SHOREBIRD CONSERVATION ACTION PLAN 2022/23 SURVEYS AND ASSESSMENT

SUNSHINE COAST

Prepared for
Sunshine Coast Council

Biodiversity Assessment and Management Pty Ltd
PO Box 1376
CLEVELAND 4163

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Date: 25/07/2023

Principal Ecologist and Director

EXECUTIVE SUMMARY

BACKGROUND

Sunshine Coast Council (SCC) has developed a Shorebird Conservation Action Plan to raise awareness and educate the public around shorebirds, to manage and protect shorebird habitat, and to provide management solutions for shorebird conservation, with a particular focus on important habitat for migratory and resident shorebirds that gather in large numbers on the sandbanks and mudflats of the lower Maroochy River and the Caloundra Banks on the northern Pumicestone Passage.

Three key objectives of the Shorebird Conservation Action Plan are to:

- Identify current migratory and resident shorebird habitats within the SCC local government area (LGA);
- Identify species and abundance of migratory and resident shorebirds in those habitats; and
- Determine the main threats to migratory and resident shorebirds in the SCC LGA and incorporate site management needs and recommendations.

STUDY APPROACH

This study aims to implement the key objectives of the Shorebird Conservation Action Plan through a combination of:

- Review and analysis of shorebird survey data for the SCC LGA collected by the Queensland Wader Study Group (QWSG); and
- Conducting shorebird surveys of the lower Maroochy River and the Caloundra Banks to determine current shorebird distribution and habitat, identify which shorebird species are present, and determine the type and extent of disturbance.

KEY RESULTS

Lower Maroochy River

Tidal flats along the lower Maroochy River supported an average of 119 and a maximum of 173 migratory shorebirds in 2022/23, compared to an average of 109 and a maximum of 146 in 2020/21. The tidal flats supported an average of 9 and a maximum of 15 resident shorebirds in 2022/23, similar to an average of 9 and a maximum of 16 resident shorebirds in 2020/21. Numbers of critically endangered Far Eastern Curlew decreased from an average of 8 (maximum 13) in 2020/21 to an average of 4.5 (maximum 6) in 2022/23. Numbers of vulnerable Bar-tailed Godwit similarly decreased from an average of 21 (maximum 35) in 2020/21 to an average of 10.5 (maximum 21) in 2022/23. The most important tidal flat area for foraging migratory shorebirds continued to be MR06 on the eastern side of Goat Island, which supported an average of 66 and a maximum of 115 migratory shorebirds at low tide in 2022/23. Other important tidal flats were MR04 and MR07 in both 2020/21 and 2022/23, both on the western side of Goat Island.

Based on analysis of long-term QWSG data, a total of 14 migratory shorebird species and six resident shorebird species have been recorded feeding at low tide through the summer period, whereas a total of six migratory shorebird species and seven resident shorebird species have been recorded feeding at low tide through the winter period. There has been a significant decline in the total migratory shorebird count between 2011 and 2022 at low tide during both the summer and winter periods.

Five main roost sites used by shorebirds and other waterbirds occur in the lower Maroochy River: Goat Island (MRGI); Nojoor Road (MRNR); north shore (MRNS); sand bar (MRSB); and tree roost (MRTR). During the four surveys in 2022/23, shorebirds were recorded roosting at only MRGI (all surveys) and MRTR (one survey); no birds were recorded at MRNR or MRNS. Over the past three seasons, the total number of migratory shorebirds using the Goat Island roost has ranged between 40 and 109 and the total number of resident shorebirds has ranged between 2 and 12. The most frequently recorded migratory shorebirds included Eurasian Whimbrel (17-72 birds), the vulnerable Bar-tailed Godwit (11-71 birds) and the critically endangered Far Eastern Curlew (3-6 birds). Analysis of Queensland Wader Study Group (QWSG) data shows that the north shore (MRNS) was the most important migratory shorebird roost site in the lower Maroochy River area up until 2004. Thereafter, Goat Island (MRGI) became more increasingly used by shorebirds for roosting. Based on QWSG data, the north shore has experienced the highest frequency of disturbance across all categories, including the presence of dogs. QWSG counters report that the north shore has largely been abandoned as a roost site due to the high frequency of disturbance from recreational activities. The dynamic changes to the sandbanks may also have altered roost suitability. This effective loss of a roost site reduces the resilience of shorebirds to disturbance since there are fewer alternative roost sites available should disturbance cause them to leave a particular roost site.

Caloundra

Four main areas of tidal flat feeding habitat occur in the northern Pumicestone Passage at Caloundra that have been subject to monitoring during this study and by the QWSG since 1993: a large tidal flat on the eastern side of the passage along the north-western tip of Bribie Island (SBN1); a large tidal flat on the western side of the passage opposite Golden Beach (SBN2); a small tidal flat connected to SBN2 opposite Pelican Waters (PEWA); and several small patches of tidal flat at Bell's Creek (BECK). SBN2 and the area nearby was found to have changed substantially following the creation of a new channel to the sea that broke through the northern tip of Bribie Island in January 2022. A high bank has established between the southern end of the isolated northern tip of Bribie Island and Golden Beach. The bank runs westwards to within about 150m of the Golden Beach shoreline and, at low tide, people can cross a channel here and walk along this bank in close proximity to feeding birds. Birds are using existing and new feeding habitat that are still referred to as SBN2 and they are able to roost here now on all high tides because the top of the bank does not usually become submerged. Birds were observed feeding on both SBN1 and SBN2 at low tide and readily retreat to the high parts of SBN2 at the peak of the tide, providing they are not disturbed. However, many people now regularly traverse this bank at low tide because they can cross over to the now isolated northern tip of Bribie Island at low tide. People also come onto the bank at high tide by boat, kayak or paddleboard. A new area of tidal flat (SBN3) has formed on the south side of the new opening into Pumicestone Passage where sediment has gradually built up on the outer southern side of the new entrance. Observations suggest shorebirds are increasingly feeding on this new area of tidal flat, which is not currently accessed by people except by boat.

The tidal flat areas of SBN1 and SBN2 (including PEWA) were important feeding areas for migratory shorebirds, particularly for the critically endangered Far Eastern Curlew, vulnerable Bar-tailed Godwit, Eurasian Whimbrel and Pacific Golden Plover. Five other migratory shorebird species were recorded occasionally in small numbers across the two seasons, together with small numbers of five resident shorebird species that included a pair of vulnerable Beach Stone-curlew at SBN1 in the 2020/21 season. In 2022/23, the tidal flats supported an average combined total of 145 and a maximum of 241 migratory shorebirds but an average of 9 and maximum of 14 resident shorebirds during the summer season. These numbers are similar to those recorded in 2020/21, when the tidal flats supported an average combined total of 198 and a maximum of 224 migratory shorebirds but an average of 8 and maximum of 14 resident shorebirds during the summer season. Numbers of the critically endangered Far Eastern Curlew averaged 32 (maximum 35) in 2020/21 but averaged 20 (maximum 35) in 2022/23. Numbers of the vulnerable Bar-tailed Godwit averaged 86 (maximum 123) in 2020/21 but averaged 44 (maximum 72) in 2022/23. The large numbers of other waterbirds recorded on some of the surveys were mostly terns roosting on the tidal flat sandbars at low tide.

Based on analysis of long-term QWSG data, a total of 19 migratory shorebird species and seven resident shorebird species have been recorded feeding at low tide on tidal flats at Caloundra since 1993. There is evidence that there has been a long-term reduction in the total numbers of migratory shorebirds using the SBN1, SBN2 and BECK tidal flat areas between 1993 and 2020. Several species also appear to have declined in abundance since 1993 across one or more of the four tidal flat areas, including Greater Sand Plover, Lesser Sand Plover, Curlew Sandpiper, Grey-tailed Tattler, Red-necked Stint and Bar-tailed Godwit.

Six known shorebird roost sites occur at Caloundra. Five of these roost sites (CBAR, SBN1, SBN2, BCTR, NTBI) were surveyed during the 2021/22 season, including NTBI that was identified as a new roost on the coastal shoreline of the northern tip of Bribie Island during 2021/22. A further new roost has formed on a sand bank (SBN3) on the southern bank of the new entrance channel to Pumicestone Passage. An average of 179 (range 143 to 235) migratory shorebirds used roost sites at Caloundra during the four high tide surveys in 2022/23, including up to 37 critically endangered Far Eastern Curlew, 66 vulnerable Bar-tailed Godwit, 102 Eurasian Whimbrel and 66 Pacific Golden Plover. Mixed flocks of migratory shorebirds moved between the SBN1, SBN2, SBN3, CBAR and NTBI roost sites, depending on the height of the tide and in response to disturbance. The mangrove tree roost opposite Bells Creek (BCTR) was regularly used by up to 45 Eurasian Whimbrel.

The three roost sites CBAR, SBN1 and SBN2 have been monitored intermittently by the QWSG since 1993 while a minor roost site at Wickham Point (WICK) has been monitored continuously since 1999. A total of 17 migratory shorebird species and seven resident shorebird species have been recorded roosting at these high tide roost sites at Caloundra. The most commonly recorded migratory shorebird species included the vulnerable Bar-tailed Godwit, the critically endangered Far Eastern Curlew, Eurasian Whimbrel and Pacific Golden Plover; the four species that were also most frequently present feeding on the tidal flats at low tide.

RECOMMENDATIONS

This report identifies the most important areas for shorebirds along the Lower Maroochy River and at Caloundra and existing levels of disturbance to shorebirds in these areas. This disturbance pressure is predicted to continue to increase as the region becomes more developed. Consequently, there is a need for proactive management of disturbance to shorebirds at the important roosting and feeding habitats along the Lower Maroochy River and at Caloundra.

Recommended approaches for reducing disturbance to feeding and roosting shorebirds include a combination of:

- Site-specific information signage to raise awareness of the presence of shorebirds in the area and the importance of the key habitat areas for shorebirds, particularly migratory shorebirds;
- Other approaches to raising public awareness of how the migration and feeding ecology of shorebirds are impacted by disturbances to try to change public awareness of, and attitudes towards, disturbing shorebirds, particularly among dog-owners that exercise their dogs along foreshore areas;
- Planning to ensure suitable dog-walking facilities such as dog-off leash areas are situated in locations convenient and attractive to the public but separated from important shorebird foreshore habitats;
- Planning to limit access to important feeding or roosting areas by people and/or dogs; and
- Effective enforcement of access restrictions and dog on-leash areas, given that compliance to access restrictions or on-leash laws is strongly dependent on the extent of enforcement.

SHOREBIRD CONSERVATION ACTION PLAN SURVEYS AND ASSESSMENT 2022/23

SUNSHINE COAST

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Table of Terms and Abbreviations

BAAM	Biodiversity Assessment and Management Pty Ltd
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
LGA	Local government area
NC Act	Queensland *Nature Conservation Act 1992*
QWSG	Queensland Wader Study Group
SCC	Sunshine Coast Council

1.0 INTRODUCTION

1.1 BACKGROUND

Sunshine Coast Council (SCC) has developed a Shorebird Conservation Action Plan to raise awareness and educate the public around shorebirds, to manage and protect shorebird habitat, and to provide management solutions for shorebird conservation, with a particular focus on important habitat for migratory and resident shorebirds that gather in large numbers on the sandbanks and mudflats of the lower Maroochy River and the Caloundra Banks on the northern Pumicestone Passage.

Three key objectives of the Shorebird Conservation Action Plan are to:

- Identify current migratory and resident shorebird habitats within the SCC local government area (LGA);
- Identify species and abundance of migratory and resident shorebirds in those habitats; and
- Determine the main threats to migratory and resident shorebirds in the SCC LGA and incorporate site management needs and recommendations.

During 2020/21 and 2021/22, BAAM completed a number of surveys at both low tide (surveying shorebird use of feeding habitat) and high tide (surveying shorebird use of roost sites) in the lower Maroochy River and at Caloundra in the northern Pumicestone Passage. Since these surveys were undertaken, SCC has implemented strategies to manage disturbance to shorebirds on the lower Maroochy River, while the configuration of shorebird habitats has been substantially altered at Caloundra after a new entrance channel to Pumicestone Passage formed when heavy seas associated with Cyclone Seth broke though the northern coastline of Bribie Island in January 2022. The new entrance has gradually widened since then; consequently, SCC requested a further four monitoring events of shorebird use of roost sites at high tide and foraging habitat at low tide during the summer period in the lower Maroochy River and at Caloundra.

1.2 OBJECTIVES OF THIS STUDY

This study aims to implement the key objectives of the Shorebird Conservation Action Plan identified in **Section 1.1** above through a combination of:

- Conducting four high tide surveys and four low tide surveys at each of the lower Maroochy River and the Caloundra Banks to monitor current shorebird distribution and habitat, identify which shorebird species are present, and determine the type and extent of disturbance; and
- conducting an updated analysis of trends in shorebird use of high tide roost sites and low tide feeding habitat areas based on the additional season of data since the analysis of 2021/22 reported by BAAM (2022), combining the survey data with the latest data for the SCC LGA collected by the Queensland Wader Study Group (QWSG).

The QWSG is a special interest group of the Queensland Ornithological Society Incorporated that monitor shorebird populations in Queensland and conducts regular shorebird surveys of different parts of the Queensland coast that have large shorebird populations. The QWSG maintains a database of these shorebird survey data that is updated on a monthly basis. The surveys and review of count data supplied by the QWSG aims to provide information on the following:

- Shorebird statistics: total abundance; species observed; and species abundance;
- Shorebird behaviour: activity (roosting/foraging); and spatial data of foraging locations; and
- Frequency and type of disturbance observed.

2.0 STUDY APPROACH

The QWSG has historical data for roost sites and feeding areas monitored at both Caloundra and the lower Maroochy River and still currently undertakes monthly monitoring of many of these sites. Therefore, the study approach combined an analysis of updated QWSG high tide and low tide data for the study area with field surveys of shorebirds using roost sites at high tide and tidal flat feeding habitats at low tide, as outlined in more detail below. Updated QWSG data were provided free of charge on the basis of a data sharing agreement with the QWSG, whereby the raw data collected by the BAAM surveys are also provided to the QWSG for incorporation into the long-term QWSG database.

2.1 HIGH TIDE SURVEYS

Four high tide surveys were conducted once a month from November 2022 to February 2023 at each of the lower Maroochy River and in the northern Pumicestone Passage at Caloundra. All surveys were conducted using a small, motorised boat, which facilitated access to roosting habitats throughout the relatively large survey areas, including on the northern tip of Bribie Island. The surveys aimed to start on the rising tide to develop a better understanding of the movements of shorebirds to mid-tide and high-tide roosts from tidal flat feeding areas during the transition between high tide and low tide. However, the counting of shorebirds at the roost sites was conducted within the 3-hour period 1.5 hours either side of high tide, when all previously known roost sites at each locality were visited. The surveys determined the total number of individuals of each species present, to enable assessment of site and habitat importance, and collected spatial data of the area used by shorebirds for roosting to facilitate mapping of roost site extents.

2.2 LOW TIDE SURVEYS

Four low tide surveys of tidal flat feeding habitat were conducted once a month from November 2022 to February 2023 at each of the lower Maroochy River and in the northern Pumicestone Passage at Caloundra. The surveys combined observations conducted from a boat with observations from the shoreline. The use of a boat allowed the surveys to be conducted over a shorter period of time and allowed access to areas that are problematic to survey from the shoreline due to the width of the open water channels. The low tide surveys of the lower Maroochy River covered the full length and width of the lower Maroochy River from 1 km upstream of the Sunshine Motorway bridge through to the river mouth. The low tide surveys at Caloundra covered the tidal flats on both sides of Pumicestone Passage from the Caloundra Bar south to Bell's Creek.

2.3 GENERAL SURVEY METHODS

The summer surveys included one survey in the December-January school holidays to get a better understanding of the amount of disturbance associated with this period. The surveys were conducted in accordance with migratory shorebird survey guidelines (Commonwealth of Australia 2015); specifically:

- The surveys for foraging shorebirds were conducted as close to the time of low tide as practicable and at a maximum of no more than two hours either side of low tide;
- The surveys for roosting shorebirds were conducted as close to the time of high tide as practicable and at a maximum of no more than two hours either side of high tide;
- The surveys were not undertaken during periods of high rainfall or strong winds;
- The surveys determined the total number of individuals of each species present, to enable assessment of site and habitat importance; and
- The surveys collected spatial data of the area used by shorebirds for roosting and feeding to facilitate mapping of roosting and foraging habitat.

Shorebirds were surveyed using a combination of a high-powered spotting telescope mounted on a secure tripod (on land) and high quality 10x40 binoculars (on the boat). Sources of actual or potential disturbance observed within or close to each survey site (close enough to cause disturbance) were recorded as a count of people, dogs on leash, dogs off leash, and watercraft during a single observation sweep of the survey site to provide a snapshot in time as per the approach of Stigner *et al*. (2016). Disturbance is an event that causes birds to cease foraging or resting activities to become alert, start walking away from the source of disturbance or take flight in response to the disturbance.

The surveys were undertaken by Dr Peter Driscoll (a shorebird specialist) with the assistance of Dr Simone Bosshard (Coastal Conservation and Permits Officer, SCC). The surveys were not undertaken during periods of high rainfall or strong winds.

2.4 STATISTICAL ANALYSIS

Tests for temporal trends in shorebird count numbers at any site were conducted using either a non-parametric Mann-Kendall trend test (trend with no missing values) or generalised linear model fitted to a Poisson distribution for count data (trend with some missing year values) in R (R Core Team 2023). Analyses were conducted separately for data at high tide and low tide due to the limited overlap in count data across years. Average counts are reported ± 1 standard deviation, where the standard deviation is a measure of the variability in the counts.

3.0 RESULTS AND DISCUSSION

3.1 BACKGROUND ON SHOREBIRD ECOLOGY

Most shorebirds live on or near the coast, on beaches, reefs and tidal mudflats, though some also visit, or are largely confined to, freshwater habitats (Colwell 2010). Most coastal species feed on flat, tidal shores with extensive muddy or sandy intertidal areas (hereafter referred to as tidal flats). Most species are gregarious, wary and fly strongly and swiftly (Geering *et al*. 2007; Colwell 2010). A large proportion of Australia's shorebird species are migratory, spending their non-breeding season (the Austral summer) in Australia and migrating up to 13,000 km north along the East Asian–Australasian Flyway to breeding grounds in eastern Siberia and western Alaska (most species, Bamford *et al*. 2008) or south to New Zealand (Double-banded Plover (*Charadrius bicinctus*), Pierce 1999).

On their non-breeding grounds in Australia, coastal migratory shorebirds have a daily activity pattern driven largely by the tidal cycle, roosting in flocks at sites above the high-water mark at high tide and moving to tidal flat feeding areas once they become exposed as the water recedes (Colwell 2010). They are capable of feeding during both the day and night. Shorebirds 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 bills, which are elongated in many species. Different shorebird species specialise on different prey, prey sizes and feeding styles depending on their evolved bill morphology and body size (Lifjeld 1984; Baker 1989; Barbosa and Moreno1999; Durell 2000). Species with long, slender bills like the Far Eastern Curlew that depend on deep probing of sediments for locating prey tend to prefer feeding in softer sediments with less resistance to bill probing (Finn *et al*. 2008).

Coastal shorebirds also depend on roosting areas near their feeding areas that allow them to rest (during times when their feeding habitat is inundated at high tide) without losing too much energy to disturbance (Colwell 2010). Migratory shorebirds select roost sites on the basis of: distance from feeding areas (preferring sites close to feeding areas since that reduces their energy expenditure flying between roosting and feeding sites); distance from tall cover (preferring sites with little cover to ensure a clear view of approaching predators); climate (preferring sites at the water's edge to stay cool); height of the tide (whether the site will be inundated); and background colour of the roost site (providing camouflage against predators) (Rogers *et al*. 2006a). There is also some

evidence that feeding site selection is influenced by distance from available roost sites (Rogers *et al*. 2006a), since energy expended flying between feeding and roosting sites reduces the birds' ability to store fat for migration (Rogers 2003). As a result of these requirements, both feeding and roosting habitats are essential to migratory shorebirds.

Migratory shorebirds are particularly sensitive to disturbance at roost sites since they are often concentrated into small areas at roost sites that may be quite distant from the nearest suitable alternative. Ongoing urban development and population growth in south-east Queensland is resulting in steadily increasing disturbance pressure on shorebirds at both roost sites and tidal flat feeding habitats sites (Fuller *et al.* 2019).

3.2 SURVEY TIMING AND CONDITIONS

The survey dates and survey conditions during the surveys of the lower Maroochy River and Caloundra are summarised in **Appendix 1**. All surveys were conducted during conditions that were suitable for conducting a shorebird survey.

3.3 LOWER MAROOCHY RIVER

3.3.1 Low tide surveys

The four summer surveys of foraging shorebirds covered seven different areas of tidal flat exposed at low tide. The locations of these areas are shown in **Figure 3.1**. **Table 3.1** summarises the summer-season survey results for both 2020/21 and 2022/23 seasons. Tidal flats along the lower Maroochy River supported an average of 119 and a maximum of 173 migratory shorebirds in 2022/23 compared to an average of 109 and a maximum of 146 in 2020/21. The tidal flats supported an average of 9 and a maximum of 15 resident shorebirds in 2022/23, similar to an average of 9 and a maximum of 16 resident shorebirds in 2020/21. Four migratory shorebird species dominated the counts: Pacific Golden Plover, Eurasian Whimbrel, Bar-tailed Godwit and Far Eastern Curlew. Numbers of critically endangered Far Eastern Curlew decreased from an average of 8 (maximum 13) in 2020/21 to an average of 4.5 (maximum 6) in 2022/23. Numbers of vulnerable Bar-tailed Godwit similarly decreased from an average of 21 (maximum 35) in 2020/21 to an average of 10.5 (maximum 21) in 2022/23.

The most important tidal flat area for foraging migratory shorebirds continued to be MR06 on the eastern side of Goat Island, which supported an average of 66 and a maximum of 115 migratory shorebirds at low tide in 2022/23 (**Table 3.1**). Other important tidal flats were MR04 and MR07 in both 2020/21 and 2022/23, both on the western side of Goat Island. The statistics for MR05 in 2022/23 were inflated by a single count of 42 Pacific Golden Plover in November 2022 that had likely been displaced from MR06 by a person walking a dog off leash in MR06.

The large numbers of other waterbirds observed at MR06 in both 2020/21 and 2022/23 (**Table 3.1**) were mostly a variety of terns roosting in large flocks at low tide.

The QWSG has undertaken regular low tide surveys of shorebirds feeding on the tidal flats of the lower Maroochy River (including areas MR02 to MR07) since 2012. Combining the QWSG (including only counts within two hours of either low tide or high tide) and BAAM survey data, five migratory shorebird species (Pacific Golden Plover, Eurasian Whimbrel, Bar-tailed Godwit, Far Eastern Curlew, Grey-tailed Tattler) and two resident shorebird species (Pied Oystercatcher, Red-capped Plover) dominated the low tide counts (**Table 3.2**). These are the same species that dominated the 2020/21 and 2022/23 counts except that Grey-tailed Tattler was relatively less important in the latter counts. A total of 14 migratory shorebird species and six resident shorebird species have been recorded feeding at low tide through the summer period, whereas a total of six migratory shorebird species and seven resident shorebird species have been recorded feeding at low tide through the winter period since 2011 (**Table 3.2**).

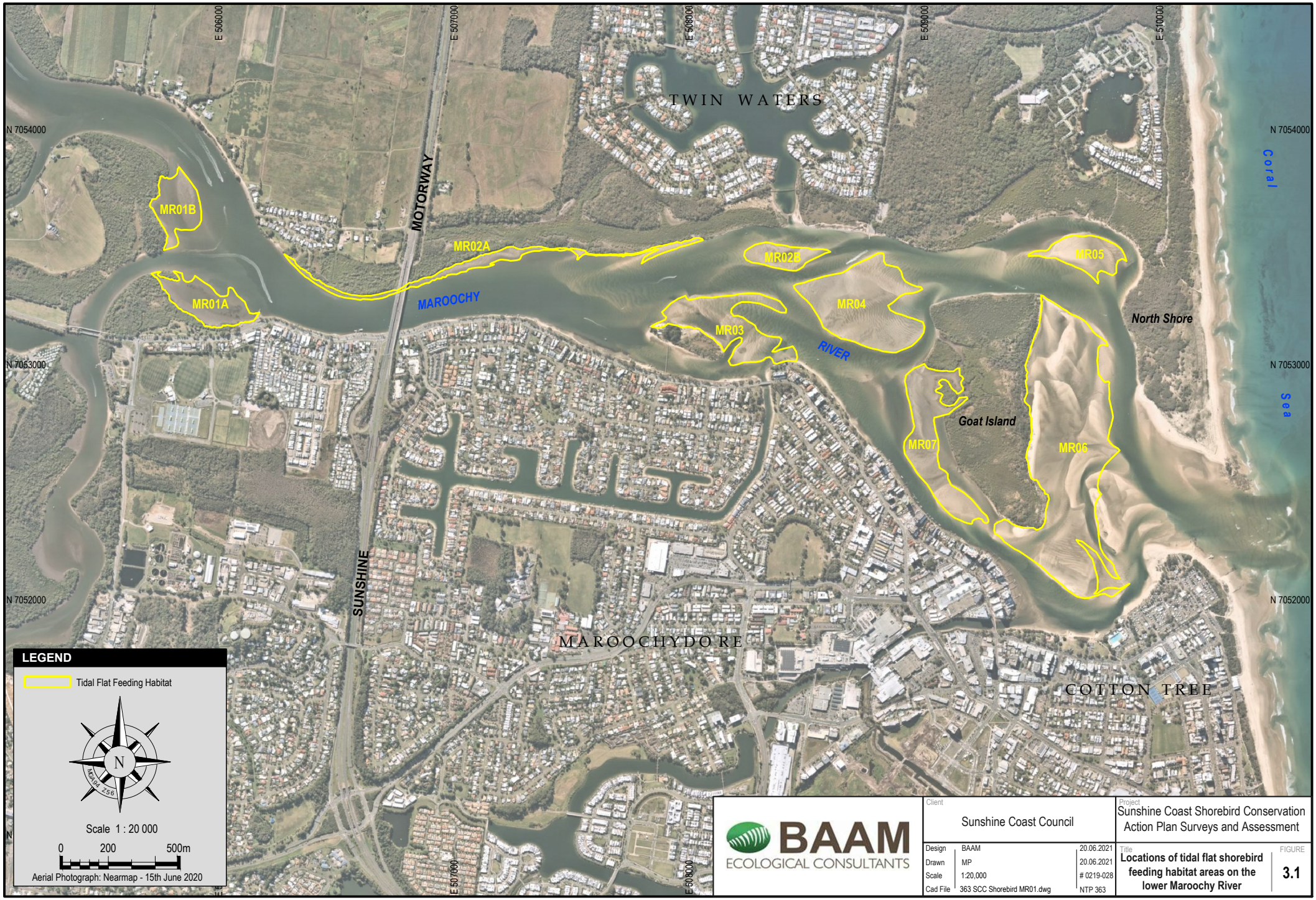

Table 3.1. Summary of shorebird species and the average ± 1 standard deviation and maximum (in brackets) numbers recorded in each of the seven low tide survey areas (MR01 to MR07) during summer season surveys of the lower Maroochy River in 2020/21 (top row, 5 surveys) and 2022/23 (bottom row, 4 surveys).

Common name	EPBC*	NCA*	MR01	MR02	MR03	MR04	MR05	MR06	MR07	Total
Far Eastern Curlew	M, CE	E	0 0	1±1.2 (3) 0	0.2±0.4 (1) 0	1.2±1.3 (3) 0.5±0.6 (1)	0 0.3±0.5 (1)	4.4±2.7 (8) 2.8±1.3 (4)	1.2±0.8 (2) 1.0±1.2 (2)	8.0±3.7 (13) 4.5±1.3 (6)
Eurasian Whimbrel	M	S	0.4±0.9 (2) 0.8±1.0 (2)	0.6±0.5 (1) 1.0±0.8 (2)	0.2±0.4 (1) 1.0±1.4 (3)	7.0±2.5 (9) 7.0±2.9 (11)	1.2±1.3 (3) 0	22.4±5.3 (29) 36.5±24.1 (72)	3.4±3.2 (8) 6.5±3.7 (9)	35.2±8.5 (46) 52.8±21.3 (82)
Bar-tailed Godwit (W Alaskan)	M, V	V	0 0	1±1.4 (3) 0	0.6±1.3 (3) 0	13.4±6.1 (23) 3.0±2.4 (5)	0 0.3±0.5 (1)	4.2±2.5 (6) 4.0±6.2 (13)	1.8±2.7 (6) 3.3±3.9 (8)	21.0±9.0 (35) 10.5±8.2 (21)
Pacific Golden Plover	M	S	0 0.3±0.5 (1)	0 1.5±3.0 (6)	0 0.3±0.5 (1)	4.8±6.7 (14) 10.5±15.6 (33)	0 11.5±20.4 (42)	36.6±24.1 (58) 22.5±36.3 (76)	2.8±6.3 (14) 3.5±7.0 (14)	44.2±20.8 (65) 50.0±52.1 (111)
Greater Sand Plover	M, V	V	0 0	0 0	0 0	0.4±0.9 (2) 0	0 0	0 0	0 0	0.4±0.9 (2) 0
Great Knot	M, CE	E	0 0	0 0	0 0	0 0	0 0	0.4±0.9 (2) 0	0 0	0.4±0.9 (2) 0
Grey-tailed Tattler	M	S	0 0	0 0	0 0	0 0	0 1.3±2.5 (5)	0 0	0 0.3±0.5 (1)	0 1.5±2.4 (5)
Pied Oystercatcher		LC	0.8±1.1 (2) 0	0 0	0 0.5±1.0 (2)	0.2±0.4 (1) 0.5±1.0 (2)	0 0	1.8±0.8 (3) 1.8±2.4 (5)	1.6±1.8 (4) 3.0±1.6 (5)	4.4±1.9 (7) 5.8±3.0 (10)
Masked Lapwing		LC	1.4±1.3 (3) 0.8±1.5 (3)	0 0	0 0	0 0	0 0	0.4±0.9 (2) 0.5±1.0 (2)	0 0	1.8±1.8 (4) 1.3±2.5 (5)
Red-capped Plover		LC	0 0	0 0	0 0	0 0	0 1.0±2.0 (4)	3.2±4.7 (11) 1.0±1.2 (2)	0 0	3.2±4.7 (11) 2.0±2.8 (6)
Beach Stone Curlew		V	0 0	0 0	0 0	0 0	0 0	0 0.3±0.5 (1)	0 0	0 0.3±0.5 (1)
Total migratory shorebirds			**0.4±0.9 (2)** **1.0±1.2 (2)**	**2.6±2.3 (5)** **2.5±2.4 (6)**	**1±2.2 (5)** **1.3±1.3 (3)**	**26.8±10 (35)** **21.0±14.6 (42)**	**1.2±1.3 (3)** **13.3±22.6 (47)**	**68±29.8 (96)** **65.8±44.7 (115)**	**9.2±9.4 (25)** **14.5±10.8 (27)**	**109.2±36.3 (146)** **119.3±42.4 (173)**
Total resident shorebirds			**2.2±1.5 (4)** **0.8±1.5 (3)**	**0** **0**	**0** **0.5±1.0 (2)**	**0.2±0.4 (1)** **0.5±1.0 (2)**	**0** **1.0±2.0 (4)**	**5.4±4.8 (13)** **3.5±4.0 (7)**	**1.6±1.8 (4)** **3.0±1.6 (5)**	**9.4±5.6 (16)** **9.3±5.1 (15)**
Total other waterbirds			6.6±7.5 (18) 5.3±7.1 (15)	4.6±3.8 (9) 7.5±2.4 (10)	3.4±7.6 (17) 3.5±3.9 (9)	19.4±9.2 (32) 24.3±23.5 (50)	3.6±8 (18) 1.0±2.0 (4)	722.8±699.2 (1754) 506.8±638.7 (1463)	20.2±11.6 (36) 29.8±7.9 (41)	780.6±689.2 (1805) 578.0±639.5 (1537)

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table 3.2. Average count per survey at low tide and high tide of migratory shorebirds during each of the summer (October to mid-March) and winter (May to August) periods and of resident shorebirds throughout the year, based on QWSG data and this study, 1997-2023.

	Summer		Winter	
	Low tide	High tide	Low tide	High tide
Migratory shorebirds				
Pacific Golden Plover	49.40	37.67	0.16	2.64
Eurasian Whimbrel	31.96	13.62	4.18	1.64
Bar-tailed Godwit	13.92	31.38	0.52	5.64
Grey-tailed Tattler	5.29	3.71	0.63	0.33
Far Eastern Curlew	5.18	3.87	1.31	1.57
Double-banded Plover	0.49	0.00	4.75	11.05
Red-necked Stint	0.40	3.97	0.00	0.81
Sharp-tailed Sandpiper	0.26	0.00	0.00	0.00
Greater Sand Plover	0.18	1.29	0.00	0.38
Lesser Sand Plover	0.12	0.34	0.00	0.60
Common Greenshank	0.09	0.04	0.00	0.00
Great Knot	0.07	0.20	0.00	0.24
Ruddy Turnstone	0.02	0.21	0.00	0.05
Wandering Tattler	0.02	0.04	0.00	0.00
Black-tailed Godwit	0.00	1.39	0.00	0.00
Terek Sandpiper	0.00	0.22	0.00	0.31
Curlew Sandpiper	0.00	0.15	0.00	0.00
Sanderling	0.00	0.02	0.00	0.00
Red Knot	0.00	0.00	0.00	0.14
Resident shorebirds				
Pied Oystercatcher	4.59	2.39		
Red-capped Plover	2.51	16.96		
Masked Lapwing	1.31	0.70		
Beach Stone-curlew	1.22	0.11		
Pied Stilt	0.26	0.39		
Sooty Oystercatcher	0.09	0.20		
Black-fronted Dotterel	0.00	0.06		

Figure 3.2 shows the average total count of migratory shorebirds each summer (October to mid-March) and winter (May to August) season. There has been a significant decline in the total migratory shorebird count between 2011 and 2022 at low tide during both the summer (χ^2 = -58.43, P <0.001) and winter (χ^2 = -14.78, P <0.001) periods. In years in which surveys at both low tide and high tide were undertaken, the average abundance of migratory shorebirds was generally greater at low tide than at high tide, suggesting that at least some of the birds that feed on the tidal flats along the lower Maroochy River do not roost at roost sites within the lower Maroochy River.

Figure 3.3 shows the long-term trends in the average total counts of the most common migratory and resident shorebirds each summer (October to mid-March: migratory shorebirds excluding Double-banded Plover, winter (May to August: Double-banded Plover) or throughout the year (resident shorebirds). Exploratory data analysis showed no seasonal trends in the counts of resident shorebird species. Abundance at low tide since 2011 has declined significantly for Pacific Golden Plover (χ^2 = -100.16, P <0.001), Grey-tailed Tattler (χ^2 = -42.43, P <0.001), Double-banded Plover (χ^2 = -4.16, P = 0.041) and Red-capped Plover (χ^2 = -73.48, <0.001), but there has been no trend in Bar-tailed Godwit (χ^2 = 1.36, P = 0.24), Far Eastern Curlew (χ^2 = -0.68, P = 0.41), Eurasian Whimbrel (χ^2 = 1.87, P = 0.17) and Pied Oystercatcher (χ^2 = -0.05, P = 0.82). All declining species are non-threatened species whose populations are not known to have declined, whereas species that showed no trend at low tide included the critically endangered Far Eastern Curlew and vulnerable Bar-tailed Godwit whose populations have declined significantly over the past 30 years.

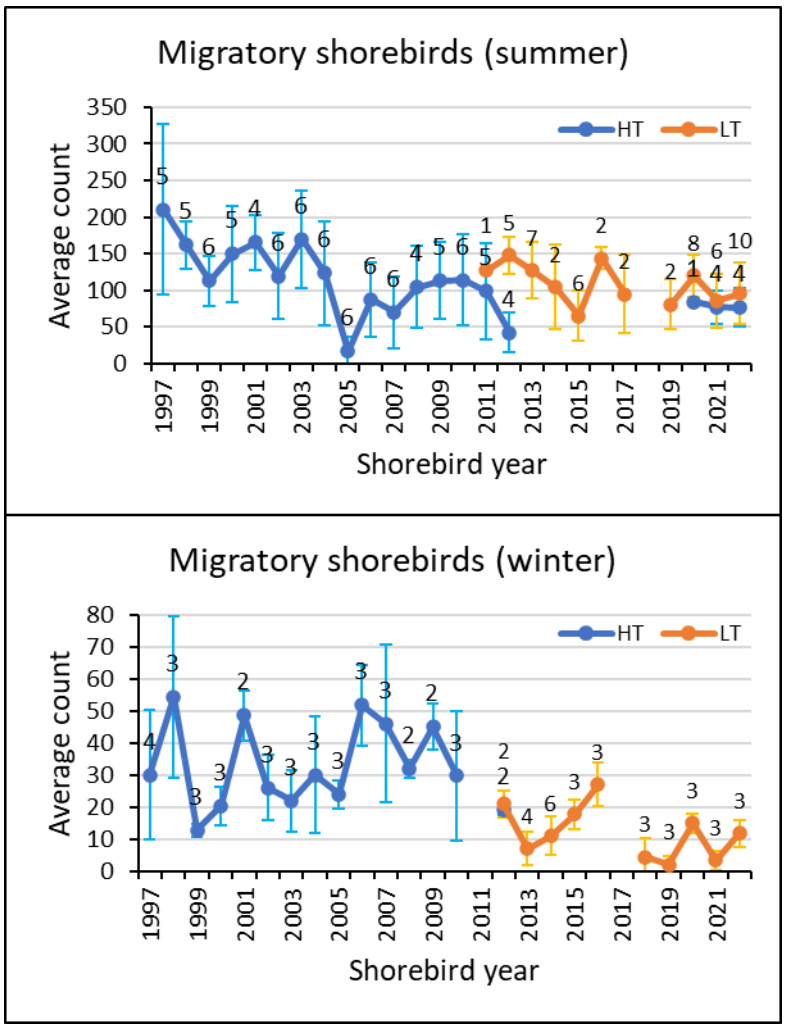

Figure 3.2. Average (±1 standard deviation) total migratory shorebirds recorded roosting at high tide (HT) and feeding at low tide (LT) in the lower Maroochy River each summer (October to mid-March) and winter (May to August) season based on QWSG data and this study. Number of counts each year shown above each point.

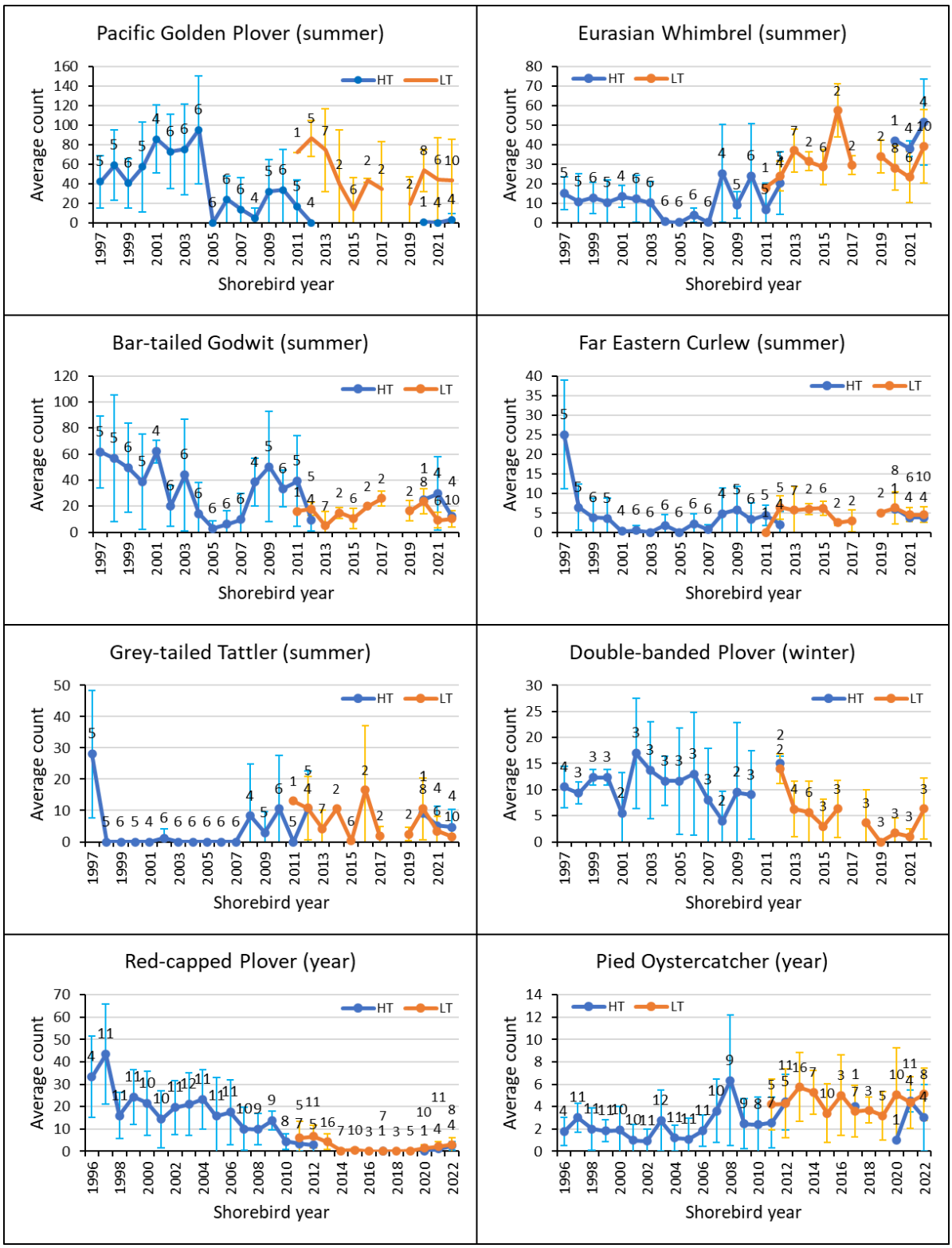

Figure 3.3. Average (±1 standard deviation) total count of different shorebird species recorded roosting at high tide (HT) and feeding at low tide (LT) in the lower Maroochy River each summer (October to mid-March), winter (May to August) or throughout the year based on QWSG data and this study. Number of counts each year shown above each point.

3.3.2 High tide surveys

Five main roost sites used by shorebirds and other waterbirds occur in the lower Maroochy River (see **Figure 3.4** for their current locations): Goat Island (MRGI); Nojoor Road (MRNR); north shore (MRNS); sand bar (MRSB); and tree roost (MRTR). During the four surveys in 2022/23, shorebirds were recorded roosting at only MRGI (all surveys) and MRTR (one survey); no birds were recorded at MRNR or MRNS. The results of the high tide surveys for the main MRGI roost are presented in **Table 3.3**, including the results of surveys in 2020/21 and 2021/22 for comparison. Over the past three seasons, the total number of migratory shorebirds using the roost has ranged between 40 and 109 and the total number of resident shorebirds has ranged between 2 and 12. The most frequently recorded migratory shorebirds included Eurasian Whimbrel (17-72 birds), the vulnerable Bar-tailed Godwit (11-71 birds) and the critically endangered Far Eastern Curlew (3-6 birds). These have also been the most commonly recorded species over the long-term since 1997 (see **Table 3.2**).

Table 3.3. Summary of the total numbers of shorebird species and other waterbirds roosting at the MRGI roost site in the lower Maroochy River during summer high tide surveys in 2020/21 (1 survey), 2021/22 (4 surveys) and 2022/23 (4 surveys).

Common name	Species	EPBC*	NCA*	12/11/2020	07/12/2021	19/01/2022	27/01/2022	07/02/2022	02/11/2022	07/12/2022	19/01/2023	20/02/2023
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	6	5	4	3	3	3	4	4	4
Eurasian Whimbrel	*Numenius phaeopus*	M	S	42	17	34	43	39	22	63	72	49
Bar-tailed Godwit (W Alaskan)	*Limosa lapponica baueri*	M, V	V	25	25	71	12	11	11	12	13	13
Pacific Golden Plover	*Pluvialis fulva*	M	S	1								13
Red-necked Stint	*Calidris ruficollis*	M	S	1					4			
Grey-tailed Tattler	*Tringa brevipes*	M	S	9	11			10			11	
Beach Stone-curlew	*Esacus magnirostris*		V	1							1	
Pied Oystercatcher	*Haematopus longirostris*		LC	1	3	5	5	5	3		7	2
Sooty Oystercatcher	*Haematopus fuliginosus*					2						
Red-capped Plover			LC				4		4	2	4	
Total migratory shorebirds				**84**	**58**	**109**	**58**	**63**	**40**	**79**	**100**	**79**
Total resident shorebirds				**2**	**5**	**7**	**9**	**5**	**7**	**2**	**12**	**2**
Total other waterbirds				41	18	124	75	46	1	982	1842	2

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

A single Beach Stone-curlew, a vulnerable resident shorebird, was observed occasionally on Goat Island at both high tide and low tide. The other waterbirds roosting on Goat Island were mostly Silver Gulls and several species of tern, the latter occasionally in large numbers. All birds recorded at MRGI in 2022/23 roosted on a raised sandbank on the eastern side of Goat Island, and no birds were found roosting in the mangroves that fringe the island. At the MRTR mangrove tree roost, a flock of 8 Grey-tailed Tattler was recorded on 7/12/2022, but no birds were present on the three other surveys in 2022/23. The MRTR roost site appears to be used occasionally by small numbers of Grey-tailed Tattler and Whimbrel when they don't roost at MRGI.

Four of the Maroochy River roost sites (MRGI, MRNR, MRNS and MRSB) were regularly monitored by the QWSG from 1997 to 2012. The locations of the roost sites at the mouth of the Maroochy River have changed over time due to the dynamic nature of the sand bars at the river mouth. A total of 20 migratory shorebird species and seven resident shorebird species have been recorded roosting at high tide at roost sites on the lower Maroochy River, with the north shore, Goat Island and the sand bank being most frequently used (**Table 3.4**).

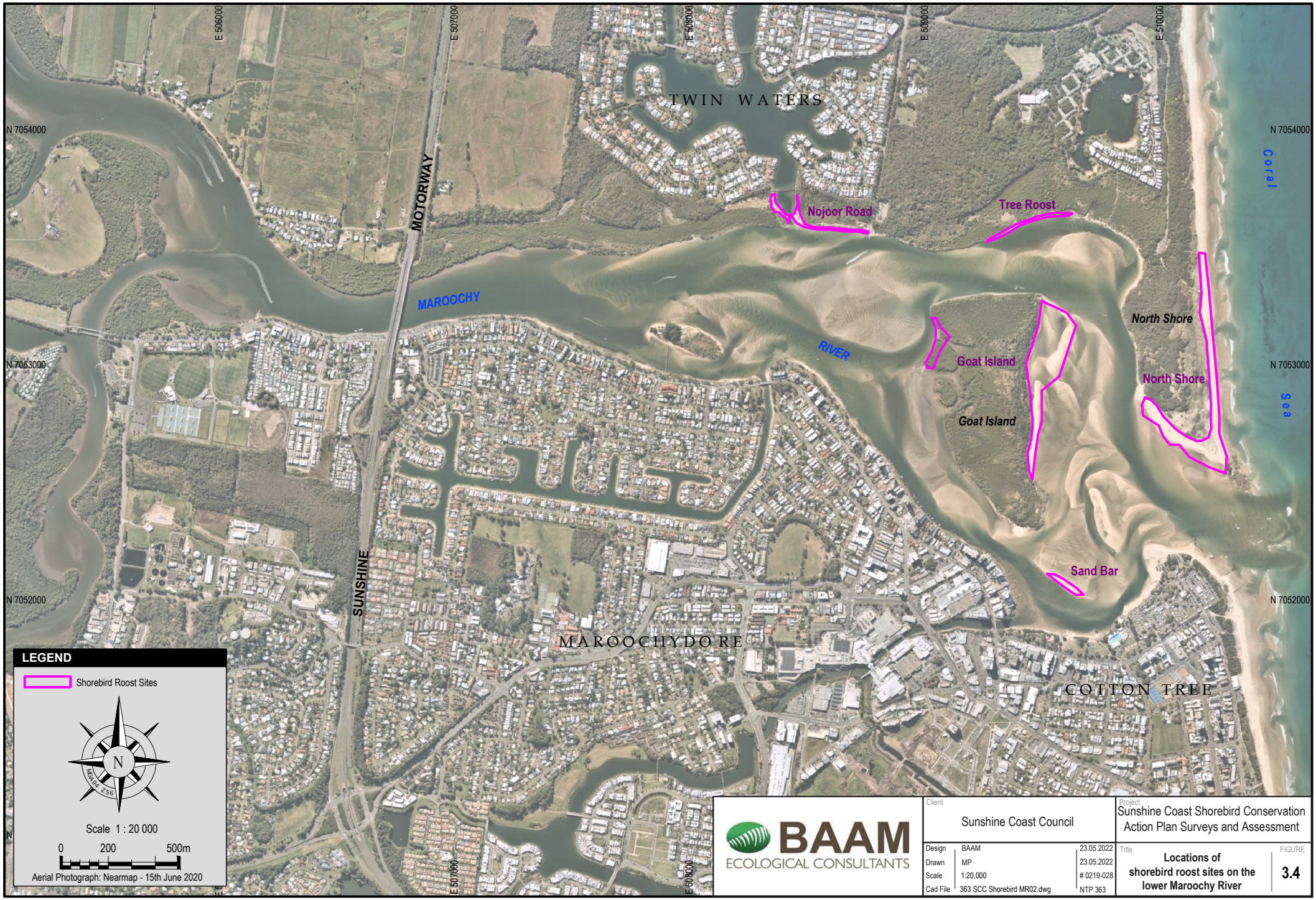

Table 3.4. Summary of the percentage of high tide surveys (within 2 hours either side of high tide) in all months of the year that shorebirds have been recorded roosting at each of the four main roost sites on the lower Maroochy River 1997-2022: Goat Island (MRGI); Nojoor Road (MRNR); north shore (MRNS); and sand bar (MRSB).

Roost site				MRGI	MRNR	MRNS	MRSB
Total number of high tide surveys (1997 to 2022, all months)				147	163	163	165
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	19%	10%	16%	20%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	27%	9%	36%	16%
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	24%	8%	33%	25%
Black-tailed Godwit	*Limosa limosa*	M	S	1%		1%	1%
Pacific Golden Plover	*Pluvialis fulva*	M	S	10%	1%	45%	7%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V			11%	1%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E		1%	14%	
Double-banded Plover	*Charadrius bicinctus*	M	S	1%		22%	4%
Ruddy Turnstone	*Arenaria interpres*	M	S		1%	7%	1%
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	1%		1%	
Sanderling	*Calidris alba*	M	S			1%	
Red Knot	*Calidris canutus*	M, E	E				1%
Broad-billed Sandpiper	*Calidris falcinellus*	M	S			1%	
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E			6%	
Red-necked Stint	*Calidris ruficollis*	M	S	1%	2%	34%	1%
Great Knot	*Calidris tenuirostris*	M, CE	E	1%		6%	2%
Grey-tailed Tattler	*Tringa brevipes*	M	S	9%	3%	6%	1%
Wandering Tattler	*Tringa incana*	M	S			3%	
Common Greenshank	*Tringa nebularia*	M	S	1%	1%		
Terek Sandpiper	*Xenus cinereus*	M	S	1%		4%	
Beach Stone-curlew	*Esacus magnirostris*		V	3%	1%	2%	
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	1%		5%	3%
Pied Oystercatcher	*Haematopus longirostris*		LC	46%	16%	21%	30%
Pied Stilt	*Himantopus leucocephalus*		LC	3%	6%		1%
Masked Lapwing	*Vanellus miles*		LC	2%	13%	4%	1%
Red-capped Plover	*Charadrius ruficapillus*		LC	2%	3%	81%	17%
Black-fronted Dotterel	*Elseyornis melanops*		LC		1%		1%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

A breakdown of the frequency of use of the roost sites by each species during different times of the year is provided in **Appendix 2**; these data confirm that the roost sites are used by migratory shorebirds during all months of the year, including by overwintering juvenile birds through the winter months. Overwintering juveniles are individuals that choose not to migrate to the northern hemisphere breeding grounds and remain in Australia through the austral winter.

Figure 3.5 shows the average annual summer-season (October to mid-March) count of migratory shorebirds at each of the four roost sites that monitoring of high tide roost sites has been undertaken since 1998. The north shore (MRNS) was the most important migratory shorebird roost site in the lower Maroochy River area up until 2004 (**Figure 3.5**). Thereafter, Goat Island (MRGI) became more increasingly used by shorebirds for roosting. The QWSG discontinued monitoring of roost sites on the lower Maroochy River after 2012 due to increasing levels of disturbance affecting the counts. Based on QWSG data, the north shore has experienced the highest frequency of disturbance across all categories, including the presence of dogs (see **Section 3.3.3** below). Over the past three summer seasons, migratory shorebirds have only used Goat Island for roosting, with no birds observed using the north shore (MRNS), Nojoor Road (MRNR) or sand bar (MRSB) roost sites (**Figure 3.5**). QWSG counters report that the north shore was largely been abandoned as a roost site due to the high frequency of disturbance from recreational activities. The dynamic changes to the sandbanks may also have altered roost suitability. Whereas migratory shorebirds regularly used all four roost sites in earlier years, they now appear to rely almost exclusively on Goat Island for

roosting, probably due to increased disturbance at the alternative roost sites. The restriction of birds to using a single roost site reduces the resilience of shorebirds to disturbance since there are fewer alternative roost sites available should disturbance cause them to leave a particular roost site.

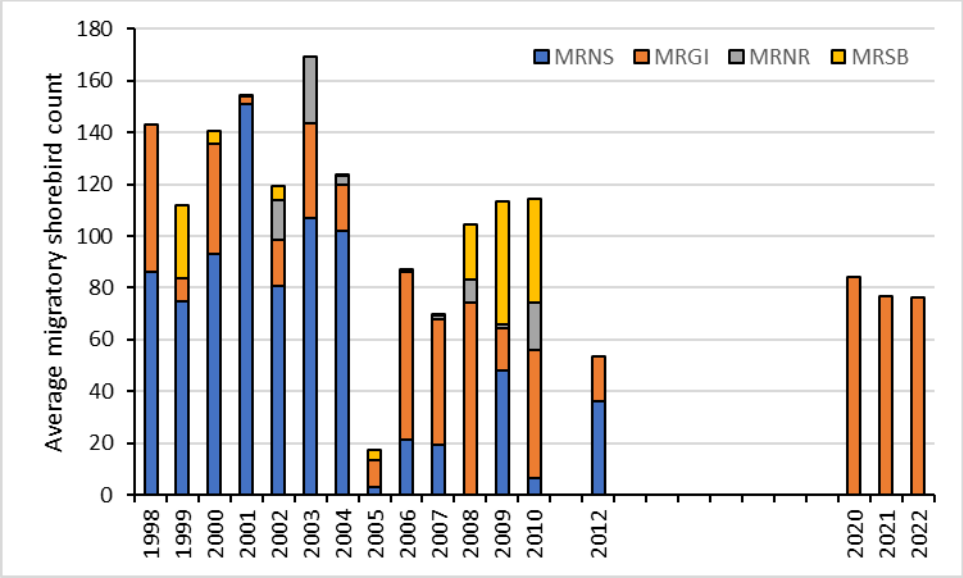

Figure 3.5. Average annual summer-season (October to mid-March) count of migratory shorebirds at high tide (within 2 hrs either side of high tide) at each of four roost sites in the lower Maroochy River since 1998 based on QWSG data and this study.

On 2/11/22, observations were made of shorebird movements between high tide and low tide as the tide rose to cover the tidal flats. A large flock of 75 Pacific Golden Plovers that had been feeding on tidal flat sites MR05 and MR04 gathered on MR05 as the tide rose. At approximately 12:00, most of the flock (about 60) flew up and left the Maroochy River heading in the direction of 32 degrees north; the remainder left about 15 minutes later in a more northerly direction. Between 15:45 and 16:45, mowed grass areas around the Novotel Resort and the southern end of the airport runway, as well as the beach front were checked to see if the birds had moved there to roost; however, no Pacific Golden Plovers were observed at those locations. Pacific Golden Plover used to regularly use the north shore for roosting (**Table 3.4**). Although Pacific Golden Plover were present foraging on the tidal flats in relatively large numbers, their substantially reduced counts at high tide relative to low tide since 2011 (**Figure 3.3**) indicates that they have shifted to roosting at an unknown location(s) to the north.

Abundance at roost sites at high tide through the summer period has declined significantly for Pacific Golden Plover (χ^2 = -1086.4, P <0.001), Bar-tailed Godwit (χ^2 = -217.22, <0.001), Far Eastern Curlew (χ^2 = -44.20, P <0.001) and Red-capped Plover (χ^2 = -781.69, <0.001), but increased significantly for Eurasian Whimbrel (χ^2 = 391.8, P <0.001) and Pied Oystercatcher (χ^2 = 19.55, P <0.001) whereas there has been no trend in Grey-tailed Tattler (χ^2 = 0.25, P = 0.62) and Double-banded Plover (χ^2 <0.01, P = 1) (**Figure 3.3**).

3.3.3 Disturbance

Shorebird roost sites and tidal flat feeding habitat areas in the lower Maroochy River are subject to multiple sources of disturbance to roosting or feeding shorebirds, including people using the area for recreation, dogs being walked on and off-leash, and various watercraft. QWSG survey data on disturbance are not captured in a format that allows examination of temporal trends in disturbance with sufficient rigour. However, the data do allow comparison of the relative frequency of different sources of potential or actual disturbance between sites. These data show that the north shore has experienced the highest disturbance pressure, particularly from people and dogs walking along the shoreline at all tides (**Table 3.5**).

Table 3.5. Percentage of surveys in which people, dogs, boats or jetskis were recorded as potential or actual sources of disturbance to roosting or feeding birds at sites in the lower Maroochy River.

Site	Surveys	People	Dogs	Boats	Jetskis
Goat Island (MRGI)	299	45%	18%	33%	14%
Nojoor Rd (MRNR)	304	55%	27%	27%	22%
North shore (MRNS)	303	72%	64%	36%	29%
Sandbank (MRSB)	312	45%	30%	29%	14%

3.4 CALOUNDRA

3.4.1 Low tide surveys

Four main areas of tidal flat feeding habitat occur in the northern Pumicestone Passage at Caloundra and have been subject to monitoring by the QWSG since 1993 (see **Figure 3.6** for locations):

- a large tidal flat on the eastern side of the passage along the north-western tip of Bribie Island (SBN1);
- a large tidal flat on the western side of the passage opposite Golden Beach (SBN2);
- a small tidal flat connected to SBN2 opposite Pelican Waters (PEWA); and
- several small patches of tidal flat at Bell's Creek (BECK).

SBN2 and the area nearby was found to have changed substantially following the creation of a new channel to the sea that broke through the northern tip of Bribie Island in January 2022. A high bank has established between the southern end of the isolated northern tip of Bribie Island and Golden Beach. The bank runs westwards to within about 150m of the Golden Beach shoreline and at low tide people can cross a channel here and walk along this bank in close proximity to feeding birds. Birds are using existing and new feeding that are still referred to as SBN2, and they are able to roost here now on all high tides because the top of the bank does not usually become submerged. Because the high bank is an integral part of this feeding area, it is included within SBN2. Birds were observed feeding on both SBN1 and SBN2 at low tide and readily retreat to the high parts of SBN2 at the peak of the tide, providing they are not disturbed. However, many people now regularly traverse this bank at low tide because they can cross over to the now isolated northern tip of Bribie Island at low tide. People also come onto the bank at high tide by boat, kayak or paddleboard.

Sandbank No 3 is a new area of tidal flat on the south side of the new opening into Pumicestone Passage where sediment has gradually built up on the outer southern side of the new entrance. Observations suggest that shorebirds are increasingly feeding on this new area of tidal flat. It is not currently accessed by people except by boat.

The results of the four summer-season surveys by this study are summarised in **Table 3.6** below, with data from the four surveys in 2020/21 also included for comparison. The tidal flat areas of SBN1 and SBN2 (including PEWA) were important feeding areas for migratory shorebirds, particularly for the critically endangered Far Eastern Curlew, vulnerable Bar-tailed Godwit, Eurasian Whimbrel and Pacific Golden Plover. Five other migratory shorebird species were recorded occasionally in small numbers across the two seasons, together with small numbers of five resident shorebird species that included a pair of vulnerable Beach Stone-curlew at SBN1 in the 2020/21 season. In 2022/23, the tidal flats supported an average combined total of 145 and a maximum of 241 migratory shorebirds but an average of 9 and maximum of 14 resident shorebirds during the summer season. These numbers are similar to those recorded in 2020/21, when the tidal flats supported an average combined total of 198 and a maximum of 224 migratory shorebirds but an average of 8 and maximum of 14 resident shorebirds during the summer season.

BAAM ECOLOGICAL CONSULTANTS

Client: Sunshine Coast Council

Project: Sunshine Coast Shorebird Conservation Action Plan Surveys and Assessment

Design	BAAM	28.04.2023
Drawn	MP	28.04.2023
Scale	1:25,000	# 0219-028
Cad File	363 SCC Shorebird C03.dwg	NTP 469

Title: **Locations of tidal flat shorebird feeding habitat areas at Caloundra**

FIGURE: **3.6**

Table 3.6. Summary of shorebird species and the average ± 1 standard deviation and maximum (in brackets) numbers recorded in each of the four low tide survey areas during the summer-season surveys at Caloundra in 2020/21 (top row, 4 surveys) and 2022/23 (bottom row, 4 surveys).

Common name	EPBC*	NCA*	SBN1	SBN2+PEWA	BECK	SBN3
Far Eastern Curlew	M, CE	E	29.3±4 (34) 11.5±11.2 (28)	1.8±0.5 (2) 13.5±12.4 (25)	0.5±1 (2) 1.3±1.5 (3)	 0.5±0.7 (1)
Eurasian Whimbrel	M	S	21.3±11.5 (34) 19.8±10.8 (32)	14.3±15.3 (35) 36.8±21.0 (51)	1±2 (4) 3.7±1.2 (5)	 2.5±0.7 (3)
Bar-tailed Godwit (W Alaskan)	M, V	V	43.5±22.9 (77) 31.0±23.0 (55)	41.0±9.4 (47) 17.3±17.6 (41)	1.3±2.5 (5) 2.7±4.6 (8)	 3.0±4.2 (9)
Pacific Golden Plover	M	S	25.3±22.7 (55) 13.3±26.5 (53)	15.3±16.2 (36) 32.5±36.2 (70)	0 0	 0.5±0.7 (1)
Greater Sand Plover	M, V	V	0 0	0 0.5±1.0 (2)	0 0	 0
Curlew Sandpiper	M, CE	E	0 0	0.5±1 (2) 0	0 0	 0
Red-necked Stint	M	S	0 0	1.3±2.5 (5) 0.5±1.0 (2)	0 0	 0
Common Sandpiper	M	S	1±2 (4) 0	0.3±0.5 (1) 0	0 0	 0
Grey-tailed Tattler	M	S	0 0	0 0.5±1.0 (2)	0 0	 0
Pied Oystercatcher		LC	3±1.8 (5) 3.0±2.2 (5)	0 1.3±1.5 (3)	0 0	 4.5±3.5 (7)
Masked Lapwing		LC	2.5±3 (6) 1.51.9± (4)	0.8±1.5 (3) 0.3±1.9 (1)	0 0.7±1.2 (2)	 0
Pied Stilt		LC	0 0	0 0	0.5±1 (2) 0	0 0
Red-capped Plover		LC	0.3±0.5 (1) 0	0 1.3±1.9 (4)	0 0	 0
Beach Stone-curlew		V	0.5±1 (2) 0	0 0	0 0	 0
Total migratory shorebirds			120.3±31 (154) 75.5±43.0 (135)	74.3±38.2 (122) 101.5±13.8 (120)	2.8±5.5 (11) 7.7±7.2 (16)	 6.5±3.5 (9)
Total resident shorebirds			6.3±5.6 (12) 4.5±3.3 (7)	0.8±1.5 (3) 2.3±3.1 (7)	0.5±1 (2) 0.7±1.2 (2)	 4.5±3.5 (9)
Total other waterbirds			328.5±293.1 (613) 33.3±18.4 (51)	523.8±468.8 (1072) 15.5±21.7 (46)	38.8±27.7 (80) 62±4.4 (65)	 157.5±167.6 (276)

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Numbers of the critically endangered Far Eastern Curlew averaged 32 (maximum 35) in 2020/21 but averaged 20 (maximum 35) in 2022/23. Numbers of the vulnerable Bar-tailed Godwit averaged 86 (maximum 123) in 2020/21 but averaged 44 (maximum 72) in 2022/23. The large numbers of other waterbirds recorded on some of the surveys were mostly terns roosting on the tidal flat sandbars at low tide.

Based on analysis of long-term QWSG data, a total of 19 migratory shorebird species and seven resident shorebird species have been recorded feeding at low tide on tidal flats in the northern Pumicestone Passage at Caloundra since 1993 (**Table 3.7**). A breakdown of the frequency of use of the tidal flats by each species during different times of the year is provided in **Appendix 3**; these data confirm that the tidal flats are used by migratory shorebirds during all months of the year, including by overwintering juvenile birds (individuals that choose not to migrate to the northern hemisphere breeding grounds) through the winter months.

The relative abundance of the different shorebird species at low tide from QWSG surveys conducted throughout the year is illustrated in **Figure 3.7**. Migratory shorebird species were substantially more abundant than resident shorebird species (**Figure 3.7**).

Table 3.7. Summary of the percentage of low tide surveys (within 1.5 hours either side of low tide) in all months of the year that shorebirds have been recorded feeding at each of the four main tidal flat feeding habitat areas at Caloundra 1993-2022 based on QWSG data.

Tidal flat feeding habitat area				SBN1	SBN2	PEWA	BECK
Total low tide surveys (all months)				329	372	303	268
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	77%	80%	23%	71%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	76%	78%	41%	70%
Little Curlew	*Numenius minutus*	M	S				<1%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	60%	85%	51%	76%
Pacific Golden Plover	*Pluvialis fulva*	M	S	45%	72%	25%	38%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	29%	56%	2%	
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	15%	27%		<1%
Double-banded Plover	*Charadrius bicinctus*	M	S	5%	19%		
Ruddy Turnstone	*Arenaria interpres*	M	S	<1%	1%	1%	<1%
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	<1%	1%	3%	4%
Red Knot	*Calidris canutus*	M, E	E	<1%	1%		
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	28%	55%	9%	10%
Red-necked Stint	*Calidris ruficollis*	M	S	12%	27%	2%	<1%
Great Knot	*Calidris tenuirostris*	M, CE	E	2%	5%		<1%
Grey-tailed Tattler	*Tringa brevipes*	M	S	6%	26%	7%	37%
Common Greenshank	*Tringa nebularia*	M	S	5%	16%	10%	26%
Marsh Sandpiper	*Tringa stagnatilis*	M	S		<1%	<1%	
Common Sandpiper	*Actitis hypoleucos*	M	S	<1%	<1%	1%	
Terek Sandpiper	*Xenus cinereus*	M	S	4%	14%	2%	8%
Beach Stone-curlew	*Esacus magnirostris*		V	4%	<1%		<1%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	<1%			<1%
Pied Oystercatcher	*Haematopus longirostris*		LC	32%	38%	18%	13%
Pied Stilt	*Himantopus leucocephalus*		LC	3%	15%	26%	79%
Masked Lapwing	*Vanellus miles*		LC	33%	9%	49%	28%
Red-capped Plover	*Charadrius ruficapillus*		LC	49%	65%	7%	9%
Black-fronted Dotterel	*Elseyornis melanops*		LC			1%	

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

The most abundant migratory shorebird species were Bar-tailed Godwit, Pacific Golden Plover, Curlew Sandpiper, Eurasian Whimbrel, Far Eastern Curlew and Greater Sand Plover. The most abundant resident shorebird species were Red-capped Plover and Pied Stilt (**Figure 3.7**).

Figure 3.8 below shows the average (± 1 standard deviation) total migratory shorebird count at low tide (within 1.5 hours either side of low tide) during the summer-season each year since 1993 for each tidal flat feeding area at Caloundra. There is evidence that there has been a long-term reduction in the total numbers of migratory shorebirds using the SBN1, SBN2 and BECK tidal flat areas between 1993 and 2021 (**Table 3.8**).

Interpretation of temporal change in migratory shorebird use of the SBN1 area is complicated by two factors. First, the position and extent of SBN1 has changed substantially since 1993 due to the dynamic nature of sand movement at the passage entrance. Second, most QWSG surveys of SBN1 have been conducted from the mainland shoreline, up to 900 m from the furthest reaches of SBN1, which results in birds, particularly individuals of smaller species, being difficult to detect and identify in some portions of the SBN1 survey area, particularly on spring low tides. The detectability of birds has likely been variable over time and some surveys may have missed birds present across SBN1. This is illustrated when comparing the results of BAAM surveys with those of QWSG volunteers in each of the 2020/21 and 2022/23 summer seasons. BAAM surveys recorded an average total

migratory shorebird count of 198±18 in 2020/21 and 145±46 in 2022/23, whereas QWSG volunteers recorded an average total migratory shorebird count of 122±40 in 2020/21 and 83±72 in 2022/23.

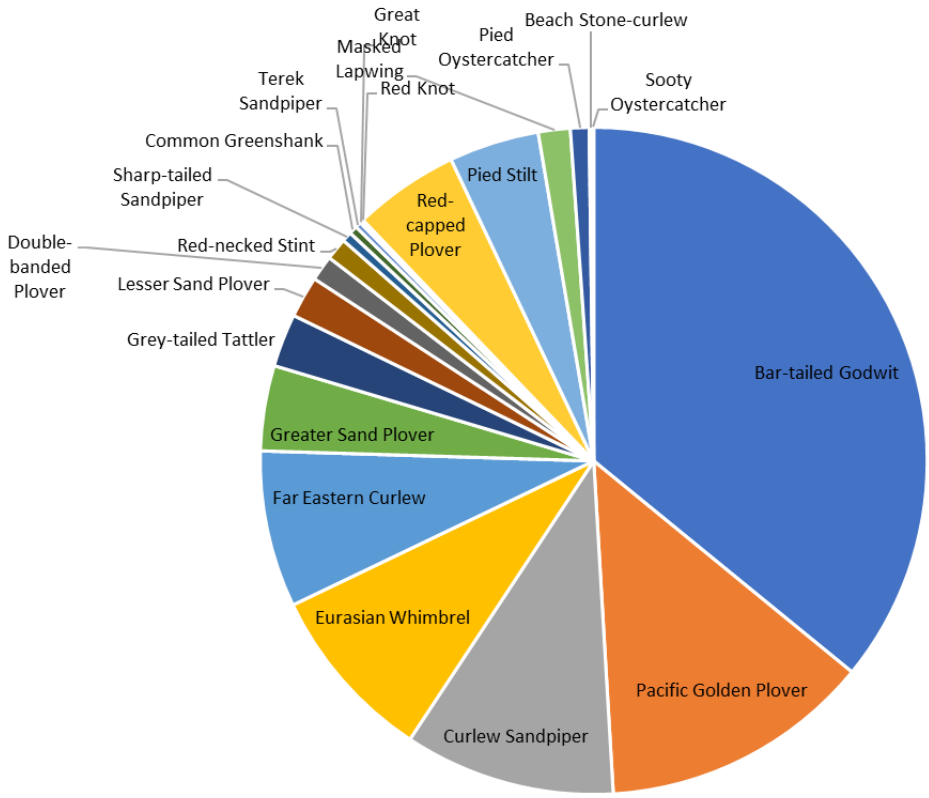

Figure 3.7. Relative abundance of migratory shorebird species (Bar-tailed Godwit to Red Knot) and resident shorebird species (Red-capped Plover to Sooty Oystercatcher) feeding on the tidal flats at Caloundra at low tide, expressed as the proportion of the sum of all shorebirds across all low tide surveys throughout each year over the period 1993-2022 from QWSG data, excluding species recorded rarely.

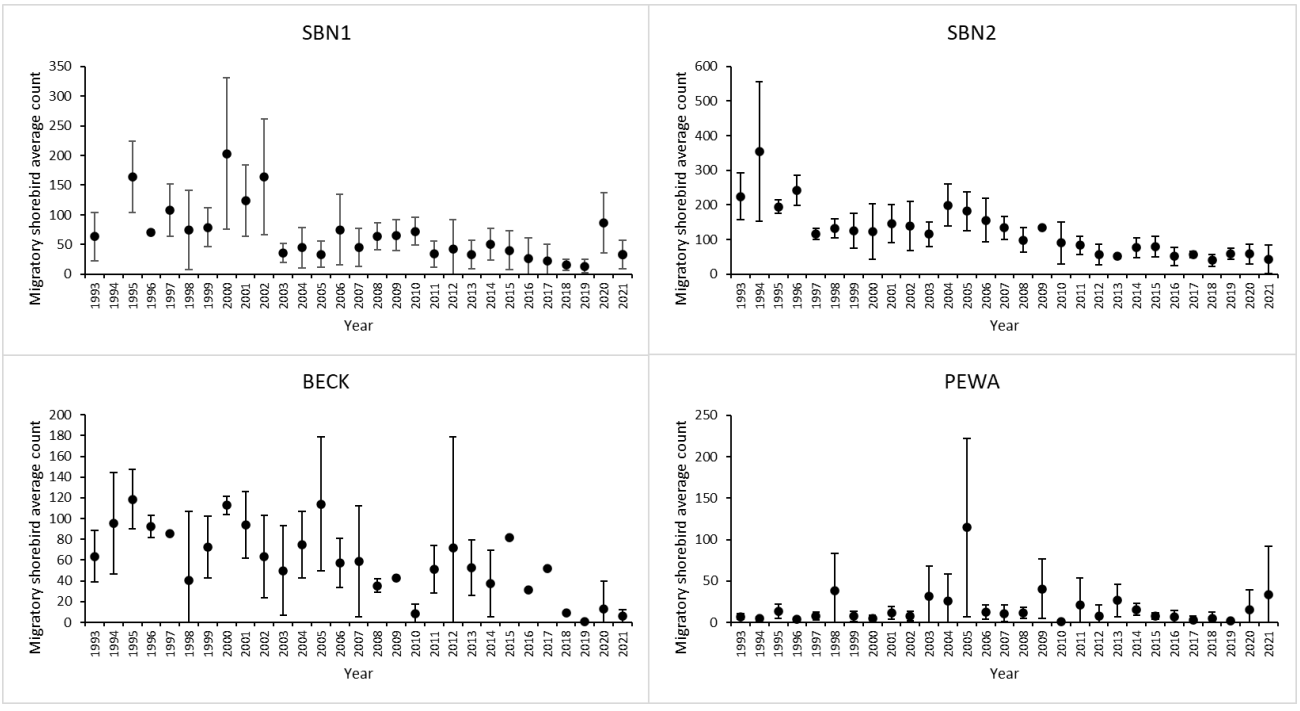

Figure 3.8. Average (± 1 standard deviation) total migratory shorebird count at low tide (within 1.5 hours either side of low tide) during the summer-season each year from 1993 to 2021 for each tidal flat feeding area at Caloundra based on QWSG data.

Table 3.8. Summary of Mann-Kendall trend test results testing whether there are trends in the abundance of migratory shorebirds and migratory shorebird species feeding on Caloundra tidal flats at low tide between 1992 and 2021.

Species / Site	Mann-Kendall trend test (*z*)[1]			
	SBN1	SBN2	PEWA	BECK
Total migratory shorebirds (average summer-season count)	-3.73 ***	-5.05 ***	-0.67	-3.73 ***
Bar-tailed Godwit (maximum annual count)	-1.61	-4.34 ***	0.96	-2.38 *
Curlew Sandpiper (maximum annual count)	-4.24 ***	-5.67 ***	-2.66 **	-3.96 ***
Greater Sand Plover (maximum annual count)	-4.18 ***	-3.40 ***		
Lesser Sand Plover (maximum annual count)	-4.21 ***	-4.62 ***		
Grey-tailed Tattler (maximum annual count)	-2.34 *	-3.20 **		-5.43 ***
Red-necked Stint (maximum annual count)	-2.48 *	-4.63 ***		
Far Eastern Curlew (maximum annual count)	0.83	1.13	0.15	-4.78 ***
Eurasian Whimbrel (maximum annual count)	0.92	1.95	0.86	-3.71 ***
Pacific Golden Plover (maximum annual count)	-1.24	-1.60	-0.17	-1.30
Double-banded Plover (maximum annual count)	-1.63	-1.71		

[1] Significance: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Examination of species-specific count data suggests several species have declined in abundance since 1993 across one or more of the four tidal flat areas; declining species include Greater Sand Plover, Lesser Sand Plover, Curlew Sandpiper, Grey-tailed Tattler, Red-necked Stint and Bar-tailed Godwit (**Figure 3.9**, **Table 3.8**). The decline in the numbers of Curlew Sandpiper is particularly notable since this was once a dominant species feeding on tidal flats at Caloundra (**Figures 3.7** and **3.9**) but has largely been absent from the area since 2012 (**Figure 3.9**).

For some species such as Greater Sand Plover, Lesser Sand Plover, Curlew Sandpiper and Bar-tailed Godwit, the decline may be linked to substantial declines in the overall population visiting Australia (Wilson *et al.* 2011, Clemens *et al.* 2016, Studds *et al.* 2017). In this respect, the Far Eastern Curlew is an apparent outlier; while the overall population of this critically endangered species visiting Australia has undergone a severe population decline of 66.8% over 20 years (5.8% per year) and 81.4 % over 30 years (TSSC 2015, Studds *et al.* 2017), the only tidal flat feeding area at Caloundra that has experienced a decline in Eastern Curlew numbers feeding at low tide was the BECK tidal flat area that has generally supported fewer Far Eastern Curlew than the SBN1 and SBN2 areas (**Figure 3.9**, **Table 3.8**). The decline in the use of the Bell's Creek tidal flats has been consistent across nearly all migratory shorebird species that have used this area, whereas the abundance of some species using the SNB1 and SBN2 tidal flats has not declined (**Figure 3.9**, **Table 3.8**), including species such as Far Eastern Curlew and Eurasian Whimbrel that are typically the most sensitive to disturbance. Consequently, it is difficult to determine the relative importance of different factors that might have influenced the observed declines in the use of the various tidal flat areas by different species.

The factors responsible for the observed migratory shorebird declines at Caloundra may include:

- The background decline in the populations of some species, as outlined above;
- Loss of some shorebird habitat to development (e.g. at Pelican Waters) and/or change in the areas of tidal flat feeding habitat resulting from sediment movement in Pumicestone Passage; and
- Increasing human disturbance of shorebirds at roost sites and feeding habitat areas as the region's population has increased.

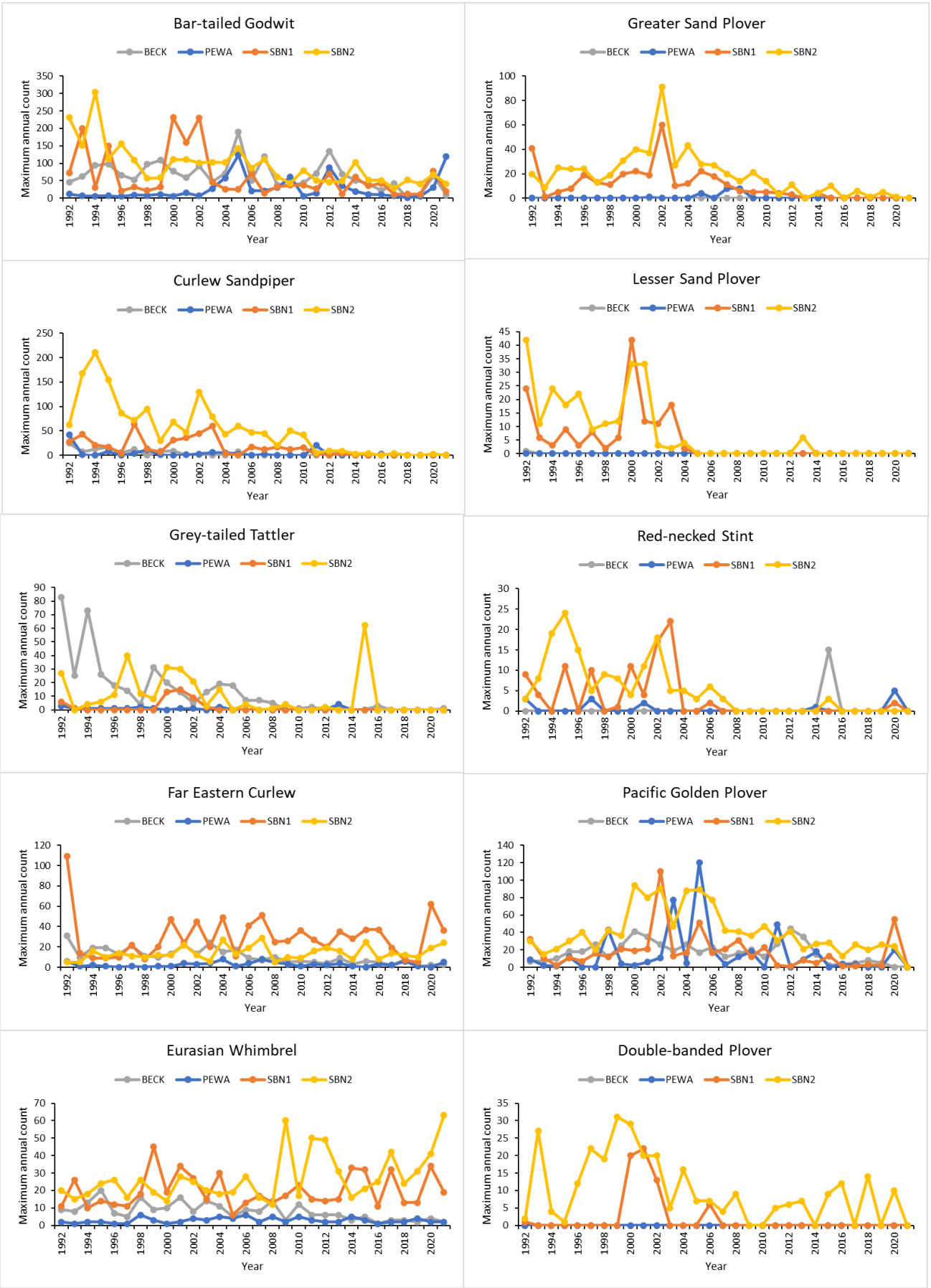

Figure 3.9. Annual maximum count of the migratory shorebird species most commonly recorded feeding at four tidal flat feeding areas at low tide at Caloundra 1992-2021 based on QWSG data.

3.4.2 High tide surveys

Seven shorebird roost sites are currently recognised at Caloundra (see **Figure 3.10**):

- Caloundra bar (CBAR), a sand bank at the Pumicestone Passage entrance;
- Northern tip of Bribie Island (NTBI), along the beach between the old and new entrances to Pumicestone Passage (prior to the 2021/22 season, the northern portion of this site was included in CBAR);
- Sandbank 1 (SBN1), including a sandbank in the passage (used on the rising tide and neap high tides), a sandbank on the north-western shoreline of Bribie Island and an adjoining area of saltmarsh on the shoreline of Bribie Island;
- Sandbank 2 (SBN2), two raised portions of sandbank on the northern side of the new entrance to Pumicestone Passage;
- Sandbank 3 (SBN3), a new sandbank on the southern side of the new entrance to Pumicestone Passage that was first seen used by shorebirds for roosting in February 2023;
- A mangrove tree roost (BCTR) on the opposite side of Pumicestone Passage from Bell's Creek; and
- Wickham Point (WICK), a rock platform on the mainland coastline north of the Pumicestone Passage entrance, where small numbers of shorebirds regularly roost.

A high bank has established between the southern end of the isolated northern tip of Bribie Island and Golden Beach. The bank runs westwards to within about 150m of the Golden Beach shoreline. Birds are able to roost here now on most high tides because the top of the bank does not usually become submerged. This high bank is now treated as an extension of SBN2. All roost sites except Wickham Point were surveyed during the 2022/23 season (**Table 3.8**).

An average of 179 (range 143 to 235) migratory shorebirds used roost sites at Caloundra during the four high tide surveys in 2022/23, including up to 37 critically endangered Far Eastern Curlew, 66 vulnerable Bar-tailed Godwit, 102 Eurasian Whimbrel and 66 Pacific Golden Plover (**Table 3.8**).

On 3/11/22, the movement of birds feeding on the tidal flats in the passage were monitored as the tide rose between low tide and high tide. A total of 31 Eurasian Whimbrel, 31 Far Eastern Curlew and 66 Bar-tailed Godwit gathered on the rising tide in the small cove on the southern side of the now isolated northern tip of Bribie Island, north of the SBN1 feeding area. They dispersed from here as the tide rose further prior to a high tide of 2.25m, moving to CBAR (all but one of the Far Eastern Curlew) or to the north-eastern tip of Bribie Island NTBI (Eurasian Whimbrel and around half the Bar-Tailed Godwits). The other three surveys in December, January and February were on spring high tides of 2.44m to 2.74m that flooded most of SBN1 and CBAR roost sites. During the December survey of 9/12/22, a flock of Far Eastern Curlew roosting at CBAR moved across to SBN2 half an hour before the peak of high tide after CBAR became completely flooded. During the February survey on 21/2/2023 all the shorebirds recorded roosting at SBN2 were put to flight by a dog off leash; the owner continued to allow this dog to persistently chase shorebirds despite being spoken to. Due to the persistent disturbance, most of the birds that were forced off SBN2 appeared to move across to NTBI, where many are likely to have been counted again. These observations confirm the importance for shorebirds of having access to a local network of available roost sites so that they can move to an alternative nearby site if they are disturbed off the preferred site.

BAAM ECOLOGICAL CONSULTANTS

Client	Sunshine Coast Council	Project	Sunshine Coast Shorebird Conservation Action Plan Surveys and Assessment
Design	BAAM	28.04.2023	
Drawn	MP	28.04.2023	
Scale	1:25,000	# 0219-028	
Cad File	363 SCC Shorebird C03.dwg	NTP 469	
Title	**Locations of shorebird roost sites at Caloundra**	FIGURE	**3.10**

Table 3.8. Results of the four summer-season surveys of shorebird roost sites at Caloundra in 2022/23.

Common name	Species	EPBC*	NCA*	3 Nov 2022	9 Dec 2022	20 Jan 2023	21 Feb 2023
Caloundra Bar (CBAR)							
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	30	0	0	
Eurasian Whimbrel	*Numenius phaeopus*	M	S	0	34	0	
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V				
Pied Oystercatcher	*Haematopus longirostris*		LC	0	2	2	
Masked Lapwing	*Vanellus miles*		LC	2	0	0	
Total migratory shorebirds				30	34	0	
Total resident shorebirds				2	2	2	
Total other waterbirds				13	0	1	
Northern tip of Bribie Island (NTBI)							
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	0	2	0	37
Eurasian Whimbrel	*Numenius phaeopus*	M	S	72	46	0	54
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	36	36	0	27
Pied Oystercatcher	*Haematopus longirostris*		LC	2	2	2	0
Total migratory shorebirds				108	84	0	118
Total resident shorebirds				2	2	2	0
Total other waterbirds				1	1101	12	0
Sandbank 1 (SBN1)							
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	31		0	
Eurasian Whimbrel	*Numenius phaeopus*	M	S	31		0	
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	66		0	
Pied Oystercatcher	*Haematopus longirostris*		LC	3		4	
Total migratory shorebirds				128		0	
Total resident shorebirds				3		4	
Total other waterbirds				0		1	
Sandbank 2 (SBN2)							
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E			35	31
Eurasian Whimbrel	*Numenius phaeopus*	M	S			28	30
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V			56	30
Pacific Golden Plover	*Pluvialis fulva*	M	S			26	0
Pied Oystercatcher	*Haematopus longirostris*		LC			3	2
Total migratory shorebirds						145	91
Total resident shorebirds						7	4
Total other waterbirds						32	158
Sandbank 3 (SBN3)							
Eurasian Whimbrel	*Numenius phaeopus*	M	S				3
Pacific Golden Plover	*Pluvialis fulva*	M	S				66
Pied Oystercatcher	*Haematopus longirostris*		LC				5
Red-capped Plover	*Charadrius ruficapillus*		LC				6
Masked Lapwing	*Vanellus miles*		LC				5
Total migratory shorebirds							69
Total resident shorebirds							16
Total other waterbirds							8
Bells Creek Tree Roost (BCTR)							
Eurasian Whimbrel	*Numenius phaeopus*	M	S	7	25	17	45
Total migratory shorebirds				7	25	17	45
Total resident shorebirds				0	0	0	0
Total other waterbirds				0	0	0	0

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

The three roost sites CBAR, SBN1 and SBN2 have been monitored intermittently by the QWSG since 1993 while the WICK roost site has been monitored continuously since 1999. A total of 17 migratory shorebird species and seven resident shorebird species have been recorded roosting at these high tide roost sites at Caloundra over the period 1993 to 2022 (**Table 3.9**). The commonly recorded migratory shorebird species included the vulnerable Bar-tailed Godwit, the critically endangered Far Eastern Curlew, Eurasian Whimbrel and Pacific Golden Plover, the four species that were also most frequently present feeding on the tidal flats at low tide (**Tables 3.5** and **3.6**). A breakdown of the frequency of use of the roost sites by each species during different times of the year is provided in **Appendix 2**; these data confirm that the roost sites are used by migratory shorebirds during all months of the year, including by overwintering juvenile birds through the winter months.

Table 3.9. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) in all months of the year that shorebirds have been recorded roosting at each of four roost sites at Caloundra 1993-2022.

Roost site				CBAR	SBN1	SBN2	WICK	BCTR	NTBI
Total high tide surveys (all months)				53	53	32	239	7	4
Common name	Species	EPBC*	NCA*						
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	58%	68%	38%			50%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	57%	62%	34%		57%	75%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	47%	72%	50%	<1%		50%
Pacific Golden Plover	*Pluvialis fulva*	M	S	43%	32%	25%	<1%		
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	43%	26%	6%			
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	38%	19%	6%			
Double-banded Plover	*Charadrius bicinctus*	M	S	15%	23%	9%			
Ruddy Turnstone	*Arenaria interpres*	M	S	2%			2%		
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	4%					
Red Knot	*Calidris canutus*	M, E	E	4%	2%				
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	42%	36%	19%			
Red-necked Stint	*Calidris ruficollis*	M	S	47%	30%	13%			
Great Knot	*Calidris tenuirostris*	M, CE	E	15%	19%	9%			
Grey-tailed Tattler	*Tringa brevipes*	M	S	2%	15%	13%			
Wandering Tattler	*Tringa incana*	M	S	2%			44%		
Common Greenshank	*Tringa nebularia*	M	S	2%	9%	13%			
Terek Sandpiper	*Xenus cinereus*	M	S	6%	6%	6%			
Australian Painted Snipe	*Rostratula australis*	E	E				<1%		
Beach Stone-curlew	*Esacus magnirostris*		V	4%	2%				
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	4%	6%		81%		
Pied Oystercatcher	*Haematopus longirostris*		LC	42%	32%	6%	5%		
Pied Stilt	*Himantopus leucocephalus*		LC			3%	<1%		
Masked Lapwing	*Vanellus miles*		LC	11%	25%		3%		
Red-capped Plover	*Charadrius ruficapillus*		LC	64%	55%	16%			

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Analysis of these data shows that the CBAR, SBN1 and SBN2 roost sites were used by up to around 550 migratory shorebirds in the period 2000 to 2002 and up to around 280 migratory shorebirds in 2008-2010 (**Figure 3.11**). Surveys in 2020 to 2023 have recorded up to 178 migratory shorebirds. This suggests there may have been a decline in the number of migratory shorebirds using these roost sites over this time period.

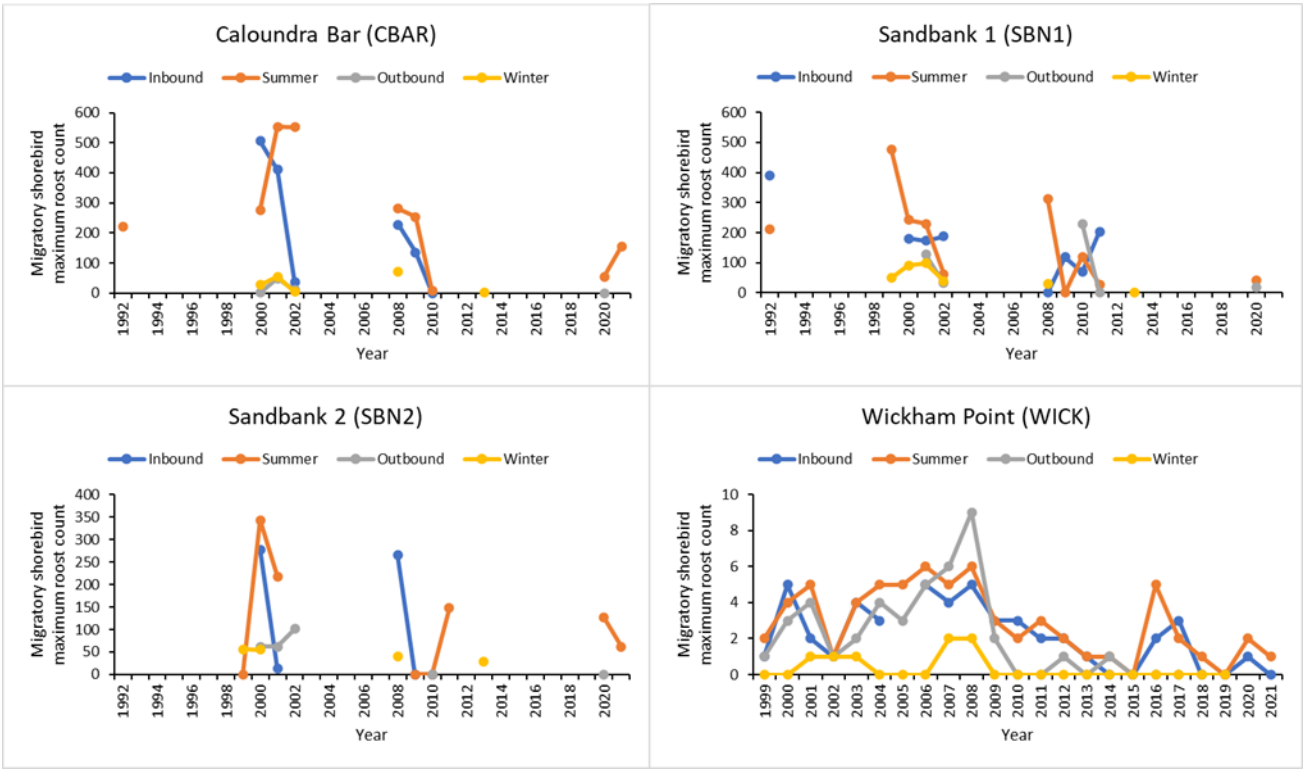

Figure 3.11. Annual maximum count of migratory shorebirds at high tide (within 1.5 hrs either side of high tide) at each of four roost sites at Caloundra 1992-2021 based on QWSG data.

The Wickham Point (WICK) roost site is used regularly by small numbers of one migratory shorebird species, Wandering Tattler (average of 3 birds in summer), and one resident shorebird species, Sooty Oystercatcher (average of 4 birds in summer), both species being associated with rocky shorelines.

3.4.3 Disturbance

Shorebird roost sites and tidal flat feeding habitat areas at Caloundra are subject to multiple sources of disturbance to roosting or feeding shorebirds, including people using the area for recreation, dogs being walked on and off-leash and various watercraft. These data show that the Wickham Point experiences the highest disturbance pressure, particularly from people and dogs visiting the rocky shoreline (**Table 3.10**); however, this site is used by small numbers of shorebirds that are likely to be able to move along the extensive rocky shoreline at this site in response to disturbance. The other roost sites at CBAR, SBN1, SBN2 and BCTR appear to experience moderate to low levels of disturbance.

Table 3.10. Percentage of surveys in which people, dogs, boats or jetskis were recorded as potential or actual sources of disturbance to roosting or feeding birds at sites at Caloundra.

Site	Surveys	People	Dogs	Boats	Jetskis
Caloundra bar (CBAR)	160	2	0	0	0
Sandbank 1 (SBN1)	517	26	4	16	32
Sandbank 2 (SBN2)	492	24	6	9	23
Pelican Waters (PEWA)	339	42	25	15	27
Bell's Creek (BECK)	344	57	29	18	39
Tree roost (BCTR)	3	0	0	0	0
Wickham Point (WICK)	252	58	32	17	9

During the 2022/23 surveys, the only disturbance observed at high tide was caused by a person walking a dog off leash who allowed the dog to persistently chase shorebirds roosting on SBN2, which forced them to leave this roost site and fly to an alternative roost site. People were observed walking across SBN2 on all low tide surveys, which included them putting flocks of foraging shorebirds to flight. During 2022/23, the QWSG recorded extensive disturbance of shorebirds on half of their low tide surveys; people and a drone were observed regularly putting shorebirds to flight on SBN1 on two surveys and people and dogs were observed regularly putting shorebirds to flight on SBN2 on one survey.

4.0 RECOMMENDATIONS

4.1 LOWER MAROOCHY RIVER

While it was historically one of the most important roost sites for shorebirds on the lower Maroochy River, the north shore (MRNS) has largely been abandoned as a roost site by shorebirds due to the high levels of disturbance by people using the sandy shoreline for recreation and walking dogs off-leash. Consequently, the sandy shoreline and sand bars on the eastern side of Goat Island (MRGI and MRSB) are currently the most important shorebird roost sites, which enjoy a moderate level of protection from disturbance by being accessible at high tide only by watercraft. Nonetheless, boaters with pets on board do regularly come ashore at Goat Island and walk their dogs, often off-leash. The tidal flats on the eastern and western edges of Goat Island (MR06, MR04 and MR07) are also the most important feeding areas on the lower Maroochy River. While the MR04 and MR07 tidal flats are seldom visited by people, people regularly access the MR06 tidal flats via watercraft or wading/swimming across the southern channel at low tide, causing regular disturbance to feeding shorebirds, including by dogs being walked off-leash. The MR05 tidal flat is located close to a well-used sandy beach in a cove on the northern shore of the river. These disturbance pressures are expected to continue to increase as the human population of the region continues to grow. Research has shown that off-leash dogs in particular cause severe disturbance to shorebirds, reducing their use of important habitats (Dhanjal-Adams *et al.* 2016), and are a key threat to migratory shorebirds in Moreton Bay (Fuller *et al.* 2019).

Recommended approaches for reducing disturbance to feeding and roosting shorebirds include a combination of:

- Site-specific information signage to raise awareness of the presence of shorebirds in the area and the importance of the key habitat areas for shorebirds, particularly migratory shorebirds (Antos *et al.* 2006, Williams *et al.* 2009);
- Other approaches to raising public awareness of how the migration and feeding ecology of shorebirds are impacted by disturbances to try to change public awareness of, and attitudes towards disturbing shorebirds, particularly among dog-owners that exercise their dogs along foreshore areas (Antos *et al.* 2006, Williams *et al.* 2009);
- Planning to ensure suitable dog-walking facilities such as dog-off leash areas are situated in locations convenient and attractive to the public but separated from important shorebird foreshore habitats (Stigner *et al.* 2016);
- Planning to limit access to important feeding or roosting areas by people and/or dogs (Weston *et al.* 2012, Stigner *et al.* 2016); and
- Effective enforcement of access restrictions and dog on-leash areas, given that compliance to access restrictions or on-leash laws is strongly dependent on the extent of enforcement (Dhanjal-Adams *et al.* 2016, Stigner *et al.* 2016).

Research based on structured decision-making has shown that cost-effective sites for enforcement are the cheapest sites with the greatest number of target species in combination with the greatest number of illegal wildlife activities (Dhanjal-Adams *et al.* 2016). Other research suggests that trying to ensure all dogs are kept on-leash in foreshore areas may be impractical where walking dogs off-leash has already become a pervasive activity; in such situations, designating foreshore dog off-leash areas in places where shorebird foraging abundance is relatively low and recreational demand is relatively high could result in reduced overall disturbance to migratory shorebirds if there is also more effective enforcement of access restrictions or on-leash laws in important shorebird areas (Stigner *et al.* 2016, Fuller *et al.* 2019).

4.2 CALOUNDRA

The important roost sites at Caloundra, including CBAR, SBN1, SBN2, NTBI and BCTR appear to experience moderate to low levels of disturbance. The BCTR tree roost is located in a position where the risk of disturbance is very low. Disturbance to birds roosting on the in-channel sandbanks of SBN1 and SBN2 on neap high tides is mostly from passing jet-skis and watercraft putting ashore. The CBAR and NTBI roost sites on the coastal shoreline of the northern tip of Bribie Island are the least disturbed roost sites that have now been isolated from the rest of Bribie Island by the new entrance to Pumicestone Passage. However, if the old entrance to Pumicestone Passage becomes silted up in the near future, as is predicted to occur, then disturbance to the CBAR and NTBI roost sites is expected to increase substantially once people, including people walking dogs, are able to access the coastal shoreline of the northern tip of Bribie Island across a silted-up Caloundra bar.

There has been a notable increase in the disturbance of shorebirds feeding on the SBN2 tidal flat over the past year following the formation of the new entrance to Pumicestone Passage. Changes in sediment deposition after the sea broke through the northern end of Bribie Island to create the new entrance has formed a high bank between the southern end of the isolated northern tip of Bribie Island and Golden Beach. The bank runs westwards to within about 150 m of the Golden Beach shoreline and at low tide people can cross a channel here and walk along this bank near feeding birds. People walking along this bank are frequently accompanied by dogs walked off leash, which have been observed chasing shorebirds. This recreational disturbance pressure is predicted to continue to increase as the region becomes more developed. Consequently, there is a need for proactive management of disturbance to shorebirds at the important roosting and feeding habitats at Caloundra that are identified above. Recommended approaches for reducing disturbance to feeding and roosting shorebirds are as recommended under **Section 4.1** above.

5.0 REFERENCES

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APPENDIX 1

Shorebird survey conditions

Table A1.1. Shorebird survey conditions.

Date	Site	LT time	LT ht (m)	HT time	HT ht (m)	Low tide (LT)			High tide (HT)		
						Wind	Cloud	Rain	Wind	Cloud	Rain
2/11/2022	Maroochy River	10:17	0.51	16:27	1.68	2-3	0	0	2	0	0
7/12/2022	Maroochy River	15:47	0.5	8:37	1.84	1	0	0	1	0	0
19/01/2023	Maroochy River	14:27	0.56	7:07	1.86	2	0	0	1	0	0
20/02/2023	Maroochy River	16:37	0.25	9:27	2.2	3	6	0	2	7	0
3/11/2022	Caloundra	11:04	0.65	16:52	2.25	2	0	0	2	0	0
8/12/2022	Caloundra	16:04	0.63			2	8	0			
9/12/2022	Caloundra			9:22	2.44				2	8	0
20/01/2023	Caloundra	15:04	0.57	7:32	2.56	2	8	0	2-3	8	0
21/02/2023	Caloundra	17:04	0.34		2.74	2	7	0	1	8	0

APPENDIX 2

Seasonal frequency of roost site use

Table A2.1. Seasonal breakdown of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at Goat Island (MRGI) on the lower Maroochy River during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total HT surveys				35	54	29	25
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	26%	22%	7%	16%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	31%	28%	24%	20%
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	26%	28%	24%	12%
Black-tailed Godwit	*Limosa limosa*	M	S		2%		
Pacific Golden Plover	*Pluvialis fulva*	M	S	11%	15%	10%	
Double-banded Plover	*Charadrius bicinctus*	M	S			3%	
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	3%			
Red-necked Stint	*Calidris ruficollis*	M	S	6%			
Great Knot	*Calidris tenuirostris*	M, CE	E			3%	
Grey-tailed Tattler	*Tringa brevipes*	M	S	14%	9%	7%	4%
Common Greenshank	*Tringa nebularia*	M	S		2%		
Terek Sandpiper	*Xenus cinereus*	M	S	3%			4%
Beach Stone-curlew	*Esacus magnirostris*		V	3%	2%	7%	4%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC		2%		
Pied Oystercatcher	*Haematopus longirostris*		LC	54%	33%	66%	40%
Pied Stilt	*Himantopus leucocephalus*		LC		2%	7%	8%
Masked Lapwing	*Vanellus miles*		LC		4%		4%
Red-capped Plover	*Charadrius ruficapillus*		LC	6%			4%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.2. Seasonal breakdown of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at Nojoor Road (MRNR) on the lower Maroochy River during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total HT surveys				39	57	34	29
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	15%	14%	3%	3%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	10%	16%	3%	
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	8%	12%	3%	7%
Pacific Golden Plover	*Pluvialis fulva*	M	S	3%	2%		
Lesser Sand Plover	*Charadrius mongolus*	M, E	E		2%		
Ruddy Turnstone	*Arenaria interpres*	M	S		2%		
Red-necked Stint	*Calidris ruficollis*	M	S		4%	3%	
Grey-tailed Tattler	*Tringa brevipes*	M	S	3%	2%	3%	3%
Common Greenshank	*Tringa nebularia*	M	S		4%		
Beach Stone-curlew	*Esacus magnirostris*		V		2%	3%	
Pied Oystercatcher	*Haematopus longirostris*		LC	21%	9%	29%	7%
Pied Stilt	*Himantopus leucocephalus*		LC	5%	2%	9%	10%
Masked Lapwing	*Vanellus miles*		LC	3%	9%	32%	10%
Red-capped Plover	*Charadrius ruficapillus*		LC	3%	4%	3%	
Black-fronted Dotterel	*Elseyornis melanops*		LC				3%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.3. Seasonal breakdown of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at the north shore (MRNS) on the lower Maroochy River during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total HT surveys				35	54	29	25
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	26%	15%	9%	11%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	38%	48%	34%	7%
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	26%	48%	38%	7%
Black-tailed Godwit	*Limosa limosa*	M	S		2%	3%	
Pacific Golden Plover	*Pluvialis fulva*	M	S	44%	53%	41%	32%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	13%	13%	13%	
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	8%	12%	31%	11%
Double-banded Plover	*Charadrius bicinctus*	M	S	3%		31%	86%
Ruddy Turnstone	*Arenaria interpres*	M	S	5%	10%	3%	7%
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S		2%		
Sanderling	*Calidris alba*	M	S	3%	2%		
Broad-billed Sandpiper	*Calidris falcinellus*	M	S			3%	
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	3%	8%	9%	
Red-necked Stint	*Calidris ruficollis*	M	S	28%	38%	44%	21%
Great Knot	*Calidris tenuirostris*	M, CE	E	5%	12%		
Grey-tailed Tattler	*Tringa brevipes*	M	S	8%	3%	16%	
Wandering Tattler	*Tringa incana*	M	S	8%	2%	3%	
Terek Sandpiper	*Xenus cinereus*	M	S	3%	3%	9%	
Beach Stone-curlew	*Esacus magnirostris*		V	5%		3%	
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	5%	7%	6%	
Pied Oystercatcher	*Haematopus longirostris*		LC	15%	23%	34%	11%
Masked Lapwing	*Vanellus miles*		LC	3%	3%	3%	7%
Red-capped Plover	*Charadrius ruficapillus*		LC	79%	77%	78%	93%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.4. Seasonal breakdown of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at a sand bar (MRSB) on the lower Maroochy River during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total HT surveys				35	54	29	25
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	25%	14%	6%	41%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	20%	17%	9%	14%
Bar-tailed Godwit (Western Alaskan)	*Limosa lapponica baueri*	M, V	V	23%	22%	32%	28%
Black-tailed Godwit	*Limosa limosa*	M	S		2%		
Pacific Golden Plover	*Pluvialis fulva*	M	S	3%	5%	9%	17%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V			3%	
Double-banded Plover	*Charadrius bicinctus*	M	S	3%		9%	7%
Ruddy Turnstone	*Arenaria interpres*	M	S	3%			
Red Knot	*Calidris canutus*	M, E	E				3%
Red-necked Stint	*Calidris ruficollis*	M	S			3%	
Great Knot	*Calidris tenuirostris*	M, CE	E	3%		3%	3%
Grey-tailed Tattler	*Tringa brevipes*	M	S	3%		3%	
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	3%	3%	6%	
Pied Oystercatcher	*Haematopus longirostris*		LC	30%	19%	35%	45%
Pied Stilt	*Himantopus leucocephalus*		LC	3%		3%	
Masked Lapwing	*Vanellus miles*		LC	3%			3%
Red-capped Plover	*Charadrius ruficapillus*		LC	13%	10%	29%	21%
Black-fronted Dotterel	*Elseyornis melanops*		LC				7%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.5. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at Caloundra Bar (CBAR) at the northern entrance to Pumicestone Passage during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total high tide surveys				9	20	8	12
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	56%	80%	38%	33%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	89%	75%	38%	25%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	67%	65%	25%	25%
Pacific Golden Plover	*Pluvialis fulva*	M	S	33%	60%	50%	33%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	78%	65%	13%	17%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	44%	60%	25%	17%
Double-banded Plover	*Charadrius bicinctus*	M	S			13%	58%
Ruddy Turnstone	*Arenaria interpres*	M	S		5%		
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S		10%		
Red Knot	*Calidris canutus*	M, E	E	11%	5%		
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	56%	65%	25%	17%
Red-necked Stint	*Calidris ruficollis*	M	S	56%	80%	13%	25%
Great Knot	*Calidris tenuirostris*	M, CE	E	33%	25%		
Grey-tailed Tattler	*Tringa brevipes*	M	S	11%			
Wandering Tattler	*Tringa incana*	M	S		5%		
Common Greenshank	*Tringa nebularia*	M	S			13%	
Terek Sandpiper	*Xenus cinereus*	M	S	11%	10%		
Beach Stone-curlew	*Esacus magnirostris*		V		5%		8%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	11%	5%		
Pied Oystercatcher	*Haematopus longirostris*		LC	44%	55%		33%
Masked Lapwing	*Vanellus miles*		LC		5%	13%	8%
Red-capped Plover	*Charadrius ruficapillus*		LC	56%	75%	63%	75%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.6. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at sandbank 1 (SBN1) at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total high tide surveys				11	19	10	13
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	82%	79%	60%	46%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	64%	63%	60%	62%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	82%	79%	60%	62%
Pacific Golden Plover	*Pluvialis fulva*	M	S	27%	26%	40%	38%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	27%	26%	40%	15%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	36%	16%	30%	
Double-banded Plover	*Charadrius bicinctus*	M	S			60%	46%
Red Knot	*Calidris canutus*	M, E	E	9%			
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	45%	42%	60%	
Red-necked Stint	*Calidris ruficollis*	M	S	45%	16%	50%	23%
Great Knot	*Calidris tenuirostris*	M, CE	E	36%	21%		15%
Grey-tailed Tattler	*Tringa brevipes*	M	S	27%	5%	20%	15%
Common Greenshank	*Tringa nebularia*	M	S		21%	10%	
Terek Sandpiper	*Xenus cinereus*	M	S	9%	11%		
Beach Stone-curlew	*Esacus magnirostris*		V			10%	
Sooty Oystercatcher	*Haematopus fuliginosus*		LC		16%		
Pied Oystercatcher	*Haematopus longirostris*		LC	55%	21%	20%	38%
Masked Lapwing	*Vanellus miles*		LC		21%	10%	62%
Red-capped Plover	*Charadrius ruficapillus*		LC	27%	58%	70%	62%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.7. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at sandbank 2 (SBN2) at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total high tide surveys				8	10	6	7
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	25%	40%	50%	43%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	25%	40%	67%	14%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	38%	50%	50%	57%
Pacific Golden Plover	*Pluvialis fulva*	M	S	13%	40%	33%	14%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	13%		17%	
Lesser Sand Plover	*Charadrius mongolus*	M, E	E			33%	
Double-banded Plover	*Charadrius bicinctus*	M	S			33%	14%
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	13%	20%	33%	14%
Red-necked Stint	*Calidris ruficollis*	M	S	13%	10%	33%	
Great Knot	*Calidris tenuirostris*	M, CE	E	25%		17%	
Grey-tailed Tattler	*Tringa brevipes*	M	S		10%	33%	14%
Common Greenshank	*Tringa nebularia*	M	S		30%	17%	
Terek Sandpiper	*Xenus cinereus*	M	S		10%	17%	
Pied Oystercatcher	*Haematopus longirostris*		LC		10%	17%	
Pied Stilt	*Himantopus leucocephalus*		LC				14%
Red-capped Plover	*Charadrius ruficapillus*		LC		10%	50%	14%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.8. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at Wickham Point (WICK) at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total high tide surveys				55	89	49	45
Common name	Species	EPBC*	NCA*				
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V		1%		
Pacific Golden Plover	*Pluvialis fulva*	M	S		1%		
Ruddy Turnstone	*Arenaria interpres*	M	S	7%	1%		
Wandering Tattler	*Tringa incana*	M	S	45%	61%	37%	13%
Australian Painted Snipe	*Rostratula australis*	E	E				2%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC	78%	82%	86%	76%
Pied Oystercatcher	*Haematopus longirostris*		LC	7%	6%		2%
Masked Lapwing	*Vanellus miles*		LC		1%		
Red-capped Plover	*Charadrius ruficapillus*		LC	2%	2%	4%	2%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A2.9. Summary of the percentage of high tide surveys (within 1.5 hours either side of high tide) that shorebirds have been recorded roosting at a mangrove tree roost opposite Bell's Creek (BCTR) at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total high tide surveys					2	1	
Common name	Species	EPBC*	NCA*				
Eurasian Whimbrel	*Numenius phaeopus*	M	S		100%	0%	

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

APPENDIX 3

Seasonal frequency of tidal flat use

Table A3.1. Seasonal breakdown of the percentage of low tide surveys (within 1.5 hours either side of low tide) that shorebirds have been recorded feeding at Sandbank #1 (SBN1) in the northern Pumicestone Passage at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total LT surveys				73	112	71	64
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	93%	92%	49%	61%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	89%	92%	68%	47%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	58%	79%	63%	33%
Pacific Golden Plover	*Pluvialis fulva*	M	S	41%	70%	51%	6%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	18%	47%	32%	9%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	12%	22%	14%	6%
Double-banded Plover	*Charadrius bicinctus*	M	S		1%	15%	8%
Ruddy Turnstone	*Arenaria interpres*	M	S	1%			
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	1%			
Red Knot	*Calidris canutus*	M, E	E				2%
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	23%	46%	25%	11%
Red-necked Stint	*Calidris ruficollis*	M	S	11%	19%	8%	8%
Great Knot	*Calidris tenuirostris*	M, CE	E	1%	4%	1%	
Grey-tailed Tattler	*Tringa brevipes*	M	S	4%	7%	8%	3%
Common Greenshank	*Tringa nebularia*	M	S	7%	5%	4%	2%
Common Sandpiper	*Actitis hypoleucos*	M	S		1%		
Terek Sandpiper	*Xenus cinereus*	M	S	4%	4%	8%	
Beach Stone-curlew	*Esacus magnirostris*		V	3%	4%	3%	5%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC			1%	
Pied Oystercatcher	*Haematopus longirostris*		LC	33%	29%	28%	33%
Pied Stilt	*Himantopus leucocephalus*		LC		6%	1%	5%
Masked Lapwing	*Vanellus miles*		LC	29%	20%	49%	45%
Red-capped Plover	*Charadrius ruficapillus*		LC	41%	60%	59%	36%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A3.2. Seasonal breakdown of the percentage of low tide surveys (within 1.5 hours either side of low tide) that shorebirds have been recorded feeding at Sandbank #2 (SBN2) in the northern Pumicestone Passage at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total LT surveys				83	127	82	71
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	95%	92%	54%	70%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	96%	88%	68%	52%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	92%	98%	87%	56%
Pacific Golden Plover	*Pluvialis fulva*	M	S	83%	88%	60%	54%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	66%	63%	49%	46%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E	35%	33%	22%	18%
Double-banded Plover	*Charadrius bicinctus*	M	S	1%	2%	35%	56%
Ruddy Turnstone	*Arenaria interpres*	M	S	2%			
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	2%			
Red Knot	*Calidris canutus*	M, E	E	2%			
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	67%	69%	41%	35%
Red-necked Stint	*Calidris ruficollis*	M	S	33%	28%	27%	21%
Great Knot	*Calidris tenuirostris*	M, CE	E	5%	7%	7%	1%
Grey-tailed Tattler	*Tringa brevipes*	M	S	23%	31%	33%	15%
Common Greenshank	*Tringa nebularia*	M	S	14%	25%	18%	3%
Marsh Sandpiper	*Tringa stagnatilis*	M	S	1%			
Common Sandpiper	*Actitis hypoleucos*	M	S		1%		
Terek Sandpiper	*Xenus cinereus*	M	S	16%	20%	16%	1%
Beach Stone-curlew	*Esacus magnirostris*		V				1%
Pied Oystercatcher	*Haematopus longirostris*		LC	31%	31%	45%	51%
Pied Stilt	*Himantopus leucocephalus*		LC	7%	6%	22%	32%
Masked Lapwing	*Vanellus miles*		LC	5%	7%	12%	13%
Red-capped Plover	*Charadrius ruficapillus*		LC	65%	55%	74%	79%

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Table A3.3. Seasonal breakdown of the percentage of low tide surveys (within 1.5 hours either side of low tide) that shorebirds have been recorded feeding at Pelican Waters Lamerough Creek (PEWA) in the northern Pumicestone Passage at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total LT surveys				66	107	66	55
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	39%	28%	9%	13%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	70%	59%	18%	5%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	68%	70%	33%	18%
Pacific Golden Plover	*Pluvialis fulva*	M	S	32%	39%	15%	2%
Greater Sand Plover	*Charadrius leschenaultii*	M, V	V	6%		2%	
Ruddy Turnstone	*Arenaria interpres*	M	S	3%			
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	6%	5%	2%	
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	18%	10%	3%	5%
Red-necked Stint	*Calidris ruficollis*	M	S	5%	2%	2%	
Grey-tailed Tattler	*Tringa brevipes*	M	S	12%	7%	5%	4%
Common Greenshank	*Tringa nebularia*	M	S	12%	15%	8%	2%
Marsh Sandpiper	*Tringa stagnatilis*	M	S	2%			
Common Sandpiper	*Actitis hypoleucos*	M	S	2%	1%		
Terek Sandpiper	*Xenus cinereus*	M	S	2%	2%	3%	
Pied Oystercatcher	*Haematopus longirostris*		LC	15%	12%	14%	35%
Pied Stilt	*Himantopus leucocephalus*		LC	26%	15%	29%	45%
Masked Lapwing	*Vanellus miles*		LC	48%	50%	62%	36%
Red-capped Plover	*Charadrius ruficapillus*		LC	14%	8%	2%	4%
Black-fronted Dotterel	*Elseyornis melanops*		LC		1%		4%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.

Table A3.4. Seasonal breakdown of the percentage of low tide surveys (within 1.5 hours either side of low tide) that shorebirds have been recorded feeding at Bell's Creek (BECK) in the northern Pumicestone Passage at Caloundra during each of the inbound migration (September to mid-November), summer (mid-November to mid-March), outbound migration (mid-March to May) and winter (June to August) periods.

Period				Inbound	Summer	Outbound	Winter
Total LT surveys				62	87	61	48
Common name	Species	EPBC*	NCA*				
Far Eastern Curlew	*Numenius madagascariensis*	M, CE	E	97%	83%	34%	69%
Eurasian Whimbrel	*Numenius phaeopus*	M	S	94%	80%	52%	44%
Little Curlew	*Numenius minutus*	M	S				2%
Bar-tailed Godwit	*Limosa lapponica baueri*	M, V	V	92%	87%	74%	46%
Pacific Golden Plover	*Pluvialis fulva*	M	S	69%	49%	20%	8%
Lesser Sand Plover	*Charadrius mongolus*	M, E	E			2%	
Ruddy Turnstone	*Arenaria interpres*	M	S	2%			
Sharp-tailed Sandpiper	*Calidris acuminata*	M	S	13%	5%		
Curlew Sandpiper	*Calidris ferruginea*	M, CE	E	26%	9%	3%	4%
Red-necked Stint	*Calidris ruficollis*	M	S		1%		
Great Knot	*Calidris tenuirostris*	M, CE	E		1%		
Grey-tailed Tattler	*Tringa brevipes*	M	S	45%	52%	33%	8%
Common Greenshank	*Tringa nebularia*	M	S	31%	41%	20%	6%
Terek Sandpiper	*Xenus cinereus*	M	S	10%	14%	7%	
Beach Stone-curlew	*Esacus magnirostris*		V				2%
Sooty Oystercatcher	*Haematopus fuliginosus*		LC				2%
Pied Oystercatcher	*Haematopus longirostris*		LC	18%	6%	10%	27%
Pied Stilt	*Himantopus leucocephalus*		LC	61%	77%	95%	94%
Masked Lapwing	*Vanellus miles*		LC	18%	16%	52%	29%
Red-capped Plover	*Charadrius ruficapillus*		LC	19%	6%		17%

* Status under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) or Queensland *Nature Conservation Act 1992* (NCA): CE = critically endangered; E = endangered; LC = least concern; M = migratory; S = special least concern (migratory); V = vulnerable.