry.