2023/24

Port of Brisbane shorebird monitoring

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Queensland Wader Study Group

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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 twelfth 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 2023 to August 2024.

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 2023/24, presented as a table of raw numbers and associated graphs.
- 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

Eleven counts were conducted over the period September 2023 to August 2024 at twelve roost sites on Fisherman Island as well as the nearby Lytton Claypan No. 1 on the mainland. 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.

Temporal trends in the annual average austral summer count (over the period 1 October to 15 March inclusive, the period that migratory shorebird numbers on Fisherman Island were consistently high and most stable) of individual species or shorebird groupings over the 22-year period of shorebird years 2002 to 2023 were tested using a generalised linear model (GLM). To assess the relative importance of the roosts on Fisherman Island to individual migratory shorebird species in Moreton Bay, an index of relative importance was calculated for each species as the ratio of the average annual maximum count on Fisherman Island over the period 2003 to 2023 to the maximum count for Moreton Bay since 2008 as reported in Fuller *et al*. (2021), expressed as a percentage. The significance of the roosts on Fisherman Island collectively and individually was also assessed on the basis of the percentage of the East Asian-Australasian Flyway (EAAF) population that the respective species counts represent, where counts representing greater than 1% of the EAAF population are internationally significant and counts representing greater than 0.1% of the EAAF population are nationally significant.

KEY RESULTS

Monthly shorebird counts

A total of 20 migratory shorebird species and five resident shorebird species were recorded at the Port, which is similar to totals of 21 migratory shorebird species and seven resident shorebird species recorded in 2022/23. The total migratory shorebird count (including Lytton Claypan No. 1) ranged between 2,859 and 8,608 birds during the south migration period (September to mid-November), between 5,861 and 9,201 birds during the non-breeding period (mid-November to mid-March), between 1,474 and 8,116 during the north migration period (mid-

March to May) and between 1,246 and 2,396 during the northern hemisphere breeding period (June to August). The total resident shorebird count ranged between 306 and 778 birds.

Three of the Port roost sites supported 74% of the total migratory shorebirds overall: reclamation area ponds C3 (42%) and R3 (16%) and Lytton Claypan No. 1 (24%). Similarly, four of the Port sites supported 74% of the total resident shorebirds overall: Lytton Claypan No. 1 (30%), reclamation area pond R3 (17%), Fisherman Island claypan (21%) and the artificial roost (12%). The artificial roost supported 1.4% of migratory shorebirds and 12.3% of resident shorebirds overall. These proportions have been approximately consistent since 2002.

Seasonal variation in shorebird counts

Total migratory shorebird numbers roosting on Fisherman Island have shown the expected cyclical pattern of increasing during the south migration period (September to mid-November, generally reaching peak numbers 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. Total migratory shorebird numbers were consistently high and most stable over the period October to mid-March. Total resident shorebird numbers have overall shown an opposite seasonal pattern to migratory shorebirds, reaching lowest average numbers during the period of high migratory shorebird numbers, increasing from mid-April to late August when migratory shorebird numbers are low. Resident shorebirds were substantially less abundant than migratory shorebirds, making up only 9% of the overall total shorebird abundance from all counts since 2003.

Long-term trends in shorebird counts

There has been no significant trend in the total migratory shorebird count on Fisherman Island over the past 21 years 2002-2022 during summer (1 October to 15 March) but there has been a significant decline in the total migratory shorebird count in winter (1 May to 31 August). The average summer count has ranged between 5,436 and 8,607 whereas the average winter count has ranged between 528 and 2,820 birds over the past 22 years. The maximum count of total migratory shorebirds roosting on Fisherman Island each year has ranged between 7,159 and 13,703. Similarly, there has also been no significant trend in the average annual total resident shorebird count over the past 22 years. Among individual migratory shorebird species, there has been a significant decreasing trend in the average summer count for three species (Far Eastern Curlew, Grey Plover and Red-necked Stint) and a significant increasing trend for three species (Great Knot, Curlew Sandpiper and Broad-billed Sandpiper) over the 22-year period 2002-2023.

Site importance

The overall index of relative importance of the roosts on Fisherman Island to different migratory shorebird species ranged between 83% for Curlew Sandpiper and <1% for Black-tailed Godwit and Sanderling for the period 2002 to 2022. Thus, the average annual maximum count of Curlew Sandpiper on Fisherman Island was 83% of the all-time maximum count of Curlew Sandpiper reported by Fuller *et al*. (2021) for the whole of Moreton Bay since 2008. In 2023, the index of relative importance was greater than 50% for five species and greater than 20% for 9 species, with the roosts on Fisherman Island supporting nationally significant numbers (greater than 0.1% of the EAAF population) of 11 migratory shorebird species and internationally significant numbers (greater than 1% of the EAAF population) of two of these.

The reclamation area ponds have consistently supported 80-90% of the migratory shorebirds over the past 22 years, with the artificial roost, Fisherman Island claypan, visitor centre and rail loop sites supporting substantially lower numbers. Averaged across all years, the reclamation area ponds have supported 88%, the Fisherman Island claypan 8%, the artificial roost 3%, and the visitor centre lake and rail loop less than 1% of the migratory shorebirds.

All four main roost sites at the Port, three on Fisherman Island together with the Lytton Claypan No. 1 on the mainland, have supported nationally significant (greater than 0.1% of the EAAF

population) and two roost sites, the reclamation area and Lytton Claypan No. 1 have supported internationally significant numbers (greater than 1% of the EAAF population) of migratory shorebird species within the most recent five years. The reclamation area was nationally significant for 13 species and internationally significant for five species, Lytton Claypan No. 1 was nationally significant for six species and internationally significant for two species, the Fisherman Island claypan was nationally significant for six species and the artificial roost was nationally significant for three species.

Shorebird banding

One visit to catch and band shorebirds took place at the Port during the reporting period, to Lytton Claypan on 22nd June 2024. Only a single bird was caught, a Pied Stilt that was fitted with a 5g GPS transmitter. This bird provided useful data on its local movements in Moreton Bay for 11 weeks before it flew inland to Qurindi, NSW where the transmitter signal was then lost. There were 9 shorebird flag re-sightings at the Port during the reporting period, including: 7 green flags on birds banded in Moreton Bay; one black over white flag on a Great Knot banded on Chongming Island, China; and one red flag on a Bar-tailed Godwit banded in New Zealand.

RECOMMENDATIONS

Port of Brisbane Pty Ltd is encouraged to continue to prioritise the management and monitoring of shorebirds at the Port. The monitoring reported here identifies the Fisherman Island claypan and Lytton Claypan No. 1 roost sites as very significant, naturally occurring shorebird roost sites that are important to the network of roost sites in central Moreton Bay. Portions of these roost sites also provide foraging resources for migratory shorebirds when inundated. These two roost sites, together with the artificial roost, are likely to become increasingly relied upon by migratory shorebirds as the availability of roosting habitat in the current Future Port Expansion (FPE) reclamation area diminishes as it approaches the point when it is all expected to be resumed for port infrastructure. Consequently, maintaining the Fisherman Island claypan, Lytton Claypan No. 1 and artificial roost sites as part of the conservation buffer land use under the Brisbane Port Land Use Plan 2020 (LUP) can make an important contribution to the sympathetic management of migratory and other shorebirds in Moreton Bay. The Lytton Claypan No. 1 roost site is accessible to the public, which increases the risk of disturbance impacts. A management focus for this site should be to proactively minimise the risk of disturbance to roosting shorebirds.

There is also a need to continue to explore opportunities to provision or improve roosting 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. Although the artificial roost has supported only 3% of the migratory shorebirds using Fisherman Island since 2002, it is occasionally used by large numbers of birds, indicating it has potential to support larger numbers of birds once currently preferred alternatives in the reclamation area are lost. There are also opportunities to improve vegetation management at the artificial roost to create a more extensive open area of sparsely vegetated substrate to accommodate larger numbers of migratory shorebirds.

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Appendices

Glossary of Terms and Acronyms

EAAF	East Asian Australasian Flyway
FPE	Future Port Expansion
IRI	Index of relative importance
Port	Port of Brisbane
QWSG	Queensland Wader Study Group

1.0 INTRODUCTION

1.1 BACKGROUND

Located on the southern side of the mouth of the Brisbane River in Moreton Bay, the Port of Brisbane (the Port) beneficially uses the sediment dredged during shipping channel maintenance dredging to create port land. The dredge material is settled in a dredge reclamation area at the north-eastern end of the port. The reclamation area was expanded considerably during 2004 with the construction of the outer bund rock wall. Between 2004 and 2023, cells within this expansion area have been progressively bunded off and used to settle dredge material and manage tailwater turbidity, a process that has resulted in the progressive infilling of these cells and their eventual incorporation into the expanded Port development. The repeated process of pumping fresh dredge material into the relatively large (10 to 20 ha) cells and then allowing it to settle and dry out has created ideal roosting habitat conditions for shorebirds, particularly migratory shorebirds (see Box 1) in the area over decades. These ideal roosting habitat conditions include: (1) large areas of bare, open ground with little to no cover that provide a clear view of approaching predators; (2) being adjacent to the shoreline or incorporating areas of water and wet substrates that allow the birds to stay cool on hot days; (3) incorporating areas with uneven relief with small surface mounds and depressions that assists with camouflage and affords some protection from strong winds; and (4) being close to preferred tidal flat feeding areas that reduces their energy expenditure flying between roosting and feeding sites (Rogers *et al.* 2006, Ryeland *et al.* 2021); and (5) periodic refreshment with a nutrient rich slurry from the dredge material that promotes the development of invertebrate communities in the shallow waters, providing food for smaller shorebirds such as Red-necked Stint and sandpipers, allowing them to continue feeding through the high-tide phase of the tidal cycle (Fuller *et al*. 2021). Additionally, the Port has also voluntarily created two large bird habitats, a permanent artificial roost and a freshwater lake on what would otherwise be industrial land.

Box 1: Shorebird ecology in Moreton Bay

Shorebirds are bird species in the order Charadriiformes, which includes avocets, curlews, dotterels, godwits, lapwings, oystercatchers, plovers, sandpipers, stilts, stone-curlews, tattlers and whimbrels, but does not include groups such as gulls and terns (Colwell 2010). Coastal shorebirds have a daily activity pattern that follows the tides, feeding on tidal flats once they become exposed at low tide and moving to rest in flocks at roost sites above the high-water mark once the rising tide covers their feeding habitat. They feed on a wide variety of benthic invertebrates, including crustaceans, molluscs and polychaete worms that are taken either on the surface of tidal flats or extracted from soft, muddy or sandy sediments by probing with their bills, which are elongated in many species. Most shorebirds can feed at night as well as during the day.

Most shorebirds using Moreton Bay are migratory, spending their non-breeding season (the austral summer) in Australia and migrating up to 13,000 km north through south-east Asia along the East Asian–Australasian Flyway (the Flyway) to breeding grounds in northern Asia, eastern Siberia and western Alaska (Bamford *et al.* 2008) where they breed through the austral winter. An exception is the Double-banded Plover (*Charadrius bicinctus*), which breeds in New Zealand during the austral summer and a portion of the population migrates to Australia for its winter non-breeding season (Pierce 1999).

Moreton Bay is recognised as a Ramsar wetland of international significance and is the most important site for shorebirds in Queensland. Up to 37,900 shorebirds including up to 35,800 migratory shorebirds have been counted in Moreton Bay (Clemens *et al*. 2008), with a total estimate of up to 50,000 migratory shorebirds using Moreton Bay in the past (Thompson 1990). Moreton Bay regularly supports internationally significant numbers (greater than 1% of the Flyway population) of nine migratory shorebird species (Fuller *et al*. 2021).

The Queensland Wader Study Group (QWSG) has monitored shorebirds and other waterbirds at the Port from as early as August 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). Between three and 16 counts were then conducted annually to 2002 in an unstandardised way. Since January 2003, the QWSG has been commissioned by Port of Brisbane Pty Ltd to undertake regular (typically monthly) standardised counts of birds on Port lands on Fisherman Island (**Figure 1.1**): within the reclamation area; a purpose-built shorebird roost site (PBAR); a nearby claypan (FICP); a freshwater lake adjacent to the old visitor centre (FIVC); and an ephemeral freshwater pondage area within a rail loop (PBRL). More recently a claypan roost site on Port lands on the mainland, Lytton Claypan No. 1 (LYN1) has been included in the monthly Port count to survey this site at the same time as the sites on Fisherman Island. 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.* 2021).

Figure 1.3. *Locations of shorebird count sites on Fisherman Island at Port of Brisbane in 2022/23, includin seven sites within the current reclamation area, a purpose-built shorebird roost site (PBAR), a nearb claypan (FICP), a freshwater lake (FIVC) and an ephemeral freshwate pondage area within a rail loop (PBRL). Also showing the Lytton Claypan No. 1 (LYN1) and Luggage Point (LUPO) roost sites. Includes material © 2023 Google, © 2023 Airbus.*

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 Flyway to their breeding grounds in the northern hemisphere.

This is the twelfth 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 2023 to August 2024.

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 2023/24, 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; and
- provide a summary of shorebird banding and leg flag re-sighting activities at the Port.

2.0 MONITORING APPROACH

The annual monitoring involved two main activities: monthly counts; and irregular shorebird banding and leg flag re-sighting.

2.1 MONTHLY SHOREBIRD COUNTS

Eleven counts were conducted within the reporting period (**Table 2.1**). 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.

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 2023 to August 2024 reporting period.*

Shorebird activity period	Date	HT height (m)	HT time
South migration	17/09/2023	2.07	10:45
South migration	15/10/2023	2.20	9:46
South migration	12/11/2023	2.27	8:45
Non-breeding	10/12/2023	2.22	7:38
Non-breeding	09/02/2024	2.68	9:15
Non-breeding	25/02/2024	2.41	10:13
North migration	24/03/2024	2.32	9:09
North migration	26/05/2024	1.77	11:04
Breeding	30/06/2024	2.12	16:59
Breeding	28/07/2024	2.07	8:58
Breeding	25/08/2024	2.16	13:52

2.2 SHOREBIRD BANDING AND FLAG RE-SIGHTING

One visit to catch and band shorebirds took place at the Port during the reporting period, to Lytton Claypan on 22nd June 2024. 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 (**Table 2.2**). The 12 species have all been recorded at some time or another on Fisherman Island (i.e. excluding Lytton Claypan No. 1) in numbers exceeding 0.2 % of the total Flyway population size, and often in numbers exceeding 1% of the Flyway population (**Table 2.2**). 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). The list of shorebird species recorded at the Port since 2002, and their conservation status is provided in **Appendix A**.

Table 2.2. *Maximum counts of 12 important species on Fisherman Island at the Port of Brisbane also expressed as the percentage of the total population size in the EAAF (Hansen et al. 2016) and year of maximum count between September 2003 and August 2023.*

Species	Maximum count since 2003 (% flyway population)	Year of maximum
Grey-tailed Tattler	1,434 (2.0)	2019
Red-necked Stint	6,803 (1.4)	2003
Lesser Sand Plover	2,433 (1.4)	2003
Curlew Sandpiper	3,408 (3.8)	2023
Sharp-tailed Sandpiper	2,078 (2.4)	2005
Far Eastern Curlew	670 (1.2)	2006
Pacific Golden Plover	1,219 (1.0)	2019
Great Knot	708 (0.2)	2013
Greater Sand Plover	441 (0.2)	2006
Ruddy Turnstone	213 (0.7)	2016
Bar-tailed Godwit	1,572 (0.5)	2019
Grey Plover	145 (0.2)	2007

2.4 ANALYSIS

Temporal trends in the annual average austral summer count (over the period 1 October to 15 March inclusive, the period that migratory shorebird numbers at the Port were consistently high and most stable) of individual species or shorebird groupings over the 22-year period of shorebird years 2002 to 2023 were tested using a generalised linear model (GLM). A Quasi-Poisson model was used for each GLM since the count data were over-dispersed i.e. the variance was greater than the mean. Models were fitted in R (R Core Team 2024) following the methods of Crawley (2002). Most of the roost sites at the Port are not influenced by the tide; consequently, the Port was thought to be a particularly important roost site for shorebirds in Moreton Bay on king spring tides when many alternative roost sites become unsuitable for roosting due to tidal inundation. However, a previous analysis of Port count data found no significant influence of tide height on the numbers of shorebirds roosting on Fisherman Island (Lloyd *et al*. 2024b).

To assess the relative importance of the roosts on Fisherman Island to individual migratory shorebird species in Moreton Bay, an index of relative importance (IRI) was calculated for each species as the ratio of the average annual (or annual) maximum count at the Port over the period 2003 to 2023 to the maximum count for Moreton Bay since 2008 as reported in Fuller *et al*. (2021), expressed as a percentage:

$$IRI = \frac{Average\ annual\ maximum\ count}{Maximum\ count\ for\ Moreton\ Bay\ since\ 2008} \times 100$$

The significance of the roosts on Fisherman Island collectively and individually was also assessed on the basis of the percentage of the East Asian-Australasian Flyway (EAAF) population that the respective species counts represent, where counts representing greater than 1% of the EAAF population are internationally significant (Ramsar 1971, Clemens *et al*. 2010) and counts representing greater than 0.1% of the EAAF population are nationally significant (Clemens *et al.* 2010).

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 2023/24

A total of 20 migratory shorebird species and five resident shorebird species were recorded at the Port during the reporting period (**Appendix B**), which is similar to totals of 21 migratory shorebird species and seven resident shorebird species recorded in 2022/23. The total counts of both migratory and resident (non-migratory) shorebirds at each site each month between September 2023 and August 2024 are summarised in **Table 3.1**.

The total migratory shorebird count (including LYN1) ranged between 2,859 and 8,608 birds during the south migration period (September to mid-November), between 5,861 and 9,201 birds during the non-breeding period (mid-November to mid-March), between 1,474 and 8,116 during the north migration period (mid-March to May) and between 1,246 and 2,396 during the northern hemisphere breeding period (June to August). The total resident shorebird count ranged between 306 and 778 birds (**Table 3.1**).

Three of the Port roost sites supported 74% of the total migratory shorebirds overall (**Table 3.1**): reclamation area ponds C3 (42%) and R3 (16%) and Lytton Claypan No. 1 (24%). Similarly, four of the Port sites supported 74% of the total resident shorebirds overall: Lytton Claypan No. 1 (30%), reclamation area pond R3 (17%), Fisherman Island claypan (21%) and the artificial roost (12%). The artificial roost supported 1.4% of migratory shorebirds and 12.3% of resident shorebirds overall.

Photo 1. *Mixed flock of Pacific Golden Plover, Lesser Sand Plover and Red-necked Stint roosting on a dry dredge reclamation pond on Fisherman Island (Robert Bush, QWSG)*.

Table 3.1. *Total counts of both migratory and resident shorebirds at each site each month between September 2023 and August 2024. The percentage contributions to total numbers made by each site are shown in the final column.*

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% of total
Migratory														
Pond C3	PBC3	175	3261	4344	2125	5299	3645	3156	522	193	33	256	23009	41.6
Lytton Claypan No.1	LYN1	1325	338	1523	1867	1329	1776	3688	327	156	416	591	13336	24.1
Pond R3	PBR3	919	744	1077	329	1104	769	610	372	763	919	1448	9054	16.4
Pond BS4	PBS4	57	9	231	981	1275	797	104	1	0	0	63	3518	6.4
FI Claypan	FICP	9	0	859	306	17	1522	345	23	134	35	1	3251	5.9
Pond C4	PBC4	8	526	193	101	36	2	17	0	0	0	0	883	1.6
Pond FPE	PFPE	241	190	337	7	0	1	106	0	0	0	0	882	1.6
Artificial roost	PBAR	112	409	37	145	74	22	0	0	0	0	2	801	1.4
Pond BS3	PBS3	13	13	0	0	67	111	90	229	0	11	17	551	1.0
Visitor Centre	FIVC	0	20	7	0	0	0	0	0	0	0	18	45	0.1
Rail Loop	PBRL		0	0	0	0	0	0	0	0	0	0	0	0.0
Pond BS2	PBS2	0	0	0	0								0	0.0
	Total	2859	5510	8608	5861	9201	8645	8116	1474	1246	1414	2396	55330	100.0
Resident														
Lytton Claypan No.1	LYN1	131	10	144	26	326	122	107	265	325	245	62	1763	29.7
Pond R3	PBR3	9	21	104	6	257	246	71	78	93	66	48	999	16.8
FI Claypan	FICP	59	4	152	2	124	105	5	129	170	112	17	879	14.8
Artificial roost	PBAR	124	186	97	175	10	12	6	3	22	59	34	728	12.3
Pond FPE	PFPE	42	43	27	31	2	2	122	53	44	22	29	417	7.0
Visitor Centre	FIVC	4	205	30	76	4	0	0	0	5	0	1	325	5.5
Pond BS3	PBS3	10	25	4	18	10	33	47	101	1	18	21	288	4.9
Pond C3	PBC3	0	1	13	2	0	15	17	54	45	10	87	244	4.1
Pond BS4	PBS4	6	2	16	12	2	2	2	95	48	31	7	223	3.8
Pond C4	PBC4	7	25	8	1	4	1	1	0	4	7	0	58	1.0
Pond BS2	PBS2	0	5	3	0	ns	ns	ns	ns	ns	ns	ns	8	0.1
Rail Loop	PBRL	ns	0	0	0	0	0	0	0	0	0	0	0	0.0
	Total	392	527	598	349	739	538	378	778	757	570	306	5932	100.0

Counts for each of the 12 important species for each site and month during the past year are given in **Appendix C**. **Appendix B** outlines the monthly totals across all Port sites for all shorebird species, not just the twelve important species. **Appendix D** summarises the results of all counts at Lytton Claypan No. 1, including counts on dates outside the Port count schedule.

The maximum summer counts recorded on Fisherman Island (i.e. excluding Lytton Claypan No. 1) during the 2023 shorebird year did not exceed the overall maximum count since 2003 for any of the 12 important species (**Table 3.2**).

Table 3.2. *Maximum summer counts of 12 important species on Fisherman Island at the Port of Brisbane also expressed as the percentage of the total population size in the EAAF (Hansen et al. 2016), year of maximum count, and their frequency of occurrence in all counts between September 2003 and August 2024, including all seasons not just summer.*

Species	Maximum count for 2023	Maximum count since 2003 (% flyway population)	Year of maximum	Frequency (% of all surveys)
Grey-tailed Tattler	1,275	1,434 (2.0)	2019	87
Red-necked Stint	2,522	6,803 (1.4)	2003	100
Lesser Sand Plover	1,304	2,433 (1.4)	2003	92
Curlew Sandpiper	2,105	3,408 (3.8)	2023	100
Sharp-tailed Sandpiper	602	2,078 (2.4)	2005	86
Far Eastern Curlew	182	670 (1.2)	2006	90
Pacific Golden Plover	410	1,219 (1.0)	2019	87
Great Knot	405	708 (0.2)	2013	72
Greater Sand Plover	75	441 (0.2)	2006	74
Ruddy Turnstone	119	248 (0.8)	2020	87
Bar-tailed Godwit	572	1,572 (0.5)	2019	95
Grey Plover	23	145 (0.2)	2007	65

3.2 SEASONAL VARIATION IN SHOREBIRD COUNTS ON FISHERMAN ISLAND

Total migratory shorebird numbers roosting on Fisherman Island have shown the expected cyclical pattern of increasing during the south migration period that extends from September to mid-November, generally reaching peak numbers through the non-breeding period that extends from mid-November to mid-March, before decreasing again during the north migration period that extends from mid-March to May to relatively low numbers during the northern hemisphere breeding period that extends from June to August (**Figure 3.1a**).

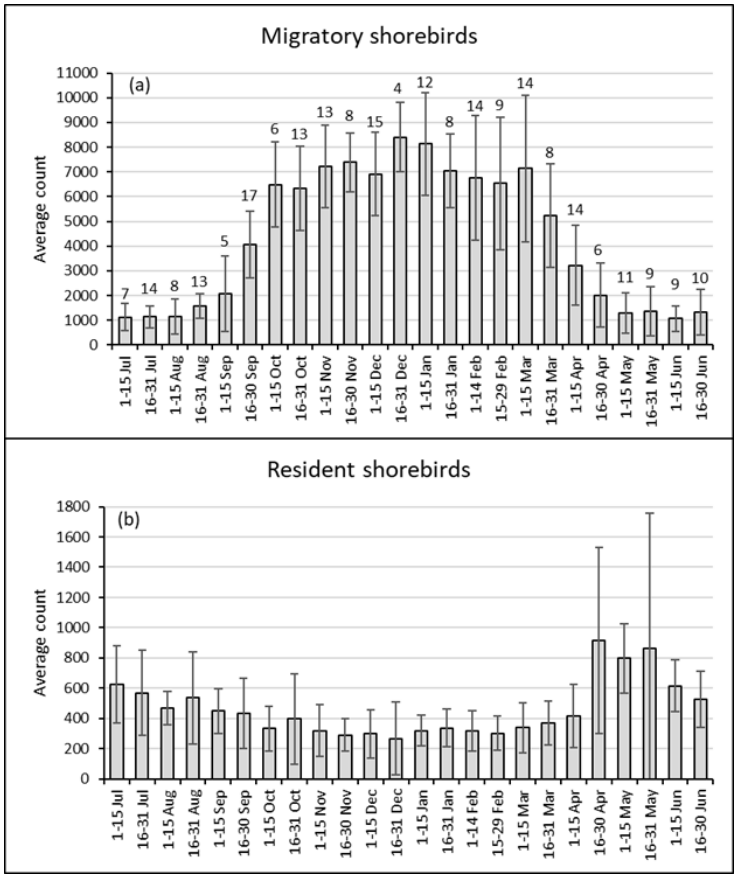

Figure 3.1. *Average (±1 SD) total migratory (a) and resident (b) shorebird counts on Fisherman Island each fortnight through the year over the shorebird years 2002-2023. The total number of counts for each fortnight are shown above the respective column*.

Total migratory shorebird numbers were consistently high and most stable over the period October to mid-March. Total resident shorebird numbers have overall shown an opposite seasonal pattern to migratory shorebirds (**Figure 3.1b**), reaching lowest average numbers during the period of high migratory shorebird numbers, increasing from mid-April to late August when migratory shorebird numbers are low. Resident shorebirds were substantially less abundant than migratory shorebirds, making up only 9% of the overall total shorebird abundance from all counts since 2003.

The maximum count of total migratory shorebirds roosting on Fisherman Island each year has ranged between 7,159 and 13,703 (**Figure 3.2**). The highest counts were generally recorded during the non-breeding period through the austral summer, occasionally during the south migration, with typically lower maximum counts during the north migration and the lowest counts during the breeding period through the austral winter (**Figure 3.2**).

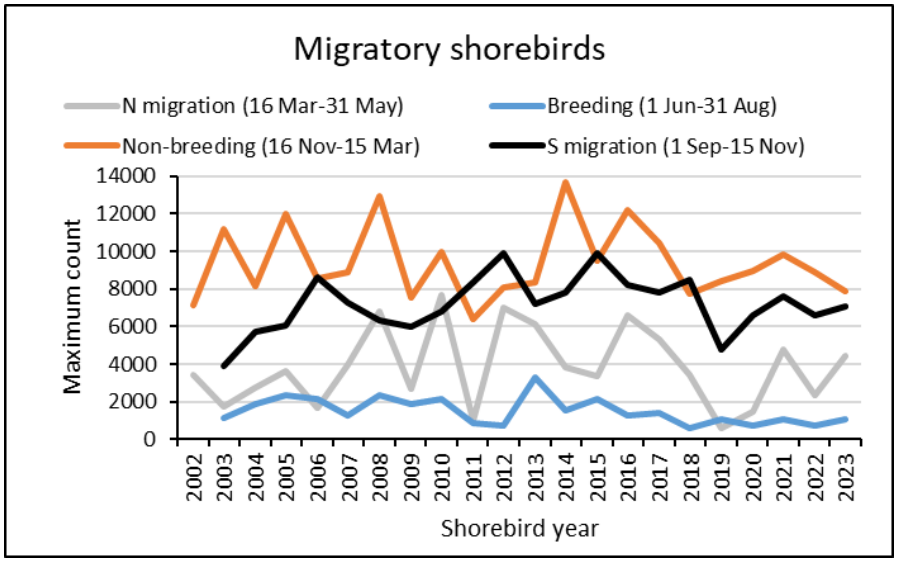

Figure 3.2. *Maximum counts of migratory shorebirds on Fisherman Island during the south migration, non-breeding, north migration and breedin periods over the shorebird years 2002-2023.*

3.3 Long Term Trends in Shorebird Counts at the Port of Brisbane

There has been no significant trend in the total migratory shorebird count on Fisherman Island over the past 22 years 2002-2023 during summer (1 October to 15 March: $F = 0.01$, $P = 0.91$) but there has been a significant decline in the total migratory shorebird count in winter (1 May to 31 August: $F = 7.74$, $P = 0.007$; **Figure 3.3**, **Table 3.3**). The average summer count has ranged between 5,436 and 8,607 whereas the average winter count has ranged between 528 and 2,820 birds over the past 22 years.

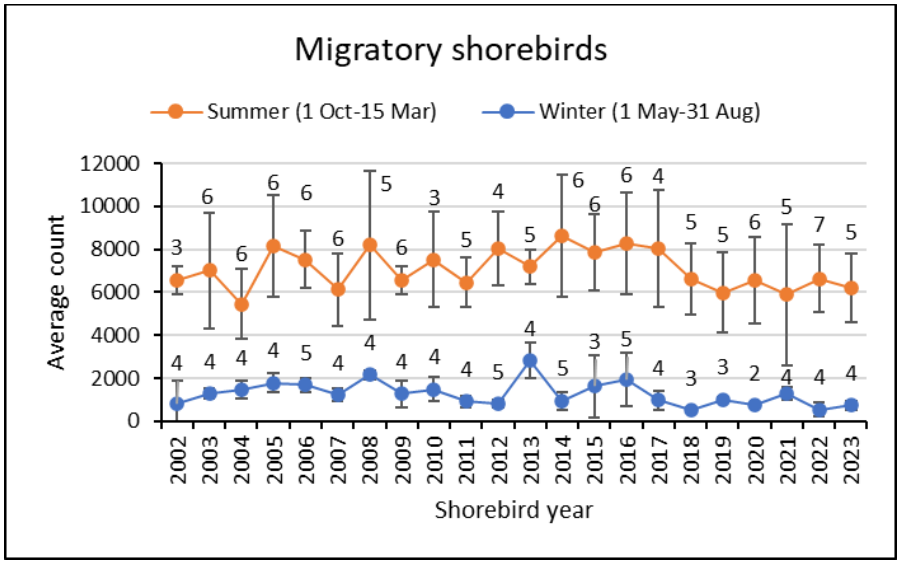

Figure 3.3. *Average total counts (±1 SD) for migrator shorebirds on Fisherman Island during the summer (1 October to 15 March) and winter (1 May to 31 August) periods over the shorebird years 2002-2023. The total number of counts for each shorebird year are shown above the respective average.*

Table 3.3. Summary of generalised linear models (GLMs) run separately for each species and shorebird grouping to examine temporal trends (2002 to 2023) in shorebird abundance on Fisherman Island; significant trends in bold text are indicated as either positive (+) or negative (-).

	Effect size ± SE		*F*	*P*	Trend
Species	Intercept	Year	Year	Year	
Migratory shorebirds (summer)	8.87±0.06	-0.001±0.004	0.01	0.91	
Migratory shorebirds (winter)	**60.64±19.34**	**-0.027±0.010**	**7.74**	**0.007**	**-**
Resident shorebirds	5.99±0.24	0.001±0.001	0.33	0.57	
Broad-billed Sandpiper	**-0.05±0.54**	**0.138±0.033**	**21.36**	**<0.001**	**+**
Bar-tailed Godwit	6.37±0.11	0.017±0.009	3.90	0.051	
Curlew Sandpiper	**6.86±0.12**	**0.023±0.009**	**6.95**	**0.010**	**+**
Double-banded Plover	49.04±30.41	-0.023±0.015	2.30	0.13	
Eurasian Whimbrel	3.88±0.24	-0.015±0.019	0.59	0.44	
Far Eastern Curlew	**5.11±0.12**	**-0.023±0.010**	**5.70**	**0.019**	**-**
Great Knot	**4.81±0.18**	**0.036±0.013**	**7.66**	**0.007**	**+**
Greater Sand Plover	4.71±0.21	-0.017±0.017	0.93	0.34	
Grey Plover	**3.73±0.12**	**-0.042±0.011**	**14.86**	**<0.001**	**-**
Grey-tailed Tattler	6.25±0.11	0.012±0.008	2.19	0.14	
Lesser Sand Plover	6.64±0.12	0.009±0.009	0.96	0.33	
Pacific Golden Plover	5.97±0.11	-0.006±0.009	0.44	0.51	
Red-necked Stint	**8.00±0.10**	**-0.026±0.008**	**10.01**	**0.002**	**-**
Ruddy Turnstone	4.04±0.16	0.017±0.012	1.97	0.16	
Sharp-tailed Sandpiper	6.07±0.17	0.004±0.013	0.10	0.75	
Pied Oystercatcher	4.38±0.12	0.001±0.001	0.28	0.60	
Pied Stilt	5.41±0.23	-0.001±0.001	2.39	0.12	
Red-capped Plover	4.21±0.24	0.001±0.001	0.26	0.61	
Red-necked Avocet	2.86±1.72	0.001±0.001	3.62	0.06	

Among individual migratory shorebird species, there has been a significant decreasing trend in the average summer count for three species (Far Eastern Curlew, Grey Plover and Red-necked Stint) and a significant increasing trend for three species (Great Knot, Curlew Sandpiper and Broad-billed Sandpiper) over the 21-year period 2002-2022 (**Figure 3.4**). The declines in Far Eastern Curlew and Grey Plover appear to have been gradual, possibly related to long-term population declines in these species (Wilson *et al*. 2011, Studds *et al*. 2017, Morrick *et al*. 2022, Rogers *et al*. 2023), whereas the decline in Red-necked Stint has occurred since 2018. There is no published 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 over the period 1996-2008 (Wilson *et al.* 2011). Red-necked Stint 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, or their use of alternative nearby roost sites such as Luggage Point where they are also able to feed.

Despite Bar-tailed Godwit and Great Knot experiencing significant population declines within Moreton Bay over the period 1992 to 2008 (Wilson *et al*. 2011), an increase in Bar-tailed Godwit counts on Fisherman Island since 2002 appears to have been gradual whereas Great Knot counts increased after 2010 (**Figure 3.4**). A similar increase in Great Knot abundance after 2010 was observed at low tide foraging habitat adjacent to the Port (Lloyd *et al.* 2021). The substantial decrease in counts of Bar-tailed Godwit over the most recent two years coincided with generally increased counts of up to 3,010 (in 2022) to 2,410 (in 2023) Bar-tailed Godwit roosting at the nearby Lytton Claypan No. 1 roost site (**Appendix D**); consequently, the reduced counts on Fisherman Island over the past two years may be due to birds preferentially roosting at Lytton Claypan No. 1.

Broad-billed Sandpiper was infrequently recorded in low numbers prior to 2014, whereafter numbers have increased, particularly during the northward migration in March-April. Variability in the counts of Broad-billed Sandpiper may also be related to difficulties in distinguishing this species from Curlew Sandpiper in some field situations when the birds are located far from observers.

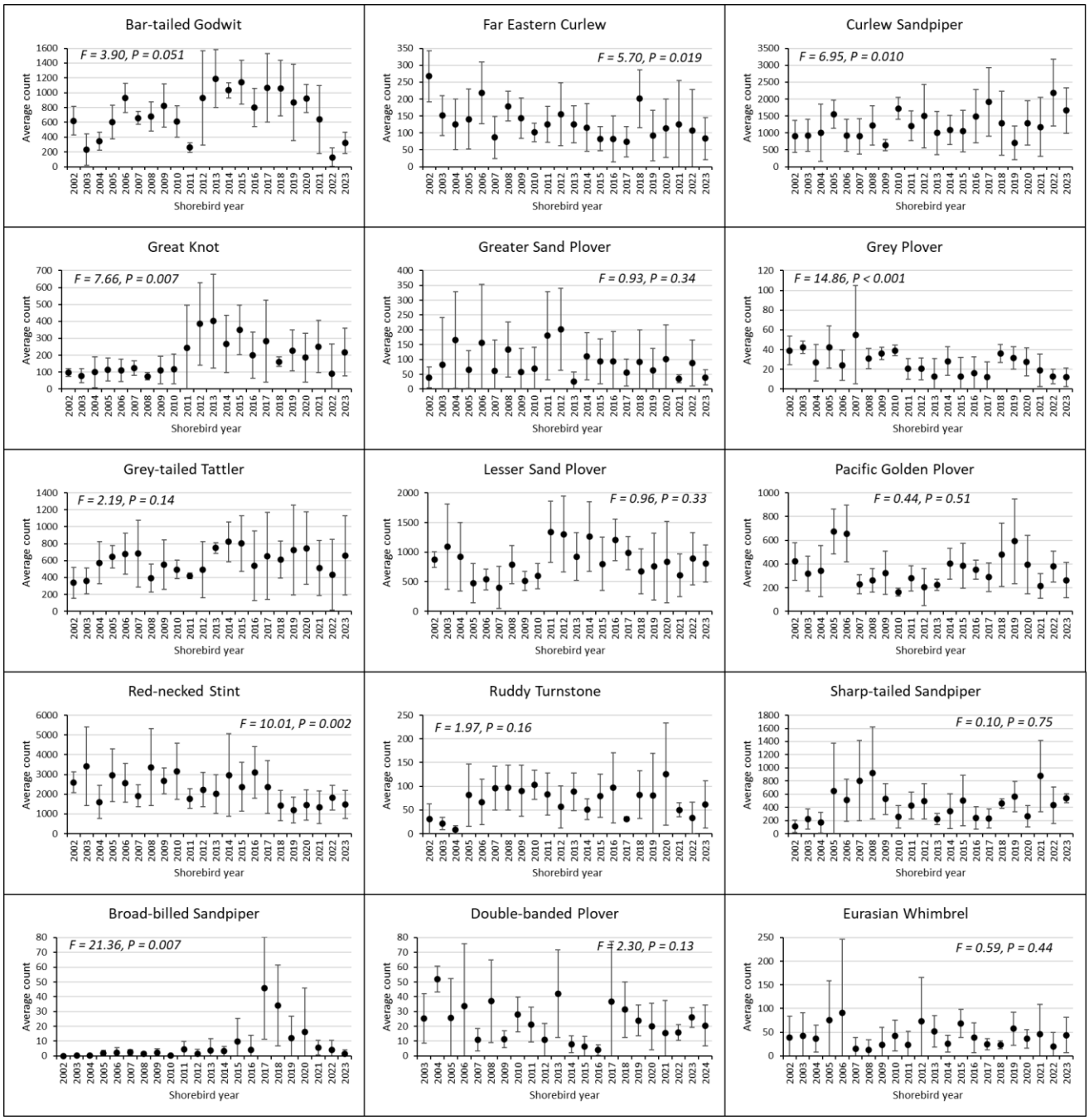

Figure 3.4. *Average total Port counts (±1 SD) for 15 migratory shorebird species during the summer period (1 October to 15 March: 14 species) or winter period (1 May to 31 August: Double-banded Plover*. *The total number of counts for each shorebird year are shown above the respective column*

The high variability of the summer season counts within each year, evidenced by the large standard deviations, indicates that many of the migratory shorebirds using roost sites on Fisherman Island are likely to also be using alternative roost sites outside the Port on a regular basis. The other important shorebird roost sites nearby include Lytton Claypan No. 1, Luggage Point, Manly Harbour and Geoff Skinner Reserve. Satellite tracking and leg flag resighting has confirmed substantial movement of birds between the roosts on Fisherman Island and other roost sites (Coleman and Milton 2012, Coleman and Bush 2020, Lilleyman *et al*. 2020).

There has been no significant trend in the average annual total resident shorebird count on Fisherman Island over the past 21 years 2002-2022 (F = 1.38, P = 0.24; **Figure 3.5**).

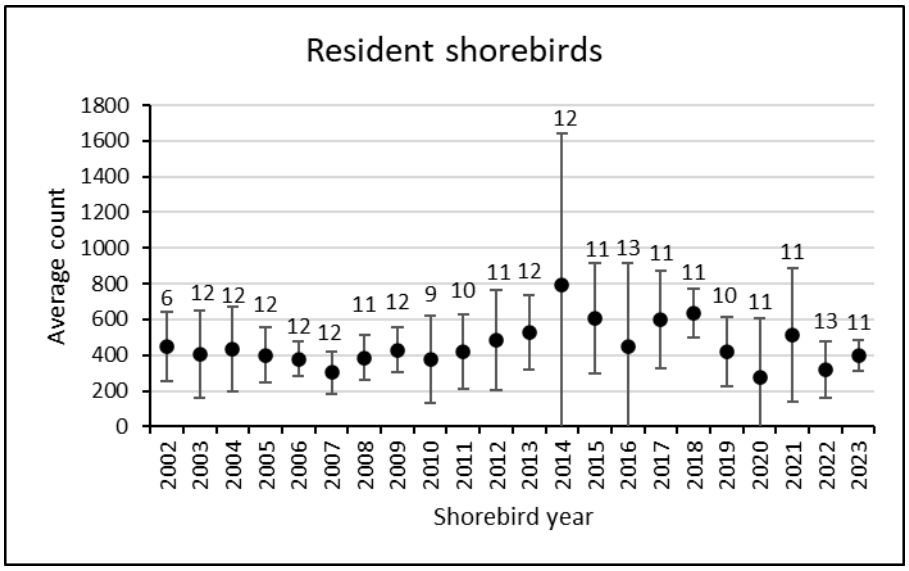

Figure 3.5. *Average total Fisherman Island counts (± SD) for resident shorebirds (annual) over the shorebird years 2002-2023. The total number of counts for each shorebird year are shown above the respective column.*

Among individual resident shorebird species, there has been no significant trend in the average annual count for the four commonly occurring species over the 22-year period 2002-2022 (**Figure 3.6**).

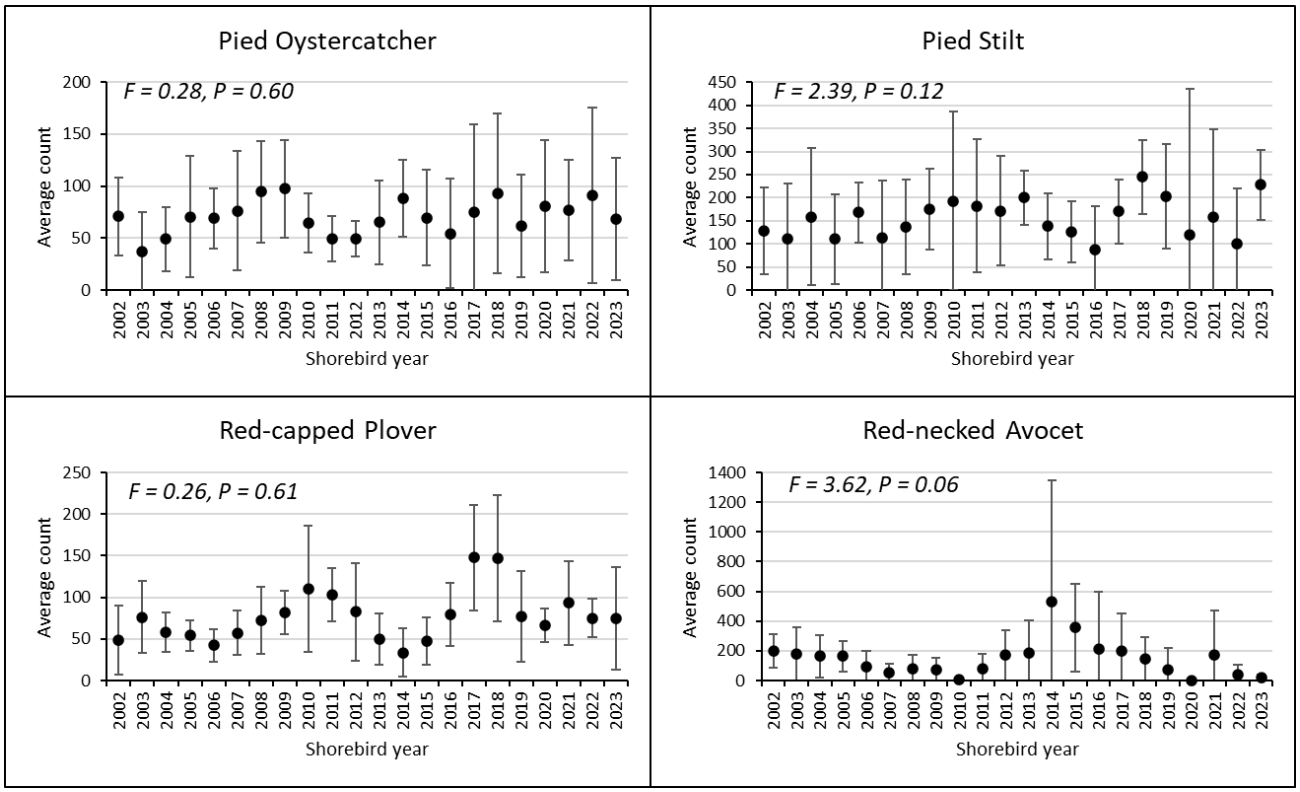

Figure 3.6. *Average annual total Fisherman Island counts (±1 SD) for four resident shorebird species over the shorebird years 2002-2023*.

The increased average and high variability in the counts of Red-necked Avocet in the 2014 shorebird year (i.e. 2014/15) were due to an influx of up to 2,810 birds to the reclamation area in April-May 2015.

3.4 SITE IMPORTANCE

The overall index of relative importance of the roosts on Fisherman Island to different migratory shorebird species ranged between 83% for Curlew Sandpiper and <1% for Black-tailed Godwit and Sanderling for the period 2002 to 2022 (**Table 3.4**). Thus, the average annual maximum count of Curlew Sandpiper on Fisherman Island was 83% of the all-time maximum count of Curlew Sandpiper reported by Fuller *et al*. (2021) for the whole of Moreton Bay since 2008.

Table 3.4. *Summary of migratory and resident shorebird species recorded on Fisherman Island at the Port of Brisbane over the shorebird years 2002 to 2022 versus 2023, their average (±1SD) summer (1 October to 15 March, migratory species) and winter (1 May to 31 August, migratory species) or annual (resident species) counts (with percentage of counts the species was present in parentheses), annual maximum counts (with overall maximum count in parentheses), and index of relative importance (IRI). Values that exceed 0.1% of the EAAF population of the species are highlighted in bold and values that exceed 1% of the EAAF population are underlined*.

	Average (±1SD) 2002-2022				2023	
Common name	**Summer (n = 111)**	**Winter (n = 83)**	**Annual maximum (max. count)**	**IRI**	**Max**	**IRI**
Curlew Sandpiper	**1216**±717 (100%)	**122**±149 (99%)	**2026**±519 (**3408**)	83%	**2105**	86%
Lesser Sand Plover	**843**±496 (100%)	48±67 (78%)	**1418**±492 (**2433**)	73%	**1304**	68%
Greater Sand Plover	95±108 (94%)	6±19 (39%)	**240**±119 (**441**)	72%	75	22%
Red-necked Stint	**2288**±1262 (100%)	**650**±558 (100%)	**3833**±1397 (**6803**)	71%	**2522**	47%
Pacific Golden Plover	**370**±211 (100%)	14±18 (65%)	**580**±266 (**1219**)	70%	**410**	50%
Ruddy Turnstone	**69**±56 (98%)	19±29 (69%)	**131**±60 (**248**)	62%	**119**	56%
Sharp-tailed Sandpiper	**448**±389 (100%)	30±171 (61%)	**922**±535 (**2078**)	59%	**602**	39%
Grey-tailed Tattler	**591**±316 (97%)	**129**±171 (74%)	**1018**±264 (**1434**)	42%	**1275**	52%
Grey Plover	28±20 (93%)	2±3 (27%)	48±24 (**145**)	41%	23	19%
Great Knot	186±164 (97%)	8±29 (35%)	379±190 (**708**)	26%	405	28%
Red Knot	35±114 (57%)	2±7 (11%)	**236**±221 (**760**)	24%	65	7%
Broad-billed Sandpiper	7±16 (59%)	<1±1 (6%)	29±38 (**131**)	22%	7	5%
Double-banded Plover	<1±<1 (7%)	**24**±22 (93%)	**46**±37 (**172**)	19%	**34**	14%
Eurasian Whimbrel	41±53 (91%)	9±38 (49%)	**146**±97 (**405**)	11%	**95**	7%
Bar-tailed Godwit	**729**±408 (99%)	210±198 (89%)	**1088**±386 (**1633**)	9%	**572**	5%
Far Eastern Curlew	**131**±83 (97%)	**43**±60 (77%)	**247**±72 (**340**)	7%	**182**	5%
Common Greenshank	4±5 (78%)	1±3 (26%)	11±8 (37)	6%	2	1%
Marsh Sandpiper	1±3 (36%)	<1±<1 (6%)	5±5 (18)	2%	3	1%
Terek Sandpiper	3±6 (60%)	1±4 (25%)	11±11 (42)	2%	10	1%
Black-tailed Godwit	1±5 (20%)	<1±1 (10%)	6±12 (54)	1%	1	<1%
Sanderling	<1±1 (4%)	<1±<1 (1%)	1±2 (8)	1%	0	0%
Wandering Tattler	<1±<1 (13%)	<1±<1 (1%)	<1±<1 (3)			
Asian Dowitcher	<1±<1 (5%)	0 (0%)	<1±<1 (1)			
Buff-breasted Sandpiper	<1±<1 (2%)	0 (0%)	<1±<1 (1)			
Common Sandpiper	<1±<1 (3%)	0 (0%)	<1±<1 (1)			
Latham's Snipe	<1±<1 (5%)	0 (0%)	<1±<1 (1)			
Ruff	0	0	<1±<1 (1)			
Total migratory	7110±917	1299±570	9473±1967 (13703)			
Black-fronted Dotterel	1±20 (41%)		4±3 (13)			

	Average (±1SD) 2002-2022				2023	
Common name	**Summer (n = 111)**	**Winter (n = 83)**	**Annual maximum (max. count)**	**IRI**	**Max**	**IRI**
Bush Stone-curlew	<1±<10 (1%)					
Masked Lapwing	5±30 (89%)		10±3 (14)			
Pied Oystercatcher	70±520 (99%)		160±47 (240)			
Pied Stilt	152±1300 (97%)		386±186 (1070)			
Red-capped Plover	76±500 (100%)		155±60 (279)			
Red-kneed Dotterel	1±60 (14%)		6±15 (53)			
Red-necked Avocet	151±2710 (76%)		543±596 (2810)			
Sooty Oystercatcher	<1±10 (12%)		1±2 (6)			
Total resident	457±123		981±566 (3126)			

The overall index of relative importance of Fisherman Island was greater than 50% for seven species and greater than 20% for 12 species (**Table 3.4**). The roosts on Fisherman Island have together supported nationally significant numbers (greater than 0.1% of the EAAF population) of 16 migratory shorebird species and internationally significant numbers (greater than 1% of the EAAF population) of six of these since 2002 (**Table 3.4**). In 2023, the index of relative importance was greater than 50% for five species and greater than 20% for 9 species, with the roosts on Fisherman Island supporting nationally significant numbers (greater than 0.1% of the EAAF population) of 11 migratory shorebird species and internationally significant numbers (greater than 1% of the EAAF population) of two of these (**Table 3.4**).

The reclamation area ponds (PBRA) have consistently supported 80-90% of the migratory shorebirds on Fisherman Island over the past 22 years, with the artificial roost (PBAR), Fisherman Island claypan (FICP), visitor centre lake (FIVC) and rail loop (PBRL) sites supporting substantially lower numbers (**Figure 3.7**).

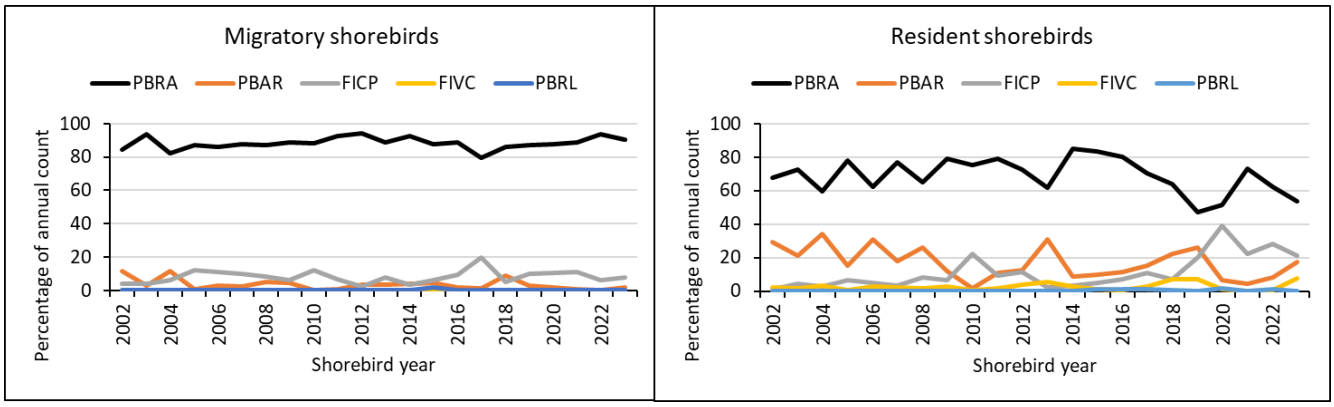

Figure 3.7. *Percentage of the total annual count of migratory and resident shorebirds on Fisherman Island supported by each of the reclamation area (PBRA), artificial roost (PBAR), Fisherman Island claypan (FICP), visitor centre (FIVC) and rail loop (PBRL) sites over the shorebird years 2002-2023.*

Averaged across all years, the reclamation area ponds have supported 88%, the Fisherman Island claypan 8%, the artificial roost 3%, and the visitor centre lake and rail loop less than 1% of the migratory shorebirds. Migratory shorebirds rarely visit the freshwater lake at the visitor centre; small numbers of Curlew Sandpiper, Sharp-tailed Sandpiper, Red-necked Stint and Marsh Sandpiper have been recorded only after the water levels at the lake have declined to very low levels during extended dry periods. The same species are similarly rarely recorded at the rail loop, but in this case only after heavy rainfall has flooded a basin inside the rail loop. The rail loop basin is an artefact of stormwater drainage management that currently allows the basin to flood after heavy rainfall. Similarly, the reclamation area ponds have consistently supported most of the resident shorebirds over the past 22 years (**Figure 3.7**). Averaged across all years, the reclamation area ponds have

supported 69%, the artificial roost 16%, the Fisherman Island claypan 12%, the visitor centre lake 3% and rail loop less than 1% of the resident shorebirds.

All four main roost sites at the Port, three on Fisherman Island together with the Lytton Claypan No. 1 on the mainland, have supported nationally significant numbers (greater than 0.1% of the EAAF population) and two roost sites, the reclamation area and Lytton Claypan No. 1 have supported internationally significant numbers (greater than 1% of the EAAF population) of migratory shorebird species within the most recent five years (**Table 3.5**). The reclamation area was nationally significant for 13 species and internationally significant for five species, Lytton Claypan No. 1 was nationally significant for six species and internationally significant for two species, the Fisherman Island claypan was nationally significant for six species and the artificial roost was nationally significant for three species.

Table 3.5. *Summary of migratory and resident shorebird species recorded at the four main roost sites at the Port of Brisbane over the past five years since September 2019, their average (±1SD) summer (1 October to 15 March, migratory species except Double-banded Plover), winter (1 May to 31 August, Double-banded Plover) or annual (resident species) counts, with overall maximum count in parentheses. Values that exceed 0.1% of the EAAF population of the species are highlighted in bold and values that exceed 1% of the EAAF population are underlined*.

Common name	Reclamation Area	Artificial Roost	Fisherman Isl. Claypan	Lytton Claypan No. 1
Migratory shorebirds				
Asian Dowitcher	0±0.2 (1)	0	0	0
Bar-tailed Godwit	**480**±430.9 (**1567**)	30.4±90.4 (**435**)	45.8±101.1 (**336**)	**769**±527.9 (**3010**)
Black-tailed Godwit	0±0.2 (1)	0.2±0.5 (2)	0.1±0.6 (3)	10.1±17.8 (71)
Broad-billed Sandpiper	7±15.6 (**76**)	0.8±2 (8)	0.1±0.4 (2)	0
Common Greenshank	0.1±0.4 (2)	1±1.6 (6)	1.3±6.6 (35)	0.7±1.5 (8)
Common Sandpiper	0±0.2 (1)	0	0	0
Curlew Sandpiper	**1376**±917.7 (**3408**)	21.8±48.2 (**166**)	53.5±91.5 (**289**)	**123.5**±266.6 (**1251**)
Double-banded Plover	**20**±11.3 (**37**)	0	0	0
Eurasian Whimbrel	0.1±0.6 (3)	6.9±13.5 (45)	32.1±40.6 (**157**)	**110.7**±65.4 (**210**)
Far Eastern Curlew	**45.9**±61.7 (**244**)	1.8±1.3 (4)	**57.2**±92.9 (**340**)	**206.8**±105.3 (**438**)
Great Knot	170.8±154.1 (**482**)	2.3±9.2 (48)	13.6±36.9 (180)	86.1±141.8 (**472**)
Greater Sand Plover	68±74 (**305**)	0	0	0
Grey Plover	20.2±13.6 (49)	0	0	0
Grey-tailed Tattler	**607.1**±424.3 (**1434**)	0±0.2 (1)	0	0
Lesser Sand Plover	**788.3**±469.9 (**2053**)	0	0	0
Marsh Sandpiper	0.6±1.4 (5)	0±0.2 (1)	0.1±0.4 (2)	2.2±5.2 (22)
Pacific Golden Plover	**363.5**±232 (**1204**)	1.4±1.9 (5)	5.2±8.4 (26)	0±0.1 (1)
Red Knot	11±30 (**152**)	2±6.5 (31)	0.8±3.8 (20)	4±8.1 (34)
Red-necked Stint	**1297.6**±686.3 (**2734**)	4.3±8.7 (42)	179.4±298.1 (**1350**)	37.7±70.8 (286)
Ruddy Turnstone	**69.5**±71.5 (**248**)	0	0	0
Sanderling	0±0.2 (1)	0	0	0
Sharp-tailed Sandpiper	**416.4**±336.7 (**1640**)	25.4±23 (**87**)	75.3±162.1 (**637**)	64.2±124 (**505**)
Terek Sandpiper	0.9±2.3 (10)	0	0	0
Wandering Tattler	0±0.2 (1)	0	0	0
Resident shorebirds				

Common name	Reclamation Area	Artificial Roost	Fisherman Isl. Claypan	Lytton Claypan No. 1
Black-fronted Dotterel	0.1±0.8 (4)	0.8±1.3 (4)	0	0.2±1.3 (9)
Masked Lapwing	0.2±0.6 (2)	1.3±1 (3)	2.8±2.1 (7)	5.3±5.9 (23)
Pied Oystercatcher	101.6±73.4 (240)	1±1.1 (3)	1.3±2.9 (11)	10.6±28.8 (189)
Pied Stilt	11.8±24 (111)	36.6±55.7 (229)	32.6±61.5 (223)	30.9±57.6 (309)
Red-capped Plover	62.5±40.3 (184)	1.3±1.3 (4)	4.2±5.4 (16)	3.5±4.2 (16)
Red-kneed Dotterel	0	0.1±0.5 (2)	0	0
Red-necked Avocet	56.8±188.7 (896)	5.2±11.9 (38)	0	2.5±10.6 (56)
Sooty Oystercatcher	0.8±1.4 (6)	0	0	0
Total migratory	*5724.4±2069.3 (9646)*	*98.3±142.8 (544)*	*464.3±473.6 (1522)*	*1427.4±756.9 (3927)*
Total resident	*233.8±191.7 (1032)*	*46.3±62.6 (232)*	*40.8±60.8 (231)*	*52.9±65.1 (326)*

3.5 SHOREBIRD BANDING AND FLAG RESIGHTING

Only a single bird was caught during the capture/banding visit to Lytton Claypan on 22nd June 2024, a Pied Stilt that was fitted with a 5g GPS transmitter. During the first 11 weeks after capture, the Pied Stilt moved mostly between the Lytton Claypan roost site (at high tide) and adjacent tidal flats (at low tide), occasionally wandering as far south as the Manly Marina artificial roost (**Figure 3.8**).

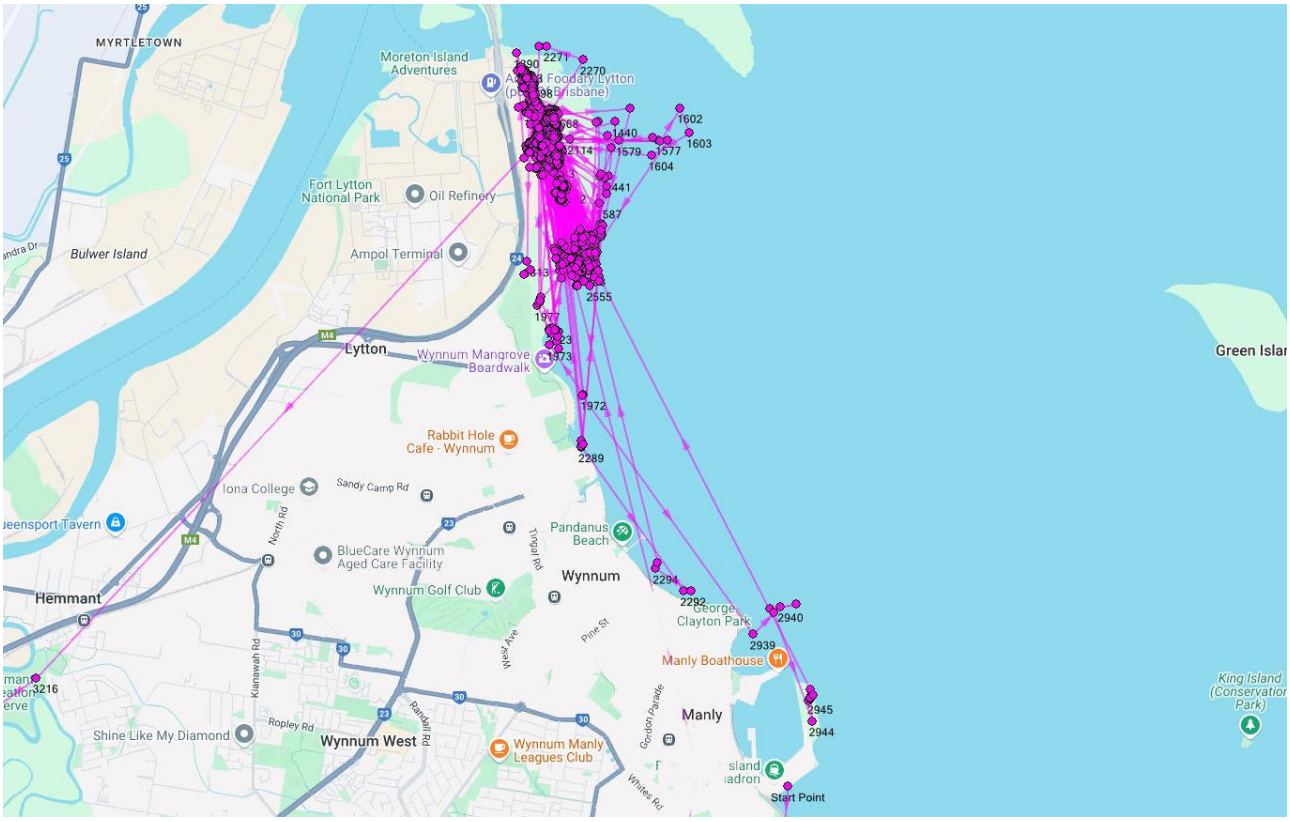

Figure 3.8: Local movements of a Pied Stilt between 22 June and 6 September 2024.

The Pied Stilt left Brisbane on 6th September arriving near Qurindi, NSW two days later where it remained until the signal was lost on 13th September (**Figure 3.9**). The loss of signal means that the bird has either shed the device or has moved further inland away from 4G signal, in which case no position data will be transmitted until it moves near a Telstra tower again.

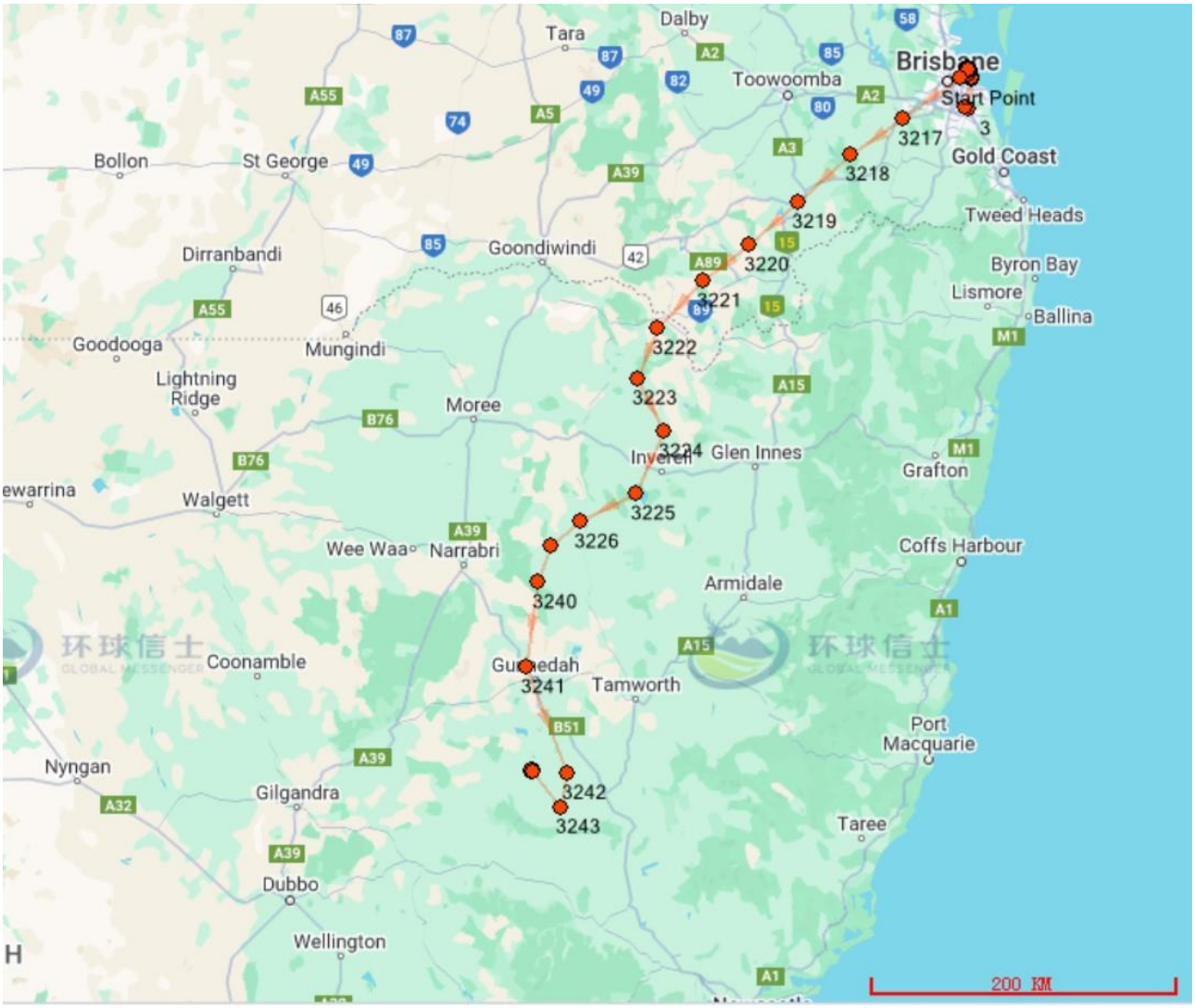

Figure 3.9: Long-distance movements of a Pied Stilt between 6 and 13 September 2024.

There were 9 shorebird flag re-sightings at the Port during the 2023/24 reporting period, including:

- 7 green flags on birds banded in Moreton Bay, including a Bar-tailed Godwit captured at Oyster Point, Cleveland (18 km south-east of the Port) in January 2024 and a Bar-tailed Godwit captured at Toorbul (35 km north of the Port) in December 2023;
- one black over white flag on a Great Knot banded on Chongming Island, China;
- one red flag on a Bar-tailed Godwit banded in New Zealand.

4.0 CONCLUSION

As reported here, the long-term monitoring supported by Port of Brisbane has shown that the combined roost sites at the Port of Brisbane, which are all located outside the boundary of the Moreton Bay Ramsar site, are the most roost area for migratory shorebirds in Moreton Bay, regularly used by around a third of migratory shorebirds that occupy the entire Moreton Bay Ramsar site through the austral summer months (Fuller *et al*. 2021, Lloyd *et al*. 2024b).

The disproportionate importance of the Port for many species may be related to several factors including suitability for roosting, availability of food, distance from preferred feeding habitat areas and protection from human disturbance. The high suitability of the reclamation area ponds as roosting habitat relates to them: (1) incorporating large areas of bare, open ground with little to no cover that provide a clear view of approaching predators; (2) being adjacent to the shoreline or incorporating areas of water and wet substrates that allow the birds to stay cool on hot days; (3)

incorporating areas with uneven relief with small surface mounds and depressions that assists with camouflage and affords some protection from strong winds; and (4) being largely protected from tidal influence such that these preferred roosting characteristics are predictably available during all high tides. The nutrient rich slurry from the dredge material pumped into the ponds promotes the development of invertebrate communities in the shallow waters, which provides food for smaller shorebirds such as Red-necked Stint and sandpipers and allows them to continue feeding through the high-tide phase of the tidal cycle when their tidal flat foraging habitat is inundated and unavailable to them (Fuller *et al*. 2021).

Shorebirds prefer to roost close their close to their preferred tidal flat feeding areas since this reduces their energy expenditure flying between roosting and feeding sites (Rogers *et al.* 2006, Ryeland *et al.* 2021). The tidal flats within a 15 km radius of the Port support relatively high foraging densities at low tide of Curlew Sandpiper, Red-necked Stint, Pacific Golden Plover, Great Knot, Lesser Sand Plover and Sharp-tailed Sandpiper compared with other areas of Moreton Bay (Thompson 1990, Driscoll 1991, Lloyd *et al*. 2021, Fuller *et al.* 2021). The disproportionate importance of the Port for roosting by these species is therefore likely related to the proximity of the Port to preferred feeding areas.

Human disturbance is a key threat to migratory shorebird use of roost sites in Moreton Bay, one that is becoming more severe as the urban population of the greater Brisbane area grows, increasing the number of people engaging in water-based recreational activities (Milton *et al.* 2011, Fuller *et al.* 2021, Lloyd *et al*. 2024a). All the main shorebird roosts at the Port of Brisbane are fenced with no public access, and disturbance from operational activities occurs only occasionally, with birds able to move between the multiple suitable roost sites in proximity when they are disturbed. This has contributed to the Port providing a predictably safe roosting environment for shorebirds over a long period of time.

5.0 RECOMMENDATIONS

Port of Brisbane Pty Ltd is encouraged to continue to prioritise the management and monitoring of shorebirds at the Port. The monitoring reported here identifies the Fisherman Island claypan and Lytton Claypan No. 1 roost sites as very significant, naturally occurring shorebird roost sites that are important to the network of roost sites in central Moreton Bay. Portions of these roost sites also provide foraging resources for migratory shorebirds when inundated. These two roost sites, together with the artificial roost, are likely to become increasingly relied upon by migratory shorebirds in future as the availability of roosting habitat in the current FPE reclamation area diminishes as it approaches the point when it is all expected to be resumed for port infrastructure. Consequently, retaining the Fisherman Island claypan, Lytton Claypan No. 1 and artificial roost sites as part of the conservation buffer land use under the Brisbane Port Land Use Plan 2020 (LUP) can make an important contribution to the sympathetic management of migratory and other shorebirds in Moreton Bay. Recognising this importance, Port of Brisbane has already made an important contribution to protecting the Lytton Claypan No. 1 roost site from disturbance through fencing it off from possible public access points. A management focus for this site should be to continue to monitor and manage the risk of disturbance.

There is also a need to continue to explore opportunities to provision or improve roosting 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.* 2021). Although the artificial roost has supported only 3% of the migratory shorebirds using Fisherman Island since 2002, it is occasionally used by large numbers of birds (see **Table 3.5**), indicating it has potential to support larger numbers of birds once currently preferred alternatives in the reclamation area are lost. For example, 1,607 and 1,149 migratory shorebirds, including up to 1,318 Bar-tailed Godwit used the artificial roost in December 2018 and January 2019.

To promote the use of the artificial roost by migratory shorebirds, Port of Brisbane implements an annual program of management that includes flooding the roost with seawater on a spring tide for a month each year to assist with managing vegetation cover and manually removing any recruiting mangrove seedlings to maintain an extensive open area of sparsely vegetated substrate to accommodate larger numbers of migratory shorebirds. These activities were performed through the 2023/24 season. In late 2023, one of the three inlet pipes was closed off to lower the water levels to provide more bare, open substrate around the perimeter of the open waters of the site. Yet, besides a count of 409 migratory shorebirds on 10th October 2023, the average count of migratory shorebirds using the artificial roost was only 70 through the remaining four summer months thereafter. The low, open islands in the artificial roost pond have gradually diminished in area over the years due to subsidence of the substrate. Consequently, an additional management intervention to improve the ability of the artificial roost site to accommodate larger numbers of birds would be to expand the area of bare substrate on the islands.

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 fully 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's FPE 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 and associated foraging areas to better understand these local dynamics (e.g. Lilleyman *et al.* 2020).

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APPENDIX A: List of migratory and resident shorebirds recorded on Fisherman Island since 2002 together with their conservation status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and Queensland *Nature Conservation Act 1992* (NC Act).

Common name	Scientific name	EPBC Act*	NC Act*
Migratory shorebirds			
Asian Dowitcher	*Limnodromus semipalmatus*	M, V	V
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, E	E
Black-tailed Godwit	*Limosa limosa*	M, E	E
Broad-billed Sandpiper	*Calidris falcinellus*	M	S
Buff-breasted Sandpiper	*Calidris subruficollis*	M	S
Common Greenshank	*Tringa nebularia*	M, E	E
Common Sandpiper	*Actitis hypoleucos*	M	S
Curlew Sandpiper	*Calidris ferruginea*	M, CE	CE
Double-banded Plover	*Charadrius bicinctus*	M	S
Eurasian Whimbrel	*Numenius phaeopus*	M	S
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	CE
Great Knot	*Calidris tenuirostris*	M, V	V
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V
Grey Plover	*Pluvialis squatarola*	M, V	V
Grey-tailed Tattler	*Tringa brevipes*	M	S
Latham's Snipe	*Gallinago hardwickii*	M, V	V
Lesser Sand Plover	*Charadrius mongolus*	M, E	E
Marsh Sandpiper	*Tringa stagnatilis*	M	S
Pacific Golden Plover	*Pluvialis fulva*	M	S
Red Knot	*Calidris canutus*	M, V	V
Red-necked Stint	*Calidris ruficollis*	M	S
Ruddy Turnstone	*Arenaria interpres*	M, V	V
Ruff	*Calidris pugnax*	M	S
Sanderling	*Calidris alba*	M	S
Sharp-tailed Sandpiper	*Calidris acuminata*	M, V	V
Terek Sandpiper	*Xenus cinereus*	M, V	V
Wandering Tattler	*Tringa incana*	M	S
Resident shorebirds			
Black-fronted Dotterel	*Elseyornis melanops*		LC
Bush Stone-curlew	*Burhinus grallarius*		LC
Hooded Dotterel	*Thinornis cucullatus*	V	LC
Masked Lapwing	*Vanellus miles*		LC
Pied Oystercatcher	*Haematopus longirostris*		LC
Pied Stilt	*Himantopus leucocephalus*		LC
Red-capped Plover	*Charadrius ruficapillus*		LC
Red-kneed Dotterel	*Erythrogonys cinctus*		LC
Red-necked Avocet	*Recurvirostra novaehollandiae*		LC
Sooty Oystercatcher	*Haematopus fuliginosus*		LC

* Conservation status: CE = critically endangered; E = endangered; M = migratory; V = vulnerable; LC = least concern; S = special least concern (migratory).

APPENDIX B: Monthly Port of Brisbane total count data for all shorebird species in 2023/24, including all sites on Fisherman Island and Lytton Claypan No. 1.

Date	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024
Migratory species	14	15	17	17	15	15	17	10	8	10	14
Resident species	6	6	6	7	4	6	6	5	7	6	6
Total migratory	2710	5510	8472	5294	9195	8568	8085	1471	1246	1411	2375
Total resident	392	527	598	349	739	538	378	778	757	570	306
Migratory											
Asian Dowitcher	0	0	0	0	0	0	0	0	0	0	0
Bar-tailed Godwit	544	290	1197	1098	1632	1547	2785	352	239	618	563
Black-tailed Godwit	2	1	34	39	34	0	4	0	0	0	2
Broad-billed Sandpiper	0	0	1	6	0	0	7	0	0	0	0
Buff-breasted Sandpiper	0	0	0	0	0	0	0	0	0	0	0
Common Greenshank	0	2	0	0	0	0	9	0	0	0	0
Common Sandpiper	0	0	0	0	0	0	0	0	0	0	0
Curlew Sandpiper	861	2029	1963	477	2105	1862	1423	32	30	8	365
Double-banded Plover	0	0	0	0	0	0	0	16	34	29	3
Eurasian Whimbrel	169	16	230	169	47	181	155	14	1	11	28
Far Eastern Curlew	383	363	276	295	289	337	131	37	50	179	113
Great Knot	68	319	185	80	405	102	179	3	0	53	48
Greater Sand Plover	8	18	75	11	50	41	30	0	0	21	53
Grey Plover	2	0	23	20	8	9	0	0	0	0	0
Grey-tailed Tattler	0	184	202	865	1275	777	941	0	0	0	299
Latham's Snipe	0	0	0	0	0	0	0	0	0	0	0
Lesser Sand Plover	47	666	725	470	860	1304	529	48	250	93	316
Marsh Sandpiper	0	0	3	1	5	4	3	0	0	0	0
Pacific Golden Plover	145	320	410	201	33	351	295	4	0	18	0
Red Knot	74	1	22	0	0	1	0	0	0	0	7
Red-necked Stint	339	793	2522	915	1897	1304	1256	953	637	381	348
Ruddy Turnstone	1	5	40	35	119	110	51	12	5	0	1
Ruff	0	0	0	0	0	0	0	0	0	0	0
Sanderling	0	0	0	0	0	0	0	0	0	0	0
Sharp-tailed Sandpiper	67	503	564	602	436	638	285	0	0	0	229
Terek Sandpiper	0	0	0	10	0	0	2	0	0	0	0
Wandering Tattler	0	0	0	0	0	0	0	0	0	0	0
unidentified shorebird	0	0	0	0	0	0	0	0	0	0	0
Resident											
Black-fronted Dotterel	3	8	10	2	0	0	4	12	8	16	2
Masked Lapwing	0	0	0	0	0	0	0	0	0	0	0
Pied Oystercatcher	0	0	0	0	0	0	0	0	0	0	0
Pied Stilt	4	5	5	13	21	10	5	8	10	5	7
Red-capped Plover	46	55	28	35	183	150	140	52	51	24	27
Red-necked Avocet	298	350	358	230	509	326	175	509	559	429	126
Sooty Oystercatcher	20	72	157	41	26	42	51	197	99	73	132

APPENDIX C: Monthly count data for the 12 most important migratory shorebird species by site in 2023/24

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond BS4	PBS4		1	202	865	1272	775	104				51	3270	72.0
Pond C3	PBC3							734					734	16.2
Pond FPE	PFPE		183				1	103					287	6.3
Pond R3	PBR3											230	230	5.1
Visitor Centre	FIVC											18	18	0.4
Pond C4	PBC4					3	1						4	0.1
	Total	**0**	**184**	**202**	**865**	**1275**	**777**	**941**	**0**	**0**	**0**	**299**	**4543**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3	4	727	1650	750	1705	534	696	517	187	33	174	6977	61.5
Pond R3	PBR3	255	20	464	110	104	129	275	225	450	337	148	2517	22.2
FI Claypan	FICP			242			533	37				1	813	7.2
Pond BS3	PBS3	13	13			65	70	62	211		11	17	462	4.1
Lytton Claypan No.1	LYN1						38	184					222	2.0
Pond C4	PBC4	2	16	64	12	23		2					119	1.0
Pond BS4	PBS4	38	3	20	38							8	107	0.9
Pond FPE	PFPE	27		73									100	0.9
Artificial roost	PBAR		14	9	5								28	0.2
	Total	**339**	**793**	**2522**	**915**	**1897**	**1304**	**1256**	**953**	**637**	**381**	**348**	**11345**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3	3	1819	1620	212	1870	1362	556	5	6		82	7535	67.5
Pond R3	PBR3	423	15	195	154	229	92	77	8	24	8	271	1496	13.4
Lytton Claypan No.1	LYN1	204		2			126	710				8	1050	9.4
FI Claypan	FICP			72			261	52					385	3.5
Artificial roost	PBAR	39	158	8	42	1	1						249	2.2
Pond FPE	PFPE	185		28	7								220	2.0
Pond C4	PBC4	3	17	32	46	4		2					104	0.9
Pond BS3	PBS3					1	20	26	18				65	0.6
Pond BS4	PBS4	4	2	4	16				1			4	31	0.3
Visitor Centre	FIVC		18	2									20	0.2
	Total	**861**	**2029**	**1963**	**477**	**2105**	**1862**	**1423**	**32**	**30**	**8**	**365**	**11155**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3		387	473	494	247	8	147					1756	52.8
FI Claypan	FICP	8					460	31					499	15.0
Pond R3	PBR3	16	13	9		115	89	21				228	491	14.8
Artificial roost	PBAR	38	59	13	87	70	18						285	8.6
Lytton Claypan No.1	LYN1	5		2			44	84				1	136	4.1
Pond C4	PBC4		42	60	7	3	1						113	3.4
Pond BS3	PBS3					1	17	2					20	0.6
Pond BS4	PBS4			5	14		1						20	0.6
Visitor Centre	FIVC		2	2									4	0.1
	Total	**67**	**503**	**564**	**602**	**436**	**638**	**285**	**0**	**0**	**0**	**229**	**3324**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Lytton Claypan No.1	LYN1	430		952	892	1060	1246	2410	291	105	258	418	8062	74.2
Pond R3	PBR3	84	5		26	292	296	60	56		360	145	1324	12.2
FI Claypan	FICP	1		237	177		5	178	5	134			737	6.8
Pond C3	PBC3					280		137					417	3.8
Artificial roost	PBAR	27	155	3	1								186	1.7
Pond C4	PBC4	2	130	3									135	1.2
Pond BS4	PBS4				2								2	0.0
Pond FPE	PFPE			2									2	0.0
	Total	**544**	**290**	**1197**	**1098**	**1632**	**1547**	**2785**	**352**	**239**	**618**	**563**	**10865**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond R3	PBR3	68			23	225	102	122	3		53	48	644	44.7
Pond C4	PBC4		319	5	21								345	23.9
Pond C3	PBC3					180		48					228	15.8
FI Claypan	FICP			180	36			9					225	15.6
	Total	**68**	**319**	**185**	**80**	**405**	**102**	**179**	**3**	**0**	**53**	**48**	**1442**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Lytton Claypan No.1	LYN1	359	338	238	221	192	155	118	22	50	144	111	1948	79.4
FI Claypan	FICP			35	71	2	148	13	15		35		319	13.0
Pond R3	PBR3	18	21			66							105	4.3
Pond C3	PBC3					26	18						44	1.8
Artificial roost	PBAR	6	3	3	3	3	1					2	21	0.9
Pond BS4	PBS4		1				14						15	0.6
Pond BS3	PBS3						1						1	0.0
	Total	**383**	**363**	**276**	**295**	**289**	**337**	**131**	**37**	**50**	**179**	**113**	**2453**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond R3	PBR3			1		67	52	14	12	5		1	152	40.1
Pond C3	PBC3			19	1	48	48	34					150	39.6
Pond BS4	PBS4				34	3	7						44	11.6
Pond FPE	PFPE		5	20				3					28	7.4
Pond BS3	PBS3						3						3	0.8
Pond C4	PBC4	1				1							2	0.5
	Total	1	5	40	35	119	110	51	12	5	0	1	379	100.0

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3	25	13	290	470	860	1304	480					3442	64.8
Pond R3	PBR3	22	652	355				36	48	250	93	316	1772	33.4
Pond FPE	PFPE		1	78									79	1.5
Pond C4	PBC4			2				13					15	0.3
	Total	**47**	**666**	**725**	**470**	**860**	**1304**	**529**	**48**	**250**	**93**	**316**	**5308**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3	8		22		50	41	30					151	49.2
Pond R3	PBR3		18	53							21	53	145	47.2
Pond C4	PBC4				11								11	3.6
	Total	**8**	**18**	**75**	**11**	**50**	**41**	**30**	**0**	**0**	**21**	**53**	**307**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond C3	PBC3	135	315	270	198	31	329	283					1561	87.8
Pond FPE	PFPE	3	1	135									139	7.8
Pond R3	PBR3	3						4	4		18		29	1.6
FI Claypan	FICP						20	8					28	1.6
Pond C4	PBC4		1	5		2							8	0.5
Pond BS4	PBS4	4	2		2								8	0.5
Artificial roost	PBAR		1		1		2						4	0.2
	Total	**145**	**320**	**410**	**201**	**33**	**351**	**295**	**4**	**0**	**18**	**0**	**1777**	**100.0**

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

Site	Date / Site code	17/09/2023	15/10/2023	12/11/2023	10/12/2023	09/02/2024	25/02/2024	24/03/2024	26/05/2024	30/06/2024	28/07/2024	25/08/2024	**Total**	% total
Pond R3	PBR3	2			16	6	8						32	51.6
Pond C4	PBC4			22	4								26	41.9
Pond C3	PBC3					2	1						3	4.8
Pond FPE	PFPE			1									1	1.6
	Total	**2**	**0**	**23**	**20**	**8**	**9**	**0**	**0**	**0**	**0**	**0**	**62**	**100.0**

APPENDIX D: Summary of 2023/24 count data for Lytton Claypan No. 1.

Table D1. *Count results for each migratory and resident shorebird species at Lytton Claypan No. 1 (LYN1) roost site from September 2023 to August 2024.*

Common name	15/09/2023	17/09/2023	14/10/2023	15/10/2023	11/11/2023	12/11/2023	09/12/2023	10/12/2023	09/02/2024	24/02/2024	25/02/2024	23/03/2024	24/03/2024	06/04/2024	11/04/2024	20/04/2024	25/05/2024	26/05/2024	30/06/2024	27/07/2024	28/07/2024	24/08/2024	25/08/2024
Tide height (m)	1.97	2.07	2.13	2.2	2.15	2.27	2.06	2.22	2.68	2.42	2.41	2.32	2.32	2.52	2.09	2.18	1.82	1.77	2.12	2.04	2.07	2.19	2.16
Bar-tailed Godwit	346	430	0	0	639	952	709	892	1060	670	1246	1596	2410	636	197	66	119	291	105	292	258	436	418
Black-tailed Godwit	0	1	0	0	36	34	37	39	34	0	0	0	4	4	12	33	0	0	0	0	0	0	2
Common Greenshank	0	0	0	0	1	0	0	0	0	2	0	2	7	3	2	0	0	0	0	0	0	0	0
Curlew Sandpiper	225	204	0	0	9	2	25	0	0	826	126	681	710	220	234	28	0	0	0	0	0	12	8
Eurasian Whimbrel	139	168	0	0	161	157	146	148	32	43	86	150	140	127	196	16	17	11	1	9	11	28	28
Far Eastern Curlew	142	359	336	338	216	238	209	221	192	237	155	118	118	37	2	38	37	22	50	156	144	128	111
Great Knot	233	149	0	0	141	136	461	472	6	7	77	42	31	2	32	0	2	3	0	3	3	39	21
Marsh Sandpiper	0	0	0	0	0	0	0	0	5	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Red Knot	4	9	0	0	12	2	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	5	2
Red-necked Stint	1	0	0	0	12	0	0	0	0	95	38	146	184	111	185	62	0	0	0	0	0	0	0
Sharp-tailed Sandpiper	22	5	0	0	63	2	0	0	0	210	44	41	84	12	0	106	0	0	0	0	0	0	1
Unidentified small wader	0	0	0	0	0	0	0	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total migratory	**1112**	**1325**	**336**	**338**	**1290**	**1523**	**1587**	**1867**	**1329**	**2090**	**1776**	**2776**	**3688**	**1153**	**860**	**351**	**175**	**327**	**156**	**460**	**416**	**648**	**591**
Black-fronted Dotterel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	18	16	0	0
Masked Lapwing	0	3	0	0	0	2	6	12	15	2	2	0	2	3	8	5	6	2	3	4	4	2	3
Pied Oystercatcher	1	0	2	8	3	4	1	0	0	0	5	0	0	0	0	0	0	0	0	4	0	0	0
Pied Stilt	219	125	0	0	28	130	26	3	309	140	104	178	78	470	280	335	182	248	300	203	219	170	53
Red-capped Plover	10	3	6	2	6	8	0	8	2	13	11	16	27	14	12	25	14	11	18	7	6	5	6
Red-necked Avocet	16	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total resident	**246**	**131**	**8**	**10**	**37**	**144**	**36**	**26**	**326**	**155**	**122**	**194**	**107**	**487**	**300**	**365**	**202**	**265**	**325**	**236**	**245**	**177**	**62**